4.1 Listing Factor (A): The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Streamflow regulation and associated habitat modification are identified as primary threats to Colorado pikeminnow populations. Regulation of streamflows in the Colorado River Basin is manifested as reservoir inundation of riverine habitats and changes in flow patterns, sediment loads, and water temperatures. For example, streamflow regulation has generally reduced the magnitude of spring peak flows and increased the magnitude of summer–winter base flows. Since 1950, annual peak flows of the Colorado River in occupied Colorado pikeminnow habitat upstream of Westwater Canyon have decreased by 29–38% (Van Steeter and Pitlick 1998). Flows of the Green River at Jensen, Utah, upstream of principal Colorado pikeminnow nursery habitat, have decreased by 13–35% during spring and increased by 10–140% during summer through winter due to regulation by Flaming Gorge Dam (Muth et al. 2000). Peak discharge of the San Juan River during the post-dam period (1962–1991) averaged 54% of the spring peak during the pre-dam period (1929–1961), and median monthly flow for the base-flow months of August through February averaged 168% of the pre-dam period (Holden 1999). The effect of flow modifications on Colorado pikeminnow includes reduction in high-velocity flows that flush sediments from spawning cobbles (Van Steeter and Pitlick 1998), reduced channel and habitat complexity and concomitant losses in food production (Osmundson 1999), reduced availability and quality of backwater nursery habitats (Tyus and Karp 1989), and loss of flooded bottomlands during spring runoff as feeding areas and as thermal refugia for maturation of gonads (Tyus 1990).

The Colorado pikeminnow was first listed as endangered following a period of dam construction throughout the Colorado River Basin. Starting with Hoover Dam in 1935, numerous dams were constructed that fragmented and inundated riverine habitat; released cold, clear waters; altered ecological processes; affected seasonal availability of habitat; and blocked fish passage. Reservoirs formed by these dams were stocked with a variety of nonnative fishes for recreational fisheries, and these fishes preyed upon and competed with the native fishes. In the 1960's, major dams were also constructed in the upper basin, primarily through the Colorado River Storage Project (CRSP) Act, including Flaming Gorge Dam (1962) on the Green River, Navajo Dam (1962) on the San Juan River, the Aspinall Units (1963) on the Gunnison River, and Glen Canyon Dam (1963) on the Colorado River. These dams had similar effects as seen in the lower basin, but there remained large undammed reaches in which the Colorado pikeminnow could complete its life cycle. The decline of the species throughout the basin and its extirpation from the lower basin is attributed largely to extensive habitat loss, modification, and fragmentation and blocked fish passage associated with dam construction and operations. Following the dams of the CRSP, fewer and smaller dams were constructed on tributaries, including McPhee Dam (1985) on the Dolores River and Taylor Draw Dam (1987) on the White River. Dams have not been constructed within occupied habitat of Colorado pikeminnow since 1987, and the threat of dam construction has been minimized considerably.

Total Colorado pikeminnow habitat lost to reservoir inundation in the upper basin is about 700 km, including Flaming Gorge Reservoir on the Green River (160 km), Lake Powell (320 km

on the Colorado River and 120 km on the San Juan River), and Navajo Reservoir on the San Juan River (100 km). Much of the habitat lost to reservoir inundation cannot be reasonably regained in the near future. Inundated habitat still occupied by Colorado pikeminnow includes the Colorado River and San Juan River inflows to Lake Powell. Large numbers of age-0 and juvenile Colorado pikeminnow are found seasonally in the Colorado River inflow and fewer numbers are reported in the San Juan River inflow, but adults are rarely caught in the reservoir; Colorado pikeminnow do not survive well in reservoirs and are not known to reproduce in lentic habitats.

Cold-water releases have eliminated most native fishes from river reaches immediately downstream of dams, except for small numbers of flannelmouth sucker (*Catostomus latipinnis*), bluehead sucker *(C. discobolus*), and speckled dace (*Rhinichthys osculus*) that remain in some tailwaters. River temperatures have been modified from seasonal lows of near freezing and highs of nearly 30°C to relatively constant dam releases of about 4–13°C. Depending on dam elevation, time of year, and river volume, river temperatures may not equilibrate with atmospheric temperatures for nearly 400 km downstream (as in the Colorado River below Glen Canyon Dam). These cold releases have caused reproductive failure and slowed growth of the warm-water native fishes. Colorado pikeminnow were last reported in Grand Canyon below Glen Canyon Dam in the early 1970's, as dam release temperatures became constant; a proposed temperature modification on Glen Canyon Dam (U.S. Bureau of Reclamation 1998) is not expected to restore Colorado pikeminnow in the region because of the lack of a full complement of habitats. The species was last reported in the San Juan River below Navajo Dam shortly after dam construction, but is currently found only in the reach starting 105 km downstream of the dam. Penstock modifications on Flaming Gorge Dam in 1976 (Holden and Selby 1979; Holden and Crist 1981) allowed for warmed releases down the Green River beginning in 1978, and Colorado pikeminnow have reinvaded Lodore Canyon, upstream of the Yampa River confluence (Bestgen and Crist 2000). In the Gunnison River, warming releases from Aspinall Unit dams could provide suitable temperatures for Colorado pikeminnow to expand their present range upstream of Delta, Colorado.

Adult Colorado pikeminnow are long distance migrators to and from spawning sites (Tyus 1990). Historically, the only physical barriers to movement were natural rapids and swift turbulent flows, which were probably only seasonal impediments to fish movement. Since 1905, numerous human-made dams have been constructed throughout the Colorado River Basin, fragmenting Colorado pikeminnow habitat and blocking migration corridors. These dams have also reduced river flow, altered water-temperature and flow regimes, trapped sediments and nutrients, changed water quality, and created reservoirs as a source of nonnative fishes (Maddux et al. 1993). In the lower basin, 14 major dams have restricted fish movement through the Colorado, Gila, Salt, and Verde rivers since completion of Hoover Dam in 1935; other dams on the Colorado River include Davis, Parker, Palo Verde Diversion, Imperial, and Laguna. Glen Canyon Dam approximately divides the lower from the upper basin and also is a barrier to fish movement.

Ten barriers are identified in the upper basin upstream of Glen Canyon Dam within occupied habitat of Colorado pikeminnow (Burdick and Kaeding 1990; Holden 1999; Table 3). Five of

Table 3. Existing dams and diversion structures within occupied Colorado pikeminnow habitat.

River	Structure	Current Status	Access to Suitable Habitat
Upper Colorado River	Grand Valley Diversion	Year-around passage completed in 1998	Passage adds 5 km additional habitat up to Price-Stubb Diversion
Upper Colorado River	Price-Stubb Diversion	Environmental Assessment to remove or modify in progress	Passage would add about 9 km additional habitat up to Government Highline Diversion
Upper Colorado River	Government Highline Diversion	No formal passage proposal	Passage would add 8 km additional habitat based on existing temperature units[a]
Gunnison River	Redlands Diversion	Fishway installed in 1996; successfully passing fish	Passage adds 50 km additional habitat based on existing temperature units[a]
Green River	Tusher Wash Diversion	Passage may be difficult at very low flows	Occupied habitat both up and downstream
Yampa River	Craig Diversion	Structure modified in 1992; successfully passing fish	Occupied habitat downstream
White River	Taylor Draw Dam	Dam completed in 1983, no current fish passage	Fish have been found downstream of dam in apparent attempt to migrate to habitat upstream of dam
San Juan River	PNM Weir	Diversion being modified to allow passage	Fish found below.
San Juan River	Cudei Diversion	Diversion has been modified to allow passage	Fish found above and below.
San Juan River	Hogback Diversion	Diversion has been modified to allow passage	Fish found below

[a]Osmundson (1999).

these barriers are classified as medium or high-head structures that are partial or seasonal barriers to fish movement or that have been modified to allow passage. The Price-Stubb Diversion presently defines the upper-most distribution of the Colorado pikeminnow in the upper Colorado River; a second structure, the Government Highline Diversion, is immediately upstream. Passage by these diversions could allow the species to expand its range by about 22 km (Osmundson 1999). The Redlands Fishway on the lower Gunnison River has allowed Colorado pikeminnow and other native fishes to move past the Redland Diversion and regain access to about 50 km of the Gunnison River. A diversion structure on the Yampa River near Craig, Colorado, was recently replaced, in part, to allow unassisted fish passage (Masslich 1993). On the San Juan River, several diversion structures are in historic habitat and act as fish barriers to limit the range of Colorado pikeminnow (Masslich and Holden 1996). The Cudei and Hogback diversions have been modified to allow fish passage and work is being done on the PNM Weir; other diversions are being evaluated. Modification of these dams and diversions could allow for considerable range expansion and increases in populations. Furthermore, water withdrawn at diversion structures can entrain Colorado pikeminnow and isolate them in canal systems where their survival is potentially low. Diversion structures should be screened (as needed) to minimize or prevent entrainment of at least subadult and adult Colorado pikeminnow.

Maintenance of streamflow is important to the ecological integrity of large western rivers (Tyus 1992; Collier et al. 1996; Poff et al. 1997; Schmidt et al. 1998). Life histories of many aquatic species, especially fish, are often specifically tied to flow magnitude, frequency, and timing, such that disruption of historic flows can jeopardize native species. The importance of flow management to the endangered fishes of the Colorado River is recognized (Tyus 1992; Stanford 1994). Enhancing natural temporal and spatial habitat complexity through flow and temperature management is the basis for benefitting the endangered fishes (Osmundson et al. 2000b).

Flow recommendations have been developed for some river systems in the Upper Colorado River Basin that identify and describe flows with the necessary magnitude, frequency, duration, and timing to benefit the endangered fish species (e.g., Modde and Smith 1995; Osmundson et al. 1995; U.S. Department of the Interior 1995b; Holden 1999; Modde et al. 1999; McAda 2000 [under revision]; Muth et al. 2000). These flows were designed to enhance habitat complexity (e.g., suitable spawning areas, inundation of floodplain areas) and to restore and maintain ecological processes (e.g., sediment transport, food production) that are believed to be important to the life history of these endangered fishes. Spring peak flows are important to the dynamic sediment processes that maintain in-channel habitat complexity, and prevent vegetation encroachment and channel narrowing. For example, cobble and gravel deposits used for spawning are relatively permanent features formed at high flows. Lower peak flows in subsequent years result in deposition of fine sediments over cobble and gravel deposits. Peak flows, whose timing coincides with the natural runoff cycle, are needed to ensure that suitable sites, cleansed of fine sediments, are available during the spawning period. Conversely, low and relatively stable base flows in summer, fall, and winter provide stable, warm, and productive nursery habitats for young fish.

Flows necessary to restore and maintain required habitats of Colorado pikeminnow mimic the natural hydrograph and include spring peak flows and summer–winter base flows. Adults utilize pools, deep runs, and eddy habitats maintained by high spring flows (see Appendix A for details on habitat requirements). These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, form gravel and cobble deposits used for spawning, and rejuvenate backwater nursery habitats (McAda 2000; Muth et al. 2000). Spawning activity begins after spring runoff at water temperatures typically between 18 and 23°C . Increased production and recruitment have been correlated with moderate-to-high water years (Converse et al. 1999; McAda and Ryel 1999; Valdez et al. 1999). Larvae typically drift downstream from spawning areas to broad alluvial reaches where they occupy sheltered nursery backwaters, restructured by high spring flows and maintained by relatively stable base flows. High spring flows also disadvantage nonnative fishes (McAda and Kaeding 1989; Valdez 1990; Hoffnagle et al. 1999), reducing predation and competition. Low base flows also increase shoreline food production.

Flow recommendations have been developed that specifically consider flow-habitat relationships within occupied habitat of Colorado pikeminnow (see section 3.1.2; Table 1) in the upper Colorado River (Osmundson et al. 1995; McAda 2000), Gunnison River (McAda 2000), Yampa River (Modde and Smith 1995; Modde et al. 1999), Green River (Muth et al. 2000), and San Juan River (Holden 1999). These flow recommendations will be evaluated and revised (as

necessary) as part of an adaptive-management process, and flow regimes to benefit the endangered fishes will be implemented through multi-party agreements or by other means (see section 4.4).

4.2 Listing Factor (B): Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization of Colorado pikeminnow for commercial, recreational, scientific, or educational purposes is not currently considered a threat to the species. This factor will be reevaluated and, if necessary, actions to ensure adequate protection will be identified before downlisting and attained before delisting.

Historically, Colorado pikeminnow were opportunistically used as food by American Indians and early explorers to the region, and were commercially harvested as "white salmon" in the early 1900's (see section A.2). Colorado pikeminnow will strike at lures and flies, and some fish are incidentally caught by recreational anglers, but the number harmed or killed is believed to be insignificant based on creel census (personal communication, T. Nesler, Colorado Division of Wildlife). All angler access points near occupied habitat are posted with signs advising anglers to release any endangered fish unharmed.

Collection of Colorado pikeminnow for scientific or educational purposes is regulated by the Service under Section 10(a) of the ESA. Scientific collecting permits are issued to investigators conducting legitimate scientific research, and "take" permits are issued where a reasonable loss of fish is expected. Permits to collect Colorado pikeminnow for educational purposes are normally not requested but are regulated by the same provisions of the ESA.

4.3 Listing Factor (C): Disease or Predation

4.3.1 Diseases and parasites

Diseases and parasites currently are not considered singly significant in the decline of the Colorado pikeminnow (see section A.11 for expanded discussion of parasites), but these factors will be reevaluated and, if necessary, actions will be identified to minimize adverse effects before downlisting. Adequate protection from deleterious diseases and parasites will be attained before delisting.

4.3.2 Nonnative fishes

Colorado pikeminnow populations in the upper basin live sympatrically with about 20 species of warm-water, nonnative fishes (Tyus et al. 1982; Lentsch et al. 1996) that are potential predators, competitors, and vectors for parasites and diseases. Backwaters and other low-velocity shoreline habitats in alluvial reaches of the upper Colorado, Green, and San Juan rivers are important nursery areas for larval and juvenile Colorado pikeminnow (Tyus 1991; Holden 1999; McAda 2000; Muth et al. 2000; see Appendix A), and researchers believe that nonnative fish species in

those habitats limit the success of Colorado pikeminnow recruitment (e.g., Muth and Nesler 1993; Bestgen 1997; Bestgen et al. 1997; McAda and Ryel 1999; Valdez et al. 1999). Osmundson (1987) confirmed predation by black bullhead (*Ameiurus melas*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), and black crappie (*Pomoxis nigromaculatus*) as a significant mortality factor of young-of-year and yearling Colorado pikeminnow stocked in riverside ponds along the upper Colorado River. Adult red shiner (*Cyprinella lutrensis*) are known predators of larval native fish in backwaters of the upper basin (Ruppert et al. 1993), and predation by nonnative fishes such as red shiner may influence within-year-class recruitment of Colorado pikeminnow (Bestgen et al. 1997). In laboratory experiments on behavioral interactions, Karp and Tyus (1990) observed that red shiner, fathead minnow (*Pimephales promelas*), and green sunfish shared activity schedules and space with young Colorado pikeminnow and exhibited antagonistic behaviors toward smaller Colorado pikeminnow. They hypothesized that Colorado pikeminnow may be at a competitive disadvantage in an environment which is resource limited and concluded that nonnative fishes could have a negative impact on growth and survival of young Colorado pikeminnow. High spatial overlap in habitat use has been documented among young Colorado pikeminnow, red shiner, sand shiner (*Notropis stramineus*), and fathead minnow (McAda and Tyus 1984; McAda and Kaeding 1989). Muth and Snyder (1995) compared the diet of young-of-year Colorado pikeminnow with the diets of other small fishes collected from backwaters of the Green River. They concluded that the potential for competition for food between Colorado pikeminnow and other fishes in backwaters appeared greatest with red shiner, which are often the most abundant fish in backwaters.

Channel catfish (*Ictalurus punctatus*) and northern pike (*Esox lucius*) have been identified as the principal nonnative threats to subadult and adult Colorado pikeminnow in the upper basin. Adult Colorado pikeminnow apparently use the same habitats as adult channel catfish and northern pike suggesting the potential for negative interactions, especially during periods of limited resource availability (Wick et al. 1985; Tyus and Karp 1989; Tyus and Beard 1990; Nesler 1995). Channel catfish were first introduced into the Upper Colorado River Basin in 1892 (Tyus and Nikirk 1990) and are now considered common to abundant throughout much of the upper basin (Tyus et al. 1982; Nelson et al. 1995). The species is one of the most prolific predators in the upper basin and, among the nonnative fishes, is thought to have the greatest adverse effect on the endangered fishes (Hawkins and Nesler 1991; Lentsch et al. 1996; Tyus and Saunders 1996), largely due to predation on juveniles and resource overlap with subadults and adults. Additionally, mortality of adult Colorado pikeminnow that prey on channel catfish has occurred due to choking on pectoral spines (McAda 1980; Pimental et al. 1985). Northern pike accidentally became established in the Yampa River in the early 1980's when individuals escaped from Elkhead Reservoir (Tyus and Beard 1990). Since then, northern pike have established a reproducing population in the Yampa River and have expanded their numbers and range in both the Yampa and middle Green rivers (Tyus and Beard 1990; Hawkins and Nesler 1991; Nesler 1995) where they pose a competitive and predatory threat to endangered and other native fishes (Wick et al. 1985; Tyus and Karp 1989; Tyus and Beard 1990; Martinez 1995; Nesler 1995).

A Strategic Plan for Nonnative Fish Control was developed for the Upper Colorado River Basin (Tyus and Saunders 1996) and implemented by the UCRRP in 1997. Some activities include

mechanical removal of nonnative fishes through intensive sampling, and modification of habitats used as residential or nursery areas by nonnative fishes. Preliminary results of the control program are inconclusive as to the beneficial effects for Colorado pikeminnow. However, increases in abundances of Colorado pikeminnow during the 1980's and 1990's in both the Green and upper Colorado rivers (see section 3.2) suggest that other factors, such as restoration of naturalized river flows, may allow the species to proliferate even in the presence of nonnative species. Colorado pikeminnow are predators during their first year of life and as major predators, may have an advantage over other sympatric native species. Data from a 7-year research period on the San Juan River suggest that efforts to date were effective in reducing density of large channel catfish, but efforts were not effective in reducing overall abundance of channel catfish in the river (Holden 1999). A positive population response by native fishes to this channel catfish reduction has not been reported (personal communication, San Juan River Basin Recovery Implementation Program, Biology Committee). A strategic control program has also been recommended for Grand Canyon (Valdez et al. 1999), and a Science Plan is being developed for implementation of nonnative fish removal starting in 2003 (GCMRC 2002).

Control of the release and escapement of nonnative fishes into the main river, floodplain, and tributaries is also a necessary management action to stop the introduction of new fish species into occupied habitats and to thwart periodic escapement of highly predaceous nonnatives from riverside features. Agreements have been signed among the Service and the States of Colorado, Utah, and Wyoming to review and regulate all stockings within the Upper Colorado River Basin (U.S. Fish and Wildlife Service 1996) in order to reduce the introduction and expansion of nonnative fishes. A Memorandum of Agreement implementing these procedures was signed on September 5, 1996, by the Service and the States and remains in effect through the life of the UCRRP. This agreement regulates releases of nonnative fishes within the 50-year floodplain of the river, and provides security against State or Federal endorsed programs introducing new species into the system or increasing the numbers or distribution of existing species. The agreement also allows the States to regulate and restrict stocking of privately owned ponds. These procedures will also reduce the likelihood of new parasites and diseases being introduced through nonnative fish stockings. Similar procedures need to be developed and implemented in the San Juan River subbasin.

Annual flooding of the river can inundate riverside ponds potentially containing large numbers of green sunfish, black bullhead, largemouth bass, and other nonnative fishes that may escape to the river during high flows (Valdez and Wick 1983). Riverside features determined to be problematic must be either isolated from high river floods, designed to drain annually with the rise and fall of the river, or treated with piscicidal compounds to eradicate nonnative fishes. The Colorado Division of Wildlife is to prepare a Colorado River Fisheries Management Plan (Plan) that will implement a more detailed nonnative fish control effort. The Plan is to be reviewed and approved by the Colorado Wildlife Commission and UCRRP. The Plan will be finalized and implemented by the dates specified in the Recovery Implementation Program Recovery Action Plan (RIPRAP) of the UCRRP. One aspect of the Plan will be pond reclamation, which can include complete removal of nonnative fish, screening ponds to prevent escapement to the river, and/or reshaping ponds so that they no longer support year-round habitation by nonnative fish.

Another aspect of nonnative fish control in the upper basin is removal of bag and possession limits on nonnative fishes in designated critical habitat of Colorado pikeminnow. For example, the State of Colorado has removed bag and possession limits on all nonnative, warm-water sport fishes within critical-habitat reaches of the Colorado and Yampa rivers. Colorado also has agreed to close river reaches to angling where and when angling mortality is determined to be significant to native fishes.

Three management actions are identified to reduce the threat of nonnative fishes: high spring flows, nonnative fish control strategies, and stocking agreements. There is documented evidence that high flows temporarily disadvantage nonnative fishes in several ways, including displacement from sheltered habitats, disruption of spawning activities, increased mortality in high mainstem currents, and physical downstream transport of individuals. Studies from the Upper Colorado River (McAda and Kaeding 1989), Green River (Valdez 1990), Yampa River (Muth and Nesler 1993), and Lower Colorado River through Grand Canyon (Hoffnagle et al. 1999; Valdez et al. 2001) showed reductions in densities of small-bodied species of fish (e.g., fathead minnow, red shiner, sand shiner, plains killifish [*Fundulus zebrinus*]) following high flows. On the San Juan River, no evidence exists to support the hypothesis that high flows even temporarily disadvantage nonnatives and promote endangered fish reproduction and recruitment (Holden 1999). Strong year classes of Colorado pikeminnow have consistently occurred in 1–3 years following high runoff years, and have been attributed to cleansing of spawning gravels and short-term reduction in nonnative fishes (McAda and Ryel 1999). Hence, even a short-term reduction in nonnative fishes could allow increased survival and recruitment of native forms (Tyus and Saunders 1996). Flow recommendations include the provision of high flows, which provide these unsuitable conditions for nonnative fishes and may at least temporarily reduce numbers of these predators and competitors.

Active control programs should be implemented or continued (as needed) for problematic nonnative fishes in Colorado pikeminnow nursery habitats, northern pike in the Yampa and middle Green rivers, and channel catfish in river reaches occupied by Colorado pikeminnow. Guidance is not provided in this document with regard to target reduction levels because such criteria may be premature and unreasonable to achieve, or may be easily achieved and exceeded. Little is known with respect to responses by nonnative fish populations to overt control measures, and these must be evaluated as part of nonnative fish control programs. Another unknown aspect of nonnative fish control is the need to maintain control measures indefinitely or periodically over time. These decisions will have to be made from information gained through these control programs during the downlist monitoring period.

4.4 Listing Factor (D): The Inadequacy of Existing Regulatory Mechanisms

Implementation of regulatory mechanisms are necessary for recovery of the Colorado pikeminnow and to ensure long-term conservation of the species. Regulatory mechanisms affect many aspects of legal protection, such as habitat and flow protection, regulation and/or control of nonnative fishes, regulation of hazardous-materials spills, and angling regulations. Flow regimes to benefit Colorado pikeminnow populations must be identified, implemented, evaluated, and

revised (as necessary) before downlisting can occur (existing flow recommendations are described in section 4.1). By the time of delisting, legal protection of habitat (including flows) necessary to provide adequate habitat and sufficient range for all life stages of Colorado pikeminnow to support recovered populations must be accomplished through various means, including instream-flow appropriations, legal agreements, contracts, operating criteria, and/or other means. Additionally, certain States may issue policies that also afford flow protection. As examples, the State of Utah has instituted a policy that subordinates all future water-rights appropriations for the Green River from Flaming Gorge Dam to the Duchesne River confluence for the summer and autumn periods to provide flows to benefit the endangered fish; actions proposed under this policy would not affect pre-existing water rights (Utah Division of Water Rights 1994). Also, the State of Colorado has established two instream-flow rights on the Colorado River under its state instream-flow law.

Before delisting, the primary regulatory mechanism for protection of Colorado pikeminnow is through Section 7(a)(2) of the ESA, as administered by the Service. *"Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency... is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical..."* In the Upper Colorado River Basin, the UCRRP provides a mechanism for dealing with Section 7 consultations in a unified manner. The SJRRIP provides a similar consolidated effort for addressing Biological Opinions in the San Juan River, including Navajo Dam. Neither of these two programs are regulatory mechanisms that provide permanent, long-term protection for the species after delisting.

In addition to Federal protection under the ESA, Colorado pikeminnow are protected by all basin States under categories such as "endangered", "threatened", or "sensitive". This protection prohibits intentional take and keeping or harming in any way any fish captured incidentally, and may need to remain in place after the species is Federally delisted. However, the States do not address the major problem of habitat destruction, and especially streamflow modification. Most States have instream-flow laws that allow "beneficial use" of water left in streams for wildlife, but these laws typically only provide for flow that is the minimum amount necessary to maintain the fishery. With some States, there is also an inherent conflict between management of nonnative sport fish and recovery of endangered fishes. Where valued sport fisheries occur, there is an ongoing dilemma between public demands for maintenance and expansion of fisheries and management actions to conserve and recover endangered fish. There is no immediate solution to the dilemma, but predation by nonnative fishes is clearly identified as a cause for the decline of many of the native Colorado River fishes, and long-term agreements between States and the Service are essential.

After removal from the list of species protected by the ESA, the Colorado pikeminnow and its habitat will continue to receive consideration and some protection through the following Federal laws and related State statutes, and will need the provisions to protect habitat previously discussed. The National Environmental Policy Act (NEPA; 42 U.S.C. 4321–4370d) requires Federal agencies to evaluate the potential effects of their proposed actions on the quality of the

human environment and requires the preparation of an environmental impact statement whenever projects may result in significant impacts. Federal agencies must identify adverse environmental impacts of their proposed actions and develop alternatives that undergo the scrutiny of other public and private organizations as a part of their decision-making process. Recovery actions identified for Colorado pikeminnow are linked to federal actions, which must undergo review under NEPA.

Section 101(a) of the Federal Water Pollution Control Act (i.e., Clean Water Act; 33 U.S.C. 1251–13287) states that the objective of this law is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters and provide the means to assure that *"...protection and propagation of fish, shellfish, and wildlife..."*. This statute contributes in a significant way to the protection of the Colorado pikeminnow and its food supply through provisions for water quality standards, protection from the discharge of harmful pollutants, contaminants [Section 303(c), Section 304(a), and Section 402] and discharge of dredge or fill material into all waters, including certain wetlands (Section 404).

The Organic Act (16 USC 1, as amended) provides for management of National Park Service areas in such a manner *"...to promote and regulate the use of the...national parks...which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."* The National Park Service is the largest single jurisdictional land owner in reaches with critical and other occupied habitats for the four Colorado River endangered fishes (Maddux et al. 1993).

The Fish and Wildlife Coordination Act (16 U.S.C. 661–666c) requires that Federal agencies sponsoring, funding, or permitting activities related to water resource development projects request review of these actions by the Service and the State natural resource management agency. These comments must be given equal consideration with other project purposes. Also, the Federal Land Policy and Management Act (43 U.S.C. 1701–1784) requires that public lands be managed to protect the quality of scientific, ecological, and environmental qualities and preserve and protect certain lands in their natural conditions to provide food and habitat for fish and wildlife.

Hazardous-materials spills are identified as a threat to Colorado pikeminnow. Although the States of Colorado, Utah, and New Mexico, where the species occurs, have state-wide hazardous-materials plans, these may not be adequate to provide protection against spills into the river. Research into the adequacy of these plans is identified as a recovery element. Hazardous-materials spills are regulated by the Hazardous Materials and Waste Management Division of the Colorado Department of Public Health and Environment; the Hazardous Waste Branch of the Utah Department of Environmental Quality; and the New Mexico Department of Environment.

The need for conservation plans and agreements was identified to provide reasonable assurances that recovered Colorado pikeminnow populations will be maintained. These plans are to be implemented after delisting and are intended to assure that relisting does not become necessary. They would be developed to ensure long-term management and protection of the species, and

should include (but not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats. Signed agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties must be in place to implement the conservation plans before delisting can occur.

4.5 Listing Factor (E): Other Natural or Manmade Factors Affecting Its Continued Existence

4.5.1 Pesticides and pollutants

The potential role of pesticides and pollutants in suppressing populations of Colorado pikeminnow is not well understood. Pesticides find their way to the Colorado River from agricultural runoff, and other pollutants in the system include petroleum products, heavy metals (e.g., mercury, lead, zine, copper), nonmetals (i.e., selenium), and radionucleides.

Potential spills of petroleum products threaten wild populations of Colorado pikeminnow. For example, numerous petroleum-product pipelines cross or parallel the Yampa River upstream of Yampa Canyon, most of which lack emergency shut-off valves. One pipe ruptured in the late 1980's releasing refined oil into the Yampa River during the spawning period for Colorado pikeminnow.

All States have hazardous-materials spills emergency-response plans that provide a quick cleanup response to accidental spills (see section 4.4). These responses may not be sufficiently rapid to minimize deleterious effects to fishes, especially a species like the Colorado pikeminnow with site-specific spawning areas. Quick response may, therefore, be inadequate to protect the species and preventive measures must be incorporated into these plans. These preventive measures may include safety shut-off valves on petroleum-products lines in or near the floodplain and filtration systems in case of accidental spills of hazardous materials at bridge crossings above occupied habitats. Identifying and implementing the most reasonable and prudent preventive measures will require a comprehensive review of existing State and Federal hazardous-materials spills emergency-response plans. These preventive measures must be implemented before delisting.

Another cause of degraded water quality is the Atlas Mills tailings pile located on the north bank of the Colorado River near Moab, Utah. In 1998, the Service determined in a final biological opinion that this pile *"...is likely to jeopardize the continued existence of..."* the Colorado pikeminnow and razorback sucker. This biological opinion was withdrawn on February 8, 2001, because of refusal by the Nuclear Regulatory Commission to reinitiate consultation. Section 3405 of the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001 (P.L. 106-398) requires that the Atlas Mills tailings site be transferred to the Department of Energy for remediation. Congress authorized $300 million for clean-up of the Atlas Mills tailings pile. Remediation is outside of the purview of the UCRRP.

There are two significant threats to endangered fish posed by the Atlas Mills tailings pile. The first is from toxic discharges of pollutants, particularly ammonia, through groundwater to the Colorado River. The second is the risk of catastrophic pile failure, that could bury important nursery areas and destroy other fish habitat. To address the threats posed by the discharge of toxic pollution, whether tailings are reclaimed on site or removed to another location, the groundwater must be cleaned up to the extent necessary to prevent the discharge of ammonia, uranium, and other toxic pollutants into the Colorado River and meet the State of Utah surface-water and groundwater quality standards for fish and wildlife. To assess whether such clean-up has occurred, groundwater-system compliance and measuring points must be established.

Selenium is hypothesized as contributing to the decline of the endangered fishes of the Colorado River Basin (U.S. Fish and Wildlife memorandum, December 22, 1998). It is a water-quality factor that may inhibit recovery by adversely affecting reproduction and recruitment (Hamilton and Wiedmeyer 1990; Stephens et al. 1992; Hamilton and Waddell 1994; Hamilton et al. 1996; Stephens and Waddell 1998; Osmundson et al. 2000a). Selenium concentrations in certain areas of the basin (e.g., Green River near Jensen, Utah; Gunnison River downstream from the Uncompahgre River confluence; and upper Colorado River downstream from Palisade, Colorado) exceed those shown to impact fish and wildlife elsewhere, and, although results are inconclusive as to exposure thresholds that cause specific effects, some studies suggest deleterious effects on Colorado pikeminnow and razorback sucker. The National Irrigation Water Quality Program is addressing selenium issues in the upper basin by implementing remediation projects to reduce selenium levels in areas of critical habitat. The adverse effects of selenium contamination on Colorado pikeminnow reproduction and survival of young will be reevaluated before downlisting and necessary protection will be implemented before delisting.

5.0 RECOVERY GOALS

The following are site-specific management actions and objective, measurable recovery criteria for the Colorado pikeminnow presented for the Upper Colorado River Basin (including the Green River, upper Colorado River, and San Juan River subbasins). The need for self-sustaining populations in the lower basin and associated site-specific management actions/tasks necessary to minimize or remove threats will be reevaluated at the status review of the species. The Colorado pikeminnow was listed prior to the 1996 DPS policy, and the Service may conduct an evaluation to designate DPSs in a future rule-making process if, in the future, lower basin populations are determined necessary for recovery. Provisional site-specific management actions/tasks and objective, measurable recovery criteria for the lower basin are presented in Appendix B as guidelines for conservation efforts (e.g., nonessential, experimental populations; see section 3.1.2).

Steps for downlisting and delisting presented in this section are consistent with provisions specified under Section 4(a)(1), Section 4(b), Section 4(c)(2)(B), and Section 4(f)(1) of the ESA (see section 2.0 of this document). The five recovery factors (i.e., Factor A, Factor B, etc.) were derived from the five listing factors (see section 2.1) and state the conditions under which threats are minimized or removed. For each recovery factor, management actions and tasks are

identified that minimize or remove threats to the Colorado pikeminnow. Under objective, measurable recovery criteria, demographic criteria and recovery factor criteria are presented for downlisting and delisting. Generally, for each downlisting criterion there is a corresponding delisting criterion. Reclassification can be considered when appropriate recovery criteria are met.

5.1 Requirements and Uncertainties Associated with Recovery Goals

5.1.1 Demographic criteria and monitoring

Demographic criteria that describe numbers of subbasin populations and individuals (adults and juveniles) for downlisting and delisting are presented for the Upper Colorado River Basin. These criteria specify maintenance of a metapopulation, based on requirements of no significant decline in numbers of adults for each population and recruitment equal to or exceeding adult mortality. To maintain the metapopulation, these criteria require a genetically and demographically viable, self-sustaining population in the Green River subbasin; and self-sustaining populations that meet or exceed estimated carrying capacity either in only the upper Colorado River subbasin, or in both the upper Colorado River subbasin and San Juan River subbasin.

Wild populations of Colorado pikeminnow have been studied since the 1960's, and population dynamics and responses to management actions have been evaluated since the early 1980's. A 5-year monitoring period is required for downlisting, and a 7-year monitoring period beyond downlisting is required for delisting. The downlist monitoring period begins with the first reliable estimates for all populations acceptable to the Service. The downlist and delist monitoring periods are expected to be continuous, and reclassification cannot be considered until each population has been monitored for the required period of time. The total 12-year monitoring period is equivalent to approximately one generation time for Colorado pikeminnow, and is considered sufficient to determine if populations are stable, increasing, or decreasing. Generation time is equal to the mean adult age and is computed as the average age of attaining sexual maturity; i.e., $age_{sex\ maturity}$ plus (1/d), where d is equal to death rate (Seber 1982; Gilpin 1993). For Colorado pikeminnow, the age of attaining sexual maturity is 5 years and the adult survival rate is 0.85 (d=1-0.85); hence, generation time is 5 + [1/(1-0.85)] = 5 + 7 = 12. It is important to note that under Section 4(g)(1) of the ESA, *"The Secretary shall implement a system in cooperation with the States to monitor effectively for not less than five years the status of all species which have recovered to the point at which the measures provided pursuant to this Act are no longer necessary..."*. Hence, populations would be monitored for at least 5 additional years after delisting.

The Service considers a reliable estimate as one that is based on a multiple mark-recapture model. Direct enumeration of fish populations is not feasible in turbid rivers, and removal estimates are unreliable because of the difficulty of blocking reaches of large rivers to meet the model assumption of no migration. Instead, closed-population, multiple mark-recapture estimators (Otis et al. 1978; Burnham et al. 1987; Chao 1989; Osmundson and Burnham 1998) are recommended for deriving population point estimates and to guide development of sampling

designs that conform to these models. The accuracy and precision of each point estimate will be assessed by the Service in cooperation with the respective recovery or conservation programs, and in consultation with investigators conducting the point estimates and with qualified statisticians and population ecologists. If, for example, an estimate is made that is considered unreliable (i.e., lacks precision and accuracy) because of poor sampling conditions or other causes, a determination will be made if an additional estimate is needed in the following year in order to accurately assess if downlisting or delisting criteria are met. Field sampling methodologies should be developed and refined to attain a balance between the need for accurate and precise population estimates while minimizing stress to fish from excessive handling.

Monitoring must be designed to determine if the demographic criteria are being met. At least three point estimates are needed for each of the Colorado pikeminnow populations to downlist, and at least five more estimates are needed to delist. Point estimates should be made in each of 3 consecutive years with 1–2 years between blocks of estimates. In order to ensure no net loss in each population, the trend in adult (age 7+; ≥450 mm TL; see section A.8) point estimates cannot decline significantly; i.e., slope is not significantly less than zero over the trend period ($p \leq 0.05$), requiring that the population is either stable or increasing during the monitoring period. Also, mean estimated recruitment of age-6 (400–449 mm TL; see section A.8) naturally produced fish in each population must equal or exceed mean annual adult mortality (i.e., ≥15%). This criterion requires that each population is reproducing, recruiting, and self-sustaining. To meet the requirement of a genetically and demographically viable, self-sustaining population in the Green River subbasin, each population point estimate must exceed 2,600 adults (MVP; see section 3.3.2). In addition to the demographic criteria, adequate habitat and sufficient range are required to support recovered populations. Recovery goals require maintenance of populations within areas of designated critical habitat (59 FR 13374).

5.1.2 Recovery factor criteria

The recovery factor criteria are directly linked to management actions/tasks. Recovery factor criteria for downlisting generally call for identification, implementation, evaluation, and revision of management tasks. Corresponding criteria for delisting call for attainment of necessary and feasible levels of protection that minimize or remove threats.

Each of the four threats identified in section 4.0 (i.e., streamflow regulation, habitat modification, competition with and predation by nonnative fishes, and pesticides and pollutants) is addressed in this section with appropriate management actions/tasks. Details of these and other management actions/tasks that contribute to recovery are or will be identified in the RIPRAP of the UCRRP and Annual Work Plan of the SJRRIP. These programs function under the general principles of adaptive management, and the plans are periodically revised. In the context of these programs, adaptive management is the process by which management actions are identified, implemented, evaluated, and revised based on results of research and monitoring.

Providing and legally protecting habitat are necessary elements in recovery of the Colorado pikeminnow. Habitat as used in these recovery goals is defined as the physical and biological components of the environment required for recovery of the species, including flow regimes

necessary to restore and maintain those environmental conditions. Hence, identification, implementation, evaluation, and revision of adequate flow regimes through adaptive management are identified as criteria necessary for downlisting. By the time of delisting, flows (as well other habitat components) identified as necessary to the life history of the species must be provided and legally protected through various means, including instream-flow appropriations, legal agreements, contracts, operating criteria, and/or other means. As stated in the governing documents of the UCRRP and the SJRRIP, under these programs legal protection of flows referenced in these recovery goals for upper basin rivers and the San Juan River will be consistent with State and Federal laws related to the Colorado River system (sometimes referred to as "Law of the River"), including State water law, interstate compacts, and Federal trust responsibilities to American Indian tribes. It is recognized that flow management alone is not sufficient to ensure self-sustaining populations of the endangered fishes, and that a combination of flow and non-flow management actions will be necessary for recovery. It is anticipated that flow management actions identified in these recovery goals can be achieved in balance with non-flow management actions to improve ecosystem conditions and enhance recovery and sustainability of the endangered fish populations. Population and demographic data collected through monitoring will be used to track progress toward meeting the habitat needs of the species.

Implementation of conservation plans is required in order to provide for the long-term management and protection of Colorado pikeminnow populations after delisting. These conservation plans will be developed and implemented through agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties, and may include (but are not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats.

Use of hatchery fish (progeny of cultured broodstock) may be necessary to expand or augment existing populations of Colorado pikeminnow. Provisions and recommendations of the UCRRP Genetics Management Plan (Czapla 1999) and the Policy Regarding Controlled Propagation of Species Listed Under the Endangered Species Act (65 FR 56916) should be used as guidelines for use of hatchery fish in recovery. The UCRRP is revising a facilities-needs plan based on revised State stocking plans.

5.1.3 Uncertainties

These recovery goals are based on the best available scientific information, and are structured to attain a balance between reasonably achievable criteria (which include an acceptable level of uncertainty) and ensuring the viability of the species beyond delisting. It is expected that research, management, and monitoring activities directed by the UCRRP and SJRRIP will fill information gaps and considerably narrow, if not eliminate, many of the uncertainties that affect recovery criteria. Additional data and improved understanding of Colorado pikeminnow biology may prompt future revision of these recovery goals. The Service intends to review, and revise as needed, these recovery goals at least once every 5 years from the date of their publication in the *Federal Register*, or as necessary when sufficient new information warrants a change in the

recovery criteria. Review of these recovery goals will be part of the review of listed species as required by Section 4(c)(2)(A) of the ESA, *"The Secretary shall ... conduct, at least once every five years, a review of all species..."*. Uncertainties associated with these recovery goals include:

- Demographic Viability. The level of exchange of individuals between the San Juan River and populations in the Green River and upper Colorado River subbasins is unknown.
- Carrying Capacity. Inferences about carrying capacity for some Colorado pikeminnow populations have been largely drawn from recent population estimates, information on condition factor and forage base, and analyses of thermal regimes. However, the information is preliminary and hypotheses associated with carrying capacity have yet to be fully tested.
- Genetic Viability. Although determination of genetic effective population size (N_e) was based on principles in conservation genetics (i.e., "50/500 rule"), genetic information on Colorado pikeminnow was insufficient to derive a species-specific value of N_e and a ratio of N_e/N_g.
- Flow and Temperature Recommendations. Flow and temperature recommendations have been developed that specifically consider flow-habitat relationships in habitats occupied by Colorado pikeminnow. However, it is uncertain to what extent these recommendations can be met and what flow regimes will be necessary to meet the life history needs of the Colorado pikeminnow. Streamflow reduction and modification from dams and water withdrawal systems have reduced spatial and temporal variability in flow regimes, reduced available habitat, and changed ecosystem function and structure. A paradigm in river management suggests that the ecological integrity of river ecosystems is linked to their natural dynamic character (Stanford et al. 1996; Poff et al. 1997), and restoring a more natural flow regime is the cornerstone of river restoration. This paradigm and the response by endangered fishes of the Colorado River Basin is largely untested, and as these flow regimes to benefit the endangered fishes are implemented, it is important to be aware of associated uncertainties and plan for management of unanticipated results. Response of Colorado pikeminnow to flows will need to be monitored in order to identify and provide flow regimes that are necessary to restore and maintain adequate habitat and sufficient range for all life stages.
- Nonnative Fish Response. Uncertainty exists regarding the responses of nonnative fishes to active control measures and to flow regimes to benefit the endangered fishes. Many of these nonnative fishes, both warm-water and cold-water, prey on and compete with native fishes. There are indications that high spring flows have a negative effect on nonnative fishes, but the overall response of nonnative fish populations to flow recommendations is uncertain. Long-term response by nonnative fishes to mechanical removal is also an uncertainty. It is unknown if reduction in numbers of nonnatives will result in lower population numbers, altered age structure, or opening of niches for new or existing nonnative fishes. It is also unknown if reduction in nonnative fishes will result in increased numbers of native fishes.

- Efficacy of Monitoring Programs. The precision and reliability of long-term monitoring programs to accurately measure the response of Colorado pikeminnow populations to management actions is an uncertainty. Mark-recapture population estimates may reflect high variability because of population variability and/or sampling variability. This variability in estimates may exceed the level of population response to a management action, masking measurement of short-term responses and cause-effect relationships. Demographic criteria proposed in this document attempt to account for this variability and set numbers that are measurable under current conditions.
- Establishing Self-Sustaining Populations. Hatchery fish may be used to expand or augment existing populations. The survival, recruitment, and reproductive success of these fish in the wild is uncertain. This uncertainty is greater in rivers or river reaches that have been extensively modified.
- Response to Management Actions. Management actions, such as regulation of escapement of nonnative fishes, control of nonnative fishes, and minimization of the risk of hazardous-materials spills, may vary in their effectiveness to benefit Colorado pikeminnow. Tasks and recovery criteria associated with each of these management actions are intended to provide some measure of success before reclassification can occur.

5.2 Site-Specific Management Actions and Tasks by Recovery Factor

5.2.1 Factor A.—Adequate habitat and range for recovered populations provided

Management Action A-1.—Provide flows necessary for all life stages of Colorado pikeminnow to support recovered populations, based on demographic criteria.

Task A-1.1.—Identify, implement, evaluate, and revise (as necessary through adaptive management) flow regimes to benefit Colorado pikeminnow populations in the Green River, upper Colorado River, and San Juan River subbasins (see section 4.1 for discussion of existing flow recommendations to benefit the endangered fishes and for discussion of Colorado pikeminnow flow-habitat requirements; see Appendix A for a synopsis of Colorado pikeminnow life history).

Task A-1.2.—Provide flow regimes (as determined under Task A-1.1) that are necessary for all life stages of Colorado pikeminnow to support recovered populations in the Green River, upper Colorado River, and San Juan River subbasins.

Management Action A-2.—Provide passage for Colorado pikeminnow within occupied habitat to allow adequate movement and, potentially, range expansion.

Task A-2.1.—Continue to provide fish passage over Redlands Diversion and Grand Valley Diversion to allow adequate movement of Colorado pikeminnow in the upper Colorado River and Gunnison River (see section 4.1 for a discussion on barriers to fish passage).

Task A-2.2.—Modify Price-Stubb Dam and Government Highline Dam to allow adequate movement of Colorado pikeminnow in the upper Colorado River.

Task A-2.3.—Identify, evaluate, and modify (as necessary) barriers on the San Juan River (e.g., Cudei Diversion and Hogback Diversion) to allow adequate movement of Colorado pikeminnow.

Management Action A-3.—Investigate options for providing appropriate water temperatures in the Gunnison River that would allow for range expansion of Colorado pikeminnow.

Task A-3.1.—Investigate the feasibility of modifying releases from Aspinall Unit dams to increase water temperatures in the Gunnison River that would allow for upstream range expansion of Colorado pikeminnow in the Gunnison River (see section 4.1 for discussion on warm-water releases).

Task A-3.2.—Modify releases from Aspinall Unit dams to increase water temperatures in the Gunnison River, if determined feasible and necessary to achieve demographic criteria for the upper Colorado River subbasin (see section 5.3.2.1.2).

Management Action A-4.—Minimize entrainment of subadult and adult Colorado pikeminnow in diversion canals.

Task A-4.1.—Identify measures (e.g., screens, baffles) to minimize entrainment of subadult and adult Colorado pikeminnow at problematic diversion structures, such as the Green River Canal, Grand Valley Irrigation Canal, Government Highline Diversion Project, and the Redlands Canal Company Diversion (see section 4.1 for discussion on entrainment).

Task A-4.2.—Install devices and/or implement other measures (as determined under Task A-4.1) to minimize entrainment.

5.2.2 Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes

Management Action B-1.—Protect Colorado pikeminnow populations from overutilization for commercial, recreational, scientific, or educational purposes.

Task B-1.1.—Reevaluate and, if necessary, identify actions to ensure adequate protection from overutilization of Colorado pikeminnow for commercial, recreational, scientific, or educational purposes; not currently identified as an existing threat (see section 4.2).

Task B-1.2.—Implement identified actions (as determined under Task B-1.1) to ensure adequate protection of Colorado pikeminnow populations from overutilization for commercial, recreational, scientific, or educational purposes.

5.2.3 Factor C.—Adequate protection from diseases and predation

Management Action C-1.—Minimize adverse effects of diseases and parasites on Colorado pikeminnow populations.

Task C-1.1.—Reevaluate and, if necessary, identify actions to minimize adverse effects of diseases and parasites on Colorado pikeminnow populations; not currently identified as an existing threat (see sections 4.3.1 and A.11 for discussion of diseases and parasites).

Task C-1.2.—Implement identified actions (as determined under Task C-1.1) to ensure adequate protection of Colorado pikeminnow populations from deleterious diseases and parasites.

Management Action C-2.—Regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.

Task C-2.1.—Develop, implement, evaluate, and revise (as necessary through adaptive management) procedures for stocking nonnative fish species in the Upper Colorado River Basin (including the San Juan River subbasin) to minimize negative interactions between nonnative fishes and Colorado pikeminnow (see sections 4.3.2 and A.7 for discussion of effects of nonnative fishes).

Task C-2.2.—Finalize and implement procedures (as determined under Task C-2.1) for stocking nonnative fish species in the Upper Colorado River Basin to minimize negative interactions between nonnative fishes and Colorado pikeminnow.

Management Action C-3.—Control problematic nonnative fishes as needed.

Task C-3.1.—Develop control programs for small-bodied nonnative fishes (e.g., cyprinids and centrarchids) in backwater nursery habitats in river reaches occupied by young Colorado pikeminnow to identify levels of control that will minimize negative interactions (e.g., competition and predation; see sections 4.3.2 and A.7 discussion of effects of nonnative fishes).

Task C-3.2.—Implement identified levels (as determined under Task C-3.1) of nonnative fish control in backwater nursery habitats in river reaches occupied by young Colorado pikeminnow.

Task C-3.3.—Develop channel catfish control programs in river reaches occupied by Colorado pikeminnow to identify levels of control that will minimize negative interactions.

Task C-3.4.—Implement identified levels (as determined under Task C-3.3) of channel catfish control in river reaches occupied by Colorado pikeminnow.

Task C-3.5.—Develop northern pike control programs in reaches of the Yampa and middle Green rivers occupied by Colorado pikeminnow to identify levels of control that will minimize negative interactions.

Task C-3.6.—Implement identified levels (as determined under Task C-3.5) of northern pike control in reaches of the Yampa and middle Green rivers occupied by Colorado pikeminnow.

5.2.4 Factor D.—Adequate existing regulatory mechanisms

Management Action D-1.—Legally protect habitat (see definition of habitat in section 5.1.2) necessary to provide adequate habitat and sufficient range for all life stages of Colorado pikeminnow to support recovered populations, based on demographic criteria.

Task D-1.1.—Determine mechanisms for legal protection of adequate habitat through instream-flow rights, contracts, agreements, or other means (see section 4.4 for discussion of regulatory mechanisms).

Task D-1.2.—Implement mechanisms for legal protection of habitat (as determined under Task D-1.1) that are necessary to provide adequate habitat and sufficient range for all life stages of Colorado pikeminnow to support recovered populations.

Management Action D-2.—Provide for the long-term management and protection of Colorado pikeminnow populations and their habitats.

Task D-2.1.—Identify elements needed for the development of conservation plans that are necessary to provide for the long-term management and protection of Colorado pikeminnow populations; elements of these plans may include (but are not limited to) provision of flows for maintenance of adequate habitat conditions for all life stages of Colorado pikeminnow, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats (see section 4.4 for discussion of need for conservation plans).

Task D-2.2.—Develop and implement conservation plans and execute agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties to provide reasonable assurances that conditions needed for recovered Colorado pikeminnow populations will be maintained.

5.2.5 Factor E.—Other natural or manmade factors for which protection has been provided

Management Action E-1.—Minimize the risk of hazardous-materials spills in critical habitat.

Task E-1.1.—Review and recommend modifications to State and Federal hazardous-materials spills emergency-response plans to ensure adequate protection for Colorado pikeminnow populations from hazardous-materials spills, including prevention and quick response to hazardous-materials spills (see section 4.5.1 for discussion of hazardous-materials spills).

Task E-1.2.—Implement State and Federal emergency-response plans that contain the necessary preventive measures (as determined under Task E-1.1) for hazardous-materials spills.

Task E-1.3.—Identify locations of all petroleum-product pipelines within the 100-year floodplain of critical habitat and assess the need for emergency shut-off valves to minimize the potential for spills.

Task E-1.4.—Install emergency shut-off valves (as determined under Task E-1.3) on problematic petroleum-product pipelines within the 100-year floodplain of critical habitat.

Management Action E-2.—Minimize threats from degraded water quality on Colorado pikeminnow.

Task E-2.1.—Identify actions to remediate groundwater contamination from the Atlas Mills tailings pile located near Moab, Utah, in order to restore water quality of the Colorado River in the vicinity of the pile in accordance with the State of Utah and Environmental Protection Agency (EPA) water-quality standards for fish and wildlife (see section 4.5.1 for discussion of groundwater contamination).

Task E-2.2.—Implement actions (as determined under Task E-2.1) to remediate groundwater contamination from the Atlas Mills tailings pile.

Management Action E-3.—Minimize adverse effects of selenium contamination on Colorado pikeminnow reproductive success and survival of young and reduce deleterious levels of selenium contamination, if necessary.

Task E-3.1.—Reevaluate the effects of selenium contamination on Colorado pikeminnow reproductive success and survival of young, and, if necessary, identify actions to reduce deleterious levels of selenium contamination (see section 4.5.1 for discussion of selenium effects).

Task E-3.2.—Implement identified actions (as determined under Task E-3.1) to reduce deleterious levels of selenium contamination.

5.3 Objective, Measurable Recovery Criteria

5.3.1 Downlist criteria

5.3.1.1 Demographic criteria for downlisting (population demographics in all subbasins must be met in order to achieve downlisting)

5.3.1.1.1 Green River Subbasin

1. A self-sustaining population is maintained over a 5-year period, starting with the first point estimates acceptable to the Service, such that:

    a. the trends in separate adult (age 7+; ≥450 mm TL) point estimates for the middle Green River and the lower Green River do not decline significantly, and

    b. mean estimated recruitment of age-6 (400–449 mm TL) naturally produced fish equals or exceeds mean annual adult mortality for the Green River subbasin, and

c. each population point estimate for the Green River subbasin exceeds 2,600 adults (Note: 2,600 adults is the estimated MVP number; see section 3.3.2).

5.3.1.1.2 Upper Colorado River Subbasin

1. A self-sustaining population of at least 700 adults (number based on inferences about carrying capacity) is maintained over a 5-year period, starting with the first point estimate acceptable to the Service, such that:

   a. the trend in adult (age 7+; ≥450 mm TL) point estimates does not decline significantly, and

   b. mean estimated recruitment of age-6 (400–449 mm TL) naturally produced fish equals or exceeds mean annual adult mortality.

5.3.1.1.3 San Juan River Subbasin

1. A target of 1,000 age-5+ fish (≥300 mm TL; number based on estimated survival of stocked fish and inferences about carrying capacity) is established through augmentation and/or natural reproduction.

5.3.1.2 Recovery factor criteria for downlisting

Factor A.—Adequate habitat and range for recovered populations provided.

1. Flow regimes to benefit Colorado pikeminnow populations in the Green River, upper Colorado River, and San Juan River subbasins identified, implemented, evaluated, and revised (Task A-1.1), such that:

   a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section 5.3.1.1.

   b. Adequate nursery habitat is available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section 5.3.1.1.

   c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) is available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section 5.3.1.1.

2. Passage over Redlands Diversion and Grand Valley Diversion continued to allow adequate movement of Colorado pikeminnow in the upper Colorado River and Gunnison River (Task A-2.1).

3. Modification of Price-Stubb Dam and Government Highline Dam initiated to allow adequate movement of Colorado pikeminnow in the upper Colorado River (Task A-2.2).

4. Barriers on the San Juan River identified and evaluated, and modifications initiated to allow adequate movement of Colorado pikeminnow (Task A-2.3).

5. Investigations initiated on the feasibility of modifying releases from Aspinall Unit dams to increase water temperatures in the Gunnison River that would allow for upstream range expansion of Colorado pikeminnow (Task A-3.1).

6. Measures identified to minimize entrainment of subadult and adult Colorado pikeminnow at problematic diversion structures (Task A-4.1).

Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

7. Overutilization of Colorado pikeminnow for commercial, recreational, scientific, or educational purposes reevaluated and, if necessary, actions identified to ensure adequate protection (Task B-1.1).

Factor C.—Adequate protection from diseases and predation.

8. Effects of diseases and parasites on Colorado pikeminnow populations reevaluated and, if necessary, actions identified to ensure adequate protection (Task C-1.1).

9. Procedures developed, implemented, evaluated, and revised for stocking nonnative fish species in the Upper Colorado River Basin (including the San Juan River subbasin) to minimize negative interactions between nonnative fishes and Colorado pikeminnow (Task C-2.1).

10. Control programs for small-bodied nonnative fishes in backwater nursery habitats in river reaches occupied by young Colorado pikeminnow developed and implemented to identify levels of control that will minimize negative interactions (Task C-3.1).

11. Channel catfish control programs in river reaches occupied by Colorado pikeminnow developed and implemented to identify levels of control that will minimize negative interactions (Task C-3.3).

12. Northern pike control programs in reaches of the Yampa and middle Green rivers occupied by Colorado pikeminnow developed and implemented to identify levels of control that will minimize negative interactions (Task C-3.5).

Factor D.—Adequate existing regulatory mechanisms.

13. Mechanisms determined for legal protection of adequate habitat (Task D-1.1).

14. Elements of conservation plans identified that are necessary to provide for the long-term management and protection of Colorado pikeminnow populations (Task D-2.1).

Factor E.—Other natural or manmade factors for which protection has been provided.

15. State and Federal hazardous-materials spills emergency-response plans reviewed and modified to ensure adequate protection for Colorado pikeminnow populations from hazardous-materials spills (Task E-1.1).

16. Locations of all petroleum-product pipelines within the 100-year floodplain of critical habitat identified and the need for emergency shut-off valves assessed (Task E-1.3).

17. Actions identified for remediation of groundwater contamination at the Atlas Mills tailings pile located near Moab, Utah (Task E-2.1).

18. Effects of selenium contamination on Colorado pikeminnow reproductive success and survival of young reevaluated and, if necessary, actions identified to reduce deleterious levels of selenium contamination (Task E-3.1).

5.3.2 Delist criteria

5.3.2.1 Demographic criteria for delisting (population demographics in all subbasins must be met in order to achieve delisting)

5.3.2.1.1 Green River Subbasin

1. A self-sustaining population is maintained over a 7-year period beyond downlisting, starting with the first point estimates acceptable to the Service, such that:

    a. the trends in separate adult (age 7+; ≥450 mm TL) point estimates for the middle Green River and the lower Green River do not decline significantly, and

    b. mean estimated recruitment of age-6 (400–449 mm TL) naturally produced fish equals or exceeds mean annual adult mortality for the Green River subbasin, and

    c. each population point estimate for the Green River subbasin exceeds 2,600 adults (MVP).

5.3.2.1.2 Upper Colorado River and San Juan River Subbasins

1. One of the following must be met over a 7-year period beyond downlisting, starting with the first point estimate acceptable to the Service:

    A self-sustaining population that exceeds 1,000 adults (age 7+; ≥450 mm TL) is maintained in the upper Colorado River subbasin **OR** a self-sustaining population that exceeds 700 adults is maintained in the upper Colorado River subbasin and a self-sustaining population that exceeds 800 adults is maintained in the San Juan River subbasin, such that for each population (numbers of adults based on inferences about carrying capacity):

    a. the trend in adult point estimates does not decline significantly, and

    b. mean estimated recruitment of age-6 (400–449 mm TL) naturally produced fish equals or exceeds mean annual adult mortality.

5.3.2.2 Recovery factor criteria for delisting

Factor A.—Adequate habitat and range for recovered populations provided.

1. Flow regimes provided that are necessary for all life stages of Colorado pikeminnow to support recovered populations in the upper Colorado River, Green River, and San Juan River subbasins (Task A-1.2), such that:

    a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.

    b. Adequate nursery habitat is available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.

    c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) is available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.

2. Passage over Redlands Diversion and Grand Valley Diversion continued to allow adequate movement of Colorado pikeminnow in the upper Colorado River and Gunnison River (Task A-2.1).

3. Modification of Price-Stubb Dam and Government Highline Dam completed to allow adequate movement of Colorado pikeminnow in the upper Colorado River (Task A-2.2).

4. Barriers on the San Juan River modified to allow adequate movement of Colorado pikeminnow (Task A-2.3).

5. Releases from Aspinall Unit dams to increase water temperatures in the Gunnison River are modified, if determined feasible and necessary to achieve demographic criteria for the upper Colorado River subbasin (see section 5.3.2.1.2) to allow for upstream range expansion of Colorado pikeminnow (Task A-3.2).

6. Devices installed and/or measures implemented at problematic diversion structures to minimize entrainment of subadult and adult Colorado pikeminnow (Task A-4.2).

Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

7. Adequate protection of Colorado pikeminnow populations from overutilization for commercial, recreational, scientific, or educational purposes attained (Task B-1.2).

Factor C.—Adequate protection from diseases and predation.

8. Adequate protection of Colorado pikeminnow populations from deleterious diseases and parasites attained (Task C-1.2).

9. Procedures finalized and implemented for stocking nonnative fish species in the Upper Colorado River Basin to minimize negative interactions between nonnative fishes and Colorado pikeminnow (Task C-2.2).

10. Identified levels of nonnative fish control to minimize negative interactions attained in backwater nursery habitats in river reaches occupied by young Colorado pikeminnow (Task C-3.2).

11. Identified levels of channel catfish control to minimize negative interactions attained in river reaches occupied by Colorado pikeminnow (Task C-3.4).

12. Identified levels of northern pike control to minimize negative interactions attained in reaches of the Yampa and middle Green rivers occupied by Colorado pikeminnow (Task C-3.6).

Factor D.—Adequate existing regulatory mechanisms.

13. Habitat necessary to provide adequate habitat and sufficient range for all life stages of Colorado pikeminnow to support recovered populations in the Green River, upper Colorado River, and San Juan River subbasins is legally protected in perpetuity (Task D-1.2).

14. Conservation plans developed and implemented, and agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties executed to provide reasonable assurances that conditions needed for recovered Colorado pikeminnow populations will be maintained (Task D-2.2).

Factor E.—Other natural or manmade factors for which protection has been provided.

15. State and Federal emergency-response plans implemented that contain the necessary preventive measures for hazardous-materials spills (Task E-1.2).

16. Emergency shut-off valves installed on all problematic petroleum-product pipelines within the 100-year floodplain of critical habitat (Task E-1.4).

17. Groundwater contamination remediated at the Atlas Mills tailings pile located near Moab, Utah, and water quality of the Colorado River in the vicinity of the pile restored in compliance with the State of Utah and EPA water-quality standards for fish and wildlife (Task E-2.2).

18. Deleterious levels of selenium contamination reduced to minimize adverse effects on Colorado pikeminnow reproductive success and survival of young (Task E-3.2).

5.4 Estimated Time to Achieve Recovery of the Colorado Pikeminnow

Estimated time to achieve recovery of the Colorado pikeminnow is 5 years for downlisting and an additional 7 years for delisting. First point estimates were completed for all populations in 2001. The Service is reviewing those estimates for reliability, and, if they are accepted by the Service and all recovery criteria are met, downlisting could be proposed in 2006 and delisting could be proposed in 2013 (Figure 4). This estimated time frame is based on current understanding of the status and trends of populations and on the monitoring time required to meet the downlisting and delisting criteria.

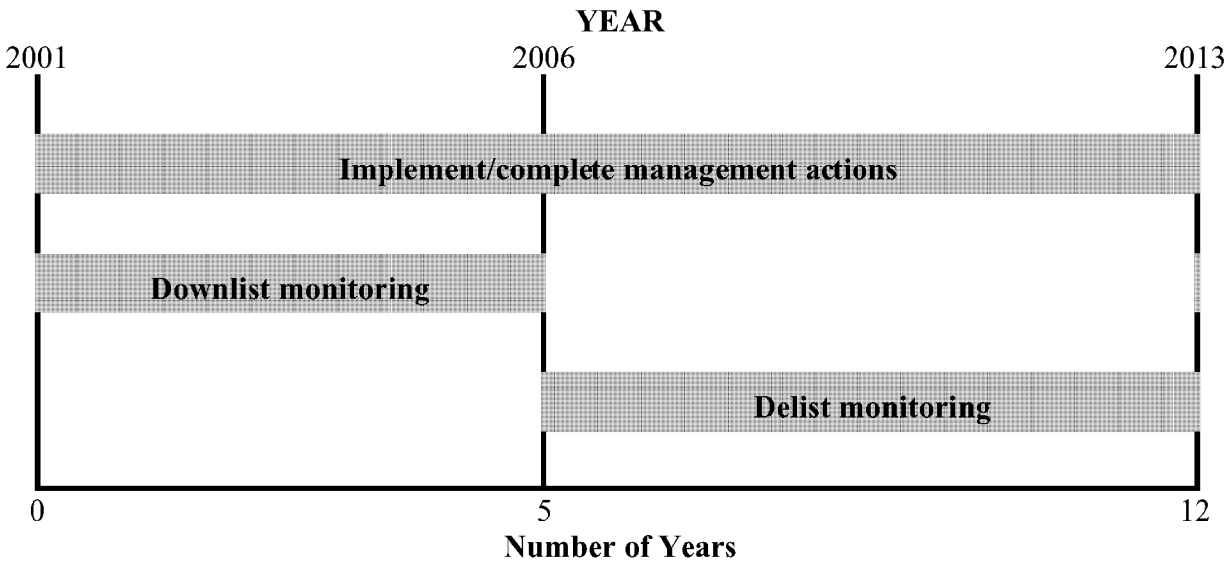

Figure 4. Estimated time to achieve recovery of the Colorado pikeminnow.

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APPENDIX A.

LIFE HISTORY OF THE COLORADO PIKEMINNOW

Following is a synopsis of Colorado pikeminnow life history. This assimilation of information represents an overview of the best scientific information available for the species at this time. Additional and more detailed information can be found in literature cited in this document and in reports and publications referenced in those citations.

A.1 Species Description

The Colorado pikeminnow is the largest member of the minnow family (Cyprinidae) in North America, with an estimated maximum total length (TL) of about 1.8 m and weight of 36 kg (Miller 1961). These large individuals were reported from the lower basin in the late 1800's and early 1900's. Largest confirmed weights are 12.2 and 15.5 kg in the 1950's from the lower basin (Wallis 1951), and about 11.4 kg in the 1990's from the upper basin (personal communication, T. Chart, U.S. Bureau of Reclamation). The species was known as the "salmon", "white salmon", "whitefish" (Evermann and Rutter 1895), and "Colorado River salmon" (Measeles 1981), although it was officially described as the "Colorado squawfish" (Girard (1856). The common name was recently changed to the Colorado pikeminnow (Nelson et al. 1998).

The Colorado pikeminnow is a long, slender, cylindrical fish with silvery sides, greenish back, and creamy-white belly. The tail trunk is thick with a triangular black patch at the base of the caudal fin. The head is large with a terminal mouth and thickened lips and jaws that lack teeth, and a maxillary (upper jaw) that extends past the middle of the eye. Large adults are silvery-white throughout and salmon-like in appearance. Spawning adults in June–August are tinged with light rosy-red on the head and body, with pimple-like tubercles on the head and paired fins. Dorsal and anal fins typically have 9 principal rays each. Scales are small, cycloid, and silvery with 83–87 along the lateral line. Teeth of the pharyngeal arch are spaced apart and barely hooked in a typical pattern of 2,5-4,2 (Girard 1856).

A.2 Distribution and Abundance

The Colorado pikeminnow is endemic to the Colorado River Basin, where it was once widespread and abundant in warm-water rivers and tributaries (Kirsch 1889; Jordan and Evermann 1896; Tyus 1991; Quartarone 1995). It was common in the lower basin in California and Arizona, where it was commercially harvested in the early 1900's (Minckley 1973). Numbers in the lower basin declined in the 1930's (Miller 1961), with few caught in the 1960's (Minckley 1973), and the last specimens reported in the mid-1970's (Moyle 1976; Minckley 1985).

The species was first reported in the upper basin in 1825 by Colonel William H. Ashley (Morgan 1964), and it was common to abundant in the Green and upper Colorado rivers and their tributaries (Banks 1964; Vanicek 1967; Holden and Stalnaker 1975; Seethaler 1978). It was

found from Rifle, Colorado, downstream in the mainstem upper Colorado River (Beckman 1963); from Delta, Colorado, downstream on the Gunnison River (Burdick 1995); and from Paradox Valley downstream on the Dolores River (Lynch et al. 1950). In the Green River, it was reported as far upstream as Green River, Wyoming (Ellis 1914; Baxter and Simon 1970); from Craig, Colorado, downstream on the Yampa River; from Rangely, Colorado, downstream and in the White, lower Price, and Duchesne rivers (Tyus and Haines 1991; Cavalli 1999; Muth et al. 2000).

Wild populations of Colorado pikeminnow are found only in the upper basin, and the species currently occupies only about 25% of its historic range basin-wide (Table 1). Occupied habitat occurs in the Green River from Lodore Canyon to the confluence of the Colorado River (Tyus 1991; Bestgen and Crist 2000); the Yampa River downstream of Craig, Colorado (Tyus and Haines 1991); the Little Snake River from its confluence with the Yampa River upstream into Wyoming (Marsh et al. 1991; Wick et al. 1991); the White River downstream of Taylor Draw Dam and Kenney Reservoir (Tyus and Haines 1991); the lower 143 km of the Price River (Cavalli 1999); the lower Duchesne River; the upper Colorado River from Palisade, Colorado, to Lake Powell (Valdez et al. 1982a; Osmundson et al. 1997, 1998); the lower 54 km of the Gunnison River (Valdez et al. 1982b; Burdick 1995); the lower 2 km of the Dolores River (Valdez et al. 1992); and 241 km of the San Juan River downstream from Shiprock, New Mexico, to the Lake Powell inflow (Jordan 1891; Koster 1960; Olson 1962; Propst 1999).

Natural reproduction of Colorado pikeminnow is currently known from the Green, Yampa, upper Colorado, Gunnison, and San Juan rivers. Tyus (1991) and Nesler (2000) estimated an average of about 8,000 adults in the Green River subbasin, for an estimated average of about 14 and 8 adults/km for about 552 and 984 km of river, respectively. Crowl and Bouwes (1998) estimated that 1,000 adults were associated with spawning sites near Three Fords Canyon in Gray Canyon of the lower Green River, and 1,400 adults were associated with spawning sites in the lower 32 km of the Yampa River. Fish associated with the two spawning sites may be demographically independent with individual stock-recruitment characteristics (personal communication, T. Modde, U.S. Fish and Wildlife Service), but overlap in adult and juvenile distributions and panmixis of genetic material suggests the mixing of these two stocks (Ammerman and Morizot 1989; Williamson et al. 1999). Fish in the upper Colorado River subbasin total about 600–900 adults (Nesler 2000; Osmundson 2002) and are believed to spawn near Grand Junction, Colorado, and in the lower Gunnison River (personal communication, C. McAda, U.S. Fish and Wildlife Service). Although fish in the Green and upper Colorado River systems spawn at four primary locales (Tyus 1985, 1991), they are likely linked genetically, based on movement throughout the system and lack of genetic separation (Ammerman and Morizot 1989).

Biochemical genetics (Ammerman and Morizot 1989) showed no differences between fish from the Green and Colorado river systems, suggesting one panmictic upper basin population, with possible exchange occurring through unmarked subadults returning randomly to upstream areas (Gilpin 1993; Osmundson 1999). Heterozygosity of Colorado pikeminnow from the upper basin was roughly 5%, an unusually low diversity due primarily to two polymorphic loci (Ammerman and Morizot 1989). Low heterozygosity may be correlated with delayed first reproduction, low adult mortality, and with K-selected species (Mitton and Lewis 1989), and possibly with fish that

return to spawn at their natal sites (Nevo 1978). Approximately 1,500 Carlin-tagged hatchery-reared juvenile Colorado pikeminnow of Green River parentage were released in the Colorado River near Moab, Utah, in February 1980 (Valdez et al. 1982a); small numbers of recaptures during annual sampling indicates that few of these fish survived and were not represented in the genetic analysis.

There are few wild fish remaining in the San Juan River; preliminary estimates range from 19 to 50 adults (Holden 1999; personal communication, D. Ryden, U.S. Fish and Wildlife Service). Over 300,000 hatchery-produced Colorado pikeminnow have been released in the mainstem as part of the San Juan River Basin Recovery Implementation Program (Ryden and Ahlm 1996; Holden 1999; personal communication, F. Pfeifer, U.S. Fish and Wildlife Service).

Over 623,000 Colorado pikeminnow were reintroduced into the Salt and Verde Rivers, Arizona, between 1981 and 1990 (Hendrickson 1994). These reintroductions are considered experimental, nonessential populations, and low survival with no successful reproduction has been documented as a result of these releases (Maddux et al. 1993).

In addition to adults, age-0 fish and juveniles are found in the lower Yampa River, the Green River downstream of the Yampa River confluence; the upper Colorado River downstream of Palisade, Colorado, to Lake Powell, Utah; and the lower 40 km of the Gunnison River. Subadults and small adults have also been found in the lower Price and Duchesne rivers (Cavalli 1999) and the lower White River (Irving and Modde 2000). The Interagency Standardized Monitoring Program (ISMP) of the Upper Colorado River Endangered Fish Recovery Program (McAda et al. 1994a, 1994b, 1995, 1996, 1997) has determined catch-rate indices of age-0 and subadult Colorado pikeminnow in the Green and upper Colorado rivers since 1988. Numbers of age-0 fish and subadults in the other rivers are believed low with no extensive surveys, except for the San Juan River. All data collected under ISMP are catch-rate indices, and there are a few mark-recapture estimates of subadults in backwaters (Haines et al. 1998).

A.3 Habitat

The Colorado pikeminnow is a long-distance migrator; adults move hundreds of kilometers to and from spawning areas, and require long sections of river with unimpeded passage. Adults require pools, deep runs, and eddy habitats maintained by high spring flows. These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, form gravel and cobble deposits used for spawning, and rejuvenate backwater nursery habitats. Spawning occurs after spring runoff at water temperatures typically between 18 and 23°C. After hatching and emerging from spawning substrate, larvae drift downstream to nursery backwaters that are restructured by high spring flows and maintained by relatively stable base flows. Flow recommendations have been developed that specifically consider flow-habitat relationships in habitats occupied by Colorado pikeminnow in the upper basin, and were designed to enhance habitat complexity and to restore and maintain ecological processes (see section 4.1). The following is a description of observed habitat uses in the Upper Colorado River Basin.

Colorado pikeminnow live in warm-water reaches of the Colorado River mainstem and larger tributaries, and require uninterrupted stream passage for spawning migrations and dispersal of young. The species is adapted to a hydrologic cycle characterized by large spring peaks of snow-melt runoff and low, relatively stable base flows. High spring flows create and maintain in-channel habitats, and reconnect floodplain and riverine habitats, a phenomenon described as the spring flood-pulse (Junk et al. 1989; Johnson et al. 1995). Throughout most of the year, juvenile, subadult, and adult Colorado pikeminnow utilize relatively deep, low-velocity eddies, pools, and runs that occur in nearshore areas of main river channels (Tyus and McAda 1984; Valdez and Masslich 1989; Tyus 1990, 1991; Osmundson et al. 1995; Table A-1). In spring, however, Colorado pikeminnow adults utilize floodplain habitats, flooded tributary mouths, flooded side canyons, and eddies that are available only during high flows (Tyus 1990, 1991; Osmundson et al. 1995). Such environments may be particularly beneficial for Colorado pikeminnow because other riverine fishes gather in floodplain habitats to exploit food and temperature resources, and may serve as prey. Such low-velocity environments also may serve as resting areas for Colorado pikeminnow. River reaches of high habitat complexity appear to be preferred.

Because of their mobility and environmental tolerances, adult Colorado pikeminnow are the most widely distributed life stage. During most of the year, distribution patterns of adults are stable (Tyus 1990, 1991; Irving and Modde 2000), but distribution of adults changes in late spring and early summer, when most mature fish migrate to spawning areas (Tyus and McAda 1984; Tyus 1985, 1990, 1991; Irving and Modde 2000). High spring flows provide an important cue to prepare adults for migration and also ensure that conditions at spawning areas are suitable for reproduction once adults arrive. Specifically, bankfull or much larger floods mobilize coarse sediment to build or reshape cobble bars, and they create side channels that Colorado pikeminnow sometimes use for spawning (Harvey et al. 1993).

Colorado pikeminnow spawning sites in the Green River subbasin have been well documented. The two principal locations are in Yampa Canyon on the lower Yampa River and in Gray Canyon on the lower Green River (Tyus 1990, 1991). These reaches are 42 and 72 km long, respectively, but most spawning is believed to occur at one or two short segments within each of the two reaches. Another spawning area may occur in Desolation Canyon on the lower Green River (Irving and Modde 2000), but the location and importance of this area has not been verified. Although direct observation of Colorado pikeminnow spawning was not possible because of high turbidity, radiotelemetry indicated spawning occurred over cobble-bottomed riffles (Tyus 1990). High spring flows and subsequent post-peak summer flows are important for construction and maintenance of spawning substrates (Harvey et al. 1993). In contrast with the Green River subbasin, where known spawning sites are in canyon-bound reaches, currently suspected spawning sites in the upper Colorado River subbasin are at six locations in meandering, alluvial reaches (McAda 2000).

After hatching and emerging from the spawning substrate, Colorado pikeminnow larvae drift downstream to backwaters in sandy, alluvial regions, where they remain through most of their first year of life (Holden 1977; Tyus and Haines 1991; Muth and Snyder 1995). Backwaters and the physical factors that create them are vital to successful recruitment of early life stages of Colorado pikeminnow, and age-0 Colorado pikeminnow in backwaters have received much

Table A-1. Seasonal frequency (%) of use of macrohabitats in the Grand Valley of the upper Colorado River subbasin by radio-tagged adult Colorado pikeminnow, 1986–1989 (Osmundson et al. 1995). Habitats: FR = fast runs, SR = slow runs, RA = rapids, RI = riffles, ED = eddies, PO = pools, SH = shorelines, BA = backwaters, and GP = off-channel flooded gravel pits.

Months	Habitats								
	FR	SR	RA	RI	ED	PO	SH	BA	GP
April–June (Spring)	3–19	13–32	0–1	0–2	2–9	8–12	3–8	22–42	3–25
July–September (Summer)	7–26	26–55	3–5	3–10	9–16	13–16	0–4	3–7	0–4
October	0	61	0	0	4	26	0	9	0
November–February (Winter)	0	27–41	0	0	0–8	42–62	0	5–15	0
March	4	43	0	0	7	32	0	14	0

research attention (e.g., Tyus and Karp 1989; Haines and Tyus 1990; Tyus 1991; Tyus and Haines 1991; Bestgen et al. 1997). It is important to note that these backwaters are formed after cessation of spring runoff within the active channel and are not floodplain features. Colorado pikeminnow larvae occupy these in-channel backwaters soon after hatching. They tend to occur in backwaters that are large, warm, deep (average, about 0.3 m in the Green River), and turbid (Tyus and Haines 1991). Recent research (Day et al. 1999a, 1999b; Trammell and Chart 1999a, 1999b) has confirmed these preferences and suggested that a particular type of backwater is preferred by Colorado pikeminnow larvae and juveniles. Such backwaters are created when a secondary channel is cut off at the upper end, but remains connected to the river at the downstream end. These chute channels are deep and may persist even when discharge levels change dramatically. An optimal river-reach environment for growth and survival of early life stages of Colorado pikeminnow has warm, relatively stable backwaters, warm river channels, and abundant food (Muth et al. 2000).

A.4 Movement

Young Colorado pikeminnow remain near nursery areas for the first 2–4 years of life, then move upstream to recruit to adult populations and establish home ranges (Osmundson et al. 1998). In the upper Colorado River, distance moved was inversely related to fish size; displacement of fish < 550 mm TL averaged 33.6 km and displacement for fish ≥ 550 mm TL was only 7.5 km (Osmundson et al. 1998). Similar average movement of 31.8 km was observed for 43 radio-tagged adults during fall and spring in the Green River (Archer et al. 1985). Adult Colorado pikeminnow remain in home ranges during fall, winter, and spring and may move considerable distances to and from spawning areas in summer. Individuals move to spawning areas shortly after runoff in early summer, and return to home ranges in August and September (Tyus 1990; Irving and Modde 2000). Round-trip movements of up to 950 km have been reported (Irving

and Modde 2000), with some fish "straying" between rivers within the Green River subbasin (Tyus 1985, 1990; Tyus and McAda 1984). Adults may return in consecutive years to overwinter in the same areas (Wick et al. 1981; Valdez and Masslich 1989).

A.5 Reproduction

The Colorado pikeminnow is an obligate warm-water species that requires relatively warm temperatures for spawning, egg incubation, and survival of young. Hatchery-reared males became sexually mature at 4 years of age and females at 5 years. Average fecundity of 24, 9-year old females was 77,400 (range, 57,766–113,341) or 55,533 eggs/kg, and average fecundity of 9 ten-year old females was 66,185 (range, 11,977–91,040) or 45,451 eggs/kg (Hamman 1986). Average-sized Colorado pikeminnow in the upper basin are 450–550 mm TL and weigh 1–2 kg. The information on sex ratio is highly variable because most observations were made from field sampling during a short interval of the total spawning event; high turbidity precludes direct observation of spawners and fish are captured with trammel nets over spawning bars. Male to female ratios reported from catches over spawning bars are 9:1 (Holden and Stalnaker 1975), 13.85:1 (Tyus 1990), and 5.6:1 (Seethaler 1978). Ratios of active males to females visually observed spawning naturally under hatchery conditions are 2:1 (Hamman 1980), and 2–3:1 (Hamman 1981, 1986). It is believed that the ratios observed under hatchery conditions more accurately reflect conditions in the wild that were not observed or reported by other investigators because sampling on spawning grounds may reflect a relatively common set of males remaining on the spawning area to service a number of transient females; hence, sampling at any one time would bias the sex ratio highly in favor of males.

Spawning activity begins after the peak of spring runoff during June–August at water temperatures typically 16°C or higher (Vanicek and Kramer 1969; Hamman 1981; McAda 2000; Muth et al. 2000). In the lower Yampa River, reproduction was initiated within days of mean daily water temperature exceeding 18°C, with water temperature at initiation ranging 16.0–22.3°C on the Yampa River and 19.8–23.0°C on the lower Green River (Bestgen et al. 1998). Colorado pikeminnow are broadcast spawners that scatter adhesive eggs over cobble substrate which incubate in interstitial spaces. Hatching success is greatest at 20–24°C with incubation time of 90–121 h (Hamman 1981; Marsh 1985). Newly hatched larvae are 6.0–7.5 mm long (Hamman 1981), which emerge from spawning cobbles 3–15 days after hatching and drift predominantly as protolarvae (Haynes et al. 1984; Nesler et al. 1988). Larvae hatched in the lower Yampa River may drift 50–120 miles downstream to nursery backwaters.

High densities of age-0 Colorado pikeminnow have been found downstream of the confluence of the Green and Colorado rivers and in the Lake Powell inflow (Valdez 1990), suggesting that fish from both systems are transferred passively or move actively downstream into these regions. Osmundson et al. (1998) showed that subadult Colorado pikeminnow in the Colorado River move back upstream as they mature. Gilpin (1993) hypothesized that this upstream return by subadults provides connectivity and gene flow between the Green and Colorado rivers, resulting in a panmictic population for the entire upper basin with evidence of source/sink dynamics. Marked fish have been recaptured to substantiate exchange of Colorado pikeminnow between the

Green and Colorado rivers, thus supporting the hypothesis of panmixis (personal communication, C. McAda, U.S. Fish and Wildlife Service).

A.6 Survival

Survival and recruitment of Colorado pikeminnow is pulsed, as a strong year class appears and is reflected in the size composition of the population over time. This "storage effect" (Gilpin 1993) enables long-lived populations to maintain themselves despite several years of failed or low reproductive success. Greatest cohort strength in the upper Colorado River (i.e., 1986, 1996) and in the Green River (1986, 1988, 1991; McAda et al. 1998) occurred 1–2 years after high river flows. High to moderate flows rework sediment deposit and this reworking seems to increase larval survival and is linked to strong year classes (Van Steeter and Pitlick 1998; Osmundson 1999). Successful cohorts during high flows may be precluded by delayed warming of the river which causes delayed spawning and age-0 fish that lack size and fat content to survive overwinter (Thompson et al. 1991; Converse et al. 1999).

Studies of overwinter survival show a significant relationship between densities of age-0 fish in fall and spring, suggesting that high spawning success and egg and larval survival by fall (i.e., 3–4 months of age) largely determine cohort strength (Valdez et al. 1999; McAda and Ryel 1999). Overwinter survival also influences cohort strength, but the linkage to environmental correlates (e.g., flow variability, river temperature and ice formation, average backwater depth, and nonnative fish density) is unclear. Overwinter survival (October–March) of age-0 fish in backwaters of the upper Green River, based on the difference between fall and spring seine catch rates for 1989, 1990, 1991, 1992, and 1993 was 96, 29, 31, 38, and 62% (mean, 51%), respectively (Valdez et al. 1999). Survival was related to backwater depth with higher survival (85%) in backwaters deeper than 120 cm and lowest survival (18%) in backwaters less than 30 cm deep. In the upper Colorado River, overwinter survival ranged 7–77% (mean, 49%; McAda and Ryel 1999). Overwinter survival of age-0 Colorado pikeminnow in Green River backwaters, based on mark-recapture population estimates, ranged 6–62% (mean, 45%), compared to catch rate estimates for the same period of 11–49% (mean, 34%; Haines et al. 1998).

Survival rates of adults ≥550 mm TL from the upper Colorado River ranged from 0.83–0.87, with the best fit at 0.85 (Osmundson et al. 1997). Similar survival rate of 0.81 was calculated by Gilpin (1993) for a population viability analysis of Colorado pikeminnow. Survival of adults in the Yampa River may be slightly lower because of incidental catch and handling from angler pressure on sympatric game species, especially northern pike (*Esox lucius*).

A.7 Predation

Nonnative fishes dominate the ichthyofauna of Colorado River Basin rivers, and certain species have been implicated as contributing to reductions in the distribution and abundance of native fishes (Carlson and Muth 1989). At least 67 species of nonnative fishes have been introduced into the Colorado River Basin during the last 100 years (Tyus et al. 1982; Carlson and Muth 1989; Minckley and Deacon 1991; Maddux et al. 1993; Tyus and Saunders 1996; Pacey and Marsh 1998). Tyus et al. (1982) reported that 42 nonnative fish species have become established

in the upper basin, and Minckley (1985) reported that 37 nonnative fish species have become established in the lower basin. Many of these species were intentionally introduced as game or forage fishes, whereas others were unintentionally introduced with game species or passively as bait fish. Potential negative interactions (i.e., predation and competition) between nonnative and native fishes have been identified (reviewed by Minckley 1991; Hawkins and Nesler 1991; Lentsch et al. 1996; Tyus and Saunders 1996; Pacey and Marsh 1998).

Colorado pikeminnow populations in the upper basin live sympatrically with about 20 species of warm-water, nonnative fishes (Tyus et al. 1982; Lentsch et al. 1996) that are potential predators, competitors, and vectors for parasites and diseases. Hawkins and Nesler (1991) identified red shiner (*Cyprinella lutrensis*), common carp (*Cyprinus carpio*), fathead minnow (*Pimephales promelas*), channel catfish (*Ictalurus punctatus*), northern pike, and green sunfish (*Lepomis cyanellus*) as the nonnatives considered by Colorado River Basin researchers to be of greatest concern because of their suspected or documented negative interactions with native fishes. Sand shiner (*Notropis stramineus*), white sucker (*Catostomus commersoni*), black bullhead (*Ameiurus melas*), smallmouth bass (*Micropterus dolomieu*), and largemouth bass (*M. salmoides*) were identified by Hawkins and Nesler (1991) as nonnatives of increasing concern because of their increasing abundance, habitat preferences, and/or piscivorous habits. Lentsch et al. (1996) identified existing threats to native fishes in the upper basin from six species of nonnative fishes including red shiner, common carp, sand shiner, fathead minnow, channel catfish, and green sunfish.

Backwaters and other low-velocity shoreline habitats in alluvial reaches of the upper Colorado, Green, and San Juan rivers are important nursery areas for larval and juvenile Colorado pikeminnow (Tyus 1991; Holden 1999; McAda 2000; Muth et al. 2000), and researchers believe that nonnative fish species in those habitats limit the success of Colorado pikeminnow recruitment (e.g., Muth and Nesler 1993; Bestgen 1997; Bestgen et al. 1997; McAda and Ryel 1999; Valdez et al. 1999). Osmundson (1987) confirmed predation by black bullhead, green sunfish, largemouth bass, and black crappie (*Pomoxis nigromaculatus*) as a significant mortality factor of young-of-year and yearling Colorado pikeminnow stocked in riverside ponds along the upper Colorado River. Adult red shiner are known predators of larval native fish in backwaters of the upper basin (Ruppert et al. 1993), and predation by nonnative fishes such as red shiner may influence within-year-class recruitment of Colorado pikeminnow (Bestgen et al. 1997). In laboratory experiments on behavioral interactions, Karp and Tyus (1990) observed that red shiner, fathead minnow, and green sunfish shared activity schedules and space with young Colorado pikeminnow and exhibited antagonistic behaviors toward smaller Colorado pikeminnow. They hypothesized that Colorado pikeminnow may be at a competitive disadvantage in an environment which is resource limited and concluded that nonnative fishes could have a negative impact on growth and survival of young Colorado pikeminnow. High spatial overlap in habitat use has been documented among young Colorado pikeminnow, red shiner, sand shiner, and fathead minnow (McAda and Tyus 1984; McAda and Kaeding 1989). Muth and Snyder (1995) compared the diet of young-of-year Colorado pikeminnow with the diets of other small fishes collected from backwaters of the Green River. They concluded that the potential for competition for food between Colorado pikeminnow and other fishes in

backwaters appeared greatest with red shiner, which are often the most abundant fish in backwaters.

Channel catfish and northern pike have been identified as the principal nonnative threats to subadult and adult Colorado pikeminnow in the upper basin. Adult Colorado pikeminnow apparently use the same habitats as adult channel catfish and northern pike suggesting the potential for competitive interactions, especially during periods of limited resource availability (Wick et al. 1985; Tyus and Karp 1989; Tyus and Beard 1990; Nesler 1995). Channel catfish were first introduced into the Upper Colorado River Basin in 1892 (Tyus and Nikirk 1990) and are now considered common to abundant throughout much of the upper basin (Tyus et al. 1982; Nelson et al. 1995). The species is one of the most prolific predators in the upper basin and, among the nonnative fishes, is thought to have the greatest adverse effect on the endangered fishes (Hawkins and Nesler 1991; Lentsch et al. 1996; Tyus and Saunders 1996), largely due to predation on juveniles and resource overlap with subadults and adults. Additionally, mortality of adult Colorado pikeminnow that prey on channel catfish has occurred due to choking on pectoral spines (McAda 1980; Pimental et al. 1985). Northern pike accidentally became established in the Yampa River in the early 1980's when individuals escaped from Elkhead Reservoir (Tyus and Beard 1990). Since then, northern pike have established a reproducing population in the Yampa River and have expanded their numbers and range in both the Yampa and middle Green rivers (Tyus and Beard 1990; Hawkins and Nesler 1991; Nesler 1995) where they pose a competitive or predatory threat to endangered and other native fishes (Wick et al. 1985; Tyus and Karp 1989; Tyus and Beard 1990; Martinez 1995; Nesler 1995).

In the lower basin, the recapture rate of Colorado pikeminnow stocked in the Salt and Verde rivers, Arizona, has been low. This low recapture rate has been attributed to severe predation by nonnative flathead catfish (*Pylodictis olivaris*; Hendrickson 1994). Hendrickson and Brooks (1987) documented predation by yellow bullhead (*Ameiurus natalis*) and largemouth bass on young Colorado pikeminnow stocked in the Verde River, Arizona.

A.8 Age and Growth

Oldest Colorado pikeminnow documented from scale annuli are 11 years (610 mm TL) from the Green River (Vanicek and Kramer 1969; Seethaler 1978); 16 years from the White River; 12 years from the Colorado River (Hawkins 1992); and 13 years (879 mm TL; Musker 1981) and 18 years (2 fish average of 804 mm TL; Hawkins 1992) from the Yampa River. However, Osmundson et al. (1997) cautioned that scale-based estimations are probably unreliable for Colorado pikeminnow beyond about age 10, and concluded that growth-rate data indicated that large fish (e.g., > 900 mm TL) average 47–55 years old with a minimum age of 34 years.

Larvae at hatching are 6.0–7.5 mm long (Hamman 1981) and average about 40 mm TL (range, 29–47 mm) in October at about 3 months of age (Valdez 1990; Tyus and Haines 1991). Growth under laboratory conditions averaged about 13 mm/30 days (Hamman 1981). Growth of adults in the Green River was about 10.2 mm/year (Tyus 1988). Mean annual growth rate of fish from the upper Colorado River aged 3–6 years ranged from 32.2 (age 6) to 82.0 (age 3) mm/year and declined to 19.8 mm/year for fish 500–549 mm TL (Osmundson et al. 1997); fish ≥ 550 mm

grew an average of 9.5 mm/year. Preliminary evidence indicates that females grow larger and perhaps live longer than males (Vanicek 1967; Tyus and Karp 1989).

The first scale annulus apparently does not form, and the first visible annulus reflects the second winter of life (Musker 1981; Hawkins 1992). Average length at the end of the second annulus formation ranged 90–123 mm TL (Hawkins 1992). Maximum length of fish examined recently is just over 800 mm TL. Asymptotic lengths, based on scale back-calculations and derived from Walford plots, indicate that maximum potential length of Colorado pikeminnow in the upper basin is 1,152 mm TL (Hawkins 1992). Historical accounts of fish in the lower basin indicate maximum length of about 1.8 m. Kaeding and Osmundson (1989) hypothesized that growth and overall size of Colorado pikeminnow in the upper basin is limited by more restrictive temperature regimes than in the lower basin.

Age to length relationships for Colorado pikeminnow are available from several investigations (Vanicek and Kramer 1969; Seethaler 1978; Musker 1981; Hawkins 1992; Osmundson 2002; Figure A-1). Vanicek and Kramer (1969) found that nearly all fish from the Green River age 7 or older (estimated at 454 mm total length [TL] from scale back-calculated lengths; Table A-2) were sexually mature. Seethaler (1978) determined that age-7 Colorado pikeminnow from the Green and Yampa rivers averaged 451 mm TL (scale back-calculations). He also necropsied 147 Colorado pikeminnow between 184 and 652 mm TL and found that all fish longer than 503 mm TL were sexually mature, and fish less than 428 mm TL were immature; 76% of 34 fish examined between 428 and 503 mm TL were sexually mature. Hamman (1981) found that hatchery-reared Colorado pikeminnow were sexually mature at age 5 (males) and age 6 (females), at total lengths of 317–376 mm and 425–441 mm, respectively. Musker (1981) found that age-7 wild fish from all rivers of the Upper Colorado River Basin averaged 461 mm TL (scale back-calculations; recalculated by Hawkins 1992). Hawkins (1992) surmised that Colorado pikeminnow hatch in late summer and either fail to form scales in their first winter or fail to form a first annulus. He assumed that all previous studies had missed the first annulus, and determined that age-7 fish averaged 396 mm TL, and age-8 fish averaged 440 mm TL. Hawkins defined mature Colorado pikeminnow as fish over 428 mm TL, based primarily on findings of Seethaler (1978). Osmundson et al. (1997) used growth-rate data from mark-recapture information and scale back-calculations from fish of the Upper Colorado River subbasin and determined that age-7 Colorado pikeminnow averaged 456 mm TL (range, 430–479 mm TL). Mark-recapture, growth-rate data from Osmundson (2002) were also used to develop the length to age relationship shown in Figure A-1. Based on the best available information on age at sexual maturity and age to length relationships, adult Colorado pikeminnow are defined as fish that are 450 mm TL or larger. This is based on the conservative assumption that all age-7 fish are sexually mature, and average length at age 7 is 450 mm TL. Subadults (age 6) are defined as those fish that are 400–449 mm TL (Table A-2).

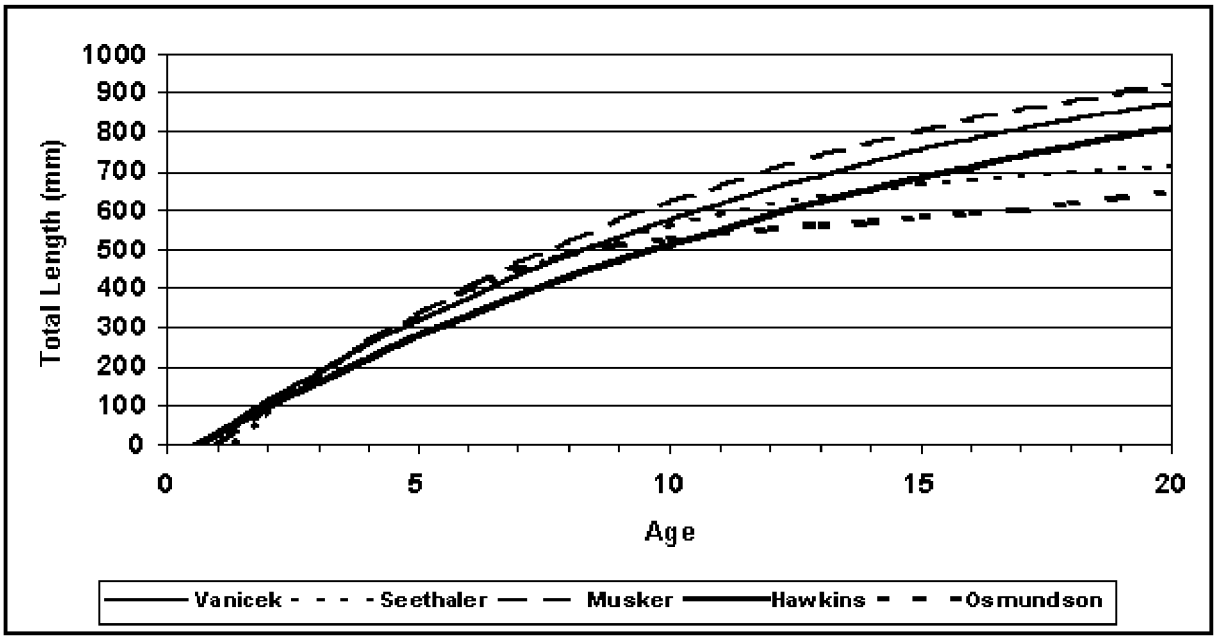


Figure A-1. Predicted length at age for Colorado pikeminnow; computed from von Bertalanffy growth functions (Vanicek and Kramer 1969; Seethaler 1978; Musker 1981; as presented in Hawkins 1992) and from growth-rate data (Osmundson 2002).

Table A-2. Lengths of adult and subadult Colorado pikeminnow as determined from scale back-calculations, mark-recapture growth data, and hatchery-reared fish.

Investigator	Area or Population	Adult		Subadult	
		Age	Total Length (mm)	Age	Total Length (mm)
Vanicek and Kramer (1969)	Dinosaur National Monument, Green River, Utah	7	454	6	391
Seethaler (1978)	Yampa and Green rivers, Colorado and Utah	7	451	6	406
Hamman (1981)	Willow Beach National Fish Hatchery	5 6	Males: 317–376 Females: 425–441		
Musker (1981)	Upper Colorado River Basin, Colorado and Utah	7	461	6	407
Hawkins (1992)	Upper Colorado River Basin, Colorado and Utah	7, 8	396, 440	6, 7	345, 396
Osmundson et al. (1997)	Upper Colorado River, Colorado and Utah	7	456 (430–479)	6	424 (375–472)

A.9 Length-Weight and Condition Factor

Length-weight relationships for Colorado pikeminnow from four rivers in the upper basin (Hawkins 1992) are:

Colorado River	$Log_{10}W = -6.384 + 3.463 * Log_{10}L$,
Green River	$Log_{10}W = -5.692 + 3.206 * Log_{10}L$,
White River	$Log_{10}W = -5.555 + 3.156 * Log_{10}L$, and
Yampa River	$Log_{10}W = -6.026 + 3.339 * Log_{10}L$,

where W is weight in grams and L is total length in millimeters. Length-weight relationships were not significantly different among rivers. Similar relationships were provided by Vanicek and Kramer (1969) and Seethaler (1978). Exponents above 3.0 suggest allometric growth in Colorado pikeminnow; i.e., the relationship of weight as a cube of the length (exponent > 3.0) changes as the fish grows (LeCren 1951; Lagler 1956), whereas exponents of ≤3.0 indicate isometric growth or a constant relationship between length and weight.

Mean relative condition of adult Colorado pikeminnow (>428 mm TL) ranged from about 0.92 to about 1.12 (Hawkins 1992). Highest condition usually occurred in June and was probably related to increase in fat reserves or gametes in preparation for spawning. Lowest condition occurred in July and August following pre-spawning migration and spawning activity. Condition usually increased again in fall after the migratory period returned fish to their home ranges.

A.10 Diet

Adult Colorado pikeminnow are generally considered piscivores and the main native predator of the Colorado River Basin because of their large size and large mouth (Vanicek and Kramer 1969; Minckley 1973; Holden and Wick 1982). As a member of the cyprinid family, Colorado pikeminnow lack jaw, vomerine, or palatine teeth, but possess instead large pharyngeal teeth, located on the first modified gill arch at the base of the throat. Cladocerans, copepods, and midge larvae are the principal food items of young up to 50 mm TL in nursery backwaters (Vanicek 1967; Jacobi and Jacobi 1982; Muth and Snyder 1995). Insects became important for fish up to 100 mm TL, after which fish are the main food item; Vanicek (1967) reported Colorado pikeminnow as small as 50 mm TL with fish remains in its gut, and Muth and Snyder (1995) reported fish remains in the gut of a Colorado pikeminnow 21 mm TL. Young in hatchery troughs may become cannibalistic at sizes of less than 50 mm TL (personal communication, F. Pfeifer, U.S. Fish and Wildlife Service). Adults consume primarily soft-rayed fishes, including bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*C. latipinnis*), red shiner, sand shiner, and fathead minnow (Osmundson 1999). Colorado pikeminnow have also been reported with channel catfish lodged in their throat, possibly leading to death of the fish (McAda 1980; Pimental et al. 1985). Colorado pikeminnow have been caught by anglers using various baits, including Mormon crickets (*Anabrus migratorius*; Tyus and Minckley 1988), carcasses of mice, birds, and rabbits (Beckman 1963), as well as artificial lures and spoons (Quartarone 1995).

A.11 Parasites

A survey of diseases and parasites of endangered fishes in the Upper Colorado River Basin in 1981 (Flagg 1982) revealed that Colorado pikeminnow are infected by two principal parasites (an intestinal tapeworm and an external parasitic copepod) and the protozoans *Myobolus* sp. and *Trichodina sp.*, as well as the trematode *Ornithodiplostomum* sp. Bass tapeworms (*Proteocephalus ambloplites*) were found in 65% of stomachs from fish longer than 200 mm TL in the Green River (Vanicek 1967). Vanicek (1967) also reported that P. Dotson (unpublished data, Utah Department of Fish and Game, Salt Lake City, 1962) found tapeworms in 80% of Colorado pikeminnow examined. A cestode identified as *Proteocephalus ptychocheilus* was found in Colorado pikeminnow from the upper basin (Flagg 1982). This may be the same species reported by Vanicek (1967), but further study has not been conducted to resolve the taxonomic discrepancy. Osmundson (1987) reported the first occurrence of Asian tapeworm (*Bothriocephalus achielognathii*) in hatchery-raised Colorado pikeminnow stocked in riverside ponds along the upper Colorado River. Asian tapeworms were identified in wild Colorado pikeminnow from the Colorado River downstream of Moab, Utah, in 1991 (personal communication, D. Osmundson, U.S. Fish and Wildlife Service). The parasitic copepod (*Lernaea cyprinacea*) is common in Colorado pikeminnow and has been reported by several investigators (Hagan and Banks 1963; Vanicek 1967; Flagg 1982). This parasite is believed to be alien to the Colorado River Basin, and transferred from other river basins via nonnative fishes.

APPENDIX B.

PROVISIONAL RECOVERY GOALS FOR COLORADO PIKEMINNOW IN THE LOWER COLORADO RIVER BASIN

Following are provisional site-specific management actions/tasks and objective, measurable recovery criteria presented as guidelines for conservation efforts (e.g., nonessential, experimental populations) for Colorado pikeminnow in the Lower Colorado River Basin. The need for self-sustaining populations in the lower basin and associated site-specific management actions/tasks necessary to minimize or remove threats will be reevaluated at the status review of the species. Anthropogenic changes in the lower basin have extensively modified the riverine ecosystem, including native-fish habitats. Therefore, these provisional recovery goals in the lower basin are based on a limited amount of habitat and taking aggressive actions that allow for the establishment and maintenance of populations in riverine and/or repatriated habitats (e.g., riverside habitats, such as oxbows, depressions, bottomlands, that are connected where feasible to the mainstem Colorado River).

B.1 Provisional Site-Specific Management Actions and Tasks by Recovery Factor

B.1.1 Factor A.—Adequate habitat and range for recovered populations provided

Management Action A-1.—Provide flows necessary for all life stages of Colorado pikeminnow to support recovered populations, based on demographic criteria.

Task A-1.1.—Identify, implement, evaluate, and revise (as necessary through adaptive management) flow regimes that are necessary for the establishment and maintenance of Colorado pikeminnow populations in the mainstem and/or tributaries.

Task A-1.2.—Provide flow regimes (as determined under Task A-1.1) that are necessary for all life stages of Colorado pikeminnow to support recovered populations in the mainstem and/or tributaries.

Management Action A-2.—Minimize entrainment of subadult and adult Colorado pikeminnow in diversion and/or out-take structures.

Task A-2.1.—Identify measures (e.g., screens, baffles) to minimize entrainment of subadult and adult Colorado pikeminnow at problematic diversion and/or out-take structures.

Task A-2.2.—Install devices and/or implement other measures (as determined under Task A-2.1) to minimize entrainment.

B.1.2 Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes

Management Action B-1.—Protect Colorado pikeminnow populations from overutilization for commercial, recreational, scientific, or educational purposes.

Task B-1.1.—Reevaluate and, if necessary, identify actions to ensure adequate protection from overutilization of Colorado pikeminnow for commercial, recreational, scientific, or educational purposes; not currently identified as an existing threat (see section 4.2).

Task B-1.2.—Implement identified actions (as determined in Task B-1.1) to ensure adequate protection of Colorado pikeminnow from overutilization for commercial, recreational, scientific, or educational purposes.

B.1.3 Factor C.—Adequate protection from diseases and predation

Management Action C-1.—Minimize adverse effects of diseases and parasites on Colorado pikeminnow populations.

Task C-1.1.—Reevaluate and, if necessary, identify actions to minimize adverse effects of diseases and parasites on Colorado pikeminnow populations; not currently identified as an existing threat (see sections 4.3.1 and A.11 for discussion of diseases and parasites).

Task C-1.2.—Implement identified actions (as determined under Task C-1.1) to ensure adequate protection of Colorado pikeminnow populations from deleterious diseases and parasites.

Management Action C-2.—Regulate nonnative fish releases and escapement into the mainstem, floodplain, and tributaries.

Task C-2.1.—Develop, implement, evaluate, and revise (as necessary through adaptive management) procedures for stocking and to minimize escapement of nonnative fish species into the mainstem, floodplain, and tributaries to minimize negative interactions between nonnative fishes and Colorado pikeminnow (see sections 4.3.2 and A.7 for discussion of effects of nonnative fishes).

Task C-2.2.—Finalize and implement procedures (as determined under Task C-2.1) for stocking and to minimize escapement of nonnative fish species into the mainstem, floodplain, and tributaries to minimize negative interaction between nonnative fishes and Colorado pikeminnow.

Management Action C-3.—Control problematic nonnative fishes as needed.

Task C-3.1.—Develop control programs for problematic nonnative fishes in the mainstem, floodplain, and tributaries to identify levels of control that will minimize negative interactions between nonnative fishes and Colorado pikeminnow.

Task C-3.2.—Implement identified levels (as determined under Task C-3.1) of nonnative fish control in the mainstem, floodplain, and tributaries.

B.1.4 Factor D.—Adequate existing regulatory mechanisms

Management Action D-1.—Legally protect habitat (see definition of habitat in section 5.1.2) necessary to provide adequate habitat and sufficient range for all life stages of Colorado pikeminnow to support recovered populations, based on demographic criteria.

Task D-1.1.—Determine mechanisms for legal protection of adequate habitat through instream-flow rights, contracts, agreements, or other means (see section 4.4 for discussion of regulatory mechanisms).

Task D-1.2.—Implement mechanisms for legal protection of habitat (as determined under Task D-1.1) that are necessary to provide adequate habitat and sufficient range for all life stages of Colorado pikeminnow to support recovered populations.

Management Action D-2.—Provide for the long-term management and protection of Colorado pikeminnow populations and their habitats.

Task D-2.1.—Identify elements needed for the development of conservation plans that are necessary to provide for the long-term management and protection of Colorado pikeminnow populations; elements of these plans may include (but are not limited to) provision of flows for maintenance of adequate habitat conditions for all life stages of Colorado pikeminnow, regulation and/or control of nonnative fishes, and monitoring of populations and habitats (see section 4.4 for discussion of need for conservation plans).

Task D-2.2.—Develop and implement conservation plans and execute agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties to provide reasonable assurances that conditions needed for recovered Colorado pikeminnow populations will be maintained.

B.1.5 Factor E.—Other natural or manmade factors for which protection has been provided

No other factors have been identified as threats.

B.2 Provisional Objective, Measurable Recovery Criteria

B.2.1 Downlist criteria

B.2.1.1 Demographic criteria for downlisting

1. Two self-sustaining populations (e.g., in the mainstem and/or tributaries) are maintained over a 5-year period, starting with the first point estimates acceptable to the Service, such that for each population:

    a. the trend in adult (age 7+; ≥450 mm TL) point estimates does not decline significantly, and

    b. mean estimated recruitment of age-6 (400–449 mm TL) naturally produced fish equals or exceeds mean annual adult mortality, and

    c. each point estimate exceeds 2,600 adults (Note: 2,600 adults is the estimated MVP number, see section 3.3.2).

B.2.1.2 Recovery factor criteria for downlisting

Factor A.—Adequate habitat and range for recovered populations provided.

1. Flow regimes that are necessary for the establishment and maintenance of Colorado pikeminnow populations in the mainstem and/or tributaries identified, implemented, evaluated, and revised (Task A-1.1), such that:

    a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section B.2.1.1.

    b. Adequate nursery habitat is available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section B.2.1.1.

    c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) is available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section B.2.1.1.

2. Measures identified to minimize entrainment of subadult and adult Colorado pikeminnow at problematic diversion and/or out-take structures (Task A-2.1).

Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

3. Overutilization of Colorado pikeminnow for commercial, recreational, scientific, or educational purposes reevaluated and, if necessary, actions identified to ensure adequate protection (Task B-1.1).

Factor C.—Adequate protection from diseases and predation.

4. Effects of diseases and parasites on Colorado pikeminnow populations reevaluated and, if necessary, actions identified to ensure adequate protection (Task C-1.1).

5. Procedures developed, implemented, evaluated, and revised for stocking and to minimize escapement of nonnative fish species into the mainstem, floodplain, and tributaries to minimize negative interactions between nonnative fishes and Colorado pikeminnow (Task C-2.1).

6. Control programs for problematic nonnative fishes in the mainstem, floodplain, and tributaries developed and implemented to identify levels of control that will minimize negative interactions between nonnative fishes and Colorado pikeminnow (Task C-3.1).

Factor D.—Adequate existing regulatory mechanisms.

7. Mechanisms determined for legal protection of adequate habitat (Task D-1.1).

8. Elements of conservation plans identified that are necessary to provide for the long-term management and protection of Colorado pikeminnow populations (Task D-2.1).

Factor E.—Other natural or manmade factors for which protection has been provided.

No other factors have been identified as threats.

B.2.2 Delist criteria

B.2.2.1 Demographic criteria for delisting

1. Two self-sustaining populations (e.g., mainstem and/or tributaries) are maintained over a 7-year period beyond downlisting, starting with the first point estimates acceptable to the Service, such that for each population:

    a. the trend in adult (age 7+; ≥450 mm TL) point estimates does not decline significantly, and

    b. mean estimated recruitment of age-6 (400–449 mm TL) naturally produced fish equals or exceeds mean annual adult mortality, and

    c. each point estimate exceeds 2,600 adults (MVP).

B.2.2.2 Recovery factor criteria for delisting

Factor A.—Adequate habitat and range for recovered populations provided.

1. Flow regimes provided that are necessary for all life stages of Colorado pikeminnow to support recovered populations in the mainstem and/or tributaries (Task A-1.2), such that:

    a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section B.2.2.1.

    b. Adequate nursery habitat is available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section B.2.2.1.

    c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) is available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section B.2.2.1.

2. Devices installed and/or measures implemented at problematic diversion and/or out-take structures to minimize entrainment of subadult and adult razorback sucker (Task A-2.2).

Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

3. Adequate protection of Colorado pikeminnow from overutilization for commercial, recreational, scientific, or educational purposes attained (Task B-1.2).

Factor C.—Adequate protection from diseases and predation.

4. Adequate protection of Colorado pikeminnow populations from deleterious diseases and parasites attained (Task C-1.2).

5. Procedures finalized and implemented for stocking nonnative fish species in the mainstem, floodplain, and tributaries to minimize negative interactions between nonnative fishes and Colorado pikeminnow (Task C-2.2).

6. Identified levels of nonnative fish control to minimize negative interactions between nonnative fishes and Colorado pikeminnow attained in the mainstem, floodplain, and tributaries (Task C-3.2).

Factor D.—Adequate existing regulatory mechanisms.

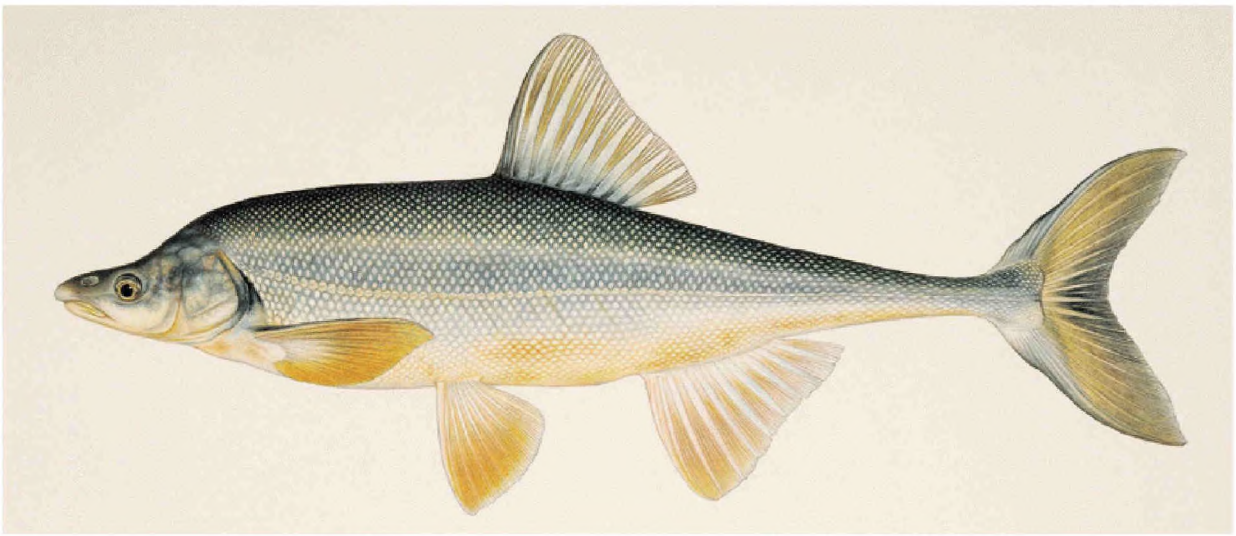
7. Habitat necessary to provide adequate habitat and sufficient range for all life stages of Colorado pikeminnow to support recovered populations is legally protected in perpetuity (Task D-1.2).

8. Conservation plans developed and implemented, and agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties executed to provide reasonable assurances that conditions needed for recovered Colorado pikeminnow populations will be maintained (Task D-2.2).

Factor E.—Other natural or manmade factors for which protection has been provided.

No other factors have been identified as threats.

BONYTAIL (*Gila elegans*) RECOVERY GOALS



BONYTAIL (*Gila elegans*)

RECOVERY GOALS
Amendment and Supplement to the Bonytail Chub Recovery Plan

U.S. Fish and Wildlife Service
Mountain-Prairie Region (6)
Denver, Colorado

Approved: Ralph O. Morgenweck
Regional Director, Region 6, U.S. Fish and Wildlife Service

Date: 8/1/02

DISCLAIMER PAGE

These recovery goals amend and supplement the 1990 Bonytail Chub Recovery Plan. Recovery plans delineate reasonable actions that are believed to be required to recover and/or protect listed species. The U.S. Fish and Wildlife Service publishes these plans, which may be prepared with the assistance of recovery teams, contractors, State agencies, and others. Attainment of the objectives and provision of any necessary funds are subject to priorities, budgetary, and other constraints affecting the parties involved. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. Recovery plans represent the official position of the U.S. Fish and Wildlife Service **only** after they have been signed by the Regional Director or Director as **approved**. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

CITATION FOR THESE RECOVERY GOALS

These recovery goals should be cited as follows:

U.S. Fish and Wildlife Service. 2002. Bonytail (*Gila elegans*) Recovery Goals: amendment and supplement to the Bonytail Chub Recovery Plan. U.S. Fish and Wildlife Service, Mountain-Prairie Region (6), Denver, Colorado.

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EXECUTIVE SUMMARY

This document amends and supplements the Bonytail Chub Recovery Plan of 1990. The purpose of this document is to describe site-specific management actions/tasks; provide objective, measurable recovery criteria; and provide an estimate of the time to achieve recovery of the endangered bonytail (*Gila elegans*), according to Section 4(f)(1) of the Endangered Species Act of 1973, as amended. Recovery or conservation programs that include the bonytail will direct research, management, and monitoring activities and determine costs associated with recovery.

Current Species Status: The bonytail is listed as endangered under the Endangered Species Act of 1973, as amended. The species is endemic to the Colorado River Basin of the southwestern United States. Adults attain a maximum size of about 550 mm total length (TL) and 1.1 kg in weight. An unknown, but small number of wild adults exist in Lake Mohave on the mainstem Colorado River of the Lower Colorado River Basin (i.e., downstream of Glen Canyon Dam, Arizona), and there are small numbers of wild individuals in the Green River and upper Colorado River subbasins of the Upper Colorado River Basin.

Habitat Requirements and Limiting Factors: The bonytail was historically common to abundant in warm-water reaches of larger rivers from Mexico to Wyoming. Little is known about the specific habitat requirements of bonytail because the species was extirpated from most of its historic range prior to extensive fishery surveys. The bonytail is considered adapted to mainstem rivers where it has been observed in pools and eddies. Similar to other closely related *Gila* spp., bonytail in rivers probably spawn in spring over rocky substrates; spawning in reservoirs has been observed over rocky shoals and shorelines. It is hypothesized, based on available distribution data, that flooded bottomland habitats are important growth and conditioning areas for bonytail, particularly as nursery habitats for young. Threats to the species include streamflow regulation, habitat modification, competition with and predation by nonnative fish species, hybridization, and pesticides and pollutants.

Recovery Objective: Downlisting and Delisting.

Recovery Criteria: Objective, measurable criteria for recovery of bonytail in the Colorado River Basin are presented for each of two recovery units (i.e., the upper basin, including the Green River and upper Colorado River subbasins; and the lower basin, including the mainstem and its tributaries from Lake Mead downstream to the southerly International Boundary with Mexico) because of different recovery or conservation programs and to address unique threats and site-specific management actions/tasks necessary to minimize or remove those threats. Recovery of the species is considered necessary in both the upper and lower basins because of the present status of populations and existing information on bonytail biology. Self-sustaining populations will need to be established through augmentation. Without viable wild populations, there are many uncertainties associated with recovery of bonytail. The bonytail was listed prior to the 1996 distinct population segment (DPS) policy, and the U.S. Fish and Wildlife Service

(Service) may conduct an evaluation to designate DPSs in a future rule-making process. These recovery goals are based on the best available scientific information, and are structured to attain a balance between reasonably achievable criteria and ensuring the viability of the species beyond delisting. These recovery criteria will need to be reevaluated and revised after self-sustaining populations are established and there is improved understanding of bonytail biology.

Downlisting can occur if, over a 5-year period: (1) genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and upper Colorado River subbasin such that — (a) the trend in adult (age 4+; ≥250 mm total length) point estimates for each of the two populations does not decline significantly, and (b) mean estimated recruitment of age-3 (150–249 mm TL) naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and (c) each point estimate for each of the two populations exceeds 4,400 adults (4,400 is the estimated minimum viable population [MVP] needed to ensure long-term genetic and demographic viability); and (2) a genetic refuge is maintained in a suitable location (e.g., Lake Mohave, Lake Havasu) in the lower basin recovery unit; and (3) two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit (e.g., mainstem and/or tributaries) such that — (a) the trend in adult point estimates for each population does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and (c) each point estimate for each population exceeds 4,400 adults; and (4) when certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can occur if, over a 3-year period beyond downlisting: (1) genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and upper Colorado River subbasin such that — (a) the trend in adult point estimates for each of the two populations does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and (c) each point estimate for each of the two populations exceeds 4,400 adults; and (2) a genetic refuge is maintained in the lower basin recovery unit; and (3) two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit such that — (a) the trend in adult point estimates for each population does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and (c) each point estimate for each population exceeds 4,400 adults; and (4) when certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Conservation plans will go into effect at delisting to provide for long-term management and protection of the species, and to provide reasonable assurances that recovered bonytail populations will be maintained without the need for relisting. Elements of those plans could include (but are not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats. Signed agreements

among State agencies, Federal agencies, American Indian tribes, and other interested parties must be in place to implement the conservation plans before delisting can occur.

Management Actions Needed:

1. Reestablish populations with hatchery-produced fish.
2. Identify genetic variability of bonytail and maintain a genetic refuge in a suitable location in the lower basin.
3. Provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations.
4. Provide passage over barriers within occupied habitat to allow unimpeded movement and, potentially, range expansion.
5. Investigate options for providing appropriate water temperatures in the Gunnison River.
6. Minimize entrainment of subadults and adults at diversion/out-take structures.
7. Investigate habitat requirements for all life stages and provide those habitats.
8. Ensure adequate protection from overutilization.
9. Ensure adequate protection from diseases and parasites.
10. Regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.
11. Control problematic nonnative fishes as needed.
12. Minimize the risk of increased hybridization among *Gila* spp.
13. Minimize the risk of hazardous-materials spills in critical habitat.
14. Remediate water-quality problems.
15. Provide for the long-term management and protection of populations and their habitats beyond delisting (i.e., conservation plans).

Estimated Time to Achieve Recovery: Wild bonytail are rare. Therefore, use of hatchery fish (progeny of cultured brood stock) will be necessary to establish new populations. Time to achieve recovery of the bonytail cannot be accurately estimated until self-sustaining populations are established through augmentation and habitat enhancement. The rate at which populations become established will depend on survival of stocked fish in the wild, integration of stocked fish with rare wild stocks, reproductive success, and recruitment. Response of the species to ongoing management activities will need to be assessed through monitoring, and strategies for recovery and estimates of time to achieve recovery will be reevaluated periodically. Based on current information and associated uncertainties, it is estimated that self-sustaining populations of bonytail will become established over the next 15 years. During this time, population dynamics and responses to management actions will be evaluated.

For bonytail populations to be self-sustaining, adults must reproduce and recruitment of young fish into the adult population must occur at a rate to maintain the population at a minimum of 4,400 adults. When this occurs, the definition of a "self-sustaining" population is met, and the "clock" starts on the downlisting and delisting process.

Once self-sustaining populations have been established, reliable population estimates, based on a multiple mark-recapture model, are needed for all populations over a 5-year monitoring period for downlisting and over a 3-year monitoring period beyond downlisting in order to achieve delisting. The accuracy and precision of each point estimate will be assessed by the Service in cooperation with the respective recovery or conservation programs, and in consultation with investigators conducting the point estimates and with qualified statisticians and population ecologists. Self-sustaining populations and first reliable point estimates for all populations are expected by 2015. If those estimates are acceptable to the Service and all recovery criteria are met, downlisting could be proposed in 2020 and delisting could be proposed in 2023.

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1.0 INTRODUCTION

1.1 Background

The bonytail *(Gila elegans)* is a large cyprinid fish endemic to the Colorado River Basin (Valdez and Clemmer 1982). Adults attain a maximum size of about 550 mm total length (TL; Bozek et al. 1984) and 1.1 kg in weight (Vanicek 1967). The bonytail is currently listed as "endangered" under the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 *et. seq.*), under a final rule published on April 23, 1980 (45 FR 27710). A recovery plan was approved on September 4, 1990 (U.S. Fish and Wildlife Service 1990a). The final rule for determination of critical habitat was published on March 21, 1994 (59 FR 13374), and the final designation became effective on April 20, 1994.

"Bonytail" is the accepted common name for *Gila elegans* (Robins et al. 1991). The synonym "bonytail chub" was used when the species was listed in 1980 and is an often-used common name (Valdez and Clemmer 1982).

The bonytail is a member of a unique assemblage of fishes native to the Colorado River Basin consisting of 35 species with 74% level of endemism (Miller 1959). It is one of four mainstem, big-river fishes currently listed as endangered under the ESA; others are the humpback chub (*Gila cypha*), Colorado pikeminnow (*Ptychocheilus lucius*, formerly Colorado squawfish; Nelson et al. 1998), and razorback sucker (*Xyrauchen texanus*). The native fish assemblage of the Colorado River is jeopardized by large mainstem dams, water diversions, habitat modification, and nonnative fish species, and degraded water quality (Miller 1961; Minckley and Deacon 1991).

1.2 Purpose and Scope

This document amends and supplements the Bonytail Chub Recovery Plan of 1990 (Recovery Plan; U.S. Fish and Wildlife Service 1990a). The purpose and scope are to assimilate current information on the life history of the species and status of populations to develop recovery goals associated with the five listing factors that [as specified under Section 4(f)(1) of the ESA] identify site-specific management actions necessary to minimize or remove threats; establish objective, measurable recovery criteria; and provide estimates of the time and costs required to achieve recovery. In developing the recovery goals, the full body of available information pertinent to issues related to species life history and conservation was considered. However, it is not the intent of this document to provide a comprehensive treatise of information on bonytail; a synopsis of the life history that includes a description of habitat requirements is provided in Appendix A. Additional and more detailed information can be found in literature cited in this document and in reports and publications referenced in those citations.

These recovery goals were developed as an amendment and supplement to the Recovery Plan to focus on the requirements of Section 4(f)(1)(B) of the ESA, which requires that the Secretary of the Interior incorporate into each plan site-specific management actions; objective, measurable

criteria; and estimates of the time and costs to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal. The Recovery Plan did not contain those key requirements of the ESA; therefore, these recovery goals take precedence over the Recovery Plan. Recovery or conservation programs that include the bonytail (see section 1.3) will direct research, management, and monitoring activities and determine costs associated with recovery. The recovery goals are not intended to include specifics on design of management strategies nor are they intended to prescribe ways that management strategies should be implemented. Those details (and associated costs) need to be developed by the respective recovery or conservation programs in their implementation plans.

An important aspect in development of these recovery goals was to attain a balance between reasonably achievable criteria and ensuring the viability and security of the species beyond delisting. Reasonably achievable criteria considered demographic and genetic requirements of self-sustainability. These recovery goals are intended to be used by the U.S. Fish and Wildlife Service (Service) in rule-making processes to downlist and/or delist the bonytail. The Service intends to review, and revise as needed, these recovery goals at least once every 5 years from the date they are made public through a Notice of Availability published in the *Federal Register*, or as necessary when sufficient new information warrants a change in the recovery criteria. Review of these recovery goals will be part of the review of listed species as required by Section 4(c)(2)(A) of the ESA, *"The Secretary shall ... conduct, at least once every five years, a review of all species..."*.

1.3 Recovery or Conservation Programs

Three of the five major endangered-species recovery or conservation programs of the Colorado River Basin include the bonytail (highlighted in Box 1). These are the Upper Colorado River Endangered Fish Recovery Program (UCRRP), the Native Fish Work Group (NFWG), and the Lower Colorado River Multi-Species Conservation Program (MSCP). The UCRRP is a recovery program that was initiated under a Cooperative Agreement signed by the Secretary of the Interior on January 22, 1988, as a coordinated effort of State and Federal agencies, water users, energy distributors, and environmental groups to recover the four endangered fishes in the upper basin downstream to Glen Canyon Dam, excluding the San Juan River (U.S. Department of the Interior 1987; Wydoski and Hamill 1991; Evans 1993). It functions under the general principles of adaptive management (see section 5.1.2) and consists of seven program elements, including instream flow protection; habitat restoration; reduction of

Box 1. Recovery or Conservation Programs

1. ***Upper Colorado River Endangered Fish Recovery Program (UCRRP)***
2. San Juan River Basin Recovery Implementation Program (SJRRIP)
3. Glen Canyon Dam Adaptive Management Program (GCDAMP)
4. ***Native Fish Work Group (NFWG)***
5. ***Lower Colorado River Multi-Species Conservation Program (MSCP)***

nonnative fish and sportfish impacts; propagation and genetics management; research, monitoring, and data management; information and education; and program management. As stated in the governing document of the UCRRP (U.S. Department of the Interior 1987), the goal is to recover the endangered fishes while water development proceeds in compliance with State and Federal laws, including the ESA, State water law, interstate compacts, and Federal trust responsibilities to American Indian tribes. Funding for the UCRRP will continue through 2011 under legislation passed in October 2000 (P.L. 106-392); Congress will review the UCRRP to determine if funding should be authorized beyond 2011. The NFWG is a conservation program coordinating efforts of State and Federal agency biologists, as well as university staffs and volunteers, to conserve and protect the genetic pool of bonytail and razorback sucker primarily in Lake Mohave (Burke and Mueller 1993).

The MSCP is a conservation program under development that was initiated in response to the designation of critical habitat for the four endangered "big river" fishes in 1994, and the listing of the southwestern willow flycatcher (*Empidonax traillii extimus*) as endangered in 1995 (SAIC/Jones & Stokes 2002). In response, representatives from the U.S. Departments of the Interior and Energy; several American Indian tribes; water, power, and wildlife resource management agencies from the three lower basin States; and a significant number of agricultural, municipal, and industrial providers of Colorado River water and power resources have formed a regional partnership that is developing a multi-species conservation program aimed at protecting sensitive, threatened, and endangered species of fish, wildlife, and their habitat. The partnership has formed a 27-member steering committee, which has been designated by the Service as an Ecosystem Conservation and Recovery Implementation Team under the ESA. The MSCP planning area comprises the historic floodplain of the Colorado River from Lake Mead to the southerly International Boundary with Mexico and areas to elevations up to and including the full pool elevations of Lakes Mead, Mohave, and Havasu (SAIC/Jones & Stokes 2002). The bonytail is one of 56 species proposed for coverage by the MSCP, and it is one of the six focus species.

2.0 THE RECOVERY PROCESS

2.1 Definition of Recovery

Understanding the Service's strategy for recovery of the bonytail, as provided in the ESA and implementing regulations, first requires an understanding of the meaning of "recover" and "conserve". The ESA does not specifically define recover, and the term "recovery" is used with respect to recovery plans *"...for the conservation and survival..."* of listed species. An endangered species, as defined in Section 3(6) of the ESA, means *"any species which is in danger of extinction throughout all or a significant portion of its range."* A threatened species is defined in Section 3(19) of the ESA as *"any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."* According to Service policy (U.S. Fish and Wildlife Service 1990b), *"Recovery is the process by which the decline of an endangered or threatened species is arrested or reversed, and threats to its survival are neutralized, so that its long-term survival in nature can be ensured. The goal of*

this process is the maintenance of secure, self-sustaining wild populations of species with the minimum necessary investment of resources." The ESA's implementing regulations (50 CFR § 402.02) further define recovery as *"...improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the Act."* The policy and regulations use the word recovery in a narrow ESA sense, giving it meaning that is different from returning a species to its normal position or condition.

The definition provided for recovery in the implementing regulations and the definition provided for conserve in the ESA have essentially the same meaning. Section 3(3) of the ESA states: *"The terms "conserve," "conserving," and "conservation" mean to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary."* Hence, recovery and conserve both mean to bring a species to the point at which it no longer needs the protection of the ESA, because the species is no longer in danger of extinction throughout all or a significant portion of its range. This definition of recovery falls far short of requiring that a species must be restored to its historic range and abundance before it can be considered recovered or delisted. It also falls short of requiring the restoration of a species to all the remaining suitable habitat, unless this is necessary to sufficiently reduce the species' susceptibility to threats to a level at which the species is no longer threatened or endangered.

The phrase "throughout all or a significant portion of its range" is used in both definitions of endangered and threatened. Neither "significant" nor "range" are defined in the ESA or implementing regulations. Hence, the ESA provides the Service with latitude to use its discretion, based on the best scientific information available, to develop recovery goals and implement recovery plans designed to conserve and recover species. The ESA clearly does not use the term significant in a statistical sense. Significance cannot be reliably and safely applied in any strictly quantitative framework, because of the great variety of organisms, habitats, and threats that must be evaluated for protection under the ESA.

Given that the ESA is intended to avoid species extinction, the Service avoids the pitfalls of a purely quantitative approach by instead viewing significant in the context of a species' long-term survival needs. The term becomes logical, meaningful, and useful if applied in this context. A significant portion of the range is that area that is important or necessary for maintaining a viable, self-sustaining, and evolving population or populations, in order for a taxon to persist into the foreseeable future. That "significant portion" may constitute a large portion of the historic range of a species or a relatively small portion of the historic range. Other parts of a species' range (regardless of whether it is historical, current, or potential range) may not be significant to its long-term survival, regardless of its geographic extent. Therefore, a species extirpated from such areas does not necessarily mean it is threatened or endangered, regardless of the geographic extent of those areas.

Implicit in the ESA definitions of threatened and endangered and in the principles of conservation biology is the need to consider genetics, demographics, population redundancy, and threats (as identified by the listing factors). The ESA is mandated to recover species to the point that they are "not likely" to be in danger of extinction for the foreseeable future throughout all or

a significant portion of their range. The Service believes that the "not likely" standard is exceeded by the requirement of the recovery goals to maintain multiple widespread populations that are independently viable, because it is unlikely that future singular threats will endanger widely separated multiple populations. Viable populations have sufficient numbers of individuals to counter the effects of deleterious gene mutations as a result of inbreeding, and to counter the effects of deaths exceeding births and recruitment failure for periods of time. Thus, the conservation biology principle of redundancy is satisfied by the required multiple genetically and demographically viable, self-sustaining populations (section 3.1.3). Furthermore, the principle of resiliency is satisfied with sufficiently large populations to persist through normal population variations, as well as through unexpected catastrophic events (section 3.1.4).

The principles of recovery and conservation as defined in the ESA, implementing regulations, and Service policy demonstrate the strong relationship between the delisting criteria used for recovery and the five listing factors in Section 4(a)(1) of the ESA. These five listing factors must be addressed in any reclassification of a species [ESA Section 4(c)(2)(B); section 4.0 of this document], and are:

> "*(A) The present or threatened destruction, modification, or curtailment of its habitat or range;*
> *(B) overutilization for commercial, recreational, scientific, or educational purposes;*
> *(C) disease or predation;*
> *(D) the inadequacy of existing regulatory mechanisms; and*
> *(E) other natural or manmade factors affecting its continued existence.*"

Recovery is based on reduction or removal of threats and improvement of the status of a species during the period in which it is listed, and not just from the time a listed species is proposed for reclassification. Environmental conditions and the structure of populations change over time, and threats recognized at listing or in subsequent recovery plans may no longer be directly applicable when reclassification is considered. Management actions and tasks conducted by recovery or conservation programs for listed species are expected to minimize or remove threats and improve the species' status.

When delisting a species, the Service must determine that the five listing factors no longer apply, e.g., the habitat is no longer threatened with destruction or modification, the current abundance and range is adequate, and the habitat needed to sustain recovered populations is present. Therefore, the recovery goals (section 5.0) include management actions and tasks, as well as downlisting and delisting criteria, presented by "recovery factor". These recovery factors were derived from the five listing factors and state the conditions under which threats are minimized or removed.

Recovery is achieved when management actions and associated tasks have been implemented and/or completed to allow genetically and demographically viable, self-sustaining populations to thrive under minimal ongoing management and investment of resources. Achievement of recovery does not mandate returning a species to all or a significant portion of its historic range, nor does it mandate establishing populations in all possible habitats, or everywhere the species

can be established or reestablished. Removing a species from protection of the ESA remands the primary management responsibility of that species to the States, who may choose to further expand its range and populations. The standard of establishing and protecting viable, self-sustaining populations is applied to the recovery of bonytail, and was used in developing recovery goals for the other three endangered fishes of the Colorado River Basin (U.S. Fish and Wildlife Service 2002a, 2002b, 2002c). This approach is consistent with recovery of other vertebrate species, such as the bald eagle (*Haliaeetus leucocephalus*; 64 FR 36453), peregrine falcon (*Falco peregrinus*; 64 FR 46541), desert tortoise (*Gopherus agassizii*; Berry 1999), Pacific salmon (*Oncorhynchus spp.*; Allendorf et al. 1997), and southern sea otter (*Enhydra lutris nereis*; Ralls et al. 1996).

2.2 Recovery Units

Recovery of bonytail in the Colorado River Basin is considered necessary in both the upper and lower basins because of the present status of populations and existing information on bonytail biology. For the purpose of these recovery goals, the upper and lower basins are divided at Glen Canyon Dam, Arizona. Separate objective, measurable recovery criteria were developed for each of two recovery units (i.e., the upper basin, including the Green River and upper Colorado River subbasins; and the lower basin, including the mainstem and its tributaries from Lake Mead downstream to the southerly International Boundary with Mexico) to address unique threats and site-specific management actions necessary to minimize or remove those threats. The recovery units encompass three management areas under different and separate recovery or conservation programs (i.e., UCRRP, NFWG, and MSCP; see section 1.3 for description of geographic coverage by each of the programs). Designation of the recovery units is consistent with goals established by these programs. For example, the governing document for the UCRRP (U.S. Department of the Interior 1987) states: *"Since the recovery plans* [for the Colorado pikeminnow, humpback chub, and bonytail; razorback sucker was not federally listed in 1987, but was included in the UCRRP] *refer to species recovery in both the upper and lower basins, these goals* [recovery/management goals in the original recovery plans] *also apply to both basins, until revised for the upper basin, through implementation of this recovery program. However, the goal of this program for the three endangered species is recovery and delisting in the upper basin. In general, this would be accomplished when the habitat necessary to maintain self-sustaining populations has been determined and provisions are in place to maintain and protect that habitat and these species. The Implementation Committee will be expected to revise these goals for the upper basin as the program develops. Attainment of these goals will result in recovery and delisting of the listed species in the upper basin."* Parties to the UCRRP agreed that the four endangered species could be downlisted and delisted separately in the upper basin. However, the document also states: *"... this program can not, and does not in anyway, diminish or detract from or add to the Secretary's ultimate responsibility for administering the Endangered Species Act."*

The bonytail was listed prior to the 1996 distinct population segment (DPS) policy, and the Service may conduct an evaluation to designate DPSs in a future rule-making process. In the Policy Regarding the Recognition of Distinct Vertebrate Population (61 FR 4721–4725), the

U.S. Fish and Wildlife Service and the National Marine Fisheries Service clarified their interpretation of the phrase *"distinct population segment of any species of vertebrate fish or wildlife"* for the purposes of listing, delisting, and reclassifying species under the ESA. Designation of DPSs is a separate listing process that is different from recovery plans/goals, and is accomplished by a rule-making process. A DPS is a segment of the population and includes a part of the range of a species or subspecies. Like all listings, the DPS is described geographically, but it is important to retain the purpose of the ESA *"...to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved..."*. The elements considered for designation of DPSs are: *"1) Discreteness of the population segment in relation to the remainder of the species to which it belongs; 2) The significance of the population segment to the species to which it belongs; and 3) The population segment's conservation status in relation to the Act's standards for listing (i.e., is the population segment, when treated as if it were a species, endangered or threatened?)."*

Species listed prior to the DPS policy may be reconsidered for DPS designation at the time of reclassification or at the 5-year status review. The DPS policy states: *"Any DPS of a vertebrate taxon that was listed prior to implementation of this policy will be reevaluated on a case-by-case basis as recommendations are made to change the listing status for that distinct population segment. The appropriate application of the policy will also be considered in the 5-year reviews of the status of listed species required by section 4(c)(2) of the Act."* Section 4(c)(2)(A) of the ESA requires a review of listed species *"at least once every five years"*. If DPSs are designated, these recovery criteria will need to be reevaluated.

2.3 Development of Recovery Goals

Development of recovery goals for the bonytail followed a specific process. First, current data on the life history of the species were assimilated (Appendix A; section 3.0). Second, the assimilated data were used to evaluate population viability and self-sustainability (section 3.0). Third, past and existing threats were identified according to the five listing factors (section 4.0). Finally, site-specific management actions were identified to minimize or remove threats, and objective, measurable recovery criteria were developed based on the five factors (section 5.0). The process of developing the recovery goals was interactive and iterative, and the recovery goals are the product of considerable input from stakeholders and scientists from throughout the Colorado River Basin and from rigorous peer review. Input from biologists and managers throughout the basin was received through meetings with the Colorado River Fishes Recovery Team; Biology, Management, and Implementation committees of the UCRRP; Colorado River Fish and Wildlife Council; American Indian tribes; State game and fish agencies; water and power interests; and appropriate Federal agencies. Input was also received through independent reviews of previous drafts (see acknowledgments). Development of these recovery goals paralleled similar efforts by the Colorado Division of Wildlife and benefitted from exchange of information with the principal author (Nesler 2000).

The process of downlisting and delisting described in this document is consistent with provisions specified under Section 4(b), Basis For Determinations, and Section 4(f)(1), Recovery Plans, of

the ESA. Under Section 4(b), the Secretary of the Interior shall determine if a species is endangered or threatened *"...solely on the basis of the best scientific and commercial data available..."*. Specifically, under Section 4(f)(1)(B), each recovery plan must incorporate (i) *"a description of such site-specific management actions as may be necessary to achieve the plan's goal for conservation and survival of the species"*; (ii) *"objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list"*; and (iii) *"estimates of the time required and cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal."* Objective, measurable recovery criteria identify downlisting and delisting requirements for each management action, and define viable, self-sustaining populations consisting of target numbers of adults and subadults for wild populations. Under Section 4(c)(2)(B) of the ESA, each determination of reclassification of a species shall be made in accordance with provisions of Sections 4(a) and 4(b).

3.0 POPULATION VIABILITY AND SELF-SUSTAINABILITY

Population viability and self-sustainability are the cornerstones to defining a recovered species. Factors that determine population viability and self-sustainability are demographics (size and age structure of populations), population redundancy (number and distribution of populations), habitat carrying capacity (resource limitations), and genetic considerations (inbreeding and genetic viability). This section discusses the development of genetic and demographic viability standards for achieving the primary objective of the Recovery Plan: *"... to prevent extinction of the bonytail chub." "Once the immediate threat of extinction is removed and essential information regarding factors that limit survival of bonytail chub is obtained, quantitative goals for downlisting and delisting will be addressed..."* Guidelines for population viability and self-sustainability are stated in Box 2 (Franklin 1980; Soulé 1980; Shaffer 1987; Allen et al. 1992).

Box 2. Guidelines for Population Viability and Self-Sustainability

- A viable, self-sustaining population has negligible probability of extinction over a 100- to 200-year period.
- A population should be sufficiently large to survive historically observed environmental variation.
- A population should be sufficiently large to maintain long-term genetic diversity and viability.
- Multiple demographically viable (redundant) populations greatly reduce the probability of extinction if the populations are independent in their susceptibility to catastrophic events.
- A viable, self-sustaining population must have positive recruitment potential sufficient to replace adult mortality near carrying capacity, and on average, exceed adult mortality when the population is below carrying capacity.
- Carrying capacity is not expected to be the same for different populations because physical habitat, water quality, and biological components are likely to vary.

3.1 Demographic Viability

3.1.1 Demographic characteristics, environmental uncertainty, and catastrophic events

Demographic or population viability refers to the persistence of a species over time, as affected by uncertainties in population dynamics. A viable, self-sustaining population has negligible probability of extinction over a 100- to 200-year time frame (Franklin 1980; Soulé 1980). Population viability can be affected by demographic characteristics, environmental uncertainty, and catastrophic events (Shaffer 1987; Allen et al. 1992). Demographic characteristics relate to random changes in birth and death rates, primarily reflecting differences at the population level. Persistence time for a population faced only with demographic variability increases geometrically as the population increases, and only populations with individuals that number in the "10s to 100s" are vulnerable to extinction due simply to demographic variability (Shaffer 1987). Hence, demographic viability is generally considered to be an issue only with severely depleted populations (Goodman 1987; Allen et al. 1992), such as the bonytail. Few wild bonytail remain, and evidence of natural reproduction has not been reported since the late 1960's (Vanicek 1967; Vanicek and Kramer 1969).

Population persistence decreases linearly with environmental uncertainty (Shaffer 1987), which is also a major factor in the decline of the bonytail. Environmental uncertainty results from changes in environmental factors such as variability in food supply; weather; population dynamics of predators, competitors, and parasites; and in the case of riverine fishes, variability in seasonal flow characteristics. Many of these environmental factors may be highly correlated to population demographics, such as reproductive success, survival, and recruitment. Population sizes necessary for persistence under environmental variability reflect the resulting variability in birth and death rates (Allen et al. 1992). Specifically linking environmental variability to birth and death rates is difficult (Ewens et al. 1987), and use of a demographic model for bonytail is limited because of the lack of reliable empirical data on these life-history parameters. Population viability analyses (PVA; Gilpin 1993; Soulé 1987; Shaffer 1987) were considered but not employed because of a lack of conclusive data on state and rate variables for the species.

As an alternative to demographic models, the concept of carrying capacity can be used to approximate population sizes and potential. Populations can be viewed as having some potential with respect to resource limitations or theoretical carrying capacity. The variance (V) in potential growth rate (r), without limitations of carrying capacity, has to be sizably greater than r ($V > 2r$) before the population is susceptible to extinction, otherwise the population tends toward the carrying capacity (Roughgarden 1979). This is difficult to ascertain for the bonytail because historic population sizes are not well known and wild populations do not currently exist.

Catastrophic events are rare incidents that may cause sizable mortality in one or more age groups. A catastrophe is an event that would, with a single act, eliminate one or more ages of bonytail in a reach of river. This may include such factors as dramatic and extensive alteration of riverine habitat, invasion of nonnative fishes as highly successful predators or competitors, or spills of toxic substances. Abundance and distribution of bonytail were greatly reduced by the

1930's as a result of land-use practices, degraded water quality, and nonnative fishes (Dill 1944; Miller 1961). Further reduction and extirpation from many regions of the Colorado River Basin followed construction of mainstem dams. The specific cause or causes are unknown, but it is believed that extirpation of the species is linked to human-caused modifications of environmental conditions critical to specific life-history needs of the species (Valdez and Clemmer 1982). Although bonytail are long-lived fishes (40+ years), persistent reproductive and recruitment failure have depleted and extirpated wild populations. It is unclear if the characteristic chronology of razorback sucker extirpations of 40–50 years following dam construction in lower basin reservoirs (i.e., Mead, Mohave, Havasu; Minckley et al. 1991) is similar for the bonytail; i.e., fish that were produced prior to habitat inundation and fragmentation reached maximum longevity with little or no recruitment to replace adult mortality.

3.1.2 Existing populations of bonytail

Currently no self-sustaining populations of bonytail exist in the wild, and very few individuals have been caught throughout the basin. Captures of wild adult bonytail have occurred in Lakes Powell, Mohave, and Havasu, and in rivers of the Upper Colorado River Basin (Table 1; Figure 1; Appendix A). Of the 34 adult bonytail captured in Lake Mohave between 1976 and 1988 (Minckley et al. 1989), 11 were used as the original brood stock (Hamman 1981, 1982, 1985). Progeny of these fish have been released into several locations in upper and lower basin habitats, with variable survival rates. Approximately 130,000 hatchery-produced F_1 and F_2 fish were released into Lake Mohave between 1981 and 1987 as part of an effort by the Service to prevent extinction and promote eventual recovery of the species. Younger bonytail of adult size and spawning ability have been collected from the reservoir in the 1990's along with the old adults of the founder population. It is unknown whether these younger adults are from the original stockings or a result of natural reproduction. Releases of hatchery-reared adults into riverine reaches in the upper basin have resulted in low survival (Chart and Cranney 1991), with no evidence of reproduction or recruitment. Recent releases into repatriated, predator-free riverside ponds near Parker, Arizona, have produced up to three year classes (Pacey and Marsh 1998; personal communication, C. Minckley, U.S. Fish and Wildlife Service). Since 1977, only 11 wild adults have been reported from the upper basin (Valdez et al. 1994), but no upper basin fish have been transferred to hatchery facilities.

3.1.3 Populations of bonytail as redundant units

Maintaining several populations with relatively independent susceptibility to threats is an important consideration in the long-term viability of a species (Shaffer 1987; Goodman 1987). These redundant populations provide security in case of a catastrophic event or repeated year-class failure. The positive effect of relatively independent populations can be demonstrated by the following examples. Consider that a single population has a probability of extinction from a catastrophic event of 10% in 200 years. If two populations are independent, the probability of both going extinct is 1% (0.1^2). For three populations, the probability reduces to 0.1% (0.1^3). Even with an extinction probability of 25% for one population, the probability of extinction for two and three populations is 6.3% and 1.6%, respectively (Casagrandi and Gatto 1999).

Table 1. Documented captures of wild bonytail from the Colorado River Basin.

Location	Number	Years	Citation
Gunnison River, near Delta, Colorado	1	1889	Jordan (1891)
Green River	5	1889	Jordan (1891)
Grand Canyon	16	1940's	Miller (1944)
Green River, Hideout Canyon, Utah	unknown	1959	Gaufin et al. (1960)
Green River, Dinosaur Natl. Monument, Colorado	2	1962	Banks (1964)
Green River, Dinosaur Natl. Monument, Colorado	67 adults	1964–66	Vanicek and Kramer (1969)
Lower Yampa & Green Rivers, Colorado and Utah	36	1967–1973	Holden and Stalnaker (1975)
Lake Mohave	19 adults	1974–1984	Bozek et al. (1984)
Lake Mohave	34 adults	1976–1988	Minckley et al. (1989)
Lake Powell, Wahweap Bay, Utah	1 adult	1977	Gustaveson et al. (1985)
Lower Yampa River	1 adult	1979	Holden and Crist (1981)
Green River, Coal Creek Rapid, Gray Canyon, Utah	1 adult	1982–1985	Tyus et al. (1982, 1987)
Lake Powell, Wahweap Bay, Utah	1 adult	1985	Personal communication, Randy Radant, Utah Division of Wildlife Resources
Colorado River, Black Rocks, Colorado	1 adult	1984	Kaeding et al. (1986)
Green River, Gray Canyon, Utah	2 adults	1985	Moretti et al. (1989)
Colorado-Green confluence, Utah	1 adult	1986	Valdez and Williams (1993)
Colorado River, Cataract Canyon, Utah	3 adults	1985, 1988	Valdez and Williams (1993)
Lake Mohave	16	1988–1989	U.S. Fish and Wildlife Service (1990a)
Lake Havasu	unknown	circa 1990	U.S. Fish and Wildlife Service (1990a)
Lake Mohave, Tequila Cove	1	2002	Personal communication, C. Minckley, U.S. Fish and Wildlife Service



Figure 1. Recent distribution of wild bonytail in the Colorado River Basin.

An important aspect of recovery for bonytail is the establishment of several viable populations that are independently susceptible to catastrophic events. Maintenance of these populations would constitute sufficient redundancy as protection against threats and catastrophic events. If one population is severely depleted or eliminated by a catastrophe, other viable, self-sustaining populations will provide a source of fish and genetic material for restarting an extirpated population.

3.1.4 Bonytail as a metapopulation

The metapopulation concept is a natural phenomenon that should be considered when evaluating species persistence. A metapopulation is defined as a network of populations or subpopulations that have some degree of intermittent or regular gene flow among geographically separate units occupying habitat patches (Meffe and Carroll 1994). Populations that make up a metapopulation exist along a continuum of connectedness, with no clear break points, from totally isolated units to those that experience regular and high gene flow (Ehrlich and Murphy 1987; Harrison et al. 1988). Connectedness among units of a metapopulation may vary seasonally or annually (U.S. Fish and Wildlife Service 1995), and the best way to identify population units is that they have some ecological and evolutionary significance (Hanski and Gilpin 1997). Under metapopulation dynamics, habitat patches that become unoccupied due to local extirpations may become repopulated by dispersing individuals from other subpopulations. Metapopulations depend on the ability of individuals to disperse and repopulate empty patches in a manner timely enough to ensure that sufficient numbers of patches always contain viable subpopulations. The role of metapopulations in bonytail population dynamics can only be determined after populations become established.

3.2 Carrying Capacity

Carrying capacity is the theoretical size of a population that can be sustained by the existing environment, and is determined by population demographics and resource limitations (i.e., limiting factors), including habitat. Functional carrying capacity is the population at its equilibrium state in the presence of resource limitations, and is determined as the level where births equal deaths, or lambda (λ) is equal to 1.0 (Begon et al. 1990). Potential carrying capacity is the maximum possible population size with resource limitations minimized or removed.

Carrying capacity of newly established populations of bonytail is not expected to be the same for different populations because physical habitat (e.g., river channel, flow, and cover), chemical constituents (water quality), and biological components (e.g., food and predators) are likely to vary among river reaches. Hence, the same or even similar numbers and densities of fish in new populations should not be expected for recovery. Carrying capacity, as a function of recovery, must be considered on its own merits for recovery of each population. Only a few bonytail currently exist in the wild, and carrying capacity cannot be determined at this time; therefore, demographic recovery criteria may need to be modified as populations are established and information on carrying capacity is developed.

3.3 Genetic Viability

Genetic viability describes the pool of genetic diversity adequate to allow a population of animals to survive environmental pressures that may exceed the limits of developmental plasticity (Frankel 1983). Genetically viable populations maintain 90% of the genetic diversity present in the ancestral (pre-disturbance) population for 200 years (Soulé 1980; Soulé and Wilcox 1980; Soulé and Simberloff 1986). Genetic variability consists of within-population genetic diversity and genetic variation found among linked populations or stocks (Meffe 1986; Meffe and Carroll 1994). The risk with bonytail is that numbers of wild individuals are so low that erosion of genetic variability may have already occurred. This loss in genetic variability can result in increased extinction probabilities and lead the population to "extinction vortices" (Gilpin and Soulé 1986). Genetic concepts that were considered are summarized in Box 3.

Box 3. Genetics Concepts and Considerations

- Genetic viability describes the pool of genetic diversity adequate to allow a population of animals to survive environmental pressures that may exceed the limits of developmental plasticity.
- Genetic variability consists of within-population genetic diversity and genetic variation found among linked populations.
- Genetic effective population size (N_e) is the number of individuals contributing genes to the next generation.
- Rate of inbreeding is an index of the amount of genetic exchange among closely related individuals and is of particular importance because it may result in offspring that are sterile or inviable after one to several generations.
- N_e of at least 50 adults avoids inbreeding depression and is necessary for conservation of genetic diversity in the short-term; N_e of 500 is needed to avoid serious long-term genetic drift; N_e of 1,000 provides a conservative estimate beyond which significant additional genetic variation is not expected.
- Minimum viable population (MVP) is defined as a population that is sufficiently abundant and well adapted to its environment for long-term persistence without significant artificial demographic or genetic manipulations.

Historic genetic diversity of the bonytail remains unknown because of the few wild specimens left today and the small amount of material available from historic collections. Genetic analyses have been performed on hatchery-propagated progeny of wild adults from Lake Mohave. Twenty-four F_2 individuals, naturally produced in earthen ponds at Dexter National Fish Hatchery, were examined electrophoretically for soluble gene products of 45 loci (Minckley et al. 1989). Six polymorphic loci were identified, and electromorphic distribution at each locus agreed with Hardy-Weinberg expectations. Although these bonytail had a lower mean level of heterozygosity than arroyo chub (*Gila orcutti*), direct-count heterozygosity for bonytail was comparable to mean values reported for other western North American cyprinids. Minckley et

al. (1989) concluded that allozyme variation expressed by these hatchery-produced bonytail suggested a genetically variable stock suitable for reintroduction into appropriate wild habitats. Similar results were reported by Rosenfeld and Wilkinson (1989), who electrophoretically examined 23 gene loci using tissues from 24 hatchery specimens derived from six females and five males from Lake Mohave. These studies suggest that despite the low numbers of bonytail in the wild, hatchery brood stocks contain sufficient genetic variability for starting new populations in the wild. Recent genetic analysis of the founder population of bonytail from Lake Mohave (N = 10, 3.48–8.48 effective mated pairs; Hedrick et al. 2000) showed that using 30 pairs of existing F1 parents (60 individuals) provides a ratio of effective number of founders in the future broodstock to maximum possible genetic variation of 89.3% to 97.1%. Increasing the number to 150 pairs only slightly increases the effective number of founders with ratios of 97.6% to 99.4%. Inclusion of additional wild individuals into the future broodstock would significantly increase the effective number of founders. For example, one additional wild fish would increase the number of effective founders to 4.5–9.5 effective mated pairs.

3.3.1 Genetic effective population size

One way to judge genetic viability is through consideration of "genetic effective population size" (N_e), which is the number of individuals contributing genes to the next generation (Crow and Kimura 1970; Gilpin and Soulé 1986; Soulé 1987; Allendorf et al. 1997). N_e was derived in order to gauge the number of adults needed in a population to maintain genetic viability. The concept of N_e was defined by Wright (1931) as the size of an ideal population whose genetic composition is influenced by random processes in the same way as the real population. Low heterozygosity is the dynamic result of low N_e, and N_e likely differs by species (Meffe 1986). The concept of N_e was used to determine if wild populations are at risk genetically, but lack of genetic structural characterization with functional relationships for bonytail precludes a specific determination of N_e at this time. In the absence of this information, N_e for bonytail was derived from principles in conservation genetics by using the "50/500 rule" (Franklin 1980). It has been suggested that a minimum genetic effective population size of 50 is required to avoid inbreeding depression (Soulé 1980), and a minimum genetic effective population size of 500 is required to reduce long-term genetic drift (Franklin 1980). Lynch (1996) suggested an N_e of 1,000 as the number of adults beyond which significant additional genetic variation is not expected. An N_e of 500 is commonly used for fishes (Waples 1990; Bartley et al. 1992; Allendorf et al. 1997) and other vertebrate species (Mace and Lande 1991; Ralls et al. 1996). Wild populations afford the long-term genetic variation needed to maintain the species over time. No wild, self-sustaining populations of bonytail exist that provide sorting of alleles to maintain natural genetic variability. Where recovery relies on artificially reared select individuals, it is necessary to start populations with large numbers of individuals to ensure genetic variability. Without wild populations, genetic viability is not assured, therefore, bonytail require an N_e of 1,000, representing the number of adults beyond which significant additional genetic variation is not expected (Lynch 1996). Recent research by fish geneticists support use of the 50/500 rule (Reiman and Allendorf 2001). An important consideration to genetic viability is maintaining natural connectedness and potential for gene flow among populations, regardless of size (Reiman and Dunham 2000).

It is important to note that the number of individuals in a population required to achieve a genetic effective population size may be several times greater than the genetic effective population size (Frankel and Soulé 1981). Sex ratio and proportion of breeding individuals in the population are two important considerations in deriving the number of individuals necessary to support N_e. A 1:1 male to female ratio is used as the effective sex ratio for bonytail based on a consensus decision of biologists (Lentsch et al. 1998). With a 1:1 sex ratio, an N_e of 1,000 adults would consist of 500 males and 500 females. If all adults in a population breed every year and contribute genes to the following generation, some minimum number of adults (N_g) would equal N_e. However, as with most populations, it is believed that not all bonytail spawn every year or contribute genes to the following generation, and hence, N_g is not equal to N_e. It is important to determine a ratio of genetic effective population size (N_e) to minimum population size (N_g), or N_e/N_g.

For various fish species (rainbow trout [*Oncorhynchus mykiss*], chinook salmon *[O. tshawytscha*], white seabass [*Atractoscion nobilis*]), the ratio N_e/N_g varies from 0.013 to 0.90 (Table 2; Bartley et al. 1992; Avise 1994; Hedrick et al. 1995; Allendorf et al. 1997) for an overall average of about 0.30, which is the ratio reported for chinook salmon (McElhany et al. 2000), and other Pacific salmon species (Waples et al. 1990a, 1990b). This overall average ratio for fishes of 0.30 was used to determine the number of adult bonytail needed to support an N_e of 1,000. Mace and Lande (1991) reported that the genetic effective population size is typically 20–50% of the actual population size.

Table 2. Estimates of effective/actual population size (N_e/N_g) ratios for various fish species.

Species	N_e/N_g	Reference
Sea bass (*Atractoscion nobilis*)	0.27–0.40	Bartley et al. (1992)
Coho salmon (*Oncorhynchus kisutch*)	0.24	Simon et al. (1986)
Rainbow trout (*Oncorhynchus mykiss*)	0.90	Bartley et al. (1992)
Chinook salmon (*Oncorhynchus tshawytscha*)	0.013–0.043	Bartley et al. (1992)
Chinook salmon (*Oncorhynchus tshawytscha*)	0.30	McElhany et al. (2000)

Using an N_e of 1,000, a 1:1 sex ratio, and an N_e/N_g ratio of 0.30, an estimated N_g of 3,333 was derived as the estimated number of adult bonytail necessary to maintain a genetic effective population size in the wild. This approach does not imply that established populations should be allowed to decrease to this level; the estimate of 3,333 is used as a gauge to evaluate genetic viability of isolated populations.

A conservative approach for determining N_g was used in order to account for unknowns in genetic diversity of the species. At best, using hatchery stocks with reduced diversity will result in populations with less than the necessary genetic diversity for their environment, similar to a

founder effect (Simberloff and Wilson 1970). It may take several generations following reintroductions for allele shifts to produce a gene pool most suitable to the environment.

3.3.2 Minimum viable population

Genetic effective population size provides a gauge for genetic viability but does not necessarily account for demographic viability. The concept of a minimum viable population (MVP) is defined as a population that is sufficiently abundant and well adapted to its environment for long-term persistence without significant artificial demographic or genetic manipulations (Shaffer 1981; Soulé 1986, 1987; Soulé and Simberloff 1986;). Meffe and Carroll (1994) define an MVP as *"the smallest isolated population size that has a specified percent chance of remaining extant for a specified period of time in the face of foreseeable demographic, genetic, and environmental stochasticities, plus natural catastrophes."* Use of MVP does not mean that populations should be allowed to drop to these levels, but is used to assess their genetic and demographic viability. It must be recognized that some populations of any wild animal species may be below an MVP, as dictated by carrying capacity. It cannot be expected that every population will exceed an MVP; linkages to other populations help to keep smaller populations viable. As stated by Thomas (1990), *"There is no single 'magic' population size that guarantees the persistence of animal populations."* Thomas (1990) also stated that MVPs are rarely lower than a few 100 individuals and often correspond to an actual population count of about 1,000.

A minimum viable population size of 4,400 was derived by adding 30% to the N_g of 3,333 to account for an estimate of the average annual mortality of adult bonytail (3,333 x 1.30 = 4,333 or about 4,400; Box 4). An average annual adult mortality factor was added to buffer against an event that may result in recruitment failure for a year. The concept of adding a mortality factor to a genetically viable population as demographic security is taken from recovery criteria established for the southern sea otter, in which the estimated mortality from exposure to simulated oil spills was added to the estimate of N_g, based on an N_e of 500 (Ralls et al. 1996).

Box 4. Computation of Minimum Viable Population (MVP)

$$N_g = N_e/(N_e/N_g)$$

where: N_e = genetic effective population size, 1,000
N_e/N_g = proportion of adults contributing genes to next generation; ~0.30 for most fish

therefore: $N_g = 1{,}000/0.30$
$N_g = 3{,}333$

hence: MVP = 3,333 x 1.30 = 4,333 (rounded to 4,400)
where: 1.30 compensates for annual adult mortality of 30%

4.0 THREATS TO BONYTAIL BY LISTING FACTOR

The bonytail was designated as an endangered species under a final rule published April 23, 1980 (45 FR 27710–27713). Reasons for decline of the species were identified as *"...the physical and chemical alteration of their habitat and introduction of exotic fishes..."*. The Bonytail Chub Recovery Plan (U.S. Fish and Wildlife Service 1990a) further stated that *"The decline of the bonytail chub has been attributed to stream alteration caused by construction of dams, flow depletion from irrigation and other uses, hybridization with other Gila, and the introduction of nonnative fish species."* Hence, the primary threats to bonytail populations are streamflow regulation and habitat modification (including cold-water dam releases, habitat loss, and blockage of migration corridors); competition with and predation by nonnative fish species; hybridization; and pesticides and pollutants (Box 5). These five threats are associated with the five listing factors (see section 2.1), and a summary of each is presented in the following sections. Site-specific management actions and objective, measurable criteria associated with five recovery factors to minimize or remove threats are provided in section 5.0.

Box 5. Primary Threats To Bonytail

- Streamflow regulation.
- Habitat modification.
- Predation by nonnative fish species.
- Hybridization.
- Pesticides and pollutants.

4.1 Listing Factor (A): The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

It is believed that bonytail once inhabited the larger rivers of the Colorado River Basin from Wyoming and Colorado to northwestern Mexico. The historic abundance and distribution of the species were never accurately documented, but a precipitous decline occurred in known populations concurrent with extensive habitat alterations. These alterations led to a loss of the contiguous complement of habitats used by the various life history phases of the species. Hence, streamflow regulation and associated habitat modification are identified as primary threats to the bonytail. Regulation of streamflows in the Colorado River Basin is manifested as reservoir inundation of riverine habitats and changes in flow patterns, sediment loads, and water temperatures. For example, streamflow regulation has generally reduced the magnitude of spring peak flows and increased the magnitude of summer–winter base flows. Since 1950, annual peak flows of the Colorado River in historic upper Colorado River habitats have decreased by 29–38% (Van Steeter and Pitlick 1998). Flows of the Green River at Jensen, Utah, have decreased by 13–35% during spring and increased by 10–140% during summer through winter due to regulation by Flaming Gorge Dam (Muth et al. 2000); the largest number of wild bonytail were collected in the early and mid-1960's upstream of Jensen (Vanicek and Kramer 1969; Table 1).

The bonytail was reported in decline following a period of dam construction throughout the Colorado River Basin. Starting with Hoover Dam in 1935, numerous dams were constructed that fragmented and inundated riverine habitat; released cold, clear waters; altered ecological

processes; affected seasonal availability of habitat; and blocked fish passage. Reservoirs formed by these dams were stocked with a variety of nonnative fishes for recreational fisheries, and these fishes preyed upon and competed with the native fishes. In the 1960's, major dams were also constructed in the upper basin, primarily through the Colorado River Storage Project (CRSP) Act, including Flaming Gorge Dam (1962) on the Green River, Navajo Dam (1962) on the San Juan River, the Aspinall Units (1963) on the Gunnison River, and Glen Canyon Dam (1963) on the Colorado River. The decline of the species throughout the basin is attributed largely to extensive habitat loss, modification, and fragmentation, and blocked fish passage associated with dam construction and operations. Following the dams of the CRSP, fewer and smaller dams were constructed on tributaries, including McPhee Dam (1985) on the Dolores River and Taylor Draw Dam (1987) on the White River. Dams have not been constructed within suspected historic habitat of bonytail since 1987, and the threat of dam construction has been minimized considerably. Although bonytail have been reported historically from lower basin reservoirs, such as Lake Mead, Lake Mohave, and Lake Havasu, numbers have declined in these environments because of lack of reproduction and recruitment sufficient to replace old and dying adults. These reservoirs became sinks for bonytail that once inhabited local riverine regions.

Cold-water releases have eliminated most native fishes from river reaches immediately downstream of dams, except for small numbers of flannelmouth sucker (*Catostomus latipinnis*), bluehead sucker *(C. discobolus*), and speckled dace (*Rhinichthys osculus*) that remain in some tailwaters. River temperatures have been modified from seasonal lows of near freezing and highs of nearly 30°C to relatively constant dam releases of about 4–13°C. Depending on dam elevation, time of year, and river volume, river temperatures may not equilibrate with atmospheric temperatures for nearly 400 km downstream (as in the Colorado River below Glen Canyon Dam). These cold releases have caused reproductive failure and slowed growth of the warm-water native fishes. Penstock modifications on Flaming Gorge Dam in 1976 (Holden and Selby 1979; Holden and Crist 1981) allowed for warmed releases down the Green River beginning in 1978. These warmed releases have provided more suitable water temperatures for several species of native fishes in Lodore Canyon (Bestgen and Crist 2000) and may allow for expansion of bonytail when reproduction and recruitment of the species are restored.

Other aspects of habitat alteration throughout the Colorado River Basin may be important for recovery as more is learned about this endangered species. Historically, the Colorado River Basin was a continuous series of habitats, and the only physical barriers to movement were natural rapids and swift turbulent flows, which were probably only seasonal impediments to fish movement. Since 1905, numerous human-made dams have been constructed throughout the Colorado River Basin, fragmenting habitat and blocking migration corridors. In the lower basin, 14 major dams have inundated habitat, altered water quality, restricted fish movement, and otherwise altered habitats through the Colorado, Gila, Salt, and Verde rivers since completion of Hoover Dam in 1935; other dams on the Colorado River include Davis, Parker, Palo Verde Diversion, Imperial, and Laguna. Glen Canyon Dam approximately divides the lower from the upper basin and also is a barrier to fish movement.

Six barriers are identified in the upper basin upstream of Glen Canyon Dam within historic habitat of bonytail (Burdick and Kaeding 1990; Table 3). Four of these barriers are classified as

Table 3. Existing dams and diversion structures within historic bonytail habitat.

River	Structure	Current Status	Access to Suitable Habitat
Upper Colorado River	Grand Valley Diversion	Year-around passage completed in 1998	Passage adds 5 km additional habitat up to Price-Stubb Diversion
Upper Colorado River	Price-Stubb Diversion	Environmental Assessment to remove or modify in progress	Passage would add about 9 km additional habitat up to Government Highline Diversion
Upper Colorado River	Government Highline Diversion	No formal passage proposal	Passage would add 5 km additional habitat
Gunnison River	Redlands Diversion	Fishway installed in 1996; successfully passing fish	Passage adds 50 km additional habitat
Green River	Tusher Wash Diversion	Passage may be difficult at very low flows	Previously occupied habitat both up and downstream
Yampa River	Craig Diversion	Structure modified in 1992; successfully passing fish	Previously occupied habitat downstream

medium or high-head structures that are partial or seasonal barriers to fish movement or that have been modified to allow passage. The Price-Stubb Diversion presently defines the upper-most distribution of stocked bonytail in the upper Colorado River; a second structure, the Government Highline Diversion, is immediately upstream. Passage by these diversions could allow the species to expand its range by about 22 km (Osmundson 1999). The Redlands Fishway on the lower Gunnison River has allowed Colorado pikeminnow, razorback sucker, and other native fishes to regain access to about 40 km of the Gunnison River. A diversion structure on the Yampa River near Craig, Colorado, was recently replaced, in part, to allow unassisted fish passage (Masslich 1993). Modification of these dams and diversions could allow for considerable range expansion and increases in populations. Further, water withdrawn at diversion structures can entrain native fishes and isolate them in canal systems where their survival is potentially low. Diversion structures should be screened (as needed) to minimize or prevent entrainment of at least subadult and adult bonytail.

Maintenance of streamflow is important to the ecological integrity of large western rivers (Tyus 1992; Collier et al. 1996; Poff et al. 1997; Schmidt et al. 1998). Life histories of many aquatic species, especially fish, are often specifically tied to flow magnitude, frequency, and timing, such that disruption of historic flows can jeopardize native species. The importance of flow management to the endangered fishes of the Colorado River is recognized (Tyus 1992; Stanford 1994). Enhancing natural temporal and spatial habitat complexity through flow and temperature management is the basis for benefitting the endangered fishes (Osmundson et al. 2000b).

Flow recommendations have been developed for some river systems in the Upper Colorado River Basin that identify and describe flows with the necessary magnitude, frequency, duration, and timing to benefit the endangered fish species (e.g., Modde and Smith 1995; Osmundson et al. 1995; U.S. Department of the Interior 1995; Holden 1999; Modde et al. 1999; McAda 2000

[under revision]; Muth et al. 2000). These flows were designed to enhance habitat complexity (e.g., suitable spawning areas, inundation of floodplain areas) and to restore and maintain ecological processes (e.g., sediment transport, food production) that are believed to be important to the life history of these endangered fishes. Spring peak flows are important to the dynamic sediment processes that maintain in-channel habitat complexity, and prevent vegetation encroachment and channel narrowing. For example, cobble and gravel deposits used for spawning are relatively permanent features formed at high flows. Lower peak flows in subsequent years result in deposition of fine sediments over cobble and gravel deposits. Peak flows, whose timing coincides with the natural runoff cycle, are needed to ensure that suitable sites, cleansed of fine sediments, are available during the spawning period. Conversely, low and relatively stable base flows in summer, fall, and winter provide stable, warm, and productive nursery habitats for young fish.

Flows necessary to restore and maintain required habitats of the native Colorado River fishes mimic the natural hydrograph and include spring peak flows and summer–winter base flows. Little is known about the specific habitat requirements of bonytail because the species was extirpated from most of its historic range prior to extensive fishery surveys (see Appendix A for details on habitat requirements). The bonytail is considered adapted to mainstem rivers where it has been observed in pools and eddies. Similar to other closely related *Gila* spp., bonytail in rivers probably spawn in spring over rocky substrates; spawning in reservoirs has been observed over rocky shoals and shorelines. It is hypothesized, based on available distribution data, that flooded bottomland habitats, inundated by spring peak flows, are important growth and conditioning areas for bonytail, particularly as nursery habitats for young. Although, little is known about the life history of bonytail, the last reported concentrations of the species in the upper basin occurred in or upstream of alluvial river reaches with significant floodplain habitat. Biologists in the lower basin have successfully introduced bonytail into repatriated riverside habitats (i.e., flooded bottomlands) and obtained a biological response of reproduction and recruitment. Hatchery personnel at Dexter National Fish Hatchery have reported natural reproduction by bonytail in earthen ponds. Appropriating flooded bottomland habitats that are relatively free of predators may provide an opportunity for successful reproduction and recruitment to start new populations in the wild.

Flow recommendations have been developed that specifically consider flow-habitat relationships within historic habitat of bonytail (see section 3.1.2; Table 1) in the upper Colorado River (Osmundson et al. 1995; McAda 2000), Gunnison River (McAda 2000), Yampa River (Modde and Smith 1995; Modde et al. 1999; U.S. Fish and Wildlife Service 2000), and Green River (Muth et al. 2000). These flow recommendations will be evaluated and revised (as necessary) as part of an adaptive-management process, and flow regimes to benefit the endangered fishes will be implemented through multi-party agreements or by other means (see section 4.4).

4.2 Listing Factor (B): Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization of bonytail for commercial, recreational, scientific, or educational purposes is not considered a threat to the species, either presently or historically. This factor will be reevaluated and, if necessary, actions to ensure adequate protection will be identified before downlisting and attained before delisting.

Bonytail have no commercial or recreational value and are not sought by commercial fishermen or anglers. Some fish may be incidentally caught when recreational angling for other sympatric species, but the number of native fish harmed or killed is believed to be insignificant based on creel surveys by the Colorado Division of Wildlife (personal communication, T. Nesler, Colorado Division of Wildlife). All angler access points near occupied habitat are posted with signs advising anglers to release any endangered fish unharmed.

Collection of bonytail for scientific or educational purposes is regulated by the Service under Section 10(a) of the ESA. Scientific collecting permits are issued to investigators conducting legitimate scientific research, and "take" permits are issued where a reasonable loss of fish is expected. Permits to collect bonytail for educational purposes are normally not requested but are regulated by the same provisions of the ESA.

4.3 Listing Factor (C): Disease or Predation

4.3.1 Diseases and parasites

Diseases and parasites currently are not considered singly significant in the decline of the bonytail (see section A.12 for expanded discussion of parasites), but these factors will be reevaluated and, if necessary, actions will be identified to minimize adverse effects before downlisting. Adequate protection from deleterious diseases and parasites will be attained before delisting.

4.3.2 Nonnative fishes

A large number of nonnative fishes are found in historic and currently occupied habitat of bonytail. Many of these are considered predators, competitors, and vectors of parasites and diseases (Tyus et al. 1982; Lentsch et al. 1996; Pacey and Marsh1999). Many researchers believe that nonnative species are a major cause for lack of recruitment in the native fishes, including bonytail (McAda and Wydoski 1980; Minckley 1991; Tyus 1987). There are numerous reports of predation of native fish eggs and larvae by common carp (*Cyprinus carpio*), channel catfish (*Ictalurus punctatus*), smallmouth bass (*Micropterus dolomeiui*), largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), green sunfish (*Lepomis cyanellus*), and redear sunfish (*Lepomis microlophus*; Jonez and Sumner 1954; Langhorst 1989; Marsh and Langhorst 1988). Marsh and Langhorst (1988) found that larval razorback sucker in Lake Mohave grew better in the absence of predators, and Marsh and Brooks (1989) reported that

channel catfish and flathead catfish (*Pylodictis olivaris*) were major predators of newly stocked razorback sucker in the Gila River. Juvenile razorback sucker (average 171 mm TL) stocked in isolated coves along the Colorado River in California suffered extensive predation by channel catfish and largemouth bass (Langhorst 1989). Similar results are reported for bonytail in isolated riverside ponds along the lower Colorado River near Parker, Arizona (personal communication, C. Minckley, U.S. Fish and Wildlife Service).

Similar effects of predation on native fishes are reported from the Upper Colorado River Basin. Lentsch et al. (1996) identified six species of nonnative fishes as existing threats, including red shiner (*Cyprinella lutrensis*), common carp, sand shiner (*Notropis stramineus*), fathead minnow (*Pimephales promelas*), channel catfish, and green sunfish. Small forms, such as adult red shiner, are known predators of larval native fish (Ruppert et al. 1993). Large predators, such as walleye (*Stizostedion vitreum*) and northern pike (*Esox lucius*) also pose a threat to subadult and adult native fishes (Tyus and Beard 1990).

A Strategic Plan for Nonnative Fish Control was developed for the Upper Colorado River Basin (Tyus and Saunders 1996) and implemented by the UCRRP in 1997. Some activities include mechanical removal of nonnative fishes through intensive sampling, and modification of habitats used as residential or nursery areas by nonnative fishes. Preliminary results of the control program are inconclusive as to the beneficial effects for native fishes. Data from a 7-year research period on the San Juan River suggest that efforts to date were effective in reducing density of large channel catfish, but efforts were not effective in reducing overall abundance of channel catfish in the river (Holden 1999). A positive population response by native fishes to this channel catfish reduction has not been reported (personal communication, San Juan River Basin Recovery Implementation Program, Biology Committee). A strategic control program has also been recommended for Grand Canyon (Valdez et al. 1999b), and a Science Plan is being developed for implementation of nonnative fish removal starting in 2003 (GCMRC 2002).

Removal of nonnative fishes from isolated habitats has become one of the major management actions in recovering the native fishes in the lower basin. Efforts to restore the gene pool of fishes in Lake Mohave by capturing and rearing larvae have identified predation by nonnative fishes as a major cause of mortality of young fish (Marsh 1987, 1994; Mueller 1995; Mueller et al. 1998). These studies have found increased survival and growth of razorback sucker and bonytail under predator-free environments (Mueller et al. 2000).

Control of the release and escapement of nonnative fishes into the main river, floodplain, and tributaries is also a necessary management action to stop the introduction of new fish species into occupied habitats and to thwart periodic escapement of highly predaceous nonnatives from riverside features. Agreements have been signed among the Service and the States of Colorado, Utah, and Wyoming to review and regulate all stockings within the Upper Colorado River Basin (U.S. Fish and Wildlife Service 1996) in order to reduce the introduction and expansion of nonnative fishes. A Memorandum of Agreement implementing these procedures was signed on September 5, 1996, by the Service and the States and remains in effect through the life of the UCRRP. This agreement regulates releases of nonnative fishes within the 50-year floodplain of the river, and provides security against State or Federal endorsed programs introducing new

species into the system or increasing the numbers or distribution of existing species. The agreement also allows the States to regulate and restrict stocking of privately owned ponds. These procedures will also reduce the likelihood of new parasites and diseases being introduced through nonnative fish stockings. Similar procedures need to be developed and implemented in the lower basin.

Annual flooding of the river can inundate riverside ponds potentially containing large numbers of green sunfish, black bullhead, largemouth bass, and other nonnative fishes that may escape to the river during high flows (Valdez and Wick 1983). Riverside features determined to be problematic must be either isolated from high river floods, designed to drain annually with the rise and fall of the river, or treated with piscicidal compounds to eradicate nonnative fishes. The Colorado Division of Wildlife is to prepare a Colorado River Fisheries Management Plan (Plan) that will implement a more detailed nonnative fish control effort. The Plan is to be reviewed and approved by the Colorado Wildlife Commission and UCRRP. The Plan will be finalized and implemented by the dates specified in the Recovery Implementation Program Recovery Action Plan (RIPRAP) of the UCRRP. One aspect of the Plan will be pond reclamation, which can include complete removal of nonnative fish, screening ponds to prevent escapement to the river, and/or reshaping ponds so that they no longer support year-round habitation by nonnative fish.

Another aspect of nonnative fish control in the Colorado River Basin is removal of bag and possession limits on nonnative fishes in designated critical habitat. For example, the State of Colorado has removed bag and possession limits on all nonnative, warm-water sport fishes within critical-habitat reaches of the Colorado and Yampa rivers. Colorado also has agreed to close river reaches to angling where and when angling mortality is determined to be significant to native fishes. The State of Arizona has implemented a similar measure of removing bag and possession limits of nonnative species within designated critical habitat.

Three management actions are identified to reduce the threat of nonnative fishes: high spring flows, nonnative fish control strategies, and stocking agreements. There is documented evidence that high flows temporarily disadvantage nonnative fishes in several ways, including displacement from sheltered habitats, disruption of spawning activities, increased mortality in high mainstem currents, and physical downstream transport of individuals. Studies from the Upper Colorado River (McAda and Kaeding 1989), Green River (Valdez 1990), Yampa River (Muth and Nesler 1993), and Lower Colorado River through Grand Canyon (Hoffnagle et al. 1999; Valdez et al. 2001) showed reductions in densities of small-bodied species of fish (e.g., fathead minnow, red shiner, sand shiner, plains killifish [*Fundulus zebrinus*]) following high flows. On the San Juan River, no evidence exists to support the hypothesis that high flows even temporarily disadvantage nonnatives and promote endangered fish reproduction and recruitment (Holden 1999). Strong year classes of native species (e.g., Colorado pikeminnow [McAda and Ryel 1999], humpback chub [Gorman 1994]) have consistently occurred following high runoff years, and have been attributed to cleansing of spawning gravels and short-term reduction in nonnative fishes. Hence, even a short-term reduction in nonnative fishes could allow increased survival and recruitment of native forms (Tyus and Saunders 1996). Flow recommendations include the provision of high flows, which provide these unsuitable conditions for nonnative fishes and may at least temporarily reduce numbers of these predators and competitors.

Active control programs should be implemented or continued (as needed) for problematic nonnative fishes in bonytail nursery habitats (potentially flooded bottomlands), northern pike in the Yampa and middle Green rivers, and channel catfish and flathead catfish in river reaches where bonytail become reestablished. Guidance is not provided in this document with regard to target reduction levels because such criteria may be premature and unreasonable to achieve, or may be easily achieved and exceeded. Little is known with respect to responses by nonnative fish populations to overt control measures, and these must be evaluated as part of nonnative fish control programs. Another unknown aspect of nonnative fish control is the need to maintain control measures indefinitely or periodically over time. These decisions will have to be made from information gained through these control programs during the downlist monitoring period.

4.4 Listing Factor (D): The Inadequacy of Existing Regulatory Mechanisms

Implementation of regulatory mechanisms are necessary for recovery of the bonytail and to ensure long-term conservation of the species. Regulatory mechanisms affect many aspects of legal protection, such as habitat and flow protection, regulation and/or control of nonnative fishes, regulation of hazardous-materials spills, and angling regulations. Flow regimes to benefit bonytail populations must be identified, implemented, evaluated, and revised (as necessary) before downlisting can occur (existing flow recommendations are described in section 4.1). By the time of delisting, legal protection of habitat (including flows) necessary to provide adequate habitat and sufficient range for all life stages of bonytail to support recovered populations must be accomplished through various means including instream-flow appropriations, legal agreements, contracts, operating criteria, and/or other means. Additionally, certain States may issue policies that also afford flow protection. As examples, the State of Utah has instituted a policy that subordinates all future water-rights appropriations for the Green River from Flaming Gorge Dam to the Duchesne River confluence for the summer and autumn periods to provide flows to benefit the endangered fish; actions proposed under this policy would not affect pre-existing water rights (Utah Division of Water Rights 1994). Also, the State of Colorado has established two instream-flow rights on the Colorado River under its state instream-flow law.

Before delisting, the primary regulatory mechanism for protection of bonytail is through Section 7(a)(2) of the ESA, as administered by the Service. *"Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency... is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical..."* In the Upper Colorado River Basin, the UCRRP provides a mechanism for dealing with Section 7 consultations in a unified manner. There are currently no formal recovery programs in the lower basin, and Section 7 consultations are addressed on a case-by-case basis. The NFWG is an ad hoc group of dedicated volunteers and agency biologists focused on protecting and augmenting the genetic diversity of current native fish populations in Lake Mohave. The goal of the MSCP is to provide a comprehensive mechanism for ensuring regulatory compliance under both Sections 7 and 10 of the ESA for all participating Federal and non-Federal MSCP agencies and entities. Similarly, the MSCP is intended, and is being

structured, to provide environmental compliance pursuant to the California Endangered Species Act and California Environmental Quality Act (CEQA). None of the recovery or conservation programs in the Colorado River Basin are regulatory mechanisms that provide permanent, long-term protection for the species after delisting.

In addition to Federal protection under the ESA, bonytail are protected by all basin States under categories such as "endangered", "threatened", or "sensitive". This protection prohibits intentional take and keeping or harming in any way any fish captured incidentally, and may need to remain in place after the species is Federally delisted. However, the States do not address the major problem of habitat destruction, and especially streamflow modification. Most States have instream-flow laws that allow "beneficial use" of water left in streams for wildlife, but these laws typically only provide for flow that is the minimum amount necessary to maintain the fishery. With some States, there is also an inherent conflict between management of nonnative sport fish and recovery of endangered fishes. Where valued sport fisheries occur, there is an ongoing dilemma between public demands for maintenance and expansion of fisheries and management actions to conserve and recover endangered fish. There is no immediate solution to the dilemma, but predation by nonnative fishes is clearly identified as a cause for the decline of many of the native Colorado River fishes, and long-term agreements between States and the Service are essential.

After removal from the list of species protected by the ESA, the bonytail and its habitat will continue to receive consideration and some protection through the following Federal laws and related State statutes, and will need the provisions to protect habitat previously discussed. The National Environmental Policy Act (NEPA; 42 U.S.C. 4321–4370d) requires Federal agencies to evaluate the potential effects of their proposed actions on the quality of the human environment and requires the preparation of an environmental impact statement whenever projects may result in significant impacts. Federal agencies must identify adverse environmental impacts of their proposed actions and develop alternatives that undergo the scrutiny of other public and private organizations as a part of their decision-making process. Recovery actions identified for bonytail are linked to federal actions, which must undergo review under NEPA.

Section 101(a) of the Federal Water Pollution Control Act (i.e., Clean Water Act; 33 U.S.C. 1251–13287) states that the objective of this law is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters and provide the means to assure that *"...protection and propagation of fish, shellfish, and wildlife..."*. This statute contributes in a significant way to the protection of the bonytail and its food supply through provisions for water quality standards, protection from the discharge of harmful pollutants, contaminants [Section 303(c), Section 304(a), and Section 402] and discharge of dredge or fill material into all waters, including certain wetlands (Section 404).

The Organic Act (16 USC 1, as amended) provides for management of National Park Service areas in such a manner *"...to promote and regulate the use of the...national parks...which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."* The National Park Service is the

largest single jurisdictional land owner in reaches with critical and other occupied habitats for the four Colorado River endangered fishes (Maddux et al. 1993).

The Fish and Wildlife Coordination Act (16 U.S.C. 661–666c) requires that Federal agencies sponsoring, funding, or permitting activities related to water resource development projects request review of these actions by the Service and the State natural resource management agency. These comments must be given equal consideration with other project purposes. Also, the Federal Land Policy and Management Act (43 U.S.C. 1701–1784) requires that public lands be managed to protect the quality of scientific, ecological, and environmental qualities and preserve and protect certain lands in their natural conditions to provide food and habitat for fish and wildlife.

The need for conservation plans and agreements was identified to provide reasonable assurances that recovered bonytail populations will be maintained. These plans are to be implemented after delisting and are intended to assure that relisting does not become necessary. They would be developed to ensure long-term management and protection of the species, and should include (but not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats. Signed agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties must be in place to implement the conservation plans before delisting can occur.

4.5 Listing Factor (E): Other Natural or Manmade Factors Affecting Its Continued Existence

4.5.1 Hybridization

Intergrades among the Colorado River *Gila* have been reported by several investigators (Holden and Stalnaker 1970; Valdez and Clemmer 1982; Kaeding et al. 1990; Douglas et al. 1989, 1998). The presence of intergrades in the wild suggests hybridization among bonytail, roundtail chub, and humpback chub; hybridization has been demonstrated under hatchery conditions (Hamman 1981). Some have suggested that hybridization is the result of a breakdown in reproductive isolating mechanisms caused by habitat and streamflow changes in the basin (Valdez and Clemmer 1982), while others (Dowling and DeMarais 1993) hypothesize that introgressive hybridization has played a significant role in generating the great morphological diversity in the genus *Gila* and providing additional genetic variability. The effect of hybridization on the *Gila* species is unclear, and the factors that lead to increased hybridization of bonytail are not evaluated, because there are no reproducing populations in the wild. Current levels of hybridization are not considered singly significant in the decline of the bonytail, but these factors will be reevaluated at downlisting and any necessary protection will be implemented at delisting. A discussion of hybridization in bonytail is presented in section A.3.

4.5.2 Pesticides and pollutants

The potential role of pesticides and pollutants in suppressing populations of *Gila* were discussed by Wick et al. (1981). Over 16% of young roundtail chub from the Yampa and Colorado rivers in 1981 showed spinal deformities (i.e., lordosis), hypothesized to be related to high pesticide levels from local agricultural applications (Haynes and Muth 1981). Other pollutants in the system include petroleum products, heavy metals (e.g., mercury, lead, zinc, copper), nonmetalics (i.e., selenium), and radionucleides. Although these elements are concentrated in some regions of the basin, no tissue analyses have been conducted for bonytail to determine current levels of bioaccumulation. Selenium has been identified as a potential problem for razorback sucker and Colorado pikeminnow (Osmundson et al. 2000a).

Potential spills of hazardous materials threaten all endangered fishes. The Denver and Rio Grande Western railroad tracks parallel the Colorado River at Black Rocks and upper Westwater Canyon with the risk of derailment and spills of materials into the river, although no known derailments have occurred in these areas. The susceptibility of stocked bonytail to toxic substances is illustrated by a large, but unquantified loss of humpback chub in Westwater Canyon in the 1980's as a result of a large ash flow following a range wildfire high in the watershed (personal communication, J. Cresto, U.S. Bureau of Land Management). Ash and large amounts of sediment washed down Westwater Creek during a sudden thunderstorm. The potential for spills of petroleum products also exists for repatriated bonytail in Yampa Canyon. For example, numerous petroleum-product pipelines cross or parallel the Yampa River upstream of Yampa Canyon, most of which lack emergency shut-off valves. One pipe ruptured in the late 1980's releasing refined oil into the Yampa River, but the effects of this spill were not documented.

All States have hazardous-materials spills emergency-response plans that provide a quick cleanup response to accidental spills (see section 4.4). These responses may not be sufficiently rapid to minimize deleterious effects to fishes. Quick response may, therefore, be inadequate to protect the species and preventive measures must be incorporated into these plans. These preventive measures may include reduced speed of railway traffic near occupied habitats, such as upper Colorado River; safety shut-off valves on petroleum-products lines in or near the floodplain; and filtration systems in case of accidental spills of hazardous materials at bridge crossings above occupied habitats. Identifying and implementing the most reasonable and prudent preventive measures will require a comprehensive review of existing State and Federal hazardous-materials spills emergency-response plans. These preventive measures must be implemented before delisting.

Another cause of degraded water quality is the Atlas Mills tailings pile located on the north bank of the Colorado River near Moab, Utah. In 1998, the Service determined in a final biological opinion that this pile *"...is likely to jeopardize the continued existence of..."* the Colorado pikeminnow and razorback sucker. This biological opinion was withdrawn on February 8, 2001, because of refusal by the Nuclear Regulatory Commission to reinitiate consultation. Section 3405 of the Floyd D. Spence National Defense Authorization Act for Fiscal Year 2001 (P.L. 106-398) requires that the Atlas Mills tailings site be transferred to the Department of Energy for

remediation. Congress authorized $300 million for clean-up of the Atlas Mills tailings pile. Remediation is outside of the purview of the UCRRP.

There are two significant threats to endangered fish posed by the Atlas Mills tailings pile. The first is from toxic discharges of pollutants, particularly ammonia, through groundwater to the Colorado River. The second is the risk of catastrophic pile failure, that could bury important nursery areas and destroy other fish habitat. To address the threats posed by the discharge of toxic pollution, whether tailings are reclaimed on site or removed to another location, the groundwater must be cleaned up to the extent necessary to prevent the discharge of ammonia, uranium, and other toxic pollutants into the Colorado River and meet the State of Utah surface-water and groundwater quality standards for fish and wildlife. To assess whether such clean-up has occurred, groundwater-system compliance and measuring points must be established.

5.0 RECOVERY GOALS

The following are site-specific management actions and objective, measurable recovery criteria for the bonytail presented by the two recovery units, i.e., the upper basin (including Green River and upper Colorado River) and the lower basin (including the mainstem and its tributaries from Lake Mead downstream to the southerly International Boundary with Mexico). The bonytail was listed prior to the 1996 DPS policy, and the Service may conduct an evaluation to designate DPSs in a future rule-making process. Steps for downlisting and delisting presented in this section are consistent with provisions specified under Section 4(a)(1), Section 4(b), Section 4(c)(2)(B), and Section 4(f)(1) of the ESA (see section 2.0 of this document). The five recovery factors (i.e., Factor A, Factor B, etc.) were derived from the five listing factors (see section 2.1) and state the conditions under which threats are minimized or removed. For each recovery factor, management actions and tasks are identified that minimize or remove threats to the bonytail. Under objective, measurable recovery criteria, demographic criteria and recovery factor criteria are presented for downlisting and delisting. Generally, for each downlisting criterion there is a corresponding delisting criterion. Reclassification can be considered when appropriate recovery criteria are met.

Anthropogenic changes in the lower basin have extensively modified the riverine ecosystem, including native-fish habitats. Therefore, recovery goals in the lower basin are based on a limited amount of habitat and taking aggressive actions (e.g., stocking large numbers of adults) that allow for the establishment and maintenance of populations in riverine and/or repatriated habitats (e.g., riverside habitats, such as oxbows, depressions, bottomlands, that are connected where feasible to the mainstem Colorado River).

5.1 Requirements and Uncertainties Associated with Recovery Goals

5.1.1 Demographic criteria and monitoring

Demographic criteria that describe numbers of populations and individuals (adults and juveniles) for downlisting and delisting are presented for upper and lower basin recovery units. These

criteria require four genetically and demographically viable, self-sustaining populations (two in each recovery unit), based on requirements of no significant decline in numbers of adults for each population and recruitment equal to or exceeding adult mortality. In addition, a genetic refuge needs to be established and maintained in a suitable location in the lower basin recovery unit.

It is anticipated that self-sustaining populations of bonytail will be established over the next 15 years, during which time population dynamics and responses to management actions will be evaluated. A 5-year monitoring period is required for downlisting, and a 3-year monitoring period beyond downlisting is required for delisting. The downlist monitoring period begins with the first reliable estimates for all populations acceptable to the Service once self-sustaining populations have been established (i.e., progeny are recruiting) The downlist and delist monitoring periods are expected to be continuous, and reclassification cannot be considered until each population has been monitored for the required period of time. The total 8-year monitoring period is equivalent to approximately one generation time for bonytail, and is considered sufficient to determine if populations are stable, increasing, or decreasing. Generation time is equal to the mean adult age and is computed as the average age of attaining sexual maturity; i.e., $age_{sex\ maturity}$ plus (1/d), where d is equal to death rate (Seber 1982; Gilpin 1993). For bonytail, the age of attaining sexual maturity is 4 years and the adult survival rate is 0.70 (d=1-0.70); hence, generation time is 4 + [1/(1-0.70)] or approximately 8. No estimates of survival are available for wild bonytail. Lacking that information and following best professional judgement, a conservative estimate of average annual adult mortality (0.30) that was equal to the estimate for razorback sucker (the highest mortality rate of the four big river fishes) was applied to bonytail.

It is important to note that under Section 4(g)(1) of the ESA, *"The Secretary shall implement a system in cooperation with the States to monitor effectively for not less than five years the status of all species which have recovered to the point at which the measures provided pursuant to this Act are no longer necessary..."*. Hence, populations would be monitored for at least 5 additional years after delisting.

The Service considers a reliable estimate as one that is based on a multiple mark-recapture model. Direct enumeration of fish populations is not feasible in turbid rivers, and removal estimates are unreliable because of the difficulty of blocking reaches of large rivers to meet the model assumption of no migration. Instead, closed-population, multiple mark-recapture estimators (Otis et al. 1978; Burnham et al. 1987; Chao 1989; Osmundson and Burnham 1998) are recommended for deriving population point estimates and to guide development of sampling designs that conform to these models. The accuracy and precision of each point estimate will be assessed by the Service in cooperation with the respective recovery or conservation programs, and in consultation with investigators conducting the point estimates and with qualified statisticians and population ecologists. If, for example, an estimate is made that is considered unreliable (i.e., lacks precision and accuracy) because of poor sampling conditions or other causes, a determination will be made if an additional estimate is needed in the following year in order to accurately assess if downlisting or delisting criteria are met. Field sampling methodologies should be developed and refined to attain a balance between the need for accurate and precise population estimates while minimizing stress to fish from excessive handling.

Monitoring must be designed to determine if the demographic criteria are being met. At least three point estimates are needed for each of the four established bonytail populations to downlist, and at least two more estimates are needed to delist. In order to ensure no net loss in each population, the trend in adult (age 4+; ≥250 mm TL; Vanicek 1967) point estimates cannot decline significantly; i.e., slope is not significantly less than zero over the trend period ($p \leq 0.05$), requiring that the population is either stable or increasing during the monitoring period. Also, mean estimated recruitment of age-3 (150–249 mm TL; Vanicek 1967) naturally produced fish in each population must equal or exceed mean annual adult mortality (i.e., ≥30%). This criterion requires that each population is reproducing, recruiting, and self-sustaining. To meet the requirement of genetically and demographically viable populations, each point estimate for each population must exceed 4,400 adults (MVP; see section 3.3.2). In addition to the demographic criteria, adequate habitat and sufficient range are required to support recovered populations. Recovery goals allow for maintenance of populations within areas of designated critical habitat (59 FR 13374).

5.1.2 Recovery factor criteria

The recovery factor criteria are directly linked to management actions/tasks. Recovery factor criteria for downlisting generally call for identification, implementation, evaluation, and revision of management tasks. Corresponding criteria for delisting call for attainment of necessary and feasible levels of protection that minimize or remove threats. Reference to management actions and tasks in occupied habitat presupposes establishment of populations through augmentation.

Each of the five threats identified in section 4.0 (i.e., streamflow regulation, habitat modification, competition with and predation by nonnative fishes, hybridization, and pesticides and pollutants) is addressed in this section with appropriate management actions/tasks. Details of these and other management actions/tasks that contribute to recovery are or will be identified in the RIPRAP of the UCRRP, and in annual work plans of the NFWG and MSCP. These programs function under the general principles of adaptive management, and the plans are periodically revised. In the context of these programs, adaptive management is the process by which management actions are identified, implemented, evaluated, and revised based on results of research and monitoring.

Providing and legally protecting habitat are necessary elements in recovery of the bonytail. Habitat as used in these recovery goals is defined as the physical and biological components of the environment required for recovery of the species, including flow regimes necessary to restore and maintain those environmental conditions. Hence, identification, implementation, evaluation, and revision of adequate flow regimes through adaptive management are identified as criteria necessary for downlisting. By the time of delisting, flows (as well other habitat components) identified as necessary to the life history of the species must be provided and legally protected through various means, including instream-flow appropriations, legal agreements, contracts, operating criteria, and/or other means. As stated in the governing document of the UCRRP (U.S. Department of the Interior 1987), under this program legal protection of flows referenced in these recovery goals for upper basin rivers will be consistent with State and Federal laws related to the Colorado River system (sometimes referred to as “Law of the River”), including State water law,

interstate compacts, and Federal trust responsibilities to American Indian tribes. It is recognized that flow management alone is not sufficient to ensure self-sustaining populations of the endangered fishes, and that a combination of flow and non-flow management actions will be necessary for recovery. It is anticipated that flow management actions identified in these recovery goals can be achieved in balance with non-flow management actions to improve ecosystem conditions and enhance recovery and sustainability of the endangered fish populations. Population and demographic data collected through monitoring will be used to track progress toward meeting the habitat needs of the species.

Implementation of conservation plans is required in order to provide for the long-term management and protection of bonytail populations after delisting. These conservation plans will be developed and implemented through agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties, and may include (but are not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats.

Use of hatchery fish (progeny of cultured broodstock) will be necessary to establish new populations of bonytail. Provisions and recommendations of the Policy Regarding Controlled Propagation of Species Listed Under the Endangered Species Act (65 FR 56916) should be used as guidelines for use of hatchery fish in recovery. The UCRRP has a genetics management plan (Czapla 1999) and is revising a facilities-needs plan based on revised State stocking plans. Similar plans need to be developed for the lower basin recovery unit.

5.1.3 Uncertainties

These recovery goals are based on the best available scientific information, and are structured to attain a balance between reasonably achievable criteria and ensuring the viability of the species beyond delisting. Without wild viable populations, considerable uncertainty exists regarding recovery of the bonytail. It is expected that research, management, and monitoring activities directed by the UCRRP, NFWG, and MSCP will fill information gaps and considerably narrow, if not eliminate, many of the uncertainties that affect recovery criteria. As self-sustaining populations are established and studied, additional data and improved understanding of bonytail biology will prompt future revision of these recovery goals. The Service intends to review, and revise as needed, these recovery goals at least once every 5 years from the date of their publication in the *Federal Register*, or as necessary when sufficient new information warrants a change in the recovery criteria. Review of these recovery goals will be part of the review of listed species as required by Section 4(c)(2)(A) of the ESA, *"The Secretary shall ... conduct, at least once every five years, a review of all species..."*. Uncertainties associated with these recovery goals include:

- Demographic Viability. The metapopulation concept may apply to bonytail populations, but the role of metapopulations in bonytail population dynamics can only be determined after populations become established.
- Carrying Capacity. The carrying capacity for bonytail populations is unknown. Numbers of wild fish are too few to make any inferences on carrying capacity.

- Genetic Viability. A conservative N_e of 1,000 was used because of the absence of wild, self-sustaining populations to provide sorting of alleles to maintain natural genetic variability. Without wild populations, genetic viability is uncertain and not assured.
- Hybridization—Hybridization of bonytail with other *Gila* species is identified as a primary threat in the Bonytail Chub Recovery Plan. Crosses among bonytail, humpback chub, and roundtail chub have been successfully performed in a hatchery, and there is a risk of hybridization for the species in the wild. However, the factors that would lead to increased risk of hybridization are not currently known. Hence, this will need to be evaluated as fish are released into the wild and populations become established in proximity or sympatry with the other *Gila* spp.
- Flow and Temperature Recommendations. Flow and temperature recommendations have been developed that specifically consider flow-habitat relationships in habitats occupied by bonytail. However, it is uncertain to what extent these recommendations can be met and what flow regimes will be necessary to meet the life history needs of the bonytail. Streamflow reduction and modification from dams and water withdrawal systems have reduced spatial and temporal variability in flow regimes, reduced available habitat, and changed ecosystem function and structure. A paradigm in river management suggests that the ecological integrity of river ecosystems is linked to their natural dynamic character (Stanford et al. 1996; Poff et al. 1997), and restoring a more natural flow regime is the cornerstone of river restoration. This paradigm and the response by endangered fishes of the Colorado River Basin is largely untested, and as these flow regimes to benefit the endangered fishes are implemented, it is important to be aware of associated uncertainties and plan for management of unanticipated results. Response of bonytail to flows will need to be monitored in order to identify and provide flow regimes that are necessary to restore and maintain adequate habitat and sufficient range for all life stages.
- Nonnative Fish Response. Uncertainty exists regarding the responses of nonnative fishes to active control measures and to flow regimes to benefit the endangered fishes. Many of these nonnative fishes, both warm-water and cold-water, prey on and compete with native fishes. There are indications that high spring flows have a negative effect on nonnative fishes, but the overall response of nonnative fish populations to flow recommendations is uncertain. Long-term response by nonnative fishes to mechanical removal is also an uncertainty. It is unknown if reduction in numbers of nonnatives will result in lower population numbers, altered age structure, or opening of niches for new or existing nonnative fishes. It is also unknown if reduction in nonnative fishes will result in increased numbers of native fishes.
- Efficacy of Monitoring Programs. The precision and reliability of long-term monitoring programs to accurately measure the response of bonytail to management actions is an uncertainty. Mark-recapture estimates of established populations may reflect high variability because of population variability and/or sampling variability. This variability in estimates may exceed the level of population response to a management action, masking measurement of short-term

responses and cause-effect relationships. Demographic criteria proposed in this document attempt to account for this variability and set numbers that are measurable under current conditions.

- Establishing Self-Sustaining Populations. Hatchery fish will be used to establish new populations. The survival, recruitment, and reproductive success of these fish in the wild is uncertain. This uncertainty is greater in rivers or river reaches that have been extensively modified.
- Response to Management Actions. Response by bonytail populations to management actions is also uncertain. Management actions, such as repatriation of riverine habitats in the lower basin, regulation of escapement of nonnative fishes, control of parasites, control of nonnative fishes, and minimization of risk to hazardous-materials spills, may vary in their effectiveness to benefit bonytail. Tasks and recovery criteria associated with each of these management actions are intended to provide some measure of success before reclassification can occur.

5.2 Site-Specific Management Actions and Tasks by Recovery Factor

5.2.1 Upper basin recovery unit

5.2.1.1 Factor A.—Adequate habitat and range for recovered populations provided

Management Action A-1.—Provide flows necessary for all life stages of bonytail to support recovered populations, based on demographic criteria.

Task A-1.1.—Identify, implement, evaluate, and revise (as necessary through adaptive management) flow regimes to benefit bonytail populations in the Green River and upper Colorado River subbasins (see section 4.1 for discussion of existing flow recommendations to benefit the endangered fishes and for discussion of suspected bonytail flow-habitat requirements; see Appendix A for a synopsis of bonytail life history).

Task A-1.2.—Provide flows regimes (as determined under Task A-1.1) that are necessary for all life stages of bonytail to support recovered populations in the Green River and upper Colorado River subbasins.

Management Action A-2.—Provide passage for bonytail within occupied habitat to allow adequate movement and, potentially, range expansion.

Task A-2.1.—Continue to provide fish passage over Redlands Diversion and Grand Valley Diversion to allow adequate movement of bonytail in the upper Colorado River and Gunnison River (see section 4.1 for a discussion on barriers to fish passage).

Task A-2.2.—Modify Price-Stubb Dam and Government Highline Dam to allow adequate movement of bonytail in the upper Colorado River.

Management Action A-3.—Investigate options for providing appropriate water temperatures in the Gunnison River that would allow for range expansion of bonytail.

Task A-3.1.—Investigate the feasibility of modifying releases from Aspinall Unit dams to increase water temperatures in the Gunnison River that would allow for upstream range expansion of bonytail in the Gunnison River (see section 4.1 for discussion on warm-water releases).

Task A-3.2.—Modify releases from Aspinall Unit dams to increase water temperatures in the Gunnison River, if determined feasible and necessary to achieve demographic criteria for the upper Colorado River subbasin (see section 5.3.2.1.2).

Management Action A-4.—Minimize entrainment of subadult and adult bonytail in diversion canals.

Task A-4.1.—Identify measures (e.g., screens, baffles) to minimize entrainment of subadult and adult bonytail at problematic diversion structures, such as the Green River Canal, Grand Valley Irrigation Canal, Government Highline Diversion Project, and the Redlands Canal Company Diversion (see section 4.1 for discussion on entrainment).

Task A-4.2.—Install devices and/or implement other measures (as determined under Task A-4.1) to minimize entrainment.

Management Action A-5.—Investigate habitat requirements for all life stages of bonytail (including importance of floodplain habitats) and provide those habitats necessary to support recovered populations, based on demographic criteria.

Task A-5.1.—Identify habitats that are necessary for the establishment and maintenance of bonytail populations in the Green River and upper Colorado River subbasins (see Appendix A).

Task A-5.2.—Provide habitats (as determined under Task A-5.1) for all life stages of bonytail that are necessary to support recovered populations in the Green River and upper Colorado River subbasins.

5.2.1.2 Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes

Management Action B-1.—Protect bonytail populations from overutilization for commercial, recreational, scientific, or educational purposes.

Task B-1.1.—Reevaluate and, if necessary, identify actions to ensure adequate protection from overutilization of bonytail for commercial, recreational, scientific, or educational purposes; not currently identified as an existing threat (see section 4.2).

Task B-1.2.—Implement identified actions (as determined under Task B-1.1) to ensure adequate protection of bonytail populations from overutilization for commercial, recreational, scientific, or educational purposes.

5.2.1.3 Factor C.—Adequate protection from diseases and predation

Management Action C-1.—Minimize adverse effects of diseases and parasites on bonytail populations.

Task C-1.1.—Reevaluate and, if necessary, identify actions to minimize adverse effects of diseases and parasites on bonytail populations; not currently identified as an existing threat (see sections 4.3.1 and A.12 for discussion of diseases and parasites).

Task C-1.2.—Implement identified actions (as determined under Task C-1.1) to ensure adequate protection of bonytail populations from deleterious diseases and parasites.

Management Action C-2.—Regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.

Task C-2.1.—Develop, implement, evaluate, and revise (as necessary through adaptive management) procedures for stocking nonnative fish species in the Upper Colorado River Basin to minimize negative interactions between nonnative fishes and bonytail (see sections 4.3.2 and A.8 for discussion of effects of nonnative fishes).

Task C-2.2—Finalize and implement procedures (as determined under Task C-2.1) for stocking nonnative fish species in the Upper Colorado River Basin to minimize negative interactions between nonnative fishes and bonytail.

Management Action C-3.—Control problematic nonnative fishes as needed.

Task C-3.1.—Develop control programs for small-bodied nonnative fishes (e.g., cyprinids and centrarchids) in nursery habitats in river reaches occupied by young bonytail to identify levels of control that will minimize negative interactions. (see sections 4.3.2 and A.8 for discussion of effects of nonnative fishes).

Task C-3.2.—Implement identified levels (as determined under Task C-3.1) of nonnative fish control in nursery habitats in river reaches occupied by young bonytail.

Task C-3.3.—Develop channel catfish control programs in river reaches occupied by bonytail to identify levels of control that will minimize negative interactions.

Task C-3.4.—Implement identified levels (as determined under Task C-3.3) of channel catfish control in river reaches occupied by bonytail.

Task C-3.5.—Develop northern pike control programs in reaches of the Yampa and middle Green rivers occupied by bonytail to identify levels of control that will minimize negative interactions.

Task C-3.6.—Implement identified levels (as determined under Task C-3.5) of northern pike control in reaches of the Yampa and middle Green rivers occupied by bonytail.

5.2.1.4 Factor D.—Adequate existing regulatory mechanisms

Management Action D-1.—Legally protect habitat (see definition of habitat in section 5.1.2) necessary to provide adequate habitat and sufficient range for all life stages of bonytail to support recovered populations, based on demographic criteria.

Task D-1.1.—Determine mechanisms for legal protection of adequate habitat through instream-flow rights, contracts, agreements, or other means (see section 4.4 for discussion of regulatory mechanisms).

Task D-1.2.—Implement mechanisms for legal protection of habitat (as determined under Task D-1.1) that are necessary to provide adequate habitat and sufficient range for all life stages of bonytail to support recovered populations.

Management Action D-2.—Provide for the long-term management and protection of bonytail populations and their habitats.

Task D-2.1.—Identify elements needed for the development of conservation plans that are necessary to provide for the long-term management and protection of

bonytail populations; elements of these plans may include (but are not limited to) provision of flows for maintenance of habitat conditions required for all life stages of bonytail, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats (see section 4.4 for discussion of need for conservation plans).

Task D-2.2.—Develop and implement conservation plans and execute agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties to provide reasonable assurances that conditions needed for recovered bonytail populations will be maintained.

5.2.1.5 Factor E.—Other natural or manmade factors for which protection has been provided

Management Action E-1.—Minimize the threat of hybridization among *Gila* species in river reaches occupied by bonytail.

Task E-1.1.—Evaluate and, if necessary, identify actions to minimize the risk of hybridization to bonytail; not currently identified as an existing threat (see sections 4.5.1 and A.3 for discussion of hybridization).

Task E-1.2.—Implement identified action (as determined under task E-1.1) to ensure adequate protection of bonytail populations from hybridization.

Management Action E-2.—Minimize the risk of hazardous-materials spills in critical habitat.

Task E-2.1.—Review and recommend modifications to State and Federal hazardous-materials spills emergency-response plans to ensure adequate protection for bonytail populations from hazardous-materials spills, including prevention and quick response to hazardous-materials spills (see section 4.5.2 for discussion of hazardous-materials spills).

Task E-2.2.—Implement State and Federal emergency-response plans that contain the necessary preventive measures (as determined under Task E-2.1) for hazardous-materials spills.

Task E-2.3.—Identify locations of all petroleum-product pipelines within the 100-year floodplain of critical habitat and assess the need for emergency shut-off valves to minimize the potential for spills.

Task E-2.4.—Install emergency shut-off valves (as determined under Task E-2.3) on petroleum-product pipelines within the 100-year floodplain of critical habitat.

Management Action E-3.—Minimize threats from degraded water quality on bonytail.

Task E-3.1.— Identify actions to remediate groundwater contamination from the Atlas Mills tailings pile located near Moab, Utah, in order to restore water quality of the Colorado River in the vicinity of the pile in accordance with the State of Utah and Environmental Protection Agency (EPA) water-quality standards for fish and wildlife (see section 4.5.2 for discussion of groundwater contamination).

Task E-3.2.— Implement actions (as determined under Task E-3.1) to remediate groundwater contamination from the Atlas Mills tailings pile.

5.2.2 Lower basin recovery unit

5.2.2.1 Factor A.—Adequate habitat and range for recovered populations provided

Management Action A-1.—Provide flows necessary for all life stages of bonytail to support recovered populations, based on demographic criteria.

Task A-1.1.—Identify, implement, evaluate, and revise (as necessary through adaptive management) flow regimes that are necessary for the establishment and maintenance of bonytail populations in the mainstem and/or tributaries.

Task A-1.2.—Provide flow regimes (as determined under Task A-1.1) that are necessary for all life stages of bonytail to support recovered populations in the mainstem and/or tributaries.

Management Action A-2.—Minimize entrainment of subadult and adult bonytail in diversion/out-take structures.

Task A-2.1.—Identify measures (e.g., screens, baffles) to minimize entrainment of subadult and adult bonytail at problematic diversion and/or out-take structures (see section 4.1 for discussion on entrainment).

Task A-2.2.—Install devices and/or implement other measures (as determined under Task A-2.1) to minimize entrainment.

Management Action A-3.—Investigate habitat requirements for all life stages of bonytail (including importance of floodplain habitats) and provide those habitats necessary to support recovered populations, based on demographic criteria.

Task A-3.1.—Identify habitats that are necessary for the establishment and maintenance of bonytail populations in the mainstem and/or tributaries (see Appendix A).

Task A-3.2.—Provide habitats (as determined under Task A-3.1) for all life stages of bonytail that are necessary to support recovered populations in the mainstem and/or tributaries.

5.2.2.2 Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes

Management Action B-1.—Protect bonytail populations from overutilization for commercial, recreational, scientific, or educational purposes.

Task B-1.1.—Reevaluate and, if necessary, identify actions to ensure adequate protection from overutilization of bonytail for commercial, recreational, scientific, or educational purposes; not currently identified as an existing threat (see section 4.2).

Task B-1.2.—Implement identified actions (as determined under Task B-1.1) to ensure adequate protection of bonytail from overutilization for commercial, recreational, scientific, or educational purposes.

5.2.2.3 Factor C.—Adequate protection from diseases and predation

Management Action C-1.—Minimize adverse effects of diseases and parasites on bonytail populations.

Task C-1.1.—Reevaluate and, if necessary, identify actions to minimize adverse effects of diseases and parasites on bonytail populations; not currently identified as an existing threat (see sections 4.3.1 and A.12 for discussion of diseases and parasites).

Task C-1.2.—Implement identified actions (as determined under Task C-1.1) to ensure adequate protection of bonytail populations from deleterious diseases and parasites.

Management Action C-2.—Regulate nonnative fish releases and escapement into the mainstem, floodplain, and tributaries.

Task C-2.1.—Develop, implement, evaluate, and revise (as necessary through adaptive management) procedures for stocking and to minimize escapement of nonnative fish species into the mainstem, floodplain, and tributaries to minimize negative interactions between nonnative fishes and bonytail (see sections 4.3.2 and A.8 for discussion of effects of nonnative fishes).

Task C-2.2.—Finalize and implement procedures (as determined under Task C-2.1) for stocking and to minimize escapement of nonnative fish species

into the mainstem, floodplain, and tributaries to minimize negative interaction between nonnative fishes and bonytail.

Management Action C-3.—Control problematic nonnative fishes as needed.

Task C-3.1.—Develop control programs for problematic nonnative fishes in the mainstem, floodplain, and tributaries to identify levels of control that will minimize negative interactions between nonnative fishes and bonytail.

Task C-3.2.—Implement identified levels (as determined under Task C-3.1) of nonnative fish control in the mainstem, floodplain, and tributaries.

5.2.2.4 Factor D.—Adequate existing regulatory mechanisms

Management Action D-1.—Legally protect habitat (see definition of habitat in section 5.1.2) necessary to provide adequate habitat and sufficient range for all life stages of Colorado pikeminnow to support recovered populations, based on demographic criteria.

Task D-1.1.—Determine mechanisms for legal protection of habitat through instream-flow rights, contracts, agreements, or other means (see section 4.4 for discussion of regulatory mechanisms).

Task D-1.2.—Implement mechanisms for legal protection of habitat (as determined under Task D-1.1) that are necessary to provide adequate habitat and sufficient range for all life stages of bonytail to support recovered populations.

Management Action D-2.—Provide for the long-term management and protection of bonytail populations and their habitats.

Task D-2.1.—Identify elements needed for the development of conservation plans that are necessary to provide for the long-term management and protection of bonytail populations; elements of these plans may include (but are not limited to) maintenance of genetic diversity in Lakes Mohave or Havasu, provision of flows for maintenance of adequate habitat conditions for all life stages of bonytail, regulation and/or control of nonnative fishes, and monitoring of populations and habitats (see section 4.4 for discussion of need for conservation plans).

Task D-2.2.—Develop and implement conservation plans and execute agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties to provide reasonable assurances that conditions needed for recovered bonytail populations will be maintained.

5.2.2.5 Factor E.—Other natural or manmade factors for which protection has been provided

Management Action E-1.—Minimize the threat of hybridization among *Gila* species in river reaches occupied by bonytail.

Task E-1.—Evaluate and, if necessary, identify actions to minimize the risk of hybridization to bonytail; not currently identified as an existing threat (see sections 4.5.1 and A.3 for discussion of hybridization).

Task E-2.—Implement identified action (as determined under task E-1) to ensure adequate protection of bonytail populations from hybridization.

5.3 Objective, Measurable Recovery Criteria

5.3.1 Downlist criteria

5.3.1.1 Demographic criteria for downlisting (population demographics in both recovery units must be met in order to achieve downlisting)

5.3.1.1.1 Upper basin recovery unit

Green River Subbasin

1. A self-sustaining population is maintained over a 5-year period, starting with the first point estimate acceptable to the Service, such that:

    a. the trend in adult (age 4+; ≥250 mm TL) point estimates does not decline significantly, and

    b. mean estimated recruitment of age-3 (150–249 mm TL) naturally produced fish equals or exceeds mean annual adult mortality, and

    c. each point estimate exceeds 4,400 adults (Note: 4,400 is the estimated MVP number; see section 3.3.2).

Upper Colorado River Subbasin

2. A self-sustaining population is maintained over a 5-year period, starting with the first point estimate acceptable to the Service, such that:

    a. the trend in adult (age 4+; ≥250 mm TL) point estimates does not decline significantly, and

b. mean estimated recruitment of age-3 (150–249 mm TL) naturally produced fish equals or exceeds mean annual adult mortality, and

c. each point estimate exceeds 4,400 adults (MVP).

5.3.1.1.2 Lower basin recovery unit

1. Genetic variability of bonytail identified and a genetic refuge (e.g., in Lake Mohave, Lake Havasu, or other suitable locations) is maintained over a 5-year period.

2. Two self-sustaining populations (e.g., mainstem and/or tributaries) are maintained over a 5-year period, starting with the first point estimate acceptable to the Service, such that for each population:

   a. the trend in adult (age 4+; ≥250 mm TL) point estimates does not decline significantly, and

   b. mean estimated recruitment of age-3 (150–249 mm TL) naturally produced fish equals or exceeds mean annual adult mortality, and

   c. each point estimate exceeds 4,400 adults (MVP).

5.3.1.2 Recovery factor criteria for downlisting (recovery factor criteria in both recovery units must be met in order to achieve downlisting)

5.3.1.2.1 Upper basin recovery unit

Factor A.—Adequate habitat and range for recovered populations provided.

1. Flow regimes to benefit bonytail populations in the Green River and upper Colorado River subbasins identified, implemented, evaluated, and revised (Task A-1.1), such that:

   a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section 5.3.1.1.1.

   b. Adequate nursery habitat is available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section 5.3.1.1.1.

   c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) are available to maintain self-sustaining populations,

as reflected by downlisting demographic criteria in section 5.3.1.1.1.

2. Passage over Redlands Diversion and Grand Valley Diversion continued to allow adequate movement of bonytail in the upper Colorado River and Gunnison River (Task A-2.1).

3. Modification of Price-Stubb Dam and Government Highline Dam initiated to allow adequate movement of bonytail in the upper Colorado River and Gunnison River (Task A-2.2).

4. Investigations initiated on the feasibility of modifying releases from Aspinall Unit dams to increase water temperatures in the Gunnison River that would allow for upstream range expansion of bonytail (Task A-3.1).

5. Measures identified to minimize entrainment of subadult and adult bonytail at problematic diversion structures (Task A-4.1).

6. Habitats identified that are necessary for the establishment and maintenance of bonytail populations in the Green River and upper Colorado River subbasins (Task A-5.1).

Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

7. Overutilization of bonytail for commercial, recreational, scientific, or educational purposes reevaluated and, if necessary, actions identified to ensure adequate protection (Task B-1.1).

Factor C.—Adequate protection from diseases and predation.

8. Effects of diseases and parasites on bonytail populations reevaluated and, if necessary, actions identified to ensure adequate protection (Task C-1.1).

9. Procedures developed, implemented, evaluated, and revised for stocking nonnative fish species in the Upper Colorado River Basin to minimize negative interactions between nonnative fishes and bonytail (Task C-2.1).

10. Control programs for small-bodied nonnative fishes in nursery habitats in river reaches occupied by young bonytail developed and implemented to identify levels of control that will minimize predation (Task C-3.1).

11. Channel catfish control programs in river reaches occupied by bonytail developed and implemented to identify levels of control that will minimize predation (Task C-3.3)

12. Northern pike control programs in reaches of the Yampa and middle Green rivers occupied by bonytail developed and implemented to identify levels of control that will minimize negative interactions (Task C-3.5).

Factor D.—Adequate existing regulatory mechanisms.

13. Mechanisms determined for legal protection of adequate habitat (Task D-1.1).

14. Elements of conservation plans identified that are necessary to provide for the long-term management and protection of bonytail populations (Task D-2.1).

Factor E.—Other natural or manmade factors for which protection has been provided.

15. Risk of hybridization to bonytail populations evaluated and, if necessary, actions identified to minimize the risk (Task E-1.1).

16. State and Federal hazardous-materials spills emergency-response plans reviewed and modified to ensure adequate protection for bonytail populations from hazardous-materials spills (Task E-2.1).

17. Locations of all petroleum-product pipelines within the 100-year floodplain of critical habitat identified and the need for emergency shut-off valves assessed (Task E-2.3).

18. Actions identified for remediation of groundwater contamination at the Atlas Mills tailings pile located near Moab, Utah (Task E-3.1).

5.3.1.2.2 Lower basin recovery unit

Factor A.—Adequate habitat and range for recovered populations provided.

1. Flow regimes that are necessary for the establishment and maintenance of bonytail populations in the mainstem and/or tributaries identified, implemented, evaluated, and revised (Task A-1.1), such that:

    a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section 5.3.1.1.2.

b. Adequate nursery habitat is available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section 5.3.1.1.2.

c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) are available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section 5.3.1.1.2.

2. Measures identified to minimize entrainment of subadult and adult bonytail at problematic diversion and/or out-take structures (Task A-2.1).

3. Habitats identified that are necessary for the establishment and maintenance of bonytail populations in the mainstem and/or tributaries (Task A-3.1).

Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

4. Overutilization of bonytail for commercial, recreational, scientific or educational purposes reevaluated and, if necessary, actions identified to ensure adequate protection (Task B-1.1).

Factor C.—Adequate protection from diseases and predation.

5. Effects of diseases and parasites on bonytail populations reevaluated and, if necessary, actions identified to ensure adequate protection (Task C-1.1).

6. Procedures developed, implemented, evaluated, and revised for stocking and to minimize escapement of nonnative fish species into the mainstem, floodplain, and tributaries to minimize negative interactions between nonnative fishes and Colorado pikeminnow (Task C-2.1).

7. Control programs for problematic nonnative fishes in the mainstem, floodplain, and tributaries developed and implemented to identify levels of control that will minimize negative interactions between nonnative fishes and bonytail (Task C-3.1).

Factor D.—Adequate existing regulatory mechanisms.

8. Mechanisms determined for legal protection of adequate habitat (Task D-1.1).

9. Elements of conservation plans identified that are necessary to provide for the long-term management and protection of bonytail populations (Task D-2.1).

Factor E.—Other natural or manmade factors for which protection has been provided.

10. Risk of hybridization to bonytail populations evaluated and, if necessary, actions identified to minimize the risk (Task E-1.1).

5.3.2 Delist criteria

5.3.2.1 Demographic criteria for delisting (population demographics in both recovery units must be met in order to achieve delisting)

5.3.2.1.1 Upper basin recovery unit

Green River Subbasin

1. A self-sustaining population is maintained over a 3-year period beyond downlisting, starting with the first point estimate acceptable to the Service, such that:

   a. the trend in adult (age 4+; ≥250 mm TL) point estimates does not decline significantly, and

   b. mean estimated recruitment of age-3 (150–249 mm TL) naturally produced fish equals or exceeds mean annual adult mortality, and

   c. each point estimate exceeds 4,400 adults (MVP).

Upper Colorado River Subbasin

2. A self-sustaining population is maintained over a 3-year period beyond downlisting, starting with the first point estimate acceptable to the Service, such that:

   a. the trend in adult (age 4+; ≥250 mm TL) point estimates does not decline significantly, and

   b. mean estimated recruitment of age-3 (150–249 mm TL) naturally produced fish equals or exceeds mean annual adult mortality, and

   c. each point estimate exceeds 4,400 adults (MVP).

5.3.2.1.2 Lower basin recovery unit

1. A genetic refuge (e.g., in Lake Mohave, Lake Havasu, or other suitable locations) is maintained over a 3-year period beyond downlisting.

2. Two self-sustaining populations (e.g., mainstem and/or tributaries) are maintained over a 3-year period beyond downlisting, starting with the first point estimate acceptable to the Service, such that for each population:

   a. the trend in adult (age 4+; ≥250 mm TL) point estimates does not decline significantly, and

   b. mean estimated recruitment of age-3 (150–249 mm TL) naturally produced fish equals or exceeds mean annual adult mortality, and

   c. each point estimate exceeds 4,400 adults (MVP).

5.3.2.2 Recovery factor criteria for delisting (recovery factor criteria in both recovery units must be met in order to achieve delisting)

5.3.2.2.1 Upper basin recovery unit

Factor A.—Adequate habitat and range for recovered populations provided.

1. Flow regimes provided that are necessary for all life stages of bonytail to support recovered populations in the mainstem and/or tributaries (Task A-1.2), such that:

   a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.1.

   b. Adequate nursery habitat are available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.1.

   c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) are available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.1.

2. Passage over Redlands Diversion and Grand Valley Diversion continued to allow adequate movement of bonytail in the upper Colorado River and Gunnison River (Task A-2.1).

3. Modification of Price-Stubb Dam and Government Highline Dam completed to allow adequate movement of bonytail in the upper Colorado River (Task A-2.2).

4. Releases from Aspinall Unit dams to increase water temperatures in the Gunnison River are modified, if determined feasible and necessary to achieve demographic criteria for the upper Colorado River subbasin (see section 5.3.2.1.1), to allow for upstream range expansion of bonytail (Task A-3.2).

5. Devices installed and/or measures implemented at problematic diversion structures to minimize entrainment of subadult and adult bonytail (Task A-4.2).

6. Habitats provided for all life stages of bonytail that are necessary to support recovered populations in the Green River and upper Colorado River subbasins (Task A-5.2).

Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

7. Adequate protection of bonytail populations from overutilization for commercial, recreational, scientific, or educational purposes attained (Task B-1.2).

Factor C.—Adequate protection from diseases and predation.

8. Adequate protection of bonytail populations from deleterious diseases and parasites attained (Task C-1.2).

9. Procedures finalized and implemented for stocking nonnative fish species in the Upper Colorado River Basin to minimize negative interactions between nonnative fishes and bonytail (Task C-2.2).

10. Identified levels of small-bodied nonnative fish control to minimize negative interactions attained in nursery habitats in river reaches occupied by young bonytail (Task C-3.2).

11. Identified levels of channel catfish control to minimize negative interactions attained in river reaches occupied by bonytail (Task C-3.4).

12. Identified levels of northern pike control to minimize negative interactions attained in reaches of the Yampa and middle Green rivers occupied by bonytail (Task C-3.6).

Factor D.—Adequate existing regulatory mechanisms.

13. Habitat necessary to provide adequate habitat and sufficient range for all life stages of bonytail to support recovered populations in the Green River and upper Colorado River subbasins is legally protected in perpetuity (Task D-1.2).

14. Conservation plans developed and implemented, and agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties executed to provide reasonable assurances that conditions needed for recovered bonytail populations will be maintained (Task D-2.2).

Factor E.—Other natural or manmade factors for which protection has been provided.

15. Adequate protection of bonytail populations from hybridization attained (Task E-1.2).

16. State and Federal emergency-response plans implemented that contain the necessary preventive measures for hazardous-materials spills (Task E-2.2).

17. Emergency shut-off valves installed on all problematic petroleum-product pipelines within the 100-year floodplain of critical habitat (Task E-2.4).

18. Groundwater contamination remediated at the Atlas Mills tailings pile located near Moab, Utah, and water quality of the Colorado River in the vicinity of the pile restored in compliance with the State of Utah and EPA water-quality standards for fish and wildlife (Task E-3.2).

5.3.2.2.2 Lower basin recovery unit

Factor A.—Adequate habitat and range for recovered populations provided.

1. Flow regimes provided that are necessary for all life stages of Colorado pikeminnow to support recovered populations in the mainstem and/or tributaries (Task A-1.2), such that:

    a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.2.

b. Adequate nursery habitat are available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.2.

c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) are available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.2.

2. Devices installed and/or measures implemented at problematic diversion and/or out-take structures to minimize entrainment of subadult and adult bonytail (Task A-2.2).

3. Habitats provided for all life stages of bonytail that are necessary to support recovered populations in the mainstem and/or tributaries (Task A-3.2).

Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

4. Adequate protection of bonytail from overutilization for commercial, recreational, scientific, or educational purposes attained (Task B-1.2).

Factor C.—Adequate protection from diseases and predation.

5. Adequate protection of bonytail populations from deleterious diseases and parasites attained (Task C-1.2).

6. Procedures finalized and implemented for stocking nonnative fish species in the mainstem, floodplain, and tributaries to minimize negative interactions between nonnative fishes and bonytail (Task C-2.2).

7. Identified levels of nonnative fish control to minimize negative interactions between nonnative fishes and bonytail attained in the mainstem, floodplain, and tributaries (Task C-3.2).

Factor D.—Adequate existing regulatory mechanisms.

8. Habitat necessary to provide adequate habitat and sufficient range for all life stages of bonytail to support recovered populations is legally protected in perpetuity (Task D-1.2).

9. Conservation plans developed and implemented, and agreements among State agencies, Federal agencies, American Indian tribes, and other

interested parties executed to provide reasonable assurances that conditions needed for recovered bonytail populations will be maintained (Task D-2.2).

Factor E.—Other natural or manmade factors which protection has been provided.

10. Adequate protection of bonytail populations from hybridization attained (Task E-1.2).

5.4 Estimated Time To Achieve Recovery of the Bonytail

Wild bonytail are rare. Therefore, use of hatchery fish (progeny of cultured brood stock) will be necessary to establish new populations. Time to achieve recovery of the bonytail cannot be accurately estimated until self-sustaining populations are established through augmentation and habitat enhancement. The rate at which populations become established will depend on survival of stocked fish in the wild, integration of stocked fish with rare wild stocks, reproductive success, and recruitment. Response of the species to ongoing management activities will need to be assessed through monitoring, and strategies for recovery and estimates of time to achieve recovery will be reevaluated periodically. Based on current information and associated uncertainties, it is estimated that self-sustaining populations of bonytail will become established over the next 15 years. During this time, population dynamics and responses to management actions will be evaluated.

For the bonytail population to be self-sustaining, adults must reproduce and recruitment of young fish into the adult population must occur at a rate to maintain the population at a minimum of 4,400 adults. When this occurs, the definition of a "self-sustaining" population is met, and the "clock" starts on the downlisting and delisting process.

Once self-sustaining populations have been established, estimated time to achieve recovery of the bonytail is 5 years for downlisting and an additional 3 years for delisting. Self-sustaining populations and first reliable point estimates for all populations are expected by 2015. If those estimates are acceptable to the Service and all recovery criteria are met, downlisting could be proposed in 2020 and delisting could be proposed in 2023 (Figure 2).

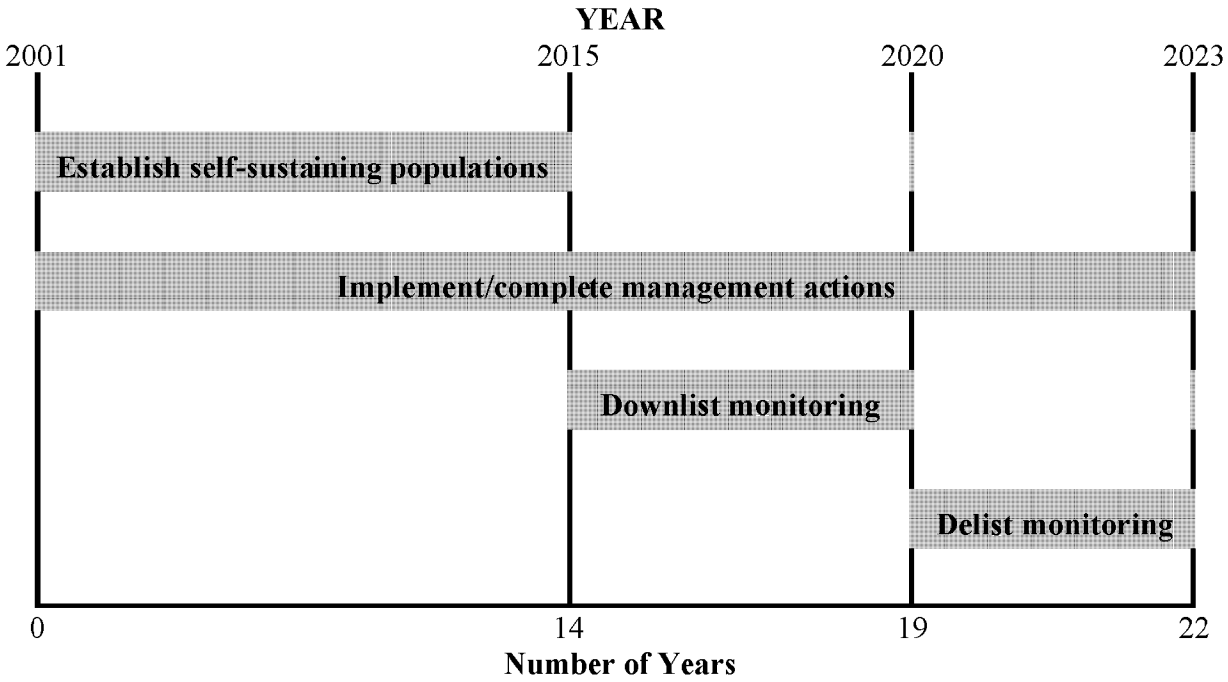

Figure 2. Estimated time to achieve recovery of the bonytail.

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APPENDIX A.

LIFE HISTORY OF THE BONYTAIL

Following is a synopsis of bonytail life history. This assimilation of information represents an overview of the best scientific information available for the species at this time. Additional and more detailed information can be found in literature cited in this document and in reports and publications referenced in those citations.

A.1 Species Description

The bonytail was originally collected and described from the Zuni River, New Mexico, of the Lower Colorado River Basin in 1853 by Baird and Girard of the Sitgreaves Expedition (Sitgreaves 1853; Girard 1856). It is commonly referred to as "bonytail chub", a name that has also been applied to other chubs of the Colorado River basin, including roundtail chub (*Gila robusta*) and humpback chub (*G. cypha*). The bonytail is a streamlined fish with a small head, slender body, and pencil-thin caudal peduncle. The head is flattened, the mouth is slightly overhung by the snout, and there is a small, smooth fleshy hump behind the head of adults; the hump is smaller than that of humpback chub. This species attains a maximum size of about 550 mm total length (TL; Bozek et al. 1994) and 1.1 kg in weight (Vanicek 1967). The color is dark gray above fading to a white belly, with yellow pigment at the base of the paired fins (pelvic and pectoral). Like the humpback chub, adult bonytail in spawning condition exhibit small pimple-like tubercles on the head and fins. There are usually 10 dorsal fin rays and 10 anal fin rays (Holden 1968). Caudal peduncle length divided by head length is 1.0 or more and head length divided by caudal peduncle depth is usually 5.0 or more (Minckley 1973). The body is mostly scaled with 75–88 along the lateral line. The scales are not as deeply embedded as in humpback chub, and they are present in small numbers on the nape, belly, and breast. Pharyngeal teeth formula is 2,5-4,2.

Bonytail are sometimes confused with the two sympatric species of Colorado River chubs—roundtail chub and humpback chub. This confusion occurs primarily with young fish that resemble the slender green and silvery young of the other species. The variability in dorsal and anal ray counts also precludes confident field identification where the three species coexist (Holden 1968). With adults, problems in identification may occur with species variants resulting from morphologic plasticity among the *Gila* complex (Douglas et al. 1998) and introgressive hybridization (Dowling and DeMarais 1993).

A.2 Distribution and Abundance

Bonytail were once widespread in the large rivers of the Colorado River Basin (Cope and Yarrow 1875; Jordan 1891; Jordan and Evermann 1896; Gilbert and Scofield 1898; Kirsch 1889; Chamberlain 1904). The species experienced a dramatic, but poorly documented, decline starting in about 1950, following construction of mainstem dams, introduction of nonnative fishes, poor land-use practices, and degraded water quality (Miller 1961; Ono et al. 1983).

Population trajectory over the past century and reasons for decline are unclear because lack of basin-wide fishery investigations precluded accurate distribution and abundance records. Also, interchangeable use of the name "bonytail" with two congeneric, sympatric species—humpback chub and roundtail chub—led to confusion in historic collections (Quartarone 1993). A photograph in Quartarone (1993) shows eight bonytail-like fish taken from the Colorado River near Moab, Utah, where none were otherwise reported.

Early collections of bonytail in the lower basin include 16 specimens from Grand Canyon (Miller 1944). The last large concentration of bonytail was seen in 1954 when about 500 adults were observed spawning over a gravel shelf in Lake Mohave, Arizona-Nevada (Jonez and Sumner 1954). Of the 34 adult bonytail captured in Lake Mohave between 1976 and 1988 (Minckley et al. 1989), 11 were used as the original brood stock (Hamman 1981, 1982, 1985). An additional 16 fish were collected from Lake Mohave in 1988–1989 (U.S. Fish and Wildlife Service 1990a).

The first record of bonytail from the upper basin was *"One specimen taken in the Gunnison at Delta; five in the Green River..."* in 1889 (Jordan 1891). There are also records of two fish collected in 1889 from an unknown location of the Green River (Bookstein et al. 1985). Ellis (1914) synonymized bonytail with roundtail chub *"...since intermediate forms and those agreeing with the descriptions of both species were taken from the same station in the Grand* [Colorado] *River at Grand Junction"*. This difficulty in segregating the species of Colorado River chubs persists today. Gaufin et al. (1960) and Smith (1960) reported bonytail from Hideout Canyon, Utah (upper Green River), before it was inundated by Flaming Gorge Reservoir, but the numbers and sizes are unknown because they were grouped with humpback chub and roundtail chub. Two bonytail *"...were observed washed up on the sandbars and banks near the ranger station..."* on the Green River in Dinosaur National Monument on September 9, 1962, following rotenone treatment (Banks 1964). "Bonytail chub" together with roundtail and humpback chub, were reported from the mouth of the Black's Fork River downstream through Flaming Gorge (Bosley 1960). This complex composed 7.3% of all fish taken in the Green River from Green River, Wyoming, to the Utah-Colorado state line (McDonald and Dotson 1960). Individuals were collected from the base of Flaming Gorge Dam in 1962 and from Little Hole (10 km below the dam) and are housed at the University of Michigan (personal communication, R. Miller, University of Michigan; Bookstein et al. 1985). Unknown numbers of bonytail were poisoned by the rotenone treatment of the Green River in Flaming Gorge in 1962 (Holden 1991).

Following closure of the Flaming Gorge Dam in 1963, bonytail were extirpated from about 105 km of the Green River between the dam and the Yampa River, primarily because of previous rotenone poisoning and cold-water releases from dam operations. Further downstream (below the Yampa River), bonytail outnumbered roundtails for the 1959, 1960, and 1961 year classes in the Green River in Dinosaur National Monument (Vanicek and Kramer 1969). But by the period 1967–1973, Holden and Stalnaker (1975) reported a scarcity of the species in the same area. Later, Joseph et al. (1977) reported catching two bonytail from the Green River below Jensen. Bonytail were seen in Lake Powell on the Colorado River soon after closure in 1962 (personal communication, K. Miller, Utah Division of Wildlife Resources) but are now rarely found in the Green River and Colorado River subbasins.

The last significant numbers of bonytail captured in the upper basin were in the Green River below the confluence of the Yampa River shortly after the closure of Flaming Gorge Dam; Vanicek and Kramer (1969) collected 67 bonytail > 200 mm TL during 1964–1966 in Dinosaur National Monument, Colorado. Holden and Stalnaker (1975) reported 36 bonytail during 1967–1973 from the lower Yampa River in Colorado, and the Green River between the confluence of the Yampa River and the confluence of the Colorado River, including Desolation/Gray Canyons, Utah. One bonytail (~330 mm TL) was caught by an angler at Antelope Canyon, near Wahweap Bay, Utah, on Lake Powell on September 4, 1977 (Gustaveson et al. 1985) and preserved by Utah Division of Wildlife Resources (UDWR). One adult bonytail was also captured in the lower Yampa River in 1979 (Holden and Crist 1981), and one adult was captured and released at Coal Creek Rapid in the Green River in Gray Canyon, Utah, in 1981 (Tyus et al. 1982). Kaeding et al. (1986) captured and released one adult bonytail (458 mm TL) in the Colorado River at Black Rocks, Colorado, on July 17, 1984. A fisherman brought a live bonytail (~380 mm TL) angled from Lake Powell near Wahweap Bay, Utah, to UDWR in 1985 (personal communication, R. Radant, Utah Division of Wildlife Resources). The fish died later in captivity and was identified by Mark Rosenfeld of the University of Utah (personal communication) as a bonytail; a taxidermy mount was made of this specimen and is on display at the University of Utah Natural History Museum. Two adult bonytail were captured, photographed, and released in Desolation/Gray Canyons in 1985 (Moretti et al. 1989). Also, four adult bonytail were reported from Cataract Canyon in 1985–1988 (Valdez 1990; Valdez and Williams 1993).

A.3 Hybridization

Intraspecific and interspecific morphological variation is extensive where humpback chub, roundtail chub, and bonytail occur sympatrically. This apparent introgressive hybridization has resulted in high phenotypic plasticity with morphologic intergrades present in all sympatric populations of Colorado River *Gila* (Holden and Stalnaker 1970; Smith et al. 1979; Valdez and Clemmer 1982; McElroy and Douglas 1995; Douglas et al. 1989, 1998; Kaeding et al. 1990). These intergrades suggest, to some, extensive hybridization with possible concomitant loss of genetic diversity and evolutionary adaptive traits (Valdez and Clemmer 1982; Rosenfeld and Wilkinson 1989). Dowling and DeMarais (1993) hypothesized that introgressive hybridization is part of the common evolutionary history of the Colorado River *Gila*, resulting in high phenotypic plasticity and adaptability to the rigorous physical habitats present in the Colorado River Basin. Evidence of intergrades was reported prior to extensive human alterations to the basin (Miller 1946).

The bonytail is part of a morphologically diverse group of western cyprinids that includes several congeneric species. This *Gila* complex consists of six forms that inhabit the Colorado River Basin, including the humpback chub, bonytail, roundtail chub, Virgin River chub *(G. robusta seminuda)*, Pahranagat roundtail chub *(G. r. jordani)*, and Gila chub *(G. intermedia)*. The humpback chub, bonytail, and roundtail chub are mainstem sympatric species with substantial evidence of introgressive hybridization (Dowling and DeMarais 1993), whereas the Virgin River chub, Pahranagat roundtail chub, and Gila chub are isolates and primarily lower Colorado River tributary inhabitants, although historic hybridization with other forms of *Gila* is evident.

Humpback chub and bonytail appear to be specialized derivatives of the roundtail chub complex, and may have arisen in response to special conditions in large erosive habitats (Smith et al. 1979; Minckley et al. 1989); a hypothesis that is supported by recent allozyme and mitochondrial DNA analysis (Dowling and DeMarais 1993).

Because only two of the three congeneric and sympatric species of the *Gila* complex are federally listed as endangered (i.e., humpback chub and bonytail), fish managers are compelled to distinguish these from the non-listed roundtail chub. Morphologic variation in these species has led to confusion in field identification, especially for young fish (Douglas et al. 1989, 1998). This confusion has precluded accurate assessment of life-history characteristics attributable to one species and definitive estimates of abundance (Chart and Lentsch 1999, 2000).

The effect of hybridization on the *Gila* species is unclear, and the factors that lead to increased hybridization of bonytail are unknown because there are no reproducing populations in the wild. Current levels of hybridization are not considered singly significant in the decline of the bonytail. The only population where hybridization of bonytail is suspected, based on morphological and morphometric examination of a limited number of specimens, is Cataract Canyon (Valdez 1990; McElroy and Douglas 1995). The incidence and potential effect of hybridization on bonytail will need to be evaluated as fish are released into the wild, and populations become established in proximity and/or sympatry with the other *Gila* species.

A.4 Habitat

Little is known about the specific habitat requirements of bonytail because the species was extirpated from most of its historic range prior to extensive fishery surveys. The bonytail is considered adapted to mainstem rivers where it has been observed in pools and eddies. Similar to other closely related *Gila* spp., bonytail in rivers probably spawn in spring over rocky substrates; spawning in reservoirs has been observed over rocky shoals and shorelines. It is hypothesized, based on available distribution data, that flooded bottomland habitats are important growth and conditioning areas for bonytail, particularly as nursery habitats for young. Flow recommendations have been developed that specifically consider flow-habitat relationships within historic habitat of bonytail in the upper basin, and were designed to enhance habitat complexity and to restore and maintain ecological processes (see section 4.1). The following is a description of observed habitat uses in various parts of the Colorado River Basin.

It has been suggested that the large fins and streamlined body of the bonytail is an adaptation to torrential flows (Miller 1946; Beckman 1963). Of five specimens captured recently in the upper basin, four were captured in deep, swift, rocky canyon regions (i.e., Yampa Canyon, Black Rocks, Cataract Canyon, and Coal Creek Rapid), but the fifth was taken in a reservoir (Lake Powell). Also, all fish taken from the lower basin since 1974 were caught in reservoirs. Specimens encountered in reservoirs are believed to be inhabiting their former habitats now inundated by these impoundments. Vanicek (1967) who handled numerous bonytail detected no difference in habitat selection from roundtail chub. These fish were generally found in pools and eddies in the absence of, although occasionally adjacent to, strong current and at varying depths generally over silt and silt-boulder substrates. No quantitative data are available for the habitat

of this species. It is hypothesized, based on historic and present distributions, that flooded bottomlands provide important nursery, growth, and conditioning habitats for bonytail. Adult bonytail captured in Cataract Canyon and Desolation/Gray Canyons were sympatric with humpback chub in shoreline eddies among emergent boulders and cobble, and adjacent to swift current (Valdez 1990).

A.5 Movement

Movement of 20 hatchery-reared bonytail released in Lake Mohave in 1996 and 1997 was monitored with the use of short-term telemetry (Marsh and Mueller 1999). Sonic tags were surgically implanted in the fish, and movement was monitored for 62 to 119 days. Cumulative distance traveled averaged 28.9 km and ranged from 19.9 to 33.0 km. Most fish were located in deep water adjacent to steep shorelines during daytime, and the fish moved to shallow shorelines at night. This movement information and capture observations corroborate that bonytail use shallow, gravel points along the lake shore.

A.6 Reproduction

Natural reproduction of bonytail was last documented in the Green River in Dinosaur National Monument for the year classes 1959, 1960, and 1961 (Vanicek and Kramer 1969). Ripe spawning fish were captured from mid-June to early July at a water temperature of 18°C. Spawning by bonytail and roundtail chub was believed to be spatially separated because ripe adults of both species were never captured in the same net.

Jonez and Sumner (1954) described the spawning act of bonytail in Lake Mohave. Approximately 500 bonytail were observed spawning over a gravel shelf up to 30 feet in depth. Each female had three to five male escorts, and adhesive eggs were broadcast over the gravel shelf. A gill net in the spawning area captured 42 males and 21 females ranging from about 280 to 350 mm (fork length); a 300-mm female contained an estimated 10,000 eggs. Vanicek (1967) reported wild bonytail of age groups V–VII in spawning condition. Hamman (1985) found that hatchery-reared bonytail began to sexually mature at age 2.

In a hatchery, adult bonytails (487–564 mm TL) yielded an average of 25,090 eggs per female (Hamman 1982). Incubation was shortest (99–174 h) and egg survival, hatching success, and fry survival were highest at 20–21°C, compared to 16–17°C and 12–13°C. Hamman (1982) found that eggs incubated at 16–17°C had only 55% survival, and those incubated at 12–13°C had only 4% survival. Survival at 20–21°C was 90%. Newly hatched fry averaged 6.8 mm TL. Over 83,500 hatchery-reared bonytail had been released by 1985 into the wild, all into Lake Mohave in the lower basin (Valdez 1985).

A.7 Survival

No estimates of survival are available for wild bonytail.

A.8 Predation

Nonnative fishes dominate the ichthyofauna of Colorado River Basin rivers, and certain species have been implicated as contributing to reductions in the distribution and abundance of native fishes (Carlson and Muth 1989). At least 67 species of nonnative fishes have been introduced into the Colorado River Basin during the last 100 years (Tyus et al. 1982; Carlson and Muth 1989; Minckley and Deacon 1991; Maddux et al. 1993; Tyus and Saunders 1996; Pacey and Marsh 1998). Tyus et al. (1982) reported that 42 nonnative fish species have become established in the upper basin, and Minckley (1985) reported that 37 nonnative fish species have become established in the lower basin. Many of these species were intentionally introduced as game or forage fishes, whereas others were unintentionally introduced with game species or passively as bait fish. Potential negative interactions (i.e., predation and competition) between nonnative and native fishes have been identified (e.g., Tyus and Beard 1990; Minckley 1991; Hawkins and Nesler 1991; Ruppert et al. 1993; Lentsch et al. 1996; Tyus and Saunders 1996; Pacey and Marsh 1998).

The threat of predation by nonnative fishes on the closely related humpback chub has been recognized in three populations. In Grand Canyon, brown trout (*Salmo trutta*), channel catfish (*Ictalurus punctatus*), black bullhead (*Ameiurus melas*), and rainbow trout (*Oncorhynchus mykiss*) have been identified as principal predators of juvenile humpback chub, with consumption estimates that suggest loss of complete year classes to predation (Marsh and Douglas 1997; Valdez and Ryel 1997). Marsh and Douglas (1997) documented predation on humpback chub in the LCR by rainbow trout, channel catfish, and black bullhead. Valdez and Ryel (1997) identified brown trout, rainbow trout, and channel catfish as known predators of humpback chub in Grand Canyon, and suggested that common carp (*Cyprinus carpio*) could be a significant predator of incubating humpback chub eggs in the LCR . In the upper basin, Chart and Lentsch (2000) identified channel catfish as the principal predator of humpback chub in Desolation/Gray Canyons. The UCRRP identified channel catfish as the principal predator of humpback chub in Yampa Canyon and is pursuing development and implementation of a control program.

A.9 Age and Growth

The only extensive study on age and growth of the bonytail is by Vanicek (1967). Of 67 bonytail aged by scales, the oldest and largest was 7 years old, 338 mm TL, and weighed 422 g. The age of putative bonytail captured in Cataract Canyon was not determined, but their length was comparable to the maximum length of 388 mm TL recorded by Vanicek and Kramer (1969) for a fish estimated to be 7 years old. Seven bonytail collected by Bozek et al. (1984) from Lake Mohave were 475–535 mm TL; the largest seen from Lake Havasu was 489 mm TL (Minckley 1973). Two bonytail from Lake Mohave were estimated to be 32 and 39 years old, based on otolith annuli (Ulmer 1983). Examination of otoliths from four bonytail from Lake Mohave indicated ages of 34, 40, 42, and 49 years (Rinne et al. 1986).

A.10 Length-Weight and Condition Factor

Vanicek (1967) reported a length-weight relationship of log W = -4.7899 + 2.860 (log L) for 67 bonytail greater than 200 mm TL collected from the Green River downstream of the Yampa River.

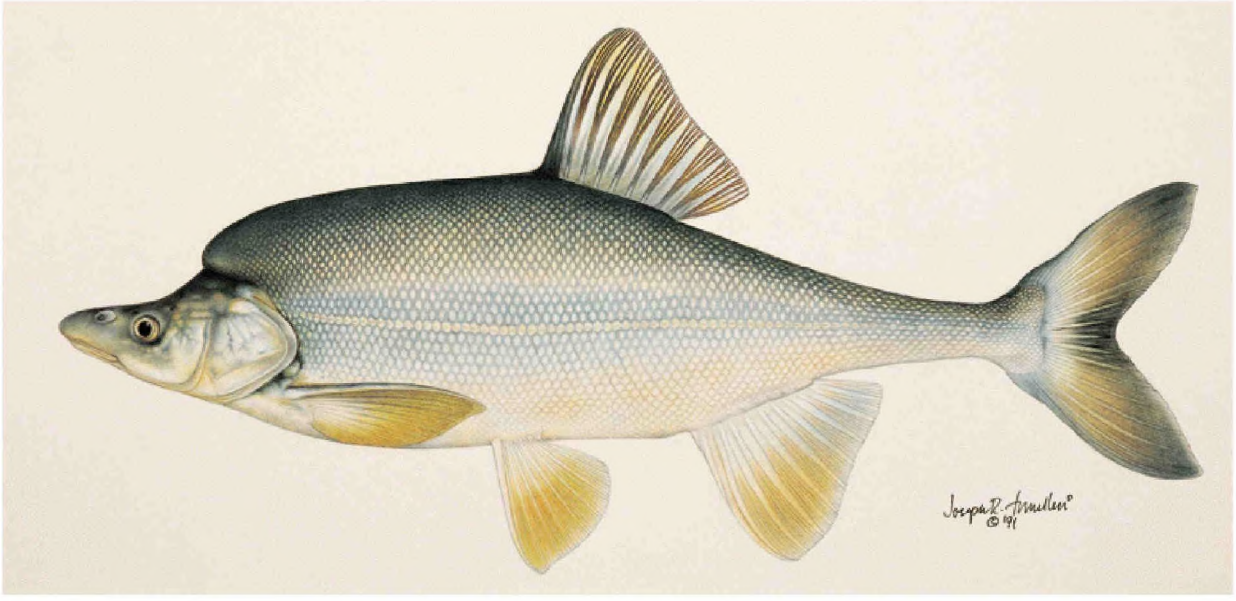
A.11 Diet

Little is known of the food habits of the bonytail. McDonald and Dotson (1960) reported that *"Colorado chub"* were largely omnivorous with a diet of terrestrial insects, plant matter, and fish. Several chubs were observed feeding on floating masses of debris washed by heavy rainfall. Vanicek (1967) reported that *"Colorado chubs"* fed mainly on terrestrial insects (mostly adult beetles and grasshoppers), plant debris, leaves, stems, and woody fragments.

A.12 Parasites

The only records of parasites from wild bonytail are from Hagen and Banks (1963) and Vanicek (1967). Both studies reported the anchor worm, *Lernea* sp., was commonly found attached to the base of fins or on gills of *"Colorado chubs"* in the Green River in Dinosaur National Monument.

HUMPBACK CHUB (*Gila cypha*) RECOVERY GOALS



HUMPBACK CHUB (*Gila cypha*)

RECOVERY GOALS
Amendment and Supplement to the Humpback Chub Recovery Plan

U.S. Fish and Wildlife Service
Mountain-Prairie Region (6)
Denver, Colorado

Approved: Ralph O. Morgenweck
Regional Director, Region 6, U.S. Fish and Wildlife Service

Date: 8/1/02

DISCLAIMER PAGE

These recovery goals amend and supplement the 1990 Humpback Chub Recovery Plan. Recovery plans delineate reasonable actions that are believed to be required to recover and/or protect listed species. The U.S. Fish and Wildlife Service publishes these plans, which may be prepared with the assistance of recovery teams, contractors, State agencies, and others. Attainment of the objectives and provision of any necessary funds are subject to priorities, budgetary, and other constraints affecting the parties involved. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. Recovery plans represent the official position of the U.S. Fish and Wildlife Service **only** after they have been signed by the Regional Director or Director as **approved**. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks.

CITATION FOR THESE RECOVERY GOALS

These recovery goals should be cited as follows:

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EXECUTIVE SUMMARY

This document amends and supplements the Humpback Chub Recovery Plan of 1990. The purpose of this document is to describe site-specific management actions/tasks; provide objective, measurable recovery criteria; and provide an estimate of the time to achieve recovery of the endangered humpback chub (*Gila cypha*), according to Section 4(f)(1) of the Endangered Species Act of 1973, as amended. Recovery or conservation programs that include the humpback chub will direct research, management, and monitoring activities and determine costs associated with recovery.

Current Species Status: The humpback chub is listed as endangered under the Endangered Species Act of 1973, as amended. The species is endemic to the Colorado River Basin of the southwestern United States. Adults attain a maximum size of about 480 mm total length (TL) and 1.2 kg in weight. Six extant wild populations are known: (1) Black Rocks, Colorado River, Colorado; (2) Westwater Canyon, Colorado River, Utah; (3) Yampa Canyon, Yampa River, Colorado; (4) Desolation/Gray Canyons, Green River, Utah; (5) Cataract Canyon, Colorado River, Utah; and (6) the mainstem Colorado River in Marble and Grand Canyons and the Little Colorado River, Arizona. The first five populations are in the Upper Colorado River Basin (i.e., upstream of Glen Canyon Dam, Arizona), and the sixth population is in the Lower Colorado River Basin.

Habitat Requirements and Limiting Factors: Populations of humpback chub are restricted to deep, swift, canyon-bound regions of the mainstem and large tributaries of the Colorado River Basin. Adults require eddies and sheltered shoreline habitats maintained by high spring flows. These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, and form gravel and cobble deposits used for spawning. Spawning occurs on the descending limb of the spring hydrograph at water temperatures typically between 16 and 22°C. Young require low-velocity shoreline habitats, including eddies and backwaters, that are more prevalent under base-flow conditions. Threats to the species include streamflow regulation, habitat modification, predation by nonnative fish species, parasitism, hybridization with other native *Gila*, and pesticides and pollutants.

Recovery Objective: Downlisting and Delisting.

Recovery Criteria: Objective, measurable criteria for recovery of humpback chub in the Colorado River Basin are presented for each of two recovery units (i.e., the upper basin, including the Green River and upper Colorado River subbasins; and the lower basin, including the mainstem and its tributaries from Glen Canyon Dam downstream to Lake Mead National Recreation Area) because of different recovery or conservation programs and to address unique threats and site-specific management actions/tasks necessary to minimize or remove those threats. Recovery of the species is considered necessary in both the upper and lower basins because of the present status of populations and existing information on humpback chub biology. The humpback chub was listed prior to the 1996 distinct population segment (DPS) policy, and the U.S. Fish and Wildlife Service (Service) may conduct an evaluation to designate DPSs in a

future rule-making process. If DPSs are designated, criteria for recovery of humpback chub will need to be reevaluated. These recovery goals are based on the best available scientific information, and are structured to attain a balance between reasonably achievable criteria (which include an acceptable level of uncertainty) and ensuring the viability of the species beyond delisting. Additional data and improved understanding of humpback chub biology may prompt future revision of these recovery goals.

Downlisting can occur if, over a 5-year period: (1) the trend in adult (age 4+; ≥200 mm TL) point estimates for each of the six extant populations does not decline significantly; and (2) mean estimated recruitment of age-3 (150–199 mm TL) naturally produced fish equals or exceeds mean annual adult mortality for each of the six extant populations; and (3) two genetically and demographically viable, self-sustaining core populations are maintained, such that each point estimate for each core population exceeds 2,100 adults (2,100 is the estimated minimum viable population [MVP] needed to ensure long-term genetic and demographic viability); and (4) when certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can occur if, over a 3-year period beyond downlisting: (1) the trend in adult point estimates for each of the six extant populations does not decline significantly; and (2) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each of the six extant populations; and (3) three genetically and demographically viable, self-sustaining core populations are maintained, such that each point estimate for each core population exceeds 2,100 adults; and (4) when certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Conservation plans will go into effect at delisting to provide for long-term management and protection of the species, and to provide reasonable assurances that recovered humpback chub populations will be maintained without the need for relisting. Elements of those plans could include (but are not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats. Signed agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties must be in place to implement the conservation plans before delisting can occur.

Management Actions Needed:

1. Provide and legally protect habitat (including flow regimes necessary to restore and maintain required environmental conditions) necessary to provide adequate habitat and sufficient range for all life stages to support recovered populations.
2. Investigate the role of the mainstem Colorado River in maintaining the Grand Canyon population.
3. Investigate the anticipated effects of and options for providing warmer water temperatures in the mainstem Colorado River through Grand Canyon.
4. Ensure adequate protection from overutilization.

5. Ensure adequate protection from diseases and parasites.
6. Regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.
7. Control problematic nonnative fishes as needed.
8. Minimize the risk of increased hybridization among *Gila* spp.
9. Minimize the risk of hazardous-materials spills in critical habitat.
10. Provide for the long-term management and protection of populations and their habitats beyond delisting (i.e., conservation plans).

Estimated Time to Achieve Recovery: Reliable population estimates, based on a multiple mark-recapture model, are needed for all six extant populations over a 5-year monitoring period for downlisting and over a 3-year monitoring period beyond downlisting in order to achieve delisting. The accuracy and precision of each point estimate will be assessed by the Service in cooperation with the respective recovery or conservation programs, and in consultation with investigators conducting the point estimates and with qualified statisticians and population ecologists. First reliable point estimates are expected for all populations by 2002. If those estimates are acceptable to the Service and all recovery criteria are met, downlisting could be proposed in 2007 and delisting could be proposed in 2010. This estimated time frame is based on current understanding of the status and trends of populations and on the monitoring time required to meet the downlisting and delisting criteria.

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1.0 INTRODUCTION

1.1 Background

The humpback chub (*Gila cypha*) is a large cyprinid fish endemic to the Colorado River Basin (Miller 1946). Adults attain a maximum size of about 480 mm total length (TL) and 1.2 kg in weight (Valdez and Ryel 1997). The humpback chub is currently listed as "endangered" under the Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 *et. seq.*). It was first included in the List of Endangered Species issued by the Office of Endangered Species on March 11, 1967 (32 FR 4001) and was considered endangered under provisions of the Endangered Species Conservation Act of 1969 (16 U.S.C. 668aa). The humpback chub was included in the United States List of Endangered Native Fish and Wildlife issued on June 4, 1973 (38 FR No. 106), and it received protection as endangered under Section 4(c)(3) of the original ESA of 1973. The latest revised humpback chub recovery plan was approved on September 19, 1990 (U.S. Fish and Wildlife Service 1990a). The final rule for determination of critical habitat was published on March 21, 1994 (59 FR 13374), and the final designation became effective on April 20, 1994.

The humpback chub is a member of a unique assemblage of fishes native to the Colorado River Basin, consisting of 35 species with 74% level of endemism (Miller 1959). It is one of four mainstem, big-river fishes currently listed as endangered under the ESA; others are the bonytail (*Gila elegans*), Colorado pikeminnow (*Ptychocheilus lucius*; formerly Colorado squawfish; Nelson et al. 1998), and razorback sucker (*Xyrauchen texanus*). The native fish assemblage of the Colorado River Basin is jeopardized by large mainstem dams, water diversions, habitat modification, nonnative fish species, and degraded water quality (Miller 1961; Minckley and Deacon 1991).

1.2 Purpose and Scope

This document amends and supplements the Humpback Chub Recovery Plan of 1990 (Recovery Plan; U.S. Fish and Wildlife Service 1990a). The purpose and scope are to assimilate current information on the life history of the species and status of populations to develop recovery goals associated with the five listing factors that [as specified under Section 4(f)(1) of the ESA] identify site-specific management actions necessary to minimize or remove threats; establish objective, measurable recovery criteria; and provide estimates of the time and costs required to achieve recovery. In developing the recovery goals, the full body of available information pertinent to issues related to species life history and conservation was considered. However, it is not the intent of this document to provide a comprehensive treatise of information on humpback chub; a synopsis of the life history that includes a description of habitat requirements is provided in Appendix A. Additional and more detailed information can be found in literature cited in this document and in reports and publications referenced in those citations.

These recovery goals were developed as an amendment and supplement to the Recovery Plan to focus on the requirements of Section 4(f)(1)(B) of the ESA, which requires that the Secretary of the Interior incorporate into each plan site-specific management actions; objective, measurable

criteria; and estimates of the time and costs to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal. The Recovery Plan did not contain those key requirements of the ESA; therefore, these recovery goals take precedence over the Recovery Plan. Recovery or conservation programs that include the humpback chub (see section 1.3) will direct research, management, and monitoring activities and determine costs associated with recovery. The recovery goals are not intended to include specifics on design of management strategies nor are they intended to prescribe ways that management strategies should be implemented. Those details (and associated costs) need to be developed by the respective recovery or conservation programs in their implementation plans.

An important aspect in development of these recovery goals was to attain a balance between reasonably achievable criteria and ensuring the viability and security of the species beyond delisting. Reasonably achievable criteria considered demographic and genetic requirements of self-sustainability in balance with available estimates of carrying capacity. These recovery goals are intended to be used by the U.S. Fish and Wildlife Service (Service) in rule-making processes to downlist and/or delist the humpback chub. The Service intends to review, and revise as needed, these recovery goals at least once every 5 years from the date they are made public through a Notice of Availability published in the *Federal Register*, or as necessary when sufficient new information warrants a change in the recovery criteria. Review of these recovery goals will be part of the review of listed species as required by Section 4(c)(2)(A) of the ESA, *"The Secretary shall ... conduct, at least once every five years, a review of all species..."*.

1.3 Recovery or Conservation Programs

Three of the five major endangered-species recovery or conservation programs in the Colorado River Basin include the humpback chub (highlighted in Box 1). These are the Upper Colorado River Endangered Fish Recovery Program (UCRRP), the Glen Canyon Dam Adaptive Management Program (GCDAMP), and the Lower Colorado River Multi-Species Conservation Program (MSCP). The UCRRP is a recovery program that was initiated under a Cooperative Agreement signed by the Secretary of the Interior on January 22, 1988, as a coordinated effort of State and Federal agencies, water users, energy distributors, and environmental groups to recover the four endangered fishes in the upper basin downstream to Glen Canyon Dam, excluding the San Juan River (U.S. Department of the Interior 1987; Wydoski and Hamill 1991; Evans 1993). It functions under the general principles of adaptive management (see section 5.1.2) and consists of seven program elements, including instream flow

Box 1. Recovery or Conservation Programs

1. ***Upper Colorado River Endangered Fish Recovery Program (UCRRP)***
2. San Juan River Basin Recovery Implementation Program (SJRRIP)
3. ***Glen Canyon Dam Adaptive Management Program (GCDAMP)***
4. Native Fish Work Group (NFWG)
5. ***Lower Colorado River Multi-Species Conservation Program (MSCP)***

protection; habitat restoration; reduction of nonnative fish and sportfish impacts; propagation and genetics management; research, monitoring, and data management; information and education; and program management. As stated in the governing document of the UCRRP (U.S. Department of the Interior 1987), the goal is to recover the endangered fishes while water development proceeds in compliance with State and Federal laws, including the ESA, State water law, interstate compacts, and Federal trust responsibilities to American Indian tribes. Funding for the UCRRP will continue through 2011 under legislation passed in October 2000 (P.L. 106-392); Congress will review the UCRRP to determine if funding should be authorized beyond 2011.

The GCDAMP is a conservation program that was established by the Secretary of the Interior under the Federal Advisory Committee Act to provide oversight on the operation of Glen Canyon Dam to protect and/or enhance development of the Colorado River ecosystem through Grand Canyon (i.e., mainstem Colorado River and its tributaries from Glen Canyon Dam downstream to Lake Mead National Recreation Area). The GCDAMP consists of a diverse group of stakeholders, including State and Federal agencies, water users, energy distributors, environmental groups, recreational interests, and American Indian tribes, that direct coordinated scientific studies conducted by the Grand Canyon Monitoring and Research Center (GCMRC) of the U.S. Geological Survey. The GCDAMP addresses the elements of the Environmental Impact Statement on the operation of Glen Canyon Dam (U.S. Department of the Interior 1995), as well as the reasonable and prudent alternatives contained in a jeopardy biological opinion for the humpback chub and razorback sucker in Grand Canyon. This adaptive-management program takes findings of the GCMRC as information for dam reoperations and conservation of the endangered fishes.

The MSCP is a conservation program under development that was initiated in response to the designation of critical habitat for the four endangered "big river" fishes in 1994, and the listing of the southwestern willow flycatcher (*Empidonax traillii extimus*) as endangered in 1995 (SAIC/Jones & Stokes 2002). In response, representatives from the U.S. Departments of the Interior and Energy; several American Indian tribes; water, power, and wildlife resource management agencies from the three lower basin States; and a significant number of agricultural, municipal, and industrial providers of Colorado River water and power resources have formed a regional partnership that is developing a multi-species conservation program aimed at protecting sensitive, threatened, and endangered species of fish, wildlife, and their habitat. The partnership has formed a 27-member steering committee, which has been designated by the Service as an Ecosystem Conservation and Recovery Implementation Team under the ESA. The MSCP planning area comprises the historic floodplain of the Colorado River from Lake Mead to the southerly International Boundary with Mexico and areas to elevations up to and including the full pool elevations of Lakes Mead, Mohave, and Havasu (SAIC/Jones & Stokes 2002); coverage by GCDAMP and MSCP overlaps by approximately 50 km between the full pool elevation at Separation Canyon and the Lake Mead National Recreation Area near Emery Falls. The humpback chub is one of 56 species proposed for coverage by the MSCP, but it is not one of the six focus species.

2.0 THE RECOVERY PROCESS

2.1 Definition of Recovery

Understanding the Service's strategy for recovery of the humpback chub, as provided in the ESA and implementing regulations, first requires an understanding of the meaning of "recover" and "conserve". The ESA does not specifically define recover, and the term "recovery" is used with respect to recovery plans *"...for the conservation and survival..."* of listed species. An endangered species, as defined in Section 3(6) of the ESA, means *"any species which is in danger of extinction throughout all or a significant portion of its range."* A threatened species is defined in Section 3(19) of the ESA as *"any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."* According to Service policy (U.S. Fish and Wildlife Service 1990b), *"Recovery is the process by which the decline of an endangered or threatened species is arrested or reversed, and threats to its survival are neutralized, so that its long-term survival in nature can be ensured. The goal of this process is the maintenance of secure, self-sustaining wild populations of species with the minimum necessary investment of resources."* The ESA's implementing regulations (50 CFR § 402.02) further define recovery as *"...improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the Act."* The policy and regulations use the word recovery in a narrow ESA sense, giving it meaning that is different from returning a species to its normal position or condition.

The definition provided for recovery in the implementing regulations and the definition provided for conserve in the ESA have essentially the same meaning. Section 3(3) of the ESA states: *"The terms "conserve," "conserving," and "conservation" mean to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary."* Hence, recovery and conserve both mean to bring a species to the point at which it no longer needs the protection of the ESA, because the species is no longer in danger of extinction throughout all or a significant portion of its range. This definition of recovery falls far short of requiring that a species must be restored to its historic range and abundance before it can be considered recovered or delisted. It also falls short of requiring the restoration of a species to all the remaining suitable habitat, unless this is necessary to sufficiently reduce the species' susceptibility to threats to a level at which the species is no longer threatened or endangered.

The phrase "throughout all or a significant portion of its range" is used in both definitions of endangered and threatened. Neither "significant" nor "range" are defined in the ESA or implementing regulations. Hence, the ESA provides the Service with latitude to use its discretion, based on the best scientific information available, to develop recovery goals and implement recovery plans designed to conserve and recover species. The ESA clearly does not use the term significant in a statistical sense. Significance cannot be reliably and safely applied in any strictly quantitative framework, because of the great variety of organisms, habitats, and threats that must be evaluated for protection under the ESA.

Given that the ESA is intended to avoid species extinction, the Service avoids the pitfalls of a purely quantitative approach by instead viewing significant in the context of a species' long-term survival needs. The term becomes logical, meaningful, and useful if applied in this context. A significant portion of the range is that area that is important or necessary for maintaining a viable, self-sustaining, and evolving population or populations, in order for a taxon to persist into the foreseeable future. That "significant portion" may constitute a large portion of the historic range of a species or a relatively small portion of the historic range. Other parts of a species' range (regardless of whether it is historical, current, or potential range) may not be significant to its long-term survival, regardless of its geographic extent. Therefore, a species extirpated from such areas does not necessarily mean it is threatened or endangered, regardless of the geographic extent of those areas.

Implicit in the ESA definitions of threatened and endangered and in the principles of conservation biology is the need to consider genetics, demographics, population redundancy, and threats (as identified by the listing factors). The ESA is mandated to recover species to the point that they are "not likely" to be in danger of extinction for the foreseeable future throughout all or a significant portion of their range. The Service believes that the "not likely" standard is exceeded by the requirement of the recovery goals to maintain multiple widespread populations that are independently viable, because it is unlikely that future singular threats will endanger widely separated multiple populations. Viable populations have sufficient numbers of individuals to counter the effects of deleterious gene mutations as a result of inbreeding, and to counter the effects of deaths exceeding births and recruitment failure for periods of time. Thus, the conservation biology principle of redundancy is satisfied by the required multiple genetically and demographically viable, self-sustaining populations (section 3.1.3). Furthermore, the principle of resiliency is satisfied with sufficiently large populations to persist through normal population variations, as well as through unexpected catastrophic events (section 3.1.4).

The principles of recovery and conservation as defined in the ESA, implementing regulations, and Service policy demonstrate the strong relationship between the delisting criteria used for recovery and the five listing factors in Section 4(a)(1) of the ESA. These five listing factors must be addressed in any reclassification of a species [ESA Section 4(c)(2)(B); section 4.0 of this document], and are:

> "*(A) The present or threatened destruction, modification, or curtailment of its habitat or range;*
> *(B) overutilization for commercial, recreational, scientific, or educational purposes;*
> *(C) disease or predation;*
> *(D) the inadequacy of existing regulatory mechanisms; and*
> *(E) other natural or manmade factors affecting its continued existence.*"

Recovery is based on reduction or removal of threats and improvement of the status of a species during the period in which it is listed, and not just from the time a listed species is proposed for reclassification. Environmental conditions and the structure of populations change over time, and threats recognized at listing or in subsequent recovery plans may no longer be directly applicable when reclassification is considered. Management actions and tasks conducted by

recovery or conservation programs for listed species are expected to minimize or remove threats and improve the species' status.

When delisting a species, the Service must determine that the five listing factors no longer apply, e.g., the habitat is no longer threatened with destruction or modification, the current abundance and range is adequate, and the habitat needed to sustain recovered populations is present. Therefore, the recovery goals (section 5.0) include management actions and tasks, as well as downlisting and delisting criteria, presented by "recovery factor". These recovery factors were derived from the five listing factors and state the conditions under which threats are minimized or removed.

Recovery is achieved when management actions and associated tasks have been implemented and/or completed to allow genetically and demographically viable, self-sustaining populations to thrive under minimal ongoing management and investment of resources. Achievement of recovery does not mandate returning a species to all or a significant portion of its historic range, nor does it mandate establishing populations in all possible habitats, or everywhere the species can be established or reestablished. Removing a species from protection of the ESA remands the primary management responsibility of that species to the States, who may choose to further expand its range and populations. The standard of establishing and protecting viable, self-sustaining populations is applied to the recovery of humpback chub, and was used in developing recovery goals for the other three endangered fishes of the Colorado River Basin (U.S. Fish and Wildlife Service 2002a, 2002b, 2002c). This approach is consistent with recovery of other vertebrate species, such as the bald eagle (*Haliaeetus leucocephalus*; 64 FR 36453), peregrine falcon (*Falco peregrinus*; 64 FR 46541), desert tortoise (*Gopherus agassizii*; Berry 1999), Pacific salmon (*Oncorhynchus spp.*; Allendorf et al. 1997), and southern sea otter (*Enhydra lutris nereis*; Ralls et al. 1996).

2.2 Recovery Units

Recovery of humpback chub in the Colorado River Basin is considered necessary in both the upper and lower basins because of the present status of populations and existing information on humpback chub biology. For the purpose of these recovery goals, the upper and lower basins are divided at Glen Canyon Dam, Arizona. Separate objective, measurable recovery criteria were developed for each of two recovery units (i.e., the upper basin, including the Green River and upper Colorado River subbasins; and the lower basin, including the mainstem and its tributaries from Glen Canyon Dam downstream to Lake Mead National Recreation Area) to address unique threats and site-specific management actions necessary to minimize or remove those threats. The recovery units encompass three management areas under different and separate recovery or conservation programs (i.e., UCRRP, GCDAMP, and MSCP; see section 1.3 for description of geographic coverage by each of the programs). Designation of the recovery units is consistent with goals established by these programs. For example, the governing document for the UCRRP (U.S. Department of the Interior 1987) states: *"Since the recovery plans* [for the Colorado pikeminnow, humpback chub, and bonytail; razorback sucker was not federally listed in 1987, but was included in the UCRRP] *refer to species recovery in both the upper and lower basins,*

these goals [recovery/management goals in the original recovery plans] *also apply to both basins, until revised for the upper basin, through implementation of this recovery program. However, the goal of this program for the three endangered species is recovery and delisting in the upper basin. In general, this would be accomplished when the habitat necessary to maintain self-sustaining populations has been determined and provisions are in place to maintain and protect that habitat and these species. The Implementation Committee will be expected to revise these goals for the upper basin as the program develops. Attainment of these goals will result in recovery and delisting of the listed species in the upper basin."* Parties to the UCRRP agreed that the four endangered species could be downlisted and delisted separately in the upper basin. However, the document also states: *"... this program can not, and does not in anyway, diminish or detract from or add to the Secretary's ultimate responsibility for administering the Endangered Species Act."*

The humpback chub was listed prior to the 1996 distinct population segment (DPS) policy, and the Service may conduct an evaluation to designate DPSs in a future rule-making process. In the Policy Regarding the Recognition of Distinct Vertebrate Population (61 FR 4721–4725), the U.S. Fish and Wildlife Service and the National Marine Fisheries Service clarified their interpretation of the phrase *"distinct population segment of any species of vertebrate fish or wildlife"* for the purposes of listing, delisting, and reclassifying species under the ESA. Designation of DPSs is a separate listing process that is different from recovery plans/goals, and is accomplished by a rule-making process. A DPS is a segment of the population and includes a part of the range of a species or subspecies. Like all listings, the DPS is described geographically, but it is important to retain the purpose of the ESA *"...to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved..."*. The elements considered for designation of DPSs are: *"1) Discreteness of the population segment in relation to the remainder of the species to which it belongs; 2) The significance of the population segment to the species to which it belongs; and 3) The population segment's conservation status in relation to the Act's standards for listing (i.e., is the population segment, when treated as if it were a species, endangered or threatened?)."*

Species listed prior to the DPS policy may be reconsidered for DPS designation at the time of reclassification or at the 5-year status review. The DPS policy states: *"Any DPS of a vertebrate taxon that was listed prior to implementation of this policy will be reevaluated on a case-by-case basis as recommendations are made to change the listing status for that distinct population segment. The appropriate application of the policy will also be considered in the 5-year reviews of the status of listed species required by section 4(c)(2) of the Act."* Section 4(c)(2)(A) of the ESA requires a review of listed species *"at least once every five years"*. If DPSs are designated, these recovery criteria will need to be reevaluated.

2.3 Development of Recovery Goals

Development of recovery goals for the humpback chub followed a specific process. First, current data on the life history of the species and on existing populations were assimilated (Appendix A; section 3.0). Second, the assimilated data were used to evaluate population

viability and self-sustainability (section 3.0). Third, past and existing threats were identified according to the five listing factors (section 4.0). Finally, site-specific management actions were identified to minimize or remove threats, and objective, measurable recovery criteria were developed based on the five factors (section 5.0). The process of developing the recovery goals was interactive and iterative, and the recovery goals are the product of considerable input from stakeholders and scientists from throughout the Colorado River Basin and from rigorous peer review. Input from biologists and managers throughout the basin was received through meetings with the Colorado River Fishes Recovery Team; Biology, Management, and Implementation committees of the UCRRP; Native Fish, Technical, and Adaptive Management work groups of the GCDAMP; Colorado River Fish and Wildlife Council; American Indian tribes; State game and fish agencies; water and power interests; and appropriate Federal agencies. Input was also received through independent reviews of previous drafts (see acknowledgments). Development of these recovery goals considered the approach taken by Lentsch et al. (1998) to develop interim management objectives, and paralleled similar efforts by the Colorado Division of Wildlife and benefitted from exchange of information with the principal author (Nesler 2000).

The process of downlisting and delisting described in this document is consistent with provisions specified under Section 4(b), Basis For Determinations, and Section 4(f)(1), Recovery Plans, of the ESA. Under Section 4(b), the Secretary of the Interior shall determine if a species is endangered or threatened *"...solely on the basis of the best scientific and commercial data available..."*. Specifically, under Section 4(f)(1)(B), each recovery plan must incorporate (i) *"a description of such site-specific management actions as may be necessary to achieve the plan's goal for conservation and survival of the species"*; (ii) *"objective, measurable criteria which, when met, would result in a determination, in accordance with the provisions of this section, that the species be removed from the list"*; and (iii) *"estimates of the time required and cost to carry out those measures needed to achieve the plan's goal and to achieve intermediate steps toward that goal."* Objective, measurable recovery criteria identify downlisting and delisting requirements for each management action, and define viable, self-sustaining populations consisting of target numbers of adults and subadults for wild populations. Under Section 4(c)(2)(B) of the ESA, each determination of reclassification of a species shall be made in accordance with provisions of Sections 4(a) and 4(b).

3.0 POPULATION VIABILITY AND SELF-SUSTAINABILITY

Population viability and self-sustainability are the cornerstones to defining a recovered species. Factors that determine population viability and self-sustainability are demographics (size and age structure of populations), population redundancy (number and distribution of populations), habitat carrying capacity (resource limitations), and genetic considerations (inbreeding and genetic viability). This section discusses the development of genetic and demographic viability standards for achieving the primary objective of the Recovery Plan, i.e., *"...the protection or restoration of...viable, self-sustaining populations..."* (U.S. Fish and Wildlife Service 1990a). Guidelines for population viability and self-sustainability stated in Box 2 (Franklin 1980; Soulé 1980; Shaffer 1987; Allen et al. 1992).

Box 2. Guidelines for Population Viability and Self-Sustainability

- A viable, self-sustaining population has negligible probability of extinction over a 100- to 200-year period.
- A population should be sufficiently large to survive historically observed environmental variation.
- A population should be sufficiently large to maintain long-term genetic diversity and viability.
- Multiple demographically viable (redundant) populations greatly reduce the probability of extinction if the populations are independent in their susceptibility to catastrophic events.
- A viable, self-sustaining population must have positive recruitment potential sufficient to replace adult mortality near carrying capacity, and on average, exceed adult mortality when the population is below carrying capacity.
- Carrying capacity is not expected to be the same for different populations because physical habitat, water quality, and biological components are likely to vary.

3.1 Demographic Viability

3.1.1 Demographic characteristics, environmental uncertainty, and catastrophic events

Demographic or population viability refers to the persistence of a species over time, as affected by uncertainties in population dynamics. A viable, self-sustaining population has negligible probability of extinction over a 100- to 200-year time frame (Franklin 1980; Soulé 1980). Population viability can be affected by demographic characteristics, environmental uncertainty, and catastrophic events (Shaffer 1987; Allen et al. 1992). Demographic characteristics relate to random changes in birth and death rates, primarily reflecting differences at the population level. Persistence time for a population faced only with demographic variability increases geometrically as the population increases, and only populations with individuals that number in the "10s to 100s" are vulnerable to extinction due simply to demographic variability (Shaffer 1987). Henee, demographic viability is generally considered to be an issue only with severely depleted populations (Goodman 1987; Allen et al. 1992). Most humpback chub populations do not appear to be severely depleted, based on the presence of six wild self-sustaining populations (see section 3.1.2). However, the current status of the species is being evaluated through population estimates.

In contrast, population persistence decreases linearly with environmental uncertainty (Shaffer 1987) and thus is of more concern for population viability of humpback chub. Environmental uncertainty results from changes in environmental factors such as variability in food supply; weather; population dynamics of predators, competitors, and parasites; and in the case of riverine fishes, variability in seasonal flow characteristics. Many of these environmental factors may be highly correlated to population demographics, such as reproductive success, survival, and recruitment. Population sizes necessary for persistence under environmental variability reflect

the resulting variability in birth and death rates (Allen et al. 1992). Specifically linking environmental variability to birth and death rates is difficult (Ewens et al. 1987), and use of a demographic model for humpback chub is limited because of the lack of reliable empirical data on these life-history parameters. Population viability analyses (PVA; Gilpin 1993; Soulé 1987; Shaffer 1987) were considered but not employed because of a lack of conclusive data on state and rate variables for the species.

As an alternative to demographic models, the concept of carrying capacity can be used to approximate population sizes and potential. Populations can be viewed as having some potential with respect to resource limitations or theoretical carrying capacity. The variance (V) in potential growth rate (r), without limitations of carrying capacity, has to be sizably greater than r ($V > 2r$) before the population is susceptible to extinction, otherwise the population tends toward the carrying capacity (Roughgarden 1979). This is difficult to ascertain for humpback chub, but relatively stable numbers of adults in most populations suggest that adult mortality is compensated by recruitment of new individuals. For humpback chub, it is doubtful that environmental uncertainty will affect populations that meet genetic considerations if the environment is protected and secured against changes that exceed environmental stochasticity for the species; e.g., anthropogenic changes such as dams and introductions of nonnative fish species can impose environmental conditions that exceed the range of conditions experienced by the species historically.

Of most concern to the viability of humpback chub populations are catastrophic events. Regular catastrophic events are not expected for humpback chub, but infrequent and unpredictable events are possible. Although the species is long-lived (20+ years), catastrophic events may impact all life stages. Of greatest concern is invasion by a predator or competitor that effectively removes one or more age classes, a parasite or disease that kills much of the population, or exposure to toxic substances. Because the adult population size may have little effect on population persistence from a catastrophic event, a larger individual population provides little gain in viability (Ewens 1989). Therefore, multiple, demographically viable populations are necessary to reduce the probability of extinction of a species if the populations are relatively independent in their susceptibility to a catastrophic event (Goodman 1987; Shaffer 1987).

3.1.2 Existing populations of humpback chub

Six self-sustaining populations of humpback chub are known to exist. Each of these populations consists of a discrete reproducing group of fish, with independent stock-recruitment dynamics, and is geographically separated from other populations. Five of the populations occur in the upper basin recovery unit: (1) Black Rocks, Colorado River, Colorado; (2) Westwater Canyon, Colorado River, Utah; (3) Yampa Canyon, Yampa River, Colorado; (4) Desolation/Gray Canyons, Green River, Utah; and (5) Cataract Canyon, Colorado River, Utah (Figure 1; Appendix A; Valdez and Clemmer 1982; U.S. Fish and Wildlife Service 1990a). The only population in the lower basin recovery unit occurs in the mainstem Colorado River in Marble and Grand Canyons and the Little Colorado River (LCR). This designation of populations differs from that presented in the Recovery Plan. The Recovery Plan identifies distribution of humpback chub in seven locations: (1) the LCR, (2) Colorado River in Marble and Grand



Figure 1. Distribution of humpback chub in the Colorado River Basin.

Canyons, (3) Cataract Canyon, (4) Black Rocks and Westwater Canyon, (5) Desolation/Gray Canyons, (6) Green River in Dinosaur National Monument, and (7) Yampa Canyon. Designation of populations in Cataract Canyon, Desolation/Gray Canyons, and Yampa Canyon in the Recovery Plan are consistent with this amendment and supplement. However, recent studies (Douglas and Marsh 1996 ;Valdez and Ryel 1995, 1997) show that humpback chub aggregations in the mainstem Colorado River in Marble and Grand Canyons are largely supported by reproduction and recruitment from the LCR, and hence, fish in these two systems are treated collectively as one Grand Canyon population in this document. The relationship between the reproducing population of humpback chub in the LCR and humpback chub in the Colorado River through Marble and Grand Canyons is not completely understood. Ongoing field investigations and stock-synthesis models reveal that the mainstem may be important habitat for large subadults and adults that spawn in the LCR (personal communication, L. Coggins, U.S. Geological Survey). Conversely, populations in Black Rocks and Westwater Canyon lack sufficient exchange of individuals for common stock-recruitment dynamics, and are considered separate populations in this document. Only small numbers of humpback chub have been captured in the Green River in Dinosaur National Monument (Vanicek et al. 1970; Holden and Stalnaker 1975b), and this area is not considered to currently support a population.

Recent preliminary estimates of abundance summed for the six humpback chub populations range from 7,300 to 13,800 wild adults. The precision and reliability of these estimates vary, and approximate numbers are provided as a general indication of the size of populations in the basin. Estimates of subadults are not currently available for all populations, and precise estimates of adults and subadults will be developed in order to determine if demographic criteria are met for downlisting and delisting. Estimates of adults in the six populations are: Black Rocks, 900–1,500 (Pfeifer et al. 1998; Nesler 2000; personal communication, C. McAda, U.S. Fish and Wildlife Service); Westwater Canyon, 2,000–5,000 (Chart and Lentsch 1999; personal communication, M. Hudson, Utah Division of Wildlife Resources); Yampa Canyon, 400–600 (Nesler 2000; personal communication, T. Modde, U.S. Fish and Wildlife Service); Desolation/Gray Canyons, 1,500 (Chart and Lentsch 2000); Cataract Canyon, 500 (Valdez 1990); and Grand Canyon, 2,000–4,700 (Douglas and Marsh 1996 [includes some subadults]; Valdez and Ryel 1997; personal communication, L. Coggins, U.S. Geological Survey).

3.1.3 Populations of humpback chub as redundant units

Maintaining several populations with relatively independent susceptibility to threats is an important consideration in the long-term viability of a species (Shaffer 1987; Goodman 1987). These redundant populations provide security in case of a catastrophic event or repeated year-class failure. The positive effect of relatively independent populations can be demonstrated by the following examples. Consider that a single population has a probability of extinction from a catastrophic event of 10% in 200 years. If two populations are independent, the probability of both going extinct is 1% (0.1^2). For three populations, the probability reduces to 0.1% (0.1^3). Even with an extinction probability of 25% for one population, the probability of extinction for two and three populations is 6.3% and 1.6%, respectively (Casagrandi and Gatto 1999).

Humpback chub occur as multiple, demographically independent populations in widely distributed regions of the Colorado River Basin; distances of 17–394 km separate adjacent populations. This widely clumped distribution pattern contributes to redundancy as species protection against threats and catastrophic events. The five populations in the upper basin occur in discrete regions of three subbasins, including three populations in the Colorado River, and one population each in the Green River and Yampa River. The lower basin population in Grand Canyon exists independently downstream of Glen Canyon Dam, where it has been geographically isolated from upper basin populations since dam construction in 1963. This pattern of geographic separation among all six populations provides population redundancy and greatly reduces the likelihood of a catastrophic event simultaneously affecting the majority of populations.

It is recognized that the six populations of humpback chub vary considerably in size, from about 400 to 5,000 adults. The larger populations are considered "core populations". A core population is an independent self-sustaining population sufficiently large to maintain genetic and demographic viability. A core population may serve as a center of dispersal from which new populations are established or existing populations are augmented. Core populations are sufficiently large and viable to protect against extreme demographic and environmental variability. A core population may consist of two or more geographically proximate populations (e.g., Black Rocks and Westwater Canyon). In case of a catastrophe, multiple or redundant core populations preserve species viability.

Existing core populations of humpback chub are Westwater Canyon/Black Rocks with an estimated range of about 2,900 to 6,500 adults and Grand Canyon with about 2,000–4,700 adults (see section 3.3 — Genetic Viability). A third potential core population is Desolation/Gray Canyons, with a current estimate of 1,500 adults; this population is believed to be larger, and more precise mark-recapture estimates are to be conducted beginning in 2002. Each of these core populations is located in a geographically separate region of the Colorado River Basin, such that no single threat is likely to affect more than one of these cores.

3.1.4 Humpback chub as a metapopulation

The metapopulation concept is a natural phenomenon that should be considered when evaluating species persistence. A metapopulation is defined as a network of populations or subpopulations that have some degree of intermittent or regular gene flow among geographically separate units occupying habitat patches (Meffe and Carroll 1994). Populations that make up a metapopulation exist along a continuum of connectedness, with no clear break points, from totally isolated units to those that experience regular and high gene flow (Ehrlich and Murphy 1987; Harrison et al. 1988). Connectedness among units of a metapopulation may vary seasonally or annually (U.S. Fish and Wildlife Service 1995), and the best way to identify population units is that they have some ecological and evolutionary significance (Hanski and Gilpin 1997). Under metapopulation dynamics, habitat patches that become unoccupied due to local extirpations may become repopulated by dispersing individuals from other subpopulations. Metapopulations depend on the ability of individuals to disperse and repopulate empty patches in a manner timely enough to ensure that sufficient numbers of patches always contain viable subpopulations.

Humpback chub exist as discrete populations with limited dispersal, even between adjacent and close populations (e.g., Black Rocks and Westwater Canyon). Dispersal rates observed in humpback chub populations may be enough to provide sufficient genetic exchange (i.e., one migrant per generation time; Mills and Allendorf 1996), but do not appear to be sufficient to provide effective metapopulation dynamics. Metapopulation dynamics may allow for repopulation of habitat patches over long periods of time, but the low dispersal rate of humpback chub will require considerable time for this phenomenon to effectively replace populations devastated by catastrophes.

3.2 Carrying Capacity

Carrying capacity is the theoretical size of a population that can be sustained by the existing environment, and is determined by population demographics and resource limitations (i.e., limiting factors), including habitat. Functional carrying capacity is the population at its equilibrium state in the presence of resource limitations, and is determined as the level where births equal deaths, or lambda (λ) is equal to 1.0 (Begon et al. 1990). Potential carrying capacity is the maximum possible population size with resource limitations minimized or removed.

Carrying capacity of humpback chub is not expected to be the same for different populations because physical habitat (e.g., river channel, flow, and cover), chemical constituents (water quality), and biological components (e.g., food and predators) are likely to vary among river reaches. Hence, the same or even similar numbers and densities of fish in each population should not be expected for recovery. Based on the highest recent preliminary estimates of abundance, the Black Rocks, Westwater Canyon, and Grand Canyon (in the LCR) populations support similar densities of adults (i.e., 300–400/km); however, densities in the other populations are substantially lower. Carrying capacity, as a function of recovery, must be considered on its own merits for each population.

3.3 Genetic Viability

Genetic viability describes the pool of genetic diversity adequate to allow a population of animals to survive environmental pressures that may exceed the limits of developmental plasticity (Frankel 1983). Genetically viable populations maintain 90% of the genetic diversity present in the ancestral (pre-disturbance) population for 200 years (Soulé 1980; Soulé and Wilcox 1980; Soulé and Simberloff 1986). Genetic variability consists of within-population genetic diversity and genetic variation found among linked populations or stocks (Meffe 1986; Meffe and Carroll 1994). Genetic concepts that were considered are summarized in Box 3.

3.3.1 Genetic effective population size

One way to judge genetic viability is through consideration of "genetic effective population size" (N_e), which is the number of individuals contributing genes to the next generation (Crow and Kimura 1970; Gilpin and Soulé 1986; Soulé 1987; Allendorf et al. 1997). N_e was derived in order to gauge the number of adults needed in a population to maintain genetic viability. The

Box 3. Genetics Concepts and Considerations

- Genetic viability describes the pool of genetic diversity adequate to allow a population of animals to survive environmental pressures that may exceed the limits of developmental plasticity.
- Genetic variability consists of within-population genetic diversity and genetic variation found among linked populations.
- Genetic effective population size (N_e) is the number of individuals contributing genes to the next generation.
- Rate of inbreeding is an index of the amount of genetic exchange among closely related individuals and is of particular importance because it may result in offspring that are sterile or inviable after one to several generations.
- N_e of at least 50 adults avoids inbreeding depression and is necessary for conservation of genetic diversity in the short-term; N_e of 500 is needed to avoid serious long-term genetic drift; N_e of 1,000 provides a conservative estimate beyond which significant additional genetic variation is not expected.
- Minimum viable population (MVP) is defined as a population that is sufficiently abundant and well adapted to its environment for long-term persistence without significant artificial demographic or genetic manipulations.

concept of N_e was defined by Wright (1931) as the size of an ideal population whose genetic composition is influenced by random processes in the same way as the real population. Low heterozygosity is the dynamic result of low N_e, and N_e likely differs by species (Meffe 1986). The concept of N_e was used to determine if wild populations are at risk genetically, but lack of genetic structural characterization with functional relationships for humpback chub precludes a specific determination of N_e at this time. In the absence of this information, N_e for humpback chub was derived from principles in conservation genetics by using the "50/500 rule" (Franklin 1980). It has been suggested that a minimum genetic effective population size of 50 is required to avoid inbreeding depression (Soulé 1980), and a minimum genetic effective population size of 500 is required to reduce long-term genetic drift (Franklin 1980). Lynch (1996) suggested an N_e of 1,000 as the number of adults beyond which significant additional genetic variation is not expected. An N_e of 500 is commonly used for fishes (Waples 1990; Bartley et al. 1992; Allendorf et al. 1997) and other vertebrate species (Mace and Lande 1991; Ralls et al. 1996), therefore an N_e of 500 was used to derive an estimate of the number of adults needed to maintain genetic viability of a population of humpback chub. Recent research by fish geneticists support use of the 50/500 rule (Reiman and Allendorf 2001).

It is important to note that the number of individuals in a population required to achieve a genetic effective population size of 500 may be several times greater than 500 (Frankel and Soulé 1981). Sex ratio and proportion of breeding individuals in the population are two important considerations in deriving the number of individuals necessary to support N_e. The commonly observed sex ratio of wild humpback chub populations is 1:1 (Valdez and Ryel 1997). With a 1:1 sex ratio, an N_e of 500 adults would consist of 250 males and 250 females. If all adults in a

population breed every year and contribute genes to the following generation, some minimum number of adults (N_g) would equal N_e. However, as with most populations, it is believed that not all humpback chub spawn every year or contribute genes to the following generation, and hence, N_g is not equal to N_e. It is important to determine a ratio of genetic effective population size (N_e) to minimum population size (N_g), or N_e/N_g.

For various fish species (rainbow trout, *Oncorhynchus mykiss*; chinook salmon, *O. tshawytscha*; white seabass, *Atractoscion nobilis*), the ratio N_e/N_g varies from 0.013 to 0.90 (Table 1; Bartley et al. 1992; Avise 1994; Hedrick et al. 1995; Allendorf et al. 1997) for an overall average of about 0.30, which is the ratio reported for chinook salmon (McElhany et al. 2000) and other Pacific salmon species (Waples et al. 1990a, 1990b). This overall average ratio for fishes of 0.30 was used to determine the number of adult humpback chub needed to support an N_e of 500. Mace and Lande (1991) reported that the genetic effective population size is typically 20–50% of the actual population size.

Table 1. Estimates of effective/actual population size (N_e/N_g) ratios for various fish species.

Species	N_e/N_g	Reference
Sea bass (*Atractoscion nobilis*)	0.27–0.40	Bartley et al. (1992)
Coho salmon (*Oncorhynchus kisutch*)	0.24	Simon et al. (1986)
Rainbow trout (*Oncorhynchus mykiss*)	0.90	Bartley et al. (1992)
Chinook salmon (*Oncorhynchus tshawytscha*)	0.013–0.043	Bartley et al. (1992)
Chinook salmon (*Oncorhynchus tshawytscha*)	0.30	McElhany et al. (2000)

Using an N_e of 500, a 1:1 sex ratio, and an N_e/N_g ratio of 0.30, an estimated N_g of 1,667 was derived as the estimated number of adult humpback chub necessary to maintain a genetic effective population size. This approach does not imply that existing populations should be allowed to decrease to this level; the estimate of 1,667 is used as a gauge to evaluate genetic viability of isolated populations. The extent of genetic linkage among humpback chub populations is not known with certainty. Although the lack of genetic differentiation among the six populations suggests panmixis (Dowling and DeMarais 1993), mark-recapture studies show only limited exchange of fish. Tag recaptures document movement between Black Rocks and Westwater Canyon, and among the LCR and four downstream aggregations in Grand Canyon, but these studies have not shown exchange of fish with or among Cataract Canyon, Yampa Canyon, or Desolation/Gray Canyons. Exchange of individuals among these populations may occur over several decades at a sufficient rate to nullify significant genetic differentiation. Mark-recapture studies in the Black Rocks/Westwater Canyon populations and the Grand Canyon population have shown no exchange of individuals outside of these "core populations", making them appear to be genetically isolated for the past two decades of study. Based on this assumption of short-term genetic isolation, existing numbers of 2,900–6,500 adults and

2,000–4,700 adults, respectively, exceed an N_g of 1,667 and indicate good genetic viability for these core populations. Although the three smaller populations (i.e., Cataract Canyon, Yampa Canyon, Desolation/Gray Canyons) are currently estimated at fewer than 1,667 adults, they are, nevertheless, important to species viability as redundant populations. Better estimates of population size may show that the Desolation/Gray Canyons population is larger than 1,500 adults; this would provide a third genetically viable core population.

3.3.2 Minimum viable population

Genetic effective population size provides a gauge for genetic viability but does not necessarily account for demographic viability. The concept of a minimum viable population (MVP) is defined as a population that is sufficiently abundant and well adapted to its environment for long-term persistence without significant artificial demographic or genetic manipulations (Shaffer 1981; Soulé 1986, 1987; Soulé and Simberloff 1986). Meffe and Carroll (1994) define an MVP as *"the smallest isolated population size that has a specified percent chance of remaining extant for a specified period of time in the face of foreseeable demographic, genetic, and environmental stochasticities, plus natural catastrophes."* Use of MVP does not mean that populations should be allowed to drop to these levels, but is used to assess their genetic and demographic viability. It must be recognized that some populations of any wild animal species may be below an MVP, as dictated by carrying capacity. It cannot be expected that every population will exceed an MVP; linkages to other populations help to keep smaller populations viable. As stated by Thomas (1990), *"There is no single 'magic' population size that guarantees the persistence of animal populations."* Thomas (1990) also stated that MVPs are rarely lower than a few 100 individuals and often correspond to an actual population count of about 1,000.

A minimum viable population size of 2,100 adults was derived by adding 24% to the N_g of 1,667 to account for an estimate of the average annual mortality of adult humpback chub (1,667 x 1.24 = 2,067 or about 2,100; Box 4; Valdez and Ryel 1995, 1997). An average annual adult mortality factor was added to buffer against an event that may result in recruitment failure for a year. The concept of adding a mortality factor to a genetically viable population as demographic security is taken from recovery criteria established for the southern sea otter, in which the estimated mortality from exposure to simulated oil spills was added to the estimate of N_g, based on an N_e of 500 (Ralls et al. 1996).

Box 4. Computation of Minimum Viable Population (MVP)

$$N_g = N_e/(N_e/N_g)$$

where: N_e = genetic effective population size, 500

N_e/N_g = proportion of adults contributing genes to next generation; ~0.30 for most fish

therefore: $N_g = 500/0.30$

$N_g = 1{,}667$

hence: MVP = 1,667 x 1.24 = 2,067 (rounded to 2,100)

where: 1.24 compensates for annual adult mortality of 24%

At least two core populations of humpback chub were identified with numbers of adults that approach or exceed the MVP of 2,100 (i.e., Black Rocks/Westwater Canyon and Grand Canyon). A third core population may exist in Desolation/Gray Canyons, but reliable population estimates are not currently available for that population. These cores contain sufficient numbers of adults to ensure genetic and demographic viability, and subadult numbers show that reproduction and recruitment provide self-sustainability (see Appendix A). These core populations become the central basis for recovery because they provide secure population centers from which dispersal can occur and provide redundancy from catastrophes that may affect one or more populations.

4.0 THREATS TO HUMPBACK CHUB BY LISTING FACTOR

The humpback chub was designated as an endangered species prior to enactment of the ESA, and a formal listing package identifying threats was not assembled. Construction and operation of mainstem dams, nonnative fish species, and local eradication of native minnows and suckers in advance of new human-made reservoirs in the early 1960's were recognized as early threats (Miller 1961; Holden 1991), and the species was included in the United States List of Endangered Native Fish and Wildlife on June 4, 1973 (38 FR No. 106). A description of Threatened Wildlife of the United States compiled by the Office of Endangered Species and International Activities (U.S. Bureau of Sports Fisheries and Wildlife 1973) identified the reasons for decline of the humpback chub as *"unknown"*. Although habitat losses were recognized, the threats were poorly understood, and distribution and abundance of the species were not well known.

Threats to the species were presented in the Recovery Plan (U.S. Fish and Wildlife Service 1990a), which stated that:

> *"The decline of the humpback chub may be due to a combination of factors such as: stream alteration (dams, irrigation, dewatering, and channelization); competition with and predation by introduced, nonnative fish species; hybridization with other Gila; and other factors."*

In addition to stream alteration, nonnative fish species, and hybridization, the Recovery Plan identified pesticides, pollutants, and parasitism as other factors that have contributed to the decline of the species. Hence, the primary threats to humpback chub populations are streamflow regulation and habitat modification (including cold-water dam releases and habitat loss), competition with and predation by nonnative fish species, parasitism, hybridization with other native *Gila*, and pesticides and pollutants (Box 5). These threats are associated with the five listing factors (see section 2.1), and a

Box 5. Primary Threats To Humpback Chub

- Streamflow regulation.
- Habitat modification.
- Predation by nonnative fish species.
- Parasitism.
- Hybridization with other native *Gila* ssp.
- Pesticides and pollutants.

summary of each is presented in the following sections. Site-specific management actions and objective, measurable criteria associated with five recovery factors to minimize or remove threats are provided in section 5.0.

4.1 Listing Factor (A): The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range

Streamflow regulation and associated habitat modification are identified as primary threats to humpback chub populations. Regulation of streamflows in the Colorado River Basin is manifested as reservoir inundation of riverine habitats and changes in flow patterns, sediment loads, and water temperatures. For example, streamflow regulation has generally reduced the magnitude of spring peak flows and increased the magnitude of summer–winter base flows. Since 1950, annual peak flows of the Colorado River immediately upstream of the Black Rocks and Westwater Canyon humpback chub populations have decreased by 29–38% (Van Steeter and Pitlick 1998). Flows of the Green River at Jensen, Utah, upstream of the Desolation/Gray Canyons population have decreased by 13–35% during spring and increased by 10–140% during summer through winter due to regulation by Flaming Gorge Dam (Muth et al. 2000). The combined flow regulation of the Colorado and Green rivers influences habitat conditions in Cataract Canyon, although to a lesser degree because of ameliorating downstream effects and tributary inflows. Habitat of the Yampa River has not been as extensively affected by streamflow regulation as in other rivers of the basin (Modde and Smith 1995; Modde et al. 1999; U.S. Fish and Wildlife Service 2000). In the lower basin, flow of the Colorado River in occupied habitat in Grand Canyon is regulated by Glen Canyon Dam, except for the influence of small tributary inflows. Spring peak flows have been reduced by about 80%, and summer–winter base flows have been increased by about 30% (U.S. Department of the Interior 1995). Regulation of the LCR, the largest tributary of the Colorado River in Grand Canyon, has eliminated surface flow to occupied habitat at all times except during spring runoff and local rainstorms. Streamflow to the lower 14.9 km of habitat occupied by the humpback chub population is sustained by a series of springs in the lower LCR (i.e., Blue Springs) and by high spring runoff and periodic rain-induced floods (see SWCA 2000 for a description of hydrology of the LCR).

Reservoir inundation, cold-water releases from dams, streamflow alteration, changes in channel geomorphology, and modification of sediment transport have impacted habitat of the native Colorado River fishes, including the humpback chub. Since 1905, numerous human-made dams have been constructed throughout the Colorado River Basin, fragmenting habitat and blocking fish passage (maintaining connection within and among populations is important to allow gene flow for maximum genetic diversity). These dams have reduced river flow, altered temperature and flow regimes, trapped sediments and nutrients, changed water quality, and created reservoirs and a continuous source of nonnative fishes (Maddux et al. 1993). In the lower basin, 14 major dams have restricted fish movement through the Colorado, Gila, Salt, and Verde rivers since completion of Hoover Dam in 1935; other dams on the Colorado River include Davis, Parker, Palo Verde Diversion, Imperial, and Laguna. Glen Canyon Dam approximately divides the lower from the upper basin and also segregates the upper and lower recovery unit populations.

Dams were considered a major threat to the humpback chub at the time of listing; however, construction of new dams affecting occupied habitat ceased nearly 4 decades ago. The ongoing threat is no longer new dam construction but the effects linked to the presence and operation of existing dams. Construction of mainstem dams during the early 1960's directly impacted about 102 km of humpback chub habitat by reservoir inundation and about 739 km indirectly through streamflow regulation (Chart and Lentsch 1999, 2000; Van Steeter and Pitlick 1998) and cold-water hypolimnetic releases (Kaeding and Zimmerman 1983; Valdez and Ryel 1997). Humpback chub have been reduced in distribution or extirpated from three areas where they historically occurred, including Flaming Gorge Canyon (Gaufin et al. 1960), Narrow and Lower Cataract canyons (Valdez 1990; Valdez and Williams 1993), and portions of Marble and Grand canyons (Miller 1944; Holden and Stalnaker 1975b; Valdez and Ryel 1995). Habitat lost to inundation by reservoirs includes 18 km in lower Grand Canyon by Lake Mead; 52 km in Narrow and Lower Cataract canyons by Lake Powell; and 32 km below Hideout Canyon by Flaming Gorge Reservoir. Abundance and distribution were possibly also reduced in Whirlpool and Split Mountain canyons by either a pre-dam fish eradication rotenone program (Holden 1991) or by cold releases from Flaming Gorge Dam. Investigators found humpback chub in these canyons during and shortly after closure of Flaming Gorge Dam (Vanicek et al. 1970; Holden and Stalnaker 1975b), but more recent surveys have reported few individuals. Clear, cold-water releases have modified the food supply and precluded mainstem spawning in the Colorado River in Marble and Grand canyons (potential habitat of 403 km) below Glen Canyon Dam. Cold-water temperatures may also reduce swimming ability of young native fish and increase their susceptibility to predation by cold-water fishes, such as trout (Valdez and Ryel 1995).

Changes in channel geomorphology of habitat occupied by humpback chub is not extensive because most habitat occurs in rocky canyon-confined reaches with low susceptibility to geomorphic modification. However, sediment-transport mechanisms through occupied habitat, particularly downstream of dams (Schmidt and Rubin 1995), have been altered substantially, resulting in overall reduction of sediment loads through occupied habitat. This sediment reduction has altered ecological riverine processes, including reduction in organic loads as sources of food production; losses of sand beaches, backwaters, and habitat diversity; and decreased water turbidity as a cover element from sight predators such as brown trout (*Salmo trutta*) and rainbow trout (Marsh and Douglas 1997; Valdez and Ryel 1997). Mean annual sediment discharge of the Green River at Green River, Utah, decreased by 48% following completion of Flaming Gorge Dam in 1962 (Andrews 1986). Sediment load in the Colorado River through Grand Canyon has been reduced by about 99% by entrainment in Lake Powell reservoir. This has resulted in a reduction in sediment supply and loss of sand beaches that provide backwater habitats for young humpback chub (U.S. Department of the Interior 1995). It is anticipated that implementation of recommended flows, discussed below, will provide adequate sediment transport and distribution to restore some of the natural riverine functions.

Maintenance of streamflow is important to the ecological integrity of large western rivers (Tyus and Karp 1989; Collier et al. 1996; Poff et al. 1997; Schmidt et al. 1998). Life histories of many aquatic species, especially fish, are often specifically tied to flow magnitude, frequency, and timing, such that disruption of historic flows can jeopardize native species. The importance of

flow management to the endangered fishes of the Colorado River is recognized (Tyus 1992; Stanford 1994). Enhancing natural temporal and spatial habitat complexity through flow and temperature management is the basis for benefitting the endangered fishes (Osmundson et al. 2000b).

Flow recommendations have been developed for some river systems in the Upper Colorado River Basin that identify and describe flows with the necessary magnitude, frequency, duration, and timing to benefit the endangered fish species (e.g., Modde and Smith 1995; Osmundson et al. 1995; U.S. Department of the Interior 1995; Holden 1999; Modde et al. 1999; McAda 2000 [under revision]; Muth et al. 2000). These flows were designed to enhance habitat complexity (e.g., suitable spawning areas, inundation of floodplain areas) and to restore and maintain ecological processes (e.g., sediment transport, food production) that are believed to be important to the life history of these endangered fishes. Spring peak flows are important to the dynamic sediment processes that maintain in-channel habitat complexity, and prevent vegetation encroachment and channel narrowing. For example, cobble and gravel deposits used for spawning are relatively permanent features formed at high flows. Lower peak flows in subsequent years result in deposition of fine sediments over cobble and gravel deposits. Peak flows, whose timing coincides with the natural runoff cycle, are needed to ensure that suitable sites, cleansed of fine sediments, are available during the spawning period. Conversely, low and relatively stable base flows in summer, fall, and winter provide stable, warm, and productive nursery habitats for young fish.

Flows necessary to restore and maintain required habitats of humpback chub mimic the natural hydrograph and include spring peak flows and summer–winter base flows. Adults utilize eddies and sheltered shoreline habitats maintained by high spring flows (see Appendix A for details on habitat requirements). These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas, rejuvenate food production, and form gravel and cobble deposits used for spawning (McAda 2000; Muth et al. 2000). Spawning occurs on the descending limb of the spring hydrograph at water temperatures typically between 16 and 22°C. Increased production and recruitment have been correlated with moderate-to-high water years (Valdez and Ryel 1995; Gorman and Stone 1999). Young typically use low-velocity shoreline habitats, including eddies and backwaters, that are more prevalent under base-flow conditions. High spring flows also disadvantage nonnative fishes (McAda and Kaeding 1989; Valdez 1990; Hoffnagle et al. 1999), reducing predation and competition. Low base flows also increase shoreline food production.

Flow recommendations have been developed that specifically consider flow-habitat relationships in habitats occupied by humpback chub in the upper basin (see section 3.1.2) including Black Rocks and Westwater Canyon (McAda 2000); Whirlpool, Split Mountain, and Desolation/Gray canyons (Muth et al. 2000); Yampa Canyon (Modde and Smith 1995; Modde et al. 1999; U.S. Fish and Wildlife Service 2000); and Cataract Canyon (McAda 2000; Muth et al. 2000). These flow recommendations will be evaluated and revised (as necessary) as part of an adaptive-management process, and flow regimes to benefit the endangered fishes will be implemented through multi-party agreements or by other means (see section 4.4). In addition to these upper basin flow recommendations, an Environmental Impact Statement (EIS) in 1995, with a Record

of Decision in 1996, established releases from Glen Canyon Dam that will be evaluated through adaptative management to protect resources of the Colorado River through Grand Canyon (U.S. Department of the Interior 1995). These Modified Low Fluctuating Flows (MLFF) reduced daily fluctuations in river flow from peak power plant releases, and allow for high spring releases to restore some aspects of the natural hydrograph. However, the 1994 Biological Opinion on the operation of Glen Canyon Dam (U.S. Fish and Wildlife Service 1994) determined that the new release regime of MLFF "*...is likely to jeopardize the continued existence of the humpback chub...*".

4.2 Listing Factor (B): Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization of humpback chub for commercial, recreational, scientific, or educational purposes is not considered a threat to the species, either presently or historically. This factor will be reevaluated and, if necessary, actions to ensure adequate protection will be identified before downlisting and attained before delisting.

Humpback chub have no commercial or recreational value and are not sought by commercial fishermen or anglers. Some fish may be incidentally caught when recreational angling for other sympatric species, but the number of native fish harmed or killed is believed to be insignificant based on creel surveys by the Colorado Division of Wildlife in Black Rocks and Westwater Canyon (personal communication, E. Wick). All angler access points near occupied habitat are posted with signs advising anglers to release any endangered fish unharmed.

Collection of humpback chub for scientific or educational purposes is regulated by the Service under Section 10(a) of the ESA. Scientific collecting permits are issued to investigators conducting legitimate scientific research, and "take" permits are issued where a reasonable loss of fish is expected. Permits to collect humpback chub for educational purposes are normally not requested but are regulated by the same provisions of the ESA.

4.3 Listing Factor (C): Disease or Predation

4.3.1 Diseases and parasites

Diseases and parasites currently are not considered singly significant in the decline of the humpback chub in the upper basin (see section A.12 for expanded discussion of parasites), but these factors will be reevaluated and, if necessary, actions will be identified to minimize adverse effects before downlisting. Adequate protection from deleterious diseases and parasites will be attained before delisting. However, in the lower basin, Meretsky et al. (2000) hypothesized that an observed decline in condition of adult humpback chub in Grand Canyon was a result of recent infestation by the internal Asian tapeworm (*Bothriocephalus acheilognathi*). During 1996–1997, the Asian tapeworm occurred in 31.6–84.2% of humpback chub examined in the LCR and 8.8–26.7% in the Colorado River (Hoffnagle et al. 2000). The Asian tapeworm is a recent invader of the LCR; it was first reported from Grand Canyon in 1990 (Clarkson et al. 1997;

Brouder and Hoffnagle 1997). It is considered a dangerous parasite capable of killing its hosts and may be a potential population-suppressing agent, although detrimental effects to humpback chub populations have not been documented. The Asian tapeworm has not been reported from upper basin humpback chub populations.

4.3.2 Nonnative fishes

The threat of predation by nonnative fishes on humpback chub has been recognized in three populations. In Grand Canyon, brown trout, channel catfish (*Ictalurus punctatus*), black bullhead (*Ameiurus melas*), and rainbow trout have been identified as principal predators of juvenile humpback chub, with consumption estimates that suggest loss of complete year classes to predation (Marsh and Douglas 1997; Valdez and Ryel 1997). Marsh and Douglas (1997) documented predation on humpback chub in the LCR by rainbow trout, channel catfish, and black bullhead. Valdez and Ryel (1997) identified brown trout, rainbow trout, and channel catfish as known predators of humpback chub in the mainstem Colorado River in Grand Canyon, and suggested that common carp (*Cyprinus carpio*) could be a significant predator of incubating humpback chub eggs in the LCR. In the upper basin, Chart and Lentsch (2000) identified channel catfish as the principal predator of humpback chub in Desolation/Gray Canyons. In Yampa Canyon, the UCRRP identified channel catfish as the principal predator and is pursuing development and implementation of a control program.

A Strategic Plan for Nonnative Fish Control was developed for the Upper Colorado River Basin (Tyus and Saunders 1996) and implemented by the UCRRP in 1997. Some activities include mechanical removal of nonnative fishes through intensive sampling, and modification of habitats used as residential or nursery areas by nonnative fishes. Preliminary results of the control program are inconclusive as to the beneficial effects for native fishes. Data from a 7-year research period on the San Juan River suggest that efforts to date were effective in reducing density of large channel catfish, but efforts were not effective in reducing overall abundance of channel catfish in the river (Holden 1999). A positive population response by native fishes to this channel catfish reduction has not been reported (personal communication, San Juan River Basin Recovery Implementation Program, Biology Committee). A strategic control program has also been recommended for Grand Canyon (Valdez et al. 1999), and a Science Plan is being developed for implementation of nonnative fish removal starting in 2003 (GCMRC 2002).

Control of the release and escapement of nonnative fishes into the main river, floodplain, and tributaries is also a necessary management action to stop the introduction of new fish species into occupied habitats and to thwart periodic escapement of highly predaceous nonnatives from riverside features. Agreements have been signed among the Service and the States of Colorado, Utah, and Wyoming to review and regulate all stockings within the Upper Colorado River Basin (U.S. Fish and Wildlife Service 1996) in order to reduce the introduction and expansion of nonnative fishes. A Memorandum of Agreement implementing these procedures was signed on September 5, 1996, by the Service and the States and remains in effect through the life of the UCRRP. This agreement regulates releases of nonnative fishes within the 50-year floodplain of the river, and provides security against State or Federal endorsed programs introducing new species into the system or increasing the numbers or distribution of existing species. The

agreement also allows the States to regulate and restrict stocking of privately owned ponds. These procedures will also reduce the likelihood of new parasites and diseases being introduced through nonnative fish stockings. Similar procedures need to be developed and implemented in reaches of the mainstem Colorado River through Grand Canyon and in the LCR.

Annual flooding of the river can inundate riverside ponds potentially containing large numbers of green sunfish (*Lepomis cyanellus*), black bullhead, largemouth bass (*Micropterus salmoides*), and other nonnative fishes that may escape to the river during high flows (Valdez and Wick 1983). Riverside features determined to be problematic must be either isolated from high river floods, designed to drain annually with the rise and fall of the river, or treated with piscicidal compounds to eradicate nonnative fishes. The Colorado Division of Wildlife is to prepare a Colorado River Fisheries Management Plan (Plan) that will implement a more detailed nonnative fish control effort. The Plan is to be reviewed and approved by the Colorado Wildlife Commission and UCRRP. The Plan will be finalized and implemented by the dates specified in the Recovery Implementation Program Recovery Action Plan (RIPRAP) of the UCRRP. One aspect of the Plan will be pond reclamation, which can include complete removal of nonnative fish, screening ponds to prevent escapement to the river, and/or reshaping ponds so that they no longer support year-round habitation by nonnative fish.

Additionally, both upper basin and lower basin States have removed bag limits on nonnative fishes in designated critical habitat of humpback chub. The State of Colorado has removed bag limits on all nonnative, warm-water sport fishes within critical-habitat reaches of the Colorado and Yampa rivers. Colorado also has agreed to close river reaches to angling where and when angling mortality is determined to be significant to native fishes. In the lower basin, the Arizona Game and Fish Commission, in January, 1998, approved fishing regulation changes for several State waters designed to reduce numbers of nonnative fishes, including the following for humpback chub occupied habitat in the Colorado River through Grand Canyon:

> *"Unlimited harvest of trout, channel catfish and striped bass from the Colorado River in the Grand Canyon from Separation Canyon (above Lake Mead) to Marble Canyon Bridge. All fish must be kept when caught."*

The regulation was modified before approval to state that *"...fish may be kept when caught."* Existing regulations in Grand Canyon also prohibit use of live fish as bait. Occasional discovery of bait minnows, such as golden shiner (*Notemigonus crysoleucas*; particularly at Lee Ferry), suggests that illegal use of live bait fish continues, albeit at low levels.

Three management actions are identified to reduce the threat of nonnative fishes: high spring flows, nonnative fish control strategies, and stocking agreements. There is documented evidence that high flows temporarily disadvantage nonnative fishes in several ways, including displacement from sheltered habitats, disruption of spawning activities, increased mortality in high mainstem currents, and physical downstream transport of individuals. Studies from the upper Colorado River (McAda and Kaeding 1989), Green River (Valdez 1990), Yampa River (Muth and Nesler 1993), and lower Colorado River through Grand Canyon (Hoffnagle et al. 1999; Valdez et al. 2001) showed reductions in densities of small-bodied species of fish (e.g.,

fathead minnow [*Pimephales promelas*], red shiner [*Cyprinella lutrensis*], sand shiner [*Notropis stramineus*], plains killifish [*Fundulus zebrinus*]) following high flows. On the San Juan River, no evidence exists to support the hypothesis that high flows even temporarily disadvantage nonnatives and promote endangered fish reproduction and recruitment (Holden 1999). A strong year class of humpback chub in Grand Canyon in 1993 followed high early spring-runoff flows from the Little Colorado River, and was attributed to cleansing of spawning gravels and short-term reduction in nonnative fishes (Gorman 1994). Strong year classes following high runoff years are also seen in other Colorado River species (e.g., Colorado pikeminnow). Hence, even a short-term reduction in nonnative fishes could allow increased survival and recruitment of native forms (Tyus and Saunders 1996). Flow recommendations include the provision of high flows, which provide these unsuitable conditions for nonnative fishes and may at least temporarily reduce numbers of these predators and competitors.

Active control programs should be implemented or continued (as needed) for problematic nonnative fishes in Yampa Canyon, Desolation/Gray Canyons, and Grand Canyon. Guidance is not provided in this document with regard to target reduction levels because such criteria may be premature and unreasonable to achieve, or may be easily achieved and exceeded. Little is known with respect to responses by nonnative fish populations to overt control measures, and these must be evaluated as part of nonnative fish control programs. Another unknown aspect of nonnative fish control is the need to maintain control measures indefinitely or periodically over time. These decisions will have to be made from information gained through these control programs during the downlist monitoring period.

4.4 Listing Factor (D): The Inadequacy of Existing Regulatory Mechanisms

Implementation of regulatory mechanisms are necessary for recovery of the humpback chub and to ensure long-term conservation of the species. Regulatory mechanisms affect many aspects of legal protection, such as habitat and flow protection, regulation and/or control of nonnative fishes, regulation of hazardous-materials spills, and angling regulations. Flow regimes to benefit humpback chub populations must be identified, implemented, evaluated, and revised (as necessary) before downlisting can occur (existing flow recommendations are described in section 4.1). By the time of delisting, legal protection of habitat (including flows) necessary to provide adequate habitat and sufficient range for all life stages of humpback chub to support recovered populations must be accomplished through various means, including instream-flow appropriations, legal agreements, contracts, operating criteria, and/or other means. Additionally, certain States may issue policies that also afford flow protection. As examples, the State of Utah has instituted a policy that subordinates all future water-rights appropriations for the Green River from Flaming Gorge Dam to the Duchesne River confluence for the summer and autumn periods to provide flows to benefit the endangered fish; actions proposed under this policy would not affect pre-existing water rights (Utah Division of Water Rights 1994). Also, the State of Colorado has established two instream-flow rights on the Colorado River under its state instream-flow law.

Before delisting, the primary regulatory mechanism for protection of humpback chub is through Section 7(a)(2) of the ESA, as administered by the Service. *"Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency ... is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species which is determined by the Secretary, after consultation as appropriate with affected States, to be critical..."* In the Upper Colorado River Basin, the UCRRP provides a mechanism for dealing with Section 7 consultations in a unified manner. There are currently no formal recovery programs in the lower basin, and Section 7 consultations are addressed on a case-by-case basis. The GCDAMP provides a mechanism for a consolidated effort addressing the Biological Opinion of the Glen Canyon Dam EIS (U.S. Fish and Wildlife Service 1994). The goal of the MSCP is to provide a comprehensive mechanism for ensuring regulatory compliance under both Sections 7 and 10 of the ESA for all participating Federal and non-Federal MSCP agencies and entities. Similarly, the MSCP is intended, and is being structured, to provide environmental compliance pursuant to the California Endangered Species Act and California Environmental Quality Act (CEQA). None of the recovery or conservation programs in the Colorado River Basin are regulatory mechanisms that provide permanent, long-term protection for the species after delisting.

In addition to Federal protection under the ESA, humpback chub are protected by all basin States under categories such as "endangered", "threatened", or "sensitive". This protection prohibits intentional take and keeping or harming in any way any fish captured incidentally, and may need to remain in place after the species is Federally delisted. However, the States do not address the major problem of habitat destruction, and especially streamflow modification. Most States have instream-flow laws that allow "beneficial use" of water left in streams for wildlife, but these laws typically only provide for flow that is the minimum amount necessary to maintain the fishery. With some States, there is also an inherent conflict between management of nonnative sport fish and recovery of endangered fishes. Where valued sport fisheries occur, there is an ongoing dilemma between public demands for maintenance and expansion of fisheries and management actions to conserve and recover endangered fish. There is no immediate solution to the dilemma, but predation by nonnative fishes is clearly identified as a cause for the decline of many of the native Colorado River fishes, and long-term agreements between States and the Service are essential.

After removal from the list of species protected by the ESA, the humpback chub and its habitat will continue to receive consideration and some protection through the following Federal laws and related State statutes, and will need the provisions to protect habitat previously discussed. The National Environmental Policy Act (NEPA; 42 U.S.C. 4321–4370d) requires Federal agencies to evaluate the potential effects of their proposed actions on the quality of the human environment and requires the preparation of an environmental impact statement whenever projects may result in significant impacts. Federal agencies must identify adverse environmental impacts of their proposed actions and develop alternatives that undergo the scrutiny of other public and private organizations as a part of their decision-making process. Recovery actions identified for humpback chub are linked to federal actions, which must undergo review under NEPA.

Section 101(a) of the Federal Water Pollution Control Act (i.e., Clean Water Act; 33 U.S.C. 1251–13287) states that the objective of this law is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters and provide the means to assure that "*...protection and propagation of fish, shellfish, and wildlife...*". This statute contributes in a significant way to the protection of the humpback chub and its food supply through provisions for water quality standards, protection from the discharge of harmful pollutants, contaminants [Section 303(c), Section 304(a), and Section 402] and discharge of dredge or fill material into all waters, including certain wetlands (Section 404).

The Organic Act (16 USC 1, as amended) provides for management of National Park Service areas in such a manner *"...to promote and regulate the use of the...national parks...which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."* The National Park Service is the largest single jurisdictional land owner in reaches with critical and other occupied habitats for the four Colorado River endangered fishes (Maddux et al. 1993).

The Fish and Wildlife Coordination Act (16 U.S.C. 661–666c) requires that Federal agencies sponsoring, funding, or permitting activities related to water resource development projects request review of these actions by the Service and the State natural resource management agency. These comments must be given equal consideration with other project purposes. Also, the Federal Land Policy and Management Act (43 U.S.C. 1701–1784) requires that public lands be managed to protect the quality of scientific, ecological, and environmental qualities and preserve and protect certain lands in their natural conditions to provide food and habitat for fish and wildlife.

Hazardous-materials spills are identified as a threat to humpback chub, particularly populations in Black Rocks, Westwater Canyon, Yampa Canyon, and the LCR. Although the States of Colorado, Utah, and Arizona, where these populations occur, have state-wide hazardous-materials plans, these may not be adequate to provide protection against spills into the river at or near these locations. Research into the adequacy of these plans is identified as a recovery element. Hazardous-materials spills are regulated by the Hazardous Materials and Waste Management Division of the Colorado Department of Public Health and Environment; the Hazardous Waste Branch of the Utah Department of Environmental Quality; and the Hazardous Waste Section of the Arizona Department of Environmental Quality.

The need for conservation plans and agreements was identified to provide reasonable assurances that recovered humpback chub populations will be maintained. These plans are to be implemented after delisting and are intended to assure that relisting does not become necessary. They would be developed to ensure long-term management and protection of the species, and should include (but not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats. Signed agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties must be in place to implement the conservation plans before delisting can occur.

4.5 Listing Factor (E): Other Natural or Manmade Factors Affecting Its Continued Existence

4.5.1 Hybridization

Humpback chub, bonytail, and roundtail chub (*Gila robusta*) are sympatric Colorado River mainstem species with substantial evidence of introgressive hybridization (Dowling and DeMarais 1993). Intraspecific and interspecific morphological variation can be extensive where these three species coexist. This apparent introgressive hybridization has resulted in high phenotypic plasticity with morphologic intergrades present in all sympatric populations of Colorado River *Gila* (Holden and Stalnaker 1970; Smith et al. 1979; Valdez and Clemmer 1982; Kaeding et al. 1990; Wick et al. 1991; McElroy and Douglas 1995; Douglas et al. 1998). These intergrades suggest, to some, extensive hybridization with possible concomitant loss of genetic diversity and evolutionary adaptive traits (Valdez and Clemmer 1982; Rosenfeld and Wilkinson 1989). Others believe that introgressive hybridization is part of the common evolutionary history of the Colorado River *Gila*, resulting in high phenotypic plasticity and adaptability to the rigorous physical habitats present in the Colorado River Basin (Dowling and DeMarais 1993). Evidence of intergrades was reported prior to extensive human alterations to the basin (Miller 1946).

Proportions of humpback chub, roundtail chub, bonytail, and intergrades from each of the six populations of humpback chub are shown in Table A-1 (see section A.3). Proportions of these phenotypes in Black Rocks and Westwater Canyon vary primarily because of increased invasion of these canyon areas by roundtail chub during low water years (Chart and Lentsch 1999). Despite this variation, overall average proportions of humpback chub:roundtail chub:intergrades for Black Rocks and Westwater Canyon are similar as 48:45:8 and 44:45:12, respectively. Average proportions in Desolation/Gray Canyons of 19:7:74 show the highest proportions of intergrades of any population of humpback chub. Proportions in the LCR and Colorado River in Grand Canyon are 100% humpback chub because the known genotype is primarily of this form (Dowling and DeMarais 1993), and recent samples show little evidence of other phenotypes in this population (McElroy and Douglas 1995). Proportions of 46:23:13:18 in Cataract Canyon include bonytail and indicate a large diverse complex of *Gila* associated with this population (McElroy and Douglas 1995). The proportion of 14:86:0 in Yampa Canyon shows a large percentage of roundtail chub relative to humpback chub and little or no intergradation between these forms.

Proportions of humpback chub to roundtail chub and catch rates recorded by investigators in Black Rocks (Kaeding et al. 1990) and Westwater Canyon (Chart and Lentsch 2000) reveal a greater proportion of roundtail chub in these areas in years of low flow; it is hypothesized that lower velocities and less turbulence in low water years allow roundtail chub to invade canyon regions not normally inhabited by this species. Increased sympatry of these species potentially increases the chances for hybridization; hybridization has been demonstrated in a hatchery among all three *Gila* species. Hence, it is necessary to provide flow regimes that reflect inter-

annual variability in hydrologic conditions (e.g., wet, average, and dry water years) in order to maintain natural proportions of *Gila* species and intergrades.

4.5.2 Pesticides and pollutants

The potential role of pesticides and pollutants in suppressing populations of *Gila* were discussed by Wick et al. (1981). Over 16% of young roundtail chub from the Yampa and Colorado rivers in 1981 showed spinal deformities (i.e., lordosis), hypothesized to be possibly related to high pesticide levels from local agricultural applications (Haynes and Muth 1981). Other pollutants in the system include petroleum products, heavy metals (e.g., mercury, lead, zinc, copper), nonmetalics (i.e., selenium), and radionucleides. Although these elements are concentrated in some regions of the basin, no tissue analyses have been conducted for humpback chub to determine current levels of bioaccumulation. Selenium has been identified as a potential problem for razorback sucker and Colorado pikeminnow (Osmundson et al. 2000a).

Potential spills of hazardous materials threaten some populations of humpback chub (Table 2). The Denver and Rio Grande Western railroad tracks parallel the Colorado River at Black Rocks and upper Westwater Canyon with the risk of derailment and spills of materials into the river, although no known derailments have occurred in these areas. The susceptibility of these humpback chub populations to toxic substances is illustrated by a large, but unquantified, fish kill in Westwater Canyon in the 1980's as a result of a large ash flow following a range wildfire high in the watershed (personal communication, J. Cresto, U.S. Bureau of Land Management). Ash and large amounts of sediment washed down Westwater Creek during a sudden thunderstorm. A similar threat from petroleum products exists for the population in the LCR with the risk of trucks overturning and spilling their loads while crossing the Highway 89 bridges at Cameron, Arizona. Shipping traffic is allowed to cross on two bridges near Cameron, which are about 60 km upstream of habitat occupied by humpback chub in the lower LCR. The potential for spills of petroleum products also exists in the upper basin. For example, numerous petroleum-product pipelines cross or parallel the Yampa River upstream of Yampa Canyon, most of which lack emergency shut-off valves. One pipe ruptured in the late 1980's releasing refined oil into the Yampa River, but the effects of this spill were not documented.

All States have hazardous-materials spills emergency-response plans that provide a quick cleanup response to accidental spills (see section 4.4). These responses may not be sufficiently rapid to minimize deleterious effects to fishes, especially a species like the humpback chub that is extremely limited in distribution within canyon reaches. Quick response may, therefore, be inadequate to protect the species and preventive measures must be incorporated into these plans. These preventive measures may include reduced speed of railway traffic near occupied habitats, such as Black Rocks and Westwater Canyon; safety shut-off valves on petroleum-products lines in or near the floodplain; and filtration systems in case of accidental spills of hazardous materials at bridge crossings above occupied habitats, such as at the Cameron bridges. Identifying and implementing the most reasonable and prudent preventive measures will require a comprehensive review of existing State and Federal hazardous-materials spills emergency-response plans. These preventive measures must be implemented before delisting.

Table 2. Potential, existing, or past threats from pesticides and pollutants to six populations of humpback chub.

Population	Threats From Pesticides and Pollutants
Upper Basin Recovery Unit	
Black Rocks	• Denver and Rio Grande Western railroad tracks parallel Colorado River at Black Rocks with risk of derailment and spills into the river
Westwater Canyon	• Denver and Rio Grande Western railroad tracks parallel Colorado River at upper Westwater Canyon and cross Westwater Creek with risk of derailment and spills into the river
Yampa Canyon	• Numerous petroleum product pipelines cross or parallel the Yampa River; most pipelines lack safety cutoff valves • A high incidence of spinal deformity has been reported in *Gila* spp., believed to be caused by agricultural pesticides
Desolation/Gray Canyons	• No identified threat
Cataract Canyon	• No identified threat
Lower Basin Recovery Unit	
Grand Canyon —Little Colorado River Grand Canyon —Colorado River	• Risk of trucks overturning and spilling their loads into the LCR while crossing Highway 89 bridges at Cameron, 55–65 km upstream of occupied habitat • Little apparent risk of spills except from materials coming down the LCR

5.0 RECOVERY GOALS

The following are site-specific management actions and objective, measurable recovery criteria for the humpback chub presented by the two recovery units, i.e., the upper basin (including the Green River and upper Colorado River subbasins) and the lower basin (including the mainstem and its tributaries from Glen Canyon Dam downstream to Lake Mead National Recreation Area). The humpback chub was listed prior to the 1996 DPS policy, and the Service may conduct an evaluation to designate DPSs in a future rule-making process. Steps for downlisting and delisting presented in this section are consistent with provisions specified under Section 4(a)(1), Section 4(b), Section 4(c)(2)(B), and Section 4(f)(1) of the ESA (see section 2.0 of this document). The five recovery factors (i.e., Factor A, Factor B, etc.) were derived from the five listing factors (see section 2.1) and state the conditions under which threats are minimized or removed. For each recovery factor, management actions and tasks are identified that minimize or remove threats to the humpback chub. Under objective, measurable recovery criteria, demographic criteria and recovery factor criteria are presented for downlisting and delisting. Generally, for each downlisting criterion there is a corresponding delisting criterion. Reclassification can be considered when appropriate recovery criteria are met.

5.1 Requirements and Uncertainties Associated with Recovery Goals

5.1.1 Demographic criteria and monitoring

Demographic criteria that describe numbers of populations and individuals (adults and juveniles) for downlisting and delisting are presented for upper and lower basin recovery units. These criteria specify no net loss in each of the six existing populations, based on requirements of no significant decline in numbers of adults for each population and recruitment equal to or exceeding adult mortality, and genetically and demographically viable, self-sustaining core populations.

Wild populations of humpback chub have been studied since the 1960's, and population dynamics and responses to management actions have been evaluated since the early 1980's. A 5-year monitoring period is required for downlisting, and a 3-year monitoring period beyond downlisting is required for delisting. The downlist monitoring period begins with the first reliable estimates for all populations acceptable to the Service. The downlist and delist monitoring periods are expected to be continuous, and reclassification cannot be considered until each population has been monitored for the required period of time. The total 8-year monitoring period is equivalent to approximately one generation time for humpback chub, and is considered sufficient to determine if populations are stable, increasing, or decreasing. Generation time is equal to the mean adult age and is computed as the average age of attaining sexual maturity; i.e., $age_{sex\ maturity}$ plus (1/d), where d is equal to death rate (Seber 1982; Gilpin 1993). For humpback chub, the age of attaining sexual maturity is 4 years and the adult survival rate is 0.76 (d=1-0.76); hence, generation time is 4 + [1/(1-0.76)] = 4 + 4 = 8. It is important to note that under Section 4(g)(1) of the ESA, *"The Secretary shall implement a system in cooperation with the States to monitor effectively for not less than five years the status of all species which have recovered to the point at which the measures provided pursuant to this Act are no longer necessary..."*. Hence, populations would be monitored for at least 5 additional years after delisting.

The Service considers a reliable estimate as one that is based on a multiple mark-recapture model. Direct enumeration of fish populations is not feasible in turbid rivers, and removal estimates are unreliable because of the difficulty of blocking reaches of large rivers to meet the model assumption of no migration. Instead, closed-population, multiple mark-recapture estimators (Otis et al. 1978; Burnham et al. 1987; Chao 1989; Osmundson and Burnham 1998) are recommended for deriving population point estimates and to guide development of sampling designs that conform to these models. The accuracy and precision of each point estimate will be assessed by the Service in cooperation with the respective recovery or conservation programs, and in consultation with investigators conducting the point estimates and with qualified statisticians and population ecologists. If, for example, an estimate is made that is considered unreliable (i.e., lacks precision and accuracy) because of poor sampling conditions or other causes, a determination will be made if an additional estimate is needed in the following year in order to accurately assess if downlisting or delisting criteria are met. Field sampling methodologies should be developed and refined to attain a balance between the need for accurate and precise population estimates while minimizing stress to fish from excessive handling.

Monitoring must be designed to determine if the demographic criteria are being met. At least three point estimates are needed for each of the six extant humpback chub populations to downlist, and at least two more estimates are needed to delist. Point estimates should be made in each of 2–3 consecutive years with 1–2 years between blocks of estimates. In order to ensure no net loss in each population, the trend in adult (age 4+; ≥200 mm TL; see section A.9) point estimates cannot decline significantly; i.e., slope is not significantly less than zero over the trend period ($p \leq 0.05$), requiring that the population is either stable or increasing during the monitoring period. Also, mean estimated recruitment of age-3 (150–199 mm TL; see section A.9) naturally produced fish in each population must equal or exceed mean annual adult mortality (i.e., ≥24%). This criterion requires that each population is reproducing, recruiting, and self-sustaining. To meet the requirement of genetically and demographically viable, self-sustaining, core populations, each point estimate for each core population must exceed 2,100 adults (MVP; see section 3.3.2); two core populations are required for downlisting and three for delisting. In addition to the demographic criteria, adequate habitat and sufficient range are required to support recovered populations. Recovery goals require maintenance of populations within areas of designated critical habitat (59 FR 13374).

5.1.2 Recovery factor criteria

The recovery factor criteria are directly linked to management actions/tasks. Recovery factor criteria for downlisting generally call for identification, implementation, evaluation, and revision of management tasks. Corresponding criteria for delisting call for attainment of necessary and feasible levels of protection that minimize or remove threats.

Each of the six threats identified in section 4.0 (i.e., streamflow regulation, habitat modification, competition with and predation by nonnative fishes, parasitism, hybridization, and pesticides and pollutants) is addressed in this section with appropriate management actions/tasks. Details of these and other management actions/tasks that contribute to recovery are or will be identified in the RIPRAP of the UCRRP, Adaptive Management Program Strategic Plan of the GCDAMP, and in annual work plans of the MSCP. These programs function under the general principles of adaptive management, and the plans are periodically revised. In the context of these programs, adaptive management is the process by which management actions are identified, implemented, evaluated, and revised based on results of research and monitoring.

Providing and legally protecting habitat are necessary elements in recovery of the humpback chub. Habitat as used in these recovery goals is defined as the physical and biological components of the environment required for recovery of the species, including flow regimes necessary to restore and maintain those environmental conditions. Hence, identification, implementation, evaluation, and revision of adequate flow regimes through adaptive management are identified as criteria necessary for downlisting. By the time of delisting, flows (as well other habitat components) identified as necessary to the life history of the species must be provided and legally protected through various means, including instream-flow appropriations, legal agreements, contracts, operating criteria, and/or other means. As stated in the governing document of the UCRRP (U.S. Department of the Interior 1987), under this program legal protection of flows referenced in these recovery goals for upper basin rivers will

be consistent with State and Federal laws related to the Colorado River system (sometimes referred to as "Law of the River"), including State water law, interstate compacts, and Federal trust responsibilities to American Indian tribes. It is recognized that flow management alone is not sufficient to ensure self-sustaining populations of the endangered fishes, and that a combination of flow and non-flow management actions will be necessary for recovery. It is anticipated that flow management actions identified in these recovery goals can be achieved in balance with non-flow management actions to improve ecosystem conditions and enhance recovery and sustainability of the endangered fish populations. Population and demographic data collected through monitoring will be used to track progress toward meeting the habitat needs of the species.

Implementation of conservation plans is required in order to provide for the long-term management and protection of humpback chub populations after delisting. These conservation plans will be developed and implemented through agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties, and may include (but are not limited to) provision of flows for maintenance of habitat conditions required for all life stages, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, and monitoring of populations and habitats.

5.1.3 Uncertainties

These recovery goals are based on the best available scientific information, and are structured to attain a balance between reasonably achievable criteria (which include an acceptable level of uncertainty) and ensuring the viability of the species beyond delisting. It is expected that research, management, and monitoring activities directed by the UCRRP, GCDAMP, and MSCP will fill information gaps and considerably narrow, if not eliminate, many of the uncertainties that affect recovery criteria. Additional data and improved understanding of humpback chub biology may prompt future revision of these recovery goals. The Service intends to review, and revise as needed, these recovery goals at least once every 5 years from the date of their publication in the *Federal Register*, or as necessary when sufficient new information warrants a change in the recovery criteria. Review of these recovery goals will be part of the review of listed species as
required by Section 4(c)(2)(A) of the ESA, *"The Secretary shall ... conduct, at least once every five years, a review of all species..."*. Uncertainties associated with these recovery goals include:

- Carrying Capacity. The carrying capacity for humpback chub populations is unknown. Humpback chub presently occupy most, if not all, of the available suitable habitat that remains in the Colorado River Basin, and the potential for establishing additional stocks is probably low. Populations that presently appear relatively stable (i.e., Black Rocks, Westwater Canyon, Grand Canyon) may not have the capacity to increase substantially and may be at or near functional carrying capacity. However, it may be possible for populations to expand their range naturally if resource limitations are minimized or removed.
- Genetic Viability. Although determination of genetic effective population size (N_e) was based on principles in conservation genetics (i.e., "50/500 rule"), genetic information on humpback chub was insufficient to derive a species-specific value

of N_e and a ratio of N_e/N_g. In addition, the extent of genetic linkage among humpback chub populations is not known with certainty.

- Flow and Temperature Recommendations. Flow and temperature recommendations have been developed that specifically consider flow-habitat relationships in habitats occupied by humpback chub. However, it is uncertain to what extent these recommendations can be met and what flow regimes will be necessary to meet the life history needs of the humpback chub. Streamflow reduction and modification from dams and water withdrawal systems have reduced spatial and temporal variability in flow regimes, reduced available habitat, and changed ecosystem function and structure. A paradigm in river management suggests that the ecological integrity of river ecosystems is linked to their natural dynamic character (Stanford et al. 1996; Poff et al. 1997), and restoring a more natural flow regime is the cornerstone of river restoration. This paradigm and the response by endangered fishes of the Colorado River Basin is largely untested, and as these flow regimes to benefit the endangered fishes are implemented, it is important to be aware of associated uncertainties and plan for management of unanticipated results. Response of humpback chub to flows will need to be monitored in order to identify and provide flow regimes that are necessary to restore and maintain adequate habitat and sufficient range for all life stages.
- Nonnative Fish Response. Uncertainty exists regarding the responses of nonnative fishes to active control measures and to flow regimes to benefit the endangered fishes. Many of these nonnative fishes, both warm-water and cold-water, prey on and compete with native fishes. There are indications that high spring flows have a negative effect on nonnative fishes, but the overall response of nonnative fish populations to flow recommendations is uncertain. Long-term response by nonnative fishes to mechanical removal is also an uncertainty. It is unknown if reduction in numbers of nonnatives will result in lower population numbers, altered age structure, or opening of niches for new or existing nonnative fishes. It is also unknown if reduction in nonnative fishes will result in increased numbers of native fishes.
- Efficacy of Monitoring Programs. The precision and reliability of long-term monitoring programs to accurately measure the response of humpback chub populations to management actions is an uncertainty. Mark-recapture population estimates may reflect high variability because of population variability and/or sampling variability. This variability in estimates may exceed the level of population response to a management action, masking measurement of short-term responses and cause-effect relationships. Demographic criteria proposed in this document attempt to account for this variability and set numbers that are measurable under current conditions.
- Response to Management Actions. Management actions, such as regulation of escapement of nonnative fishes, control of parasites, control of nonnative fishes, and minimization of the risk of hazardous-materials spills, may vary in their effectiveness to benefit humpback chub. Tasks and recovery criteria associated

with each of these management actions are intended to provide some measure of success before reclassification can occur.

5.2 Site-Specific Management Actions and Tasks by Recovery Factor

5.2.1 Upper basin recovery unit

5.2.1.1 Factor A.—Adequate habitat and range for recovered populations provided

Management Action A-1.—Provide flows necessary for all life stages of humpback chub to support recovered populations, based on demographic criteria.

Task A-1.1.—Identify, implement, evaluate, and revise (as necessary through adaptive management) flow regimes to benefit humpback chub populations in the upper Colorado, Green, and Yampa rivers (see section 4.1 for discussion of existing flow recommendations to benefit the endangered fishes and for discussion of humpback chub flow-habitat requirements; see Appendix A for a synopsis of humpback chub life history).

Task A-1.2.—Provide flow regimes (as determined under Task A-1.1) that are necessary for all life stages of humpback chub to support recovered populations in Black Rocks, Westwater Canyon, Yampa Canyon, Desolation/Gray Canyons, and Cataract Canyon.

5.2.1.2 Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes

Management Action B-1.—Protect humpback chub populations from overutilization for commercial, recreational, scientific, or educational purposes.

Task B-1.1.—Reevaluate and, if necessary, identify actions to ensure adequate protection from overutilization of humpback chub for commercial, recreational, scientific, or educational purposes; not currently identified as an existing threat (see section 4.2).

Task B-1.2.—Implement identified actions (as determined under Task B-1.1) to ensure adequate protection for humpback chub populations from overutilization for commercial, recreational, scientific, or educational purposes.

5.2.1.3 Factor C.—Adequate protection from diseases and predation

Management Action C-1.—Minimize adverse effects of diseases and parasites on humpback chub populations.

Task C-1.1.—Reevaluate and, if necessary, identify actions to minimize adverse effects of diseases and parasites on humpback chub populations; not currently identified as an existing threat in the upper basin (see sections 4.3.1 and A.12 for discussion of diseases and parasites).

Task C-1.2.—Implement identified actions (as determined under Task C-1.1) to ensure adequate protection of humpback chub populations from deleterious diseases and parasites.

Management Action C-2.—Regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.

Task C-2.1.—Develop, implement, evaluate, and revise (as necessary through adaptive management) procedures for stocking nonnative fish species in the Upper Colorado River Basin to minimize negative interactions between nonnative fishes and humpback chub (see sections 4.3.2 and A.8 for discussion of effects of nonnative fishes).

Task C-2.2.—Finalize and implement procedures (as determined under Task C-2.1) for stocking nonnative fish species in the Upper Colorado River Basin to minimize negative interactions between nonnative fishes and humpback chub.

Management Action C-3.—Control problematic nonnative fishes as needed.

Task C-3.1.—Develop channel catfish control programs in Yampa Canyon and Desolation/Gray Canyons to identify levels of control that will minimize predation on humpback chub (see sections 4.3.2 and A.8 for discussion of effects of nonnative fishes).

Task C-3.2.—Implement identified levels (as determined under Task C-3.1) of channel catfish control in Yampa Canyon and Desolation/Gray Canyons.

5.2.1.4 Factor D.—Adequate existing regulatory mechanisms

Management Action D-1.—Legally protect habitat (see definition of habitat in section 5.1.2) necessary to provide adequate habitat and sufficient range for all life stages of humpback chub to support recovered populations, based on demographic criteria.

Task D-1.1.—Determine mechanisms for legal protection of adequate habitat through instream-flow rights, contracts, agreements, or other means (see section 4.4 for discussion of regulatory mechanisms).

Task D-1.2.—Implement mechanisms for legal protection of habitat (as determined under Task D-1.1) that are necessary to provide adequate habitat and sufficient range for all life stages of humpback chub to support recovered populations.

Management Action D-2.—Provide for the long-term management and protection of humpback chub populations and their habitats.

Task D-2.1.—Identify elements needed for the development of conservation plans that are necessary to provide for the long-term management and protection of humpback chub populations; elements of these plans may include (but are not limited to) provision of flows for maintenance of adequate habitat conditions for all life stages of humpback chub, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, minimization of risks of parasites, and monitoring of populations and habitats (see section 4.4 for discussion of need for conservation plans).

Task D-2.2.—Develop and implement conservation plans and execute agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties to provide reasonable assurances that conditions needed for recovered humpback chub populations will be maintained.

5.2.1.5 Factor E.—Other natural or manmade factors for which protection has been provided

Management Action E-1.—Minimize the threat of hybridization among *Gila* species in river reaches occupied by humpback chub.

Task E-1.1.—Provide flow regimes that reflect inter-annual variability in hydrologic conditions in order to maintain natural proportions of *Gila* species and intergrades in Black Rocks, Westwater Canyon, Yampa Canyon, Desolation/Gray Canyons, and Cataract Canyon (see sections 4.5.1 and A.3 for discussion of hybridization).

Management Action E-2.—Minimize the risk of hazardous-materials spills in critical habitat.

Task E-2.1.—Review and recommend modifications to State and Federal hazardous-materials spills emergency-response plans to ensure adequate protection for humpback chub populations from hazardous-materials spills, including prevention and quick response to hazardous-materials spills (see section 4.5.2 for discussion of hazardous-materials spills).

Task E-2.2.—Implement State and Federal emergency-response plans that contain the necessary preventive measures (as determined under Task E-2.1) for hazardous-materials spills.

Task E-2.3.—Identify measures to minimize the risk of hazardous-materials spills in Black Rocks and Westwater Canyon from transport of materials along the adjacent railway.

Task E-2.4.—Implement measures (as determined under Task E-2.3) to minimize the risk of hazardous-materials spills in Black Rocks and Westwater Canyon from transport of materials along the adjacent railway.

Task E-2.5.—Identify locations of all petroleum-product pipelines within the 100-year floodplain of critical habitat and assess the need for emergency shut-off valves to minimize the potential for spills.

Task E-2.6.—Install emergency shut-off valves (as determined under Task E-2.5) on problematic petroleum-product pipelines within the 100-year floodplain of critical habitat.

5.2.2 Lower basin recovery unit

5.2.2.1 Factor A.—Adequate habitat and range for recovered populations provided

Management Action A-1.—Investigate the role of the mainstem Colorado River in maintaining the Grand Canyon humpback chub population and provide appropriate habitats in the mainstem as necessary for recovery.

Task A-1.1.—Identify life stages and habitats of humpback chub in the mainstem Colorado River and determine the relationship between individuals in the mainstem Colorado River and Little Colorado River.

Task A-1.2.—Provide appropriate habitats for humpback chub in the mainstem Colorado River (as determined necessary under Task A-1.1).

Management Action A-2.—Provide flows necessary for all life stages of humpback chub to support a recovered Grand Canyon population, based on demographic criteria.

Task A-2.1.— As determined necessary and feasible, continue to operate Glen Canyon Dam water releases under adaptive management to benefit humpback chub in the mainstem Colorado River through Grand Canyon (see section 4.1 for discussion of existing releases from Glen Canyon Dam and for discussion of humpback chub flow-habitat requirements; see Appendix A for a synopsis of humpback chub life history).

Task A-2.2.—Identify, implement, evaluate, and revise (as necessary through adaptive management) a flow regime in the Little Colorado River to benefit humpback chub.

Task A-2.3.—Provide flow regimes (as determined under Tasks A-2.1 and A-2.2) that are necessary for all life stages of humpback chub to support a recovered Grand Canyon population.

Management Action A-3.—Investigate the anticipated effects of and options for providing warmer water temperatures in the mainstem Colorado River through Grand Canyon that would allow for range expansion of the Grand Canyon humpback chub population and provide appropriate water temperatures if determined feasible and necessary for recovery.

Task A-3.1.—Determine the effects and feasibility of a temperature control device for Glen Canyon Dam under the Glen Canyon Dam Adaptive Management Program (U.S. Bureau of Reclamation 1999) to increase water temperatures in the mainstem Colorado River through Grand Canyon that would allow for range expansion of humpback chub.

Task A-3.2.—Implement a temperature control device for Glen Canyon Dam if determined feasible and necessary for recovery of humpback chub.

5.2.2.2 Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes

Management Action B-1.—Protect humpback chub populations from overutilization for commercial, recreational, scientific, or educational purposes.

Task B-1.1.—Reevaluate and, if necessary, identify actions to ensure adequate protection from overutilization of humpback chub for commercial, recreational, scientific, or educational purposes; not currently identified as an existing threat (see section 4.2).

Task B-1.2.—Implement identified actions (as determined under Task B-1.1) to ensure adequate protection for humpback chub populations from overutilization for commercial, recreational, scientific, or educational purposes.

5.2.2.3 Factor C.—Adequate protection from diseases and predation

Management Action C-1.—Control Asian tapeworm as needed.

Task C-1.1.—Develop an Asian tapeworm control program in the Little Colorado River to identify the levels of control that will minimize the negative effects of parasitism on the humpback chub population (see sections 4.3.1 and A.12 for discussion of diseases and parasites).

Task C-1.2.—Implement identified levels (as determined under Task C-1.1) of Asian tapeworm control in the Little Colorado River.

Management Action C-2.—Regulate nonnative fish releases and escapement into the main river, floodplain, and tributaries.

Task C-2.1.—Develop, implement, evaluate, and revise (as necessary through adaptive management) procedures for stocking and to minimize escapement of nonnative fish species into the Colorado River and its tributaries through Grand Canyon to minimize negative interactions between nonnative fishes and humpback chub (see sections 4.3.2 and A.8 for discussion of effects of nonnative fishes).

Task C-2.2.—Finalize and implement procedures (as determined under Task C-2.1) for stocking and to minimize escapement of nonnative fish species into the Colorado River and its tributaries through Grand Canyon to minimize negative interactions between nonnative fishes and humpback chub.

Management Action C-3.—Control problematic nonnative fishes as needed.

Task C-3.1.—Develop rainbow trout, channel catfish, black bullhead, and common carp control programs in the Little Colorado River to identify levels of control that will minimize predation on humpback chub (see sections 4.3.2 and A.8 for discussion of effects of nonnative fishes).

Task C-3.2.—Implement identified levels (as determined under Task C-3.1) of rainbow trout, channel catfish, black bullhead, and common carp control in the Little Colorado River.

Task C-3.3.—Develop brown trout and rainbow trout control programs in the Colorado River through Grand Canyon to identify levels of control that will minimize predation on humpback chub.

Task C-3.4.—Implement identified levels (as determined under Task C-3.3) of brown trout and rainbow trout control in the Colorado River through Grand Canyon.

5.2.2.4 Factor D.—Adequate existing regulatory mechanisms

Management Action D-1.—Legally protect habitat (see definition of habitat in section 5.1.2) necessary to provide adequate habitat and sufficient range for all life stages of humpback chub to support a recovered Grand Canyon population, based on demographic criteria.

Task D-1.1.—Determine mechanisms for legal protection of adequate habitat in the mainstem Colorado River through Grand Canyon and the Little Colorado River through instream-flow rights, contracts, agreements, or other means (see section 4.4 for discussion of regulatory mechanisms).

Task D-1.2.—Implement mechanisms for legal protection of habitat in the mainstem Colorado River and the Little Colorado River (as determined under Task D-1.1) that are necessary to provide adequate habitat and sufficient range for all life stages of humpback chub to support a recovered Grand Canyon population.

Management Action D-2.—Provide for the long-term management and protection of humpback chub populations and their habitats.

Task D-2.1.—Identify elements needed for the development of conservation plans that are necessary to provide for the long-term management and protection of humpback chub populations; elements of these plans may include (but are not limited to) provision of flows for maintenance of adequate habitat conditions for all life stages of humpback chub, regulation and/or control of nonnative fishes, minimization of the risk of hazardous-materials spills, minimization of risks of parasites, and monitoring of populations and habitats (see section 4.4 for discussion of need for conservation plans).

Task D-2.2.—Develop and implement conservation plans and execute agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties to provide reasonable assurances that conditions needed for recovered humpback chub populations will be maintained.

5.2.2.5 Factor E.—Other natural or manmade factors for which protection has been provided

Management Action E-1.—Minimize the risk of hazardous-materials spills in critical habitat.

Task E-1.1.—Review and recommend modifications to State and Federal hazardous-materials spills emergency-response plans to ensure adequate protection for humpback chub populations from hazardous-materials spills, including prevention and quick response to hazardous-materials spills (see section 4.5.2 for discussion of hazardous-materials spills).

Task E-1.2.—Implement State and Federal emergency-response plans that contain the necessary preventive measures (as determined under Task E-1.1) for hazardous-materials spills.

Task E-1.3.—Identify measures to minimize the risk of hazardous-materials spills from transport of materials along U.S. Highway 89 at and near the two Cameron bridges spanning the Little Colorado River.

Task E-1.4.—Implement measures (as determined under Task E-1.3) to minimize risk of hazardous-materials spills from transport of materials along U.S. Highway 89 at and near the two Cameron bridges spanning the Little Colorado River.

5.3 Objective, Measurable Recovery Criteria

5.3.1 Downlist criteria

5.3.1.1 Demographic criteria for downlisting (population demographics in both recovery units must be met in order to achieve downlisting)

5.3.1.1.1 Upper basin recovery unit

1. Each of the five self-sustaining populations is maintained over a 5-year period, starting with the first point estimate acceptable to the Service, such that:

    a. the trend in adult (age 4+; ≥200 mm TL) point estimates does not decline significantly, and

    b. mean estimated recruitment of age-3 (150–199 mm TL) naturally produced fish equals or exceeds mean annual adult mortality, and

2. One of the five populations (e.g., Black Rocks/Westwater Canyon or Desolation/Grey canyons) is maintained as a core population such that each point estimate exceeds 2,100 adults (Note: 2,100 is the estimated MVP number; see section 3.3.2).

5.3.1.1.2 Lower basin recovery unit

1. The Grand Canyon population is maintained as a core over a 5-year period, starting with the first point estimate acceptable to the Service, such that:

   a. the trend in adult (age 4+; ≥200 mm TL) point estimates does not decline significantly, and

   b. mean estimated recruitment of age-3 (150–199 mm TL) naturally produced fish equals or exceeds mean annual adult mortality, and

   c. each core population point estimate exceeds 2,100 adults (MVP).

5.3.1.2 Recovery factor criteria for downlisting (recovery factor criteria in both recovery units must be met in order to achieve downlisting)

5.3.1.2.1 Upper basin recovery unit

Factor A.—Adequate habitat and range for recovered populations provided.

1. Flow regimes to benefit humpback chub populations in the upper Colorado, Green, and Yampa rivers identified, implemented, evaluated, and revised (Task A-1.1), such that:

   a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section 5.3.1.1.1.

   b. Adequate nursery habitat is available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section 5.3.1.1.1.

   c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) is available to maintain self-sustaining populations, as reflected by downlisting demographic criteria in section 5.3.1.1.1.

Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

2. Overutilization of humpback chub for commercial, recreational, scientific, or educational purposes reevaluated and, if necessary, actions identified to ensure adequate protection (Task B-1.1).

Factor C.—Adequate protection from diseases and predation.

3. Effects of diseases and parasites on humpback chub populations reevaluated and, if necessary, actions identified to ensure adequate protection (Task C-1.1).

4. Procedures developed, implemented, evaluated, and revised for stocking nonnative fish species in the Upper Colorado River Basin to minimize negative interactions between nonnative fishes and humpback chub (Task C-2.1).

5. Channel catfish control programs developed and implemented to identify levels of control that will minimize predation on humpback chub in Yampa Canyon and Desolation/Gray Canyons (Task C-3.1).

Factor D.—Adequate existing regulatory mechanisms.

6. Mechanisms determined for legal protection of adequate habitat (Task D-1.1).

7. Elements of conservation plans identified that are necessary to provide for the long-term management and protection of humpback chub populations (Task D-2.1).

Factor E.—Other natural or manmade factors for which protection has been provided.

8. State and Federal hazardous-materials spills emergency-response plans reviewed and modified to ensure adequate protection for humpback chub populations from hazardous-materials spills (Task E-2.1).

9. Measures identified to minimize the risk of hazardous-materials spills in Black Rocks and Westwater Canyon from transport of materials along the adjacent railway (Tasks E-2.3).

10. Locations of all petroleum-product pipelines within the 100-year floodplain of critical habitat identified and the need for emergency shut-off valves assessed (Task E-2.5).

5.3.1.2.2 Lower basin recovery unit

Factor A.—Adequate habitat and range for recovered populations provided.

1. Life stages and habitats of humpback chub in the mainstem Colorado River identified and the relationship between individuals in the mainstem and the Little Colorado River determined (Task A-1.1).

2. Operations of Glen Canyon Dam to benefit humpback chub in the Colorado River through Grand Canyon continued (Task A-2.1) and a flow regime to benefit humpback chub in the Little Colorado River identified, implemented, evaluated, and revised (Task A-2.2), such that:

    a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain a self-sustaining population, as reflected by downlisting demographic criteria in section 5.3.1.1.2.

    b. Adequate nursery habitat is available to maintain a self-sustaining population, as reflected by downlisting demographic criteria in section 5.3.1.1.2.

    c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) is available to maintain a self-sustaining population, as reflected by downlisting demographic criteria in section 5.3.1.1.2.

3. Effects and feasibility of a temperature control device for Glen Canyon Dam to increase water temperatures in the mainstem Colorado River through Grand Canyon that would allow for range expansion of humpback chub determined (Task A-3.1).

Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

4. Overutilization of humpback chub for commercial, recreational, scientific or educational purposes reevaluated and, if necessary, actions identified to ensure adequate protection (Task B-1.1).

Factor C.—Adequate protection from diseases and predation.

5. Asian tapeworm control program developed and implemented in the Little Colorado River to identify levels of control that will minimize the negative effects of parasitism on the humpback chub population (Task C-1.1).

6. Procedures developed, implemented, evaluated, and revised for stocking and to minimize escapement of nonnative fish species into the Colorado River and its tributaries through Grand Canyon to minimize negative interactions between nonnative fishes and humpback chub (Task C-2.1).

7. Rainbow trout, channel catfish, black bullhead, and common carp control programs developed and implemented to identify levels of control that will minimize predation on humpback chub in the Little Colorado River (Task C-3.1).

8. Brown trout and rainbow trout control programs developed and implemented to identify levels of control that will minimize predation on humpback chub in the Colorado River through Grand Canyon (Task C-3.3).

Factor D.—Adequate existing regulatory mechanisms.

9. Mechanisms determined for legal protection of adequate habitat in the mainstem Colorado River through Grand Canyon and the Little Colorado River (Task D-1.1).

10. Elements of conservation plans identified that are necessary to provide for the long-term management and protection of humpback chub populations (Task D-2.1).

Factor E.—Other natural or manmade factors for which protection has been provided.

11. State and Federal hazardous-materials spills emergency-response plans reviewed and modified to ensure adequate protection for humpback chub populations from hazardous-materials spills (Task E-1.1).

12. Measures identified to minimize the risk of hazardous-materials spills from transport of materials along U.S. Highway 89 at and near the two Cameron bridges spanning the Little Colorado River (Task E-1.3).

5.3.2 Delist criteria

5.3.2.1 Demographic criteria for delisting (population demographics in both recovery units must be met in order to achieve delisting)

5.3.2.1.1 Upper basin recovery unit

1. Each of the five self-sustaining populations is maintained over a 3-year period beyond downlisting, starting with the first point estimate acceptable to the Service, such that:

    a. the trend in adult (age 4+; ≥200 mm TL) point estimates does not decline significantly, and

    b. mean estimated recruitment of age-3 (150–199 mm TL) naturally produced fish equals or exceeds mean annual adult mortality, and

2. Two of the five populations (e.g., Black Rocks/Westwater Canyon and Desolation/Grey canyons) are maintained as core populations such that each point estimate exceeds 2,100 adults (MVP).

5.3.2.1.2 Lower basin recovery unit

1. The Grand Canyon population is maintained as a core over a 3-year period beyond downlisting, starting with the first point estimate acceptable to the Service, such that:

    a. the trend in adult (age 4+; ≥200 mm TL) point estimates does not decline significantly, and

    b. mean estimated recruitment of age-3 (150–199 mm TL) naturally produced fish equals or exceeds mean annual adult mortality, and

    c. each core population point estimate exceeds 2,100 adults (MVP).

5.3.2.2 Recovery factor criteria for delisting (recovery factor criteria in both recovery units must be met in order to achieve delisting)

5.3.2.2.1 Upper basin recovery unit

Factor A.—Adequate habitat and range for recovered populations provided.

1. Flow regimes provided that are necessary for all life stages of humpback chub to support recovered populations in Black Rocks, Westwater Canyon, Yampa Canyon, Desolation/Gray Canyons, and Cataract Canyon (Task A-1.2), such that:

    a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.1.

    b. Adequate nursery habitat is available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.1.

    c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) is available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.1.

Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

2. Adequate protection of humpback chub populations from overutilization for commercial, recreational, scientific, or educational purposes attained (Task B-1.2).

Factor C.—Adequate protection from diseases and predation.

3. Adequate protection of humpback chub populations from deleterious diseases and parasites attained (Task C-1.2).

4. Procedures finalized and implemented for stocking nonnative fish species in the Upper Colorado River Basin to minimize negative interactions between nonnative fishes and humpback chub (Task C-2.2).

5. Identified levels of channel catfish control to minimize predation on humpback chub attained in Yampa Canyon and Desolation/Gray Canyons (Task C-3.2).

Factor D.—Adequate existing regulatory mechanisms.

6. Habitat necessary to provide adequate habitat and sufficient range for all life stages of humpback chub to support recovered populations in Black Rocks, Westwater Canyon, Yampa Canyon, Desolation/Gray Canyons, and Cataract Canyon is legally protected in perpetuity (Task D-1.2).

7. Conservation plans developed and implemented, and agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties executed to provide reasonable assurances that conditions needed for recovered humpback chub populations will be maintained (Task D-2.2).

Factor E.—Other natural or manmade factors for which protection has been provided.

8. Flow regimes provided that reflect inter-annual variability in hydrologic conditions in order to maintain natural proportions of *Gila* species and intergrades in Black Rocks, Westwater Canyon, Yampa Canyon, Desolation/Gray Canyons, and Cataract Canyon (Task E-1.1).

9. State and Federal emergency-response plans implemented that contain the necessary preventive measures for hazardous-materials spills (Task E-2.2).

10. Measures finalized and implemented to minimize the risk of hazardous-materials spills in Black Rocks and Westwater Canyon from transport of materials along the adjacent railway (Task E-2.4).

11. Emergency shut-off valves installed on all problematic petroleum-product pipelines within the 100-year floodplain of critical habitat (Task E-2.6).

5.3.2.2.2 Lower basin recovery unit

Factor A.—Adequate habitat and range for recovered populations provided.

1. Appropriate habitats for humpback chub in the mainstem Colorado River provided (Task A-1.2).

2. Flow regimes provided in the mainstem Colorado River and the Little Colorado River (Task A-2.3) that are necessary for all life stages of humpback chub to support a recovered Grand Canyon population, such that:

    a. Adequate spawning habitat and appropriate spawning cues (e.g., flow patterns and water temperatures) are available to maintain

self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.2.

b. Adequate nursery habitat is available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.2.

c. Adequate juvenile and adult habitat (e.g., cover, resting, and feeding areas) is available to maintain self-sustaining populations, as reflected by delisting demographic criteria in section 5.3.2.1.2.

3. Temperature control device for Glen Canyon Dam implemented, if determined feasible and necessary for recovery of humpback chub (Task A-3.2).

Factor B.—Protection from overutilization for commercial, recreational, scientific, or educational purposes.

4. Adequate protection of humpback chub populations from overutilization for commercial, recreational, scientific, or educational purposes attained (Task B-1.2).

Factor C.—Adequate protection from diseases and predation.

5. Identified levels of Asian tapeworm control to minimize the negative effects of parasitism on the humpback chub population attained in the Little Colorado River (Task C-1.2).

6. Procedures finalized and implemented for stocking and to minimize escapement of nonnative fish species into the Colorado River and its tributaries through Grand Canyon to minimize negative interactions between nonnative fishes and humpback chub (Task C-2.2).

7. Identified levels of rainbow trout, channel catfish, black bullhead, and common carp control to minimize predation on humpback chub attained in the Little Colorado River (Task C-3.2).

8. Identified levels of brown trout and rainbow trout control to minimize predation on humpback chub attained in the Colorado River through Grand Canyon (Task C-3.4).

Factor D.—Adequate existing regulatory mechanisms.

9. Habitat necessary to provide adequate habitat and sufficient range for all life stages of humpback chub to support a recovered Grand Canyon population is legally protected in perpetuity (Task D-1.2).

10. Conservation plans developed and implemented and agreements among State agencies, Federal agencies, American Indian tribes, and other interested parties executed to provide reasonable assurances that conditions needed for the recovered Grand Canyon humpback chub population will be maintained (Task D-2.2).

Factor E.—Other natural or manmade factors for which protection has been provided.

11. State and Federal emergency-response plans implemented that contain the necessary preventive measures for hazardous-materials spills (Task E-1.2).

12. Measures finalized and implemented to minimize the risk of hazardous-materials spills from transport of materials along U.S. Highway 89 at and near the two Cameron bridges spanning the Little Colorado River (Task E-1.4).

5.4 Estimated Time to Achieve Recovery of the Humpback Chub

Estimated time to achieve recovery of the humpback chub is 5 years for downlisting and an additional 3 years for delisting. First reliable point estimates are expected for all populations by 2002. If those estimates are acceptable to the Service and all recovery criteria are met, downlisting could be proposed in 2007 and delisting could be proposed in 2010 (Figure 2). This estimated time frame is based on current understanding of the status and trends of populations and on the monitoring time required to meet the downlisting and delisting criteria.

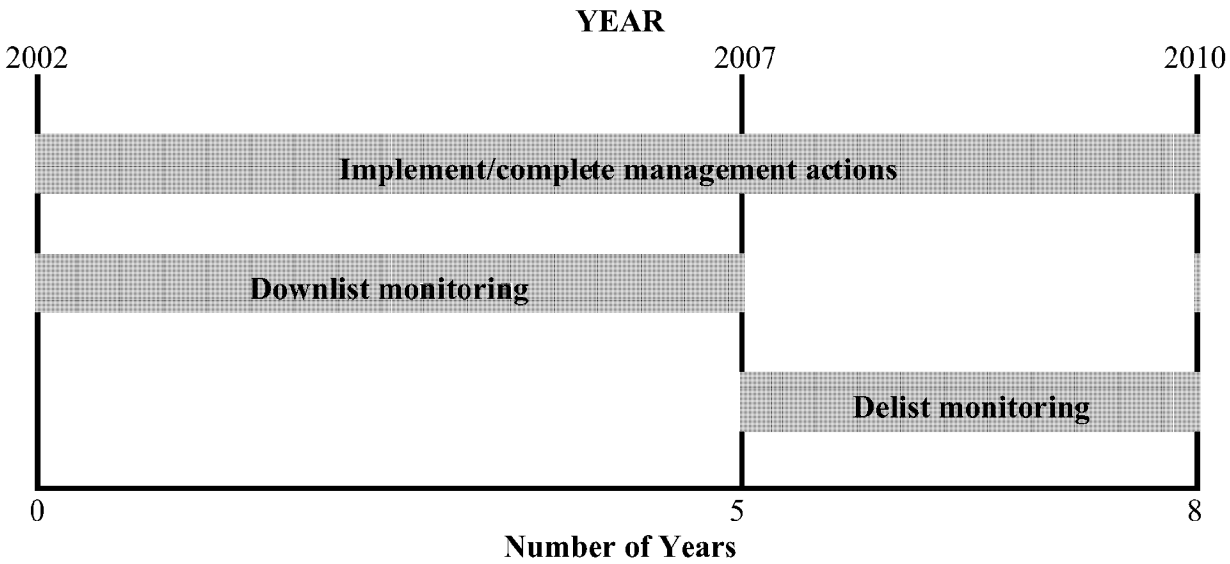

Figure 2. Estimated time to achieve recovery of the humpback chub.

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APPENDIX A.

LIFE HISTORY OF THE HUMPBACK CHUB

Following is a synopsis of humpback chub life history. This assimilation of information represents an overview of the best scientific information available for the species at this time. Additional and more detailed information can be found in literature cited in this document and in reports and publications referenced in those citations.

A.1 Species Description

The humpback chub is a big-river cyprinid with maximum size of about 480 mm total length (TL) and 1,165 g (Valdez and Ryel 1997). The body is laterally compressed and fusiform, tapering abruptly to a narrow caudal peduncle (tail trunk) with a deeply forked tail fin and large fan-like falcate fins. A fleshy dorsal hump develops behind the head as the fish matures. Subadults have an olivaceous back and silvery sides fading to a creamy white belly; adults are light olivaceous and slate-gray dorsally and laterally, with a white belly tinged with light orange and yellow. Spawning adults in March–June are tinged with rosy-red gill coverings, paired fins, and belly; they develop pimple-like tubercles on the head and paired fins. The head is narrow and flattened and may be dorsally concave, with small eyes and a protruding fleshy snout and inferior, subterminal mouth. Dorsal and anal fins typically have 9 and 10 principal rays, respectively. Scales are deeply embedded, isolated dorsally and imbricated laterally and ventrally, with the head and nuchal hump devoid of scales. The pharyngeal arch is small with a short lower ramus and deciduous teeth in a typical pattern of 2,5-4,2 (Miller 1946).

A.2 Distribution and Abundance

Historic abundance of the humpback chub is unknown, and historic distribution is surmised from various reports and collections that indicate the species presently occupies about 68% of its historic habitat of about 756 km of river. The species exists primarily in relatively inaccessible canyons of the Colorado River Basin and was rare in early collections (Tyus 1998). Common use of the name "bonytail" for all six Colorado River species or subspecies of the genus *Gila* confounded an accurate early assessment of distribution and abundance (Holden and Stalnaker 1975a, 1975b; Valdez and Clemmer 1982; Minckley 1996). Of three closely related and sympatric *Gila* species, the roundtail chub (*G. robusta*) and bonytail (*G. elegans*) were described in 1853 by Baird and Girard (Sitgreaves 1853; Girard 1856), but the humpback chub was the last big-river fish species to be described from the Colorado River Basin in 1946 (Miller 1946). Also, extensive human alterations throughout the basin prior to faunal surveys may have depleted or eliminated the species from some river reaches before its occurrence was documented.

It is surmised that the humpback chub speciated from a *G. robusta*-like form in canyons of northern Arizona (i.e., Grand Canyon) about 3–5 million years ago (Miller 1946; Uyeno and Miller 1965; Holden 1968; Minckley et al. 1986) during the mid-Pliocene and early Pleistocene epochs. Earliest evidence of the species are skeletal remains from 4,000-year old flood deposits

in Stanton's Cave in Grand Canyon (Miller 1955; Euler 1978; Miller and Smith 1984), from a 750–1,100-year old archeological site in Catclaw Cave near present-day Hoover Dam (Miller 1955; Jones 1985), and from 1,000-year old archeological sites in Dinosaur National Monument, Colorado (Tyus 1998).

Earliest collections of humpback chub are anecdotal and related to early explorations of the Colorado River Basin that pre-date the species description in 1946. In 1911, Elsworth and Emory Kolb (Kolb and Kolb 1914) reported a large aggregation of *"bony tail"* in the lower Little Colorado River (LCR) in Grand Canyon; photographs show that the fish were humpback chub. A specimen in the fish collection at Grand Canyon National Park, caught in 1932 by angler N.N. Dodge at Bright Angel Creek, was examined in fall 1942 and used as the holotype for the species description (Miller 1946), along with a second specimen of unknown origin. In the 1940's, five specimens of humpback chub were collected from the Grand Canyon region along with 16 specimens of *G. elegans* and six *G. robusta* (Miller 1944; Bookstein et al. 1985). In 1950, juvenile humpback chub were reported from Spencer Creek in lower Grand Canyon (Wallis 1951; Kubly 1990), but icthyofaunal surveys in 1958–1959 (McDonald and Dotson 1960) failed to find humpback chub immediately upstream in the gentle meandering reaches of Glen Canyon.

Following completion of Glen Canyon Dam in 1963, humpback chub were consistently reported by Arizona Game and Fish Department creel surveys from Lee Ferry during 1963–1968 (Stone 1964, 1966; Stone and Queenan 1967; Stone and Rathbun 1968). However, Stone and Rathbun (1968) failed to find humpback chub in seven tributaries sampled between Lee Ferry and Lake Mead in 1968, excluding the LCR. Humpback chub were captured in July 1967 and August 1970 (Holden and Stalnaker 1975b), all within *"...a few hundred meters downstream of Glen Canyon Dam"* (personal communication, P. Holden, Bio/West, Inc.). Humpback chub have not been captured in this reach since the dam began releasing cold hypolimnetic waters in about 1970. Humpback chub have consistently been reported in the LCR and Colorado River in Grand Canyon since 1967 as a result of better sampling gear and a better understanding of the life history of the species (Stone and Rathbun 1968; Miller and Smith 1972; Holden and Stalnaker 1975b; Suttkus et al. 1976; Minckley and Blinn 1976; Suttkus and Clemmer 1977; Carothers et al. 1981; Kaeding and Zimmerman 1983; Maddux et al. 1987; Valdez and Ryel 1995; Arizona Game and Fish Department 1996a; Douglas and Marsh 1996).

Humpback chub were first reported in the Upper Colorado River Basin in the 1940's from Castle Park, Yampa River, Colorado, in June and July 1948 (Tyus 1998). Pre-impoundment surveys of Flaming Gorge Dam on the Green River in 1958–1959 (Bosley 1960; Gaufin et al. 1960; McDonald and Dotson 1960) treated all *Gila* as *"bonytail"*, which were common downstream of Green River, Wyoming. Humpback chub were reported from Hideout Canyon in the upper Green River (Smith 1960), although a checklist of fish killed by a massive rotenone operation from Hideout Canyon to Brown's Park in September 1962 stated that *"...no humpback chub were collected..."* (Binns 1967). Post-impoundment investigations (Vanicek et al. 1970) reported three humpback chub from the Green River downstream of Flaming Gorge Dam; one each from Echo Park, Island Park, and Swallow Canyon. Specimens were collected in Desolation Canyon on the Green River in 1967 (Holden and Stalnaker 1970), in Yampa Canyon in 1969 (Holden and Stalnaker 1975b), in Cross Mountain Canyon of the Yampa River in the 1970's (personal

communication, C. Haynes), and an individual specimen was reported from the White River in Utah in the 1950's (Sigler and Miller 1963). Seven suspected humpback chub were captured in the Little Snake River, a tributary of the Yampa River, in 1988 (Wick et al. 1991). Surveys downstream of Flaming Gorge Dam, including Lodore Canyon, have not yielded humpback chub in that region of the Green River, despite warmer dam releases (Holden and Crist 1981; Bestgen and Crist 2000).

Five specimens were reported from Lake Powell in the late 1960's (Holden and Stalnaker 1970) following completion of Glen Canyon Dam in 1963 and impoundment of the upper Colorado River through Glen, Narrow, and Cataract canyons. Reproducing populations of humpback chub were first reported from Black Rocks, Colorado in 1977 (Kidd 1977), and from Westwater and Cataract canyons, Utah, in 1979 (Valdez et al. 1982; Valdez and Clemmer 1982).

Six humpback chub populations are currently identified: (1) Black Rocks, Colorado; (2) Westwater Canyon, Utah; (3) LCR and Colorado rivers in Grand Canyon, Arizona; (4) Yampa Canyon, Colorado; (5) Desolation/Gray Canyons, Utah; and (6) Cataract Canyon, Utah (see Figure 1 in section 3.1.2; Valdez and Clemmer 1982; U.S. Fish and Wildlife Service 1990a). Each population consists of a discrete group of fish, geographically separated from the other populations, but with some exchange of individuals. River length occupied by each population varies from 3.7 km in Black Rocks to 73.6 km in Yampa Canyon.

A.3 Hybridization

The humpback chub is part of a morphologically diverse group of western cyprinids that includes several congeneric species. This *Gila* complex consists of six forms that inhabit the Colorado River Basin, including the humpback chub, roundtail chub, bonytail, Virgin River chub *(G. robusta seminuda)*, Pahranagat roundtail chub *(G. r. jordani),* and Gila chub *(G. intermedia).* The humpback chub, bonytail, and roundtail chub are mainstem sympatric species with substantial evidence of introgressive hybridization (Dowling and DeMarais 1993). The Virgin River chub, Pahranagat roundtail chub, and Gila chub are isolates and primarily tributary inhabitants, although historic hybridization with other forms of *Gila* is evident. Humpback chub and bonytail appear to be specialized derivatives of the roundtail chub complex, and may have arisen in response to special conditions in large erosive habitats (Smith et al. 1979; Minckley et al. 1989); a hypothesis that is supported by recent allozyme and mitochondrial DNA analysis (Dowling and DeMarais 1993).

Intraspecific and interspecific morphological variation can be extensive where humpback chub, roundtail chub, and bonytail occur sympatrically. This apparent introgressive hybridization has resulted in high phenotypic plasticity with morphologic intergrades present in all sympatric populations of Colorado River *Gila* (Holden and Stalnaker 1970; Smith et al. 1979; Valdez and Clemmer 1982; Kaeding et al. 1990; Wick et al. 1991; McElroy and Douglas 1995; Douglas et al. 1998). These intergrades suggest, to some, extensive hybridization with possible concomitant loss of genetic diversity and evolutionary adaptive traits (Valdez and Clemmer 1982; Rosenfeld and Wilkinson 1989). Others suggest that introgressive hybridization is part of the common evolutionary history of the Colorado River *Gila*, resulting in high phenotypic plasticity and

adaptability to the rigorous physical habitats present in the Colorado River Basin (Dowling and DeMarais 1993). Evidence of intergrades was reported prior to extensive human alterations to the basin (Miller 1946).

Because only two of the three congeneric and sympatric species of the *Gila* complex are Federally listed as endangered (i.e., humpback chub and bonytail), fish managers are compelled to distinguish these from the nonlisted roundtail chub. Morphologic variation in these species has led to confusion in field identification, especially for young fish (Douglas et al. 1998). This confusion has precluded accurate assessment of life history characteristics attributable to one species and definitive estimates of abundance; e.g., the inability to distinguish sympatric young humpback chub from roundtail chub afield has precluded species separation for the purpose of estimating densities and survival (Chart and Lentsch 1999, 2000).

Proportions of humpback chub, roundtail chub, bonytail, and intergrades from each of the six populations of humpback chub are shown in Table A-1. Proportions of these phenotypes in Black Rocks and Westwater Canyon vary primarily because of increased invasion of these canyon areas by roundtail chub during low water years (Chart and Lentsch 1999). Despite this variation, overall average proportions of humpback chub:roundtail chub:intergrades for Black Rocks and Westwater Canyon are similar as 48:45:8 and 44:45:12, respectively. Average proportions in Desolation/Gray Canyons of 19:7:74 show the highest proportions of intergrades of any population of humpback chub. Proportions in the LCR and Colorado River in Grand Canyon are 100% humpback chub because the known genotype is primarily of this form (Dowling and DeMarais 1993), and recent samples show little evidence of other phenotypes in this population (McElroy and Douglas 1995). Proportions of 46:23:13:18 in Cataract Canyon include bonytail and indicate a large diverse complex of *Gila* associated with this population (McElroy and Douglas 1995). The proportion of 14:86:0 in Yampa Canyon shows a large percentage of roundtail chub relative to humpback chub and little or no intergradation between these forms.

Proportions of humpback chub to roundtail chub and catch rates recorded by investigators in Black Rocks (Kaeding et al. 1990) and Westwater Canyon (Chart and Lentsch 2000) reveal a greater proportion of roundtail chub in these areas in years of low flow; it is hypothesized that lower velocities and less turbulence in low water years allow roundtail chub to invade canyon regions not normally inhabited by this species. Increased sympatry of these species potentially increases the chances for hybridization; hybridization has been demonstrated in a hatchery among all three *Gila* species. Hence, it is necessary to provide flow regimes that reflect inter-annual variability in hydrologic conditions (e.g., wet, average, and dry water years) in order to maintain natural proportions of *Gila* species and intergrades.

A.4 Habitat

The humpback chub evolved in seasonally warm and turbid water and is highly adapted to the unpredictable hydrologic conditions that occurred in the pristine Colorado River system. Adults require eddies and sheltered shoreline habitats maintained by high spring flows. These high spring flows maintain channel and habitat diversity, flush sediments from spawning areas,

Table A-1. Proportion of *Gila cypha*, *G. robusta*, *G. elegans*, and intergrades in six populations of humpback chub, based on morphology of adult specimens.

Population or Habitat	Years Sampled	Total Number (N)	Percent of Total Number				Source
			G. cypha	*G. robusta*	*G. elegans*	Intergrades	
Upper Basin							
Black Rocks	1979–81	552	29	70	0	1	Valdez et al. (1982)
	1983–85	569	47	44	<1	9	Kaeding et al. (1990)
	1988	91	58	39	0	3	McAda et al. (1994)
	1991	127	58	25	0	17	McAda et al. (1994)
Westwater Canyon	1979–81	226	19	77	0	4	Valdez et al. (1982)
	1986	126	36	31	0	33	McAda et al. (1994)
	1988	143	72	27	0	1	McAda et al. (1994)
	1991	247	47	45	0	8	McAda et al. (1994)
Yampa Canyon	1986–89	922	14	86	0	0	Karp and Tyus (1990)
Desolation/Gray Canyons	1992	24	46	29	0	25	Chart and Lentsch (2000)
	1993	43	5	0	0	95	Chart and Lentsch (2000)
	1994	41	10	5	0	85	Chart and Lentsch (2000)
	1995	48	25	4	0	71	Chart and Lentsch (2000)
	1996	26	23	8	0	69	Chart and Lentsch (2000)
Cataract Canyon	1979–81	48	46	23	13	18	Valdez (1990)
Lower Basin–Grand Canyon							
Little Colorado River	1980–81	433	100	0	0	0	Kaeding and Zimmerman (1983)
Colorado River	1990–93	1791	100	0	0	0	Valdez and Ryel (1995)

rejuvenate food production, and form gravel and cobble deposits used for spawning. Spawning occurs on the descending limb of the spring hydrograph at water temperatures typically between 16 and 22°C. Young require low-velocity shoreline habitats, including eddies and backwaters, that are more prevalent under base-flow conditions. Flow recommendations have been developed that specifically consider flow-habitat relationships in habitats occupied by humpback chub in the upper basin, and were designed to enhance habitat complexity and to restore and maintain ecological processes (see section 4.1). The following is a description of observed habitat uses in various parts of the Colorado River Basin.

Humpback chub live and complete their entire life cycle in canyon-bound reaches of the Colorado River mainstem and larger tributaries. These reaches are characterized by deep water, swift currents, and rocky substrates (Valdez et al. 1990). Subadults use shallow, sheltered shoreline habitats, whereas adults use primarily offshore habitats of greater depths (Valdez and Ryel 1995; Karp and Tyus 1990; Childs et al. 1998; Chart and Lentsch 1999). In Grand Canyon, nearly all fish smaller than 100 mm TL were captured near shore, whereas most fish larger than 100 mm TL were captured in offshore habitats (Valdez and Ryel 1995). Highest densities of

subadults in the Colorado River in Grand Canyon were from shorelines with vegetation, talus, and debris fans (Converse et al. 1998). Adults were captured (88%) and radio-contacted (74%) primarily in large recirculating eddies disproportionate to their availability (21%; Valdez and Ryel 1997). Smaller percentages of adults were captured or radio contacted in runs (7% and 16%, respectively) that comprised 56% of surface area, pools (1% and 3%, respectively) that comprised 16% of surface area, and backwaters (4% and 7%, respectively) that comprised 0.1% of surface area (Table A-2). Adults remained in similar habitats during an experimental flood through Grand Canyon (Arizona Game and Fish Department 1996b; Valdez and Hoffnagle 1999).

Table A-2. Habitat of adult humpback chub in the Colorado River in Grand Canyon (Valdez and Ryel 1997).

Capture or Radio-contact	Habitats (Percent of Surface Area)				
	Eddies	Runs	Pools	Backwaters	Other
Captures (1,579 fish)	88	7	1	4	0
Radio-contacts (835 from 75 fish)	74	16	3	7	<0.1
Surface Riverine Area	21	56	16	<0.1	7

As young humpback chub grow, they exhibit an ontogenic shift toward deeper and swifter offshore habitats. In Westwater Canyon during summer, fish smaller than 40 mm TL used low-velocity areas, including backwaters and shorelines. Later in summer and fall, as fish attained sizes of 40–50 mm TL, their habitat use shifted toward higher-velocity, flowing-water habitats (Chart and Lentsch 1999). Karp and Tyus (1990) reported similar habitat use by larger humpback chub, noting that fish 88–228 mm TL in the Yampa and Green rivers used habitats consisting of rocky shoreline runs and small shoreline eddies. Average depths selected by larvae, young-of-year, juveniles, and adults in the upper basin were 0.4, 0.6, 0.7, and 3.1 m, respectively (Valdez et al. 1990), and average velocities were 0.03, 0.06, 0.18, and 0.18 m/s, respectively. Dominant substrates were silt and sand for Young-of-year, and boulders, sand, and bedrock for juveniles and adults.

Valdez and Ryel (1995, 1997) also reported ontogenic shifts in habitat use by humpback chub in Grand Canyon. In the mainstem Colorado River, juveniles (50–200 mm TL) used primarily shallow shoreline habitats; adults primarily used offshore habitats at greater depths. Minimum, average, and maximum velocities selected by young-of-year (21–74 mm TL) were 0.0, 0.06, and 0.30 m/s, respectively, all at depths less than 1 m. Minimum, average, and maximum velocities selected by humpback chub (75–259 mm TL) were 0.0, 0.18, and 0.79 m/s, respectively, all at depths less than 1.5 m. In the LCR, larval and early juvenile humpback chub used shallow, low-velocity habitats, different than those used by young of other native species, indicating resource partitioning (Childs et al. 1998). Gorman (1994) found that juveniles or early stages less than

50 mm TL occupied near-benthic to mid-pelagic positions in shallow, nearshore areas that were less than 10 cm deep and had low-velocity flow, small substrate particle sizes, moderate cover, and vertical structure. Larger juveniles or fish 50–100 mm TL used similar habitats of moderate depth (less than 20 cm) that had small to large substrate particle size, moderate to high cover, and vertical structure. Juveniles (100–150 mm TL) used shoreline and offshore areas of moderate to deep water (less than 30 cm during the day; less than 20 cm at night) that had slow currents, small and large substrate particle size, moderate to high levels of cover, and vertical structure.

Little is known about spawning habitats of adult humpback chub during high spring-runoff flows. Habitats where ripe humpback chub have been collected are typically deep, swift, and turbid. As a result, spawning in the wild has not been directly observed. Gorman and Stone (1999) reported that ripe male humpback chub in the LCR aggregated in areas of complex habitat structure (i.e., matrix of large boulders and travertine masses combined with chutes, runs, and eddies, 0.5–2.0 m deep) and were associated with deposits of clean gravel. Valdez and Ryel (1995, 1997) reported that during spring, adult humpback chub in the Colorado River in Grand Canyon primarily used large recirculating eddies, occupying areas of low velocity adjacent to high-velocity currents that deliver food items. They also reported that adults congregated at tributary mouths and flooded side canyons during high flows.

In the Upper Colorado River Basin during spring runoff, spawning adult humpback chub appear to utilize cobble bars and shoals adjacent to relatively low-velocity shoreline habitats that are typically described as shoreline eddies (Valdez et al. 1982; Karp and Tyus 1990; Valdez et al. 1990; Valdez and Ryel 1995, 1997). Tyus and Karp (1989) reported that humpback chub in the Yampa River occupy and spawn in or near shoreline eddy habitats. They also hypothesized that spring peak flows were important for reproductive success because availability of these habitats is greatest during spring runoff; loss or reduction of spring peak flows could potentially reduce availability of spawning habitat.

A.5 Movement

Humpback chub move substantially less than other native Colorado River fishes (Valdez and Carothers 1998). Radiotelemetry and tagging studies consistently show high fidelity by humpback chub for specific riverine locales occupied by respective populations. Mean net movement of eight radio-tagged adults in Black Rocks was 0.8 km over a maximum of 93 days (range, 30–170 days), and average distance between captures for 218 Carlin-tagged fish in Black Rocks and Westwater Canyon over a maximum of 434 days was 1.6 km for 1980–1981 (Valdez and Clemmer 1982). A second study in Black Rocks found similar results with mean maximum displacement of 33 radio-tagged adults of 1.4 km, and 63 Carlin-tagged fish at large up to 56 months were recovered 1.1 km from release sites during 1988–1989 (Kaeding et al. 1990). In the Colorado River in Grand Canyon, mean net movement of 69 radio-tagged adults monitored year-around for an average of 93 days (range, 30–170 days) was 1.49 km (range, 0–6.11 km); 51% moved less than 1 km and 84% moved less than 3 km. This was comparable to net movement of 1.94 km (range, 0–99.8 km) for 188 PIT-tagged fish at large 20–1,065 days (i.e., up to 2.9 years) for the same study and area. Mark-recapture data from 92 humpback chub with Carlin and Floy tags and at large for an average of 2,990 days (range, 304–4,496 days; up to 12.3 years) showed

average distance from original capture to recapture of 4.29 km (range, 0.1–14.4 km), revealing remarkable fidelity for specific river locales (Valdez and Ryel 1995, 1997). In contrast, net movement of 43 radio-tagged Colorado pikeminnow (*Ptychocheilus lucius*) in fall and spring in the upper basin was 31.8 km (Archer et al. 1985), and 33.9 km for radio-tagged adult roundtail chub in spring and summer (Kaeding et al. 1990). Although Colorado pikeminnow have considerable fidelity to winter home ranges, round trip movements during spawning migrations may be up to 950 km.

Despite remarkable fidelity for given river regions, individual humpback chub adults have been known to move between populations. Of 218 fish tagged in Black Rocks and Westwater Canyon in 1980, 16 were recaptured, with one (6%) having moved 23 km from Westwater Canyon upstream to Black Rocks (Valdez and Clemmer 1982). Kaeding et al. (1990) recaptured 63 tagged fish, with two (3%) having moved from Westwater Canyon upstream to Black Rocks. These studies indicate an exchange of 3–6% of these populations over the periods of study (i.e., 2–3 years). Two additional exchanges between these populations (Black Rocks downstream to Westwater Canyon) have been documented more recently (Chart and Lentsch 1999), showing that movement occurs to and from each population. Considering that the generation time of humpback chub is approximately 8 years (= mean adult age of 4 plus [1/d], where d is the death rate; = 4 + [1/1-0.76] = 4+4 = 8; Seber 1982), the indicated level of exchange suggests far more than a minimum of one migrant per generation, which is considered the necessary level of connectivity to minimize the loss of polymorphism and heterozygosity in wild animal populations (Mills and Allendorf 1996).

Greatest movement of humpback chub has been reported from Grand Canyon, primarily because adults from the mainstem annually ascend the LCR to spawn (Valdez and Ryel 1995). Average movement of 401 PIT-tagged fish marked in the mainstem and recaptured in the LCR was 7.2 km (range, 0.08–34.1 km). However, most of these fish returned to the mainstem with remarkable fidelity to mainstem locales. Of 60 PIT-tagged fish consecutively captured in the mainstem, then the LCR, and again in the mainstem, 54 (90%) returned to within 2 km of their original mainstem locale; 31 (52%) were recaptured within 0.5 km; and 10 (17%) were recaptured within 0.1 km. No significant difference in movements was noted between male and female humpback chub. Fish moving from the mainstem to the LCR and back to the mainstem tended to be larger fish than those remaining in the LCR (81% were > 300 mm TL).

Movement by juveniles is not as well documented as for adults, but is also believed to be limited in distance. No out-migration by young fish is seen from population centers such as Black Rocks and Westwater Canyon (Valdez et al. 1982; Chart and Lentsch 1999). However, Valdez and Ryel (1995, 1997) reported large numbers of juveniles moving downstream from the LCR into the Colorado River in Grand Canyon during monsoonal freshets; it is not clear if this movement is active or passive. Hoffnagle (1995) reported greater nighttime use of backwaters in Grand Canyon by juvenile humpback chub and flannelmouth sucker (*Catostomus latipinnis*). Juveniles and subadults were nocturnally active, and post-larvae and young-of-year were diurnally active, primarily in the morning and at night.

A.6 Reproduction

The humpback chub is an obligate warm-water species that requires relatively warm temperatures for spawning, egg incubation, and survival of larvae. Highest hatching success is at 19–20°C with incubation time of 3 days, and highest larval survival is slightly warmer at 21–22°C. Hatching success under laboratory conditions was 12%, 62%, 84%, and 79% in 12–13°C, 16–17°C, 19–20°C, and 21–22°C, respectively, whereas survival of larvae was 15%, 91%, 95%, and 99%, at the same respective temperatures (Table A-3; Hamman 1982). Time from fertilization to hatching ranged from 465 hours at 10.0°C to 72 hours at 26.0°C, and time from hatching to swim-up varied from 372 hours at 15.0°C to 72 hours at 21.0–22.0°C. Marsh (1985) found similar results. Proportion of abnormal fry varied with temperature and was highest at 15.0°C (33%) and 25.0°C (17%). Marsh and Pisano (1985) also found optimum spawning temperature of 19–20°C, and total mortality of embryos at 5, 10, and 30°C.

Table A-3. Hatching success and larval survival for humpback chub at various temperatures in laboratory conditions (Hamman 1982).

Parameter	Temperature			
	12–13°C	16–17°C	19–20°C	21–22°C
Hatching Success (%)	12	62	84	79
Larval Survival (%)	15	91	95	99

Humpback chub are broadcast spawners with a relatively low fecundity rate, compared to cyprinids of similar size (Carlander 1969). Eight humpback chub (355–406 mm TL), injected with carp pituitary and stripped in a hatchery, produced an average of 2,523 eggs/female, or about 5,262 eggs/kg of body weight (Hamman 1982). Egg diameter ranged from 2.6 to 2.8 mm (mean, 2.7 mm). Eleven humpback chub from the LCR yielded 4,831 eggs/female following variable injections of carp pituitary and field stripping (Clarkson 1993). Male to female ratios for mainstem adults captured near the LCR, based on external morphological examination of papillae and expression of gametes, ranged by sample from 41:59 to 53:47, for an overall average of 49:51 (Valdez and Ryel 1995). Observed male to female ratio of humpback chub in Westwater Canyon was 58:42 (Chart and Lentsch 1999).

Humpback chub spawn primarily during March–May in the LCR (Kaeding and Zimmerman 1983; Minckley 1996; Gorman and Stone 1999; Stone 1999) and during April–June in the upper basin (Kaeding et al. 1990; Valdez 1990; Karp and Tyus 1990). In the LCR, ripe males aggregated in areas of complex habitat structure (Gorman and Stone 1999), and gravid females appeared to move to these male aggregations to spawn. Abrasions on anal and lower caudal fins of males and females in the LCR and in Cataract Canyon (Valdez 1990) suggest that spawning involves rigorous contact with gravel substrates, although actual spawning events have not been observed.

Unlike larvae of other Colorado River fishes (e.g., Colorado pikeminnow and razorback sucker), larval humpback chub show no evidence of long-distance drift (Robinson et al. 1998). At hatching, larvae have nonfunctional mouths and small yolk sacs (Muth 1990). The larvae swim up about 3 days after hatching but tend to remain close to spawning sites. Robinson et al. (1998) found small numbers of larvae drifting in the LCR from May through July, primarily at night.

The presence of juveniles in populations with complete size structure suggests successful reproduction in all or portions of the six populations; i.e., Black Rocks (Kaeding et al. 1990), Westwater Canyon (Chart and Lentsch 1999), the LCR in Grand Canyon (Douglas and Marsh 1996, Gorman and Stone 1999), Cataract Canyon (Valdez 1990), Desolation/Gray Canyons (Chart and Lentsch 2000), and Yampa Canyon (Karp and Tyus 1990). Reproduction in the mainstem Colorado River in Grand Canyon is precluded by cold-water temperatures, and the only documented evidence of reproduction (i.e., post-larvae) is in a thermal riverside spring located 72 km downstream of Glen Canyon Dam (Valdez and Masslich 1999). The large size structure of the humpback chub aggregation associated with this spring indicates little or no recruitment (Valdez and Ryel 1995).

A.7 Survival

Survival of humpback chub during the first year of life is low, but increases through the first 2–3 years of life with decreased susceptibility to predation, starvation, and environmental changes. Survival of adults is markedly higher than that of subadults. Annual survival rate of subadult humpback chub in the mainstem Colorado River in Grand Canyon through the first 3 years of life was estimated at 0.10, based on monthly electrofishing and minnow trap catches along shorelines near the LCR (Valdez and Ryel 1995, 1997). Survival from larval to adult life stages was estimated at 0.001 (0.10^3). Survival rate of young fish apparently varies with presently unknown environmental factors. Survival rates of young-of-year humpback chub of the 1991 year class, based on monthly electrofishing, were 0.824, 0.312, and 0.097 for 1, 6, and 12 months, respectively, and rates for 1992 were similar at 0.829, 0.326, and 0.106, respectively. However, survival rates for the 1993 year class, following high reproductive success, were much lower at 0.216, $1x10^{-4}$, and $1x10^{-8}$ for 1, 6, and 12 months, respectively. The decrease in density of subadults from September to November 1993 was 95% (521 to 24 fish/10 hours; Valdez and Ryel 1995), and was comparable to a 98% decrease (2,082 to 58) in total catch of subadults in backwaters (i.e., eddy return-current channels; Arizona Game and Fish Department 1994). Fall density of the 1993 year class was comparable to that of the 1991 and 1992 year classes, suggesting density-dependent mortality of first-year humpback chub in the mainstem.

Annual survival rate of mainstem Grand Canyon adults, based on mark-recapture data and open population model estimates, was 0.755 (95% C.I. = 0.627–0.896; Valdez and Ryel 1995). Survival rate between seasons was estimated at 0.932 (95% C.I. = 0.890–0.973). According to these estimates, 204–238 adults are lost seasonally out of a population of 3,000–3,500, and 735–857 are lost annually. Survival rates were not available for humpback chub from the LCR or from other populations in the basin.

A.8 Predation

Nonnative fishes dominate the ichthyofauna of Colorado River Basin rivers, and certain species have been implicated as contributing to reductions in the distribution and abundance of native fishes (Carlson and Muth 1989). At least 67 species of nonnative fishes have been introduced into the Colorado River Basin during the last 100 years (Tyus et al. 1982; Carlson and Muth 1989; Minckley and Deacon 1991; Maddux et al. 1993; Tyus and Saunders 1996; Pacey and Marsh 1998). Tyus et al. (1982) reported that 42 nonnative fish species have become established in the upper basin, and Minckley (1985) reported that 37 nonnative fish species have become established in the lower basin. Many of these species were intentionally introduced as game or forage fishes, whereas others were unintentionally introduced with game species or passively as bait fish. Potential negative interactions (i.e., predation and competition) between nonnative and native fishes have been identified (e.g., Tyus and Beard 1990; Minckley 1991; Hawkins and Nesler 1991; Ruppert et al. 1993; Lentsch et al. 1996; Tyus and Saunders 1996; Pacey and Marsh 1998).

The threat of predation by nonnative fishes on humpback chub has been recognized in three populations. In Grand Canyon, brown trout (*Salmo trutta*), channel catfish (*Ictalurus punctatus*), black bullhead (*Ameiurus melas*), and rainbow trout (*Oncorhynchus mykiss*) have been identified as principal predators of juvenile humpback chub, with consumption estimates that suggest loss of complete year classes to predation (Marsh and Douglas 1997; Valdez and Ryel 1997). Marsh and Douglas (1997) documented predation on humpback chub in the LCR by rainbow trout, channel catfish, and black bullhead. Valdez and Ryel (1997) identified brown trout, rainbow trout, and channel catfish as known predators of humpback chub in Grand Canyon, and suggested that common carp (*Cyprinus carpio*) could be a significant predator of incubating humpback chub eggs in the LCR. In the upper basin, Chart and Lentsch (2000) identified channel catfish as the principal predator of humpback chub in Desolation/Gray Canyons. The UCRRP identified channel catfish as the principal predator of humpback chub in Yampa Canyon and is pursuing development and implementation of a control program.

A.9 Age and Growth

Use of scales for aging humpback chub has limited use because of crowding, extensive cross-overs, and loss of growth rings because of resorption (Valdez and Ryel 1995). The humpback chub is endangered, therefore sacrificing individuals for extracting otoliths (i.e., inner ear bones) or other bony structures for traditional age-growth studies is not practical. Length-frequency analyses distinguish only the first three or four cohorts and slowed growth distorts cohort separation after the fish reach maturity at about 175–200 mm TL. The only information available on growth of humpback chub is from laboratory studies with young fish, mark-recapture data, and a limited amount of scale aging of young individuals. A limited number of otoliths (lapilli) from LCR fish was examined for total age and showed a maximum of 23 annular rings (Hendrickson 1993), indicating that the species is long-lived; measurements of individual annual rings were not taken for age-growth analysis by back-calculation, and incomplete analyses render these results preliminary and putative.

Humpback chub grow relatively quickly at warm temperatures until maturity, at which time growth slows dramatically. Humpback chub larvae are approximately 7 mm long at hatching (Muth 1990). In a laboratory, post-larvae grew at a rate of 10.63 mm/30 days at 20°C, but only 2.30 mm/30 days at 10°C (Lupher and Clarkson 1994). Similar growth rates were reported from back-calculations of scale growth rings in wild juveniles at similar water temperatures from the LCR (10.30 mm/30 days; temperature of 18–25°C) and the mainstem Colorado River in Grand Canyon (3.50–4.00 mm/30 days; temperature of 10–12°C; Valdez and Ryel 1995). Clarkson and Childs (2000) found that lengths, weights, and specific growth rates of humpback chub were significantly lower at 10°C and 14°C (similar to hypolimnetic dam releases) than at 20°C.

Growth rates of humpback chub vary by population. Based on scale back-calculations, humpback chub from the LCR were 100 mm TL at 1 year of age and 250–300 mm TL at 3–4 years of age (Kaeding and Zimmerman 1983); whereas, fish 1, 2, and 3 years old from the mainstem Colorado River in Grand Canyon were 95, 155, and 206 mm TL, respectively (Valdez and Ryel 1995). Fish 1–6 years old from Cataract Canyon were 50, 100, 144, 200, 251, and 355 mm TL, respectively (Valdez 1990).

Mark-recapture data from the LCR (Minckley 1992) and the Colorado River in Grand Canyon (Valdez and Ryel 1995) show that young humpback chub grow faster in the LCR (about 10 mm/30 days) than in the mainstem (2–4 mm/30 days), but fish older than about 3 years of age grow faster in the mainstem (0.79–2.79 mm/30 days) than in the LCR (<1–1.4 mm/30 days). Apparently food resources, habitat, and water temperatures are more suitable for young fish in the LCR, but habitat, food, and space may be limiting for adults. Abundant habitat, suitable food, and a relatively stable, regulated flow may favor adult growth in the mainstem, despite cold water temperatures. Mark-recapture data for humpback chub from Westwater Canyon, Utah (personal communication, T. Chart, U.S. Bureau of Reclamation) showed average monthly growth rates of 1.08 mm and 1.35 mm for fish 200–250 mm TL and 250–300 mm TL, respectively, which are similar to the growth rates of LCR fish, but well below growth rates of mainstem Grand Canyon fish.

Age to length relationships for humpback chub are available from several investigations (Vanicek and Kramer 1969; Kaeding and Zimmerman 1983; Valdez 1990; Minckley 1992; Hendrickson 1993; Valdez and Ryel 1995; personal communication, G. Haines, U.S. Fish and Wildlife Service). Vanicek and Kramer (1969) determined average length of age-4 roundtail chub from the Green River at 218 mm TL, and average length of age-3 *"Colorado chub"* (*Gila* sp.) at 156 mm TL (based on scale back-calculations); roundtail chub can be used as a surrogate for humpback chub because of similar growth rates and lengths. Valdez (1990) determined average length of age-4 humpback chub in Cataract Canyon at 200 mm TL, and length of age 3 at 144 mm TL. Using 30-day growth rates of humpback chub from the LCR (Minckley 1992), lengths at ages 3 and 4 were estimated at 170 and 200 mm TL, respectively. Hendrickson (1993) aged humpback chub from the LCR and the mainstem Colorado River in Grand Canyon; based on polynomial regression of average number of annuli from otoliths (lapillus and asteriscus) and opercles, age-3 fish were 157 mm TL and age-4 fish were 196 mm TL (Figure A-1). Valdez and Ryel (1995) recorded size at first observed maturity (based on expression of gametes, presence of spawning tubercles) of humpback chub in Grand Canyon at 202 mm TL for males and 200 mm

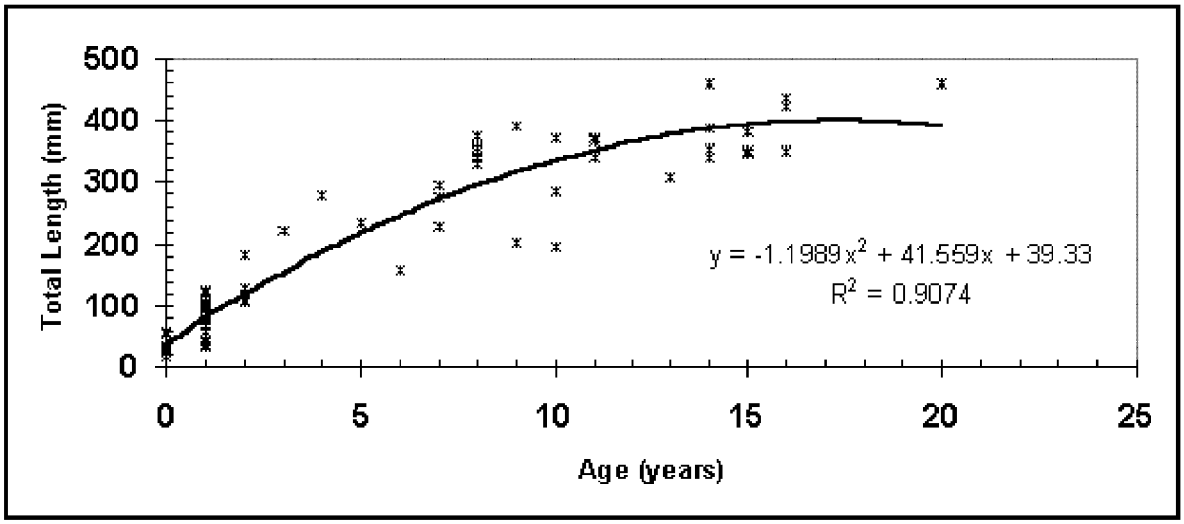


Figure A-1. Total length to age relationship for humpback chub from Grand Canyon, based on average number of annuli from otoliths (lapillus and asteriscus) and opercles (Hendrickson 1993).

TL for females; average length of age-3 fish, based on scale back-calculations, was 186 mm TL. In Yampa Canyon, approximate length of age-4 roundtail chub from otolith age (personal communication, G. Haines, U.S. Fish and Wildlife Service) was 200 mm TL, and approximate length at age 3 was 150 mm TL. These investigations show that average length of age-4 humpback chub ranged from 196 to 218 mm TL, and length of a tracked cohort was 140–210 mm TL (Table A-4). From this information on age at sexual maturity and age to length relationships, adult humpback chub are defined as fish that are 200 mm TL or larger. This is based on the conservative assumption that all age-4 fish are sexually mature, and the average length at age 4 is 200 mm TL. Based on an approximate length at age 3, subadults are defined as those fish that are 150–199 mm TL (Table A-4).

A.10 Length-Weight and Condition Factor

Length-weight relationships and condition factor provide valuable indices to the general health of a fish population. Length-weight relationships for mainstem Grand Canyon humpback chub for 1990–1991 (log W = -5.324 + 3.117 log TL, R^2 = 0.99), 1992 (log W = -5.176 + 3.056 log TL, R^2 = 0.99), and 1993 (log W = -5.034 + 2.986 log TL, R^2 = 0.98) reveal exponents of 3.117, 3.056, and 2.986, which indicate approximately isometric growth (Valdez and Ryel 1995); i.e., the relationship of weight as a cube of the length (exponent = 3.0) remains constant as the fish grows (LeCren 1951; Lagler 1956). However, Meretsky et al. (2000) provided length-weight relationships for eight groups of fish from all six populations of humpback chub; exponents ranged from 2.505 to 3.288, indicating different degrees of allometry among populations. Douglas (1993) reported from video image technology that changing body shape of humpback chub affects length to weight relationships, also suggesting allometric growth; no significant difference in morphology was found between males and females.

Table A-4. Lengths of adult and subadult humpback chub as determined from scale back-calculations, otolith and opercle ages, and field observations.

Investigator	Area or Population	Adult		Subadult	
		Age	Total Length (mm)	Age	Total Length (mm)
Vanicek and Kramer (1969)	Dinosaur National Monument, Green River, Colorado and Utah	4	218[a]	3	156[b]
Valdez (1990)	Cataract Canyon, Colorado River, Utah	4	200	3	144
Minckley (1992)	Little Colorado River, Grand Canyon, Arizona	4	~200[c]	3	~170[c]
Hendrickson (1993)	Little Colorado River, Grand Canyon, Arizona	4	196	3	157
Valdez and Ryel (1995)	Colorado River, Grand Canyon, Arizona		Males: 202 Females: 200[d]	3	186
Chart and Lentsch (1999)	Westwater Canyon, Utah	4	140–210[e]	3	120–170[e]
Haines (pers. comm.)	Yampa River, Colorado[f]	4	200[a]	3	150[a]

[a]based on roundtail chub (*Gila robusta*).
[b]based on "Colorado chub" (*Gila* sp.).
[c]based on 30-day growth rates.
[d]based on size at first maturity from field observations.
[e]based on length ranges of cohorts tracked with length-frequency.
[f]based on otoliths.

Relative condition factor for adult humpback chub (>200 mm TL) from the mainstem Colorado River in Grand Canyon for 1990–1993 ranged from 0.783 to 1.023 for males and from 0.883 to 1.092 for females (Valdez and Ryel 1995). Highest condition was typically seen during February-April, just prior to spawning, and lowest condition was usually seen during June–September, after spawning. Meretsky et al. (2000) reported a decline in condition factor of adult humpback chub not in immediate spawning condition from the LCR confluence from 1978 to 1996, hypothesizing that the decline could be caused by one or more factors; e.g., a recent invasion of the Asian tapeworm (*Bothriocephalus acheilognathi*), researcher variation in weighing fish, or natural population variation.

Hoffnagle (2000) reported that condition and abdominal fat were greater in the mainstem Colorado River than in the LCR during 1996, 1998, and 1999. This may have been due to the increased prevalence and abundance of parasites (especially *Lernaea cyprinacea* and *Bothriocephalus acheilognathi*) in the LCR fish and/or greater food availability in the Colorado River.

A.11 Diet

Humpback chub are typically omnivores with a diet consisting of insects, crustaceans, plants, seeds, and occasionally small fish and reptiles. They appear to be opportunistic feeders, capable of switching diet according to available food sources, and ingesting food items from the water's surface, mid-water, and river bottom. A number of investigators have reported large volumes of the green alga *Cladophora* mixed with a variety of invertebrates and detritus in diets of humpback chub from Grand Canyon (Minckley et al. 1980; Carothers and Minckley 1981; Kubly 1990; Valdez and Ryel 1995), suggesting that either incidentally consumed items are significant in the diet or nutritional value is gained from miscellaneous plant parts. Leibfried (1988) found that epiphytic diatoms on *Cladophora glomerata* consumed by rainbow trout provided an important source of lipids in the diet. This is unlikely for humpback chub because of a simple S-shaped gut with no defined stomach or lower intestine, and no pyloric caeca, all of which function in other fishes to help break down cellulose and absorb fats and nutrients.
The only detailed dietary studies of humpback chub are from Grand Canyon. Guts of 158 adults from the mainstem Colorado River, flushed with a nonlethal stomach pump, had 14 invertebrate taxa and nine terrestrial taxa (Valdez and Ryel 1995), including simuliids (blackflies, in 77.8% of fish), chironomids (midges, 57.6%), *Gammarus* (freshwater shrimp, 50.6%), *Cladophor*a (green alga, 23.4%), Hymenoptera (wasps, 20.9%), and cladocerans (water fleas, 19.6%). Seeds and human food remains were found in eight (5.1%) and seven (4.4%) fish respectively.
Longitudinal differences in diet were evident reflecting relative abundance of available food sources; i.e., simuliids were available and consumed throughout the canyon, but terrestrial invertebrates replaced *Gammarus* in lower reaches where the latter were absent. Seasonal differences were also evident with *Gammarus* as the primary food item in spring (40.1% by volume), and simuliids in summer (46.4%) and fall (44.7%). Diets of adult humpback chub during an experimental high dam release in 1996 showed a preference for terrestrial insects and aquatic invertebrates dislodged by the flood and entrained in large recirculating eddies (Valdez and Hoffnagle 1999). Specimens caught below Glen Canyon Dam in the early 1970's had been feeding on zooplankton flushed from Lake Powell (Minckley 1973).

Diets of humpback chub from the LCR and mainstem differ markedly, reflecting available food sources. Although larvae of simuliids and chironomids were present in both groups, *Gammarus* comprised only 1% volume of the diet of LCR fish (Kaeding and Zimmerman 1983), but approximately 64% of the diet of mainstem fish (Valdez and Ryel 1995); *Gammarus* are abundant in the mainstem but rare in the LCR. Adult humpback chub from the LCR have also been reported to be cannibalistic on their young during periods of high reproductive success (Gorman 1994).

Arizona Game and Fish Department (1996a) reported that juvenile humpback chub in Grand Canyon consumed 19 different prey items, eight more than any other species examined. Chironomid larvae, terrestrial insects, simuliid larvae, and copepods were all found in at least 5% of the stomachs examined.

Diet studies for humpback chub from populations outside the Grand Canyon are limited. Analysis of 25 young-of-year and juvenile *Gila* spp. from the Green and upper Colorado Rivers

showed that Ephemeroptera and Diptera were important food items (Jacobi and Jacobi 1982). The diet of "Colorado chub" (i.e., roundtail chub and bonytail) was chironomid larvae and ephemeroptera nymphs for small fish (< 200 mm TL), and aquatic and terrestrial insects (i.e., adult beetles, grasshoppers and ants) for larger fish (> 200 mm TL; Vanicek 1967). Tyus and Minckley (1988) reported that humpback chub utilized migrating Mormon crickets (*Anabrus simplex*), a large flightless locust, in the Green and Yampa rivers within Dinosaur National Monument. These studies also suggest that humpback chub are opportunistic in their feeding habits, utilizing food sources as they become available. Periodic increases in availability of terrestrial and aquatic invertebrates from stochastic flooding events or hatches may have been an important factor in the evolution of feeding strategies of the species. Preference for terrestrial invertebrates and relatively uncommon taxa of aquatic invertebrates that are only sporadically available may reflect these strategies.

A.12 Parasites

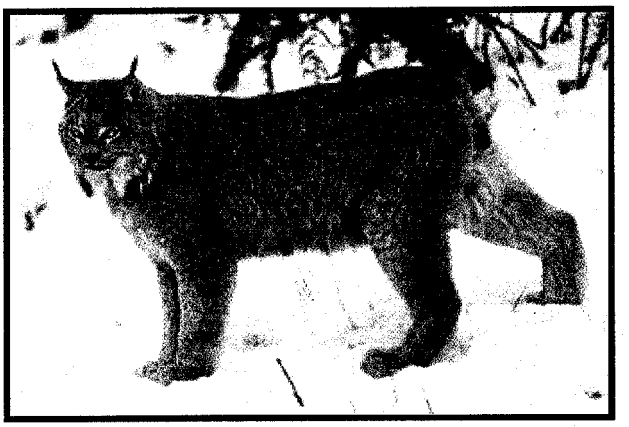
The majority of parasites of humpback chub are alien to the Colorado River Basin, introduced through nonnative fishes. Most notable are the external parasitic copepod, *Lernaea cyprinacea*, and the intestinal Asian tapeworm. During 1990–1993, *L. cyprinacea* was found on 8 of 6,294 fish from the Colorado River in Grand Canyon for an infection rate of only 0.13% and an average of 1.25 copepods (range, 1–2) per infected fish (Valdez and Ryel 1997). None of the infected fish showed signs of stress or illness, although open lesions had formed at some anchor points. This parasite infected 5.3% of humpback chub from the LCR (Hoffnagle et al. 2000). *Lernaea cyprinacea* was first reported from Grand Canyon in 1979 (Carothers et al. 1981) but has not become problematic because the mainstem fails to reach optimum maturation temperatures of 23–30°C (Bulow et al. 1979). *Lernaea* matures at temperatures as low as 18°C (Grabda 1963). In Black Rocks, Westwater Canyon, and Cataract Canyon, *L. cyprinacea* was found on 17% and 31% of juvenile and adult humpback chub, respectively during 1979–1981 (range, 1–13 copepods/infected fish; Valdez et al. 1982).

The internal Asian tapeworm was first reported from Grand Canyon in 1990 (Brouder and Hoffnagle 1997; Clarkson et al. 1997). During 1990–1993, this parasite was found in gut contents of 6 of 168 (3.6%) mainstem adult humpback chub treated with a nonlethal stomach pump, for an average of 6.7 tapeworms per infected fish (range, 1–28; Valdez and Ryel 1997). Clarkson et al. (1997) found Asian tapeworms in 28% of sacrificed humpback chub examined from the LCR in 1990–94. They also reported the parasite in intestines of common carp (*Cyprinus carpio*), fathead minnow (*Pimephales promelas*), speckled dace (*Rhinichthys osculus*), and plains killifish (*Fundulus zebrinus*). Brouder and Hoffnagle (1997) also found Asian tapeworms in humpback chub (22.5%) from the LCR in 1994, as well as in plains killifish (10.3%), speckled dace (3.8%), and fathead minnow (2.2%). They reported that nearly all (66.7–100%) of infected fish were captured near the LCR, although the parasite was found as far downstream as Kanab Creek, 132 km downstream of the LCR. During 1996–1997, the internal Asian tapeworm (*Bothriocephalus acheilognathi*) occurred in 31.6–84.2% of humpback chub examined in the LCR and 8.8–26.7% in the Colorado River (Hoffnagle et al. 2000); the crustacean (*Lernaea cyprinacea*) was found on 5.3–47.6% of chubs in the LCR and 0–6.7% in the Colorado River; the trematode (*Ornithodiplostomum sp.*) in 50%; and the nematode

(*Rhabodochona sp.*) in 5.3%. Markedly lower infestation rates of most parasites in the Colorado River in Grand Canyon demonstrate the detrimental effect of cold temperatures on most fish parasites of the Colorado River Basin. Infection of humpback chub by the Asian tapeworm is a concern because of possible stress and death to the host and widespread infestation during periods of stress. This parasite is able to complete its life cycle in the LCR where the temperature requirement of >20°C is met (Granath and Esch 1983), and although unable to complete its life cycle in the mainstem, it is apparently able to survive in a fish host in the cold temperatures. Meretsky et al. (2000) hypothesized that an observed decline in condition of adult humpback chub in Grand Canyon was a result of recent infestation by the internal Asian tapeworm.

A survey of diseases of endangered fishes in the Upper Colorado River Basin in 1981 (Flagg 1982) revealed that humpback chub carried the protozoans *Myxobolus* sp., *Apiosoma*, *Tetrahymena*, *Ambiphyra*, and *Chilodonella*; as well as the nematode *Philometra* sp., and the crustacean *Lernaea cyprinacea*.

RECOVERY OUTLINE
Contiguous United States Distinct Population Segment of the Canada Lynx



Common Name: Canada lynx
Scientific Name: *Lynx canadensis*

Listing Status: Threatened
Date Listed: March 24, 2000

Lead Region: U.S. Fish and Wildlife Service, Region 6. Cooperating regions are Regions 1, 3 and 5.

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Purpose of the Recovery Outline: This document serves as an interim strategy to guide recovery efforts and inform the critical habitat designation process for the contiguous United States population of the Canada lynx until a draft recovery plan has been completed. Recovery outlines are intended primarily for internal U.S. Fish and Wildlife Service (Service) use; formal public participation will be invited upon release of the draft recovery plan. We will consider any new information or comments that members of the public may wish to offer regarding this outline during the recovery planning process. For more information on Federal recovery efforts for the contiguous United States population of the Canada lynx, or to provide additional comments, interested parties may contact the lead biologist for this species, Lori Nordstrom, at the above address, telephone, or e-mail.

Scope of Recovery and Available Information: The scope of this recovery effort is the contiguous United States distinct population segment of the Canada lynx (U.S. Department of the Interior [USDI] 2000, 2003). This outline provides a general overview of the available information on the contiguous United States lynx distinct population segment, and provides preliminary recovery objectives and actions based on our understanding of current and historical lynx occurrence and lynx population dynamics in the contiguous United States Because of the gaps in our knowledge of this species, for this recovery outline we made some assumptions regarding lynx population dynamics and the relative importance of different geographic areas to the persistence of lynx in the contiguous United States. We recognize the uncertainties of this information and identified the assumptions we made.

OVERVIEW

Species Description and Life History: Canada lynx are medium-sized cats, generally measuring 75-90 centimeters long (30-35 inches) and weighing 8-10.5 kilograms (18-23 pounds) (Quinn and Parker 1987). They have large feet adapted to walking on snow, long legs, tufts on the ears, and black-tipped tails. They are highly adapted for hunting snowshoe hare, the primary prey, in the snows of the boreal forest.

Lynx in the contiguous United States are at the southern margins of a widely-distributed range across Canada and Alaska. The center of the North American range is in north-central Canada. Lynx occur in mesic coniferous forests that have cold, snowy winters and provide a prey base of snowshoe hare (Ruggiero et al. 2000). These forests are generally described as boreal forests. In North America, the distribution of lynx is nearly coincident with that of snowshoe hares (Bittner and Rongstad 1982; McCord and Cardoza 1982). Lynx survivorship, productivity and population dynamics are closely related to snowshoe hare density in all parts of its range. A minimum density of snowshoe hares (greater than 0.5 hare per hectare (1.2 hares per acre) [Ruggiero et al. 2000]) distributed across a large landscape is necessary to support survival of lynx kittens and recruitment into and maintenance of a lynx population.

In the United States, lynx inhabit conifer and conifer-hardwood habitats that support their primary prey, snowshoe hares. Both timber harvest and natural disturbance processes, including fire, insect infestations, catastrophic wind events, and disease outbreaks, can provide foraging habitat for lynx when resulting understory stem densities and structure provide the forage and cover needs of snowshoe hare (Keith and Surrendi 1971; Fox 1978; Conroy et al. 1979; Wolff 1980; Parker et al. 1983; Litvaitis et al. 1985; Bailey et al. 1986; Monthey 1986; Koehler 1990, 1991; Agee 2000). These characteristics include a dense, multi-layered understory that maximizes cover and browse at both ground level and at varying snow depths throughout the winter (crown cover within the lower 4.5 meters (15 feet) in order to provide cover and food for snowshoe hares to 2 meters (6 feet) high at maximum snow depths). Despite the variety of habitats and settings, good snowshoe hare habitat has a common denominator – dense, horizontal vegetative cover 1-3 meters (3-10 feet) above the ground or snow level (Hodges 2000).

In northern Canada, lynx populations fluctuate in response to the cycling of snowshoe hare (Mowat et al. 2000). Although snowshoe hare populations in the southern portion of the range in the contiguous United States may fluctuate, they do not show strong, regular population cycles as in the north (Hodges 2000). In the contiguous United States, the degree to which regional local lynx population fluctuations are influenced by local snowshoe hare population dynamics is unclear.

The southernmost extent of the boreal forest that supports lynx occurs in the contiguous United States in the Northeast, western Great Lakes, northern and southern Rockies, and northern Cascades (Ruediger et al. 2000). Here the boreal forest transitions into other vegetation communities and becomes more patchily distributed. As a result, the southern boreal forests generally support lower snowshoe hare densities, hare populations do not appear to be as highly cyclic as snowshoe hares further north, and lynx densities are lower compared to the northern boreal forest.

Individual lynx maintain large home ranges (reported as generally ranging between 31-216 kilometers^2 (km^2) (12-83 miles^2 (mi^2)) (Koehler 1990; Aubry et al. 2000; Squires and Laurion 2000; Vashon et al. 2005). Thus, a lynx population can only persist in a large boreal forested landscape that contains appropriate forest types, snow depths and high snowshoe hare densities. In the Northeast, lynx were most likely to occur in areas that support deep snow (greater than 268 centimeters [106 inches] annual snowfall) associated with regenerating boreal forests in landscapes 100 km^2 (40 mi^2) or greater in area (Hoving 2001; Hoving et al. 2004). We assume areas with smaller patches of boreal forest are unlikely to provide a sufficient amount of habitat suitable to support a lynx population.

Lynx are highly mobile and have a propensity to disperse long distances, particularly when prey becomes scarce (Mowat et al. 2000). Lynx also make long distance exploratory movements outside their home ranges (Aubry et al. 2000; Squires et al. 2001; Moen et al. 2004). Areas or habitats used by lynx during dispersal or exploratory movements are poorly understood at this time. Dispersing lynx may colonize suitable but unoccupied habitats, augment existing resident populations, or disperse to unsuitable or marginal habitats where they cannot survive. Numerous lynx mortality records exist from anomalous habitats or habitats where no records support evidence (either current or historical) of a reproducing population (McKelvey et al. 2000a). Many of these records correspond to post-population peaks in Canada, with some lag time for immigration (McKelvey et al. 2000a). We find no evidence of lynx populations becoming established in such areas.

Lynx populations in the contiguous United States seem to be influenced by lynx population dynamics in Canada (Thiel 1987; McKelvey et al. 2000a, c). Many of these populations in Canada are directly interconnected United States populations, and are likely a source of emigration into contiguous United States lynx populations. Therefore, we assume that retaining connectivity with larger lynx populations in Canada is important to ensuring long-term persistence of lynx populations in the United States. We assume that, regionally, lynx within the contiguous United States and adjacent Canadian provinces interact as metapopulations and, therefore, assessments of population viability must be made at this larger scale and not solely based on populations within the contiguous United States.

PRELIMINARY RECOVERY ASSESSMENT

The historical and current range of the lynx in the contiguous United States is within the southern extensions of the boreal forest in the Northeast, Great Lakes, Rocky Mountains, and Cascade Mountains. The lynx is listed in the14 States that support boreal forest types and contain verified records of lynx occurrence--Colorado, Idaho, Maine, Michigan, Minnesota, New Hampshire, New York, Oregon, Montana, Utah, Vermont, Washington, Wisconsin, and Wyoming.

Based on our examination of historical and recent evidence, lynx habitat and occurrence within the contiguous United States can be categorized as--1) core areas, 2) secondary areas, and 3) peripheral areas. The areas with the strongest long-term evidence of the persistence of lynx populations within the contiguous United States are defined as "**core areas.**" Core areas have both persistent verified records of lynx occurrence over time and recent evidence of reproduction. Six core areas and one "provisional" core area are identified within the contiguous

United States. The provisional core area in the Southern Rockies was identified because it contains a reintroduced population[1]. Reproduction has been documented in this introduced population; however, it is too early to determine whether a self-sustaining lynx population will result. Focusing lynx conservation efforts on these core areas will ensure the continued persistence of lynx in the contiguous United States by addressing fundamental principles of conservation biology:

1) representation by conserving the breadth of ecological settings of the distinct population segment;

2) redundancy by retaining a sufficient number of populations to provide a margin of safety to withstand catastrophic events; and

3) resiliency by maintaining sufficient numbers of animals in each population to withstand randomly occurring events and prey population dynamics.

At this time, the role of areas outside of these core areas in sustaining lynx populations in the contiguous United States is unclear. The fluctuating nature of lynx population dynamics and the ability of lynx to disperse long distances have resulted in many individual occurrence records outside of core areas, without accompanying evidence of historic or current presence of lynx populations. Areas classified as "secondary areas" are those with historical records of lynx presence with no record of reproduction; or areas with historical records and no recent surveys to document the presence of lynx and/or reproduction. If future surveys document presence and reproduction in a secondary area, the area could be considered for elevation to core. We hypothesize that secondary areas may contribute to lynx persistence by providing habitat to support lynx during dispersal movements or other periods, allowing animals to then return to "core areas." In "**peripheral areas**" the majority of historical lynx records is sporadic and generally corresponds to periods following cyclic lynx population highs in Canada. There is no evidence of long-term presence or reproduction that might indicate colonization or sustained use of these areas by lynx. However, some of these peripheral areas may provide habitat enabling the successful dispersal of lynx between populations or subpopulations. At this time, we simply do not have enough information to clearly define the relative importance of secondary or peripheral areas to the persistence of lynx in the contiguous United States.

[1] Since 1999, 204 lynx from Canada and Alaska have been released into Colorado. In 2003, 6 litters were documented with a total of 16 kittens; in 2004, 14 litters were documented with a total of 39 kittens (T. Shenk, Colorado Division of Wildlife, pers. comm. 2005).

I. **CORE AREA CRITERIA** To meet the definition of a core area for lynx, the area must meet all of the following conditions (Table 1):

- Has verified evidence (e.g., McKelvey et al. 2000a; Hoving et al. 2003) of long-term historical and current presence of lynx populations. Lynx occurrences within the core area are persistent over time despite the cyclic or fluctuating nature of lynx and snowshoe hare populations that may periodically result in reduced populations or suspected local extirpation of lynx. This is normal unless populations do not show a positive response when snowshoe hare populations increase.
- Has recent (within the past 20 years) evidence of reproduction. Reproduction or recruitment into the lynx population may not occur every year because of natural cyclic or fluctuating populations that are tied to snowshoe hare population levels.
- Contains boreal forest vegetation types of the quality and quantity to support both lynx and snowshoe hare life needs.
    - Large or numerous patches of habitat supporting average snowshoe hare densities over time of at least 0.5 hare per hectare (1.2 hares per acre) (Ruggiero et al. 2000); the best available information suggests that this is the minimum density necessary to support survival of lynx kittens and recruitment into and maintenance of a lynx population.
    - Contains a minimum of 1,250 km^2 (483 mi^2) of boreal forest habitat as part of a larger landscape for conservation (can include boreal forest habitat directly adjacent in Canada). This is the minimum size considered necessary to support a minimum lynx population of at least 25 adults based on information from the North Cascades in Washington (1 lynx per 50 km^2) (Brittell et al. 1989; Koehler 1990; McKelvey et al. 2000b). Habitat patches must be sufficiently large and connected to enable movement within and between patches within a core area.
- Snow conditions are generally fluffy and/or deep enough to favor the competitive advantage of lynx.

❖ **CORE AREAS (Figure 1)**

♦ **NORTHEAST**

* Northern Maine/northern New Hampshire

♦ **GREAT LAKES**

* Northeastern Minnesota

♦ **NORTHERN ROCKIES/CASCADES**

* Northwestern Montana/northeastern Idaho
* Northern Cascades (Washington)
* Kettle/Wedge (Washington)
* Greater Yellowstone Area (portions of Wyoming, Montana, Idaho)

❖ **PROVISIONAL CORE AREA (Figure 1)**

♦ **SOUTHERN ROCKIES**

* Entire (Colorado and southern Wyoming)

II. SECONDARY AREA CRITERIA (Table 1)

- Compared to core areas, secondary areas have fewer and more sporadic current and historical records of lynx and, as a result, historical lynx abundance has been relatively low. Reproduction has not been documented. Some of the secondary areas have not been surveyed following any survey protocol; as a result the current status of lynx occupancy in some secondary areas is not known.
- Quality and quantity of lynx habitat (including snowshoe hare densities and snow conditions) is less clear. Information is currently lacking to understand why historical lynx abundance in these areas appears to be less than in core areas. Compared to core areas, habitat in secondary areas may be patchier, drier, and/or more maritime resulting in snow or habitat conditions that are not favorable to lynx. Another explanation may be that lynx populations were extirpated because of changes in vegetation structure that resulted in poor prey populations or some disturbance, such as past trapping, and the area has not been recolonized by lynx.
- As new information becomes available, some areas currently classified as secondary may be elevated to core status.

❖ **SECONDARY AREAS (Figure 1)**

♦ **NORTHEAST**

* None

♦ **GREAT LAKES**

* Northern Minnesota/northwestern Wisconsin (portions)

♦ **NORTHERN ROCKIES/CASCADES**

* Southwest Montana
* Northern/central Idaho(north of the Salmon River)
* Northern Chelan County (Washington)
* Salmo Priest (Washington)
* Little Pend Oreille (Washington)

♦ **SOUTHERN ROCKIES**

* None

III. PERIPHERAL AREA CRITERIA (Table 1)

- Areas that contain few verified historical or recent records of lynx; records are sporadic and usually associated with periods when there were unprecedented cyclic population highs in Canada, such as the early to mid 1960s and/or 1970s. There may be large gaps in time, e.g., from 1920s to 1960s, with no records of lynx.
- Quality and quantity of habitat to support adequate snowshoe hare or lynx populations are questionable. Habitat may occur in small patches and is not well-connected to larger patches of high quality habitat.
- May sustain short-term survival during lynx dispersal.

❖ **PERIPHERAL AREAS (Figure 1)**

♦ **NORTHEAST**

* Vermont
* New York
* Eastern Maine
* Central New Hampshire

♦ **GREAT LAKES**

* Northeastern Wisconsin
* Michigan

♦ **NORTHERN ROCKIES/CASCADES**

* Utah
* Big Horn Mountains (Wyoming)
* Northeast Oregon/southeast Washington
* Southern Cascades (Washington)
* Vulcan/Tunk (Washington)
* Snowy Mountains and Highwood Mountains (Montana)

♦ **SOUTHERN ROCKIES**

* None

Land Ownership Pattern: Coarse estimates of the amount of lynx habitat and land ownership in the different regions of the contiguous United States can be found in our 2003 Clarification of the Final Rule (USDI 2003). Outside of the Northeast, lynx habitat occurs primarily on a federally-owned land base, predominantly U.S. Forest Service (FS). In the Northeast, nearly all the lynx habitat is privately-owned, most of which is commercial forest in Maine.

SUMMARY OF LISTING FACTORS

A) The present or threatened destruction, modification or curtailment of habitat or range.

In all regions within the range of lynx in the contiguous United States, timber harvest, recreation and their related activities are the predominant land use affecting lynx habitat. The final rule stated that timber harvest and associated forest management can be benign, beneficial, or detrimental to lynx depending on harvest methods, spatial and temporal specifications, and the inherent vegetation potential of the site (USDI 2000, 2003).

The primary factor that caused the lynx to be listed was the lack of guidance for conservation of lynx and snowshoe hare habitat in National Forest Land and Resource Plans and Bureau of Land Management (BLM) Land Use Plans given that a substantial amount of lynx habitat in the contiguous United States is federally managed (USDI 2000). This lack of guidance allowed the continued degradation of lynx habitat on Federal lands through timber management and other Federal activities. The remanded final rule[2] found that timber harvest and/or fire suppression may have had regional or local impacts but we believe that they are not currently at a level threatening the contiguous United States lynx distinct population segment, as a result of conservation agreements[3] between the FS, BLM, and Service. The FS and BLM have curtailed pre-commercial thinning, thought to be detrimental to snowshoe hare and thus lynx, since the signing of a Lynx Conservation Agreement with the Service and the programmatic biological opinion on FS and BLM land management plans. Both the Conservation Agreement and programmatic biological opinion require that the information and recommendations in the Lynx Conservation Assessment and Strategy (Ruediger et al. 2000), which was based on the current state of knowledge, be considered for project planning and used as the basis for effects determinations.

Except for lynx habitat management plans on some private and State lands in Washington, in the remainder of the contiguous United States range there are no management plans that specifically address lynx conservation.

NORTHERN ROCKIES/CASCADES AND SOUTHERN ROCKIES

The remanded final rule (USDI 2003) concluded that some timber harvest activities, such as pre-commercial thinning, may reduce the quality of snowshoe hare habitat in local areas on non-Federal lands in the Northern Rocky Mountains/Cascades and Southern Rocky Mountains, and thus may negatively affect lynx or lynx habitat at local scales. Alternatively, timber harvest regimes in lynx habitat that create a dense understory provide good snowshoe hare and lynx conditions. Furthermore, lynx habitat on National Forest and BLM lands is currently managed to conserve lynx since the signing of a Lynx Conservation Agreement and the programmatic

[2] A 2002 court order directed the Service to reconsider the status of the Canada lynx under the Endangered Species Act. The remanded final rule reaffirmed the decision to list as threatened in the contiguous United States.

[3] Both conservation agreements expired in December 2004. The Forest Service agreement has been revised (May 2005), resulting in changes from the original conservation agreement.

biological opinion on FS and BLM land management plans, both of which require that the information and recommendations in the Lynx Conservation Assessment and Strategy be considered for project planning and used as the basis for effects determinations.

The remanded final rule (USDI 2003) found that fire suppression has had only limited effects on lynx habitat in the Northern Rocky Mountains/Cascades and Southern Rocky Mountains; however, it may affect lynx habitat quality at some local scales, particularly on non-Federal lands. Fire suppression and reduction of heavy fuels has the potential to affect snowshoe hare habitat. Because the highest priorities for fuels treatment projects are in low elevation forests with low-intensity-high frequency fire regimes (which are not lynx habitat) and for wildland-urban interface areas, the overall effects on lynx habitat are anticipated to be limited.

GREAT LAKES

Timber harvest and fire suppression on non-Federal lands may cause local impacts to lynx and snowshoe hare habitat in the Great Lakes Region. Since the lynx was listed, lynx habitat on National Forest lands is managed to conserve lynx and National Forest Plans on the Superior and Chippewa National Forests have been revised to provide for the conservation of lynx.

NORTHEAST

Timber harvest and associated activities on non-Federal lands exert the most influence on lynx habitat in the Northeast and have created the favorable conditions that currently exist for lynx and snowshoe hares (Homyack 2003) in northern Maine. As a result of the Standards (Maine Department of Conservation 1999) that implement the Maine Forest Practices Act, as amended (Maine Department of Conservation 2004) harvest management in Maine has shifted away from clearcutting and now favors partial cutting, which, in some situations, may result in less favorable conditions for snowshoe hare and lynx.

B) Overutilization for commercial, recreational, scientific, or educational purposes.

We found that in the contiguous United States, lynx populations occur at naturally low densities. This is expected because of limited habitat and limited availability of their primary prey, snowshoe hares. At southern latitudes, low snowshoe hare densities are likely a result of the naturally patchy, transitional boreal habitat. Such habitat prevents hare populations from achieving high densities similar to those in the extensive northern boreal forest. The final rule (USDI 2000) and remanded final rule (USDI 2003) found that despite concerns that overtrapping had severely depressed the United States populations of lynx, low numbers of lynx in the contiguous United States compared to northern Canada occur not as a result of historical overtrapping within the United States, but because lynx and their prey are naturally limited by the amount of habitat, topography, and climate. Precautions taken by States to restrict lynx trapping since the 1980s likely prevented and continue to prevent the overharvest of resident lynx.

Legal trapping, snaring, and hunting for bobcat, coyote, wolverine, and other furbearers create a potential for incidental capture or shooting of lynx. Lynx persist throughout their range despite the incidental catch that presumably has occurred throughout the past, probably at higher levels than presently. Although we are concerned about the mortality of lynx that are incidentally

captured, we have no information to indicate that the loss of these individuals has negatively affected the overall ability of lynx in the contiguous United States to persist. We recognize that individuals may be lost, which could affect small, local populations.

Lynx trapping in Canada, where lynx are a legally harvested furbearer, may affect rates of lynx immigration into the contiguous United States Immigration of lynx into the contiguous United States is believed important to sustaining persistent lynx populations in core areas adjacent to Canada, therefore, contiguous United States lynx populations might be negatively affected if trapping reduces the numbers of emigrating lynx.

C) Disease or predation.

Disease or predation is not known to be a factor threatening lynx at a population level.

D) Inadequacy of existing regulatory mechanisms.

As a result of Federal, State, and Tribal regulations and plans that conserve lynx, in particular the Forest Service and BLM Lynx Conservation Agreements and the revision of some Forest Plans, the threats to lynx from the inadequacy of existing regulatory mechanisms have been reduced since the lynx was listed. However, establishment of consistent guidance that provides adequate regulatory mechanisms over the longer term is needed throughout the range of the lynx. Similarly, plans to conserve lynx habitat and provide long-term conservation of lynx in the Northeast are currently lacking. The Maine Forest Practices Act has significantly changed silvicultural practices from clearcutting to partial harvesting, which may not create conditions that are beneficial to lynx and snowshoe hares (Hoving et al. 2004).

E) Other natural or manmade factors affecting the species' continued existence.

Lynx move between boreal habitats in Canada and the contiguous United States. Immigration of lynx from Canada plays a vital role in sustaining lynx in the contiguous United States (McKelvey et al. 2000c). It is essential that landscape connectivity between lynx habitats and populations in Canada and the contiguous United States be maintained. Lynx movements may be negatively influenced by high traffic volume on roads that bisect suitable lynx habitat, such as in the Southern Rockies. At this time there is no evidence that, if competition exists between lynx and potential competitors such as coyotes and bobcats, it exerts a population-level impact on lynx. The theory that compacted snow trails and roads that are maintained for winter recreation and forest management facilitate competition by giving other species, particularly coyotes, access to lynx winter habitat has neither been proven or disproven at this time.

The ranges of lynx and bobcat naturally interface within the contiguous United States. The range of bobcats is limited by snow conditions that provide a competitive advantage to lynx. In 2003, lynx-bobcat hybridization was first documented in Minnesota and has since been documented elsewhere in the Great Lakes and the Northeast (Schwartz et al. 2004). Whether lynx-bobcat hybridization has implications for lynx conservation is unknown at this time.

Scientific evidence has demonstrated that globally the climate has been warming as evidenced by changes in the amount of snow cover, among other indicators (Intergovernmental Panel on Climate Change 2001). Continued warming temperatures are likely to negatively affect the cold climatic conditions that create and maintain the boreal forest ecosystem for which lynx are highly adapted. As a result, we anticipate that continued warming trends may eventually cause the boreal forests in the contiguous United States to recede north and/or recede to higher, colder elevations, which would likely result in adverse effects to the contiguous United States population of lynx.

Conservation Efforts: The FS and BLM signed 4-year Conservation Agreements with the Service in 2000. The FS agreement has been revised and renewed (FS and Service 2005). The BLM agreement has not been renewed although the agency continues to work within the agreement. Under the agreements, lynx habitat was mapped on all National Forest and BLM lands across the contiguous United States and section 7 consultation occurs on these lands. Determinations of project effects on lynx are based on the most current science, including the Lynx Conservation Assessment and Strategy. National Forest Land and Resource Plans and BLM Land Use Plans have been revised or amended, or are in the process of revision or amendment, to address lynx conservation needs. In the Northeast, there are no land management plans to address lynx conservation at this time.

Research on lynx and snowshoe hare ecology, habitat requirements, population demographics and factors influencing lynx populations continues in Colorado, Maine, Minnesota, Montana, Washington, and Wyoming. The State of Colorado is continuing its intensive effort to augment or reestablish resident lynx populations in the Southern Rocky Mountains (>http://wildlife.state.co.us/species_cons/lynx.asp<). Results of a 3-year effort to document lynx distribution in the United States through the National Lynx Survey are being prepared for publication (K. McKelvey, Rocky Mountain Research Station, pers. comm. 2005). The Washington Department of Fish and Wildlife has adopted a Lynx Recovery Plan given that the lynx is a classified by the Washington Fish and Wildlife Commission as threatened (Stinson 2001).

PRELIMINARY RECOVERY STRATEGY

Recovery Priority Number: 15, on a scale of 1C (highest) to 18 (lowest) (USDI 1983a, b). This ranking is based on a low degree of threat, a high potential for recovery, and a taxonomic classification as a distinct population segment under the Endangered Species Act (16 U.S.C. 1531, et seq.).

Recovery Goal: The goal of this recovery effort is to address threats to the lynx so that protection of this species under the Endangered Species Act is no longer required, and delisting is warranted.

Preliminary Recovery Objectives and Actions: Recovery of the lynx will be achieved when conditions have been attained that will allow lynx populations to persist long-term within each of the identified core areas. Here we present our preliminary recovery objectives and measures for calculating progress toward the recovery goal of delisting the lynx, as well as the recommended

recovery actions to attain that goal, with the understanding that all are subject to change as new information is gathered. More specific recovery objectives, delisting criteria, and actions will be developed in the course of the formal recovery planning process and as additional data become available for analysis. Note that the development of demographic criteria for delisting is not possible at this time (see "Additional Recovery Considerations," below). We present our recommended preliminary recovery actions here to encourage the immediate implementation of such actions, rather than waiting on the release of the draft recovery plan, to make positive progress toward recovery of the lynx.

Objective 1: Retain adequate habitat of sufficient quality to support the long-term persistence of lynx populations within each of the identified core areas.

Objective 2: Ensure that sufficient habitat is available to accommodate the long-term persistence of immigration and emigration between each core area and adjacent populations in Canada or secondary areas in the United States.

Objective 3: Ensure that habitat in secondary areas remains available for continued occupancy by lynx.

Objective 4: Ensure that threats have been addressed so that lynx populations will persist in the contiguous United States for at least the next 100 years.

Recovery Actions Needed to Attain Objectives

1. **Establish management commitments in core areas** that will provide for adequate quality and quantity of habitat such that there is a reasonable expectation that persistent lynx populations can be supported in each of the core areas for at least the next 100 years.

   1.1. On major Federal land ownerships within each core area, establish and implement long-term guidance whose adequacy to conserve lynx has been verified in a biological opinion.

   1.2. On non-Federal lands in the core areas, develop and implement best management practices and long-term management agreements for lynx with key State, private and/or Tribal forest managers.

2. **Maintain baseline inventories of lynx habitat in each core area,** monitoring changes in structure and the distribution of habitat components.

3. **Monitor lynx use in lynx analysis units[4] or other appropriate management unit** at least once every 10 years to determine distribution and occupancy within the core area.

[4] As defined in Ruediger et al. (2000), a lynx analysis unit is a project analysis unit upon which direct, indirect, and cumulative effects analyses are performed. The size of a lynx analysis unit approximates the area used by an individual lynx, about 65 to 129 square kilometers (25 to 50 square miles).

4. Identify habitat facilitating movement between each core area and lynx populations in Canada.

4.1. Develop and implement long-term management commitments with key Canadian, United States Federal, State, Tribal, and private forest landowners to conserve these habitats.

4.2. Develop agreements with appropriate Canadian wildlife authorities to survey lynx populations in Provinces adjacent to core areas and closely monitor the effects of lynx harvest to ensure lynx populations in southern Canada persist.

5. Ensure that habitat in secondary areas remains available for occupancy by lynx.

5.1. Conduct surveys to determine whether any of the unsurveyed secondary areas support lynx populations that have not been recently documented. Based on results, adjust core and secondary area designations as appropriate.

5.2. Conduct research to determine the role of secondary areas in ensuring the persistence of lynx in both the contiguous United States and individual core areas. Based on results, adjust recovery objectives and criteria as appropriate.

5.3. In secondary areas, monitor amount and condition of habitat and conduct surveys (at least once every 10 years during population peaks) to document occurrence of lynx.

5.4. Identify and implement management efforts as necessary to provide lynx habitat in secondary areas. Use the Lynx Conservation Assessment and Strategy (Ruediger et al. 2000) as habitat management guidance in secondary areas.

5.5. Determine whether dispersal occurs between core areas and secondary areas and develop and implement management agreements with key landowners to conserve these habitats if necessary.

6. Identify population and habitat limiting factors for lynx in the contiguous United States.

6.1. Continue and complete studies necessary to gather basic information on the ecological requirements, distribution, population size and trends in each of the core areas and as possible for secondary areas.

6.2. Identify the risk to lynx populations posed by forest management techniques and human-induced mortality from factors such as roads, trapping and hunting. Address these factors as necessary to ensure the long-term persistence of lynx populations in core areas.

6.3. Continue and complete studies to assess the role of potential competitors (bobcat, coyotes) and predators (fisher, mountain lions) in limiting persistence of lynx populations in core areas; if determined to be limiting factors address as necessary.

6.4. Research the role hybrization between lynx and bobcats may have in limiting the persistence of lynx populations in core areas; if determined to be a limiting factor address as appropriate.

6.5. Monitor the effects of climate change on boreal forest habitat in each of the core areas. Modify the delineation of core areas and adjust management strategies if necessary.

7. **Develop a post-delisting monitoring plan** that will be in place and ready for implementation prior to delisting to ensure the continuing effectiveness of the recommended recovery actions and allow for adaptive management, as necessary.

Additional Recovery Considerations: This recovery outline provides preliminary recovery objectives for the contiguous United States distinct population segment of the Canada lynx. At the present time, there are inadequate methods available to develop lynx population estimates for each of the six core areas. Without methods to assess population size or trends, it is not yet possible to develop demographic criteria for delisting the species. The cyclic or fluctuating nature of lynx populations provides an additional element of uncertainty in assessing population trends. As a result, the Service has concluded that it is not practicable at this time to establish demographic criteria for delisting the species.

The delineation of demographic recovery criteria would be facilitated by the development of regional population viability models for each of the core areas (and adjacent lynx populations in Canada, if appropriate) to better understand the population sizes needed for long-term persistence. Modeling also can provide insights into how the cyclic or fluctuating nature of lynx populations and threats affect long-term persistence.

Further uncertainty in recovery and persistence of lynx in the contiguous United States lies in the potential effects of global climate change. Continued warming trends may eventually have a profound effect on the winter conditions that create the habitats for which lynx are highly adapted, and could result in a substantial reduction or even elimination of lynx habitats from the contiguous United States.

Federal Recovery Plan Coordination and Preparation: The Service does not anticipate appointing a formal Recovery Team to develop a recovery plan. Comments and suggestions regarding this outline will be considered in preparing a draft recovery plan. The public will be invited to comment on the draft recovery plan at the time it is released. A final recovery plan will be made available to all interested parties.

Given staff and budget limitations, the Service intends to begin formal recovery planning for the lynx in early 2007, after the final lynx critical habitat designation is complete (due November 2006). We anticipate a draft recovery plan would be available for public review in January 2008.

There will be a 60-day public comment period. Based on this timeframe, a final recovery plan would be available in June 2009. This timeframe may be affected by ongoing litigation over the listing.

Stakeholder Involvement: Stakeholders will be involved during the process of plan development. Stakeholders may include but are not limited to: States, U.S. Department of Agriculture Forest Service, Tribes, Bureau of Land Management, National Park Service, U.S. Department of Agriculture Animal Plant Health Inspection Service–Wildlife Services, researchers, timber industry, trappers, environmental groups, Canadian wildlife and land managers, recreational interests and other members of the general public. At the local or regional level, stakeholders will be able to participate in lynx conservation efforts.

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TABLE 1. PRELIMINARY LYNX RECOVERY AREA ASSESSMENT SUMMARY

	ROLE IN RECOVERY	CRITERIA	IDENTIFIED AREAS
CORE	Ensure the continued persistence of lynx in the contiguous United States by providing: 1) representation by conserving the breadth of ecological settings of the DPS; 2) redundancy by retaining a sufficient number of populations to provide a margin of safety to withstand catastrophic events; 3) resiliency by maintaining sufficient numbers of animals in each population to withstand randomly occurring events and prey population dynamics.	1. Verified evidence of long-term historical and current presence of lynx populations. 2. Recent (within the past 20 years) evidence of reproduction. 3. Average snowshoe hare densities over time are at least 0.5 hares/ha. 4. Contains a minimum of 1,250km^2 (483mi^2) of boreal forest habitat (can include boreal forest habitat directly adjacent in Canada). Habitat patches must be sufficiently large and connected to enable movement within and between patches within a core area. 5. Snow conditions favor the competitive advantage of lynx.	**Northeast** - Northern Maine/northern New Hampshire **Great Lakes** - Northeastern Minnesota **Northern Rockies/Cascades** - Northwestern Montana/northeastern Idaho - North Cascades (WA) - Kettle/Wedge (WA) - Greater Yellowstone Area (WY, ID, MT) **Provisional Core Area:** Southern Rockies - Entire (CO and WY)
SECONDARY	Unclear: possibly unable to sustain lynx populations or actions may have caused local extirpation without recolonizition. May enable successful dispersal of lynx between populations or subpopulations.	1. Fewer and more sporadic current and historical records of lynx and relatively low historical abundance. 2. Surveys lacking in some areas to identify whether lynx populations may be present 3. Reproduction not documented. 4. Reason for relatively few lynx records in secondary areas unclear at this time.	**Northeast** - None **Great Lakes** – Northern Minnesota/northwestern Wisconsin **Northern Rockies/Cascades** - Southwest Montana - Northern/central Idaho - Northern Chelan County (WA) - Salmo Priest (WA) - Little Pend Oreille (WA) **Southern Rockies** – None
PERIPHERAL	Unclear: May enable successful dispersal of lynx between populations or subpopulations.	1. Few historic or recent verified records of lynx 2. Habitat in small patches not well-connected to larger patches of high quality habitat.	**Northeast** - Vermont - New York - Eastern Maine -Central New Hampshire **Great Lakes** - Northeastern Wisconsin; - Michigan **Northern Rockies/Cascades** - Utah - Big Horn Mountains (WY) - Northeast Oregon/southeast Washington - Southern Cascades (WA) - Vulcan/Tunk (WA) - Snowy Mountains (MT) - Highwood Mountains (MT) **Southern Rockies** - None

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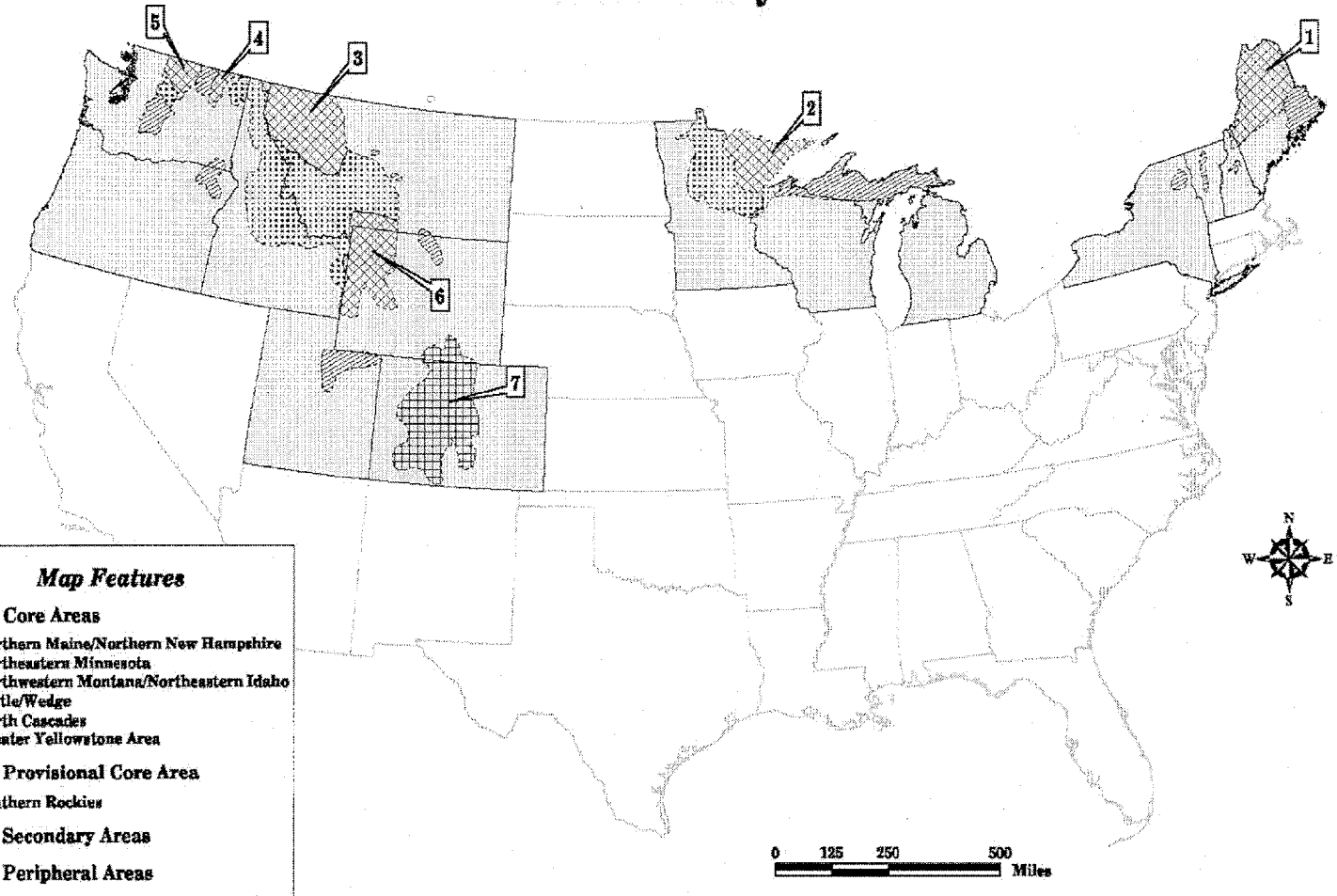
Figure 1: Canada Lynx Recovery Areas

Preliminary



Map Features

- Core Areas
  1. Northern Maine/Northern New Hampshire
  2. Northeastern Minnesota
  3. Northwestern Montana/Northeastern Idaho
  4. Kettle/Wedge
  5. North Cascades
  6. Greater Yellowstone Area
- Provisional Core Area
  7. Southern Rockies
- Secondary Areas
- Peripheral Areas
- States Where Listed
- State Boundaries

Map compiled by USFWS, Bismarck, ND, June 14, 2005. All features are for representative purposes only and may not depict the actual size, shape and/or boundary.

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BIRDS OF CONSERVATION CONCERN 2008

U.S. Fish and Wildlife Service
Division of Migratory Bird Management
Arlington, Virginia

December 2008

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Prepared by

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LIST OF ACRONYMS

AI	Area Importance (an assessment factor)
ABC	American Bird Conservancy
BBS	Breeding Bird Survey
BCC	Birds of Conservation Concern
BCR	Bird Conservation Region
BD	Breeding Distribution
CCS	Continental Combined Score
DPS	Distinct Population Segment
ESA	Endangered Species Act
FWCA	Fish and Wildlife Conservation Act
MBTA	Migratory Bird Treaty Act
NABCI	North American Bird Conservation Initiative
NAWCP	North American Waterbird Conservation Plan
ND	Non-breeding Distribution
NWR	National Wildlife Refuge
PIF	Partners in Flight
PS	Population Size
PT	Population Trend
RD	Relative Density
TB	Threats in the Breeding Season
TN	Threats in the Non-breeding season
USFWS	U.S. Fish and Wildlife Service
USSCP	United States Shorebird Conservation Plan

EXECUTIVE SUMMARY

The 1988 amendment to the Fish and Wildlife Conservation Act mandates the U.S. Fish and Wildlife Service (USFWS) to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973." *Birds of Conservation Concern 2008* (*BCC 2008*) is the most recent effort to carry out this mandate. The overall goal of this report is to accurately identify the migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent our highest conservation priorities. The geographic scope of this endeavor is the United States in its entirety, including island "territories" in the Pacific and Caribbean. *BCC 2008* encompasses three distinct geographic scales—North American Bird Conservation Initiative (NABCI) Bird Conservation Regions (BCRs), USFWS Regions, and National—and is primarily derived from assessment scores from three major bird conservation plans: the Partners in Flight North American Landbird Conservation Plan, the United States Shorebird Conservation Plan, and the North American Waterbird Conservation Plan.

Bird species considered for inclusion on lists in this report include nongame birds, gamebirds without hunting seasons, subsistence-hunted nongame birds in Alaska; and Endangered Species Act candidate, proposed endangered or threatened, and recently delisted species. Assessment scores from all three bird conservation plans are based on several factors, including population trends, threats, distribution, abundance, and relative density. These assessment scores serve as the foundation on which we built the *BCC 2008* lists. Although the different bird conservation plans use somewhat different methods for determining the highest priority species, the scores from each represent true conservation priorities for each of the three species groups (landbirds, shorebirds, and waterbirds). We therefore view the conservation priorities within each plan as approximately equivalent. After creating BCR lists, we developed specific criteria for including species on USFWS Region and National lists. The various BCR lists contain 10 to 53 species, USFWS Region lists contain 27 to 78 species, and the National list contains 147 species. On average, priority species make up about 10 to 15 percent of the native bird species in any given geographic unit.

While all of the bird species included in *BCC 2008* are priorities for conservation action, this list makes no finding with regard to whether they warrant consideration for ESA listing. Our goal is to prevent or remove the need for additional ESA bird listings by implementing proactive management and conservation actions. We recommend that these lists be consulted in accordance with Executive Order 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds." This report should also be used to develop research, monitoring, and management initiatives. *BCC 2008* is intended to stimulate coordinated and collaborative proactive conservation actions among Federal, State, Tribal, and private partners. We hope that, by focusing attention on these highest-priority species, this report will promote greater study and protection of the habitats and ecological communities upon which these species depend, thereby contributing to healthy avian populations and communities.

ACKNOWLEDGMENTS

This document was the result of close collaboration between staff in all regions of the U.S. Fish and Wildlife Service's Migratory Bird Program. The primary collaborators were Mila Plavsic, Jeff Shenot, and Marie Strassburger (Region 9); the initiative coordinators, Brad Andres (U.S. Shorebird Conservation Plan; USSCP), Jennifer Wheeler (North American Waterbird Conservation Plan; NAWCP) and Terry Rich (Partners in Flight; PIF); and the Regional Coordinators: Tara Zimmerman, Mike Green, Nanette Seto, Sue Thomas, and Maura Naughton (Region 1), Bill Howe and Dave Krueper (Region 2), Steve Lewis, Tom Will, and Bob Russell (Region 3), Dean Demarest, Chuck Hunter, Jaime Collazo, and Stefani Melvin (Region 4), Randy Dettmers (Region 5), Stephanie Jones, Suzanne Fellows, and Kevin Kritz (Region 6), Kent Wohl, Steve Matsuoka, and Richard Lanctot (Region 7). All were involved in developing selection criteria, compiling and finalizing BCR and USFWS Region lists, and reviewing and commenting on several drafts of this report.

The basis of this list is the work that many people have done to reach true avian priorities, and we have based this document on their work. We are particularly grateful for all of the work the initiatives (USSCP, NAWCP, and PIF) have done completing prioritization scores and methods. We thank Arvind Panjabi (Rocky Mountain Bird Observatory) for making available the PIF database and for responding to our many questions.

This edition of the *BCC 2008* is dedicated to John L. Trapp, who retired from USFWS in 2007 after 33 years of outstanding contributions to bird conservation. John had an extensive ornithological knowledge and passion for birds, and he oversaw almost all of the previous editions of the Birds of Conservation Concern.

INTRODUCTION

The purpose of this document is to identify migratory and non-migratory birds of the United States and its territories that are of conservation concern so as to stimulate coordinated and proactive conservation actions among Federal, State, Tribal, and private partners. The conservation concerns may be the result of population declines, naturally or human-caused small ranges or population sizes, threats to habitat, or other factors. The primary statutory authority for *Birds of Conservation Concern 2008* (*BCC 2008*) is the Fish and Wildlife Conservation Act of 1980 (FWCA), as amended; other authorities include the Endangered Species Act (ESA) of 1973, the Fish and Wildlife Act of 1956, and 16 U.S.C. § 701. The 1988 amendment (Public Law 100-653, Title VIII) to the FWCA requires the Secretary of the Interior, through the United States Fish and Wildlife Service (USFWS), to "identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act of 1973." *BCC 2008* is the most recent effort by the USFWS to carry out this proactive conservation mandate and update *Birds of Conservation Concern 2002* (USFWS 2002). The overall goal of this report is to accurately identify those species (beyond those already federally listed as threatened or endangered) in greatest need of conservation action at three different geographic scales.

A primary goal of the USFWS is to conserve avian diversity in North America (USFWS 1990, 2004). This goal includes reducing or removing threats that may necessitate that a species be considered for listing under the ESA. The Birds of Conservation Concern are largely a subset of a larger list known as the Birds of Management Concern (BMC). The BMC is a subset of all species protected by the Migratory Bird Treaty Act (MBTA, see 50 CFR 10.13), and includes those which pose special management challenges due to a variety of factors (e.g., too few, too many, conflicts with human interests, or societal demands) (USFWS 2004). The BMC includes both game birds below their desired condition and nongame birds. As indicated in its strategic plan (USFWS 2004), the Migratory Bird Program places priority emphasis on these birds in its activities.

The philosophy underlying this report is that proactive bird conservation is necessary at a time when human impacts are at an all-time high. We strongly believe that a well-designed program that addresses resource-management issues up front will prevent or remove the need to consider listing species as threatened or endangered, and will promote and conserve long-term avian diversity in the United States. In addition, proactive conservation clearly is more cost-effective than the extensive recovery efforts required once a species is federally listed under the ESA. Our intent is for *BCC 2008* to stimulate coordinated efforts to develop and implement comprehensive and integrated approaches for the study, management, and protection of "non-ESA listed" bird species deemed to be in the most need of additional conservation actions. It should also be noted that, while the inclusion of native species not listed under the MBTA is beyond the scope of the FWCA, the USFWS has an incentive to encourage proactive management of these species by State agencies and other partners to prevent the need for listing them as endangered or threatened.

Bird species assemblages, guilds, or communities have recently been promoted as indicators of ecological integrity in a variety of habitats (Bradford et al. 1998, O'Connell et al. 2000, Canterbury et al. 2000, Venier and Pearce 2007), and at-risk bird species are good measures of ecosystem threats (Beissinger et al. 1996). Setting priorities in conservation is crucial because resources are limited. Many systems for setting wildlife-conservation priorities have been proposed. Some have focused heavily on identifying and quantifying threats to endangered or rare species (Master 1991, Wilcove et al. 1998). Others have focused on highlighting species that deserve attention due to threats to their populations, widespread or long-term declines, or low potential for population recovery (Millsap et al. 1990). The Canadian Wildlife Service developed a priority ranking system that focuses on conservation concerns and agency responsibilities to assist in setting conservation priorities for landbird species (Dunn 1997, Dunn et al. 1999). The mandate of the 1988 FWCA amendment requires a more proactive approach.

BCC 2008 uses current conservation assessment scores from three bird conservation plans: Partners in Flight North American Landbird Conservation Plan (PIF; Rich et al. 2004), the United States Shorebird Conservation Plan (USSCP; Brown et al. 2001, USSCP 2004), and the North American Waterbird Conservation Plan (NAWCP, Kushlan et al. 2002). Waterfowl game species covered by the North American Waterfowl Management Plan (Canadian Wildlife Service, U.S. Fish and Wildlife Service, Secretario de Medio Ambiente y Recursos Naturales, 2004) are specifically excluded from the BCC list in accordance with the FWCA of 1980. Species in need of additional conservation attention are identified at three distinct geographic scales: North American Bird Conservation Initiative (NABCI) Bird Conservation Regions (BCRs; U.S. NABCI Committee 2000a, 2000b, 2000c), USFWS Regions, and National.

Assessment scores are based on several parameters including population trend, threats, distribution, abundance, and the importance of an area to a species. Partners in Flight, a coalition of Federal and State government agencies, non-governmental organizations, and private interests, developed species assessment scores out of concern for the sharp declines in many North American landbirds (Rich et al. 2004). The PIF approach (Carter et al. 2000, Rich et al. 2004) has been peer-reviewed by an independent body of avian biologists (Beissinger et al. 2000). Similar coalitions have prepared and reviewed conservation assessment scores for shorebirds at the National scale (Brown et al. 2000, USSCP 2004), and in step-down regional shorebird conservation plans (see http://www.fws.gov/shorebirdplan) and for waterbirds at the continental scale (Kushlan et al. 2002) and in step-down regional waterbird conservation plans (see http://www.waterbirdconservation.org). Additionally, we found it necessary to develop conservation assessment scores for species not yet evaluated by any of the bird conservation plans, such as Pacific Island birds. Taken together, these assessment scores can be used to develop a comprehensive set of integrated bird conservation priorities; this represents a unique conservation effort unmatched in any other major group of organisms in North America.

BACKGROUND

Why Did We Create Lists at Different Geographic Scales?

Listing birds of conservation concern at three geographic scales maximizes the utility of the lists for a variety of partner agencies and organizations. The different geographic scales, from smallest to largest, are as follows:

Bird Conservation Regions (BCRs). We have adopted BCRs as the smallest of our geographic scales. BCRs have been endorsed by the North American Bird Conservation Initiative (NABCI, U.S. NABCI Committee 2000a, 2000b, 2000c) as the basic units within which all-bird conservation efforts will be planned and evaluated (Fig. 1). The NABCI is an endeavor to increase the effectiveness of bird conservation at the continental level and currently includes the United States, Canada, and Mexico. Its goal is to deliver "the full spectrum of bird conservation through regionally based, biologically driven, landscape-oriented partnerships" (U.S. NABCI Committee 2000a). A published map of BCRs and accompanying written descriptions of each are available (U.S. NABCI Committee 2000b, 2000c). The BCR lists will be most useful to Federal land-managing agencies and their partners in their efforts to abide by the bird conservation principles embodied in the MBTA and Executive Order 13186, "Responsibilities of Federal agencies to protect migratory birds" (Clinton 2001). The NABCI has recognized 35 BCRs that cover the contiguous 48 States, Alaska, and Hawaii, numbered 1 to 5, 9 to 37, and 67 (Hawaii) (U.S. NABCI Committee 2000a, 2000b, 2000c, http://www.nabci-us.org/bcrs.html). For purposes of this report, we created two additional BCRs to encompass island "territories" of the United States,[1] "Other U.S. Pacific Islands" (i.e., excluding Hawaii) and "U.S. Caribbean Islands." In the *BCC 2002* report, these two BCRs were referred to as BCR 68 for the Pacific Ocean and BCR 69 for the Caribbean, but those designations were changed for *BCC 2008* because NAWCP uses those numbers to refer to marine areas ("pelagic" BCRs). Although *BCC*

[1] Island "territories" and other affiliations of the United States considered in this document include (a) *American Samoa*—an unincorporated and unorganized territory; (b) *Baker Island*—an unincorporated territory administered by the USFWS as a National Wildlife Refuge (NWR); (c) *Commonwealth of the Northern Marianas Islands*—aligned through a covenant of "political union"; (d) *Guam*—an unincorporated organized territory; (e) *Howland Island*—an unincorporated territory administered by the USFWS as a NWR; (f) *Jarvis Island*—an unincorporated territory administered by the USFWS as a NWR; (g) *Johnston Atoll*—an unincorporated and unorganized territory under joint operational control of the Department of Defense and USFWS (and administered as a NWR); (h) *Kingman Reef*—an unincorporated territory administered by the USFWS as a NWR; (i) *Midway Atoll*—an unincorporated territory administered by the USFWS as a NWR; (j) *Navassa Island*—administered by the USFWS as a NWR; *(k) Palmyra Atoll*—an incorporated territory that is partially privately owned and partially administered by USFWS as an NWR; (l) *Commonwealth of Puerto Rico*—a commonwealth; (m) *U.S. Virgin Islands*—an unincorporated organized territory; and (n) *Wake Island*—an unincorporated territory administered by the Department of the Interior (Central Intelligence Agency 2001).

2008 does not adopt the pelagic BCR system, it recognizes that some BCC species occur in the U.S. primarily or only at sea. These species are listed under the adjacent terrestrial BCR. Thus, there are 37 BCR lists of priority species.

USFWS Regions. BCC lists are presented in this document for 8 USFWS Regions.[2] The USFWS Region lists will be useful to USFWS administrators and biologists, other Federal and State agencies within a Region, and their partners and cooperators.

National. The National list encompasses the United States in its entirety, including island "territories" in the Caribbean and the Pacific. The National list should be viewed as a barometer of the status of U.S. bird populations, providing an "early warning" of birds that may decline to levels requiring ESA protection unless additional conservation measures are taken. The National list will be most useful as an outreach tool for educating the public about the precarious status of bird species in the U.S. It will also be useful for National bird conservation planning. The National list should not be used to foster bird conservation at smaller geographic scales; that is the purpose of the BCR and USFWS Region lists.

Although there are other lists of this nature, such as the National Audubon Society/American Bird Conservancy 2007 WatchList (Butcher et al. 2007), *BCC 2008* is the only list that meets USFWS mandates for the conservation of migratory nongame birds. Conservation organizations create lists of concern that reflect their unique missions, and it is important to keep this in mind when comparing lists. With regard to birds, the USFWS focuses on its trust responsibilities as defined by the Code of Federal Regulations, which excludes, for example, gallinaceous birds (resident game birds) unless they are listed as threatened or endangered under the Endangered Species Act (ESA). Similarly, the *Birds of Conservation Concern*, as mandated by Congressional legislation, excludes birds regulated as hunted species and birds listed under the ESA. Nongovernmental organizations like American Bird Conservancy (ABC) or National Audubon are not limited by these legal distinctions, and as a result they can provide lists that are more inclusive. The USFWS *Birds of Conservation Concern*, the ABC/Audubon Watch List, and a number of other lists share a common base: they are all reliant on the conservation assessments of the major bird partner initiatives and the surveys upon which those initiative assessments are grounded. National Audubon, American Bird Conservancy, and the USFWS are all partners, among others, in participating in the assessments of those initiatives.

[2] The Pacific Region (Region 1) includes Idaho, Oregon, Washington, Hawaii, and the Pacific Islands. The Southwest Region (Region 2) includes Arizona, New Mexico, Oklahoma, and Texas. The Great Lakes-Big Rivers Region (Region 3) includes Illinois, Indiana, Iowa, Michigan, Missouri, Minnesota, Ohio, and Wisconsin. The Southeast Region (Region 4) includes Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Puerto Rico/Virgin Islands, South Carolina, and Tennessee. The Northeast Region (Region 5) includes Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia. The Mountain-Prairie Region (Region 6) includes Colorado, Kansas, Montana, North Dakota, Nebraska, South Dakota, Utah, and Wyoming. The Alaska Region (Region 7) consists of the state of Alaska. The California and Nevada Region (Region 8) consists of the states of California and Nevada.

What Bird Species Did We Consider?

The various species groups considered for inclusion in *BCC 2008* are described in Table 1 and include nongame birds; gamebirds without hunting seasons; subsistence-hunted nongame birds in Alaska; and Endangered Species Act candidate, proposed endangered or threatened, and recently delisted species. The major groups of species not considered in this assessment are (1) migratory gamebirds for which hunting regulations are established (i.e., cooperatively managed by Federal-State flyway councils); (2) species that are peripheral to the U.S. (i.e., population fragments within U.S. jurisdiction are too small to be managed capably); (3) species, subspecies, and populations of federally-endangered or -threatened birds (i.e., those subject to the provisions of the ESA); (4) resident gamebirds (i.e., managed by State wildlife agencies), unless listed as a federal ESA candidate; and (5) non-native species.

Because the assessments of the three bird conservation initiatives that we use here are all species-based, assessment scores were available only for full species. However, where appropriate, subspecies and populations are included in this assessment based on geographic range, federal candidate status, or available local data. Such subspecies and populations are noted on lists at all three geographic scales.

In the spirit of all-bird conservation, we include native species not specifically covered by the MBTA when they are deemed to be conservation priorities, as long as they are not part of one the groups excluded from consideration (see above). To avoid confusion, we clearly differentiate between those species that are and are not protected by the MBTA. A list of species protected by the MBTA is found in Title 50, Part 10, of the *Code of Federal Regulations*.

What Sources of Information Did We Use?

The methods used to assess and prioritize species differ between PIF, the USSCP, and the NAWCP. These differences relate to geographic scope, factor thresholds, and treatment of uncertainty. Although the methods for determining the highest-priority species are somewhat different among the different initiatives, scoring reflects state-of-the-art conservation assessments for each of the three species groups (landbirds, shorebirds, and waterbirds); we therefore view the conservation priorities within the three conservation plans as approximately equivalent.

PIF Assessment Scores. We used assessment scores from the PIF Species Assessment Database (version 2005, with unpublished 2007 updates) housed at the Rocky Mountain Bird Observatory, which we believe were the best available data at the time this report was prepared. In this database a panel of bird species experts has assigned each landbird species in North America scores ranging from 1 (lowest priority or degree of concern) to 5 (highest priority or degree of concern) for each of six factors, assessing aspects of future vulnerability at the range-wide scale: Population Size (PS), Breeding Distribution (BD), Non-breeding Distribution (ND), Threats in the Breeding Season (TB), Threats in the Non-breeding season (TN), and Population Trend (PT) (Panjabi et al. 2005). These factors are then used to calculate a Continental Combined Score

(CCS): PS + max(BD, ND) + max(TB, TN) + PT. The threats scores and the distribution scores are highly correlated so PIF used this score rather than a simple total. Thus, CCS ranges from 4 for a widespread and increasing species which is expected to face even more favorable conditions in the future, to 20 for a species of the very highest future conservation concern. The CCS was used to develop the landbird portion of the National BCC list.

Partners in Flight also assesses species at the BCR level. That assessment includes two additional criteria, Relative Density (RD) and Percent of Population, which reflect the importance of a particular BCR to each species. The global scores for TB, TN, and PT are also adjusted using BCR-specific data. These BCR scores informed the selection of landbirds for the *BCC 2008* BCR lists.

All of these factors are defined and discussed in detail in Panjabi et al. (2005). Both PIF breeding and wintering (non-breeding) scores, where available, were used in assessing species for inclusion in the *BCC 2008* report. In consultation with experts, the USFWS prepared scores for landbirds of Hawaii and Pacific island "territories" using the PIF process.

USSCP Assessment Scores. For shorebird species, we started with the updated assessment scores from the USSCP (USSCP 2004), which were built on original plan assessments (Brown et al. 2000, Brown et al. 2001). We incorporated new information on shorebird population trends and sizes published by Morrison et al. (2006) and Bart et al. (2007). Information on population sizes were ranked according to the PIF criteria. We also included updates in breeding and nonbreeding threats provided by regional shorebird working groups. The USSCP assessment process uses most of the same factor scores (with slightly different criteria) as PIF, but priorities were derived using a categorical (rather than a summation) approach (Brown et al. 2001). A prioritization protocol for shorebirds (in Brown et al. 2001) describes prioritization categories and their relationship to factor scores.

NAWCP Assessment Scores. Like USSCP, the NAWCP assessment process also uses most of the same factor scores (with slightly different criteria) as PIF and derives priorities using a categorical approach (Kushlan et al. 2002). For all three scales used in the BCC, we referred to the continental-scale assessment results documented in the NAWCP plan (Kushlan et al. 2002) and subsequent analyses (i.e., for non-colonial waterbirds, documented at http://www.waterbirdconservation.org), which we considered to be the best available data for waterbirds and seabirds. For *BCC 2008* BCR lists, we also referred to assessments in regional waterbird conservation plans or documents that most closely resemble regional waterbird conservation plans, where available (see www.waterbirdconservation.org.) These regional-scale status assessments are, in general, based on the continental-scale assessment, though regional planning groups made adjustments based on BCR-scale needs and values.

What Selection Criteria Did We Use For *Birds of Conservation Concern 2008* Lists?

The following are the criteria used to select species for consideration and inclusion on BCR, USFWS Region, and National lists. At each scale, USFWS expertise and discretion refined the

pool of species under consideration from the three bird conservation initiatives—as well as those selected for priority lists—to comply with the FWCA amendment of 1988. The same criteria were used for all subspecies and populations considered separately for inclusion.

There may be additions to the lists over the next several years. Newly designated Federal candidate species, species proposed for listing, and species removed from the list of endangered and threatened species will automatically be considered to be on the appropriate BCC list(s), effective the day of their designation or delisting as published in the *Federal Register*.

General criteria (rule-sets) for placing species on any BCC list

1. Begin with list from appropriate bird conservation initiative.

2. Follow criteria below for appropriate bird groups (see Panjabi et al. 2005 for explanation of terms).

3. Add non-breeding species if the species occurs at significant Relative Density scores and/or has moderate or high threat levels (based on expert opinion or data) in non-breeding season, if not already included due to breeding population (indicate with "nb").

4. Consider subspecies and populations where appropriate and where information on their status is available (e.g., Dickinson 2003).

5. Remove sport-hunted species (including their non-hunted populations) and federally-listed threatened or endangered populations (retaining non-listed populations with notation).

6. Add any recently ESA de-listed, candidate, or proposed species not already included.

7. In very limited circumstances, add or remove species (and document rationale) when Service expertise, supplemental information, or local data indicates a much greater or lesser degree of concern than that reflected by bird conservation initiative scoring.

Criteria for placing species on BCR lists

***LANDBIRD* criteria for *BCR* lists (see Panjabi 2005 for explanation of terms):**

1. Include species meeting the PIF criteria for Species of Regional Importance – Continental Concern (U.S. and Canada), EXCEPT

   a) if Regional Combined Score <15 and Action Code = "Planning and Responsibility"

   b) in BCRs shared with Canada and Mexico, those with Relative Density ≥1 in the *U.S.* portion of the BCR (consult state population data).

c) for species shared with Latin America and the Caribbean (LAC), remove species with core ranges outside the U.S. and its territories if <1% of population or range-wide distribution is in the U.S. and threats in LAC are low. However, if conservation action for a species is warranted in the U.S. due to high threats in LAC, then it could be included in the appropriate U.S. BCR lists.

2. Include species meeting the PIF criteria for Species of Regional Importance – Regional Concern IF:

   a) Regional Combined Score ≥15 and Action Code = "Critical Recovery" or "Immediate Management"

   b) Regional Combined Score ≥ 17 and Action Code = "Management Attention"

3. Rank species in Hawaii and Pacific island territories using latest PIF criteria and above criteria as appropriate.

***SHOREBIRD* criteria for *BCR* lists:**

1. Include all species, subspecies, and populations meeting criteria for National BCC List if >1% of taxon occurs anytime during annual cycle in the BCR (i.e., Relative Density ≥1 in the BCR). The criteria for National BCC List are:

   a) population is undergoing a strong decline (Population Trend = 5), regardless of population size; OR
   b) population is declining or stable (Population Trend = 4 or 3) and populations are small, distributions are limited and threats are high (Population Size + Breeding Distribution + Non-breeding Distribution + Threats to Breeding + Threats to Non-breeding ≥ 18).

***WATERBIRD* criteria for *BCR* lists:**

1. Initially identify species of greatest concern from each BCR using the regional waterbird conservation plans or similar documentation (e.g., Joint Venture implementation plans). Depending on BCR-scale approaches, include species regionally assessed as High or Highest/Highly Imperiled, as Tier I (if the PIF approach was used), or priority species for BCR-scale partnership.

2. Remove species from BCR lists if U.S. populations are considered unmanageable (e.g., Relative Density <1).

3. Identify and retain only those species of greatest conservation concern, as some regional-plan species lists were designed to maximize support for a wide range of conservation activities by partners or identify species around which partnerships could operate.

Criteria for placing species on USFWS Regional lists

1. Include species from the BCC BCR lists if the species has the equivalent of a RD >1 or a manageable population in 50% or more of the BCRs in which it occurs within a USFWS region.

Criteria for placing species on BCC National list

***LANDBIRD* criteria for *National* list:**

1. Include all PIF "Continental Watchlist" (which includes the U.S. and Canada) species and U.S. island territories' species that meet PIF Continental Watchlist criteria EXCEPT,

   a) species without manageable populations in the U.S. or its territories; however, if conservation action is warranted in the U.S. due to high threats elsewhere, then such species could be included;

   b) species that are not listed on any BCC BCR list.

***SHOREBIRD* criteria for *National* list:**

1. Include species (or subspecies/population designations where supported by USSCP Conservation Assessment [2000] or more recent work) that meet any ONE of the following criteria:

   a) population is undergoing a strong decline (Population Trend = 5), regardless of population size; OR
   b) population is declining or unknown (Population Trend = 4 or 3) and populations are small, distributions are limited and threats are high (Population Size + Breeding Distribution + Non-breeding Distribution + Threats to Breeding + Threats to Non-breeding ≥ 18).

Scores have been revised and reflect the best science to date and are under review (Andres unpubl.).

WATERBIRD criteria for *National* list:

1. Include species ranked "Highly Imperiled" in the NAWCP continental-scale assessment unless not occurring on any BCR list.

2. Consider all species ranked "High" in the NAWCP continental-scale assessment (unless not

occurring on any BCR list) and include those with global population size (PS) factor score of 5, 4, 3 or 2. Populations at PS = 2 are included if they are at the lower end of the range in this category (i.e., 69,200) and experiencing steep declines.

THE *BIRDS OF CONSERVATION CONCERN 2008* LISTS

To maximize the usefulness of this report to multiple partners, the *BCC 2008* lists are presented in 46 separate tables, comprising 37 BCR lists (Tables 2 to 38), 8 USFWS Region lists (Tables 39 to 47) and 1 National list (Table 48). Summaries of the status of each species at each of the three distinct geographic scales are provided in Appendix B, and a list of scientific names of all species mentioned is found in Appendix C. The BCR lists range from 10 to 53 species, USFWS Region lists range from 27 to 78 species, and the National list consists of 147 species. The number of priority species represents roughly 10 to 15 percent of all bird species of any given geographic unit.

BCR Lists

The number of species on individual BCR lists (Tables 2 to 38) ranges from 10 to 53, averaging about 27. Lists are generally larger for BCRs in the southern United States, reflecting greater species diversity at lower latitudes and the importance of these regions for wintering migrants. Island birds are at increased risk of becoming endangered. Thus, the "Other U.S. Pacific Islands" BCR and "U.S. Caribbean Islands" BCR have relatively high proportions of their native species represented as birds of conservation concern. Roughly ten percent of the bird species native to Hawaii (BCR 67) are identified as birds of conservation concern, but that region also has a disproportionately large number of bird species listed as either endangered or threatened under the ESA; combining birds of conservation concern with endangered or threatened species, about 25 percent of the native Hawaiian avifauna is at risk.

USFWS Region Lists

The number of species on individual USFWS Region lists (Tables 39 to 47) ranges from 27 to 78, averaging about 50. Following the trend seen in BCRs, USFWS Region lists of priority species are larger in the southern United States, although this is partially attributed by the disparities in area covered by each of the Regions. The birds on the USFWS Region lists generally represent about 10 percent of the species native to the respective Regions.

National List

The National list (Table 48) is comprised of 147 species, and includes disproportionately larger numbers of species from the orders Procellariformes (albatrosses, petrels, shearwaters, and storm-petrels), Charadriiformes (shorebirds, gulls, terns, and auks), and Piciformes (woodpeckers). Within the Charadriiformes, the families Charadriidae (plovers), Haematopodidae (oystercatchers), Scolopacidae (sandpipers), and Alcidae (murres, murrelets,

and auklets) are represented on the list by greater numbers of species than expected. Among the Passeriformes—a large and diverse order of perching birds—the families Parulidae (wood-warblers) and Emberizidae (sparrows) and the subfamily Drepanidinae (Hawaiian honeycreepers) dominate the list in terms of both actual and relative numbers.

DISCUSSION

BCC 2008 is the latest update in a continuing effort to assess and prioritize bird species for conservation purposes (USFWS 1982, 1987, 1995, 2002; and U.S. Department of the Interior 1990). It is difficult to make meaningful comparisons among the lists because of differences in the way each succeeding report was prepared. In chronological order, these previous lists contained 28, 30, 77, 124, and 131 species of conservation concern at a National scale in 1982, 1987, 1990, 1995, and 2002 respectively; by comparison, *BCC 2008* includes 147 species at the National scale.

Do these figures reflect an actual decline in the conservation status of the Nation's birdlife, or do they merely reflect improvements in our ability to accurately identify and characterize species in real need of conservation attention? The truth probably lies somewhere in between. The preparation of prioritized species lists should be viewed as an evolving process, improving as our knowledge base increases, with each list reflecting the best available information at the time of its publication. The three bird conservation initiatives update their own assessments and scoring as new data or analyses become available. The data from these initiatives—which form the basis of *BCC 2008*—incorporate a great deal of input from many bird experts and have wide acceptance among members of avian conservation and scientific communities. We are confident that the methods used in *BCC 2008* are the best available for identifying avian conservation priorities as directed by the FWCA amendment of 1988.

Of the 131 species on the *BCC 2002* National list, 103 were retained on the current 2008 list and 28 were deleted due to a lack of convincing evidence that continued elevated concern is warranted. Forty-four species were added to the National list, resulting in a net gain of sixteen species for a current total of 147 species.

Of the 211 species on the Audubon WatchList (Butcher et al. 2007) that are not also a) endangered or threatened or b) hunted, 106 are on the *BCC 2008* National list and an additional 8 are on USFWS Region or BCR lists.

The selection criteria that we used identified 10 to 15 percent of all species at each geographic scale to be in need of additional conservation attention. Nongame migratory birds protected by the MBTA, the primary focus of this effort, make up an overwhelming proportion of the species on the *BCC 2008* lists. However, the proportional representation of non-MBTA species increases progressively at larger scales, reflecting the vulnerability of the island-endemic species that form the bulk of this group. The proportional representation of ESA candidate species also increases progressively at larger scales. ESA-delisted and ESA-proposed species make up a progressively smaller proportion of the species at larger scales.

BCC 2008 can be used as a barometer of the condition of our country's avifauna. Although there are general patterns that can be inferred from this report, there is no single reason why any species was placed on any one of these lists; some are relatively common but are undergoing sharp declines in population numbers, others are rare but may actually be increasing in numbers in certain locations, and others may be both rare and declining. However, habitat loss due to alteration or destruction continues to be the major reason for the declines of many species (Askins et al. 1990, USFWS 1995, Samson et al. 1998, Askins 2000). Birds included in the *BCC 2008* lists are deemed priorities for conservation actions, and the lists will be consulted for actions taken on Federal lands in accordance with Executive Order 13186, "Responsibilities of Federal agencies to protect migratory birds" (Clinton 2001). BCC species will also receive priority attention in the USFWS when allocating research, monitoring, and management funding. Our hope is that *BCC 2008* will stimulate coordinated, collaborative proactive conservation actions among Federal, State, and private partners.

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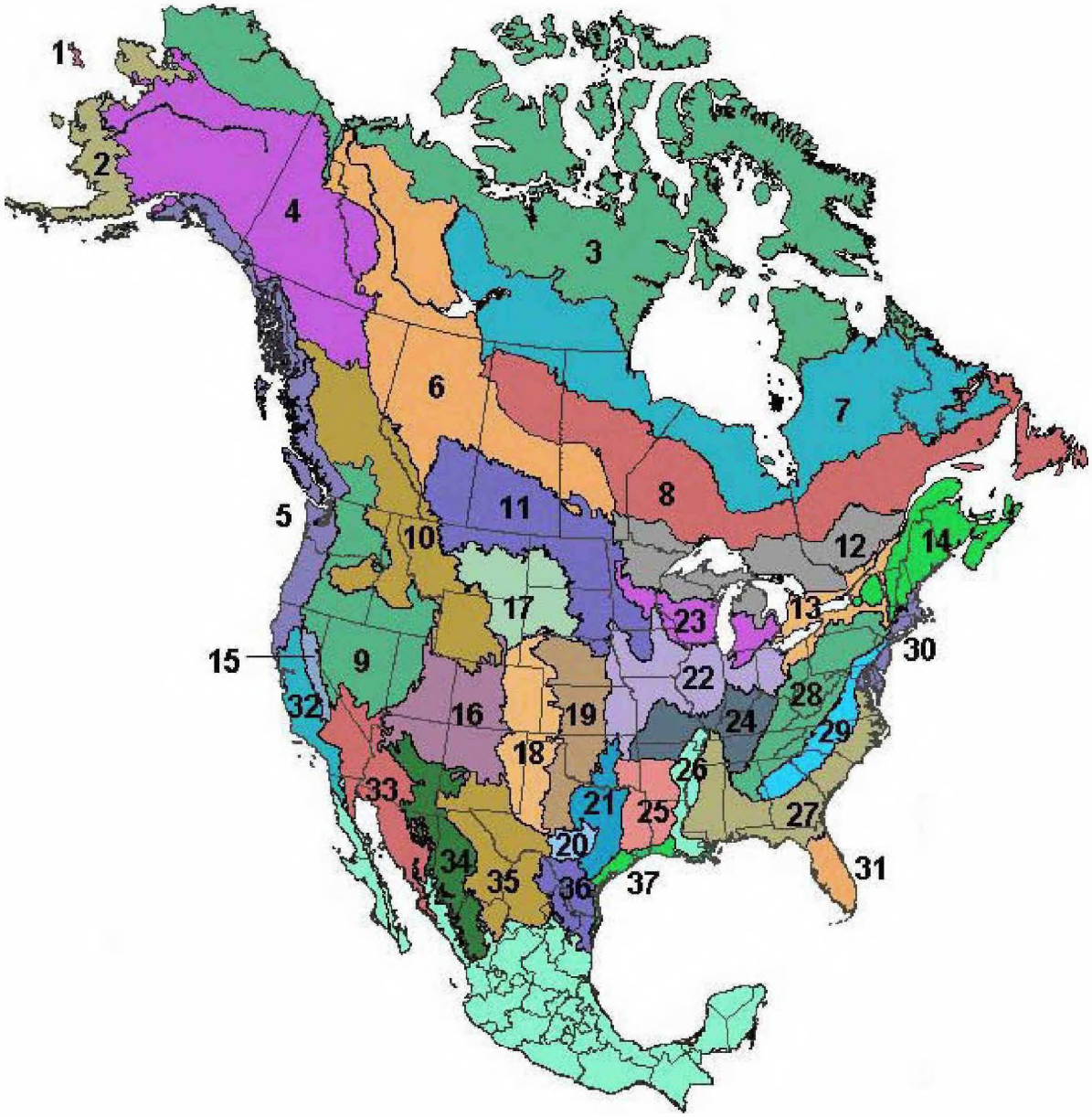
APPENDIX A

Figure 1 Map of the Bird Conservation Regions (BCRs) of the United States [3]



3 The figure does not show BCR 67 (Hawaii) or two other Bird Conservation Regions from the report that included islands in the Pacific and Caribbean which are either U.S. Territories or other affiliates.

Table 1 Eligibility of Various Species Groups for *BCC 2008* Consideration.

Applicable Federal Authority	Eligible	Not Eligible
Migratory Bird Treaty Act	"Nongame" and "other" species (as variously defined by bilateral migratory bird conventions with Canada, Mexico, Japan, and Russia)	Species peripheral to the U.S. (e.g., population fragments too small to be managed capably)
	"Gamebirds" (as defined by 50 CFR 20.11) for which hunting seasons have not recently been established (e.g., most shorebirds)	"Gamebirds" (as defined by 50 CFR 20.11) for which sport hunting seasons are established
	All subsistence-hunted species in Alaska (except "gamebirds" with established sport hunting seasons)	
Endangered Species Act	Candidates, including "resident gamebirds" (see below), or proposed Endangered or Threatened	Species, subspecies, and populations designated as Endangered or Threatened (as listed at 50 CFR 17.11)
	Non-listed subspecies and populations of otherwise Endangered or Threatened species (e.g., *occidentalis* ssp. of Spotted Owl)	
	Recently delisted MBTA species (e.g., Peregrine Falcon)	
	Other MBTA species delisted in the future	
None	Endemic Hawaiian honeycreepers of the subfamily Drepanididae (e.g., Hawai`i `Amakihi)	"Resident gamebirds" (generally hunted and managed by State wildlife agencies), unless listed as ESA Candidate (see above)
	Other island endemics (e.g., Fiji Shrikebill)	Non-native species

Table 2 BCR 1 (Aleutian/Bering Sea Islands) *BCC 2008* list[4]

Laysan Albatross (nb)
Black-footed Albatross (nb)
Red-faced Cormorant
Pelagic Cormorant
Black Oystercatcher
Rock Sandpiper (*ptilocnemis* ssp.)
Red-legged Kittiwake
Aleutian Tern
Arctic Tern
Marbled Murrelet (c)
Kittlitz's Murrelet (a)
Whiskered Auklet
McKay's Bunting

4 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 3 BCR 2 (Western Alaska) *BCC 2008* list[5]

Red-throated Loon
Yellow-billed Loon
Red-faced Cormorant
Pelagic Cormorant
Peregrine Falcon (b)
Black Oystercatcher
Solitary Sandpiper
Lesser Yellowlegs
Whimbrel
Bristle-thighed Curlew
Hudsonian Godwit
Bar-tailed Godwit
Marbled Godwit
Red Knot (*roselaari* ssp.)
Rock Sandpiper (*ptilocnemis* ssp.) (nb)
Dunlin (*arcticola* ssp.) (nb)
Short-billed Dowitcher
Aleutian Tern
Arctic Tern
Marbled Murrelet (c)
Kittlitz's Murrelet (a)
McKay's Bunting (nb)

5 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 4 BCR 3 (Arctic Plains and Mountains U.S. portion only) *BCC 2008* list.[6]

Red-throated Loon
Yellow-billed Loon
Peregrine Falcon (b)
Whimbrel
Bar-tailed Godwit
Red Knot (*roselaari* ssp.)
Dunlin (*arcticola* ssp.)
Buff-breasted Sandpiper
Arctic Tern
Smith's Longspur

6 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 5 BCR 4 (Northwestern Interior Forest U.S. portion only) *BCC 2008* list.[7]

Horned Grebe
Peregrine Falcon (b)
Solitary Sandpiper
Lesser Yellowlegs
Upland Sandpiper
Whimbrel
Bristle-thighed Curlew
Hudsonian Godwit
Red Knot (*roselaari* ssp.)
Rock Sandpiper (*ptilocnemis* ssp.) (nb)
Short-billed Dowitcher
Olive-sided Flycatcher
Smith's Longspur
Rusty Blackbird

7 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 6 BCR 5 (Northern Pacific Forest U.S. portions only) *BCC 2008* list.[8]

Yellow-billed Loon (nb)
Western Grebe (nb)
Laysan Albatross (nb)
Black-footed Albatross (nb)
Pink-footed Shearwater (nb)
Red-faced Cormorant
Pelagic Cormorant (*pelagicus* ssp.)
Bald Eagle (b)
Northern Goshawk (*laingi* ssp.)
Peregrine Falcon (b)
Black Oystercatcher
Solitary Sandpiper (nb)
Lesser Yellowlegs (nb)
Whimbrel (nb)
Long-billed Curlew (nb)
Hudsonian Godwit (nb)
Marbled Godwit (nb)
Red Knot (*roselaari* ssp.) (nb)
Short-billed Dowitcher (nb)
Aleutian Tern
Caspian Tern
Arctic Tern
Marbled Murrelet (c)
Kittlitz's Murrelet (a)
Black Swift
Rufous Hummingbird
Allen's Hummingbird
Olive-sided Flycatcher
Willow Flycatcher (c)
Horned Lark (*strigata* ssp.) (a)
Oregon Vesper Sparrow (*affinis* ssp.)
Purple Finch

8 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 7 BCR 9 (Great Basin) *BCC 2008* list.[9]

Greater Sage-Grouse (Columbia Basin DPS) (a)
Eared Grebe (nb)
Bald Eagle (b)
Ferruginous Hawk
Golden Eagle
Peregrine Falcon (b)
Yellow Rail
Snowy Plover (c)
Long-billed Curlew
Marbled Godwit (nb)
Yellow-billed Cuckoo (w. U.S. DPS) (a)
Flammulated Owl
Black Swift
Calliope Hummingbird
Lewis's Woodpecker
Williamson's Sapsucker
White-headed Woodpecker
Willow Flycatcher (c)
Loggerhead Shrike
Pinyon Jay
Sage Thrasher
Virginia's Warbler
Green-tailed Towhee
Brewer's Sparrow
Black-chinned Sparrow
Sage Sparrow
Tricolored Blackbird
Black Rosy-Finch

9 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 8 BCR 10 (Northern Rockies U.S. portion only) *BCC 2008* list.[10]

Bald Eagle (b)
Swainson's Hawk
Ferruginous Hawk
Peregrine Falcon (b)
Upland Sandpiper
Long-billed Curlew
Yellow-billed Cuckoo (w. U.S. DPS) (a)
Flammulated Owl
Black Swift
Calliope Hummingbird
Lewis's Woodpecker
Williamson's Sapsucker
White-headed Woodpecker
Olive-sided Flycatcher
Willow Flycatcher (c)
Loggerhead Shrike
Sage Thrasher
Brewer's Sparrow
Sage Sparrow
McCown's Longspur
Black Rosy-Finch
Cassin's Finch

10 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 9 BCR 11 (Prairie Potholes U.S. portion only) *BCC 2008* list.[11]

Horned Grebe
American Bittern
Least Bittern
Bald Eagle (b)
Swainson's Hawk
Peregrine Falcon (b)
Yellow Rail
Mountain Plover
Solitary Sandpiper (nb)
Upland Sandpiper
Long-billed Curlew
Hudsonian Godwit (nb)
Marbled Godwit
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Black Tern
Black-billed Cuckoo
Short-eared Owl
Red-headed Woodpecker
Sprague's Pipit
Grasshopper Sparrow
Baird's Sparrow
Nelson's Sharp-tailed Sparrow
McCown's Longspur
Smith's Longspur (nb)
Chestnut-collared Longspur
Dickcissel

11 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 10 BCR 12 (Boreal Hardwood Transition U.S. portion only) *BCC 2008* list.[12]

Pied-billed Grebe
Horned Grebe (nb)
American Bittern
Bald Eagle (b)
Peregrine Falcon (b)
Yellow Rail
Solitary Sandpiper (nb)
Upland Sandpiper
Whimbrel (nb)
Hudsonian Godwit (nb)
Marbled Godwit (nb)
Red Knot (*rufa* ssp.) (a) (nb)
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Black Tern
Common Tern
Red-headed Woodpecker
Olive-sided Flycatcher
Wood Thrush
Golden-winged Warbler
Canada Warbler
Henslow's Sparrow
Rusty Blackbird

12 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 11 BCR 13 (Lower Great Lakes/St. Lawrence Plain U.S. portion only) *BCC 2008* list.[13]

Pied-billed Grebe
Horned Grebe (nb)
American Bittern
Least Bittern
Black-crowned Night-Heron
Bald Eagle (b)
Peregrine Falcon (b)
Solitary Sandpiper (nb)
Lesser Yellowlegs (nb)
Upland Sandpiper
Whimbrel (nb)
Hudsonian Godwit (nb)
Marbled Godwit (nb)
Red Knot (*rufa* ssp.) (a) (nb)
Semipalmated Sandpiper (Eastern) (nb)
Buff-breasted Sandpiper (nb)
Black Tern
Common Tern
Black-billed Cuckoo
Short-eared Owl (nb)
Red-headed Woodpecker
Wood Thrush
Blue-winged Warbler
Golden-winged Warbler
Cerulean Warbler
Canada Warbler
Henslow's Sparrow

13 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 12 BCR 14 (Atlantic Northern Forests U.S. portion only) *BCC 2008* list.[14]

Red-throated Loon (nb)
Pied-billed Grebe
Horned Grebe (nb)
Greater Shearwater (nb)
Great Cormorant (nb)
American Bittern
Least Bittern
Snowy Egret
Bald Eagle (b)
Peregrine Falcon (b)
Yellow Rail
Solitary Sandpiper (nb)
Lesser Yellowlegs (nb)
Upland Sandpiper
Whimbrel (nb)
Hudsonian Godwit (nb)
Red Knot (*rufa* ssp.) (a) (nb)
Semipalmated Sandpiper (Eastern) (nb)
Purple Sandpiper (nb)
Arctic Tern
Olive-sided Flycatcher
Bicknell's Thrush
Wood Thrush
Blue-winged Warbler
Bay-breasted Warbler
Canada Warbler
Nelson's Sharp-tailed Sparrow
Saltmarsh Sharp-tailed Sparrow
Rusty Blackbird

14 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 13 BCR 15 (Sierra Nevada) *BCC 2008* list.[15]

Bald Eagle (b)
Peregrine Falcon (b)
Flammulated Owl
Spotted Owl (*occidentalis* ssp.) (c)
Black Swift
Calliope Hummingbird
Lewis's Woodpecker
Williamson's Sapsucker
Olive-sided Flycatcher
Willow Flycatcher (c)
Cassin's Finch

15 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 14 BCR 16 (Southern Rockies/Colorado Plateau) *BCC 2008* list.[16]

Gunnison Sage Grouse
American Bittern
Bald Eagle (b)
Ferruginous Hawk
Golden Eagle
Peregrine Falcon (b)
Prairie Falcon
Snowy Plover (c)
Mountain Plover
Long-billed Curlew
Yellow-billed Cuckoo (w. U.S. DPS) (a)
Flammulated Owl
Burrowing Owl
Lewis's Woodpecker
Willow Flycatcher (c)
Gray Vireo
Pinyon Jay
Juniper Titmouse
Veery
Bendire's Thrasher
Grace's Warbler
Brewer's Sparrow
Grasshopper Sparrow
Chestnut-collared Longspur
Black Rosy-Finch
Brown-capped Rosy-Finch
Cassin's Finch

16 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 15 BCR 17 (Badlands and Prairies) *BCC 2008* list.[17]

Horned Grebe
American Bittern
Bald Eagle (b)
Ferruginous Hawk
Golden Eagle
Peregrine Falcon (b)
Prairie Falcon
Yellow Rail
Mountain Plover
Upland Sandpiper
Long-billed Curlew
Marbled Godwit
Black-billed Cuckoo
Burrowing Owl
Short-eared Owl
Lewis's Woodpecker
Red-headed Woodpecker
Loggerhead Shrike
Pinyon Jay
Sage Thrasher
Sprague's Pipit
Brewer's Sparrow
Sage Sparrow
Grasshopper Sparrow
Baird's Sparrow
McCown's Longspur
Chestnut-collared Longspur
Dickcissel

17 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 16 BCR 18 (Shortgrass Prairie) *BCC 2008* list.[18]

Lesser Prairie-Chicken (a)
Bald Eagle (b)
Golden Eagle
Prairie Falcon
Snowy Plover (c)
Mountain Plover
Upland Sandpiper
Long-billed Curlew
Burrowing Owl
Lewis's Woodpecker
Willow Flycatcher (c)
Bell's Vireo (c)
Sprague's Pipit (nb)
Lark Bunting
McCown's Longspur
Chestnut-collared Longspur

18 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 17 BCR 19 (Central Mixed-Grass Prairie) *BCC 2008* list.[19]

Lesser Prairie-Chicken (a)
Little Blue Heron
Mississippi Kite
Bald Eagle (b)
Swainson's Hawk
Black Rail
Snowy Plover (c)
Mountain Plover (nb)
Solitary Sandpiper (nb)
Upland Sandpiper
Long-billed Curlew
Hudsonian Godwit (nb)
Marbled Godwit (nb)
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Red-headed Woodpecker
Scissor-tailed Flycatcher
Loggerhead Shrike
Bell's Vireo (c)
Sprague's Pipit (nb)
Cassin's Sparrow
Lark Bunting
Henslow's Sparrow
Harris's Sparrow (nb)
McCown's Longspur (nb)
Smith's Longspur (nb)
Chestnut-collared Longspur (nb)

19 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 18 BCR 20 (Edwards Plateau) *BCC 2008* list.[20]

Bald Eagle (b)
Peregrine Falcon (b)
Mountain Plover (nb)
Upland Sandpiper (nb)
Long-billed Curlew (nb)
Gray Vireo
Rufous-crowned Sparrow
Harris's Sparrow (nb)
McCown's Longspur (nb)
Chestnut-collared Longspur (nb)
Orchard Oriole

20 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 19 BCR 21 (Oaks and Prairies) *BCC 2008* list.[21]

Little Blue Heron
Swallow-tailed Kite
Bald Eagle (b)
Peregrine Falcon (b)
Black Rail (nb)
Upland Sandpiper
Long-billed Curlew (nb)
Hudsonian Godwit (nb)
Buff-breasted Sandpiper (nb)
Red-headed Woodpecker
Scissor-tailed Flycatcher
Loggerhead Shrike
Bell's Vireo (c)
Sprague's Pipit (nb)
Swainson's Warbler
Henslow's Sparrow (nb)
Harris's Sparrow (nb)
Smith's Longspur (nb)
Orchard Oriole

21 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 20 BCR 22 (Eastern Tallgrass Prairie) *BCC 2008* list.[22]

Pied-billed Grebe
Horned Grebe (nb)
American Bittern
Least Bittern
Black-crowned Night-Heron
Bald Eagle (b)
Peregrine Falcon (b)
Black Rail
Solitary Sandpiper (nb)
Upland Sandpiper
Whimbrel (nb)
Hudsonian Godwit (nb)
Marbled Godwit (nb)
Red Knot (*roselaari* ssp.) (nb)
Red Knot (*rufa* ssp.) (a) (nb)
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Black Tern
Common Tern
Black-billed Cuckoo
Short-eared Owl (nb)
Whip-poor-will
Red-headed Woodpecker
Northern Flicker
Acadian Flycatcher
Loggerhead Shrike
Bell's Vireo (c)
Bewick's Wren (*bewickii* ssp.)
Wood Thrush
Blue-winged Warbler
Cerulean Warbler
Prothonotary Warbler
Kentucky Warbler
Field Sparrow
Grasshopper Sparrow
Henslow's Sparrow
Smith's Longspur (nb)
Dickcissel
Rusty Blackbird (nb)

22 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 21 BCR 23 (Prairie Hardwood Transition) *BCC 2008* list.[23]

Pied-billed Grebe
Horned Grebe (nb)
American Bittern
Bald Eagle (b)
Peregrine Falcon (b)
Yellow Rail
Solitary Sandpiper (nb)
Upland Sandpiper
Whimbrel (nb)
Hudsonian Godwit (nb)
Marbled Godwit (nb)
Red Knot (*roselaar*i ssp.) (nb)
Red Knot (*rufa* ssp.) (a) (nb)
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Black Tern
Common Tern
Black-billed Cuckoo
Short-eared Owl (nb)
Red-headed Woodpecker
Willow Flycatcher (c)
Marsh Wren
Brown Thrasher
Blue-winged Warbler
Golden-winged Warbler
Cerulean Warbler
Henslow's Sparrow
Dickcissel
Bobolink
Rusty Blackbird (nb)

23 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 22 BCR 24 (Central Hardwoods) *BCC 2008* list.[24]

Bald Eagle (b)
Peregrine Falcon (b)
Black Rail
Solitary Sandpiper (nb)
Buff-breasted Sandpiper (nb)
Short-eared Owl (nb)
Whip-poor-will
Red-headed Woodpecker
Loggerhead Shrike
Bell's Vireo (c)
Brown-headed Nuthatch
Bewick's Wren (*bewickii* ssp.)
Sedge Wren
Wood Thrush
Blue-winged Warbler
Prairie Warbler
Cerulean Warbler
Worm-eating Warbler
Swainson's Warbler
Kentucky Warbler
Bachman's Sparrow
Henslow's Sparrow
LeConte's Sparrow (nb)
Smith's Longspur (nb)
Painted Bunting
Rusty Blackbird (nb)

24 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 23 BCR 25 (West Gulf Coastal Plain/Ouachitas) *BCC 2008* list.[25]

Least Bittern
Little Blue Heron
Swallow-tailed Kite
Bald Eagle (b)
American Kestrel (*paulus* ssp.)
Yellow Rail (nb)
Solitary Sandpiper (nb)
Hudsonian Godwit (nb)
Buff-breasted Sandpiper (nb)
Chuck-will's-widow
Red-headed Woodpecker
Loggerhead Shrike
Brown-headed Nuthatch
Bewick's Wren (*bewickii* ssp.)
Wood Thrush
Sprague's Pipit (nb)
Prairie Warbler
Cerulean Warbler
Prothonotary Warbler
Worm-eating Warbler
Swainson's Warbler
Louisiana Waterthrush
Kentucky Warbler
Bachman's Sparrow
Henslow's Sparrow (nb)
Smith's Longspur (nb)
Painted Bunting
Orchard Oriole

25 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 24 BCR 26 (Mississippi Alluvial Valley) *BCC 2008* list.[26]

American Bittern (nb)
Least Bittern
Swallow-tailed Kite
Bald Eagle (b)
Peregrine Falcon (b)
Yellow Rail (nb)
Black Rail
Solitary Sandpiper (nb)
Hudsonian Godwit (nb)
Marbled Godwit (nb)
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Short-eared Owl (nb)
Red-headed Woodpecker
Sedge Wren (nb)
Wood Thrush
Cerulean Warbler
Prothonotary Warbler
Swainson's Warbler
Kentucky Warbler
Henslow's Sparrow (nb)
LeConte's Sparrow (nb)
Painted Bunting
Dickcissel
Rusty Blackbird (nb)
Orchard Oriole

26 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 25 BCR 27 (Southeastern Coastal Plain) *BCC 2008* list.[27]

Red-throated Loon
Black-capped Petrel (nb)
Audubon's Shearwater (nb)
American Bittern (nb)
Least Bittern
Roseate Spoonbill (nb)
Swallow-tailed Kite
Bald Eagle (b)
American Kestrel (*paulus* ssp.)
Peregrine Falcon (b)
Yellow Rail (nb)
Black Rail
Limpkin
Snowy Plover (c)
Wilson's Plover
American Oystercatcher
Solitary Sandpiper (nb)
Upland Sandpiper (nb)
Whimbrel (nb)
Long-billed Curlew (nb)
Marbled Godwit (nb)
Red Knot (*rufa* ssp.) (a) (nb)
Semipalmated Sandpiper (Eastern) (nb)
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Least Tern (c)
Gull-billed Tern
Sandwich Tern
Black Skimmer
Common Ground-Dove
Chuck-will's-widow
Whip-poor-will
Red-headed Woodpecker
Loggerhead Shrike
Brown-headed Nuthatch
Bewick's Wren (*bewickii* ssp.)
Sedge Wren (nb)
Wood Thrush
Blue-winged Warbler
Black-throated Green Warbler
Prairie Warbler
Cerulean Warbler
Prothonotary Warbler
Swainson's Warbler
Kentucky Warbler
Bachman's Sparrow
Henslow's Sparrow
LeConte's Sparrow (nb)
Nelson's Sharp-tailed Sparrow (nb)
Saltmarsh Sharp-tailed Sparrow (nb)
Seaside Sparrow (c)
Painted Bunting
Rusty Blackbird (nb)

27 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 26 BCR 28 (Appalachian Mountains) *BCC 2008* list.[28]

Bald Eagle (b)
Peregrine Falcon (b)
Upland Sandpiper
Northern Saw-whet Owl (S. Appalachian breeding pop.)
Whip-poor-will
Red-headed Woodpecker
Yellow-bellied Sapsucker (S. Appalachian breeding pop.)
Olive-sided Flycatcher
Loggerhead Shrike
Black-capped Chickadee (S. Appalachian pop.)
Bewick's Wren (*bewickii* ssp.)
Sedge Wren (nb)
Wood Thrush
Blue-winged Warbler
Golden-winged Warbler
Prairie Warbler
Cerulean Warbler
Worm-eating Warbler
Swainson's Warbler
Louisiana Waterthrush
Kentucky Warbler
Canada Warbler
Henslow's Sparrow
Rusty Blackbird (nb)
Red Crossbill (S. Appalachian pop.)

28 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 27 BCR 29 (Piedmont) *BCC 2008* list.[29]

Bald Eagle (b)
Peregrine Falcon (b)
Black Rail
Short-eared Owl (nb)
Whip-poor-will
Loggerhead Shrike
Brown-headed Nuthatch
Bewick's Wren (*bewickii* ssp.)
Sedge Wren
Wood Thrush
Blue-winged Warbler
Prairie Warbler
Cerulean Warbler
Swainson's Warbler
Kentucky Warbler
Bachman's Sparrow
Henslow's Sparrow
Rusty Blackbird (nb)

29 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 28 BCR 30 (New England/Mid-Atlantic Coast) *BCC 2008* list.[30]

Red-throated Loon (nb)
Pied-billed Grebe
Horned Grebe (nb)
Greater Shearwater (nb)
Audubon's Shearwater (nb)
American Bittern
Least Bittern
Snowy Egret
Bald Eagle (b)
Peregrine Falcon (b)
Black Rail
Wilson's Plover
American Oystercatcher
Solitary Sandpiper (nb)
Lesser Yellowlegs (nb)
Upland Sandpiper
Whimbrel (nb)
Hudsonian Godwit (nb)
Marbled Godwit (nb)
Red Knot (*rufa* ssp.) (a) (nb)
Semipalmated Sandpiper (Eastern) (nb)
Purple Sandpiper (nb)
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Least Tern (c)
Gull-billed Tern
Black Skimmer
Short-eared Owl (nb)
Whip-poor-will
Red-headed Woodpecker
Loggerhead Shrike
Brown-headed Nuthatch
Sedge Wren
Wood Thrush
Blue-winged Warbler
Golden-winged Warbler
Prairie Warbler
Cerulean Warbler
Worm-eating Warbler
Kentucky Warbler
Henslow's Sparrow
Nelson's Sharp-tailed Sparrow
Saltmarsh Sharp-tailed Sparrow
Seaside Sparrow (c)
Rusty Blackbird (nb)

30 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 29 BCR 31 (Peninsular Florida) *BCC 2008* list.[31]

Black-capped Petrel (nb)
Audubon's Shearwater (nb)
Brown Booby (nb)
Magnificent Frigatebird
American Bittern (nb)
Least Bittern
Reddish Egret
Roseate Spoonbill
Swallow-tailed Kite
Bald Eagle (b)
Short-tailed Hawk
American Kestrel (*paulus* ssp.)
Peregrine Falcon (b)
Yellow Rail (nb)
Black Rail
Limpkin
Snowy Plover (c)
Wilson's Plover
American Oystercatcher
Solitary Sandpiper (nb)
Lesser Yellowlegs (nb)
Whimbrel (nb)
Long-billed Curlew (nb)
Marbled Godwit (nb)
Red Knot (*rufa* ssp.) (a) (nb)
Semipalmated Sandpiper (Eastern) (nb)
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Least Tern (c)
Black Skimmer
White-crowned Pigeon
Common Ground-Dove
Mangrove Cuckoo
Smooth-billed Ani
Chuck-will's-widow
Red-headed Woodpecker
Loggerhead Shrike
Black-whiskered Vireo
Brown-headed Nuthatch
Yellow Warbler (*gundlachi* ssp.)
Prairie Warbler
Prothonotary Warbler
Bachman's Sparrow
Grasshopper Sparrow
Henslow's Sparrow (nb)
Nelson's Sharp-tailed Sparrow (nb)
Saltmarsh Sharp-tailed Sparrow (nb)
Seaside Sparrow (c)
Painted Bunting (nb)

31 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 30 BCR 32 (Coastal California U.S. portion only) *BCC 2008* list.[32]

Black-footed Albatross (nb)
Pink-footed Shearwater (nb)
Black-vented Shearwater (nb)
Ashy Storm-Petrel
Bald Eagle (b)
Peregrine Falcon (b)
Yellow Rail (nb)
Black Rail
Snowy Plover (c)
Mountain Plover (nb)
Black Oystercatcher
Whimbrel (nb)
Long-billed Curlew (nb)
Marbled Godwit (nb)
Red Knot (*roselaari* ssp.) (nb)
Short-billed Dowitcher (nb)
Gull-billed Tern
Black Skimmer
Xantus's Murrelet (a)
Cassin's Auklet
Yellow-billed Cuckoo (w. US DPS) (a)
Flammulated Owl
Burrowing Owl
Spotted Owl (*occidentalis* ssp.) (c)
Black Swift
Costa's Hummingbird
Allen's Hummingbird
Lewis's Woodpecker
Nuttall's Woodpecker
White-headed Woodpecker
Loggerhead Shrike
Island Scrub-Jay
Yellow-billed Magpie
Oak Titmouse
Cactus Wren
LeConte's Thrasher
Yellow Warbler (*brewsteri*ssp.)
Common Yellowthroat (*sinuosa* ssp.)
Spotted Towhee (*clementae* ssp.)
Black-chinned Sparrow
Song Sparrow (*graminea* ssp.)
Song Sparrow (*maxillaris* ssp.)
Song Sparrow (*pusillula* ssp.)
Song Sparrow (*samuelis* ssp.)
Tricolored Blackbird
Lawrence's Goldfinch

32 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 31 BCR 33 (Sonoran and Mojave Deserts U.S. portion only) *BCC 2008* list.[33]

Least Bittern
Bald Eagle (b)
Peregrine Falcon (b)
Prairie Falcon
Black Rail
Snowy Plover (c)
Mountain Plover (nb)
Whimbrel (nb)
Long-billed Curlew (nb)
Marbled Godwit (nb)
Red Knot (*roselaari* ssp.) (nb)
Gull-billed Tern
Black Skimmer
Yellow-billed Cuckoo (w. US DPS) (a)
Elf Owl
Burrowing Owl
Costa's Hummingbird
Gila Woodpecker
Gilded Flicker
Bell's Vireo (c)
Gray Vireo
Bendire's Thrasher
LeConte's Thrasher
Lucy's Warbler
Yellow Warbler (*sonorana* ssp.)
Rufous-winged Sparrow
Black-chinned Sparrow
Lawrence's Goldfinch

33 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 32 BCR 34 (Sierra Madre Occidental U.S. portion only) *BCC 2008* list.[34]

Bald Eagle (b)
Common Black-Hawk
Peregrine Falcon (b)
Mountain Plover (nb)
Yellow-billed Cuckoo (w. U.S. DPS) (a)
Flammulated Owl
Elf Owl
Blue-throated Hummingbird
Elegant Trogon
Lewis's Woodpecker
Arizona Woodpecker
Northern Beardless-Tyrannulet
Buff-breasted Flycatcher
Rose-throated Becard
Bell's Vireo (c)
Gray Vireo
Pinyon Jay
Bendire's Thrasher
Sprague's Pipit (nb)
Phainopepla
Olive Warbler
Lucy's Warbler
Yellow Warbler (*sonorana* ssp.)
Black-throated Gray Warbler
Grace's Warbler
Red-faced Warbler
Canyon Towhee
Rufous-winged Sparrow
Botteri's Sparrow
Five-striped Sparrow
Black-chinned Sparrow
Lark Bunting (nb)
Grasshopper Sparrow (nb)
Grasshopper Sparrow (*ammolegus* ssp.)
Baird's Sparrow (nb)
Chestnut-collared Longspur (nb)
Varied Bunting

34 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 33 BCR 35 (Chihuahuan Desert U.S. portion only) *BCC 2008* lists.[35]

Bald Eagle (b)
Common Black-Hawk
Ferruginous Hawk (nb)
Golden Eagle
Peregrine Falcon (b)
Snowy Plover (c)
Mountain Plover
Long-billed Curlew (nb)
Yellow-billed Cuckoo (w. US DPS) (a)
Flammulated Owl
Elf Owl
Burrowing Owl
Lucifer Hummingbird
Loggerhead Shrike
Bell's Vireo (c)
Gray Vireo
Bendire's Thrasher
Sprague's Pipit (nb)
Virginia's Warbler
Colima Warbler
Yellow Warbler (*sonorana* ssp.)
Grace's Warbler
Red-faced Warbler
Cassin's Sparrow
Black-chinned Sparrow
Lark Bunting (nb)
Baird's Sparrow (nb)
McCown's Longspur (nb)
Chestnut-collared Longspur (nb)
Varied Bunting
Painted Bunting

35 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 34 BCR 36 (Tamaulipan Brushlands U.S. portion only) *BCC 2008* list.[36]

Harris's Hawk
Swainson's Hawk
Snowy Plover (c)
Mountain Plover (nb)
Solitary Sandpiper (nb)
Lesser Yellowlegs (nb)
Long-billed Curlew (nb)
Gull-billed Tern
Red-billed Pigeon
Green Parakeet (d)
Red-crowned Parrot (d)
Elf Owl
Burrowing Owl
Buff-bellied Hummingbird
Northern Beardless-Tyrannulet
Rose-throated Becard
Bell's Vireo (c)
Verdin
Curve-billed Thrasher
Sprague's Pipit (nb)
Tropical Parula
Summer Tanager
White-collared Seedeater
Cassin's Sparrow
Lark Bunting (nb)
Chestnut-collared Longspur (nb)
Varied Bunting
Painted Bunting
Dickcissel
Hooded Oriole
Altamira Oriole
Audubon's Oriole

36 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 35 BCR 37 (Gulf Coastal Prairie U.S. portion only) *BCC 2008* list.[37]

Audubon's Shearwater (nb)
Band-rumped Storm-Petrel (nb)
American Bittern
Least Bittern
Reddish Egret
Swallow-tailed Kite
Bald Eagle (b)
White-tailed Hawk
Peregrine Falcon (b) (nb)
Yellow Rail (nb)
Black Rail
Snowy Plover (c)
Wilson's Plover
Mountain Plover (nb)
American Oystercatcher
Solitary Sandpiper (nb)
Lesser Yellowlegs (nb)
Upland Sandpiper (nb)
Whimbrel (nb)
Long-billed Curlew
Hudsonian Godwit (nb)
Marbled Godwit (nb)
Red Knot (*roselaari* ssp.) (nb)
Red Knot (*rufa* ssp.) (a) (nb)
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Least Tern (c)
Gull-billed Tern
Sandwich Tern
Black Skimmer
Short-eared Owl (nb)
Loggerhead Shrike
Sedge Wren (nb)
Sprague's Pipit (nb)
Prothonotary Warbler
Swainson's Warbler
Botteri's Sparrow
Grasshopper Sparrow
Henslow's Sparrow (nb)
LeConte's Sparrow (nb)
Nelson's Sharp-tailed Sparrow (nb)
Seaside Sparrow (c)
Painted Bunting
Dickcissel

37 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 36 BCR 67 (Hawaii) *BCC 2008* list.[38]

Laysan Albatross
Black-footed Albatross
Christmas Shearwater
Band-rumped Storm-Petrel (a)
Tristram's Storm-Petrel
Bristle-thighed Curlew (nb)
Short-eared Owl
`Elepaio (d)
`Oma`o
Hawai`i `Amakihi (d)
Oahu `Amakihi (d)
Kaua`i `Amakihi (d)
`Anianiau (d)
`Akikiki (a,d)
Maui `Alauahio (d)
`Akeke`e (d)
`I`iwi (d)
`Apapane (d)

38 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 37 Other U.S. Pacific Islands *BCC 2008* list.[39]

Laysan Albatross
Black-footed Albatross
Herald Petrel
Tahiti Petrel (d)
Phoenix Petrel (d)
Christmas Shearwater
Audubon's Shearwater
Polynesian Storm-Petrel (d)
Spotless Crake (American Samoa pop.) (a,d)
Purple Swamphen
Bristle-thighed Curlew (nb)
Friendly Ground-Dove (American Samoa DPS) (a,d)
Micronesian Myzomela (d)
Rufous Fantail (*mariae* ssp.) (d)
Rufous Fantail (*saipanensis* ssp.) (d)
Fiji Shrikebill (d)
Tinian Monarch (d)
Bridled White-eye (*saypani* ssp.) (c,d)
Golden White-eye (d)
Micronesian Starling (*guami* ssp.) (d)
Polynesian Starling (d)

39 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 38 U.S. Caribbean Islands (Puerto Rico and U.S. Virgin Islands) *BCC 2008* list.[40]

West Indian Whistling-Duck
White-cheeked Pintail
Masked Duck
Ruddy Duck (*jamaicensis* ssp.)
Audubon's Shearwater
Masked Booby
Brown Booby
Red-footed Booby
Magnificent Frigatebird
Least Bittern
Greater Flamingo
Black Rail
Yellow-breasted Crake
Caribbean Coot
Limpkin
Snowy Plover (c)
Wilson's Plover
American Oystercatcher
Red Knot (*rufa* ssp.) (a) (nb)
Semipalmated Sandpiper (Eastern) (nb)
White-crowned Pigeon
Bridled Quail-Dove
Antillean Mango (d)
Loggerhead Kingbird
Puerto Rican Vireo
Elfin-woods Warbler (a)
Greater Antillean Oriole

40 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 39 USFWS Region 1 (Pacific Region) *BCC 2008* list.[41]

Greater Sage-Grouse (Columbia Basin DPS)(a)
Black-footed Albatross
Herald Petrel
Tahiti Petrel (d)
Phoenix Petrel (d)
Pink-footed Shearwater (nb)
Polynesian Storm-Petrel (d)
Band-rumped Storm-Petrel (a)
Tristram's Storm-Petrel
Bald Eagle (b)
Swainson's Hawk
Ferruginous Hawk
Peregrine Falcon (b)
Yellow Rail
Spotless Crake (American Samoa pop.) (a,d)
Purple Swamphen
Snowy Plover (c)
Black Oystercatcher
Whimbrel (nb)
Bristle-thighed Curlew (nb)
Long-billed Curlew
Marbled Godwit (nb)
Red Knot (*roselaari* ssp.) (nb)
Short-billed Dowitcher (nb)
Friendly Ground-Dove (American Samoa DPS) (a,d)
Yellow-billed Cuckoo (w. US DPS) (a)
Flammulated Owl
Short-eared Owl
Black Swift
Calliope Hummingbird
Rufous Hummingbird
Lewis's Woodpecker
Williamson's Sapsucker
White-headed Woodpecker
Olive-sided Flycatcher
Willow Flycatcher (c)
Loggerhead Shrike
Pinyon Jay
Rufous Fantail (*mariae* ssp.) (d)
`Elepaio (d)
Tinian Monarch (d)
Horned Lark (*strigata* ssp.) (a)
`Oma`o
Golden White-eye (d)
Sage Thrasher
Virginia's Warbler
Green-tailed Towhee
Brewer's Sparrow
Oregon Vesper Sparrow (*affinis* ssp.)
Sage Sparrow
Black Rosy-Finch
Cassin's Finch
Hawai`i `Amakihi (d)
Oahu `Amakihi (d)
Kaua`i` `Amakihi (d)
`Anianiau (d)
`Akikiki (a,d)
Maui `Alauahio (d)
`Akeke`e (d)
`I`iwi (d)
`Apapane (d)

41 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 40 USFWS Region 2 (Southwest Region) *BCC 2008* list.[42]

Lesser Prairie-Chicken (a)
Reddish Egret
Swallow-tailed Kite
Bald Eagle (b)
Common Black-Hawk
White-tailed Hawk
Golden Eagle
Peregrine Falcon (b)
Yellow Rail (nb)
Black Rail
Snowy Plover (c)
Wilson's Plover
Mountain Plover
American Oystercatcher
Solitary Sandpiper (nb)
Lesser Yellowlegs (nb)
Upland Sandpiper
Whimbrel (nb)
Long-billed Curlew
Hudsonian Godwit (nb)
Red Knot (*roselaari* ssp.) (nb)
Red Knot (*rufa* ssp.) (a) (nb)
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Gull-billed Tern
Sandwich Tern
Black Skimmer
Yellow-billed Cuckoo (w. U.S. DPS) (a)
Flammulated Owl
Elf Owl
Burrowing Owl
Lucifer Hummingbird
Costa's Hummingbird
Lewis's Woodpecker
Red-headed Woodpecker
Gilded Flicker
Northern Beardless-Tyrannulet
Buff-breasted Flycatcher
Loggerhead Shrike
Bell's Vireo (c)
Gray Vireo
Pinyon Jay
Brown-headed Nuthatch
Sedge Wren (nb)
Wood Thrush
Bendire's Thrasher
LeConte's Thrasher
Sprague's Pipit (nb)
Olive Warbler
Colima Warbler
Lucy's Warbler
Yellow Warbler (*sonorana* ssp.)
Grace's Warbler
Prairie Warbler
Cerulean Warbler
Prothonotary Warbler
Worm-eating Warbler
Swainson's Warbler
Kentucky Warbler
Red-faced Warbler
Rufous-winged Sparrow
Bachman's Sparrow
Botteri's Sparrow
Five-striped Sparrow
Black-chinned Sparrow
Lark Bunting
Grasshopper Sparrow (*ammolegus* ssp.)
Baird's Sparrow (nb)
Henslow's Sparrow (nb)
LeConte's Sparrow (nb)
Nelson's Sharp-tailed Sparrow (nb)
Seaside Sparrow (c)
Harris's Sparrow (nb)
McCown's Longspur (nb)
Smith's Longspur (nb)
Chestnut-collared Longspur (nb)
Varied Bunting
Painted Bunting
Rusty Blackbird (nb)
Audubon's Oriole

42 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 41 USFWS Region 3 (Great Lakes-Big Rivers Region) *BCC 2008* list.[43]

Pied-billed Grebe
Horned Grebe (nb)
American Bittern
Least Bittern
Bald Eagle (b)
Swainson's Hawk
Peregrine Falcon (b)
Yellow Rail
Black Rail
Solitary Sandpiper (nb)
Upland Sandpiper
Whimbrel (nb)
Hudsonian Godwit (nb)
Marbled Godwit
Red Knot (*roselaari* ssp.) (nb)
Red Knot (*rufa* ssp.) (a) (nb)
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Black Tern
Common Tern
Black-billed Cuckoo
Short-eared Owl (nb)
Whip-poor-will
Red-headed Woodpecker
Olive-sided Flycatcher
Loggerhead Shrike
Bell's Vireo (c)
Bewick's Wren (*bewickii* ssp.)
Wood Thrush
Blue-winged Warbler
Golden-winged Warbler
Prairie Warbler
Cerulean Warbler
Worm-eating Warbler
Swainson's Warbler
Kentucky Warbler
Canada Warbler
Bachman's Sparrow
Henslow's Sparrow
Nelson's Sharp-tailed Sparrow
Smith's Longspur (nb)
Chestnut-collared Longspur
Dickcissel
Rusty Blackbird

43 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 42 USFWS Region 4 (Southeast Region) mainland *BCC 2008* list.[44]

Red-throated Loon
Black-capped Petrel
Audubon's Shearwater
Band-rumped Storm-Petrel (a) (Hawaii DPS is candidate; Atlantic pop. is not)
American Bittern
Least Bittern
Reddish Egret
Swallow-tailed Kite
Bald Eagle (b)
Short-tailed Hawk
American Kestrel (*paulus* ssp.)
Peregrine Falcon (b)
Yellow Rail
Black Rail
Limpkin
Snowy Plover (c)
Wilson's Plover
American Oystercatcher
Solitary Sandpiper (nb)
Whimbrel (nb)
Long-billed Curlew (nb)
Hudsonian Godwit (nb)
Marbled Godwit (nb)
Red Knot (*rufa* ssp.) (nb)
Semipalmated Sandpiper (Eastern) (nb)
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Least Tern (c)
Gull-billed Tern
Black Skimmer
White-crowned Pigeon
Mangrove Cuckoo
Smooth-billed Ani
Short-eared Owl
Chuck-will's-widow
Red-headed Woodpecker
Olive-sided Flycatcher
Loggerhead Shrike
Black-whiskered Vireo
Brown-headed Nuthatch
Bewick's Wren (*bewickii* ssp.)
Sedge Wren
Wood Thrush
Sprague's Pipit
Blue-winged Warbler
Golden-winged Warbler
Prairie Warbler
Cerulean Warbler
Prothonotary Warbler
Worm-eating Warbler
Swainson's Warbler
Kentucky Warbler
Canada Warbler
Bachman's Sparrow
Henslow's Sparrow
LeConte's Sparrow
Nelson's Sharp-tailed Sparrow
Saltmarsh Sharp-tailed Sparrow
Seaside Sparrow (c)
Smith's Longspur
Painted Bunting
Rusty Blackbird

44 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 43 USFWS Region 4 (Puerto Rico and U.S. Virgin Islands) *BCC 2008* list.[45]

West Indian Whistling-Duck
White-cheeked Pintail
Masked Duck
Ruddy Duck (*jamaicensis* ssp. only)
Audubon's Shearwater
Masked Booby
Brown Booby
Red-footed Booby
Magnificent Frigatebird
Least Bittern
Greater Flamingo
Black Rail
Yellow-breasted Crake
Caribbean Coot
Limpkin
Snowy Plover (c)
Wilson's Plover
American Oystercatcher
Red Knot (*rufa* ssp.) (a) (nb)
Semipalmated Sandpiper (Eastern) (nb)
White-crowned Pigeon
Bridled Quail-Dove
Antillean Mango (d)
Loggerhead Kingbird
Puerto Rican Vireo
Elfin-woods Warbler (a)
Greater Antillean Oriole

45 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 44 USFWS Region 5 (Northeast Region) *BCC 2008* list.[46]

Red-throated Loon (nb)
Pied-billed Grebe
Horned Grebe (nb)
Greater Shearwater (nb)
Audubon's Shearwater (nb)
American Bittern
Least Bittern
Snowy Egret
Bald Eagle (b)
Peregrine Falcon (b)
Yellow Rail
Black Rail
Wilson's Plover
American Oystercatcher
Solitary Sandpiper (nb)
Lesser Yellowlegs (nb)
Upland Sandpiper
Whimbrel (nb)
Hudsonian Godwit (nb)
Marbled Godwit (nb)
Red Knot (*rufa* ssp.) (a) (nb)
Semipalmated Sandpiper (Eastern) (nb)
Purple Sandpiper (nb)
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Least Tern (c)
Gull-billed Tern
Arctic Tern
Black Skimmer
Short-eared Owl (nb)
Whip-poor-will
Red-headed Woodpecker
Olive-sided Flycatcher
Loggerhead Shrike
Bewick's Wren (*bewickii* ssp.)
Sedge Wren
Bicknell's Thrush
Wood Thrush
Blue-winged Warbler
Golden-winged Warbler
Prairie Warbler
Bay-breasted Warbler
Cerulean Warbler
Worm-eating Warbler
Swainson's Warbler
Kentucky Warbler
Canada Warbler
Henslow's Sparrow
Nelson's Sharp-tailed Sparrow
Saltmarsh Sharp-tailed Sparrow
Seaside Sparrow (c)
Rusty Blackbird

46 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 45 USFWS Region 6 (Mountain-Prairie Region) *BCC 2008* list.[47]

Gunnison Sage-Grouse
Lesser Prairie-Chicken (a)
Horned Grebe
American Bittern
Least Bittern
Bald Eagle (b)
Ferruginous Hawk
Golden Eagle
Peregrine Falcon (b)
Prairie Falcon
Yellow Rail
Black Rail
Snowy Plover (c)
Mountain Plover
Upland Sandpiper
Long-billed Curlew
Hudsonian Godwit (nb)
Marbled Godwit
Buff-breasted Sandpiper (nb)
Short-billed Dowitcher (nb)
Black-billed Cuckoo
Flammulated Owl
Burrowing Owl
Short-eared Owl
Lewis's Woodpecker
Red-headed Woodpecker
Willow Flycatcher (c)
Loggerhead Shrike
Bell's Vireo (c)
Gray Vireo
Pinyon Jay
Bewick's Wren (*bewickii* ssp.)
Sage Thrasher
Sprague's Pipit
Sage Sparrow
Grasshopper Sparrow
Baird's Sparrow
Henslow's Sparrow
Nelson's Sharp-tailed Sparrow
McCown's Longspur
Smith's Longspur
Chestnut-collared Longspur
Black Rosy-Finch
Brown-capped Rosy-Finch
Cassin's Finch

47 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 46 USFWS Region 7 (Alaska Region) *BCC 2008* list.[48]

Red-throated Loon
Yellow-billed Loon
Horned Grebe
Laysan Albatross
Black-footed Albatross
Red-faced Cormorant
Pelagic Cormorant
Northern Goshawk (*laingi* ssp.)
Peregrine Falcon (b)
Black Oystercatcher
Solitary Sandpiper
Lesser Yellowlegs
Whimbrel
Bristle-thighed Curlew
Hudsonian Godwit
Bar-tailed Godwit
Marbled Godwit
Red Knot (*roselaari* ssp.)
Rock Sandpiper (*ptilocnemis* spp.)
Dunlin (*arcticola* ssp.)
Buff-breasted Sandpiper
Short-billed Dowitcher
Red-legged Kittiwake
Aleutian Tern
Arctic Tern
Marbled Murrelet (c)
Kittlitz's Murrelet (a)
Whiskered Auklet
Rufous Hummingbird
Olive-sided Flycatcher
Smith's Longspur
McKay's Bunting
Rusty Blackbird

48 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 47 USFWS Region 8 (California and Nevada) *BCC 2008* list.[49]

Black-footed Albatross
Pink-footed Shearwater (nb)
Ashy Storm-Petrel
Bald Eagle (b)
Peregrine Falcon (b)
Yellow Rail
Black Rail
Snowy Plover (c)
Mountain Plover (nb)
Black Oystercatcher
Whimbrel (nb)
Long-billed Curlew (nb)
Marbled Godwit (nb)
Red Knot (*roselaari* ssp.) (nb)
Short-billed Dowitcher (nb)
Gull-billed Tern
Black Skimmer
Xantus's Murrelet (a)
Yellow-billed Cuckoo (w. US DPS) (a)
Flammulated Owl
Burrowing Owl
Spotted Owl (*occidentalis* ssp.) (c)
Black Swift
Costa's Hummingbird
Calliope Hummingbird
Allen's Hummingbird
Lewis's Woodpecker
Williamson's Sapsucker
Olive-sided Flycatcher
Willow Flycatcher (c)
Loggerhead Shrike
Bell's Vireo (c)
Gray Vireo
Island Scrub-Jay
Pinyon Jay
Yellow-billed Magpie
Oak Titmouse
Cactus Wren
Sage Thrasher
LeConte's Thrasher
Virginia's Warbler
Yellow Warbler (*brewsteri* ssp.)
Yellow Warbler (*sonorana* ssp.)
Common Yellowthroat (*sinuosa* ssp.)
Green-tailed Towhee
Spotted Towhee (*clementae* ssp.)
Brewer's Sparrow
Black-chinned Sparrow
Sage Sparrow
Song Sparrow (*graminea* ssp.)
Song Sparrow (*maxillaris* ssp.)
Song Sparrow (*pusillula* ssp.)
Song Sparrow (*samuelis* ssp.)
Tricolored Blackbird
Lawrence's Goldfinch

49 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Table 48 National (including Caribbean and Pacific Island "Territories") *BCC 2008* list.[50]

West Indian Whistling-Duck
Greater Sage-Grouse (Colum. Basin DPS) (a)
Gunnison Sage-Grouse
Lesser Prairie-Chicken (a)
Yellow-billed Loon
Black-footed Albatross
Tahiti Petrel (d)
Phoenix Petrel (d)
Black-capped Petrel
Pink-footed Shearwater
Christmas Shearwater
Audubon's Shearwater
Polynesian Storm-Petrel (d)
Ashy Storm-Petrel
Band-rumped Storm-Petrel (a) (Hawaii DPS is candidate; Atlantic pop. is not)
Reddish Egret
Swallow-tailed Kite
Bald Eagle (b)
Swainson's Hawk
Peregrine Falcon (b)
Yellow Rail
Black Rail
Spotless Crake (Am. Samoa pop.) (a, d)
Caribbean Coot
Limpkin
Snowy Plover (c)
Wilson's Plover
Mountain Plover
American Oystercatcher
Black Oystercatcher
Solitary Sandpiper
Lesser Yellowlegs
Upland Sandpiper
Whimbrel
Bristle-thighed Curlew
Long-billed Curlew
Hudsonian Godwit
Bar-tailed Godwit
Marbled Godwit
Red Knot (*roselaari* ssp.)
Red Knot (*rufa* ssp.) (a) (nb)
Semipalmated Sandpiper (Eastern) (nb)
Purple Sandpiper (nb)
Rock Sandpiper (*ptilocnemis* ssp.)
Dunlin (*arcticola* spp.)
Buff-breasted Sandpiper
Short-billed Dowitcher
Red-legged Kittiwake
Aleutian Tern
Least Tern (c)
Gull-billed Tern
Black Skimmer
Marbled Murrelet (c)
Kittlitz's Murrelet (a)
Xantus's Murrelet (a)
White-crowned Pigeon
Friendly Ground-Dove (Am. Samoa) (a,d)
Green Parakeet (d)
Red-crowned Parrot (d)
Yellow-billed Cuckoo (w. U.S. DPS) (a)
Mangrove Cuckoo
Flammulated Owl
Elf Owl
Spotted Owl (*occidentalis* ssp.) (c)
Short-eared Owl
Black Swift
Costa's Hummingbird
Calliope Hummingbird
Rufous Hummingbird
Allen's Hummingbird
Elegant Trogon
Lewis's Woodpecker
Red-headed Woodpecker
Table 48 Continued

50 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of Threatened or Endangered species, (d) MBTA protection uncertain or lacking, (nb) non-breeding in this BCR

Nuttall's Woodpecker
Arizona Woodpecker
White-headed Woodpecker
Olive-sided Flycatcher
Willow Flycatcher (c)
Loggerhead Shrike
Puerto Rican Vireo
Bell's Vireo (c)
Gray Vireo
Island Scrub-Jay
Pinyon Jay
Yellow-billed Magpie
Rufous Fantail (*mariae* ssp.) (d)
`Elepaio (d)
Tinian Monarch (d)
Horned Lark (*strigata* ssp.) (a)
Oak Titmouse
Brown-headed Nuthatch
Bewick's Wren (*bewickii* ssp.)
`Omao
Bicknell's Thrush
Wood Thrush
Golden White-eye (d)
Bendire's Thrasher
LeConte's Thrasher
Sprague's Pipit
Blue-winged Warbler
Golden-winged Warbler
Virginia's Warbler
Colima Warbler
Lucy's Warbler
Grace's Warbler
Prairie Warbler
Bay-breasted Warbler
Cerulean Warbler
Elfin-woods Warbler (a)
Prothonotary Warbler
Worm-eating Warbler
Swainson's Warbler
Kentucky Warbler
Canada Warbler
Red-faced Warbler

Rufous-winged Sparrow
Bachman's Sparrow
Five-striped Sparrow
Brewer's Sparrow
Black-chinned Sparrow
Baird's Sparrow
Henslow's Sparrow
Nelson's Sharp-tailed Sparrow
Saltmarsh Sharp-tailed Sparrow
Seaside Sparrow (c)
Harris's Sparrow
McCown's Longspur
Smith's Longspur
McKay's Bunting
Varied Bunting
Painted Bunting
Dickcissel
Tricolored Blackbird
Rusty Blackbird
Audubon's Oriole
Black Rosy-Finch
Brown-capped Rosy-Finch
Lawrence's Goldfinch
Hawai`i `Amakihi (d)
Oahu `Amakihi (d)
Kaua`i `Amakihi (d)
`Anianiau (d)
`Akikiki (a,d)
Maui `Alauahio (d)
`Akek`ee (d)
`I`iwi (d)
`Apapane (d)

Appendix B

Matrix of Species on BCR, USFWS Region, and National Lists in *BCC 2008*, Arranged Taxonomically (according to American Ornithologists' Union 48th Checklist) [51]

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51 (a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of threatened or endangered species, (d) MBTA protection uncertain or lacking

	Bird Conservation Regions																																USFWS Regions								National
	'x' indicates species is included for breeding period (plus non-breeding where species occurs year-round), 'nb' indicates species is included only for non-breeding period																																(4a = Puerto Rico & USVI)								
	1	2	3	4	5	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	67	U.S. Pacif. Islds.	U.S. Carib. Islds.	1	2	3	4	4a	5	6	7	8	
West Indian Whistling-Duck																																					x					+				+
White-cheeked Pintail																																					x					+				
Masked Duck																																					x					+				
Ruddy Duck (*jamaicensis* ssp. only)																																					x					+				
Greater Sage-Grouse (Columbia Basin DPS)(a)						x																																+								+
Gunnison Sage-Grouse													x																														+			+
Lesser Prairie-Chicken (a)															x	x																								+			+			+
Red-throated Loon		x	x								nb													nb			nb														+		+		+	
Yellow-billed Loon		x	x		nb																																							+		+
Pied-billed Grebe									x	x	x								x	x							x														+		+			
Horned Grebe				x				x	nb	nb	nb			x					nb	nb							nb														+		+	+	+	
Eared Grebe						nb																																							
Western Grebe					nb																																								
Laysan Albatross	nb				nb																															x	x						+		
Black-footed Albatross	nb				nb																							nb							x	x						+	+	+
Herald Petrel																																				x		+							
Tahiti Petrel (d)																																				x		+							+
Phoenix Petrel (d)																																				x		+							+
Black-capped Petrel																								nb				nb														+			+
Pink-footed Shearwater					nb																								nb														+		+
Greater Shearwater											nb																nb															+			
Christmas Shearwater																																				x	x								+
Black-vented Shearwater																													nb																
Audubon's Shearwater																								nb			nb	nb						nb		x	x				+	+	+		+
Polynesian Storm-Petrel (d)																																				x		+							+
Ashy Storm-Petrel																													x														+		+

	Bird Conservation Regions																																	USFWS Regions								National
	'x' indicates species is included for breeding period (plus non-breeding where species occurs year-round), 'nb' indicates species is included only for non-breeding period																																	(4a = Puerto Rico & USVI)								
	1	2	3	4	5	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	67	U.S. Pacif. Islds.	U.S. Carib. Islds.	1	2	3	4	4a	5	6	7	8	
Band-rumped Storm-Petrel (a) (Hawaii DPS is candidate; Atlantic pop. is not)																																nb	x			+			+					+
Tristram's Storm-Petrel																																	x			+								
Masked Booby																																				x					+				
Brown Booby																												nb								x					+				
Red-footed Booby																																				x					+				
Great Cormorant											nb																																		
Red-faced Cormorant	x	x			x																																					+		
Pelagic Cormorant (*pelagicus* ssp.)	x	x			x																																					+		
Magnificent Frigatebird																												x								x					+				
American Bittern								x	x	x	x		x	x					x	x			nb	nb			x	nb					nb						+	+		+	+		
Least Bittern								x		x	x								x			x	x	x			x	x		x			x			x			+	+	+	+	+		
Snowy Egret											x																	x														+				
Little Blue Heron																x		x				x																								
Reddish Egret																												x						x											+
Black-crowned Night-Heron										x									x																										
Roseate Spoonbill																								nb				x																
Greater Flamingo																																				x					+				
Swallow-tailed Kite																		x				x	x	x				x						x						+				+
Mississippi Kite																x																													
Bald Eagle (b)					x	x	x	x	x	x	x	x	x	x	x	x	nb	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x			+	+	+	+		+	+		+	+
Northern Goshawk (*laingi* ssp.)					x																																						+		
Common Black-Hawk																															x	x							+					
Harris's Hawk																																	x											
Short-tailed Hawk																												x													+				
Swainson's Hawk							x	x								x																	x					+		+					+

	Bird Conservation Regions																																	USFWS Regions								National
	'x' indicates species is included for breeding period (plus non-breeding where species occurs year-round), 'nb' indicates species is included only for non-breeding period																																	(4a = Puerto Rico & USVI)								
	1	2	3	4	5	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	67	U.S. Pacif. Islds.	U.S. Carib. Islds.	1	2	3	4	4a	5	6	7	8	
White-tailed Hawk																																		x					+							
Ferruginous Hawk						x	x						x	x																		nb					+					+			
Golden Eagle						x							x	x	x																	x					+					+			
American Kestrel (*paulus* ssp.)																						x		x				x													+				
Peregrine Falcon (b)		x	x	x	x	x	x	x	x	x	x	x	x	x			x	x	x	x	x		x	x	x	x	x	x	x	x	x	x		nb				+	+	+	+		+	+	+	+	+
Prairie Falcon													x	x	x															x													+				
Yellow Rail						x		x	x		x			x						x		nb	nb	nb			nb	nb					nb					+	+	+	+		+	+		+	+
Black Rail																x		nb	x		x		x	x		x	x	x	x	x				x			x			+	+	+	+	+	+		+	+
Spotless Crake (American Samoa pop.) (a,d)																																				x		+									+
Yellow-breasted Crake																																					x					+				
Purple Swamphen																																				x		+									
Caribbean Coot																																					x					+				+
Limpkin																								x				x									x					+				+
Snowy Plover (c)						x							x		x	x								x				x	x	x		x	x	x			x	+	+		+	+		+		+
Wilson's Plover																								x			x	x						x				x		+		+	+	+			+
Mountain Plover								x					x	x	x	nb	nb												nb	nb	nb	x	nb	nb					+				+		+	+
American Oystercatcher															x									x			x	x						x				x		+		+	+	+			+
Black Oystercatcher	x	x			x																								x								x		+					+	+	+
Solitary Sandpiper		x		x	nb			nb	nb	nb	nb					nb			nb	nb	nb	nb	nb	nb			nb	nb					nb	nb					+	+	+		+		+		+
Lesser Yellowlegs		x		x	nb					nb	nb																nb	nb					nb	nb					+				+		+		+
Upland Sandpiper				x			x	x	x	x	x			x	x	x	nb	x	x					nb	x		x							nb					+	+			+	+	+		+
Whimbrel		x	x	x	nb				nb	nb	nb								nb	nb				nb			nb	nb	nb	nb				nb					+	+	+	+		+		+	+	+
Bristle-thighed Curlew		x		x																															nb	nb		+							+		+

	Bird Conservation Regions																																USFWS Regions								National
	'x' indicates species is included for breeding period (plus non-breeding where species occurs year-round), 'nb' indicates species is included only for non-breeding period																																(4a = Puerto Rico & USVI)								
	1	2	3	4	5	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	67	U.S. Pacif. Islds.	U.S. Carib. Islds.	1	2	3	4	4a	5	6	7	8	
Long-billed Curlew					nb	x	x	x					x	x	x	x	nb	nb						nb				nb	nb	nb		nb	nb	x				+	+		+		+		+	+
Hudsonian Godwit		x		x	nb			nb	nb	nb	nb					nb		nb	nb	nb		nb	nb				nb							nb					+	+	+		+	+	+		+
Bar-tailed Godwit		x	x																																									+		+
Marbled Godwit		x			nb	nb		x	nb	nb				x		nb			nb	nb			nb	nb			nb	nb	nb	nb				nb				+		+	+		+	+	+	+	+
Red Knot (*roselaari* ssp.)		x	x	x	nb														nb	nb									nb	nb				nb				+	+	+					+	+	+
Red Knot (*rufa* ssp.) (a)									nb	nb	nb								nb	nb				nb			nb	nb						nb			nb		+	+	+	+	+			+
Semipalmated Sandpiper (Eastern)										nb	nb													nb			nb	nb									nb				+	+	+			+
Purple Sandpiper											nb																nb																+			+
Rock Sandpiper (*ptilocnemis*)	x	nb		nb																																							+		+
Dunlin (*arcticola*)		nb	x																																								+		+
Buff-breasted Sandpiper			x					nb	nb	nb						nb		nb	nb	nb	nb	nb	nb	nb			nb	nb						nb					+	+	+		+	+	+		+
Short-billed Dowitcher		x		x	nb			nb	nb							nb			nb	nb			nb	nb			nb	nb	nb					nb				+	+	+	+		+	+	+	+	+
Red-legged Kittiwake	x																																										+		+
Aleutian Tern	x	x			x																																						+		+
Least Tern (c)																								x			x	x						x						+		+			+
Gull-billed Tern																								x			x		x	x			x	x					+		+		+		+
Caspian Tern					x																																								
Black Tern								x	x	x									x	x																				+					
Common Tern									x	x									x	x																				+					
Arctic Tern	x	x	x		x						x																																+				
Sandwich Tern																								x										x						+					
Black Skimmer																								x			x	x	x	x				x						+		+		+		+
Marbled Murrelet (c)	x	x			x																																						+			+

	Bird Conservation Regions																															USFWS Regions								National
	'x' indicates species is included for breeding period (plus non-breeding where species occurs year-round), 'nb' indicates species is included only for non-breeding period																															(4a = Puerto Rico & USVI)								
	1	2	3	4	5	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	67	U.S. Pacif. Islds.	U.S. Carib. Islds.	1	2	3	4	4a	5	6	7	8	
Kittlitz's Murrelet (a)	x	x			x																																				+		+
Xantus's Murrelet (a)																												x													+		+
Cassin's Auklet																												x															
Whiskered Auklet	x																																								+		
White-crowned Pigeon																											x									x				+	+			+
Red-billed Pigeon																																x											
Common Ground-Dove																								x			x																
Bridled Quail-Dove																																				x					+			
Friendly Ground-Dove (American Samoa DPS) (a,d)																																			x		+						+
Green Parakeet (d)																																x											+
Red-crowned Parrot (d)																																x											+
Yellow-billed Cuckoo (w. U.S. DPS) (a)						x	x						x																x	x	x	x					+	+					+	+
Mangrove Cuckoo																											x													+				+
Black-billed Cuckoo								x		x				x					x	x																					+			+	
Smooth-billed Ani																											x														+			
Flammulated Owl						x	x					x	x															x		x	x							+	+			+		+	+
Elf Owl																													x	x	x	x					+						+
Burrowing Owl													x	x	x													x	x		x	x					+					+		+	
Spotted Owl (*occidentalis* ssp.) (c)												x																x															+	+
Short-eared Owl								x		nb				x					nb	nb	nb		nb			nb	nb							nb	x			+		+	+		+	+		+
Northern Saw-whet Owl (S. Appalachian breeding pop.)																									x																			
Chuck-will's-widow																						x		x				x														+		
Whip-poor-will																			x		x			x	x	x	x														+		+		
Black Swift					x	x	x					x																x														+			+	+

	Bird Conservation Regions																															USFWS Regions								National
	'x' indicates species is included for breeding period (plus non-breeding where species occurs year-round), 'nb' indicates species is included only for non-breeding period																															(4a = Puerto Rico & USVI)								
	1	2	3	4	5	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	67	U.S. Pacif. Islds.	U.S. Carib. Islds.	1	2	3	4	4a	5	6	7	8	
Antillean Mango (d)																																					x				+					
Buff-bellied Hummingbird																																x														
Blue-throated Hummingbird																														x															
Lucifer Hummingbird																															x						+								
Costa's Hummingbird																													x	x							+							+	+
Calliope Hummingbird						x	x					x																									+							+	+
Rufous Hummingbird					x																																+						+		+
Allen's Hummingbird					x																								x								+							+	+
Elegant Trogon																															x														+
Lewis's Woodpecker						x	x					x	x	x	x														x		x						+	+				+		+	+
Red-headed Woodpecker								x	x	x				x		x		x	x	x	x	x	x	x		x	x												+	+	+		+	+			+
Gila Woodpecker																														x																
Williamson's Sapsucker						x	x					x																									+							+	
Yellow-bellied Sapsucker (S. Appalachian breeding pop.)																									x																				
Nuttall's Woodpecker																													x																+
Arizona Woodpecker																															x														+
White-headed Woodpecker						x	x																						x							+							+	+
Northern Flicker																			x																										
Gilded Flicker																														x								+								
Northern Beardless-Tyrannulet																															x		x					+								
Olive-sided Flycatcher				x	x		x		x		x	x													x													+		+	+		+		+	+	+
Acadian Flycatcher																			x																										
Willow Flycatcher (c)					x	x	x					x	x		x					x																		+					+		+	+
Buff-breasted Flycatcher																															x							+								
Loggerhead Kingbird																																				x					+					
Scissor-tailed Flycatcher																x		x																										

	Bird Conservation Regions																															USFWS Regions								National
	'x' indicates species is included for breeding period (plus non-breeding where species occurs year-round), 'nb' indicates species is included only for non-breeding period																															(4a = Puerto Rico & USVI)								
	1	2	3	4	5	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	67	U.S. Pacif. Islds.	U.S. Carib. Islds.	1	2	3	4	4a	5	6	7	8	
Rose-throated Becard																															x		x													
Micronesian Myzomela (d)																																				x										
Loggerhead Shrike						x	x							x		x		x	x		x	x		x	x	x	x	x	x			x		x				+	+	+	+		+	+		+	+
Puerto Rican Vireo																																					x						+				+
Bell's Vireo (c)															x	x		x	x		x										x	x	x	x						+	+			+		+	+
Gray Vireo													x				x														x	x	x							+				+		+	+
Black-whiskered Vireo																												x													+						
Island Scrub-Jay																													x																+	+
Pinyon Jay						x							x	x																	x									+	+			+	+	+
Yellow-billed Magpie																													x																+	+
Rufous Fantail (*mariae* ssp.) (d)																																				x		+								+
Rufous Fantail (*saipanensis* ssp.) (d)																																				x										
`Elepaio (d)																																			x			+								+
Fiji Shrikebill (d)																																				x										
Tinian Monarch (d)																																				x		+								+
Horned Lark (*strigata* ssp.) (a)					x																																	+								+
Black-capped Chickadee (S. Appalachian pop.)																									x																				
Oak Titmouse																													x																+	+
Juniper Titmouse													x																																	
Verdin																																	x													
Brown-headed Nuthatch																					x	x		x		x	x	x												+		+					+
Cactus Wren																													x																+	
Bewick's Wren (*bewickii* ssp.)																			x		x	x		x	x	x															+	+		+	+	
Sedge Wren																					x		nb	nb	nb	x	x								nb						+		+		+			
Marsh Wren																				x																										

	Bird Conservation Regions																															USFWS Regions								National
	'x' indicates species is included for breeding period (plus non-breeding where species occurs year-round), 'nb' indicates species is included only for non-breeding period																															(4a = Puerto Rico & USVI)								
	1	2	3	4	5	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	67	U.S. Pacif. Islds.	U.S. Carib. Islds.	1	2	3	4	4a	5	6	7	8	
`Omao																																			x			+								+
Veery													x																																	
Bicknell's Thrush											x																																+			+
Wood Thrush									x	x	x								x		x	x	x	x	x	x														+	+	+		+			+
Bridled White-eye (*saypani* ssp. only) (c,d)																																				x										
Golden White-eye (d)																																				x		+								+
Sage Thrasher						x	x							x																									+					+		+	
Brown Thrasher																				x																										
Bendire's Thrasher													x																	x	x	x							+						+
Curve-billed Thrasher																																	x												
LeConte's Thrasher																												x	x										+					+	+
Micronesian Starling (*guami ssp.) (d)*																																				x										
Polynesian Starling (d)																																				x										
Sprague's Pipit								x						x	nb	nb		nb				nb								nb	nb	nb	nb						+		+			+			+
Phainopepla																															x															
Olive Warbler																															x								+							
Blue-winged Warbler										x	x								x	x	x			x	x	x	x														+	+			+			+
Golden-winged Warbler									x	x										x					x		x															+	+			+			+
Virginia's Warbler						x																											x							+					+		+
Colima Warbler																																	x								+							+
Lucy's Warbler																														x	x										+							+
Tropical Parula																																	x														
Yellow Warbler (*brewsteri*)																													x																	+	
Yellow Warbler (*gundlachi* ssp.)																												x																		
Yellow Warbler (*sonorana*)																														x	x	x								+					+	

	Bird Conservation Regions																															USFWS Regions								National
	'x' indicates species is included for breeding period (plus non-breeding where species occurs year-round), 'nb' indicates species is included only for non-breeding period																															(4a = Puerto Rico & USVI)								
	1	2	3	4	5	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	67	U.S. Pacif. Islds.	U.S. Carib. Islds.	1	2	3	4	4a	5	6	7	8	
Black-throated Gray Warbler																															x													
Black-throated Green Warbler																								x																			
Grace's Warbler													x																		x	x							+					+
Prairie Warbler																					x	x		x	x	x	x	x											+	+	+		+				+
Bay-breasted Warbler											x																																+				+
Cerulean Warbler										x									x	x	x	x	x	x	x	x	x												+	+	+		+				+
Elfin-woods Warbler (a)																																					x					+				+
Prothonotary Warbler																			x			x	x	x				x						x					+		+					+
Worm-eating Warbler																					x	x			x		x												+	+	+		+				+
Swainson's Warbler																		x			x	x	x	x	x	x													+	+	+		+				+
Louisiana Waterthrush																						x			x																					
Kentucky Warbler																			x		x	x	x	x	x	x	x												+	+	+		+				+
Common Yellowthroat (*sinuosa* ssp.)																													x																+	
Canada Warbler									x	x	x														x																+	+		+				+
Red-faced Warbler																															x	x							+								+
Summer Tanager																																	x													
White-collared Seedeater																																	x													
Green-tailed Towhee						x																																+								+	
Spotted Towhee (*clementae* ssp.)																													x																+	
Canyon Towhee																															x															
Rufous-winged Sparrow																														x	x							+								+
Cassin's Sparrow																x																x	x													
Bachman's Sparrow																					x	x		x		x		x											+	+	+						+
Botteri's Sparrow																															x			x					+								
Rufous-crowned Sparrow																	x																													

	Bird Conservation Regions																																	USFWS Regions								National
	'x' indicates species is included for breeding period (plus non-breeding where species occurs year-round), 'nb' indicates species is included only for non-breeding period																																	(4a = Puerto Rico & USVI)								
	1	2	3	4	5	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	67	U.S. Pacif. Islds.	U.S. Carib. Islds.	1	2	3	4	4a	5	6	7	8	
Five-striped Sparrow																															x								+							+
Brewer's Sparrow						x	x						x	x																								+						+		+
Field Sparrow																			x																										
Black-chinned Sparrow						x																							x	x	x	x						+					+		+
Oregon Vesper Sparrow (*affinis* ssp.)					x																																	+								
Sage Sparrow						x	x							x																								+					+		+	
Lark Bunting															x	x															nb	nb	nb						+							
Grasshopper Sparrow								x					x	x					x									x			nb			x									+		
Grasshopper Sparrow (*ammolegus* ssp.)																															nb								+							
Baird's Sparrow								x						x																	nb	nb							+					+		+
Henslow's Sparrow									x	x						x		nb	x	x	x	nb	nb	x	x	x	x	nb						nb					+	+	+		+	+			+
LeConte's Sparrow																					nb		nb	nb										nb					+		+					
Nelson's Sharp-tailed Sparrow								x			x													nb			x	nb						nb					+	+	+		+	+			+
Saltmarsh Sharp-tailed Sparrow											x													nb			x	nb													+		+				+
Seaside Sparrow (c)																								x			x	x						x					+		+		+			+
Song Sparrow (*graminea* ssp.)																													x															+	
Song Sparrow (*maxillaris* ssp.)																													x															+	
Song Sparrow (*pusillula* ssp.)																													x															+	
Song Sparrow (*samuelis* ssp.)																													x															+	
Harris's Sparrow																nb	nb	nb																					+							+
McCown's Longspur							x	x						x	x	nb	nb															nb								+					+		+
Smith's Longspur			x	x				nb								nb		nb	nb		nb	nb																	+	+	+			+	+		+
Chestnut-collared Longspur								x					nb	x	x	nb	nb														nb	nb	nb						+	+				+			
McKay's Bunting	x	nb																																										+		+

	Bird Conservation Regions																																USFWS Regions								National
	'x' indicates species is included for breeding period (plus non-breeding where species occurs year-round), 'nb' indicates species is included only for non-breeding period																																(4a = Puerto Rico & USVI)								
	1	2	3	4	5	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	67	U.S. Pacif. Islds.	U.S. Carib. Islds.	1	2	3	4	4a	5	6	7	8	
Varied Bunting																															x	x	x					+							+
Painted Bunting																					x	x	x	x				nb				x	x	x					+		+					+
Dickcissel								x						x					x	x			x											x	x						+					+
Bobolink																				x																										+
Tricolored Blackbird						x																							x																+	+
Rusty Blackbird				x					x		x								nb	nb	nb		nb	nb	nb	nb	nb												+	+	+		+		+		+
Greater Antillean Oriole																																					x					+					
Orchard Oriole																	x	x				x	x																							
Hooded Oriole																																	x												
Altamira Oriole																																	x												
Audubon's Oriole																																	x					+							+
Black Rosy-Finch						x	x						x																									+					+		+
Brown-capped Rosy-Finch													x																														+		+
Purple Finch					x																																								
Cassin's Finch							x					x	x																									+					+		
Red Crossbill (S. Appalachian pop.)																									x																			
Lawrence's Goldfinch																													x	x													+	+
Hawai`i `Amakihi (d)																																			x			+							+
Oahu `Amakihi (d)																																			x			+							+
Kaua`i `Amakihi (d)																																			x			+							+
`Anianiau (d)																																			x			+							+
`Akikiki (a,d)																																			x			+							+
Maui `Alauahio (d)																																			x			+							+
`Akeke`e (d)																																			x			+							+
`I`iwi (d)																																			x			+							+
`Apapane (d)																																			x			+							+

	Bird Conservation Regions																																	USFWS Regions								National
	'x' indicates species is included for breeding period (plus non-breeding where species occurs year-round), 'nb' indicates species is included only for non-breeding period																																	(4a = Puerto Rico & USVI)								
	1	2	3	4	5	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	67	U.S. Pacif. Islds.	U.S. Carib. Islds.	1	2	3	4	4a	5	6	7	8	
Totals	13	22	10	14	30	28	22	27	23	27	29	11	27	28	16	26	11	19	39	30	26	27	26	53	25	18	45	48	45	28	37	31	31	42	18	20	27	61	78	45	61	27	51	45	34	55	147

(a) ESA candidate, (b) ESA delisted, (c) non-listed subspecies or population of ESA listed species, (d) MBTA protection uncertain or lacking

APPENDIX C

Index of Scientific Names of Species Appearing in the BCC 2008 Lists (Tables 2-48), Arranged Alphabetically by Common Name

Common Name	Scientific Name
Akekee	*Loxops caeruleirostris*
Akikiki	*Oreomystis bairdi*
Alauahio, Maui	*Paroreomyza maculata*
Albatross, Black-footed	*Phoebastria nigripes*
Albatross, Laysan	*Phoebastria immutabilis*
Amakihi, Hawaii	*Hemignathus virens*
Amakihi, Kauai	*Hemignathus kauaiensis*
Amakihi, Oahu	*Hemignathus flavus*
Ani, Smooth-billed	*Crotophaga ani*
Anianiau	*Hemignathus pan*/us
Apapane	*Mimatione sanguinea*
Auklet, Cassin's	*Ptychororamphus aleuticus*
Auklet, Whiskered	*Aethia pygmaea*
Beardless-Tyrannulet, Northern	*Camptostoma imberbe*
Becard, Rose-throated	*Pachyramphus aglaiae*
Bittern, American	*Botaurus lentiginosus*
Blackbird, Rusty	*Euphagus carolinus*
Blackbird, Tricolored	*Agelaius tricolor*
Black-Hawk, Common	*Buteogallus anthracinus*
Bobolink	*Dolichonyx oryzivorus*
Booby, Brown	*Sula leucogaster*
Booby, Masked	*Sula dactylatra*
Booby, Red-footed	*Sula sula*
Bunting, Lark	*Calamospiza melanocorys*
Bunting, McKay's	*Plectrophenax hyperboreus*
Bunting, Painted	*Passerina ciris*
Bunting, Varied	*Passerina versicolor*
Chickadee, Black-capped	*Poecile atricapillus*
Chuck-will's-widow	*Caprimulgus carolinensis*
Coot, Caribbean	*Fulica caribaea*
Cormorant, Red-faced	*Phalacrocorax urile*
Cormorant, Pelagic	*Phalacrocorax pelagicus pelagicus*
Crake, Spotless	*Porzana tabuensis*
Crake, Yellow-breasted	*Porzana flaviventer*
Crossbill, Red	*Loxia curvirostra*
Cuckoo, Black-billed	*Coccyzus erythropthalmus*
Cuckoo, Mangrove	*Coccyzus minor*
Cuckoo, Yellow-billed	*Coccyzus americanus*
Curlew, Bristle-thighed	*Numenius tahitiensis*
Curlew, Long-billed	*Numenius americanus*
Dickcissel	*Spiza americana*
Dowitcher, Short-billed	*Limnodromus griseus*
Duck, Masked	*Nomonyx dominicus*
Duck, Ruddy	*Oxyura jamaicensis jamaicensis*
Dunlin	*Calidris alpina arcticola*

Eagle, Golden	*Aquila chrysaetos*
Egret, Reddish	*Egretta rufescens*
Elepaio	*Chasiempis sandwichensis*
Falcon, Peregrine	*Falco peregrinus*
Falcon, Prairie	*Falco mexicanus*
Fantail, Rufous	*Rhipidura rufifrons mariae*
Fantail, Rufous	*Rhipidura rufifrons saipanensis*
Flicker, Gilded	*Colaptes chrysoides*
Flycatcher, Acadian	*Empidonax virescens*
Flycatcher, Buff-breasted	*Empidonax fulvifrons*
Flycatcher, Olive-sided	*Contopus cooperi*
Flycatcher, Puerto Rican	*Myiarchus antillarum*
Flycatcher, Scissor-tailed	*Tyrannus forficatus*
Frigatebird, Lesser	*Fregata ariel*
Frigatebird, Magnificent	*Fregata magnificens*
Fruit-Dove, Crimson-crowned	*Ptilinopus porphyraceus*
Fruit-Dove, Many-colored	*Ptilinopus superbus*
Fruit-Dove, Mariana	*Ptilinopus roseicapilla*
Godwit, Bar-tailed	*Limosa lapponica baueri*
Godwit, Hudsonian	*Limosa haemastica*
Godwit, Marbled	*Limosa fedoa*
Goldfinch, Lawrence's	*Carduelis lawrencei*
Goshawk, Northern	*Accipiter gentilis laingi*
Ground-Dove, Common	*Columbina passerina*
Ground-Dove, Friendly	*Gallicolumba stairi*
Ground-Dove, White-throated	*Gallicolumba xanthonura*
Harrier, Northern	*Circus cyaneus*
Hawk, Ferruginous	*Buteo regalis*
Hawk, Gray	*Asturina nitida*
Hawk, Harris's	*Parabuteo unicinctus*
Hawk, Short-tailed	*Buteo brachyurus*
Hawk, Swainson's	*Buteo swainsoni*
Hawk, White-tailed	*Buteo albicaudatus*
Heron, Little Blue	*Egretta caerulea*
Honeyeater, Wattled	*Foulehaio carunculata*
Hummingbird, Broad-billed	*Cynanthus latirostris*
Hummingbird, Buff-bellied	*Amazilia yucatanensis*
Hummingbird, Costa's	*Calypte costae*
Hummingbird, Lucifer	*Calothorax lucifer*
Hummingbird, Rufous	*Selasphorus rufus*
Ibis, White	*Eudocimus albus*
liwi	*Vestiaria coccinea*
Jay, Pinyon	*Gymnorhinus cyanocephalus*
Kestrel, American	*Falco sparverius paulus*
Kite, Mississippi	*Ictinia mississippiensis*

Kite, Swallow-tailed	*Elanoides forficatus*
Kittiwake, Red-legged	*Rissa brevirostris*
Knot, Red	*Calidris canutu roselaari*
Knot, Red	*Calidris canutus rufa*
Koel, Long-tailed	*Eudynamys taitensis*
Lark, Horned	*Eremophila alpestris strigata*
Limpkin	*Aramus guarauna*
Longspur, Chestnut-collared	*Calcarius ornatus*
Longspur, McCown's	*Calcarius mccownii*
Longspur, Smith's	*Calcarius pictus*
Loon, Red-throated	*Gavia stellata*
Loon, Yellow-billed	*Gavia adamsii*
Omao	*Gymnomyza samoensis*
Mango, Antillean	*Anthracothorax dominicus*
Monarch, Tinian	*Monarcha takatsukasae*
Murrelet, Ancient	*Synthliboramphus antiquus*
Murrelet, Kittlitz's	*Brachyramphus brevirostris*
Murrelet, Marbled	*Brachyramphus marmoratus*
Murrelet, Xantus's	*Synthliboramphus hypoleucus*
Myzomela, Cardinal	*Myzomela cardinalis*
Myzomela, Micronesian	*Myzomela rubrata*
Noddy, Blue-gray	*Procelsterna cerulea*
Nuthatch, Brown-headed	*Sitta pusilla*
Nuthatch, Pygmy	*Sitta pygmaea*
Omao	*Myadestes obscurus*
Oriole, Altamira	*Icterus gularis*
Oriole, Audubon's	*Icterus graduacauda*
Oriole, Baltimore	*Icterus galbula*
Oriole, Greater Antillean	*Icterus dominicensis*
Oriole, Hooded	*Icterus cucullatus*
Oriole, Orchard	*Icterus spurius*
Owl, Burrowing	*Athene cunicularia*
Owl, Elf	*Micrathene whitneyi*
Owl, Flammulated	*Otus flammeolus*
Owl, Long-eared	*Asio otus*
Owl, Northern Saw-whet	*Aegolius acadicus*
Owl, Short-eared	*Asio flammeus*
Owl, Spotted	*Strix occidentalis occidentalis*
Oystercatcher, American	*Haematopus palliatus palliatus*
Oystercatcher, Black	*Haematopus bachmani*
Parakeet, Green	*Aratinga holochlora*
Parrot, Red-crowned	*Amazona viridigenalis*
Parula, Northern	*Parula americana*
Parula, Tropical	*Parula pitiayumi*
Pelican, American White	*Pelecanus erythrorhynchos*
Petrel, Black-capped	*Pterodroma hasitata*
Petrel, Herald	*Pterodroma arminjoniana*

Petrel, Phoenix	*Pterodroma alba*
Petrel, Tahiti	*Pterodroma rostrata*
Pewee, Greater	*Contopus pertinax*
Pewee, Lesser Antillean	*Contopus latirostris*
Pigeon, Red-billed	*Columba flavirostris*
Pigeon, White-crowned	*Columba leucocephala*
Pintail, White-cheeked	*Anas bahamensis*
Pipit, Sprague's	*Anthus spragueii*
Plover, Mountain	*Charadrius montanus*
Plover, Snowy	*Charadrius alexandrinus nivosus/temirostris*
Plover, Wilson's	*Charadrius wilsonia wilsonia*
Prairie-Chicken, Lesser	*Tympanuchus pallidicinctus*
Pygmy-Owl, Ferruginous	*Glaucidium brasilianum*
Pyrrhuloxia	*Cardinalis sinuatus*
Quail-Dove, Bridled	*Geotrygon mystacea*
Quail-Dove, Key West	*Geotrygon chrysia*
Rail, Black	*Laterallus jamaicensis*
Rail, Buff-banded	*Gallirallus philippensis*
Rail, Yellow	*Coturnicops noveboracensis*
Razorbill	*Alca torda*
Sage-Grouse, Greater	*Centrocerus urophasianus*
Sage-Grouse, Gunnison	*Centrocercus minimus*
Sandpiper, Buff-breasted	*Tryngites subruficollis*
Sandpiper, Purple	*Calidris maritima maritima/belcheri*
Sandpiper, Rock	*Calidris ptilocnemis ptilocnemis*
Sandpiper, Semipalmated	*Calidris pusilla*
Sandpiper, Solitary	*Tringa solitaria*
Sandpiper, Upland	*Bartramia longicauda*
Sapsucker, Red-naped	*Sphyrapicus nuchalis*
Sapsucker, Williamson's	*Sphyrapicus thyroideus*
Sapsucker, Yellow-bellied	*Sphyrapicus varius*
Screech-Owl, Whiskered	*Otus trichopsis*
Scrub-Jay, Island	*Aphelocoma insularis*
Seedeater, White-collared	*Sporophila torqueola*
Shearwater, Audubon's	*Puffinus nativitatis*
Shrike, Loggerhead	*Lanius ludovicianus*
Shrikebill, Fiji	*Clytorhynchus vitiensis*
Skimmer, Black	*Rynchops niger*
Sparrow, Bachman's	*Aimophila aestivalis*
Sparrow, Baird's	*Ammodramus bairdii*
Sparrow, Black-chinned	*Spizella atrogularis*
Sparrow, Botteri's	*Aimophila botterii*
Sparrow, Brewer's	*Spizella breweri*
Sparrow, Cassin's	*Aimophila cassinii*
Sparrow, Field	*Spizella pusilla*
Sparrow, Grasshopper	*Ammodramus savannarum*
Sparrow, Grasshopper	*Ammodramus savannarum ammolegus*

Sparrow, Harris's	*Zonotrichia querula*
Sparrow, Henslow's	*Ammodramus henslowii*
Sparrow, Le Conte's	*Ammodramus leconteii*
Sparrow, Nelson's Sharp-tailed	*Ammodramus nelsoni*
Sparrow, Rufous-crowned	*Aimophila ruficeps*
Sparrow, Rufous-winged	*Aimophila carpalis*
Sparrow, Sage	*Amphispiza belli*
Sparrow, Saltmarsh Sharp-tailed	*Ammodramus caudacutus*
Sparrow, Seaside	*Ammodramus maritimus*
Sparrow, Song	*Melospiza melodia graminea*
Sparrow, Song	*Melospiza melodia maxillaris*
Sparrow, Song	*Melospiza melodia pusillula*
Sparrow, Song	*Melospiza melodia samuelis*
Sparrow, Oregon Vesper	*Pooecetes gramineus affinis*
Starling, Micronesia	*Aplonis opaca guami*
Starling, Polynesian	*Aplonis tabuensis*
Starling, Samoan	*Aplonis atrifusca*
Storm-Petrel, Ashy	*Oceanodroma homochroa*
Storm-Petrel, Band-rumped	*Oceanodroma castro*
Storm-Petrel, Polynesian	*Nesofregatta fuliginosa*
Storm-Petrel, Tristram's	*Oceanodroma tristrami*
Swamphen, Purple	*Porphyrio porphyrio*
Swift, Black	*Cypseloides niger*
Swiftlet, White-rumped	*Aerodramus spodiopygius*
Tanager, Summer	*Piranga rubra*
Tern, Caspian	*Hydroprogne caspia*
Tern, Aleutian	*Sterna aleutica*
Tern, Arctic	*Sterna paradisaea*
Tern, Black	*Chlidonias niger*
Tern, Common	*Sterna hirundo*
Tern, Elegant	*Thalasseus elegans*
Tern, Gull-billed	*Gelochelidon nilotica*
Tern, Least	*Sternula antillarum*
Thrasher, Bendire's	*Toxostoma bendirei*
Thrasher, Crissal	*Toxostoma crissale*
Thrasher, Curve-billed	*Toxostoma curvirostre*
Thrasher, Le Conte's	*Toxostoma lecontei*
Thrush, Bicknell's	*Catharus bicknelli*
Thrush, Wood	*Hylocichla mustelina*
Towhee, Canyon	*Pipilo fuscus*
Towhee, Green- tailed	*Pipilo chlorurus*
Towhee, Spotted	*Pipilo maculates clementae*
Trogon, Elegant	*Trogon elegans*
Tropicbird, Red-billed	*Phaethon aethereus*
Tropicbird, White-tailed	*Phaethon lepturus*
Verdin	*Auriparus flaviceps*
Vireo, Bell's	*Vireo bellii*

Vireo, Black-whiskered	*Vireo altiloquus*
Vireo, Gray	*Vireo vicinior*
Vireo, Puerto Rican	*Vireo latimeri*
Warbler, Adelaide's	*Dendroica adelaidae*
Warbler, Arctic	*Phylloscopus borealis*
Warbler, Bay-breasted	*Dendroica castanea*
Warbler, Blackpoll	*Dendroica striata*
Warbler, Canada	*Wilsonia canadensis*
Warbler, Elfin-wood	*Dendroica angelae*
Warbler, Kentucky	*Oporornis formosus*
Warbler, Prothonotary	*Protonotaria citrea*
Warbler, Red-faced	*Cardellina rubrifrons*
Warbler, Swainson's	*Limnothlypis swainsonii*
Warbler, Worm-eating	*Helmitheros vermivorus*
Warbler, Yellow	*Dendroica petechia brewsteri*
Warbler, Yellow	*Dendroica petechia gundlachi*
Warbler, Yellow	*Dendroica petechia sonorana*
Waterthrush, Louisiana	*Seiurus motacilla*
Whistling-Duck, West Indian	*Dendrocygna arborea*
White-eye, Bridled	*Zosterops conspicillatus saypani*
Wren, Bewick's	*Thryomanes bewickii bewickii*
Wren, Cactus	*Campylorhynchus brunneicapillus*
Wren, Marsh	*Cistothorus palustris*
Wren, Sedge	*Cistothorus platensis*
Yellowthroat, Common	*Geothlypis trichas sinuosa*

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
764 Horizon Drive, Building B
Grand Junction, Colorado 81506-3946

IN REPLY REFER TO:
ES/GJ-6-CO-08-F-0010
TAILS: 65413-2009-F-0042

February 25, 2009

Memorandum

To: Deputy State Director, Bureau of Land Management, Resources and Fire, Colorado State Office, Lakewood, Colorado

From: Acting Western Colorado Supervisor, Fish and Wildlife Service, Ecological Services, Grand Junction, Colorado

Subject: Programmatic Biological Opinion (PBO) for Water Depletions associated with Bureau of Land Management (BLM) Projects (excluding Fluid Mineral Development) Authorized by BLM within the Upper Colorado River Basin in Colorado.

In accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.), and the Interagency Cooperation Regulations (50 CFR 402), this transmits the U.S. Fish and Wildlife Service's (Service) final biological opinion (BO) for impacts to the four endangered Colorado River fish species (Colorado pikeminnow (*Ptychocheilus lucius*), razorback sucker (*Xyrauchen texanus*), bonytail (*Gila elegans*), and humpback chub (*Gila cypha*)) and their critical habitats from water depletions associated with BLM projects (excluding the Fluid Mineral Program) authorized by BLM within the Upper Colorado River Basin in Colorado. For the purposes of this BO, the area of consideration within the Upper Colorado River Basin includes all tributaries ultimately draining into the Colorado River within western Colorado except the San Juan River.

This BO is in response to your correspondence requesting initiation of consultation for the subject project, which was received in our office on September 16, 2008. The Service concurs that the proposed project is likely to adversely affect the Colorado pikeminnow, razorback sucker, bonytail, and humpback chub. Likewise, the project is also likely to adversely affect designated critical habitats for these endangered fish along the Green, Yampa, White, Colorado, and Gunnison Rivers.

The BLM activities described below require the use of various amounts of water. This consultation only addresses the effects of water depletions on the endangered Colorado River fishes and does not include other direct or indirect impacts to the four listed fish species. Any projects that involve potential water quality or habitat impacts are not covered under this programmatic biological opinion. A separate section 7 consultation will be required for any such project.

Consultation History

Implementation of the ESA in the Colorado River Basin started with section 7 consultation on Bureau of Reclamation projects in the late 1970s. At that time, the Service determined that a jeopardy situation existed for the subject endangered fishes. Subsequently, the ESA was amended to direct Federal agencies to work with State and local agencies to resolve water resource issues in concert with conservation of endangered species.

In 1984, the Department of the Interior, Colorado, Wyoming, Utah, water users, and environmental groups formed a coordinating committee to discuss a process to recover the endangered fishes while new and existing water development proceeds in the Upper Colorado River Basin in compliance with Federal and State law and interstate compacts. After four years of negotiations, the Recovery Implementation Program for the Endangered Fish Species in the Upper Colorado River Basin (Recovery Program) was developed.

On January 21-22, 1988, the Secretary of the Interior; Governors of Wyoming, Colorado, and Utah; and the Administrator of the Western Area Power Administration (WAPA) cosigned a Cooperative Agreement to implement the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (USFWS 1987). Current participants in the Recovery Program include: the Service, Bureau of Reclamation, WAPA, Colorado, Utah, Wyoming, Environmental Defense Fund, The Nature Conservancy, Colorado Water Congress, Utah Water Users Association, Wyoming Water Development Association, and the Colorado River Energy Distributors Association.

The Recovery Program was intended to be the reasonable and prudent alternative to avoid jeopardy to the endangered fishes by depletions from the Upper Colorado River Basin. The goal of the Recovery Program is to recover the listed species while providing for new and existing water development in the Upper Colorado River Basin. All participants agreed to cooperatively work toward the successful implementation of a recovery program that will provide for recovery of the endangered fish species, consistent with Federal law and all applicable State laws and systems for water resource development and use. Each signatory assumed certain responsibilities in implementing the Recovery Program.

In order to further define and clarify the process in the Recovery Program, a section 7 agreement was implemented on October 15, 1993, by the Recovery Program participants. Incorporated into this agreement is a Recovery Implementation Program Recovery Action Plan (RIPRAP) which identifies actions currently believed to be required to recover the endangered fishes in the most expeditious manner. Included in the Recovery Program was the requirement that a depletion fee would be paid to offset the effects of the depletions by helping to support the Recovery Program. The funds are received by the Service's designated agent, the National Fish and Wildlife Foundation, and used for acquisition of water rights (or directly-related activities) to meet the instream flow needs of the endangered fishes or to support other recovery activities for the endangered fishes described in the RIPRAP.

PBA, the Service issued a BO (1994 BO) on June 13, 1994 (USFWS 1994), which determined that water depletions from the Colorado River Basin would jeopardize the continued existence of the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker and result in the destruction or adverse modification of their critical habitats. The 1994 BO included reasonable and prudent alternatives developed by the Service to allow BLM to authorize projects with resultant water depletions of less than 125 acre-feet (AF).

The 1994 PBA and 1994 BO were written to remain in effect until a total depletion threshold of 1,417 AF of new depletions is reached. The threshold for historic depletions is 1,588 AF. As of January 2008, BLM has depleted or authorized the depletion of all of new depletions contemplated in the 1994 PBA and 1,019 AF of the historic depletions. The 1994 BO was amended March 2, 2000 and September 27, 2005. The BLM has paid depletion fees on an annual basis for projects covered by the 1994 consultation.

In January 2007, the Glenwood Springs Field Office (FO) of the BLM prepared a biological assessment (BA) for the Resource Management Plan Amendment, Roan Plateau Planning Area (Roan BA) that among other things, addressed water-depleting activities within the planning area. In response to the Roan BA, the Service issued a memo dated February 7, 2007, which concurred with BLM's determination that, water depletions from the Colorado River Basin would adversely affect the Colorado pikeminnow, humpback chub, bonytail, and razorback sucker and their critical habitats. Because the average annual depletion was less than 125 AF (83.6 AF/year), these depletions were addressed by the 1994 small water depletions BO.

On December 20, 1999, the Service issued the final PBO for Bureau of Reclamation's Operations and Depletions, Other Depletions, and Funding and Implementation of Recovery Program Actions in the Upper Colorado River above the Confluence with the Gunnison River (Colorado River PBO). The Service has determined that projects that fit under the umbrella of the Colorado River PBO would avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletion impacts. Projects fit under the umbrella of the Colorado River PBO if they deplete water from the Colorado River above the confluence with the Gunnison River; the water user signs a Recovery Agreement; the project sponsors make a one-time monetary contribution for water depletions greater than 100 AF to help fund their share of the costs of recovery actions.

On January 10, 2005, the Service issued the final PBO on the *Management Plan for Endangered Fishes in the Yampa River Basin* (Yampa River PBO). The Service has determined that projects that fit under the umbrella of the Yampa River PBO would avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletion impacts to the Yampa River Basin. Projects fit under the umbrella of the Yampa River PBO if they deplete water from the Yampa River above the confluence with the Green River; the water user signs a Recovery Agreement for projects greater than 100 AF; the project sponsors make a one-time monetary contribution for water depletions greater than 100 AF to help fund their share of the costs of recovery actions.

On November 21, 2008, the Service issued the final PBO on water depletions associated with BLM's fluid mineral program and other actions authorized by BLM for the San Juan River Basin

(San Juan River PBO). The Service has determined that projects that fit under the umbrella of the San Juan River PBO would avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletion impacts to the San Juan River. Projects fit under the umbrella of the San Juan River PBO if they deplete relatively small quantities of water from the San Juan River Basin and they are deemed appropriate for use under the PBO (i.e., projects involving large water depletions would need to undergo a separate section 7 consultation).

On December 19, 2008, the Service issued the final PBO on water depletions associated with BLM's fluid mineral program for western Colorado, excluding the San Juan River Basin (Fluid Mineral PBO). The Service has determined that projects that fit under the umbrella of the Fluid Mineral Depletion PBO would avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletion impacts to the Upper Colorado River Basin. Projects fit under the umbrella of the Fluid Mineral PBO if they deplete relatively small amounts of water from the Upper Colorado River Basin within western Colorado; the water user signs a Recovery Agreement; and the project sponsors (or a representative group) make a one-time monetary contribution for all water depletions to help fund their share of the costs of recovery actions.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Across western Colorado, public lands administered by the BLM encompass 28 percent (7,189,639 acres) of the land area. These lands are administered by eight BLM administrative units/FOs within western Colorado.

The proposed action consists of water use associated with ongoing and projected activities (except for fluid mineral development), as administered by the BLM in Colorado. The primary activities addressed in this consultation include (but are not limited to): construction of stock ponds, spring developments, wildlife guzzlers, water pipelines, irrigation ditches, and retention dams. For the purpose of this analysis, all surface and groundwater depletions resulting from BLM projects or actions will be considered "depletions of tributary waters" from the Upper Colorado River Basin. The average-annual depletion is the evaporative loss from ponds or the annual diversion minus the annual return flow, averaged over the life of the project (see calculation methods below).

The Service addresses new and historic depletions differently under the section 7 agreement of March 11, 1993. Historic depletions, regardless of size, do not pay a depletion fee, whereas new depletions over 100 AF per year pay the fee, according to the agreement.

It is anticipated that cumulative historic depletion amounts will be substantially less over the next 15 years than they were between 1994 and 2008, since many historic depletions have already been included in BLM's depletion logs. BLM estimates that historic depletions over the next 15 years will be 306.3 AF, which is 30 percent of the historic depletion amount (1,019 AF) from 1994 to 2008.

For the purposes of calculating the amount of water depleted, the following assumptions apply:

- For springs and wells, depletion is 100 percent of the flow rate sustained over the given period of time. If no time period is given, then a one-year period is used.
- For guzzlers, the depletion equals the total amount of water collected.
- For diversions, the depletion equals the total amount of water diverted minus return flow, if any.
- For impoundments, a mean depletion value of 4.25 AF/surface acre is used.

All of the water depletions analyzed in this consultation will occur within the Upper Colorado River Basin, which includes the Colorado River and all of its tributaries above Lake Powell, but this consultation does not include the San Juan River Basin. Within the Upper Colorado River Basin, individual subbasins will be affected to varying degrees. BLM's water depletions by FO between 1994 and 2007 (Table 4) will be used to estimate water depletions over the next 15 years. However, past projects do not dictate where future projects within each FO will occur. In offices where only one river basin is affected (e.g., the Glenwood Springs FO which is located entirely within the Colorado River mainstem watershed), it is easy to discern that all projects within the FO will deplete water from the Colorado River. In FOs where multiple river basins exist (e.g., the Grand Junction FO which encompasses portions of the Colorado, Dolores, and Gunnison River Basins), BLM will use the same percentages as were used in the recently completed fluid minerals PBA.

Estimated Average Annual Water Depletion by Affected River Basin

River Basin FO	% of FO Depletions occurring in the Basin	Depletion Estimate (AF/yr)	Calculation Method
Colorado River Basin			
Glenwood Springs FO	100%	450.3	
Grand Junction FO	96%	195.2	(203.3 AF x 0.96)
Kremmling FO	100%	47.5	
	Total	**693**	
Gunnison River Basin			
Gunnison FO	100%	75.4	
Grand Junction FO	4%	8.1	(203.3 x 0.04)
Uncompahgre FO	85%	128.3	(150.9 x 0.85)
	Total	**211.8**	
Dolores River Basin			
Grand Junction FO	no projects here	0	
San Juan Public Lands	100%	127.6	
Uncompahgre FO	15%	22.6	(150.9 x 0.15)

	Total	**150.2**
Yampa River Basin		
Little Snake FO	100%	361.8
	Total	**361.8**
White River Basin		
White River FO	100%	368.5
	Total	**368.5**
Green River Basin		
Little Snake FO	no projects here	0
Total (all river basins)		**1785.3**

Conservation Measures

Conservation measures are actions that the action agency and applicant agree to implement to minimize negative effects of the action and to further the recovery of the species under review. The beneficial effects of conservation measures were taken into consideration for determining both jeopardy and incidental take analyses. The BLM agrees to incorporate the following conservation measures as a condition of any BLM authorized water-use project (excluding fluid mineral development):

- Spring developments will ensure that riparian areas associated with the spring are maintained and excess water will be allowed to bypass or pass through any troughs or holding tanks.

- Stock ponds will be designed to allow excess water to bypass or pass through the pond.

- As a means of offsetting the impacts associated with the proposed action, the BLM proposes to make annual contributions in the form of a monetary payment to the National Fish and Wildlife Foundation on behalf of the Recovery Program based on the cumulative average annual depletion for all BLM projects statewide. The current amount (FY 09) is $18.29 per AF of the project's average annual depletion. These funds are used by the Upper Colorado River Endangered Fish Recovery Program to contribute to the recovery of endangered fish through habitat restoration, propagation and genetics management, instream flow identification and protection, program management, nonnative fish management, research and monitoring, and public education (UCREFRP 2006).

- Water depletions in the Colorado and Yampa River subbasins have been addressed in previous PBOs. These opinions require water users to sign Recovery Agreements that state that the water users will not interfere with the implementation of recovery actions and the Service will provide ESA compliance. The BLM will ensure Recovery Agreements are signed by project proponents (if other than the BLM).

The BLM state office will track all projects that result in water depletions from the Upper Colorado River Basin. The BLM will complete and submit a log of all water depleting projects by river subbasin to the Service by October 31 of each year.

The following excerpts from the Cooperative Agreement to implement the Recovery Implementation Program for Endangered Fish Species in the Upper Colorado River Basin (USFWS 1987) are pertinent to this consultation because they summarize portions of the Recovery Program that address depletion impacts, section 7 consultation, and project proponent responsibilities:

> All future Section 7 consultations completed after approval and implementation of this program (establishment of the Implementation Committee, provision of congressional funding, and initiation of the elements) will result in a one-time contribution to be paid to the Service by water project proponents in the amount of $10.00 per AF based on the average annual depletion of the project . . . . This figure will be adjusted annually for inflation [the FY 09 figure is $18.29 per AF].

It is important to note that these provisions of the Recovery Program were based on appropriate legal protection of the instream flow needs of the endangered Colorado River fishes. The Recovery Program further states:

> . . . it is necessary to protect and manage sufficient habitat to support self-sustaining populations of these species. One way to accomplish this is to provide long term protection of the habitat by acquiring or appropriating water rights to ensure instream flows . . . . Since this program sets in place a mechanism and a commitment to assure that the instream flows are protected under State law, the Service will consider these elements under section 7 consultation as offsetting project depletion impacts.

Thus, the Service has determined that project depletion impacts can be offset by (a) BLM's contribution to the Recovery Program based on the project's average annual depletion amount, and (b) appropriate legal protection of instream flows pursuant to State law, and accomplishment of activities necessary to recover the endangered fishes as specified under the RIPRAP.

The annual depletion fees will be provided to the Service's designated agent, the National Wildlife Foundation. The funds will be used to support recovery activities for the Colorado River endangered fishes. The fees will be sent to the National Fish and Wildlife Foundation.

National Fish and Wildlife Foundation
Attn: Donna McNamara, Finance Department
1133 15th Street, NW, Suite 1100
Washington, D.C. 20005

The payment will be accompanied by a cover letter that identifies the projects and BO number (ES/GJ-6-CO-08-F-0010) that requires the payment, the amount of payment enclosed, check number, and the following notation on the check – "Upper Colorado Fish Recovery Program,

NA.1104". The cover letter also shall identify the name and address of the name and address of the Federal agency responsible for authorizing the project, and the address of the Service office issuing the BO. This information will be used by the Foundation to notify the BLM and the Service that payment has been received. The Foundation is to send notices of receipt to these entities within 5 working days of its receipt of payment.

STATUS OF THE SPECIES AND CRITICAL HABITAT

Colorado Pikeminnow

The pikeminnow is the largest cyprinid (member of the minnow family, Cyprinidae) native to North America and it evolved as the top predator in the Colorado River system. It is an elongated pike-like fish that once grew as large as 1.8 meters (6 feet) in length and weighed nearly 45 kilograms (100 pounds) (Behnke and Benson 1983); such fish were estimated to be 45-55 years old (Osmundson et al. 1997). Today, fish rarely exceed 1 meter (approximately 3 feet) in length or weigh more than 8 kilograms (18 pounds). The mouth of this species is large and nearly horizontal with long slender pharyngeal teeth (located in the throat), adapted for grasping and holding prey. The diet of pikeminnow longer than 80 to 100 millimeters (3 or 4 inches) consists almost entirely of other fishes (Vanicek and Kramer 1969). Young Colorado pikeminnow feed on insects and plankton. Adults are strongly counter-shaded with a dark, olive back, and a white belly. Young are silvery and usually have a dark, wedge-shaped spot at the base of the caudal fin. The common name for this species was changed from Colorado squawfish by the American Fisheries Society (Nelson et al. 1998).

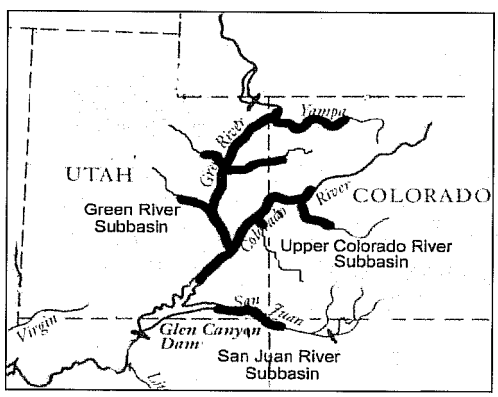
Status and Distribution

Based on early fish collection records, archaeological finds, and other observations, the pikeminnow was once found throughout warm water reaches of the entire Colorado River Basin down to the Gulf of California, including reaches of the Upper Colorado River and its major tributaries, the Green River and its major tributaries, the San Juan River and some of its tributaries, and the Gila River system in Arizona (Seethaler 1978, Platania 1990). Pikeminnow apparently were never found in colder, headwater areas. Seethaler (1978) indicates that the species was abundant in suitable habitat throughout the entire Colorado River Basin prior to the 1850s. By the 1970s they were extirpated from the entire lower basin (downstream of Glen Canyon Dam) and from portions of the upper basin as a result of major alterations to the riverine environment. Having lost approximately 75-80 percent of its former range, the pikeminnow was federally listed as an endangered species in 1967 under the Endangered Species Preservation Act of 1966 (USFWS 1967, Miller 1961, Moyle 1976, Tyus 1991, Osmundson and Burnham 1998).

The Recovery Plan (USFWS 2002a, Table 1) provides a summary of habitat occupied by wild Colorado pikeminnow in the Upper Colorado River Basin and limits to its distribution.

River	Occupied Habitat	Limits to Distribution
Green River Subbasin		
1. Green River	Lodore Canyon to Colorado River confluence (580 km)	Cold releases from Flaming Gorge Dam have been warmed and species has naturally expanded upstream into Lodore Canyon; species distributed continuously downstream to Colorado River confluence
1a. Yampa River	Craig, Colorado, to Green River confluence (227 km)	Present distribution similar to historic
1b. Little Snake River	Wyoming to Yampa River confluence (80 km)	Habitat is marginal; flows are reduced; historic distribution unknown
1c. White River	Taylor Draw Dam to Green River confluence (100 km)	Upstream distribution blocked by Taylor Draw Dam
1d. Price River	Lower 143 km above Green River confluence	Streamflow reduced; barriers occur above current distribution
1e. Duchesne River	Lower 10 km above Green River confluence	Streamflow reduced; barriers occur above current distribution
Upper Colorado River Subbasin		
2. Upper Colorado River	Palisade, Colorado, to Lake Powell inflow (298 km)	Passage by Grand Valley Diversion completed in 1998; Price-Stubb and Government Highline diversion dams restrict upstream distribution; Lake Powell inflow defines downstream distribution
2a. Gunnison River	Lower 54 km above Colorado River confluence	Redlands Fishway allowed passage in 1996; upstream distribution is limited by Hartland Diversion Dam and possibly cold-water releases from the Aspinall Unit
2b. Dolores River	Lower 2 km above Green River confluence	Streamflow altered; no barriers in potential historic habitat
San Juan River Subbasin		
3. San Juan River	Shiprock, New Mexico, to Lake Powell inflow (241 km)	Irrigation diversions block upstream movement; Lake Powell defines downstream distribution

The map below of wild Colorado pikeminnow in the Colorado River Basin was reproduced from the Colorado Pikeminnow Recovery Goals (USFWS 2002a, Figure 1).



Estimates of abundance summed for the three Colorado pikeminnow populations range from about 6,600 to 8,900 wild adults. Estimates of subadults are not currently available for all populations. Estimates of adults for the three subbasins are: Green River, 6,000–8,000; Upper Colorado River, 600–900 [includes some subadults]; and San Juan River, 19–50 (USFWS 2002a).

A more recent report on the status of Colorado pikeminnow in the Green River Basin (Bestgen et al. 2007) presented population estimates for adult (>450 mm total length (TL)) and recruit-sized (400 – 449 mm TL) Colorado pikeminnow. The report suggested that numbers of adult pikeminnow declined in the Green River Basin from 3,300 in 2001 to 2,142 in 2003, a reduction of 35 percent. The 2003 population estimates for Colorado pikeminnow were: Yampa River, 224 adults; White River, 407 adults and zero recruits (approximately 44 recruits were estimated for each year in 2000-2001); mainstem Green River (from the confluence with the Yampa River to the confluence with the Colorado River), 1511 adults and 284 recruits.

The species was extirpated from the Lower Colorado River Basin in the 1970s but has been reintroduced into the Gila River subbasin where it exists in small numbers in the Verde River (USFWS 2002a).

Threats to the Species

Because the pikeminnow was designated as endangered prior to passage of the ESA of 1973, a formal listing package identifying threats was not prepared. The pikeminnow recovery goals (USFWS 2002a) summarize threats to the species as follows: stream regulation, habitat modification, competition with and predation by nonnative fish, and pesticides and pollutants.

Major declines in pikeminnow populations occurred in the Lower Colorado River Basin during the dam-building era of the 1930s through the 1960s. Behnke and Benson (1983) summarized the decline of the natural ecosystem, pointing out that dams, impoundments, and water use practices drastically modified the river's natural hydrology and channel characteristics throughout the Colorado River Basin. Dams on the main stem fragmented the river ecosystem into a series of disjunct segments, blocked native fish migrations, reduced water temperatures downstream of dams, created lake habitat, and provided conditions that allow competitive and predatory nonnative fishes to thrive both within the impounded reservoirs and in the modified river segments that connect them. The highly modified flow regime in the lower basin coupled with the introduction of nonnative fishes decimated populations of native fish.

In the Upper Colorado River Basin, declines in pikeminnow populations occurred primarily after the 1960s, when the following dams were constructed: Glen Canyon Dam on the main stem Colorado River, Flaming Gorge Dam on the Green River, Navajo Dam on the San Juan River, and the Aspinall Unit dams on the Gunnison River. Some native fish populations in the upper basin have managed to persist, while others are nearly extirpated. River reaches where native fish have declined more slowly, more closely resemble pre-dam hydrologic regimes, where adequate habitat for all life phases still exists, and where migration corridors allow connectivity among habitats used during the various life phases.

Stream flow regulation, which includes mainstem dams, cause the following adverse effects to the Colorado pikeminnow and its habitat:

- block migration corridors,
- changes in flow patterns, reduced peak flows and increased base flows,
- release cold water, making temperature regimes less than optimal,
- change river habitat into lake habitat, and
- retain sediment that is important for forming and maintaining backwater habitats

In the Upper Basin, 435 miles of Colorado pikeminnow habitat has been lost by reservoir inundation from Flaming Forge Reservoir on the Green River, Lake Powell on the Colorado River, and Navajo Reservoir on the San Juan River. Cold water releases from these dams have eliminated suitable habitat for native fishes, including Colorado pikeminnow, from river reaches downstream for approximately 50 miles below Flaming Gorge Dam and Navajo Dam. In addition to main stem dams, many dams and water diversion structures occur in and upstream from critical habitat that reduce flows and alter flow patterns, which adversely affect critical habitat. Diversion structures in critical habitat divert fish into canals and pipes where the fish are permanently lost to the river system. It is unknown how many endangered fish are lost in irrigation systems, but in some years, in some river reaches, majority of the river flow is diverted into unscreened canals.

At least 67 species of nonnative fishes have been introduced into the Colorado River Basin during the last 100 years (Tyus et al. 1982, Carlson and Muth 1989, Minckley and Deacon 1991, Tyus and Saunders 1996). Tyus et al. (1982) reported that 42 nonnative fish species have become established in the upper basin, and Minckley (1985) reported that 37 nonnative fish species have become established in the lower basin. Many of these species were intentionally introduced as game or forage fishes, whereas others were unintentionally introduced with game species or passively as bait fish.

Pikeminnow in the Upper Colorado River Basin live with about 20 species of warm-water nonnative fishes (Tyus et al. 1982, Lentsch et al. 1996) that are potential predators, competitors, and vectors for parasites and disease. Researchers believe that nonnative fish species limit the success of pikeminnow recruitment (Bestgen 1997, Bestgen et al. 1997, McAda and Ryel 1999). Osmundson (1987) documented predation by black bullhead (*Ameiurus melas*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), and black crappie (*Pomoxis nigromaculatus*) as a significant mortality factor for young-of-year (YOY) and yearling pikeminnow stocked in riverside ponds along the Upper Colorado River. Adult red shiners (*Cyprinella lutrensis*) are known predators of larval native fish in backwaters of the upper basin (Ruppert et al. 1993). High spatial overlap in habitat use has been documented among young pikeminnow, red shiner, sand shiner (*Notropis stramineus*), and fathead minnow (*Pimephales promelas*). In laboratory experiments on behavioral interactions, Karp and Tyus (1990) observed that red shiner, fathead minnow, and green sunfish shared activity schedules and space with young pikeminnow and exhibited antagonistic behaviors to smaller pikeminnow. They hypothesized that pikeminnow may be at a competitive disadvantage in an environment that is resource limited. Data collected by Osmundson and Kaeding (1991) indicated that during low

water years, nonnative minnows capable of preying on or competing with larval endangered fishes greatly increased in numbers.

Channel catfish (*Ictalurus punctatus*) has been identified as a threat to juvenile, subadult, and adult pikeminnow. Channel catfish were first introduced in the Upper Colorado River Basin in 1892 (Tyus and Nikirk 1990) and are now considered common to abundant throughout much of the upper basin (Tyus et al. 1982, Nelson et al. 1995). The species is one of the most prolific predators in the upper basin and, among the nonnative fishes, is thought to have the greatest adverse effect on endangered fishes due to predation on juveniles and resource overlap with subadults and adults (Hawkins and Nesler 1991, Lentsch et al. 1996, Tyus and Saunders 1996). Predation upon stocked juvenile Colorado pikeminnow by adult channel catfish has been documented in the San Juan River (Jackson 2005). Stocked juvenile and adult pikeminnow that have preyed on channel catfish have died from choking on the pectoral spines (McAda 1983, Pimental et al. 1985, Ryden and Smith 2002, Lapahie 2003). Although mechanical removal (electrofishing, seining) of channel catfish began in 1995, intensive efforts (10 trips/year) did not begin until 2001. Mechanical removal has not yet led to a positive population response in pikeminnow (Davis 2003); however, because the pikeminnow population is so low, documenting a population response would be extremely difficult.

Threats from pesticides and pollutants include accidental spills of petroleum products and hazardous materials; discharge of pollutants from uranium mill tailings; and high selenium concentration in the water and food chain (USFWS 2002a). Accidental spills of hazardous material into critical habitat, particularly when considering water of sufficient quality as a primary constituent element, can cause immediate mortality when lethal toxicity levels are exceeded. Pollutants from uranium mill tailings cause high levels of ammonia that exceed water quality standards. High selenium levels may adversely affect reproduction and recruitment (Stephens et al. 1992; Stephens and Waddell 1998; Osmundson et al. 2000).

Recovery

Colorado pikeminnow will be considered eligible to be reclassified from federally endangered to threatened when naturally self-sustaining populations are being maintained in the following areas (USFWS 2002a):

- ✓ The Green River from its confluence with the Colorado River to its confluence with the Yampa River, the lower 137 miles of the Yampa River, and the lower 150 miles of the White River. The population estimate for the Green River subbasin must exceed 2,600 adults (2,600 is the estimated minimum viable population needed to ensure long-term genetic and demographic viability).

- ✓ The Colorado River from Palisade, Colorado, to Lake Powell. At least 700 adults (number based on inferences about carrying capacity) must be maintained in the Upper Colorado River subbasin.

- ✓ The San Juan River from Lake Powell upstream to the confluence of the Animas River. A target number of 1,000 age-5+ fish (number based on estimated survival of stocked fish and inferences about carrying capacity) must be established through augmentation and/or natural reproduction in the San Juan River subbasin.

This fish species will be eligible for removal from the federal endangered species list when all of the following conditions have been met:

- ✓ Self-sustaining populations exist in the areas of the Green and Colorado Rivers identified above. A self-sustaining population of at least 800 adults must also exist in the San Juan River unless the Colorado River population is maintained above 1,000 adults.

- ✓ A population exists and habitat has been protected either in the Salt River or in the Verde River.

- ✓ The threat of significant "fragmentation" of the population has been removed (fragmentation refers to separation between fish populations caused by geographical distance or by physical barriers).

- ✓ Essential habitats, including primary migration routes, required stream flows and necessary water quality, have been legally protected.

- ✓ Other identifiable threats that could significantly affect the population have been removed.

Life History

The life history phases that appear to be most limiting for pikeminnow populations include spawning, egg hatching, development of larvae, and the first year of life. These phases of pikeminnow development are tied closely to specific habitat requirements. Natural spawning of pikeminnow is initiated on the descending limb of the annual hydrograph as water temperatures approach the range of 16 °C (60.8 °F) to 20 °C (68 °F) (Vanicek and Kramer 1969, Hamman 1981, Haynes et al. 1984, Tyus 1990, McAda and Kaeding 1991). Temperature at initiation of spawning varies by river. In the Green River, spawning begins as temperatures exceed 20-23 °C (68-73 °F); in the Yampa River, 16-23 °C (61-68 °F) (Bestgen et al. 1998); in the Colorado River, 18-22 °C (64-72 °F) (McAda and Kaeding 1991); in the San Juan River temperatures were estimated to be 16-22 °C (61-72 °F). Spawning, both in the hatchery and under natural riverine conditions, generally occurs in a 2-month period between late June and late August. However, sustained high flows during wet years may suppress river temperatures and extend spawning into September (McAda and Kaeding 1991). Conversely, during low flow years, when the water warms earlier, spawning may commence in mid-June.

Temperature also has an effect on egg development and hatching success. In the laboratory, egg development was tested at five temperatures and hatching success was found to be highest at 20 °C (68 °F), and lower at 25 °C (77 °F). Mortality was 100 percent at 5, 10, 15, and 30 °C (41, 50,

59, and 86 °F). In addition, larval abnormalities were twice as high at 25 °C (77 °F) than at 20 °C (68 °F) (Marsh 1985). Experimental tests of temperature preference of yearling (Black and Bulkley 1985a) and adult (Bulkley et al. 1981) pikeminnow indicated that 25 °C (77 °F) was the most preferred temperature for both life phases. Additional experiments indicated that optimum growth of yearlings also occurs at temperatures near 25 °C (77 °F) (Black and Bulkley 1985b). Although no such tests were conducted using adults, the tests with yearlings supported the conclusions of Jobling (1981) that the final thermal preference of 25 °C (77 °F) provides a good indication of optimum growth temperature for all life phases.

Males become sexually mature earlier and at a smaller size than do females, though all are mature by about age 7 and 500 millimeters (20 inches) in length (Vanicek and Kramer 1969, Seethaler 1978, Hamman 1981). Hatchery-reared males became sexually mature at 4 years of age and females at 5 years. After about 10 years of age, female pikeminnow typically grow to larger sizes than males (Osmundson 2002b). Average fecundity of 24, 9-year old females was 77,400 (range, 57,766-113,341) or 55,533 eggs/kg, and average fecundity of 9 ten-year old females was 66,185 (range, 11,977-91,040) or 45,451 eggs/kg (Hamman 1986).

Most information on pikeminnow reproduction has been gathered from spawning sites on the lower 20 miles (12.2 kilometers) of the Yampa River and in Gray Canyon on the Green River (Tyus and McAda 1984, Tyus 1985, Wick et al. 1985, Tyus 1990). Pikeminnow spawn after peak runoff subsides. Spawning is probably triggered by several interacting variables such as day length, temperature, flow level, and perhaps substrate characteristics. Known spawning sites in the Yampa River are characterized by riffles or shallow runs with well-washed coarse substrate (cobble containing relatively deep interstitial voids (for egg deposition)) in association with deep pools or areas of slow non-turbulent flow used as staging areas by adults (Lamarra et al. 1985, Tyus 1990). Recent investigations at a spawning site in the San Juan River by Bliesner and Lamarra (1995) and at one site in the Upper Colorado River (USFWS, unpublished data) indicate a similar association of habitats. The most unique feature at the sites used for spawning, in comparison with otherwise similar sites nearby, is the lack of embeddedness of the cobble substrate and the depth to which the rocks are devoid of fine sediments; this appears consistent at the sites in all three rivers (Lamarra et al. 1985, Bliesner and Lamarra 1995).

Collections of larvae and YOY downstream of known spawning sites in the Green, Yampa, and San Juan Rivers demonstrate that downstream drift of larval pikeminnow occurs following hatching (Haynes et al. 1984, Nesler et al. 1988, Tyus 1990, Tyus and Haines 1991, Platania 1990, Ryden 2003a). Studies on the Green and Colorado Rivers found that YOY used backwaters almost exclusively (Holden 2000). During their first year of life, pikeminnow prefer warm, turbid, relatively deep (averaging 0.4 meters [1.3 feet]) backwater areas of zero velocity (Tyus and Haines 1991). After about 1 year, young are rarely found in such habitats, although juveniles and subadults are often located in large deep backwaters during spring runoff (USFWS, unpublished data; Osmundson and Burnham 1998). Studies indicate that significant recruitment of Colorado pikeminnow may not occur every year, but occurs in episodic intervals of several years (Osmundson and Burnham 1998).

Pikeminnow often migrate considerable distances to spawn in the Green and Yampa Rivers (Miller et al. 1982, Archer et al. 1986, Tyus and McAda 1984, Tyus 1985, Tyus 1990), and similar movement has been noted in the main stem San Juan River. A fish captured and tagged in the San Juan arm of Lake Powell in April 1987, was recaptured in the San Juan River approximately 80 miles upstream in September 1987 (Platania 1990). Ryden and Ahlm (1996) report that a pikeminnow captured at river mile (RM) 74.8 (between Bluff and Mexican Hat) made a 50-60 mile migration during the spawning season in 1994, before returning to within 0.4 river miles of its original capture location. In the Green River system, adult Colorado pikeminnow converge to reproduce at two known spawning areas, Yampa Canyon in the Lower Yampa River and Gray Canyon in the Green River (Tyus and McAda 1984; Tyus 1985; Tyus 1990; Tyus 1991; Irving and Modde 2000). Rates of movement for individuals are not precisely known, but 2 individuals made the approximately 400 km migration from the White River below Taylor Draw Dam to the Yampa River spawning area in less than 2 weeks. Bestgen et al. (2007) state that adults migrate up to 745 river km round-trip to spawning areas in Yampa Canyon and in Desolation–Gray Canyon.

Although migratory behavior has been documented for pikeminnow in the San Juan River (Platania 1990, Ryden and Ahlm 1996), of 13 radio-tagged fish tracked from 1991 to 1994, 12 were classified as sedentary and only one as migratory (Ryden and Ahlm 1996). In contrast to pikeminnow in the Green and Yampa Rivers, the majority of pikeminnow in the San Juan River reside near the area in which they spawn (Ryden and Ahlm 1996, Miller and Ptacek 2000). During their study, Ryden and Ahlm (1996) found that pikeminnow in the San Juan River aggregated at the mouth of the Mancos River prior to spawning, a behavior not documented in other rivers in the Upper Colorado River Basin. Information on radio-tagged adult pikeminnow during the fall suggests that pikeminnow seek out deep water areas in the Colorado River (Miller et al. 1982, Osmundson and Kaeding 1989), as do many other riverine species. Pools, runs, and other deep water areas, especially in upstream reaches, are important winter habitats for pikeminnow (Osmundson et al. 1995).

Very little information is available on the influence of turbidity on the endangered Colorado River fishes. Osmundson and Kaeding (1989) found that turbidity allows use of relatively shallow habitats ostensibly by providing adults with cover; this allows foraging and resting in areas otherwise exposed to avian or terrestrial predators. Tyus and Haines (1991) found that young pikeminnow in the Green River preferred backwaters that were turbid. Clear conditions in these shallow waters might expose young fish to predation from wading birds or exotic, sight-feeding, piscivorous fish. It is unknown whether the river was as turbid historically as it is today. For now, it is assumed that these endemic fishes evolved under conditions of high turbidity. Therefore, the retention of these highly turbid conditions is probably an important factor in maintaining the ability of these fish to compete with nonnatives that may not have evolved under similar conditions.

Critical Habitat

Critical habitat was designated in 1994 within the 100-year floodplain of the Colorado pikeminnow's historical range in the following area of the Upper Colorado River (59 FR 13374).

Colorado pikeminnow now only occur in the Upper Colorado River Basin (upstream of Lee Ferry just below the Glen Canyon Dam). Most of Lake Powell is not suitable habitat for Colorado pikeminnow and is not designated critical habitat. The total designated miles is 1,148 and represents 29 percent of the historical habitat for the species.

- Colorado, Moffat County. The Yampa River and its 100-year floodplain from the State Highway 394 bridge in T. 6 N., R. 91 W., section 1 (6th Principal Meridian) to the confluence with the Green River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian).

- Utah, Uintah, Carbon, Grand, Emery, Wayne, and San Juan Counties; and Colorado, Moffat County. The Green River and its 100-year floodplain from the confluence with the Yampa River in T. 7 N., R. 103 W., section 28 (6th Principal Meridian) to the confluence with the Colorado River in T. 30 S., R. 19 E., section 7 (Salt Lake Meridian).

- Colorado, Rio Blanco County; and Utah, Uintah County. The White River and its 100-year floodplain from Rio Blanco Lake Dam in T. 1 N., R. 96 W., section 6 (6th Principal Meridian) to the confluence with the Green River in T. 9 S., R. 20 E., section 4 (Salt Lake Meridian).

- Colorado, Delta and Mesa Counties. The Gunnison River and its 100-year floodplain from the confluence with the Uncompahgre River in T. 15 S., R. 96 W., section 11 (6th Principal Meridian) to the confluence with the Colorado River in T. 1 S., R. 1 W., section 22 (Ute Meridian).

- Colorado, Mesa and Garfield Counties; and Utah, Grand, San Juan, Wayne, and Garfield Counties. The Colorado River and its 100-year floodplain from the Colorado River Bridge at exit 90 north off Interstate 70 in T. 6 S., R. 93 W., section 16 (6th Principal Meridian) to North Wash, including the Dirty Devil arm of Lake Powell up to the full pool elevation, in T. 33 S., R. 14 E., section 29 (Salt Lake Meridian).

- New Mexico, San Juan County; and Utah, San Juan County. The San Juan River and its 100-year floodplain from the State Route 371 Bridge in T. 29 N., R. 13 W., section 17 (New Mexico Meridian) to Neskahai Canyon in the San Juan arm of Lake Powell in T. 41 S., R. 11 E., section 26 (Salt Lake Meridian) up to the full pool elevation.

The Service identified water, physical habitat, and the biological environment as primary constituent elements of critical habitat. This includes a quantity of water of sufficient quality that is delivered to specific habitats in accordance with a hydrologic regime that is required for the particular life stage for the species. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, which when inundated provide access to spawning, nursery, feeding, and rearing habitats, are included. Food supply, predation, and competition are important elements of the biological environment.

Razorback Sucker

Like all suckers (family *Catostomidae*, meaning "down mouth"), the razorback sucker has a ventral mouth with thick lips covered with papillae and no scales on its head. In general, suckers are bottom browsers, sucking up or scraping off small invertebrates, algae, and organic matter with their fleshy, protrusible lips (Moyle 1976). The razorback sucker is the only sucker with an abrupt sharp-edged dorsal keel behind its head. The keel becomes more massive with age. The head and keel are dark, the back is olive-colored, the sides are brownish or reddish, and the abdomen is yellowish white (Sublette et al. 1990). Adults often exceed 3 kilograms (6 pounds) in weight and 600 millimeters (2 feet) in length. Like pikeminnow, razorback suckers may live 40-plus years. The diet consists primarily of algae, plant debris, and aquatic insect larvae (Sublette et al. 1990).

Status and Distribution

On March 14, 1989, the Service was petitioned to conduct a status review of the razorback sucker. Subsequently, the razorback sucker was designated as endangered under a final rule published on October 23, 1991 (56 FR 54957). The final rule stated "Little evidence of natural recruitment has been found in the past 30 years, and numbers of adult fish captured in the last 10 years demonstrate a downward trend relative to historic abundance. Significant changes have occurred in razorback sucker habitat through diversion and depletion of water, introduction of nonnative fishes, and construction and operation of dams" (56 FR 54957). Recruitment of razorback suckers to the population continues to be a problem.

Historically, razorback suckers were found in the main stem Colorado River and major tributaries in Arizona, California, Colorado, Nevada, New Mexico, Utah, Wyoming, and in Mexico (Ellis 1914; Minckley 1983). Bestgen (1990) reported that this species was once so numerous that it was commonly used as food by early settlers and that a commercially marketable quantity was caught in Arizona as recently as 1949. In the Upper Colorado River Basin, razorback suckers were reported to be very abundant in the Green River near Green River, Utah, in the late 1800s (Jordan 1891). An account in Osmundson and Kaeding (1989) reported that residents living along the Colorado River near Clifton, Colorado, observed several thousand razorback suckers during spring runoff in the 1930s and early 1940s. In the San Juan River drainage, the first razorback sucker from the river was documented in 1988 (Platania 1990); however, Platania and Young (1989) relayed historical accounts of alleged razorback suckers ascending the Animas River to Durango, Colorado, around the turn of the century.

The Recovery Plan (USFWS 2002b, Table 1) provides a summary of habitat occupied by the razorback sucker and limits to its distribution.

River	Occupied Habitat	Limits to Distribution
Green River Subbasin		
Green River	Lodore Canyon to Colorado River confluence (580 km); population being augmented	Cold-water releases from Flaming Gorge Dam previously restricted range, but warmed releases may allow for range expansion
Yampa River	Craig, Colorado, to Green River confluence (227 km)	Present in low numbers in historic habitat
White River	Taylor Draw Dam to Green River confluence (100 km)	Found in low numbers; upstream distribution blocked by Taylor Draw Dam
Duchesne River	Lower 2 km above Green River confluence	Found as small aggregations during spring runoff at mouth
Upper Colorado River Subbasin		
Upper Colorado River	Palisade, Colorado, to Lake Powell inflow (29 8 km); population being augmented	Found in low numbers; passage by Grand Valley Diversion completed in 1998; Price-Stubb and Government Highline diversion dams restrict upstream distribution; Lake Powell inflow defines downstream distribution
Gunnison River	Lower 54 km above Colorado River confluence; population being reestablished through stocking.	Wild population considered extirpated from the river, but fish are being stocked in the lower 54 km above the Colorado River confluence to reestablish the population; Redlands Fishway allows passage since 1996; upstream distribution limited by Hartland Diversion Dam and possibly cold-water releases from the Aspinall Unit
San Juan River Subbasin		
San Juan River	Shiprock, New Mexico, to Lake Powell inflow (241 km); population being reestablished through stocking	Wild population considered extirpated from the river, but fish are being stocked between Shiprock, NM and Lake Powell inflow (241 km) to reestablish the population; diversion structures block upstream movement; Lake Powell defines downstream distribution
Lower Colorado River Subbasin		
Lake Mohave	Potential lake-wide distribution; population being augmented	Found only in reservoir
Lake Mead	Potential lake-wide distribution	Found only in reservoir but may extend upstream into Lower Grand Canyon; cold-water releases from Glen Canyon Dam prevent expansion into Upper Grand Canyon
Lower Colorado River	Lake Havasu to Davis Dam (96 km)	Stocked fish have not remained in Lake Havasu, but have populated the river between the reservoir and Davis Dam; fish spawned and produced larvae in 2000 and 2001
Gila River Subbasin		
Verde River	Limited distribution of hatchery stocks	
Salt River	Limited distribution of hatchery stocks	

The map below of wild or stocked razorback sucker in the Colorado River Basin was reproduced from the Razorback Sucker Recovery Goals (USFWS 2002b, Figure 1).



Currently, the largest concentration of razorback sucker remaining in the Colorado River Basin is in Lake Mohave on the border of Arizona and California. Estimates of the wild stock in Lake Mohave have fallen precipitously in recent years from 60,000 as late as 1991, to 25,000 in 1993 (Marsh 1993; Holden 1994), to about 9,000 in 2000 (USFWS 2002b). Until recently, efforts to introduce young razorback sucker into Lake Mohave have failed because of predation by nonnative species (Minckley et al. 1991, Clarkson et al. 1993; Burke 1994). While limited numbers of razorback suckers persist in other locations in the Lower Colorado River, they are considered rare or incidental and may be continuing to decline.

In the Upper Colorado River Basin, above Glen Canyon Dam, razorback suckers are found in limited numbers in both lentic (lake-like) and riverine environments. Small numbers of razorback suckers have been found in Lake Powell at the mouths of the Dirty Devil, San Juan and Colorado Rivers. The largest populations of razorback suckers in the upper basin are found in the Upper Green and Lower Yampa Rivers (Tyus 1987). Lanigan and Tyus (1989) estimated a population of 948 adults in the Upper Green River. Eight years later, the population was estimated at 524 adults and the population was characterized as stable or declining slowly with some evidence of recruitment (Modde et al. 1996). In the Colorado River, most razorback suckers occur in the Grand Valley area near Grand Junction, Colorado; however, they are increasingly rare. More recent accounts are less encouraging on the status of the razorback sucker in the Upper Colorado River Basin, "Less than 100 wild adults are estimated to still occur in the middle Green River of Utah and Colorado, and wild populations are considered gone from the Gunnison, Colorado, and San Juan Rivers" (UCREFRP 2006).

Scientifically documented records of wild razorback sucker adults in the San Juan River are limited to two fish captured in a riverside pond near Bluff, Utah in 1976, and one fish captured in the river in 1988, also near Bluff (Platania 1990). Large numbers were anecdotally reported from a drained pond near Bluff in 1976, but no specimens were preserved to verify the species. No wild razorback suckers were found during the 7-year research period (1991-1997) on the San Juan River (Holden 1999). However, hatchery-reared razorback sucker, especially fish greater than 350 millimeters (13.8 inches), introduced into the San Juan River in the 1990s have survived and reproduced, as evidenced by recapture data and collection of larval fish (Ryden

2000b). Until 2003, there was very limited evidence indicating natural recruitment to any population of razorback sucker in the Colorado River system (Bestgen 1990, Platania 1990, Platania et al. 1991, Tyus 1987, McCarthy and Minckley 1987, Osmundson and Kaeding 1989, Modde et al. 1996). In 2003, two juvenile (age-2) razorback sucker (9.8 and 10.6 inches) thought to be wild-produced from stocked fish were collected in the Lower San Juan River (Ryden 2004a).

Razorback suckers are being reintroduced into the Colorado, Gunnison, Green, and San Juan Rivers, and lakes Havasu and Mohave; see Baseline for more details.

Recovery

Objective, measurable criteria for recovery of razorback sucker in the Colorado River Basin are presented for each of two recovery units (i.e., the upper basin, including the Green River, Upper Colorado River, and San Juan River subbasins; and the lower basin, including the mainstem and its tributaries from Glen Canyon Dam downstream to the southerly International Boundary with Mexico) because of different recovery or conservation programs and to address unique threats and site-specific management actions/tasks necessary to minimize or remove those threats. Recovery of the species is considered necessary in both the upper and lower basins because of the present status of populations and existing information on razorback sucker biology. Self-sustaining populations will need to be established through augmentation. These recovery criteria will need to be reevaluated and revised after self-sustaining populations are established and there is improved understanding of razorback sucker biology.

Downlisting can occur if, over a 5-year period: (1) genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and **EITHER** in the Upper Colorado River subbasin or the San Juan River subbasin such that — (a) the trend in adult point estimates for each of the two populations does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and (c) each point estimate for each of the two populations exceeds 5,800 adults (5,800 is the estimated minimum viable population needed to ensure long-term genetic and demographic viability); and (2) a genetic refuge is maintained in Lake Mohave of the lower basin recovery unit; and (3) two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit (e.g., mainstem and/or tributaries) such that — (a) the trend in adult point estimates for each population does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and (c) each point estimate for each population exceeds 5,800 adults; and (4) when certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can occur if the same criteria are maintained over a 3-year period beyond downlisting and necessary levels of protection are attained (USFWS 2002b).

Threats to the Species

A marked decline in populations of razorback suckers can be attributed to construction of dams and reservoirs, introduction of nonnative fishes, and removal of large quantities of water from the Colorado River system. Dams on the main stem Colorado River and its major tributaries have fragmented populations and blocked migration routes. Dams also have drastically altered flows, water temperatures, and channel geomorphology. These changes have modified habitats in many areas so that they are no longer suitable for breeding, feeding, or sheltering. Major changes in species composition have occurred due to the introduction of nonnative fishes, many of which have thrived due to man-induced changes to the natural riverine system. Habitat has been significantly degraded to a point where it impairs the essential life history functions of razorback sucker, such as reproduction and recruitment into the adult population. The threats to razorback sucker are essentially the same threats identified for Colorado pikeminnow.

The razorback sucker recovery goals identified streamflow regulation, habitat modification, predation by nonnative fish species, and pesticides and pollutants as the primary threats to the species (USFWS 2002b). Within the Upper Colorado River Basin, recovery efforts include the capture and removal of razorback suckers from all known locations for genetic analyses and development of brood stocks. In the short term, augmentation (stocking) may be the only means to prevent the extirpation of razorback sucker in the Upper Colorado River Basin. However, in the long term it is expected that natural reproduction and recruitment will occur. A genetics management plan and augmentation plan have been written for the razorback sucker (Crist and Ryden 2003, Ryden 2003a).

Many species of nonnative fishes occur in occupied habitat of the razorback sucker. These nonnative fishes are predators, competitors, and vectors of parasites and diseases (Tyus et al. 1982, Lentsch et al. 1996, Pacey and Marsh 1999, Marsh et al. 2001). Many researchers believe that nonnative species are a major cause for the lack of recruitment and that nonnative fish are the most important biological threat to the razorback sucker (e.g., McAda and Wydoski 1980, Minckley 1983, Tyus 1987, Service 1998a, Muth et al. 2000). There are reports of predation of razorback sucker eggs and larvae by common carp (*Cyprinus carpio*), channel catfish, smallmouth bass (*Micropterus dolomieui*), largemouth bass, bluegill (*Lepomis macrochirus*), green sunfish, and red-ear sunfish (*Lepomis microlophus*) (Jonez and Sumner 1954, Marsh and Langhorst 1988, Langhorst 1989). Marsh and Langhorst (1988) found higher growth rates in larval razorback sucker in the absence of predators in Lake Mohave, and Marsh and Brooks (1989) reported that channel catfish and flathead catfish were major predators of stocked razorback sucker in the Gila River. Juvenile razorback sucker stocked in isolated coves along the Colorado River in California suffered extensive predation by channel catfish and largemouth bass (Langhorst 1989). Predation upon a recently-stocked razorback sucker by an adult channel catfish was documented in the San Juan River (Jackson 2005). Aggressive behavior between channel catfish and adult razorback sucker has been inferred from the presence of distinct bite marks on the dorsal keels of four razorback suckers that match the bite characteristics of channel catfish (Ryden 2004a).

Lentsch et al. (1996) identified six species of nonnative fishes in the Upper Colorado River Basin as threats to razorback sucker: red shiner, common carp, sand shiner, fathead minnow, channel catfish, and green sunfish. Smaller fish, such as adult red shiner, are known predators of larval native fish (Ruppert et al. 1993). Large predators, such as walleye (*Stizostedion vitreum*), northern pike, and striped bass (*Morone saxatilis*), also pose a threat to subadult and adult razorback sucker (Tyus and Beard 1990).

Life History

McAda and Wydoski (1980) and Tyus (1987) reported springtime aggregations of razorback suckers in off-channel habitats and tributaries; such aggregations are believed to be associated with reproductive activities. Tyus and Karp (1990) and Osmundson and Kaeding (1991) reported off-channel habitats to be much warmer than the main stem river and that razorback suckers presumably moved to these areas for feeding, resting, sexual maturation, spawning, and other activities associated with their reproductive cycle. Reduction in spring peak flows eliminates or reduces the frequency of inundation of off-channel habitats. The absence of these seasonally flooded riverine habitats is believed to be a limiting factor in the successful recruitment of razorback suckers in their native environment (Tyus and Karp 1989; Osmundson and Kaeding 1991). Wydoski and Wick (1998) identified starvation of larval razorback suckers due to low zooplankton densities in the main channel and loss of floodplain habitats which provide adequate zooplankton densities for larval food as one of the most important factors limiting recruitment. Tyus and Karp (1990) and Modde and Wick (1997) suggested that use of warmer, more productive flooded habitats by adult razorback suckers during the breeding season is related to temperature preferences 23–25 °C (Bulkley and Pimental 1983) and abundance of appropriate foods (Jonez and Sumner 1954; Vanicek 1967; Marsh 1987; Wolz and Shiozawa 1995; Modde 1997; Wydoski and Wick 1998).

While razorback suckers have never been directly observed spawning in turbid riverine environments within the Upper Colorado River Basin, captures of ripe specimens, both males and females, have been recorded in the Yampa, Green, Colorado, and San Juan Rivers (Valdez et al. 1982, McAda and Wydoski 1980, Tyus 1987, Osmundson and Kaeding 1989, Tyus and Karp 1989, Tyus and Karp 1990, Osmundson and Kaeding 1991, Platania 1990, Ryden 2000b, Jackson 2003, Ryden 2005). Sexually mature razorback suckers are generally collected on the ascending limb of the hydrograph from mid-April through June and are associated with coarse gravel substrates. Because of the relatively steep gradient in the San Juan River and lack of a wide flood plain, razorback sucker are likely spawning in low velocity, turbid, main channel habitats. Aggregations of ripe adults have only been documented in a few locations.

Both sexes mature as early as age four (McAda and Wydoski 1980). Fecundity, based on ovarian egg counts, ranges from 75,000-144,000 eggs (Minckley 1983). McAda and Wydoski (1980) reported an average fecundity (N=10) of 46,740 eggs/fish (27,614–76,576). Several males attend each female; no nest is built. The adhesive eggs drift to the bottom and hatch there (Sublette et al. 1990). Marsh (1985) reported that, in laboratory experiments, the percentage of egg hatch was greatest at 20 °C (68 °F) and all embryos died at incubation temperatures of 5, 10, and 30 °C (41, 50, and 86 °F).

Because young and juvenile razorback suckers are rarely encountered, their habitat requirements in the wild are not well known, particularly in native riverine environments. However, it is assumed that low-velocity backwaters and side channels are important for YOY and juveniles, as it is to the early life stages of most riverine fish. Prior to construction of large main stem dams and the suppression of spring peak flows, low velocity, off-channel habitats (seasonally flooded bottomlands and shorelines) were commonly available throughout the Upper Colorado River Basin (Tyus and Karp 1989, Osmundson and Kaeding 1991). Modde (1996) found that on the Green River, larval razorback suckers entered flooded bottomlands that are connected to the main channel during high flow. However, as mentioned earlier, because of the relatively steep gradient of the San Juan River and the lack of a wide flood plain, flooded bottomlands are probably much less important in this system than are other low velocity habitats such as backwaters and secondary channels (Ryden, 2004a).

Spring migrations by adult razorback suckers were associated with spawning in historic accounts (Jordan 1891; Hubbs and Miller 1953; Sigler and Miller 1963; Vanicek 1967) and a variety of local and long-distance movements and habitat-use patterns have been subsequently documented. Spawning migrations (one-way movements of 30.4–106.0 kilometers) observed by Tyus and Karp (1990) included movements between the Ouray and Jensen areas of the Green River and between the Jensen area and the Lower Yampa River. Initial movement of adult razorback suckers to spawning sites was influenced primarily by increases in river discharge and secondarily by increases in water temperature (Tyus and Karp 1990; Modde and Wick 1997; Modde and Irving 1998). Flow and temperature cues may serve to effectively congregate razorback suckers at spawning sites, thus increasing reproductive efficiency and success. Reduction in spring peak flows may hinder the ability of razorback suckers to form spawning aggregations, because spawning cues are reduced (Modde and Irving 1998).

A few domestic-reared razorback suckers released into the wild have exhibited long-distance dispersals. One individual released into the Gunnison River was recaptured 3.5 years later 90 miles up the Green River, having traveled a minimum distance of 228 RMs. Another individual released into the Gunnison River was recaptured 205 RMs downstream in the Colorado River only 6.5 months later (Burdick 2003).

Outside of the spawning season, adult razorback suckers occupy a variety of shoreline and main channel habitats including slow runs, shallow to deep pools, backwaters, eddies, and other relatively slow velocity areas associated with sand substrates (Tyus 1987, Tyus and Karp 1989, Osmundson and Kaeding 1989, Valdez and Masslich 1989, Osmundson and Kaeding 1991, Tyus and Karp 1990).

Critical Habitat

Critical habitat was designated in 1994 within the 100-year floodplain of the razorback sucker's historical range in the following areas of the Upper Colorado River (59 FR 13374). The primary constituent elements are the same as critical habitat for Colorado pikeminnow described previously. We designated 15 reaches of the Colorado River system as critical habitat for the razorback sucker. These reaches total 1,724 miles as measured along the center line of the river

within the subject reaches. The designation represents approximately 49 percent of the historical habitat for the species and includes reaches of the Green, Yampa, Duchesne, Colorado, White, Gunnison and San Juan Rivers.

- The Yampa River and its 100-year floodplain from the mouth of Cross Mountain Canyon (T. 6 N., R. 98 W., section 23, 6th Principal Meridian) to the confluence with the Green River.

- The Green River and its 100-year floodplain from the confluence with the Yampa River to the confluence with the Colorado River.

- The White River and its 100-year floodplain from the boundary of the Uintah and Ouray Indian Reservation at RM 18 (T. 9 S., R. 22 E., section 21, Salt Lake Meridian) to the confluence with the Green River.

- The Duchesne River and its 100-year floodplain from RM 2.5 (T. 4 S., R. 3 E., section 30, Salt Lake Meridian) to the confluence with the Green River.

- The Gunnison River and its 100-year floodplain from the confluence with the Uncompahgre River to Redlands Diversion Dam (T. 1 S., R. 1 W., section 27, Ute Meridian).

- The Colorado River and its 100-year floodplain from Colorado River Bridge in Rifle at exit 90 north off Interstate 70 (T. 6 S., R. 93 W., section 16, 6th Principal Meridian) to full pool elevation, upstream of North Wash, and including the Dirty Devil arm of Lake Powell (T. 33 S., R. 14 E., section 29, Salt Lake Meridian).

- The San Juan River and its 100-year floodplain from the Hogback Diversion (T. 29 N., R. 16 W., section 9, New Mexico Meridian) to the full pool elevation at the mouth of Neskahai Canyon on the San Juan arm of Lake Powell (T. 41 S., R. 11 E., section 26, Salt Lake Meridian).

The primary constituent elements of critical habitat are the same as those described earlier for pikeminnow.

Humpback Chub

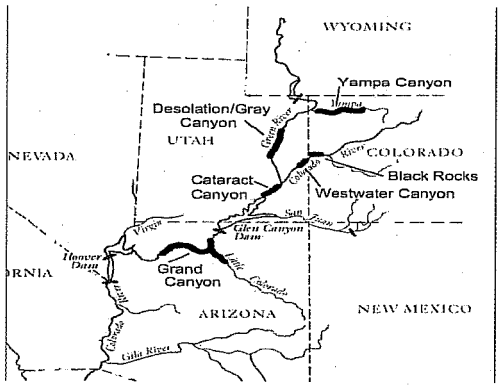
The humpback chub is a medium-sized fish (up to 20 inches) in the minnow family that can live 30 years. The adults have a pronounced dorsal hump, a narrow flattened head, a fleshy snout with an inferior-subterminal mouth, and small eyes. It has silvery sides with a brown or olive colored back.

Status and Distribution

The humpback chub is endemic to the Colorado River Basin. Humpback chub remains have been dated to about 4000 B.C., but the fish was not described as a species until the 1940s (Miller 1946), presumably because of its restricted distribution in remote white water canyons (USFWS 1990a). Because of this, its original distribution is not known. The humpback chub was listed as endangered on March 11, 1967.

Failure to recognize *Gila cypha* as a species until 1946 complicated interpretation of the historic distribution of humpback chubs (Douglas et al. 1989, 1998). Until the 1950s, the humpback chub was known only from Grand Canyon. During surveys in the 1950s and 1960s humpback chub were also found in the Green River (Holden and Stalnaker 1970, Vanicek et al. 1970). Best available information indicates that before Flaming Gorge Dam, humpback chubs were distributed in canyon regions throughout much of the Green River, from the present site of Flaming Gorge Reservoir downstream through Desolation and Gray Canyons (Vanicek 1967, Holden and Stalnaker 1975). Historic collection records of humpback chub also exist from the Yampa and White Rivers (Holden and Stalnaker 1975, Miller et al. 1982b, Sigler and Miller 1963, Tyus 1998) and the Colorado River near Moab (Sigler and Miller 1963).

The map below of the distribution of humpback chub in the Colorado River Basin was reproduced from the Humpback Chub Recovery Goals (USFWS 2002c, Figure 1).



Today the largest populations of this species occur in the Little Colorado and Colorado Rivers in the Grand Canyon, and in Black Rocks and Westwater Canyon in the Upper Colorado River. Other populations have been reported in De Beque Canyon of the Colorado River, Desolation and Gray Canyons of the Green River, Yampa and Whirlpool Canyons in Dinosaur National Monument (USFWS 1990a). One individual was recently captured in the Gunnison River (Burdick 1995).

Monitoring humpback chub populations is ongoing and sampling protocols and reliability of population estimates are being assessed by the Service and cooperating entities. The humpback chub recovery goals (USFWS 2002c) provided the following preliminary population estimates for adults in the six primary populations:

Black Rocks, Colorado River, Colorado -- 900–1,500
Westwater Canyon, Colorado River, Utah -- 2,000–5,000
Yampa Canyon, Yampa River, Colorado -- 400–600
Desolation/Gray Canyons, Green River, Utah -- 1,500
Cataract Canyon, Colorado River, Utah -- 500
Grand Canyon, Colorado River and Little Colorado River, Arizona -- 2,000–4,700

Low numbers of humpback chub have been captured in Whirlpool Canyon and Split Mountain Canyon on the Green River in Dinosaur National Monument; however, these fish were considered part of the Yampa River population in the Recovery Goals (USFWS 2002c), and not separate populations.

Recovery

Recovery goals for the humpback chub (USFWS 2002c) were approved on August 1, 2002. According to these recovery goals, downlisting can be considered if, over a 5-year period:

- ✓ the trend in adult (age 4+; > 200 mm total length) point estimates for each of the six extant populations does not decline significantly; and
- ✓ mean estimated recruitment of age-3 (150–199 mm total length) naturally produced fish equals or exceeds mean annual adult mortality for each of the six extant populations; and
- ✓ two genetically and demographically viable, self-sustaining core populations are maintained, such that each point estimate for each core population exceeds 2,100 adults (2,100 is the estimated minimum viable population needed to ensure long-term genetic and demographic viability); and
- ✓ certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can be considered if, over a 3-year period beyond downlisting:

- ✓ the trend in adult point estimates for each of the six extant populations does not decline significantly; and
- ✓ mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each of the six extant populations; and

- ✓ three genetically and demographically viable, self-sustaining core populations are maintained, such that each point estimate for each core population exceeds 2,100 adults; and

- ✓ certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Threats to the Species

Although historic data are limited, the apparent range-wide decline in humpback chubs is likely due to a combination of factors including alteration of river habitats by reservoir inundation, changes in stream discharge and temperature, competition with and predation by introduced fish species, and other factors such as changes in food resources resulting from stream alterations (USFWS 1990a).

The primary threats to humpback chub are stream flow regulation and habitat modification (affecting constituent elements: water and physical habitat); competition with and predation by nonnative fishes; parasitism; hybridization with other native *Gila* species; and pesticides and pollutants (USFWS 2002c) (all affecting constituent element: biological environment). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. The threats to humpback chub in relation to flow regulation and habitat modification, predation by nonnative fishes, and pesticides and pollutants are essentially the same threats identified for Colorado pikeminnow.

The humpback chub population in the Grand Canyon is threatened by predation from nonnative trout in the Colorado River below Glen Canyon Dam. This population is also threatened by the Asian tapeworm reported in humpback chub in the Little Colorado River (USFWS 2002c). No Asian tapeworms have been reported in the upper basin populations. In the Grand Canyon, brown trout (*Salmo trutta*), channel catfish (*Ictalurus punctatus*), black bullhead (*Ameiurus melas*), and rainbow trout (*Oncorhynchus mykiss*) have been identified as principal predators of juvenile humpback chub, with consumption estimates that suggest loss of complete year classes to predation (Marsh and Douglas 1997; Valdez and Ryel 1997). Valdez and Ryel (1997) also suggested that common carp (*Cyprinus carpio*) could be a significant predator of incubating humpback chub eggs in the Lower Colorado River. In the upper basin, Chart and Lentsch (2000) identified channel catfish as the principal predator of humpback chub in Desolation and Gray Canyons. The Upper Colorado River Recovery Plan identified channel catfish as the principal predator of humpback chub in Yampa Canyon and is pursuing development and implementation of a control program (USFWS 2002c).

Survival rates are extremely low and believed to be less than 1 in 1,000 to 2 years of age. Low water temperatures and predation are believed to be the primary factors. Valdez and Ryel (1995) estimate that 250,000 young humpback chub are consumed by brown trout, rainbow trout, and channel catfish.

Hybridization with roundtail chub (*Gila robusta*) and bonytail, where they occur with humpback chub, is recognized as a threat to humpback chub. A larger proportion of roundtail chub have been found in Black Rocks and Westwater Canyon during low flow years (Kaeding et al. 1990, Chart and Lentsch 2000), which increase the chances for hybridization.

Life History

Unlike Colorado pikeminnow and razorback sucker, which are known to make extended migrations of up to several hundred miles to spawning areas in the Green and Yampa Rivers, humpback chubs in the Green River do not appear to make extensive migrations (Karp and Tyus 1990). Generally, humpback chub show fidelity for canyon reaches and move very little (Miller et al. 1982; Valdez and Clemmer 1982; Archer et al. 1985; Burdick and Kaeding 1985; Kaeding et al. 1990; Chart and Lentsch 1999a; Chart and Lentsch 1999b). Movements of adult humpback chub in Black Rocks on the Colorado River were essentially restricted to a 1-mile reach. These results were based on the recapture of Carlin-tagged fish and radiotelemetry studies conducted from 1979 to 1981 (Valdez et al. 1982) and 1983 to 1989 (Archer et al. 1985; Kaeding et al. 1990). However, a few fish have moved between Black Rocks and Westwater Canyon, a distance of 14 miles (Valdez and Clemmer 1982, Kaeding et al. 1990, Chart and Lentsch 1999a).

Tyus and Karp (1991) found that in the Yampa and Green Rivers in Dinosaur National Monument, humpback chubs spawn during spring and early summer following peak flows at water temperatures of about 20 °C. They estimated that the spawning period for humpback chub ranges from May into July, with spawning occurring earlier in low-flow years and later in high-flow years; spawning was thought to occur only during a 4–5 week period (Karp and Tyus 1990). Similar to the Yampa and Green Rivers, peak hatch of *Gila* larvae in Westwater Canyon on the Colorado River appears to occur on the descending limb of the hydrograph following spring runoff at maximum daily water temperatures of approximately 20 to 21 °C (Chart and Lentsch 1999a). Tyus and Karp (1989) reported that humpback chubs occupy and spawn in and near shoreline eddy habitats and that spring peak flows were important for reproductive success because availability of these habitats is greatest during spring runoff.

High spring flows that simulate the magnitude and timing of the natural hydrograph provide a number of benefits to humpback chubs in the Yampa and Green Rivers. Bankfull and overbank flows provide allochthonous energy input to the system in the form of terrestrial organic matter and insects that are utilized as food. High spring flows clean spawning substrates of fine sediments and provide physical cues for spawning. High flows also form large recirculating eddies used by adult fish. High spring flows (50 percent exceedance or greater) have been implicated in limiting the abundance and reproduction of some nonnative fish species under certain conditions (Chart and Lentsch 1999a, 1999b) and have been correlated with increased recruitment of humpback chubs (Chart and Lentsch 1999b).

In the Green River and Upper Colorado River, humpback chubs spawned in spring and summer as flows declined shortly after the spring peak (Valdez and Clemmer 1982; Valdez et al. 1982; Kaeding and Zimmerman 1983; Tyus and Karp 1989; Karp and Tyus 1990; Chart and Lentsch 1999a, 1999b). Similar spawning patterns were reported from Grand Canyon (Kaeding and

Zimmerman 1983; Valdez and Ryel 1995, 1997). Little is known about spawning habitats and behavior of humpback chub. Although humpback chub are believed to broadcast eggs over mid-channel cobble and gravel bars, spawning in the wild has not been observed for this species. Gorman and Stone (1999) reported that ripe male humpback chubs in the Little Colorado River aggregated in areas of complex habitat structure (i.e., matrix of large boulders and travertine masses combined with chutes, runs, and eddies, 0.5–2.0 meters deep) and were associated with deposits of clean gravel.

Muth et al. (2000) summarized flow and temperature needs of humpback chub in the Green River subbasin as:

> "…The habitat requirements of the humpback chub are incompletely understood. It is known that fish spawn on the descending limb of the spring hydrograph at temperatures greater than 17 °C. Rather than migrate, adults congregate in near-shore eddies during spring and spawn locally. They are believed to be broadcast spawners over gravel and cobble substrates. Young humpback chubs typically use low-velocity shoreline habitats, including eddies and backwaters, that are more prevalent under base-flow conditions. After reaching approximately 40-50 mm TL, juveniles move into deeper and higher-velocity habitats in the main channel.
>
> Increased recruitment of humpback chubs in Desolation and Gray Canyons was correlated with moderate to high water years from 1982 to 1986 and in 1993 and 1995. Long, warm growing seasons, which stimulate fish growth and a low abundance of competing and predatory nonnative fishes also have been implicated as potential factors that increase the survival of young humpback chubs.
>
> High spring flows increase the availability of the large eddy habitats utilized by adult fish. High spring flows also maintain the complex shoreline habitats that are used as nursery habitat by young fish during subsequent base flows. Low-velocity nursery habitats that are used by young fish are warmer and more productive at low base flows."

Newly hatched larvae average 6.3–7.5 millimeters TL (Snyder 1981, Behnke and Benson 1983, Muth 1990), and 1-month-old fish are approximately 20 millimeters long (Hamman 1982). Unlike Colorado pikeminnow and razorback sucker, no evidence exists of long-distance larval drift (Miller and Hubert 1990; Robinson et al. 1998). Upon emergence from spawning gravels, humpback chub larvae remain in the vicinity of bottom surfaces (Marsh 1985) near spawning areas (Chart and Lentsch 1999a).

Backwaters, eddies, and runs have been reported as common capture locations for YOY humpback chub (Valdez and Clemmer 1982). These data indicate that in Black Rocks and Westwater Canyon, young utilize shallow areas. Habitat suitability index curves developed by Valdez et al. (1990) indicate YOY prefer average depths of 2.1 feet with a maximum of 5.1 feet. Average velocities were reported at 0.2 feet per second. In the Grand Canyon, nearly all fish

smaller than 100 millimeters TL were captured near shore, whereas most fish larger than this were captured in offshore habitats (Valdez and Ryel 1995).

Valdez et al. (1982) and Wick et al. (1981) found adult humpback chub in Black Rocks and Westwater Canyons in water averaging 50 feet in depth with a maximum depth of 92 feet. In these localities, humpback chub were associated with large boulders and steep cliffs. Valdez and Ryell (1997) captured or located adults most often in large recirculating eddies.

Critical Habitat

Critical habitat was designated for the humpback chub along seven river reaches totaling 379 miles on March 21, 1994 (59 FR 13374). Designated critical habitat makes up about 28 percent of the species' original range and occurs in both the Upper and Lower Colorado River Basins. Although humpback chub life history and habitat use differs greatly from the other endangered Colorado River fish, the Service determined that the primary constituent elements (water, physical habitat, and biological environment) of their critical habitat were the same. Critical habitat was designated in the following areas:

- The Yampa River within Dinosaur National Monument in Colorado,
- The Green River from its confluence with the Yampa River downstream to the southern boundary of Dinosaur National Monument (including the canyon reaches of Whirlpool and Split Mountain), and the Green River within Desolation and Gray Canyons,
- The Colorado River in Utah from Black Rocks to Fish Ford and from Brown Betty Rapid River to Imperial Canyon, and in Arizona from Nautiloid Canyon to Granite Park.
- The Little Colorado River in Arizona from RM 8 to the confluence with the Colorado River

Yampa Canyon has not been affected by stream flow regulation like Split Mountain, Desolation, and Gray Canyons on the Green River. However, Yampa canyon has recently been invaded by high numbers of smallmouth bass changing the biological environment of critical habitat.

Bonytail

Bonytail are medium-sized fish (up to 22 inches) in the minnow family that can live 50 years. Adult bonytail are gray or olive colored on the back with silvery sides and a white belly. The adult bonytail has an elongated body with a long, thin caudal peduncle. The head is small and compressed compared to the rest of the body. The mouth is slightly overhung by the snout and there is a smooth low hump behind the head that is not as pronounced as the hump on a humpback chub.

Status and Distribution

The bonytail is endemic to the Colorado River Basin and was historically common to abundant in warm-water reaches of larger rivers of the basin from Mexico to Wyoming. The species experienced a dramatic, but poorly documented, decline starting in about 1950, following construction of several mainstem dams, introduction of nonnative fishes, poor land-use practices, and degraded water quality (USFWS 2002d).

The bonytail is the rarest native fish in the Colorado River. Little is known about its specific habitat requirements or cause of decline, because the bonytail was extirpated from most of its historic range prior to extensive fishery surveys. It was listed as endangered on April 23, 1980. Currently, no self-sustaining populations of bonytail are known to exist in the wild, and very few individuals have been caught anywhere within the basin. Since 1977, only 11 wild adults have been reported from the upper basin (Valdez et al. 1994).

Formerly reported as widespread and abundant in mainstem rivers (Jordan and Evermann 1896), its populations have been greatly reduced. Remnant populations presently occur in the wild in low numbers in Lake Mohave and several fish have been captured in Lake Powell and Lake Havasu (USFWS 2002d). The last known riverine area where bonytail were common was the Green River in Dinosaur National Monument, where Vanicek (1967) and Holden and Stalnaker (1970) collected 91 specimens during 1962-1966. From 1977 to 1983, no bonytail were collected from the Colorado or Gunnison Rivers in Colorado or Utah (Wick et al. 1981, Valdez et al. 1982; Miller et al. 1984). However, in 1984, a single bonytail was collected from Black Rocks on the Colorado River (Kaeding et al. 1986). Several suspected bonytail were captured in Cataract Canyon in 1985-1987 (Valdez 1990).

Bonytail were extirpated between Flaming Gorge Dam and the Yampa River, primarily because of rotenone poisoning and cold-water releases from the dam (USFWS 2002c). Surveys from 1964 to 1966 found large numbers of bonytail in the Green River in Dinosaur National Monument downstream of the Yampa River confluence (Vanicek and Kramer 1969). Surveys from 1967 to 1973 found far fewer bonytail (Holden and Stalnaker 1975). Few bonytail have been captured after this period, and the last recorded capture in the Green River was in 1985 (USFWS 2002d). Bonytail are so rare that it is currently not possible to conduct population estimates.

The map below of the recent distribution of wild bonytail in the Colorado River Basin was reproduced from the Bonytail Recovery Goals (USFWS 2002d, Figure 1).



Approximately 130,000 hatchery-produced F_1 and F_2 fish were released into Lake Mohave between 1981 and 1987 as part of an effort by the Service to prevent extinction and promote eventual recovery of the species. Younger bonytail of adult size and spawning ability have been collected from the reservoir in the 1990s along with the old adults of the founder population. It is unknown whether these younger adults are from the original stockings or a result of natural reproduction. Releases of hatchery-reared adults into riverine reaches in the upper basin have resulted in low survival (Chart and Cranney 1991), with no evidence of reproduction or recruitment.

Current stocking plans for bonytail identify the middle Green River and the Yampa River in Dinosaur National Monument as the highest priority for stocking in Colorado and the plan calls for 2,665 fish to be stocked per year over the next six years (Nesler et al. 2003). Between 1998 and 2003, the number of bonytail stocked in the Green River subbasin was 189,438 fish, with the majority of the fish being juveniles at the time of stocking. The only known bonytail that presently occur in the Yampa River are the individuals recently reintroduced at Echo Park, near the confluence with the Green River. In July of 2000 approximately 5,000 juveniles (5 to 10 centimeters) were stocked.

Recovery

Recovery goals for the bonytail (USFWS 2002d) were approved on August 1, 2002. According to these recovery goals, downlisting can be considered if, over a 5-year period:

- ✓ genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and Upper Colorado River subbasin such that (a) the trend in adult (age 4+; > 250 millimeters TL) point estimates for each of the two populations does not decline significantly, and (b) mean estimated recruitment of age-3 (150–249 millimeters TL) naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and (c) each point estimate for each of the two populations exceeds 4,400 adults (4,400 is the estimated minimum viable population needed to ensure long-term genetic and demographic viability); and

- ✓ a genetic refuge is maintained in a suitable location (e.g., Lake Mohave, Lake Havasu) in the lower basin recovery unit; and

- ✓ two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit (e.g., mainstem and/or tributaries) such that (a) the trend in adult point estimates for each population does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and (c) each point estimate for each population exceeds 4,400 adults; and

- ✓ certain site-specific management tasks to minimize or remove threats have been identified, developed, and implemented.

Delisting can be considered if, over a 3-year period beyond downlisting:

- ✓ genetically and demographically viable, self-sustaining populations are maintained in the Green River subbasin and Upper Colorado River subbasin such that (a) the trend in adult point estimates for each of the two populations does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each of the two populations, and (c) each point estimate for each of the two populations exceeds 4,400 adults; and

- ✓ a genetic refuge is maintained in the lower basin recovery unit; and

- ✓ two genetically and demographically viable, self-sustaining populations are maintained in the lower basin recovery unit such that (a) the trend in adult point estimates for each population does not decline significantly, and (b) mean estimated recruitment of age-3 naturally produced fish equals or exceeds mean annual adult mortality for each population, and (c) each point estimate for each population exceeds 4,400 adults; and

- ✓ certain site-specific management tasks to minimize or remove threats have been finalized and implemented, and necessary levels of protection are attained.

Threats to the Species

The primary threats to bonytail are stream flow regulation and habitat modification (affecting constituent elements: water and physical habitat); competition with and predation by nonnative fishes; hybridization with other native *Gila* species; and pesticides and pollutants (USFWS 2002d) (affecting constituent element: biological environment). The existing habitat, altered by these threats, has been modified to the extent that it impairs essential behavior patterns, such as breeding, feeding, and sheltering. The threats to bonytail in relation to flow regulation and habitat modification, predation by nonnative fishes, and pesticides and pollutants are essentially the same threats identified for Colorado pikeminnow. Threats to bonytail in relation to hybridization are essentially the same threats identified for humpback chub.

Life History

The bonytail is considered a species that is adapted to mainstem rivers, where it has been observed in pools and eddies (Vanicek 1967; Minckley 1973). Of five specimens captured most recently in the upper basin, four were captured in deep, swift, rocky canyons (Yampa Canyon, Black Rocks, Cataract Canyon, and Coal Creek Rapid), but the fifth was taken in Lake Powell. Since 1974, all bonytails captured in the lower basin were caught in reservoirs. It has been suggested that the large fins and streamlined body of the bonytail is an adaptation to torrential flows (Miller 1946).

Little is known of the food habits of the bonytail. McDonald and Dotson (1960) reported that "Colorado chub" were largely omnivorous with a diet of terrestrial insects, plant matter, and fish. Several chubs were observed feeding on floating masses of debris washed by heavy rainfall. Vanicek (1967) reported that "Colorado chubs" fed mainly on terrestrial insects (mostly adult beetles and grasshoppers), plant debris, leaves, stems, and woody fragments.

Spawning of bonytail has never been observed in a river, but ripe fish were collected in Dinosaur National Monument during late June and early July suggesting that spawning occurred at water temperatures of about 18 °C (Vanicek and Kramer 1969). Similar to other closely related *Gila* species, bonytail probably spawn in rivers in spring over rocky substrates; spawning has been observed in reservoirs over rocky shoals and shorelines. It has been recently hypothesized that flooded bottomlands may provide important bonytail nursery habitat.

In the Green River, Vanicek (1967) reported that bonytails were generally found in pools and eddies in the absence of, although occasionally adjacent to, strong current and at varying depths generally over silt and silt-boulder substrates. Adult bonytail captured in Cataract, Desolation, and Gray Canyons were sympatric with humpback chub in shoreline eddies among emergent boulders and cobble, and adjacent to swift current (Valdez 1990). The diet of the bonytail is presumed similar to that of the humpback chub (USFWS 2002d).

Although sufficient information on physical processes that affect bonytail habitats was not available to recommend specific flow and temperature regimes in the Green River to benefit this species, Muth et al. (2000) concluded that flow and temperature recommendations made for Colorado pikeminnow, razorback sucker, and humpback chub would presumably benefit bonytail and would not limit their its future recovery potential. The species is being reintroduced into the Colorado, Green, and Yampa Rivers, and into Lake Havasu and Lake Mojave.

Critical Habitat

A total of 499 kilometers (312 miles) of river, representing about 14 percent of the species' historic range, has been designated as critical habitat for the bonytail in the following sections of the Upper Colorado River Basin (59 FR 13374).

- The Yampa River within Dinosaur National Monument in Colorado.
- The Green River (Whirlpool and Split Mountain) from the confluence with the Yampa River to the southern boundary of Dinosaur National Monument.
- The Green River (Desolation and Gray Canyons) from Sumner's Amphitheater in T. 12 S., R. 18 E., section 5 (Salt Lake Meridian) to Swasey's Rapid (RM 12) in T. 20 S., R. 16 E., section 3 (Salt Lake Meridian).
- The Colorado River from Black Rocks (RM 137) in T. 10 S., R. 104 W., section 25 (6th Principal Meridian) to Fish Ford in T. 21 S., R. 24 E., section 35 (Salt Lake Meridian).
- The Colorado River from Brown Betty Rapid in T. 30 S., R. 18 E., section 34 (Salt Lake Meridian) to Imperial Canyon in T. 31 S., R. 17 E., section 28 (Salt Lake Meridian).
- The Colorado River from Hoover Dam to Davis Dam including Lake Mohave up to its full pool elevation.
- The Colorado River from the northern boundary of Havasu National Wildlife Refuge to Parker Dam, including Lake Havasu up to its full pool elevation.

The Service has identified water, physical habitat, and the biological environment as the primary constituent elements of bonytail critical habitat (59 FR 13374). Water includes a quantity of water of sufficient quality delivered to a specific location in accordance with a hydrologic regime required for the particular life stage for each species. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, when inundated, provide access to spawning, nursery, feeding, and rearing habitats. Food supply, predation, and competition are important elements of the biological environment. Recent information collected by the Recovery Program suggests that floodplain habitats may be more important to the survival and recovery of the bonytail than the Service originally thought.

The Green River sections of critical habitat (Whirlpool, Split Mountain, Desolation, and Gray Canyons) have been affected by stream flow regulation. Yampa Canyon flows, on the other hand, have not been affected by upstream dams. However, Yampa Canyon has recently been invaded by high numbers of smallmouth bass changing the biological environment of critical habitat.

ENVIRONMENTAL BASELINE

The environmental baseline includes the past and present impacts of all Federal, State, and private actions and other human activities in the action area; the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal section 7 consultation; and the impact of State or private actions contemporaneous with the consultation process.

The action area is defined at 50 CFR 402 to mean "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the purposes of this consultation, the action area has been defined to include all BLM lands in western Colorado that ultimately drain into the Colorado River, excluding the San Juan River Basin, and those river reaches in Utah that are downstream of these lands (to Lake Powell) that are occupied by any of the four endangered fish species. The environmental baseline will focus on conditions within Colorado where the impacts of water depletions would be greatest. Thus, the environmental baseline will emphasize conditions within the Yampa, White, Colorado (upstream from the Utah border), and Gunnison Rivers, more so than those in the Green River or Utah portion of the Colorado River.

Colorado pikeminnow

The Colorado pikeminnow is a year-round resident of the Yampa and Green Rivers, and occurs seasonally in the Little Snake River (Marsh et al. 1991; Wick et al. 1991). Spawning habitat in the Yampa River below the confluence with the Little Snake River is one of the known spawning sites in the Green River subbasin and has been identified as important habitat for Colorado pikeminnow (Bestgen et al. 1998, Tyus 1990). The estimate of adult Colorado pikeminnow associated with the spawning site in Yampa Canyon in the lower 32 kilometers of the Yampa River is approximately 1,400 fish. The estimate for the Three Fords spawning site in Gray Canyon in the Lower Green River is approximately 1,000 adults (Crowl and Bouwes 1998). Because some Colorado pikeminnow from the Green River migrate into the Yampa River to spawn, the Colorado pikeminnow in the Yampa River are considered part of the Green River subbasin population. The Yampa River spawning area consistently produces more larvae than the spawning area in the Lower Green River (Bestgen et al. 1998).

As stated in the Status of the Species section, more recent data presented by Bestgen et al. (2007) indicates that numbers of adult pikeminnow declined in the Green River Basin from 3,300 in 2001 to 2,142 in 2003, a reduction of 35 percent. According to the authors, it was difficult to ascertain whether the decline was from anthropogenic or natural causes, or some combination of the two. The most recent (2003) population estimate for the Yampa River is 224 adults; no recruits were found in the Yampa River because larvae drift downstream to the Green River for growth and development.
The White River provides 168 river kilometers of quality in-channel habitat that is utilized by adult and juvenile Colorado pikeminnow (Martinez et al. 1994). Although spawning sites are unknown on the White River, some of the highest catch rates for adult Colorado pikeminnow have been from the White River immediately below Taylor Draw Dam near Rangely, Colorado.

Radiotagged adults were found to move out of the White River to spawn in the Green and Yampa Rivers before returning again to the White River (Lentsch et al. 2000). Adult abundance estimates in the White River declined from 1,100 animals in 2000 to 407 animals in 2003 and recruit-sized estimates declined from 45 animals in 2001 to zero in 2003 (Bestgen et al. 2007).

Osmundson and Burnham (1998) estimated the population of adult and subadult Colorado pikeminnow in the Colorado River (from Palisade to the confluence with the Green River) to be 600-650 individuals during 1991-1994. The population estimate for the Colorado River increased to an average of 742 for the next three-year sampling period, 1998-2000 (Osmundson 2002b). Estimates of wild adult (> 450 millimeters) Colorado pikeminnow in the Upper Colorado River (from Palisade, Colorado to Lake Powell) averaged approximately 750 fish during the 2003-2005 surveys (D. Osmundson, Fisheries Biologist, USFWS, unpublished data, 2008). There are no specific population estimates for Colorado pikeminnow in the Gunnison River and no specific population estimates for this species above Palisade on the mainstem Colorado River; few wild pikeminnow are likely to be found in these reaches. However, since fish passage was constructed in 1996 at the Redlands Diversion Dam on the Gunnison River, 81 Colorado pikeminnow have used the passage and reproduction has recently been documented upstream of the fish passage (UCREFRP 2007).

The Colorado River in the Grand Valley area near Grand Junction is occupied year round by Colorado pikeminnow. A 15-mile reach in this section of river between the Grand Valley Diversion and the confluence with the Gunnison River has been identified as important habitat for Colorado pikeminnow. Pikeminnow are known to spawn within this reach and larval pikeminnow have been found within and just downstream of this reach. The 10 miles below this reach are also important and have been classified as a "YOY Nursery Area" by the Basin Biology Subcommittee (USFWS 1984).

The Colorado pikeminnow population has been augmented by stocking both in the Colorado and Gunnison Rivers. The integrated stocking plan (Nesler et al. 2003) calls for 1,125 age 3+ fish to be stocked into each of two river reaches for 8 successive years: 1) Colorado River (Rifle to De Beque Canyon), and 2) Gunnison River (Hartland to Redland dams). During the period from 2000 through 2004, over 2,800 Colorado pikeminnow were stocked into the Upper Colorado River. During 2003-2004, approximately 2,250 Colorado pikeminnow were stocked into the Gunnison River. During 2005 surveys, recaptures of these stocked pikeminnow in both reaches led to an estimate of 185 remaining individuals, or 3.6 percent of those that were stocked (D. Osmundson, Fisheries Biologist, USFWS, pers. comm. 2008). Most, if not all, pikeminnow ultimately moved downstream and out of the Upper Colorado and Gunnison River reaches where they were stocked (D. Osmundson, Fisheries Biologist, USFWS, pers. comm. 2008). Despite the goals of the integrated stocking plan, no further Colorado pikeminnow stocking has taken place since 2004. In the Green River, Colorado pikeminnow were only stocked in 1999 when 36 were released.

Razorback sucker

Prior to 1991, the last confirmed documentation of a razorback sucker juvenile in the upper basin was a capture in the Colorado River near Moab, Utah (Taba et al. 1965). In 1991, two early juvenile razorback suckers were collected in the Lower Green River near Hell Roaring Canyon (Gutermuth et al. 1994). Between 1992 and 1995 larval razorback suckers were collected in the middle and Lower Green River and within the Colorado River inflow to Lake Powell (Muth 1995).

No current population estimates of razorback sucker in the Upper Colorado or Yampa Rivers are available due to low numbers captured in recent years. The Lower Yampa River provides adult habitat, spawning habitat, and potential nursery areas occur downstream in the Green River (USFWS 1998a). Modde and Smith (1995) reported that adult razorback suckers were collected between RM 13 and RM 0.1 of the Yampa River, but just one juvenile. The single fish (389 millimeters) was collected at RM 39 in June 1994. Razorback suckers are rarely found upstream as far as the confluence with the Little Snake River (McAda and Wydoski 1980, Lanigan and Tyus 1989). Tyus and Karp (1990) located concentrations of ripe razorback suckers at the mouth of the Yampa River during the spring in 1987-1989. Ripe fish were captured in runs associated with bars of cobble, gravel, and sand substrates in water averaging 0.63 meters deep and mean velocity of 0.74 meters/second.

Osmundson and Kaeding (1991) reported that the number of razorback sucker captures in the Grand Junction area has declined dramatically since 1974. Between 1984 and 1990, intensive collecting effort captured only 12 individuals in the Grand Valley (Osmundson and Kaeding 1991). In 1991 and 1992, 28 adult razorback suckers were collected from isolated ponds adjacent to the Colorado River near De Beque, Colorado (Burdick 1992). No young razorback suckers have been collected in recent times in the Colorado River. The wild population of razorback sucker is considered extirpated from the Gunnison River (Burdick and Bonar 1997).

The population is being augmented by stocking both in the Colorado and Gunnison Rivers. Nearly 50,000 juvenile, sub-adult, and adult razorback sucker were stocked in both the Upper Colorado (approximately 31,500) and Gunnison (approximately 18,500) Rivers in Colorado between 1994 and 2001. However, despite regular sampling, only 84 of these fish were recaptured 6 months or more following stocking (Burdick 2003). Many of the stocked fish were less than 200 millimeters; Burdick (2003) determined that it may be futile to stock individuals of this size or smaller due to their very low survival rate. Since fish passage was constructed in 1996 at the Redlands Diversion Dam on the Gunnison River (after 80 years of blocked fish passage), 20 Razorback suckers have used the passage and reproduction has recently been documented upstream of the diversion dam (McAda 2003, UCREFRP 2007). Sampling for larval fish was done in the Gunnison River for the first time in 2002; 8 larval razorback suckers were collected that year (Osmundson 2002a), 7 were collected in 2003, and 2 were collected in 2005.

Twenty radiotagged razorback suckers were also stocked in 1994 into historical habitat in the Upper Colorado River between De Beque and Rifle. This is above the Price-Stubb Diversion

Dam near Palisade, which at that time was a barrier to upstream fish passage. Twenty razorback suckers were also stocked into the Gunnison River near Delta in 1994, and five more in 1995. Unfortunately, post-stocking survival for all of these stocked fish was less than anticipated, with mortality possibly as high as 85 percent within approximately one year (Burdick and Bonar 1997).

The integrated stocking plan (Nesler et al. 2003) calls for 3,310 age 2+ fish to be stocked into each of 3 river reaches in Colorado for 6 successive years: 1) Colorado River (Rifle to De Beque Canyon), 2) Colorado River (Palisade to Stateline), and 3) Gunnison River (Hartland to Redland dams). Additionally, 19,860 razorback suckers are to be stocked into the Green River each year, split between the middle and lower reaches.

After the release of the integrated stocking plan (Nesler et al. 2003), the numbers of razorback suckers stocked into each river has been relatively high, although the stocking targets have not always been met. Combining all years from 1995 through 2007, the total number of razorback suckers stocked into each of the main rivers approximately totals: Green River = 75,300; Colorado River = 63,500; Gunnison River = 27,300 (T. Francis, in litt., 2008). Recapture rates of these stocked fish are typically quite low. River-wide and localized sampling efforts from 2000 to 2004 recaptured only approximately 1 percent of the razorback suckers stocked into the Colorado River prior to sampling, and approximately 8 percent of the razorback suckers stocked into the Green River prior to sampling. Some of these razorbacks, however, have persisted and have been captured 4 years after stocking and fish from earlier stocking efforts have been recaptured up to 9 years after stocking (UCREFRP 2006). Additionally, some of these stocked fish have moved long distances; razorbacks stocked in the Green River have been captured in the Colorado River and some stocked in the Gunnison River have been captured in the Green River (UCREFRP 2006). Stocked razorback suckers have also been recaptured or observed in reproductive condition at spawning sites in the Green and San Juan Rivers, larval razorbacks have been captured in the Green, Gunnison, Colorado, and San Juan Rivers, and razorback larvae are surviving through the first year based on the capture of juveniles in the Green and San Juan Rivers (UCREFRP 2007).

Humpback chub

Two populations of humpback chub are found in the Upper Colorado River—Black Rocks, a 1-mile long reach just upstream from the Colorado-Utah state line, and Westwater Canyon, not far below the state line, that is an 18-mile long canyon–bound reach of rapids, deep pools, and violent eddies. The two populations are generally considered to be distinct because they are separated by about 11 miles, but movement between the two populations has been documented (McAda 2003). Chart and Lentsch (1999a) sampled Westwater Canyon during 1993-1996 and estimated the humpback chub population to be 6,985 adults. The average adult population size for Black Rocks during 1998-2000 was estimated to be about 740 individuals (McAda 2002).

Between 1986 and 1989, Karp and Tyus (1990) collected 130 humpback chubs from Yampa Canyon and indicated that a small but reproducing population was present. Continuing captures of juveniles and adults within Dinosaur National Monument indicate that a population persists in

Yampa Canyon (USFWS 2006). Small numbers of humpback chub also have been reported in Cross Mountain Canyon on the Yampa River and in the Little Snake River about 10 kilometers upstream of its confluence with the Yampa River (Wick et al. 1981; Hawkins et al. 1996).

Recent population estimates put the approximate number of humpback chub in the combined Westwater-Black Rocks population at 3,000 adults, Desolation-Gray Canyons at 1,000 adults, and a few hundred adults each in Cataract Canyon and Yampa Canyon populations (UCREFRP 2007).

The integrated stocking plan (Nesler et al. 2003) does not call for any captive rearing or stocking of humpback chub in Utah or Colorado.

Bonytail

The only known bonytail that presently occur in western Colorado are those that have been stocked. Experimental stocking of bonytail began in the Colorado River in 1996 and in the Green River in 1998. Combining all years from 1996 through 2007, the number of bonytail stocked into the Colorado River totals approximately 47,700, and into the Green River the total is approximately 63,800 (T. Francis, in litt., 2008).

Bonytail were also recently reintroduced in the Yampa River at Echo Park, near the confluence with the Green River. In July of 2000 approximately 5,000 juveniles (5 to 10 centimeters) were stocked. The integrated stocking plan (Nesler et al. 2003) calls for 2,665 age 2+ fish to be stocked into each of 5 river reaches for 6 successive years: 1) Colorado River (RM 110.5), 2) Colorado River (Palisade to Loma), 3) Middle Green/Yampa Rivers (Dinosaur N.P.), 4) Middle Green River (RM 302-249), and 5) Lower Green River (RM 120-249). Bonytail stocking has occurred close to or at these levels since that time (Francis 2008).

Relatively few hatchery-produced bonytail have been recaptured from the Green or Colorado Rivers since the integrated stocking plan was implemented. Despite thousands of released fish, only about two dozen bonytail have been recaptured from the Green River (through 2004), and only about three dozen have been recaptured from the Colorado River (through 2004). None of the recaptured bonytail from either river were recaptured more than a full year after stocking (T. Francis, in litt., 2008).

Bestgen et al. (2008) conducted a study in the Upper Green River where 24,422 bonytail were stocked from 2002 through June of 2005. During August and September of 2005, 45 of these bonytail were captured during sampling efforts in the same area. Many had infections or fungus, their appearance and condition was poor, they weighed less than when they were released, and none were in reproductive condition. During subsequent sampling in 2006 and 2007, no bonytail were recaptured in the study area.

Changes in fish passage

Fish passage structures were installed at the Price-Stubb Diversion Dam in the Colorado River above Palisade in the summer of 2008. Fish passage structures and a fish trap had also been installed a few years earlier at the Government Diversion Dam, approximately 5 miles further upstream. Endangered fish may now move upstream beyond Palisade and reach the upper end of critical habitat at Rifle; however, none have been found in the Government Diversion Dam trap to date.

Water depletions and changes in the timing and magnitude of flows

Typical of rivers in the Southwest, the Colorado River and its tributaries were originally characterized by large spring snowmelt peak flows, low summer and winter base flows, and high-magnitude, short-duration summer and fall storm events. However, during the twentieth century, over 140 main-stem and tributary dams and reservoirs have been installed in the Colorado River Basin. As a result, the Colorado River Basin is one of the most tightly controlled water supplies in the world (Bestgen et al. 2007). Peak spring-time flood flows have typically been reduced and late summer-time minimum flows have been elevated resulting in a generally flatter hydrograph.

Major upstream dams altering flows on the Colorado River as it flows through critical habitat include Granby, Dillon, Green Mountain, Williams Fork, and Ruedi. Major upstream dams altering flows through critical habitat on the Gunnison River include Blue Mesa, Morrow Point, Crystal and Taylor Park. Additionally, flows through critical habitat along the Yampa River are affected by reservoirs such as Elkhead, Steamboat, and Stagecoach, and flows through critical habitat along the White River are affected by Taylor Draw Dam. Taylor Draw Dam, installed within the White River itself, also lacks fish passage facilities and is an absolute barrier to any upstream fish movement.

Osmundson and Kaeding (1991) showed that average peak runoff along the Colorado River near Cameo in recent times (1954-1989) had declined by 44 percent from earlier times (1902-1942), which preceded the construction of major dams (but also included a portion of the 20th century that is considered to have been relatively wet). Similarly, Pitlick et al. (1999) found that peak flows on the Gunnison River declined 38 percent after construction of the large Blue Mesa (1966) and Morrow Point (1968) Dams. Average annual flows did not change, however, demonstrating that the change in average peak flow was not due to differing precipitation amounts. Flooding streamflows were reduced over 40 percent in the White River downstream from Taylor Draw Dam, which was constructed in 1984 (Lentsh et al. 2000).

Not only do dams change the timing and magnitude of river flows, but they also allow for trans-mountain water diversions via tunnels through the Continental Divide. There are 19 points where water is diverted out of the Colorado and Gunnison River Basins into the South Platte, Arkansas, and Rio Grand River Basins. Unlike some water diversions where a percentage of return flows can be expected (e.g., irrigation), trans-mountain diversions are forever lost from the Colorado River system. During the 5-year period from 1986-1990, these trans-mountain

diversions ranged from approximately 226,000 to 422,000 AF of water (McAda 2003). In 1986, a reasonably wet year, the trans-mountain diversions were approximately 5 percent of the total water that ultimately flowed out of, or would have flowed out of, the state in the Colorado River. However, in 1989 and 1990, relatively dry years, approximately 12 percent-13 percent of the water entering the Upper Colorado River watershed (above the state-line) was diverted out of the system to Front-Range users. There is also a trans-mountain water diversion from the headwaters of the Little Snake River, a tributary to the Yampa River, where 15,800 AF of water is removed annually to augment the municipal water supply for the City of Cheyenne, Wyoming.

Considering trans-mountain diversions along with other water projects, the Green and Colorado Rivers have been depleted approximately 20 percent (at Green River) and 32 percent (at Cisco), respectively (Holden 1999). In the Yampa River Basin, depletions are estimated to average about 125,000 annually in Colorado and roughly 43,000 AF per year in Wyoming. In total, these depletions represent about 10 percent of the average annual undepleted yield of the Yampa River at its confluence with the Green River (~1.7 MAF). Projections of water demand through the year 2045 indicate that additional depletions will bring the basin-wide total to about 221,000 AF or about 13 percent of the average annual undepleted yield of the Yampa River. And in the White River, annual water depletions amount to between 8 percent and 12 percent, although with return flows, water consumption totals approximately 5 percent (Lentsh et al. 2000).

These depletions have likely contributed to the decline in pikeminnow and razorback sucker populations (USFWS 1998a). To the extent that water is exported out of the basin or consumptively used (e.g., evaporation from fields, irrigation canals, reservoir surface, road surfaces), it is not available to maintain flows within the river. Maintenance of streamflow is essential to the ecological integrity of large western rivers (USFWS 1998a).

Flow Recommendations

Within Colorado, flow recommendations have been developed for reaches within endangered fish critical habitat along the Yampa River (USFWS 2005), three reaches of the Colorado River (Osmundson and Kaeding 1991, Osmundson et al. 1995, Osmundson 2001, McAda 2003), and the Gunnison River (McAda 2003). Flow recommendations have not been completed for the White River. Recommended flows vary by season and by water availability for a given year (e.g., flow recommendations are reduced for drought years). In general, spring flows recommended for dry years provide small peaks used as spawning cues by endangered fish, but contribute little to habitat maintenance; spring flows recommended for average years promote scouring of cobble and gravel bars and provide localized flooding of short duration; and spring flows for wet years promote wide-spread scouring of cobble and gravel bars, flushing of side channels, removal of encroaching vegetation, and inundation of floodplain habitats (McAda 2003).

For the Yampa River, the Service recommends that summer flows not drop below 93 cfs (at Maybell) with any greater frequency, magnitude, or duration than has occurred historically (1916-1995). Historically, flows have dropped below 93 cfs approximately 38 percent of the years of record with an average duration of about 9 days. Winter flows are typically somewhat

higher; these should not drop below 124 cfs beyond what has occurred historically. The Service has established a water augmentation protocol and entered into agreements with other governmental agencies to provide the recommended flows in 90 percent of the years, and partially satisfy the flow recommendation during the driest 10 percent of years. Water from the recently expanded Elkhead Reservoir will be used to meet these goals. Water would be delivered at a rate of 50 cfs until augmented water flow at Maybell surpasses flow recommendations. During drought years, water would be delivered at a rate of 33 cfs (see USFWS 2005 for further details).

For the Palisade-to-Rifle reach along the Colorado River, Osmundson (2001) recommended that base-flow levels be between 1,600 and 2,500 cfs as measured at the USGS gage at Cameo (09095500). However, due to the need to provide the recommended base flows in the 15-mile reach, provide minimum flows through the De Beque Canyon, and allow local diversion canals to continue operating, additional water must pass by the Cameo gage. Given this, the mean monthly recommended base flow levels range as high as 3,280 cfs (above average and wet years during August-October) and as low as 1,555 cfs (dry years during November-March). Mean monthly flows in excess of 3,280 cfs at Cameo during August-March is considered detrimental to endangered fish habitat and Osmundson (2001) recommended that it be stored in upstream reservoirs if possible. Since 2001 when the flow recommendations were established, baseline flows (monthly means) have never exceeded 3,280 cfs (data through 2007-09). However, from 2001-2007, baseline flows fell below 1,555 cfs for at least 1 month in every year except 2006. During the drought of 2002, mean monthly base line flows were below 1,555 every month from August-March, with February, 2003, averaging the lowest flows at 1,073 cfs (USGS Surface-Water Monthly Statistics at http://nwis.waterdata.usgs.gov/co/nwis).

Osmundson (2001) recommended that peak flows at the Cameo gage reach 25,000 cfs during wet years (wettest 25 percent, or 5 in 20 years) and reach 14,400 cfs during dry years (driest 20 percent, or 4 in 20 years). Intermediate peak flows were recommended for years of intermediate precipitation; mean monthly flows for each month were provided as well. Peak flows during wet years should be maintained for at least 3 weeks to give razorback sucker larvae adequate time to feed and grow in flooded bottomlands before being compelled to migrate to the main channel. Since 2001 when the flow recommendations were established, daily mean peak flows at the Cameo gage have ranged from 4,260 cfs, during the drought of 2002, to 22,500 cfs in 2008 (USGS Surface-Water for Colorado: Peak Streamflow and Daily Data at http://nwis.waterdata.usgs.gov/co/nwis).

As stated previously, one of the most important reaches within the Colorado River for Colorado pikeminnow and razorback sucker is the 15-mile reach within the Grand Valley. It has experienced major agricultural water depletions for many years and during late summer and early fall this reach can be severely dewatered. Water depletions in the 15-mile reach have been identified as a limiting factor for Colorado pikeminnow. Osmundson et al. (1995) provided recommendations for summer flows through the 15-mile reach. They state that in years with above average winter precipitation levels, a flow of 1,630 cfs is recommended for summer months. In years of somewhat below average precipitation, when the ideal flow of 1,630 cfs would be difficult to meet, the recommendation could be relaxed to 1,240 cfs. In years of

drought (20 percent lowest precipitation years), when even 1,240 cfs would be difficult to meet, flows should not fall below 810 cfs. The assumption and hope is that at this low level the fish that remain in the reach can wait out the dry period until more favorable conditions return with the end of the irrigation season. Mean monthly flows have, nevertheless, dropped below 810 cfs for at least one of the summer-time months during 7 of the last 17 years (1991-2007). The lowest monthly mean occurred during the drought of 2002 when only 115 cfs flowed through the 15-mile reach in August of that year (USGS Surface-Water Monthly Statistics at http://nwis.waterdata.usgs.gov/co/nwis).

Numerous approaches are being taken to restore flows in the 15-mile reach immediately upstream of from the confluence of the Gunnison River to levels recommended by the Service. The Bureau of Reclamation has made available 5,000 AF of water annually plus an additional 5,000 AF in four of every five years from Ruedi Reservoir to augment flows in the 15-mile reach during July, August, and September. In addition, water is available from the lease of 10,825 AF/year of water from Ruedi Reservoir and permanent commitment of 10,825 AF/year from East and West slope water users. The East and West slope commitments were secured in 2000 by a Memoranda of Agreement (MOA) with the Colorado River Water Conservation District (CRWCD) and Denver Water for delivery of 5,412 AF of water from Wolford Mountain Reservoir and 5,412 AF from Williams Fork Reservoir, respectively. By 2009, CRWCD and Denver Water will have a plan in place to permanently replace the water now being delivered by Wolford and Williams Fork reservoirs. Additional water is being provided through an MOA with CRWCD for delivery of up to 6,000 AF of water from Wolford Mountain Reservoir.

Osmundson and Kaeding (1991) stated that the availability of good winter habitat has probably not been a limiting factor for adult Colorado pikeminnow or razorback sucker in the Upper Colorado River. Unlike spring flows, recent (1954-1989) mean monthly winter flows have increased to approximately 112 percent to 134 percent of historic flows (1902-1942). It is not apparent that these increased winter flows have had any negative effects on the endangered fishes. Given this, Osmundson and Kaeding (1991) recommended that mean monthly winter flows through the 15-mile reach simply not drop below historic levels, averaging approximately 1,470 cfs. From 1996 through 2006 mean monthly winter flows have averaged higher than historic levels, with flows dropping somewhat below historic flows on occasion (USGS Surface-Water Monthly Statistics at http://nwis.waterdata.usgs.gov/co/nwis).

Flow recommendations during spring run-off call for high spring flows that are critical for shaping the river channel, determining substrate composition, and influencing the abundance of various species for the remainder of the year. Recommended peak flows (1-day average) in the 15-mile reach are: 1) 20,500 to 23,500 cfs in at least 1 of 4 years, 2) greater than 23,500 cfs in at least 1 of 4 years, and 3) 14,800 cfs to 20,500 cfs to occur no more often than 2 of 4 years. See Osmundson and Kaeding (1991) for more details, including state-line peak flow and 15-mile reach mean monthly flow recommendations. Osmundson et al. (1995) updated the minimum recommended peak flows to be greater than 12,900 cfs rather than 14,800 in 2 of 4 years. Since the publication of the spring flow recommendations in 1991, peak 1-day average flows through the 15-mile reach have been below 12,900 cfs approximately one third of the years through 2006

and these targets have not been met (USGS Surface-Water for Colorado: Peak Streamflow at http://nwis.waterdata.usgs.gov/co/nwis).

Peak flow recommendations for the Colorado River at the USGS gage near the Colorado-Utah state line (09163500) were provided by McAda (2003). Flow recommendations vary by hydrologic category; summarized excerpts are presented here. During wet years, instantaneous peak flow should fall between 39,300 and 69,800 cfs, should exceed 35,000 cfs for 30-35 days, and should exceed 18,500 cfs for 80-100 days. During dry years, instantaneous peak flows should range between 5000-12,100 cfs. Intermediate peak flows are recommended for the four hydrologic categories between wet and dry. From 2003-2006, peak flows have ranged between 9,450-31,000 cfs (USGS Surface-Water for Colorado: Peak Streamflow at http://nwis.waterdata.usgs.gov/co/nwis).

Baseflow recommendations for the Colorado River at the USGS gage near the Colorado-Utah state line (09163500) were also provided by McAda (2003). The base-flow period begins after spring runoff is completed and continues through initiation of spring runoff the following year. A minimum flow of 3,000-6,000 cfs should be maintained at the state-line USGS gage (09152500) in wet years. During dry years, flows should remain above 1,800 cfs, which will make backwaters available for young-of-the-year Colorado pikeminnow, although not at a maximum number or surface area. Intermediate base flow levels are recommended for the four hydrologic categories between wet and dry. From 2003 to 2008, flows at this gage dropped below 1,800 cfs in 2003 and 2004 (USGS Surface-Water for Colorado: Daily Data at http://nwis.waterdata.usgs.gov/co/nwis)

Flow recommendations for the Gunnison River apply to the USGS gage at Whitewater (09152500), which is within critical habitat for the Colorado pikeminnow and razorback sucker. Detailed flow recommendations can be found in McAda (2003); summarized excerpts are presented here. During wet years, peak flow should fall between 15,000 and 23,000 cfs for 1 day, should exceed 14,350 cfs for 15–25 days, and should exceed 8,070 cfs for 60-100 days. During dry years, flows should peak between 900-4,000 cfs for a day. Intermediate peak flows are recommended for the four hydrologic categories between wet and dry. From 2003-2006, peak flows have ranged between 3,790-12,300 cfs (USGS Surface-Water for Colorado: Peak Streamflow at http://nwis.waterdata.usgs.gov/co/nwis).

Similarly, baseflow recommendations for the Gunnison River are provided by McAda (2003). A minimum flow of at least 1,050 cfs should be maintained at the USGS gage (09152500) in all but dry and moderately dry years. This flow maximizes the amount of pool habitat in the Gunnison River, which is preferred by adult Colorado pikeminnow and razorback sucker. Also, flows exceeding 950 cfs prevent fine sediments from settling in riffles, which might smother eggs and larvae of endangered fishes. Additionally, flow of 1,050 cfs roughly corresponds to providing a minimum of 300 cfs downstream from Redlands Diversion Dam (based on senior water rights of 750 cfs) and provides access for migrating fish to the fishway there. During dry and moderately dry years, flows may decrease below 1,050 cfs after the Colorado pikeminnow migration period and only after consultation with Service biologists. The 2.5-mile reach downstream from Redlands Diversion Dam could experience severe dewatering at this level and endangered fish

may be forced to leave this reach of critical habitat. From 2003 to 2008, flows at this gage have dropped below 1050 cfs in 3 of the 6 years (USGS Surface-Water for Colorado: Daily Data at http://nwis.waterdata.usgs.gov/co/nwis)

Official flow recommendations have not been finalized for critical habitat along the White River, which was designated for the Colorado pikeminnow. However, Haines et al. (2004) made a preliminary recommendation that base flow patterns remain at current levels in order to maintain habitat for the Colorado pikeminnow. They stated that between 1923-1997, baseflow (August through October) discharge in the White River has only dropped below 200 cfs 5 percent of the time at the USGS Watson Gage (09306500), and below 150 cfs 1 percent of the time. They found that to provide for fish passage over riffles, flows greater than 300 cfs are apparently needed. To maintain riffle productivity during base flow periods, flows of 400-500 cfs are needed, and if flows fall below 161 cfs, riffle habitat declines rapidly. From 1985 to 2007, mean monthly flows at the Watson gage have occasionally fallen below 200 cfs, with the lowest monthly mean occurring during July of 2002 at 73 cfs (USGS Surface-Water: Monthly Statistics at http://nwis.waterdata.usgs.gov/nwis).

EFFECTS OF THE ACTION

Effects to Endangered Species

The project would adversely affect Colorado pikeminnow, razorback sucker, humpback chub, and bonytail by reducing the amount of water in the river systems upon which they depend accumulating to the following approximate amounts over the next 15 years (estimate):

Colorado River Basin	693 AF/year	Yampa River Basin	362 AF/year
Gunnison River Basin	212 AF/year	White River Basin	369 AF/year
Dolores River Basin	150 AF/year	Green River in Colorado	zero

The effects to the species primarily result from the effects of the action upon their habitats. In general, the proposed action would adversely affect the listed fishes by reducing the amount of water available to them, increasing the likelihood of water quality issues, increasing their vulnerability to predation, and reducing their breeding opportunities by shrinking the amount of breeding habitat within their range.

Removing water from these rivers would change the natural hydrological regime that creates and maintains important fish habitats, such as spawning habitats, and reduces the frequency and duration of availability of these habitats to the endangered fishes. The reduction of available habitats will directly affect individuals by decreasing reproductive potential and foraging and sheltering opportunities. Many of the habitats required for breeding become severely diminished when flows are reduced. As a result, individual fish within the action area may not be able to find a place to breed or will deposit eggs in less than optimal habitats more prone to failure or predation. In addition, reduction in flow rates lessens the ability of the river to inundate bottomland, a source of nutrient supply for fish productivity. Water depletions also exacerbate

competition and predation by nonnative fishes by altering flow and temperature regimes that favor nonnatives.

The proposed project would affect the physical condition of habitat for the listed fish by resulting in a reduction of water. Because the timing of the proposed water-use projects is not restricted, water use for these activities is expected to occur throughout all seasons. However, in general the primary challenge in meeting recommended flows for endangered fish comes during spring run-off and late summer periods of low flow. Water use during the spring months would contribute to the cumulative reduction in high spring flows, which are essential for creating and maintaining complex channel geomorphology and suitable spawning substrates, creating and providing access to off-channel habitats, and stimulating spawning migrations. Adequate summer and winter flows are important for providing a sufficient quantity of preferred habitats for duration and at a frequency necessary to support all life stages of these endangered fishes. To the extent that the project will reduce flows, particularly peak flows in wet years and baseline flows in dry years, the ability of the river to provide these functions will be reduced. This reduction of water affects habitat availability and habitat quality.

To the extent that it would reduce flows and contribute to further habitat alteration, the project may contribute to an increase in nonnative fish populations. The modification of flow regimes, water temperatures, sediment levels, and other habitat conditions caused by water depletions has contributed to the establishment of nonnative fishes. Endangered fishes within the action area are likely to experience increased competition and predation as a result.

The potential exists for water intake or diversion structures placed on any of the occupied river reaches including the Colorado, Green, Gunnison, White, and Yampa Rivers to result in direct mortality to eggs, larvae, young-of-the-year, and juvenile life stages. Endangered larval fish are very small (<0.5 inches total length) and incapable of directed swimming from the time of hatching through the first 2-4 weeks of their life. Depending on the water year, larval fish may be present in occupied habitats from as early as April 1 to as late as August 31 (earlier in dry years, later in wet years). Young of the year endangered fish are most susceptible to entrainment from pumping water directly out of occupied river drainages. However, entrainment of larval and young fish of any of the four endangered species is not expected to be a common occurrence. Most or all spawning sites in the Yampa River are protected within Dinosaur National Monument. Along the Colorado River, spawning sites within the 15-mile reach and rearing locations downstream to Loma are mostly bordered by non-BLM lands; thus, it is unlikely that many, if any, water intake structures would be placed in these areas for BLM projects. Spawning has not been documented for any of the endangered fishes within the White River, and very little spawning is currently taking place in the Gunnison River. Beyond the simple act of removing water, any physical changes to spawning sites or other habitat occupied by any of the endangered fish for BLM projects would require separate section 7 consultation and would not fall under the umbrella of this PBO.

Effects to Critical Habitat

The Service identified water, physical habitat, and the biological environment as primary constituent elements of critical habitat. This includes a quantity of water of sufficient quality that is delivered to specific habitats in accordance with a hydrologic regime that is required for the particular life stage for the species. The physical habitat includes areas of the Colorado River system that are inhabited or potentially habitable for use in spawning and feeding, as a nursery, or serve as corridors between these areas. In addition, oxbows, backwaters, and other areas in the 100-year floodplain, which when inundated provide access to spawning, nursery, feeding, and rearing habitats, are included. Food supply, predation, and competition are important elements of the biological environment.

Water Quantity & Physical Habitat

Water depletions cause discrete, identifiable, additive, adverse impacts to critical habitat of the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail. The proposed action would result in new depletions of water from critical habitats for one or more of these four endangered fish species along the Colorado, Gunnison, White, Green, and Yampa Rivers. The depletions are likely to reduce the quantity of water delivered to specific habitats important for particular life stages of these species.

Water Quality

This BO is limited to addressing depletions of water quantity; however, changes in water quantity affect water quality, which is a primary constituent element of critical habitat. Most projects covered by this opinion would remove water before it enters downstream river segments where the fish currently reside, therefore, depletions could reduce the dilution effect provided by this relatively clean water. This may result in an increase in heavy metal, selenium, salts, polycyclic aromatic hydrocarbons, pesticides, and other contaminant concentrations in the Colorado River and its main-stem tributaries (USFWS 1999). An increase in contaminant concentrations in the river would likely result in an increase in the bioaccumulation of these contaminants in the food chain which could adversely affect the endangered fishes, particularly the predatory Colorado pikeminnow. Selenium may be of particular concern due to its effects on fish reproduction and its tendency to concentrate in low velocity areas that are important habitats for Colorado pikeminnow and razorback suckers. Selenium concentrations are most worrisome in the Gunnison River and the Colorado River below its confluence with the Gunnison River due to return irrigation flows (Osmundson et al. 2000). The Recovery Program is intended to offset some water quality impacts associated with flow reductions (USFWS 1987). These impacts include changes in temperature, salinity and turbidity, as well as the reduced dilution factor associated with depletions. However, the Recovery Program is not intended to offset any point or nonpoint discharges of pollutants, such discharges will have to be offset or avoided by other means. This would include discharges of irrigation water with elevated levels of selenium.

Biological Environment

The modification of flow regimes, water temperatures, sediment levels, and other habitat alterations caused by water depletions has likely contributed to the establishment of nonnative fishes. To the extent that it would reduce flows and contribute to further habitat alteration, the project may contribute to an increase in nonnative fish populations. Endangered fishes could experience increased competition and predation as a result.

Species and Critical Habitat Response to the Proposed Action

In most cases, the project would not substantially impact the ability for the flow recommendations through critical habitat to be met. In the Yampa River, the Service has developed an augmentation protocol to meet base-flow (summer-fall-winter) recommendations with water releases from upstream reservoirs (USFWS 2005). The anticipated 362 AF/year of water depleted from the Yampa River for this project would equate to approximately 1 AF/day. As stated above, most water use for BLM projects would likely be withdrawn on a year-round basis. An average of 1 AF/day equates to an approximate reduction in river flows of 0.5 cfs (base-flows typically remain above 100 cfs). The augmentation protocol, which would provide 50 cfs of water (33 cfs during drought conditions), should be able to meet base flow recommendations in the Yampa River despite the 0.5 cfs of water consumed for anticipated BLM projects during base-flow months.

During spring peak flows, however, the augmentation protocol does not call for reservoir releases to meet specified target flows. Therefore, water depletions from this project during peak flows (May-June) would likely lessen peak flows through critical habitat by 0.5 cfs. Nevertheless, given that peak flows through critical habitat (near Maybell) are typically 5,000 to 20,000 cfs (USGS Surface-Water for Colorado: Peak Streamflow at http://nwis.waterdata.usgs.gov/co/nwis), this relatively small flow reduction would likely not change any of the important effects of flood flows (e.g., cobble bar construction; scouring of fine sediment from the interstitial spaces within the cobble so it is suitable for spawning; flushing sediments from backwaters; maintaining channel complexity; overbank flows to provide nursery habitat; spawning initiation). Therefore, the depletions caused by the proposed project, with implementation of the augmentation protocol to meet flow recommendations, are not expected to impact the survival or recovery of the endangered fish in the Yampa River.

The anticipated 693 AF/year of water that would be depleted from the Colorado River for this project equates to an approximate reduction in river flows of 1 cfs. As with the Yampa River, agreements have been made to provide water for endangered fish in the Colorado River. A multi-party agreement involving the Grand Valley Irrigation Company, Grand Valley Power Plant, Orchard Mesa Irrigation District and Grand Valley Water Users Association and Bureau of Reclamation was reached that has made up to 30,000 AF of water available to endangered fish each year. The water will be used to boost flows in the Colorado River in the 15-mile reach between Palisade and the Gunnison River confluence. In addition, the Bureau of Reclamation has made 31,650 AF of water available for release from Ruedi Reservoir to increase flows in this same part of the Colorado River. Although recommended flows through endangered fish critical

habitat along the Colorado River have not always been achieved in the past, agreements are in place to provide the recommended water. Additionally, even if the water consumed by the projects' activities was not replaced by upstream dam releases, the reduction in flows of 1 cfs likely would not result in a large reduction in the suitability of endangered fish habitat in the Colorado River. A flow of 1 cfs represents about one tenth of one percent of the smallest recommended flow in the Colorado River—flows through the 15-mile reach during a dry year should be at least 810 cfs. Recommended flows in other seasons and through other segments of the Colorado River (state-line and Palisade-to-Rifle) are all larger; thus, 1 cfs is an even smaller percentage of those recommended flows.

Approximately 212 AF/year is projected to be depleted from the Gunnison River for project activities. This equates to a reduction of approximately 0.3 cfs in river flows, a very small proportion of actual flows. A flow of 0.3 cfs represents one tenth of one percent of the smallest recommended flow in the Gunnison River—base flows during a dry year are recommended to be at least 1050 cfs above the Redlands Diversion Dam, which would result in flows of at least 300 cfs below the Diversion Dam (0.3 cfs is 0.1 percent of 300 cfs). Additionally, the provision of adequate flows for endangered fish in the Gunnison River is taking place as part of the Aspinall Unit consultation, which involves Bureau of Reclamation re-operation of the Aspinall Unit, affecting instream flows in the Gunnison River.

According to the BA for this project, no BLM water projects are planned or projected for the Colorado portion of the Green River Basin, which drains the extreme northwest corner of Colorado.

In the Dolores River Basin, 23 AF/year is projected to be depleted for BLM projects. This equates to a reduction in flows of approximately 0.03 cfs. To attempt to put this in perspective, the lowest mean monthly flows for the Dolores River near its confluence with the Colorado River (USGS Gage 09180000 near Cisco) occur November through February and range from 140 cfs to 165 cfs, on average (averaged from 2000 through 2007; USGS Surface-Water: Monthly Statistics at http://waterdata.usgs.gov/nwis). A flow reduction of 0.03 cfs would reduce a flow of 140 cfs by less than one tenth of one percent. Although Colorado pikeminnow may use the lower 2 kilometers of the Dolores River (USFWS 2002a), no other endangered fish are documented to use the Dolores River (USFWS 2002b, 2002c, 2002d) and the Dolores River was not included in the designation of critical habitat for any of the four endangered fish in the Upper Colorado River Basin.

In the White River Basin, 369 AF/year is projected to be depleted for BLM projects. This equates to an average reduction in flows of approximately 0.5 cfs throughout the year, similar to the depletions projected for the Yampa River. Although the White River is not known to be used regularly by the other endangered fish, it is important to the Colorado pikeminnow. As stated above, official flow recommendations have not been established for pikeminnow critical habitat along the White River. However, traditional baseflows have remained above 150 cfs in 99 percent of the years since 1923 (Haines et al. 2004). A flow of 0.5 cfs is approximately 0.3 percent of 150 cfs. A flow reduction of 0.5 cfs would have less of an effect on spring flood flows as it would be a much smaller portion of the overall flow at that time (less than one tenth of one percent), which typically peaks between 1500 cfs and 8000 cfs near Watson, Utah (USGS Surface water for Utah: Peak Streamflow at http://nwis.waterdata.usgs.gov/ut/nwis/peak).

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Reasonably foreseeable future activities that may affect river-related resources in the area include oil and gas exploration and development, irrigation, urban development, industrial development, recreational activities such as angling, and activities associated with the Recovery Program. Implementation of these projects may affect both water quantity and quality.

Cumulative effects to these endangered fish species would likely include the following types of impacts:

- Changes in land use patterns that would further fragment, modify, or destroy potential spawning sites or designated critical habitat;
- Shoreline recreational activities and encroachment of human development that would remove upland or riparian/wetland vegetation and potentially degrade water quality;
- Competition with, and predation by, exotic fish species introduced by anglers or other sources.
- Non-Federal fluid mineral development. Various reasonable foreseeable development scenarios project that 880 wells to access private minerals may be drilled annually during the next 15 years in western Colorado (excluding the San Juan River Basin). The drilling and production of these private minerals are estimated to require 1,052 AF/year from the primary basins draining this area.
- Water depletions for activities other than fluid mineral development, including the construction of ponds, reservoirs, ditches, and water diversion structures for activities such as irrigation, stock watering, power production, municipal use, and industrial needs.

The development and extraction of oil from oil shale in northwestern Colorado could also require large amounts of water. However, the quantity of water that would be required is unknown at this time and the extraction of oil from shale rock has not yet been shown to be economically viable. Thus, this activity cannot be considered reasonably certain to occur, at least not over the 15-year life-span of this BO.

CONCLUSION

After reviewing the current status of the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the Project, as described in this BO, is not likely to jeopardize the continued existence of the Colorado pikeminnow, razorback sucker, humpback chub, or bonytail and the proposed project is not likely to destroy or adversely modify designated critical habitat for any of these fish. This conclusion is based, in part, on the project description which includes the payment of depletion fees by the BLM. These fees help to offset the effects of the water depletions by supporting the Recovery Program in implementing recovery actions as outlined in the RIPRAP. Additionally, the depletions associated with the proposed action are a small portion of the flows in each of the respective rivers and are not of sufficient magnitude that they would jeopardize the survival and recovery of the listed fish, nor adversely modify their critical habitat.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury of listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Colorado pikeminnow, humpback chub, bonytail, and razorback sucker are harmed from the reduction of water in their habitats resulting from the project in the following manner--1) habitat conditions may be rendered unsuitable for breeding because reduced flows would impact habitat formulation and maintenance as described in the biological opinion, 2) habitat conditions may be rendered unsuitable for nursery, feeding, and rearing habitats due to a reduced inundation of oxbows, backwaters, and other areas in the 100-year floodplain, 3) baseflow habitat conditions may be compromised due to a reduction in available habitat and potentially higher water temperatures, and 4) individuals using habitats diminished by the proposed water depletions could be more susceptible to predation and competition from nonnative fish;

Estimating the number of individuals of these species that would be taken as a result of water depletions is difficult to quantify for the following reasons--1) determining whether an individual forwent breeding as a result of water depletions versus natural causes would be extremely difficult; 2) finding a dead or injured listed fish would be difficult, due to the large size of the

project area and because carcasses are subject to scavenging; 3) natural fluctuations in river flows and species abundance may mask project effects; and 4) effects that reduce fecundity are difficult to detect or quantify.

According to Service policy, as stated in the Endangered Species Consultation Handbook (Handbook)(USFWS 1998b), some detectable measure of effect should be provided, such as the relative occurrence of the species or a surrogate species in the local community, or amount of habitat used by the species, to serve as a measure for take. Take also may be expressed as a change in habitat characteristics affecting the species, such as water quality or flow (Handbook, pp 4-47). Because estimating the number of individuals of the four listed fishes that could be taken by the water depletions addressed in this BO is difficult for the reasons stated above, we have developed a surrogate measure to estimate the amount of anticipate take to listed fish in the form of harm. The surrogate we are using is the reduction of water that would occur from the proposed action. We exempt all take in the form of harm that would occur from the depletion of water from the occupied habitats listed above. Water depletions above the amounts addressed in this BO would exceed the anticipated level of incidental take and are not exempt from the prohibitions of section 9 of the ESA.

The implementation of the Recovery Program is intended to minimize impacts of water depletions and, therefore, the actions implemented by the Recovery Program serve as reasonable and prudent measures for minimizing the take that results from this project's water depletions. Any amount of water withdrawal above this level would exceed the anticipated level of incidental take.

REINITIATION NOTICE

This concludes formal consultation on the proposed project. As provided in 50 CFR sec. 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded, 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion, or 4) a new species is listed or critical habitat designated that may be affected by the action.

The RIPRAP is expected to result in a positive population response for the four endangered fishes in the Upper Colorado River Basin. If a positive population response for any of these species is not realized, as measured by the criteria outlined in the RIPRAP, this would be considered new information that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion. Therefore, reinitiation of section 7 consultation would be required for all projects dependent on the Recovery Program, including this project.

Projects that fall under the umbrella of the Colorado River PBO have the following specific reinitiation criteria.

a. The amount or extent of take specified in the incidental take statement for the Colorado River PBO is exceeded. The Service has determined that no incidental take, including harm, is anticipated to occur as a result of the depletions contemplated in this opinion because of the implementation of recovery actions. The implementation of the recovery actions contained in the Colorado River PBO will further decrease the likelihood of any take caused by depletion impacts.

b. New information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in the Colorado River PBO. In preparing the Colorado River PBO, the Service describes the positive and negative effects of the action it anticipates and considered in the section of the opinion entitled "Effects of the Action." New information would include, but is not limited to, not achieving a "positive response" or a significant decline in population, as described in Appendix D of the Colorado River PBO. Significant decline shall mean a decline in excess of normal variations in population. The current population estimate of adult Colorado pikeminnow in the Colorado River is 600 individuals, with a confidence interval of ± 250. Therefore, with the criteria established in Appendix D of the Colorado River PBO, a negative population response would trigger reinitiation if the population declined to 350 adults. The Service has developed recovery goals for the four endangered fishes (USFWS 2002a-d). If a population meets or exceeds the numeric goal for that species, it will be considered to exhibit a positive response. The Service retains the authority to determine whether a significant decline in population has occurred, but will consult with the Recovery Program's Biology Committee prior to making its determination. In the event of a significant population decline, the Service is to first rely on the Recovery Program to take actions to correct the decline. If nonflow recovery actions have not been implemented, the Service will assess the impacts of not completing these actions prior to reexamining any flow related issues.

New information would also include the lack of a positive population response by the year 2015 or when new depletions reach 50,000 AF/year. According to the criteria outlined in Appendix D of the Colorado River PBO, a positive response would require the adult Colorado pikeminnow population estimate to be 1,100 individuals (±250) in the Colorado River (Rifle, Colorado to the confluence with the Green River). When the population estimate increases above 1,100, a new population baseline is established at the higher population level.

c. The Recovery Action Plan actions listed as part of the proposed action in the Colorado River PBO are not implemented within the required time frames. This would be considered a change in the action subject to consultation; section 7 regulations (50 CFR 402.16 (c)) state that reinitiation of consultation is required if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the BO. The Recovery Action Plan is an adaptive management plan because additional information, changing priorities, and the development of the States' entitlement may require modification of the Recovery Action Plan. Therefore, the Recovery Action Plan is reviewed annually and updated and

changed when necessary and the required time frames include changes in timing approved by means of the normal procedures of the Recovery Program, as explained in the description of the proposed action. In 2003 and every 2 years thereafter, for the life of the Recovery Program, the Service and Recovery Program will review implementation of the Recovery Action Plan actions to determine timely compliance with applicable schedules.

d. The Service lists new species or designates new or additional critical habitat, where the level or pattern of depletions covered under the Colorado River PBO may have an adverse impact on the newly listed species or habitat. If the species or habitat may be adversely affected by depletions, the Service will reinitiate consultation on the Colorado River PBO as required by its section 7 regulations. The Service will first determine whether the Recovery Program can avoid such impact or can be amended to avoid the likelihood of jeopardy and/or adverse modification of critical habitat for such depletion impacts. If the Recovery Program can avoid the likelihood of jeopardy and/or adverse modification of critical habitat no additional recovery actions for individual projects would be required, if the avoidance actions are already included in the Recovery Action Plan. If the Recovery Program is not likely to avoid the likelihood of jeopardy and/or adverse modification of critical habitat then the Service will reinitiate consultation and develop reasonable and prudent alternatives/measures, as appropriate.

For purposes of any future reinitiation of consultation, depletions have been divided into two categories.

Category 1:

a) existing depletions, both Federal and non-Federal as described in the Colorado River PBO project description, from the Upper Colorado River Basin above the confluence with the Gunnison River that had actually occurred on or before September 30, 1995 (average annual depletion of approximately 1 million AF/year);

b) depletions associated with the total 154,645 AF/year volume of Green Mountain Reservoir, including power pool (which includes but is not limited to all of the 20,000 AF contract pool and historic user's pool), the Colorado Big-Thompson replacement pool; and

c) depletions associated with Ruedi Reservoir including Round I sales of 7,850 AF, Round II sales of 6,135 AF/year as discussed in the Service's BO to Reclamation dated May 26, 1995, and as amended on January 6, 1999, and the Fryingpan Arkansas Project replacement pool as governed by the operating principles for Ruedi Reservoir but excluding 21,650 AF of the marketable yield.

Category 1 depletions shall remain as Category 1 depletions regardless of any subsequent change, exchange, or abandonment of the water rights resulting in such depletions. Category 1 depletions associated with existing facilities may be transferred to other facilities and remain in Category 1 so long as there is no increase in the amount of total depletions attributable to existing depletions. However, section 7 consultation is still required for Category 1 depletion projects when a new Federal action occurs which may affect endangered species except as provided by the criteria established for individual consultation under the umbrella of the Colorado River PBO. Reinitiation of this consultation will be required if the water users fail to provide 10,825 AF/year on a permanent basis.

Category 2:

Category 2 is defined as all new depletions up to 120,000 AF/year, this includes all depletions not included in Category 1 that occur after 1995 regardless of whether section 7 consultation has been completed. This category is further divided into two 60,000 AF/year blocks of depletions.

The recovery actions are intended to avoid the likelihood of jeopardy and/or adverse modification of critical habitat and to result in a positive response as described in Appendix D of the Colorado River PBO for both 60,000 AF blocks of depletions in Category 2. However, prior to depletions occurring in the second block, the Service will review the Recovery Program's progress and adequacy of the species response to the Recovery Action Plan actions. According to the criteria outlined in Appendix D of the Colorado River PBO, a positive response would require the adult Colorado pikeminnow population estimate to be maintained at approximately 1,100 individuals in the Colorado River (Rifle, Colorado to the confluence with the Green River), unless the criteria in Appendix D of the Colorado River PBO is changed because of new information. If the adult Colorado pikeminnow population is maintained at approximately 1,100 adults or whatever is determined to be the recovery goal in the Colorado River, a new population baseline would be established to determine a positive or negative population response.

When population estimates for wild adult humpback chub are finalized, they will also be used to determine population response. As outlined in Appendix D of the Colorado River PBO, Colorado pikeminnow and humpback chub population estimates will serve as surrogates for razorback sucker and bonytail to assess the status of their populations for 10 years. Recovery goals for all four species were completed August 1, 2002 (USFWS 2002a-d). If a population meets or exceeds the numeric goal for that species, it will be considered to exhibit a positive response. However, short of reaching a specific recovery goal, trends in certain population indices provide an interim assessment of a species' progress toward recovery. This review will begin when actual depletion levels from the first depletion block reach 50,000 AF/year or the year 2015, whichever comes first.

Calculation of actual depletions is to be accomplished using Cameo gage records and State Division of Water Resources data (Appendix B of the Colorado River PBO). The

review will include a determination if all the recovery actions have been satisfactorily completed, that all ongoing recovery actions are continuing, and the status of the endangered fish species. If it is determined that the recovery actions have all been completed and the status of all four endangered fish species has improved (based on criteria in Appendix D of the Colorado River PBO), then the Service intends that the Colorado River PBO would remain in effect for new depletions up to 120,000 AF/year (total of both 60,000 AF blocks of Category 2 depletions).

Monitoring, as explained in Appendix D of the Colorado River PBO, will be ongoing to determine if a population estimate of 1,100 (± one confidence interval) adult Colorado pikeminnow is maintained. If it is not maintained, this would be considered new information and section 7 would have to be reinitiated. Population baselines will be adjusted as population estimates change. If the adult Colorado pikeminnow population estimates increase, a new population baseline will be established to determine a positive or negative population response. If the population estimate for Colorado pikeminnow in the year 2015 is greater than 1,100 adults, then the higher number will be used to establish a new population baseline. These numeric values may be revised as new information becomes available. Revisions will be made to Appendix D of the Colorado River PBO as needed.

If the 50,000 acre-foot or 2015 review indicates that either the recovery actions have not been completed or the status of all four fish species has not sufficiently improved, the Service intends to reinitiate consultation on the Recovery Program to specify additional measures to be taken by the Recovery Program to avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletions associated with the second 60,000 AF/year block. Any additional measures will be evaluated every 5 years. If other measures are determined by the Service or the Recovery Program to be needed for recovery prior to the review, they can be added to the Recovery Action Plan according to standard procedures, outlined in that plan. If the Recovery Program is unable to complete those actions which the Service has determined to be required for the second 60,000 AF/year, consultation on projects with a Federal nexus may be reinitiated in accordance with ESA regulations and this opinion's reinitiation requirements. The Service may also reinitiate consultation on the Recovery Program if fish populations do not improve according to the criteria in Appendix D of the Colorado River PBO or if any positive response achieved prior to the 50,000 acre-foot or the year 2015 is not maintained. Once a positive response is achieved, failure to maintain it will be considered a negative response.

If the Service reinitiates consultation, it will first provide information on the status of the species and recommendations for improving population numbers to the Recovery Program. The Service will reinitiate consultation with individual projects only if the Recovery Program does not implement recovery actions to improve the status of the listed fish species. The Service will reinitiate consultation first on Category 2 projects and second on Category 1 projects. The Service will only reinitiate consultations on Category 1 depletions if Category 2 depletion impacts are offset to the full extent of the

capability of the covered projects as determined by the Service, and the likelihood of jeopardy to the listed fishes and/or adverse modification of critical habitat still cannot be avoided. The Service intends to reinitiate consultations simultaneously on all depletions within the applicable category.

Projects that fall under the umbrella of the Yampa River PBO have the following specific reinitiation criteria.

1. The amount or extent of take specified in the incidental take statement for that opinion is exceeded. The implementation of the recovery actions contained in that opinion will further decrease the likelihood of take caused by water depletion impacts.

2. New information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion. In preparing this opinion, the Service describes the positive and negative effects of the action it anticipates and considered in the section of the opinion entitled "EFFECTS OF THE ACTION." New information would include, but is not limited to, not achieving one or more response criteria that will be developed as part of the terms and conditions to minimize incidental take. The Service retains the authority to determine whether a significant decline in population has occurred, but will consult with the Recovery Program's Biology Committee prior to making its determination. In the event that one or more population criteria have not been achieved, the Service is to first rely on the Recovery Program to take timely actions to correct the deficiency.

3. The section 7 regulations (50 CFR 402.16 (c)) state that reinitiation of consultation is required if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the BO. It would be considered a change in the action subject to consultation if the Recovery Action Plan items listed as part of the proposed action (Green River Action Plan: Yampa and Little Snake Rivers) in the Yampa BO are not implemented within the required timeframes. Also, the analysis for that biological opinion assumed implementation of the Green River Mainstem Action Plan of the RIPRAP because the Colorado pikeminnow and razorback sucker that occur in the Yampa River use the Green River and are considered one population. The essential elements of the Green River Plan are as follows: 1) provide and protect instream flows; 2) restore floodplain habitat; 3) reduce impacts of nonnative fishes; 4) augment or restore populations; and 5) monitor populations and conduct research to support recovery actions. The analysis for the non-jeopardy determination of the Yampa Plan that includes about 53,000 AF/year of new water depletions from the Yampa River Basin relies on the Recovery Program to provide and protect flows on the Green River. Specifically, the analysis for that BO assumed operation of Flaming Gorge Dam to meet the flow recommendations according to the Record of Decision on the Flaming Gorge Dam Operations environmental impact statement (EIS).

   The Service recognizes that the RIPRAP is an adaptive management plan that is modified according to additional information and changing priorities. The plan is reviewed

annually and updated when necessary. The required timeframes include changes in timing approved by means of normal procedures of the Recovery Program. In 2006, and every 2 years thereafter, for the life of the Recovery Program, the Service and the Recovery Program will review implementation of the RIPRAP actions to determine timely compliance with applicable schedules.

Also, the analysis for that BO assumed impacts to peak flows based on anticipated future uses of water, if water is used in a substantially different timing regime that adversely affects endangered fishes in a way not considered in that opinion, then reinitiation of consultation is required. The Recovery Program will monitor all new water projects that deplete more than 100 AF/year to determine their impacts to peak flows on the Yampa River. In addition, the Recovery Program will monitor projects individually depleting 100 AF/year or less in cumulative increments of 3,000 AF/year to determine their impacts to peak flows.

4. The Service lists new species or designates new or additional critical habitat, where the level or pattern of depletions covered under this opinion may have an adverse impact on the newly listed species or habitat. If the species or habitat may be adversely affected by depletions, the Service will reinitiate consultation on the PBO as required by its section 7 regulations. The Service will first determine whether the Recovery Program can avoid such impact or can be amended to avoid the likelihood of jeopardy and/or adverse modification of critical habitat for such depletion impacts. If the Recovery Program can avoid the likelihood of jeopardy and/or adverse modification of critical habitat no additional recovery actions for individual projects would be required, if the avoidance actions are included in the Recovery Action Plan. If the Recovery Program is not likely to avoid the likelihood of jeopardy and/or adverse modification of critical habitat then the Service will reinitiate consultation and develop reasonable and prudent alternatives.

If the annual assessment indicates that either the recovery actions specified in the Yampa and Colorado River opinions have not been completed or that the status of all four fish species has not sufficiently improved, the Service intends to reinitiate consultation on these opinions to specify additional measures to be taken by the Recovery Program to avoid the likelihood of jeopardy and/or adverse modification of critical habitat for depletions. If other measures are determined by the Service or the Recovery Program to be needed for recovery prior to the review, they can be added to the Recovery Action Plan according to standard procedures, outlined in that plan. If the Recovery Program is unable to complete those actions which the Service has determined to be required, consultation on projects with a Federal nexus may be reinitiated in accordance with ESA regulations and those opinion's reinitiation requirements. The Service may also reinitiate consultation on the Recovery Program if fish populations do not improve according to the population response criteria to be developed within one year of the issuance of the biological opinion on the Program. Failure to maintain a positive response, whenever achieved, will be considered a negative response and subject to reinitiation.

If the Service reinitiates consultation, it will first provide information on the status of the species and recommendations for improving population numbers to the Recovery Program. Only if the

Recovery Program does not implement recovery actions to improve the status of the species, will the Service reinitiate consultation with individual projects. The Service intends to reinitiate consultations simultaneously on all depletions.

All individual consultations conducted under the Yampa and Colorado River PBOs contain language requesting the applicable Federal agency to retain sufficient authority to reinitiate consultation should reinitiation become necessary. The BLM will retain regulatory authority over the activities they include in this consultation.

Thank you for your cooperation in this consultation and your interest in conserving endangered species.

CClayton:BLMsSmallDepletionsFPBO#08-010.doc:022509

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DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS-R6-ES-2009-0037]
[92210-1117-0000-B4]

Endangered and Threatened Wildlife and Plants; 12-month Finding on a Petition To Revise Critical Habitat for Eriogonum pelinophilum (Clay-Loving Wild Buckwheat)

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Notice of 12-month petition finding.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), announce our 12-month finding on a petition to revise critical habitat for Eriogonum pelinophilum (clay-loving wild buckwheat) under the Endangered Species Act of 1973, as amended (Act). After a thorough review of all available scientific and commercial information, we find that revisions to critical habitat for E. pelinophilum are warranted but precluded by other priorities. Given this finding, we intend to initiate rulemaking when we complete the higher priorities and we have the necessary resources to do so.

DATES: The finding announced in this document was made on September 29, 2009.

ADDRESSES: This finding is available on the Internet at http://www.regulations.gov. Supporting documentation we used to prepare this finding is available for public inspection, by appointment during normal business hours at the U.S. Fish and Wildlife Service, Western Colorado Ecological Services Office, 764 Horizon Drive, Building B, Grand Junction, CO 81506-3946, by telephone at 970-243-2778; or by facsimile at 970-245-6933.

FOR FURTHER INFORMATION CONTACT: Patty Gelatt, Acting Western Colorado Supervisor, Fish and Wildlife Service, Western Colorado Ecological Services Office, 764 Horizon Drive, Building B, Grand Junction, CO 81506-3946, by telephone at 970-243-2778; or by facsimile at 970-245-6933. Persons who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 800-877-8339. Please include ``Eriogonum pelinophilum scientific information'' in the subject line for faxes and emails.

SUPPLEMENTARY INFORMATION: Section 4(b)(3)(D)(ii) of the Act (16 U.S.C. 1531 et seq.) requires that, for any petition containing substantial scientific and commercial information that indicates revisions to critical habitat may be warranted, we make a finding within 12 months of the date of receipt of the petition and publish a notice in the Federal Register indicating how we intend to proceed with the requested revision.

Background

Previous Federal Actions

We proposed to list Eriogonum pelinophilum as an endangered species in 1983, and we proposed critical habitat at the same time (48 FR 28504; June 22, 1983). We published the final rule designating the species as endangered in 1984, along with a final critical habitat designation (49 FR 28562; July 13, 1984). Critical habitat, as designated in 1984, encompassed 119.8 acres (ac) (48.5 hectares (ha)), which was then the entire known range of the species (49 FR 28562; July 13, 1984).

On July 24, 2006, we received a petition dated July 17, 2006, from the Center for Native Ecosystems, the Colorado Native Plant Society, and the Uncompahgre Valley Association (collectively referred to here

as the petitioners) requesting that we amend the critical habitat designation for Eriogonum pelinophilum (Center for Native Ecosystems et al. 2006, p. 1). The petition clearly identified itself as a petition and included the requisite identification information that 50 CFR 424.14(a) requires. The petition contained a species and habitat description for E. pelinophilum, a description of previous Federal actions, a section addressing statutory requirements for E. pelinophilum, a description of the various populations and their status, a section addressing threats to E. pelinophilum, and recommendations regarding critical habitat for the species. Potential threats discussed in the petition include destruction and modification of habitat, herbivory, and inadequate regulatory mechanisms.

On September 29, 2006, we acknowledged the receipt of the petition but stated that given staff and budget limitations we could not work on the administrative finding at that time (Service 2006, in litt.). On November 13, 2006, we received a letter dated November 9, 2006, from the petitioners notifying us of their 60-day intent to sue for our failure to make a 90-day finding for Eriogonum pelinophilum (Center for Native Ecosystems 2006, in litt.). On March 3, 2008, the petitioners filed suit with the United States District Court for the District of Colorado for our failure to make a 90-day finding for the species (Center for Native Ecosystems 2008). On September 25, 2008, a settlement agreement was reached whereby the Service agreed to submit a 90-day finding to the Federal Register by June 15, 2009, and, if the petition was considered substantial, submit a 12-month finding to the Federal Register by September 21, 2009 (U.S. Department of Justice 2008). This 12-month finding evaluates the status of existing critical habitat as stipulated in the settlement.

We published our 90-day finding regarding the petition to revise critical habitat for Eriogonum pelinophilum on June 22, 2009 (74 FR 29456). We determined the petition presented substantial information indicating that revising critical habitat for E. pelinophilum under the Act may be warranted, thus initiating this 12-month finding (74 FR 29456; June 22, 2009). We have fully considered all information received in response to information requested in our 90-day finding.

This 12-month finding discusses only those topics directly relevant to the revisions of existing critical habitat for Eriogonum pelinophilum. We also are in the process of preparing a 5-year review for E. pelinophilum where we are conducting a more thorough review of the species' status (73 FR 58261; October 6, 2008).

Species Information

Eriogonum pelinophilum was first collected near Hotchkiss, Colorado, in Delta County in 1958 (Reveal 2006, p. 1). The species was first recognized as its own taxon in 1969, and officially described in 1973 (Reveal 1969, pp. 75-76; 1973, pp. 120-122). No other locations were identified until 1984 (Colorado Natural Areas Program (CNAP) 1986, p. 1).

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Eriogonum pelinophilum is a low growing, rounded, densely branched subshrub in the buckwheat family (Polygonaceae). It has dark green inrolled leaves that appear needlelike, and clusters of white to cream colored flowers with greenish-red to brownish-red bases and veins at the end of the branches.

The life history of Eriogonum pelinophilum has been examined in two short-term demography studies that track a plant population's change in size and structure through time. The first study was conducted on Bureau of Land Management (BLM) lands at the Fairview Research Natural Area in 1987 and 1988 (CNAP 1986; 1987). The second study was conducted at the Wacker Ranch where life history information was gathered in 1990, 1992, 1993, and 1994 (Carpenter and Schulz 1994), and again in 2008 (Lyon 2008). Neither of these studies occurred over sufficient time periods nor were they conducted frequently enough to calculate critical life history stages for E. pelinophilum's success. In addition, neither study has enough demographic detail to assist in the development of a population viability model. However, both studies do add to our understanding of the species' longevity, habitat, and site differences, as described in the following two paragraphs.

The CNAP life history study for Eriogonum pelinophilum established four permanent monitoring plots, two plots at Fairview North and two plots 4 miles (mi) (6 kilometers (km)) south at Fairview South, and tagged 220 plants (CNAP 1987, p. 1). Significant differences in aerial cover, flowering rate, and vigor of E. pelinophilum between plots (CNAP 1987, p. 3) suggest site characteristics may influence plant characteristics such as abundance and size. Artemisia nova (black sagebrush) was the dominant species by basal area in most plots, but E. pelinophilum had the greatest density and frequency (CNAP 1987, p. 8). E. pelinophilum occurred in the highest densities away from other shrubs (CNAP 1987, p. 8).

Mortality from 1990 to 1994 averaged 6.0 percent at six permanent Eriogonum pelinophilum transects at the Wacker Ranch site but varied from 1.2 to 26.1 percent and was spread across age classes (Carpenter and Schultz 1994, p. 3). Observed growth rates and the number of seedlings observed varied considerably by transect (Carpenter and Schultz 1994, p. 3). This information supports the conclusion that E. pelinophilum is very long-lived and that environmental conditions vary considerably over relatively short distances (Carpenter and Schultz 1994, pp. 3-4). When five of the six transects were revisited in 2008, 67 percent remained alive after 18 years, further supporting the idea that the plant is long-lived (Lyon 2008, p. 2). In addition to the 181 tagged plants, at least 321 new plants were located along the 5 relocated transects (Lyon 2008, p. 2). Results were not statistically adequate to detect a change in species abundance (Lyon 2008, p. 3), but do suggest that the species may be stable or increasing at the Wacker Ranch site.

Eriogonum pelinophilum requires a pollinator, and for much of the flowering season is the most abundant species in bloom in its habitat (Bowlin et al. 1992, p. 300). Flowering typically occurs from late May to early September with individual flowers lasting fewer than 3 days (Bowlin et al. 1992, p. 298). Over 50 species of insects visit E. pelinophilum flowers (Bowlin et al. 1992, pp. 299-300). Roughly half of these 50 species are native bees and 18 species are native ants (Bowlin et al. 1992, pp. 299-300). Seed set is similar between plants that were pollinated by ants versus flying pollinators, suggesting the importance of ants to pollination of the species (Bowlin et al. 1992, p. 299). Harvester ants remove some fruits (Bowlin et al. 1992, p. 299); however, no information is available for the species on seed dispersal mechanisms.

Eriogonum pelinophilum plants have been found to be smaller at disturbed sites but the number, richness, diversity, or equitability of pollinators was not significantly different between disturbed and undisturbed sites (Tepedino 2009, p. 38). Of all Eriogonum species studied to date, none has as many pollinators as E. pelinophilum (Tepedino 2009, p. 39). These pollinators cover a wide array of taxonomic and functional types of insects that visit the flowers for nectar and pollen (Tepedino 2009, pp. 38-39). No single pollinator or group of pollinators appears particularly important for E. pelinophilum pollination (Tepedino 2009, pp. 38-39, Appendix A). Therefore, preservation of specific pollinators is not a significant concern in conservation of the species (Tepedino 2009, p. 38). Conservation of E. pelinophilum should focus primarily on the conservation of undisturbed habitat and associated plant species in as many separate areas as possible to manage for the wide array of pollinators (Tepedino 2009, p. 40).

Eriogonum pelinophilum is considered a close relative or synonymous with E. clavellatum and a close relative of E. contortum (Reveal 2006, p. 3). All three species are currently recognized as distinct (Reveal 2005b, p. 1; J. Kartesz, Biota of North America Project 2009, in litt., p. 1). The most recent assessment indicates that preliminary genetic analyses show that E. pelinophilum is allied to, but distinct from E. clavellatum, and both are distinct from E. contortum (Reveal 2006, p. 3). Morphological and distributional differences also occur between E. pelinophilum, E. contortum, and E. clavellatum. E. pelinophilum has white flowers and occurs in Delta and Montrose Counties, Colorado, whereas E. contortum has yellow flowers and occurs farther north in Mesa and Garfield Counties, Colorado, and Grand County, Utah (Spackman et al. 1997, E. pelinophilum page). E. pelinophilum is shorter, measuring 2 to 4 inches (in.) (0.5 to 1 decimeters (dm)), has smaller involucres (bracts below the flowers - 0.12 to 0.14 in. [3 to 3.5 millimeters (mm)] long), with petals all the same length. E. clavellatum is taller measuring 4 to 8 in. (1 to 2 dm), has larger involucres (0.16 to 0.18 in. [4 to 4.5 mm] long), with two different sized petals, and is only known from Montezuma County, Colorado and adjacent San Juan Counties in Utah and New Mexico (Spackman et al. 1997, E. pelinophilum page; Reveal 2005c, p. 1).

Habitat Information

Eriogonum pelinophilum is endemic to the rolling clay (adobe) hills and flats immediately adjacent to the communities of Delta and Montrose, Colorado. The plants extend from near Lazear, east of Delta on the northern end of the species' range, to the southeastern edge of Montrose in Delta and Montrose Counties, Colorado, and occur from 5,180 to 6,350 feet (1,579 to 1,965 meters) in elevation (Colorado Natural Heritage Program (CNHP) 2006, p. 3; Nature Serve 2008, pp. 4-5; CNHP 2009, spatial data; Service 2009a, Table 1). E. pelinophilum is known from an area measuring roughly 11.5 mi (18.5 km) from east to west and 28.5 mi (45.6 km) from north to south (CNHP 2009, spatial data). The Delta/Montrose area is dry, receiving an average of 8 to 9 in. (20 to 23 centimeters (cm)) of precipitation a year (Western Regional Climate Center 2009a, p. 1; 2009b, p. 1). Winters are cold, with January being

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the coldest month, averaging 12 to 39 degrees Fahrenheit (-11 to 4 degrees Celsius). Summers are hot, with July being the hottest month, averaging 55 to 93 degrees Fahrenheit (13 to 34 degrees Celsius) (Western Regional Climate Center 2009a, p. 1; 2009b, p. 1).

The soils where Eriogonum pelinophilum are found are whitish, alkaline (with a pH over 7), clay soils of

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the Mancos shale formation, a Cretaceous marine sediment formation. Mancos shale outcrops are relatively barren of vegetation in comparison to surrounding areas (Potter et al. 1985, p. 137). Several components of the clay soils of the Mancos shale limit plant growth: soils are fine-textured and lose moisture more readily; clay soils are compactable which limits gas exchange and thus root growth; and clay soils hold more water which is unavailable for plant use because water infiltration is slower than other soil types, and the extreme swelling and shrinking of the soils limits water availability and oxygen exchange for plant roots (Potter et al. 1985, p. 139). In addition, the soils are calcareous (containing calcium carbonate).

The U. S. Geological Survey is researching the Mancos shale soils occupied by Eriogonum pelinophilum at the Gunnison Gorge National Conservation Area (GGNCA). Preliminary results suggest that E. pelinophilum is associated with silty clay and silty clay loam soils that can be classified as normal or saline-sodic in relation to pH, electrical conductivity, and sodium adsorption ratio (SAR) of saturated soil paste extracts (Grauch 2009, in litt., p. 1). The principal difference between occupied and unoccupied soils is that the occupied soils have fairly constant SAR values with depth while unoccupied soils have more variable SAR values. Electrical conductivity values of the saturated soil paste extracts have a similar pattern of variation with depth (R. Grauch, in litt. 2009, p. 1). A subsequent study comparing the soil samples collected in the study above to soil samples across the Mancos shale terrain of the GGNCA is underway and expected to be available within the next 3 years.

Soils appear to play a large role in the distribution of Eriogonum pelinophilum. Therefore, we conducted a geospatial analysis using Natural Resources Conservation Service (NRCS) soil layers (Paonia and Ridgeway soil surveys - NRCS 2006a, metadata; 2008, metadata) to better understand the distribution of E. pelinophilum. The analysis overlaid soil types with the distribution of E. pelinophilum in an effort to determine which soil types were most common where the plants occur. For this analysis, we buffered all known locations by 33 feet (10 meters). We employed this buffer so that E. pelinophilum sites represented by a point would more accurately represent the plant habitat where those points are located (Service 2009b, p. 1). For this reason, acreage figures differ significantly from those listed in the ``Population Status'' section below.

The Paonia and Ridgeway soil surveys differ in their naming and definitions of the various soil units, making the data analysis inconsistent between the two surveys. Data was not available for 9 percent (96 ac (39 ha)) of habitat occupied by E. pelinophilum. Given these shortcomings, we found the following five soils were most common within the 1,129 ac (457 ha) of occupied habitat of E. pelinophilum: 1) typic torriorthents (both 10- to 25-percent slopes, and -Badland complex with 25- to 75-percent slopes) comprised roughly 35 percent (390 ac (158 ha)); 2) ellaybee-persayo silty clay loams (5- to 12-percent slopes) comprised roughly 26 percent (294 ac (119 ha)); 3) killpack silty clay loam (3- to 12-percent slopes) comprised roughly 7 percent (84 ac (34 ha)); 4) chipeta silty clay (3- to 30-percent slopes) comprised 7 percent (77 ac (31 ha)); and 5) Montrose-Delta complex (0- to 2-percent slopes) comprised 6 percent (64 ac (26 ha)). Soil types are described as erosion remnants weathered from calcareous shale and are highly erodible by water (Soil Conservation Service 1981, pp. 24 and 39; NRCS 2006b, map unit descriptions). Several other soil types occurred within occupied habitat, but none comprised over 3 percent or 30 ac (12 ha).

Eriogonum pelinophilum plants are generally found within swales or drainages where there is more moisture than surrounding areas. These swales are generally located in low-lying areas with rolling topography. Steeper, more barren slopes within the Mancos shale habitats, but with more toxic soils for plant life, exist upslope of where the plants occur, generally within 1 mi (1.6 km). E. pelinophilum plants at lower elevation sites near Delta were associated with small areas where snow lingers longer than surrounding areas because of their north- and east-facing aspects (Ewing and Glenne 2009, p. 2).

Plant communities associated with Eriogonum pelinophilum are characterized by low species diversity, low productivity, and minimal canopy cover (NatureServe 2008, p. 4). The associated vegetation is sparse, with E. pelinophilum generally one of the dominant species (CNAP 1987, Table 2). In lower elevations near Delta, the dominant plant species is Atriplex corrugata (mat saltbrush) but at higher

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elevations near Montrose the dominant plant species is Artemesia nova (black sagebrush), although A. corrugata is still abundant (Southwest Regional Gap Analysis Project 2004, spatial data). Other associated species include Atriplex confertifolia (shadscale), Atriplex gardneri (Gardner's saltbush), Picrothamnus desertorum (formerly Artemisia spinescens) (bud sagebrush), Xylorhiza venusta (charming woodyaster), and another local endemic Penstemon retrorsus (Adobe Hills beardtongue) (CNAP 1987, Table 2; Coles 2006, p. 1; NatureServe 2008, p. 4).

Population Status

Based on information provided by the CNHP in January 2009, 20 Eriogonum pelinophilum Element Occurrences (EOs) are currently known (CNHP 2009, pp. 1-81; Service 2009a, Table 1). The EOs are utilized by Natural Heritage Programs to track rare species and are defined as an area where a species is or was present. For E. pelinophilum, EOs are comprised of one to many polygons (sites) based on a standardized maximum separation distance, in this case 1.2 mi (2 km) across suitable habitat and 0.6 mi (1 km) across unsuitable habitat (CNHP 2007, p. 1). However, upon closer examination, we found that several EOs, as designated by CNHP, were within 0.6 mi (1 km) of one another. For the purpose of this discussion, we have left the EOs as designated by CNHP. Of these 20 EOs, 7 have not been relocated in over 20 years and are considered historical. A survey was conducted at an additional EO where no plants were relocated (CNHP 2009, pp. 1-81; Service 2009a, Table 1). Table 1 is provided below to portray the EOs and their land management or ownership status. Figure 1 shows the distribution of E. pelinophilum habitat in Colorado with EO Numbers and percent occupancy.

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TABLE 1. The Colorado Natural Heritage Program Eriogonum pelinophilum EOs. The EO ranks A, B, C, and D represent the quality of the EO (from best to worst quality, respectively), H indicates an EO has not been visited in over 20 years, and F indicates an EO that could not be relocated upon subsequent visit.

EO Number	EO Rank\1\	Acreage\2\	Population Name	Land Management with Rough Estimates of Ownership Percentage
001			Lawhead Gulch	private
003	B	67	North Selig Canal	33% BLM- 66% private
004	B	17	Olathe South	private
006	B	15	North Mesa	private
007	H, C		Peach Valley	private
011	C	110	North Fairview	50% BLM - 50% private
012	B	25	Sunshine Road	5% BLM - 95% private
013	H, C	(4)	Cedar Creek	private
014	A	7	Candy Lane/Peach Valley	BLM
015	F	(70)	Selig Canal 3	private
016	C	13	Dry Cedar Creek	BLM
017	H, C	(20)	Oak Grove Road	private
018	A	212	Wacker Ranch/ Fairview South	70% BLM - 20% Colorado State (CNAP) - 10% private
019	H	(2)	Star Nelson Airport	private
021	H, C	(26)	Montrose East	private
022	H, C	(19)	Montrose East	private
023	H		Hotchkiss	unknown
024	D	8	Montrose Northeast	private

025	B	18	Selig Canal	90% BLM - 10% private
041	B	6	Garret Ditch	66% BLM - 33% private
none	none	3	Peach Valley North	33% BLM - 66% private
none	none	2	Loutsenhizer Canal	BLM

\1\ EOs with both historical (H) rank and C (fair) quality ranks were ranked as C prior to becoming H.
\2\ Acreages are approximate, are based on a geospatial layer when available, and on surveyor estimates when a geospatial estimate is not available (CNHP 2009, pp. 1-81). Methods for estimating acreage vary between surveys. Acres listed in parentheses are not included in the total based on their historical (H) or failed to find (F) ranks.

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Distribution of Eriogonum pelinophilun habitat in Colorado with Element Occurrence (EO) Numbers and percent occupancy.

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[GRAPHIC] [TIFF OMITTED] TP29SE09.092

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The most recent rangewide E. pelinophilum population estimate for all 14 current sites is roughly 277,000 individuals across 582 occupied ac (233 ha). Roughly 46 percent of the acres are in private ownership (14 percent of the total acres have conservation easements), and 54 percent of the acres are managed by either the BLM or the CNAP (CNHP 2009, pp. 1-81; Service 2009a, Table 1). The difference between rangewide population estimates from the 2006 petition and those in 2009 are largely attributable to surveys that occurred in 2007 near Fairview South (EO 018), where increased survey efforts greatly expanded the known locations of E. pelinophilum as well as the number of individuals (an increase from roughly 30,000 to 250,000 individuals) (CNHP 2009, EO 18; Ferguson 2007, pp. 2 and 4). Survey intensity has not been consistent in the different EOs.

We are aware of two additional populations of Eriogonum pelinophilum that are not incorporated into the CNHP database and, based on appropriate separation distances, would comprise two new EOs (Table 1). Although not yet numbered or named by CNHP, we now refer to these sites as Peach Valley North and Loutsenhizer Canal (Table 1). Peach Valley North has fewer than 100 plants and the Loutsenhizer Canal site has an estimated 500 plants (BIO-Logic Environmental 2004, Site 219 p. 7 and spatial data; BIO-Logic Inc. 2008, Figure 2 and spatial data; Boyle 2009, in litt., p. 1). We have a short report in our files (Reveal 2006, p. 2) with a map portraying seven extirpated E. pelinophilum locations. These locations are not included in the CNAP's database. We do not have any information on how these extirpations

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were determined, their exact locations, if they were portions of other EOs, or how many plants were lost; therefore, they are not included in our assessment of populations (Table 1).

Of the 14 occupied Eriogonum pelinophilum sites, 4 occur wholly on private land; 6 occur on a combination of BLM and private land; 1 occurs on a combination of BLM, Colorado State (CNAP), and private land; and 3 occur wholly on BLM land (Table 1). Sites on Federal lands are afforded the protections of section 7 of the Act. In addition, four EOs have special land designations that provide some additional level of protection: (1) The majority of Lawhead Gulch is protected through a conservation easement held by the Black Canyon Land Trust, as well as being within the existing critical habitat designation; (2) a portion of the North Selig Canal is protected through a conservation easement held by the Black Canyon Land Trust; (3) roughly half of North Fairview is protected as a BLM Area of Critical Environmental Concern (ACEC), and as a Colorado Natural Area, which was fenced in 2008; and (4) Wacker Ranch/Fairview South is partially protected through a BLM designated ACEC, the CNAP (both at the Fairview South ACEC and Wacker Ranch), and The Nature Conservancy at Wacker Ranch.

Each of these special designations protects Eriogonum pelinophilum differently. Easements held by the Black Canyon Land Trust provide permanent protection for Eriogonum pelinophilum, are not actively managed, and have not yet been surveyed for E. pelinophilum, although the presence of the plant has been confirmed on all easements (B. Hawke, Executive Director, Black Canyon Land Trust, in litt. 2008, pp. 1-2). The BLM's Fairview ACECs, both north and south, were designated to manage and protect E. pelinophilum (Ferguson 2006, in litt. pp. 1-

6). The Fairview North ACEC has been fenced and livestock use has been halted, whereas the Fairview South ACEC is not fenced and receives livestock use. Both Fairview ACECs also are designated as Colorado Natural Areas. The CNAP has provided qualitative monitoring, quantitative monitoring, and management recommendations at both ACECs (Kurzel 2008, in litt. pp. 1-4). Wacker Ranch was acquired through a U.S. Fish and Wildlife Recovery Land Acquisition Grant in 2007 to protect E. pelinophilum (McGillivary 2007, in litt. p. 1). The property is owned by the Colorado Division of Parks and Outdoor Recreation (CNAP), is a Colorado Natural Area, and is managed by The Nature Conservancy (Colorado Division of Parks and Outdoor Recreation and The Nature Conservancy 2007, pp. 1-5). A formal management plan has been completed and nonnative weed control, qualitative and quantitative monitoring, as well as public outreach are ongoing for this property (Kurzel 2008, in litt. pp. 1-4).

Critical Habitat

Current Critical Habitat Designation

At the time we designated critical habitat, the designation represented the entire known range of the species. The rule designating critical habitat included as the primary constituent elements those factors associated with the whitish alkaline clay soils within the sparsely vegetated badlands of Mancos shale. The existing critical habitat for E. pelinophilum, as designated in 1984, encompasses 119.8 ac (48.5 ha) and one population (Lawhead Gulch, EO 001,50 CFR 17.96(a)). Within that designation, approximately 65 ac (26 ha) of habitat remains occupied containing approximately 2,000 individual plants. The current critical habitat designation for E. pelinophilum includes approximately 65 of 582 ac (26 of 233 ha) of currently occupied habitat (11 percent), and 2,000 of 276,000 individuals (0.7 percent) (Service 2009, Table 1). E. pelinophilum has special protections in portions of 4 of 20 extant EOs.

Background

Critical habitat is defined in section 3(5)(A) of the Act as:
(i) The specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the Act, on which are found those physical or biological features
(I) essential to the conservation of the species and
(II) which may require special management considerations or protection; and
(ii) specific areas outside the geographical area occupied by the species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.
Conservation, as defined under section 3 of the Act, means the use of all methods and procedures that are necessary to bring any endangered or threatened species to the point at which the measures provided under the Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, or transplantation.
Critical habitat receives protection under section 7 of the Act through the prohibition against Federal agencies carrying out, funding, or authorizing the destruction or adverse modification of critical habitat. Section 7(a)(2) of the Act requires consultation on Federal actions that may affect critical habitat. The designation of critical habitat does not affect land ownership or establish a refuge, wilderness, reserve, preserve, or other conservation area. Such designation does not allow the government or public to access private lands. Such designation does not require implementation of restoration, recovery, or enhancement measures by private landowners. Where a landowner requests Federal agency funding or authorization for an action that may affect a listed species or critical habitat, the consultation requirements of section 7(a)(2) would apply, but even in the event of a destruction or adverse modification finding, the landowner's obligation is not to restore or recover the species, but to implement reasonable and prudent alternatives to avoid destruction or adverse modification of critical habitat.
For inclusion in a critical habitat designation, habitat within the geographical area occupied by the species must contain the physical and biological features essential to the conservation of the species, and be included only if those features may require special management considerations or protection. Critical habitat designations identify, to the extent known using the best scientific and commercial data available, habitat areas containing the essential physical and biological features essential to the conservation of the species. The essential features consist of the primary constituent elements (PCEs) in the appropriate quantity and spatial arrangement that provide for

requisite life cycle needs of the species. Under the Act and regulations at 50 CFR 424.12, we can designate critical habitat in areas outside the geographical area occupied by the species at the time it is listed only when we determine that those areas are essential for the conservation of the species and that designation limited to those areas occupied at the time of listing would be inadequate to ensure the conservation of the species.

Section 4 of the Act requires that we designate critical habitat on the basis of the best scientific and commercial data available. Further, our Policy on Information Standards Under the Act

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(published in the Federal Register on July 1, 1994 (59 FR 34271)), the Information Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Pub. L. 106-554; H.R. 5658)), and our associated Information Quality Guidelines, provide criteria, establish procedures, and provide guidance to ensure that our decisions are based on the best scientific data available. They require our biologists, to the extent consistent with the Act and with the use of the best scientific data available, to use primary and original sources of information as the basis for recommendations to designate critical habitat.

12-Month Finding

Section 4(b)(3)(D)(ii) of the Act requires that if we find that a revision to critical habitate should be made, then we are to indicate how we intend to proceed with such revision and promptly publish a notice of our intention. We have reviewed the best available scientific and commercial information available, and we find that revisions to critical habitat for E. pelinophilum under the Act should be made. However, we have determined that the development of a revised critical habitat designation for the species is currently precluded by higher priority listing and critical habitat determinations. The resources available for listing actions, including critical habitat designations and revisions, are determined through the annual Congressional appropriations process. We cannot spend more than is appropriated for the Listing Program without violating the Anti-Deficiency Act (see 31 U.S.C. 1341(a)(1)(A)). Recognizing that designation of critical habitat for species already listed would consume most of the overall Listing Program appropriation, Congress also put a critical habitat subcap in place in FY 2002 and has retained it each subsequent year. In FY 2002 and each year until FY 2006, the Service has had to use virtually the entire critical habitat subcap to address court-mandated designations of critical habitat, and consequently none of the critical habitat subcap funds have been available for other listing activities. In FY 2007, we were able to use some of the critical habitat subcap funds to fund proposed listing determinations for high-priority candidate species. While we were unable to use any of the critical habitat subcap funds to fund proposed listing determinations in FY 2008, we did use a portion of this money to fund the critical habitat portion of some proposed listing determinations. In those cases, this allowed combining the proposed listing determination and proposed critical habitat designation into one rule, thereby increasing efficiency. In FY 2009, we have been able to continue this practise. However, our current projection for FY 2010 is that all of the funding anticipated for the critical habitat portion of the listing allocation will be used to address court-ordered critical habitat designations. As such, we do not anticipate having funding available to work on non-court-ordered actions in FY 2010.

Thus, through the critical habitat subcap, and the amount of funds needed to address court-mandated critical habitat designations, Congress and the courts have in effect determined the amount of money available for critical habitat revisions. Therefore, the funds in the critical habitat subcap, other than those needed to address court-mandated critical habitat for already listed species, set the limits on revisions to critical habitat.

We have endeavored to make our critical habitat designation and revision actions as efficient and timely as possible, given the requirements of the relevant law and regulations, and constraints relating to workload and personnel. We are continually considering ways to streamline processes or achieve economies of scale, such as by batching related actions together.

While we are not proposing to revise critical habitat at this time, we have considered whether the physical and biological features essential to the conservation of the species identified in the previous designation are still appropriate for this species. The original critical habitat designation included only the alkaline clay soils as a primary constituent element, and therefore the feature essential to the conservation of the species. Appropriate native vegetation and features that allow for dispersal were not included. Based on the biology of the

species, we intend to revise the PCEs, and therefore the essential features, in order to address the following needs of the species: appropriate native vegetation, appropriate soils, and features that allow for dispersal within units. Such features may include suitable habitat for pollinators, appropriate slopes, depressions, rivulets, and sites where snow banks linger. We find that incorporating these concepts into the revised critical habitat designation for Eriogonum pelinophilum is important for identifying the specific areas essential to the conservation of the species. We are soliciting any additional information or input on these potential PCEs and essential features.

How the Service Intends To Proceed

We intend to undertake rulemaking to revise critical habitat for Eriogonum pelinophilum when funding and staff resources become available. Based on the best available science, including the status review, we will take the following steps to propose the revision of designated critical habitat for Eriogonum pelinophilum: (1) Determine the geographical area occupied by the species at the time of listing; (2) identify the physical or biological features essential to the conservation of the species; (3) delineate areas within the geographical area occupied by the species that contain these features, and which may require special management considerations or protections; (4) delineate any areas outside of the geographical area occupied by the species that are essential for the conservation of the species; (5) conduct appropriate analyses under section 4(b)(2) of the Act; and (6) invite the public to review and provide comments on the proposed revision through a public comment period.

We intend that any revisions to critical habitat for E. pelinophilum be as accurate as possible. Therefore, we will continue to accept additional information and comments from all concerned governmental agencies, the scientific community, industry, or any other interested party concerning this finding.

Current Designation and Protections

Until we are able to revise the critical habitat designation for Eriogonum pelinophilum, areas that support populations but are outside the critical habitat designation will continue to be subject to conservation actions implemented under section 7(a)(1) of the Act. Federal agency actions are subject to the regulatory protections afforded by section 7(a)(2), as determined on the basis of the best available scientific information at the time of the action. Approximately a third of the areas currently known to be occupied by the species are on private land outside of the current designation. We expect occasional projects on private land to involve a Federal nexus, in which case protections under section 7(a)(2) would also apply. Where a landowner requests Federal agency funding or authorization (i.e., Federal nexus) for an action that may affect a listed species or critical habitat, the consultation requirements of section 7(a)(2) would apply.

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Federally funded or permitted projects affecting listed species outside their designated critical habitat areas may still result in jeopardy findings in some cases. Similarly, critical habitat designations made on the basis of the best available information at the time of designation will not control the direction and substance of future recovery plans, habitat conservation plans, or other species conservation planning efforts if new information available to these planning efforts calls for a different outcome. Section 7(a)(2) of the Act requires Federal agencies, including the Service, to ensure that actions they fund, authorize, or carry out are not likely to destroy or adversely modify critical habitat. If a Federal action may affect a listed species or its critical habitat, the responsible Federal agency (action agency) must enter into consultation with us. As a result of this consultation, we document compliance with the requirements of section 7(a)(2) through our issuance of:

(1) A concurrence letter for Federal actions that may affect, but are not likely to adversely affect, listed species or critical habitat; or

(2) A biological opinion for Federal actions that may affect, and are likely to adversely affect, listed species or critical habitat.

When we issue a biological opinion concluding that a project is likely to jeopardize the continued existence of a listed species or destroy or adversely modify critical habitat, we also provide reasonable and prudent alternatives to the project, if any are identifiable. We define ``Reasonable and prudent alternatives'' at 50 CFR 402.02 as alternative actions identified during consultation that:

Can be implemented in a manner consistent with the intended purpose of the action,

Can be implemented consistent with the scope of the Federal agency's legal authority and jurisdiction,

Are economically and technologically feasible, and

Would, in the Director's opinion, avoid jeopardizing the continued existence of the listed species or destroying or adversely modifying critical habitat.

Reasonable and prudent alternatives can vary from slight project modifications to extensive redesign or relocation of the project. Costs associated with implementing a reasonable and prudent alternative are similarly variable.

Regulations at 50 CFR 402.16 require Federal agencies to reinitiate consultation on previously reviewed actions in instances where we have listed a new species or subsequently designated critical habitat that may be affected and the Federal agency has retained discretionary involvement or control over the action (or the agency's discretionary involvement or control is authorized by law). Consequently, Federal agencies may sometimes need to request reinitiation of consultation with us on actions for which formal consultation has been completed, if those actions with discretionary involvement or control may affect subsequently listed species or designated critical habitat.

References Cited

A complete list of all references cited in this document is available, upon request, from the Western Colorado Ecological Services Office (see FOR FURTHER INFORMATION CONTACT).

Author

The primary authors of this notice are the staff members of the Western Colorado Ecological Services Office (see FOR FURTHER INFORMATION CONTACT).

Authority

The authority for this action is the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.).

Dated: September 16, 2009.
Thomas L. Strickland
Assistant Secretary for Fish and Wildlife and Parks
[FR Doc. E9-23155 Filed 9-28- 09; 8:45 am]
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DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[FWS-R6-ES-2009-0035]
[MO9221050083-B2]
RIN 1018-AW24

Endangered and Threatened Wildlife and Plants; Taxonomic Change of Sclerocactus Glaucus to Three Separate Species

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), announce the revised taxonomy of Sclerocactus glaucus (Uinta Basin hookless cactus) under the Endangered Species Act of 1973, as amended (Act). We determine that S. glaucus (previously considered a complex), which is currently listed as a threatened species, is actually three distinct species: S. brevispinus, S. glaucus, and S. wetlandicus. We are revising the List of Endangered and Threatened Plants to reflect the scientifically accepted taxonomy and nomenclature of these species. In addition, we revise the common names for these species as follows: S. brevispinus (Pariette cactus), S. glaucus

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(Colorado hookless cactus), and S. wetlandicus (Uinta Basin hookless cactus). These three species will continue to be listed as threatened with no regulatory changes.

DATES: This rule is effective on October 15, 2009.

ADDRESSES: Comments and materials received, as well as supporting documentation used in the preparation of this final rule, are available for public inspection, by appointment, during normal business hours, at the Utah Field Office, U.S. Fish and Wildlife Service, 2369 W. Orton Circle, Suite 50, West Valley City, UT 84119; telephone 801-975-3330. The final rule is also available on the Internet at http://www.regulations.gov and at http://www.fws.gov/mountain-prairie/species/plants/pariettecactus/.

FOR FURTHER INFORMATION CONTACT: Larry Crist, Field Supervisor, Utah Field Office (see ADDRESSES) (telephone 801-975-3330). People who use a telecommunications device for the deaf (TDD) may call the Federal Information Relay Service (FIRS) at 800-877-8339.

SUPPLEMENTARY INFORMATION:

Background

Section 17.12(b) of Title 50 of the Code of Federal Regulations (CFR) requires us to use the most recently accepted scientific name of any species determined by the Service to be an endangered or threatened species. This final rule documents a taxonomic change (scientific and common names) to an entry on the List of Endangered and Threatened Plants (50 CFR 17.12(h)). We find that Sclerocactus glaucus (Uinta Basin hookless cactus), as listed under section 4 of the Act (16 U.S.C. 1531 et seq.), is three separate species: S. brevispinus (Pariette cactus), S. glaucus (Colorado hookless cactus), and S. wetlandicus (Uinta Basin hookless cactus). Previously, these three species were scientifically classified under the single scientific name of S. glaucus (Benson 1966, pp. 50-57; 1982, pp. 728-729). We make this change to the List of Endangered and Threatened Plants (50 CFR 17.12(h)) to reflect the most recently accepted scientific names in accordance with 50 CFR 17.12(b).

These three species will now be listed as threatened under the Act until we conduct a five-factor analysis for each species. As soon as our staff and funding resources allow, we will publish a document in the Federal Register that provides the updated five-factor analysis and the prudency determination for critical habitat for each of the three species, and requests public comment on our analyses and prudency determinations.

Previous Federal Actions

On October 11, 1979, we published a final rule listing Sclerocactus glaucus (Uinta Basin hookless cactus) as threatened (44 FR 58868).

On February 5, 1997, we received a petition from the National Wilderness Institute to remove Sclerocactus glaucus from the List of Endangered and Threatened Plants. On April 25, 2005, we received a petition from the Center for Native Ecosystems and the Utah Native Plant Society requesting that we list S. brevispinus (Pariette cactus) as an endangered or threatened species under the Act (independent of its current listing as threatened as part of S. glaucus) and that we designate critical habitat.

On December 14, 2006, we published a 90-day finding on both petitions (71 FR 75215). First, we found that the petition to remove Sclerocactus glaucus from the List of Endangered and Threatened Plants did not provide substantial information to indicate that delisting may be warranted. Second, we found that the petition to list S. brevispinus (Pariette cactus) as an endangered or threatened species provided substantial information to indicate that independent listing of S. brevispinus as endangered or threatened may be warranted, and we

initiated a status review. In addition, we found that emergency listing of S. brevispinus was not warranted, and that designation of critical habitat was not prudent. Further, we defined our understanding of the ``Sclerocactus glaucus complex'' as including the three Sclerocactus species: S. brevispinus, S. glaucus, and S. wetlandicus.

On September 18, 2007, we published a 12-month finding (72 FR 53211) on Sclerocactus brevispinus (Pariette cactus). We found that reclassifying S. brevispinus as a single species and listing that species as endangered was warranted, but precluded by higher priority actions to amend the Lists of Endangered and Threatened Wildlife and Plants. However, S. brevispinus remains listed as threatened as part of the S. glaucus (Uinta Basin hookless cactus) complex.

The September 18, 2007, publication (72 FR 53211) also announced our proposal to revise the taxonomy of Sclerocactus glaucus (Uinta Basin hookless cactus) to recognize three separate species. In accordance with the best available scientific information, we proposed to recognize three distinct species and assign the following common names: S. brevispinus (Pariette cactus), S. glaucus (Colorado hookless cactus), and S. wetlandicus (Uinta Basin hookless cactus). We also stated that S. glaucus and S. wetlandicus continued to meet the definition of ``threatened'' under the Act, and that listing S. brevispinus as endangered under the Act was warranted, but precluded by higher priority actions.

Comments on Proposed Taxonomic Classification

Peer Review

In accordance with our joint policy published in the Federal Register on July 1, 1994 (59 FR 34270), and based on our implementation of the Office of Management and Budget's Final Information Quality Bulletin for Peer Review, dated December 16, 2004, we sought the expert opinions of appropriate and independent specialists regarding the science in our proposed rule. The basis for the proposed taxonomic change has appeared in peer-reviewed journals (Succulenta, A Utah Flora, Flora of North America). In addition, we solicited the opinions of seven specialists in general plant taxonomy, and the taxonomy and ecology of the Sclerocactus glaucus in particular. We received peer reviews from three individuals, Dr. Bruce Glisson, Dr. Leila Shultz, and Professor Kenneth Heil. All agreed with our taxonomic analysis of the ``Sclerocactus glaucus complex'' and its component species.

Other Comments

We received three comments from the public on our proposal to designate Sclerocactus brevispinus, S. glaucus, and S. wetlandicus as separate species under the Act. All three comments indicated strong agreement with the proposed taxonomic changes and with listing S. brevispinus as endangered. All three comments also expressed concern about the ``warranted but precluded'' finding for S. brevispinus, because the commenters believed that listing the species as endangered should not be delayed.

Species Information

Taxonomic Classification

The original listing rule for Sclerocactus glaucus (44 FR 58868; October 11, 1979) included all hookless (straight central spines) Sclerocactus populations at the extreme periphery of the Sclerocactus distribution in western Colorado and northeastern Utah, and referred to them as S. glaucus per Benson (1966, pp. 50-57; 1982, pp. 728-729). This taxonomic classification is no longer supported by the results of

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genetic and morphological research. The separation of S. glaucus into three species (S. brevispinus, S. glaucus, and S. wetlandicus) is reinforced by recent genetic studies (Porter et al. 2000, pp. 14, 16; Porter et al. 2007, pp. 8, 9, 11, 15, 23), common garden experiments (to determine in a controlled environment whether plants exhibit different morphological characteristics when grown under different conditions) (Hochstatter 1993b, pp. 94, 98; Welsh et al. 2003, p. 79), and a reevaluation of morphological characteristics (Heil and Porter 2004, pp. 200-201; Hochstatter 1989, pp. 123-125; Hochstatter 1993a, pp. 85-92; Hochstatter 1993b, pp. 93, 97, 99; Porter et al. 2007, pp. 13, 15, 24-25).

Revisions to the taxonomy of Sclerocactus glaucus began in 1989 (Hochstatter 1989, pp. 123-125; Hochstatter 1993a , pp. 85-92; Hochstatter 1993b, pp. 91-92; Heil and Porter 1994, pp. 25-27; Porter et al. 2000, pp. 8-23; Welsh et al. 2003, p. 79). By 2004, the Flora of North America recognized the plant S. glaucus (that we listed in 1979; 44 FR 58868; October 11, 1979) as three distinct species: S. brevispinus (Pariette cactus), S. glaucus (Uinta Basin hookless cactus), and S. wetlandicus (no common name). The Flora of North America (Heil and Porter 2004, pp. 197-207) recognizes 15 species in the genus Sclerocactus, including S. brevispinus, S. glaucus, and S. wetlandicus.

Sclerocactus brevispinus (Pariette cactus) is a morphologically unique Sclerocactus population, occurring only in the Pariette Draw in the central Uinta Basin in Utah. This cactus is much smaller than either S. glaucus or S. wetlandicus and retains the vegetative characteristics of juvenile S. wetlandicus individuals in adult flowering plants. At the time of the species listing in 1979, these smaller individuals were thought to represent an ecotypic variation of S. glaucus. This unique cactus from Pariette Draw has been variously named S. wetlandicus var. ilseae (Hochstatter 1993b, pp. 95-97), S. brevispinus (Heil and Porter 1994, p. 26), and S. whipplei var. ilseae (Welsh et al. 2003, p. 79). We have adopted the taxonomic nomenclature accepted by the Flora of North America (Heil and Porter 2004, pp. 197-207) and adopt a new common name: S. brevispinus (Pariette cactus).

Sclerocactus glaucus (former common name was Uinta Basin hookless cactus; now Colorado hookless cactus) is endemic to western Colorado. Its former common name in the List of Endangered and Threatened Plants referred to a geographical area in Utah. Therefore, the common name was a misnomer that more accurately applies to S. wetlandicus (which formerly had no common name). Colorado hookless cactus is a more applicable common name for S. glaucus.

Sclerocactus wetlandicus (new common name is Uinta Basin hookless cactus) was first described in 1989 (Hochstatter 1993b, pp. 91-92), and

comprises the bulk of the previously termed Uinta Basin hookless cactus complex in Utah (in the Uinta Basin proper). Its population is significantly disjunct from that of S. glaucus in Colorado. The common name ``Uinta Basin hookless cactus'' is appropriate for this species.

Species Descriptions

Cacti species of the Uinta Basin hookless cactus complex are a small ball- or barrel-shaped cactus, usually with straight (``hookless'' as opposed to ``fishhook'' in most other species within the genus) central spines. Benson (1966, p. 53) describes Sclerocactus glaucus as a leafless, succulent plant in the cactus family; with solitary, ovoid to nearly globular stems that are 3.8 to 17.8 centimeters (cm) (1.5 to 7 inches (in)) tall and 2.5 to 11.4 cm (1 to 4.5 in) in diameter; with about 12 ribs with spine clusters born on tubercles (short protuberances) arising from the ribs.

These cacti have two types of spines (radial and central) and two types of central spines (abaxial and lateral). These spines are defined by size and position on the plant:

(1) The 4 to 12 radial spines radiate around the margin of the areole (a distinct non-photosynthetic surface area bearing spines), extend in a plane roughly parallel to the body of the plant, and are usually white, less than 2.5 cm (1 in) in length, and much finer and shorter than the dark central spines.

(2) The central spines number from 1 to 4 (sometimes absent), are 2.5 to 3.8 cm (1 to 1.5 in) long (generally longer than radial spines), and extend from the center of the areole. The central spines include abaxial and lateral forms:

Abaxial spines are typically single and often longer than lateral spines.

Lateral spines are often displayed in pairs on either side of the abaxial spine.

Flowers have numerous pinkish to lavender perianth parts (sepaloids [outer whorls, usually greenish] and petaloids [inner whorls, usually non-green]) and are 2.5 to 5.1 cm (1 to 2 in) in diameter and length. Flower stamens are numerous, with yellow anthers (the male pollen-bearing structures) and green filaments (structures that display the anthers). The fruit is barrel-shaped, 0.8 to 1.3 cm (0.3 to 0.5 in) long, and about 0.8 cm (0.3 in) in diameter. The seeds are small and black.

The revised species descriptions in Table 1 are based on those by Hochstatter (2005, pp. 14-18, 37-38) and Heil and Porter (2004, pp. 200-201) as used in the Flora of North America.

Table 1: Comparison of morphology for three Sclerocactus species.

Characteristic	Sclerocactus glaucus	Sclerocactus wetlandicus	Sclerocactus brevispinus
Plant Description	Leafless, stem-succulent plant with short cylindrical to ovoid body, usually 3 to12 cm (1.2 to 4.8 in) tall, but up to 30 cm (12 in) tall; 4 to 9 cm (1.6 to 3.6 in) diameter; with 8 to 15 (usually 12 or 13) tubercle-bearing ribs	Leafless, stem-succulent plant with short, cylindrical to elongate-cylindrical body, usually 3 to 15 cm (1.2 to 6.0 in) tall, but up to 25 cm (10 in)); 4 to 12 cm (1.6 to 4.8 in) diameter; with 12 to 15 tubercle-bearing ribs	Leafless, stem-succulent plant with a depressed-spherical to short-cylindrical body, usually 2.5 to 8.5 cm (1.0 to 3.4 in) tall, but most individuals less than 5 cm (2.0 in)); 1.8 to 7.5 cm (0.7 to 3.0 in) in diameter (most individuals less than 5 cm (2.0 in)); with (usually) 13 tubercle-bearing ribs
Spines	Spines occur in clusters within the areoles at tip of tubercles	Spines occur in clusters within the areoles at tip of tubercles	Spines occur in clusters within the areoles at tip of tubercles
Areoles	Pubescent in juvenile individuals	Not pubescent in juvenile individuals	Not pubescent in juvenile individuals

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Radial Spines	2 to 12 (usually 6 to 8) per cluster; white or gray to light brown; up to 17 millimeters (mm) (0.67 in) long; less than 1 mm (0.04 in) in diameter	6 to 14 (usually 6 to 10) per cluster; white, or gray to light brown (rarely black), up to 6 to 20 mm (0.24 to 0.8 in) long; less than 0.6 mm (0.01 in) in diameter	5 to 13 (usually 6 or 7) per cluster; white or gray-to-light brown, up to 5 to 15 mm (0.2 to 0.6 in) long; less than 1 mm (0.04 in) in diameter
Central Spines	Longer and heavier than radial spines; numbering one to five (usually three: one abaxial and two lateral), 12 to 50 mm (0.5 to 2.0 in) long, and 0.8 to 1.8 mm (0.03 to 0.07 in) thick	Usually longer and heavier than radial spines, numbering one to five (usually three: one abaxial and two lateral), are 15 to 30 mm (0.5 to 2.0 in) long, and 0.5 to 1.8 mm (0.02 to 0.07 in) thick	Usually longer and heavier than radial spines, numbering 0 to 3 (usually 1: the abaxial, rarely with two laterals), 2 to 5 mm (0.08 to 0.2 in) long, and 0.5 to 1.8 mm (0.02 to 0.07 in) thick
Abaxial Spines	Usually solitary (sometimes lacking) and ascending toward the apex of the plant body with its tip noticeably bent at an angle usually less than 90 degrees	Usually solitary (sometimes lacking or double), and ascending toward the apex of the plant body with its tip usually noticeably bent at an angle usually less than 90 degrees (sometimes straight, or rarely hooked up to 180 degrees)	Solitary (sometimes lacking) and usually descending away from the apex of the plant body with entire spine bent or in short spines (1 to 3 mm (0.04 to 0.12 in) long), strongly hooked with the tip almost touching the surface of the areole

Lateral Spines	Usually displayed in pairs on either side of the abaxial spine; they are of approximately the same length and thickness but are relatively straight without obvious bent tip of the abaxial spine; these diverge from abaxial spine at an acute angle, usually between 20 and 50 degrees	Usually displayed in pairs on either side of the abaxial spine and are of approximately same length and thickness but are more or less straight without obvious bent tip of abaxial spine; these diverge from the abaxial spine at acute angle, usually between 20 and 50 degrees	Usually absent; when present, are on either side of abaxial spine and are of approximately same length and thickness, more or less straight without the obvious bend or hook of abaxial spine, and diverge from abaxial spine at acute angle (usually between 20 and 50 degrees)
Flowers	Fragrant and funnelform (funnel-shaped) or rarely campanulate (bell-shaped), 3 to 6 cm (1.2 to 2.4 in) long, and 3 to 5 cm (1.2 to 2.0 in) in diameter	Fragrant and funnelform, 2 to 5 cm (0.8 to 2 in) long and 2 to 5 cm (0.8 to 2 in) in diameter	Campanulate 1.0 to 1.5 cm (0.4 to 0.6 in) (occasionally up to 3 cm (1.2 in)) high, and 1.2 to 3 cm (0.4 to 1.2 in) in diameter
Tepals (the colored corolla parts of the cactus flower)	Consist of two whorls. Outer: 20 to 30 tepals; have broad, greenish-lavender midstripe with pink margins, and are oblanceolate; tepals transition from small, leaf-like scales low on the floral tube to petal-like structures near rim of floral tube; are 4 to 30 mm (0.16 to 1.2 in) long and 4 to 6 mm (0.16 to 0.24 in) wide. Inner: 12 to 20 tepals, pale pink to dark pink, oblanceolate to lanceolate, and 25 to 35 mm (1 to 1.4 in) long and 4 to 6 mm (0.16 to 0.24 in) wide; borne at rim of floral tube	Consist of two whorls. Outer: 20 to 30 tepals; have broad, brownish-lavender midstripe with pink to violet margins; oblanceolate, transition from small leaf-like scales low on the floral tube to petal-like structures near the rim of the floral tube, and are 4 to 30 mm (0.16 to 1.2 in) long and 4 to 6 mm (0.16 to 0.24 in) wide. Inner: 12 to 20 tepals; pink to violet, oblanceolate to lanceolate, are 17 to 30 mm (0.67 to 1.2 in) long, and 3 to 6 mm (0.12 to 0.24 in) wide; borne at rim of floral tube	Consist of two whorls. Outer: 20 to 30 tepals; greenish to purple with a brownish midstripe and pink or purple margins; oblanceolate and transition from small, leaf-like scales low on the floral tube to petal-like structures near the rim of the floral tube; 4 to 16 mm (0.16 to 0.63 in) long and 2 to 6 mm (0.08 to 0.24 in) wide. Inner: 12 to 20 tepals; pink to purple, oblanceolate to lanceolate, 10 to 22 mm (0.40 to 0.87 in) long and 3 to 7 mm (0.12 to 0.28 in) wide; borne at rim of floral tube
Stamens	Numerous, have yellow anthers a:ttached by filaments (from green to white) to the interior surface of the floral tube	Numerous, with yellow anthers attached by green-to-white filaments to the interior surface of the floral tube	Numerous, with yellow anthers attached by green-to-white filaments to the interior surface of the floral tube
Floral Tube	Arises from upper margin of the seed-producing ovary	Arises from upper margin of the seed-producing ovary	Arises from the upper margin of the seed-producing ovary
Ovary	Bears one style (from pink to yellow) with stigma of about 12 lobes. After pollination, ovary ripens into dry fruit in approximately 4 to 6 weeks, with 15 to 30 seeds turning from green to brown	Bears one style (from pink to yellow) with stigma of about 12 lobes. After pollination, ovary ripens into dry fruit in about 4 to 6 weeks, with 15 to 30 seeds turning from green to brown	Bears one style (from pink to yellow) with stigma of about 12 lobes. After pollination, ovary ripens into dry fruit in about 4 to 6 weeks, with 15 to 30 seeds turning from green to brown
Fruit	Ovoid, barrel-shaped, 9 to 30 mm (0.35 to 1.2 in) long (usually less than 22 mm (0.87 in) long), and 8 to 12 mm (0.31 to 0.47 in) wide	Ovoid, barrel-shaped, 9 to 30 mm (0.35 to 1.2 in) long (usually less than 25 mm (1 in) long), and 7 to 12 mm (0.28 to 0.47 in) wide	Ovoid, barrel-shaped, 9 to 30 mm (0.35 to 1.2 in) long (usually less than 25 mm (1 in) long), and 7 to 12 mm (0.28 to 0.47 in) wide

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Seeds	Black, asymmetrically elongated, with hilum (seed scar at point of attachment to ovary wall) near side of smaller seed lobe; 1.5 mm (0.06 in) wide and 2.5 mm (0.1 in) long; testa (seed coat) covered by rounded papillae	Black, asymmetrically elongated, with hilum near side of smaller seed lobe; 1.5 mm (0.06 in) wide and 2.5 mm (0.1 in) long; testa composed of hexagonal papillae with flattened tops	Black, asymmetrically elongated, with hilum near the side of the smaller seed lobe; 1.5 mm (0.06 in) wide and 2.5 mm (0.1 in) long; testa composed of hexagonal papillae with flattened tops
Main Differences	Seed characteristics with areole pubescence of juvenile individuals are the most consistent morphological characteristics separating S. glaucus from S. wetlandicus and S. brevispinus	Testa characteristics are the most consistent morphological characteristics separating S. wetlandicus and S. brevispinus from S. glaucus	Diminutive nature of central spines and overall plant size are the most consistent morphological characteristics separating S. brevispinus from S. wetlandicus and S. glaucus. Testa characteristics are the most consistent morphological characteristics

							separating S. wetlandicus and S. brevispinus from S. glaucus

Required Determinations

Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.)

This rule does not contain any new collections of information that require approval by OMB under the Paperwork Reduction Act. This rule will not impose recordkeeping or reporting requirements on State or local governments, individuals, businesses, or organizations. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

National Environmental Policy Act

We have determined that we do not need to prepare an Environmental Assessment or an Environmental Impact Statement as defined under the authority of the National Environmental Policy Act of 1969, in connection with regulations adopted pursuant to section 4(a) of the Act. We published a notice outlining our reasons for this determination in the Federal Register on October 25, 1983 (48 FR 49244).

References Cited

A complete list of all references cited is available upon request from the Supervisor at the U.S. Fish and Wildlife Service, Utah Field Office (see ADDRESSES).

Authors

The authors of this document are the staff members of the Utah Field Office (see ADDRESSES).

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

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Regulation Promulgation
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Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as set forth below:

PART 17--[AMENDED]

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1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361-1407; 16 U.S.C. 1531-1544; 16 U.S.C. 4201-4245; Pub. L. 99-625, 100 Stat. 3500; unless otherwise noted.

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2. Amend Sec. 17.12(h) by revising the entry for Sclerocactus glaucus, and by adding entries for Sclerocactus brevispinus and Sclerocactus wetlandicus, in alphabetical order under FLOWERING PLANTS, to the List of Endangered and Threatened Plants, to read as follows:

Sec. 17.12 Endangered and threatened plants.

* * * * *
(h) * * *

Species		Historic range	Family	Status	When listed	Critical habitat	Special rules
Scientific name	Common name						
FLOWERING PLANTS							
* * * * * *							
Sclerocactus brevispinus	Pariette cactus	U.S.A. (UT)	Cactaceae	T	59	NA	NA
Sclerocactus glaucus	Colorado hookless cactus	U.S.A. (CO)	Cactaceae	T	59	NA	NA
* * * * * *							
Sclerocactus wetlandicus	Uinta Basin hookless cactus	U.S.A. (UT)	Cactaceae	T	59	NA	NA
* * * * * *							

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Dated: August 24, 2009.
Will Shafroth,
Acting Director, U.S. Fish and Wildlife Service.
[FR Doc. E9-22125 Filed 9-14-09; 8:45 am]
BILLING CODE 4310-55-S

Federal Register

Wednesday,
February 25, 2009

Part II

Department of the Interior

Fish and Wildlife Service

50 CFR Part 17

Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx; Final Rule

DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[FWS–R6–ES–2008–0026; 92210–1117–0000–B4]

RIN 1018–AV78

Endangered and Threatened Wildlife and Plants; Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), designate revised critical habitat for the contiguous United States distinct population segment of the Canada lynx (*Lynx canadensis*) (lynx) under the Endangered Species Act of 1973, as amended (Act). In total, approximately 39,000 square miles (mi²) (101,010 square kilometers (km²)) fall within the boundaries of the revised critical habitat designation, in five units in the States of Maine, Minnesota, Montana, Wyoming, Idaho, and Washington.

DATES: This rule becomes effective on March 27, 2009.

ADDRESSES: Comments and materials received, as well as supporting documentation used in the preparation of this final rule, are available for public inspection, by appointment, during normal business hours, at the Montana Ecological Services Office, 585 Shepard Way, Helena, MT 59601; telephone 406–449–5225. The final rule, environmental assessment, and economic analysis are available on the Internet at *http://www.regulations.gov* and at *http://mountain-prairie.fws.gov/species/mammals/lynx/criticalhabitat.htm.*

FOR FURTHER INFORMATION CONTACT: Mark Wilson, Field Supervisor, Montana Ecological Services Office (see **ADDRESSES** section) (406–449–5225); Lori Nordstrom, Field Supervisor, Maine Field Office (207–827–5938); Tony Sullins, Field Supervisor, Twin Cities Ecological Services Office (Minnesota) (612–725–3548); or Mark Miller, Field Supervisor, Upper Columbia Fish and Wildlife Office (Washington) (509–891–6839).

SUPPLEMENTARY INFORMATION:

Background

It is our intent to discuss only topics relevant to the revised designation of critical habitat in this rule. For more information about the listing of the Canada lynx, refer to the final listing rule published in the **Federal Register** on March 24, 2000 (65 FR 16052), the clarification of findings published in the **Federal Register** on July 3, 2003 (68 FR 40076), the proposed rule to designate revised critical habitat rule published in the **Federal Register** on February 28, 2008 (73 FR 10860), and the notice announcing the availability of the draft economic analysis (DEA), draft environmental assessment, and reopening the comment period that published on October 21, 2008 (73 FR 62450).

Species Information

Canada lynx are medium-sized cats, generally measuring 30 to 35 inches (in) (75 to 90 centimeters (cm)) long and weighing 18 to 23 pounds (8 to 10.5 kilograms) (Quinn and Parker 1987, Table 1). They have large, well-furred feet and long legs for traversing snow; tufts on the ears; and short, black-tipped tails.

Lynx are highly specialized predators of snowshoe hare (*Lepus americanus*) (McCord and Cardoza 1982, p. 744; Quinn and Parker 1987, pp. 684–685; Aubry *et al.* 2000, pp. 375–378). Lynx and snowshoe hares are strongly associated with what is broadly described as boreal forest (Bittner and Rongstad 1982, p. 154; McCord and Cardoza 1982, p. 743; Quinn and Parker 1987, p. 684; Agee 2000, p. 39; Aubry *et al.* 2000, pp. 378–382; Hodges 2000a, pp. 136–140 and 2000b, pp. 183–191; McKelvey *et al.* 2000b, pp. 211–232). The predominant vegetation of boreal forest is conifer trees, primarily species of spruce (*Picea* spp.) and fir (*Abies* spp.) (Elliot-Fisk 1988, pp. 34–35, 37–42). In the contiguous United States, the boreal forest types transition to deciduous temperate forest in the Northeast and Great Lakes and to subalpine forest in the west (Agee 2000, pp. 40–41). Lynx habitat can generally be described as moist boreal forests that have cold, snowy winters and a snowshoe hare prey base (Quinn and Parker 1987, p. 684–685; Agee 2000, pp. 39–47; Aubry *et al.* 2000, pp. 373–375; Buskirk *et al.* 2000b, pp. 397–405; Ruggiero *et al.* 2000, pp. 445–447). In mountainous areas, the boreal forests that lynx use are characterized by scattered moist forest types with high hare densities in a matrix of other habitats (e.g., hardwoods, dry forest, non-forest) with low hare densities. In these areas, lynx incorporate the matrix habitat (non-boreal forest habitat elements) into their home ranges and use it for traveling between patches of boreal forest that support high hare densities where most foraging occurs.

Snow conditions also determine the distribution of lynx (Ruggiero *et al.* 2000, pp. 445–449). Lynx are morphologically and physiologically adapted for hunting snowshoe hares and surviving in areas that have cold winters with deep, fluffy snow for extended periods. These adaptations provide lynx a competitive advantage over potential competitors, such as bobcats (*Lynx rufus*) or coyotes (*Canis latrans*) (McCord and Cardoza 1982, p. 748; Buskirk *et al.* 2000a, pp. 86–95; Ruediger *et al.* 2000, p. 1–11; Ruggiero *et al.* 2000, pp. 445, 450). Bobcats and coyotes have a higher foot load (more weight per surface area of foot), which causes them to sink into the snow more than lynx. Therefore, bobcats and coyotes cannot efficiently hunt in fluffy or deep snow and are at a competitive disadvantage to lynx. Long-term snow conditions presumably limit the winter distribution of potential lynx competitors such as bobcats (McCord and Cardoza 1982, p. 748) or coyotes.

Lynx Habitat Requirements

Because of the patchiness and temporal nature of high-quality snowshoe hare habitat, lynx populations require large boreal forest landscapes to ensure that sufficient high quality snowshoe hare habitat is available and to ensure that lynx may move freely among patches of suitable habitat and among subpopulations of lynx. Populations that are composed of a number of discrete subpopulations, connected by dispersal, are called metapopulations (McKelvey *et al.* 2000c, p. 25). Individual lynx maintain large home ranges (reported as generally ranging between 12 to 83 mi² (31 to 216 km²)) (Koehler 1990, p. 847; Aubry *et al.* 2000, pp. 382–386; Squires and Laurion 2000, pp. 342–347; Squires *et al.* 2004b, pp. 13–16, Table 6; Vashon *et al.* 2005a, pp. 7–11). The size of lynx home ranges varies depending on abundance of prey, the animal's gender and age, the season, and the density of lynx populations (Koehler 1990, p. 849; Poole 1994, pp. 612–616; Slough and Mowat 1996, pp. 951, 956; Aubry *et al.* 2000, pp. 382–386; Mowat *et al.* 2000, pp. 276–280; Vashon *et al.* 2005a, pp. 9–10). When densities of snowshoe hares decline, for example, lynx enlarge their home ranges to obtain sufficient amounts of food to survive and reproduce.

In the contiguous United States, the boreal forest landscape is naturally patchy and transitional because it is the southern edge of the boreal forest range. This generally limits snowshoe hare populations in the contiguous United States from achieving densities similar to those of the expansive northern

boreal forest in Canada (Wolff 1980, pp. 123–128; Buehler and Keith 1982, pp. 24, 28; Koehler 1990, p. 849; Koehler and Aubry 1994, p. 84). Additionally, the presence of more snowshoe hare predators and competitors at southern latitudes may inhibit the potential for high-density hare populations (Wolff 1980, p. 128). As a result, lynx generally occur at relatively low densities in the contiguous United States compared to the high lynx densities that occur in the northern boreal forest of Canada (Aubry *et al.* 2000, pp. 375, 393–394) or the densities of species such as the bobcat, which is a habitat and prey generalist.

Lynx are highly mobile and generally move long distances (greater than 60 mi (100 km)) (Aubry *et al.* 2000, pp. 386–387; Mowat *et al.* 2000, pp. 290–294). Lynx disperse primarily when snowshoe hare populations decline (Ward and Krebs 1985, pp. 2821–2823; O'Donoghue *et al.* 1997, pp. 156, 159; Poole 1997, pp. 499–503). Subadult lynx disperse even when prey is abundant (Poole 1997, pp. 502–503), presumably to establish new home ranges. Lynx also make exploratory movements outside their home ranges (Aubry *et al.* 2000, p. 386; Squires *et al.* 2001, pp. 18–26).

The boreal forest landscape is naturally dynamic. Forest stands within the landscape change as they undergo succession after natural or human-caused disturbances such as fire, insect epidemics, wind, ice, disease, and forest management (Elliot-Fisk 1988, pp. 47–48; Agee 2000, pp. 47–69). As a result, lynx habitat within the boreal forest landscape is typically patchy because the boreal forest contains stands of differing ages and conditions, some of which are suitable as lynx foraging or denning habitat (or will become suitable in the future due to forest succession) and some of which serve as travel routes for lynx moving between foraging and denning habitat (McKelvey *et al.* 2000a, pp. 427–434; Hoving *et al.* 2004, pp. 290–292).

Snowshoe hares comprise a majority of the lynx diet (Nellis *et al.* 1972, pp. 323–325; Brand *et al.* 1976, pp. 422–425; Koehler 1990, p. 848; Apps 2000, pp. 358–359, 363; Aubry *et al.* 2000, pp. 375–378; Mowat *et al.* 2000, pp. 267–268; von Kienast 2003, pp. 37–38; Squires *et al.* 2004b, p. 15, Table 8). When snowshoe hare populations are low, female lynx produce few or no kittens that survive to independence (Nellis *et al.* 1972, pp. 326–328; Brand *et al.* 1976, pp. 420, 427; Brand and Keith 1979, pp. 837–838, 847; Poole 1994, pp. 612–616; Slough and Mowat 1996, pp. 953–958; O'Donoghue *et al.* 1997, pp. 158–159; Aubry *et al.* 2000, pp. 388–389; Mowat *et al.* 2000, pp. 285–287). Lynx prey opportunistically on other small mammals and birds, particularly during lows in snowshoe hare populations, but alternate prey species may not sufficiently compensate for low availability of snowshoe hares, resulting in reduced lynx populations (Brand *et al.* 1976, pp. 422–425; Brand and Keith 1979, pp. 833–834; Koehler 1990, pp. 848–849; Mowat *et al.* 2000, pp. 267–268).

In northern Canada, lynx populations fluctuate in response to the cycling of snowshoe hare populations (Hodges 2000a, pp. 118–123; Mowat *et al.* 2000, pp. 270–272). Although snowshoe hare populations in the northern portion of their range show strong, regular population cycles, these fluctuations are generally much less pronounced in the southern portion of their range in the contiguous United States (Hodges 2000b, pp. 165–173). In the contiguous United States, the degree to which regional lynx population fluctuations are influenced by local snowshoe hare population dynamics is unclear. However, it is anticipated that because of natural fluctuations in snowshoe hare populations, there will be periods when lynx densities are extremely low.

Because lynx population dynamics, survival, and reproduction are closely tied to snowshoe hare availability, snowshoe hare habitat is a component of lynx habitat. Lynx generally concentrate their foraging and hunting activities in areas where snowshoe hare populations are high (Koehler *et al.* 1979, p. 442; Ward and Krebs 1985, pp. 2821–2823; Murray *et al.* 1994, p. 1450; O'Donoghue *et al.* 1997, pp. 155, 159–160 and 1998, pp. 178–181). Snowshoe hares are most abundant in forests with dense understories that provide forage, cover to escape from predators, and protection during extreme weather (Wolfe *et al.* 1982, pp. 665–669; Litvaitis *et al.* 1985, pp. 869–872; Hodges 2000a, pp. 136–140 and 2000b, pp. 183–195). Generally, hare densities are higher in regenerating, earlier successional forest stages because they have greater understory structure than mature forests (Buehler and Keith 1982, p. 24; Wolfe *et al.* 1982, pp. 665–669; Koehler 1990, pp. 847–848; Hodges 2000b, pp. 183–195; Homyack 2003, pp. 63, 141; Griffin 2004, pp. 84–88). However, snowshoe hares can be abundant in mature forests with dense understories (Griffin 2004, pp. 53–54).

Within the boreal forest, lynx den sites are located where coarse woody debris, such as downed logs and windfalls, provides security and thermal cover for lynx kittens (McCord and Cardoza 1982, pp. 743–744; Koehler 1990, pp. 847–849; Slough 1999, p. 607; Squires and Laurion 2000, pp. 346–347; Organ 2001). The amount of structure (*e.g.*, downed, large, woody debris) appears to be more important than the age of the forest stand for lynx denning habitat (Mowat *et al.* 2000, pp. 10–11).

Future of Lynx Habitat

In 2003, we determined that climate change was not a threat to lynx within the contiguous U.S. DPS because the best available science we had at that time (Hoving 2001) was too uncertain in nature (68 FR 40083). Since that time, new information on regional climate changes and potential effects to lynx habitat has been developed (e.g., Gonzalez *et al.* 2007, entire; Knowles *et al.* 2006, pp. 4545–4559; Danby and Hick 2007, pp. 358–359), and this new information suggests that climate change may be an issue of concern for the future conservation of lynx because lynx distribution and habitat is likely to shift upward in elevation within its currently occupied range as temperatures increase (Gonzalez *et al.* 2007, pp. 7, 13–14, 19). This information, combined with the information in Hoving 2001, still needs to be evaluated further to determine how climate change might affect lynx and lynx habitat. We are evaluating this information in the 5-year review we are conducting for lynx.

At this time, we find it appropriate to designate critical habitat for the lynx in areas occupied by the species that currently contain the physical and biological features essential to the conservation of the lynx. Revisions to the critical habitat designation may be necessary in the future to accommodate shifts in the occupied range of the lynx. The revised critical habitat units in this rule include higher-elevation habitats that lynx would be able to continue to use if lynx distribution or habitat shifted upward in elevation.

Previous Federal Actions

For more information on previous Federal actions concerning the lynx, refer to the final listing rule published in the **Federal Register** on March 24, 2000 (65 FR 16052), the clarification of findings published in the **Federal Register** on July 3, 2003 (68 FR 40076), and the final rule designating critical habitat for lynx published in the **Federal Register** on November 9, 2006 (71 FR 66007). On July 20, 2007, we announced that we would review the November 9, 2006, final critical habitat rule after questions were raised about the integrity of scientific information used and whether the decision made was consistent with the appropriate legal standards. Based on our review of

the previous final critical habitat designation, we determined that the critical habitat designation was improperly influenced by then deputy assistant secretary of the Interior Julie MacDonald and, as a result, may not be supported by the record, may not be adequately explained, or may not comport with the best available scientific and commercial information. On January 15, 2008, the U.S. District Court for the District of Columbia issued an order stating the Service's deadlines for a proposed rule for revised critical habitat by February 15, 2008, and a final rule for revised critical habitat by February 15, 2009. Consequently, our proposed rule was signed on February 13, 2008, and submitted to the **Federal Register**. The proposed rule was subsequently published in the **Federal Register** on February 28, 2008 (73 FR 10860). We initiated a 5-year review of the status of lynx on April 18, 2007 (72 FR 19549).

Summary of Comments and Recommendations

We requested written comments from the public on the proposed revised designation of critical habitat for the lynx during two comment periods. The first comment period, associated with the publication of the proposed revised rule (73 FR 10860), opened on February 28, 2008, and closed on April 28, 2008. Five informal public meetings were held during this comment period in Washington (2), Minnesota (2), and Maine (1). We also requested comments on the proposed revised critical habitat designation, associated DEA, and draft environmental assessment during a second comment period which opened October 21, 2008, and closed on November 20, 2008 (73 FR 62450). During this comment period, we held a public hearing on November 7, 2008, in Kalispell, Montana, and one on November 13, 2008, in Cody, Wyoming. We contacted appropriate Federal, State, and local agencies; Tribes; scientific organizations; and other interested parties and invited them to comment on the proposed rule, DEA, and draft environmental assessment.

During the comment period for the proposed rule that was open between February 28, 2008, and April 28, 2008, we received a total of 338 comment letters. For the comment period open from October 21, 2008, to November 20, 2008, we received 184 comment letters and 17 comments at the two public hearings. Comments were received from Federal, State, Tribal and local governments, non-government organizations, private businesses, and individuals.

In accordance with our policy published on July 1, 1994 (59 FR 34270), we solicited expert opinions from 17 knowledgeable individuals with scientific expertise that included familiarity with the species, the geographic region in which the species occurs, and conservation biology principles. We received responses from three of the peer reviewers. The peer reviewers had differing assessments of our methods and conclusions and provided additional information, clarifications, and suggestions to improve the final critical habitat rule. Peer reviewer comments are addressed in the following summary and incorporated into the final rule as appropriate.

We reviewed all comments received from the peer reviewers and the public for substantive issues and new information regarding critical habitat for the lynx, and we addressed them in the following summary.

Peer Review Comments

(1) Comment: Some peer reviewers commented that Federal lands should be included in the final rule due to their importance for lynx in the Distinct Population Segment area and because designation would provide clarification to land managers as to the importance of conserving those lands. The general public also submitted comments noting this issue.

Our response: We agree that that in all units except Unit 1 (where Federal lands make up a very small portion of the designation), Federal lands are an essential component of the revised critical habitat designation. We have designated critical habitat on Federal lands, as described in this final rule.

(2) Comment: Some peer reviewers and other commenters stated that our criteria (especially regarding evidence of occupancy and reproduction) for defining lynx critical habitat were too narrow or arbitrary, and resulted in omission of areas they consider important to lynx conservation, particularly the Selkirk and Kettle Mountains, the Southern Rockies/Colorado, and a slightly more extensive area in Minnesota. Other general comments addressed expanding the Greater Yellowstone Area (GYA) to include Grand Teton National Park and southwest Wyoming to protect a corridor for dispersal. Other comments noted the GYA should not be included in critical habitat because it is isolated from populations in Canada. Several peer reviewers noted that it has not been established that the Southern Rockies population is isolated, and therefore this area should be considered critical habitat. Additionally, we received comments recommending we designate critical habitat according to the lynx recovery outline, which included the areas of concern noted above by peer reviewers in addition to areas considered secondary or peripheral to recovery.

General comments also were concerned with our criteria, asserting we should not restrict our designation solely to areas with confirmed evidence of the presence of reproducing lynx populations because lynx surveys have not been adequate to detect all reproducing lynx populations. General comments also questioned why critical habitat designation was restricted to areas of confirmed evidence of reproducing lynx populations and that our revised critical habitat designation should be extended to all occupied areas, areas currently managed for lynx, all habitats supporting snowshoe hares, and unoccupied areas in the historic range of the lynx.

Our response: Critical habitat is defined in section 3 of the Act as: (1) The specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (a) essential to the conservation of the species and (b) which may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species. Not all locations with records of lynx presence are essential for the conservation of the species; lynx are a wide-ranging species, and areas containing periodic records that lack evidence of reproducing populations are not considered essential to the species (see Criteria Uses to Identify Critical Habitat section below). In that section of the proposed and final revised critical habitat rules, we describe in detail the parameters used for delineating areas that contain the physical and biological features essential to the conservation of lynx, as required by the definition of critical habitat when considering occupied areas. We also determined that occupied areas containing the features essential to the conservation of lynx support the majority of recent lynx records and evidence of breeding lynx populations since 1995.

We relied on records since 1995 to ensure that the revised critical habitat designation is based on the best available data that most closely represents the current status of lynx in the contiguous United States and the

geographic area occupied by the species. We recognize that adequate surveys to confirm the presence of lynx populations have not occurred everywhere throughout the species' range; however, no information was provided to us during the public comment periods to suggest where there might be locations with undetected breeding populations that we should more closely evaluate for designation as critical habitat other than the areas we already considered. We determined that the additional areas suggested by commenters are secondary or peripheral areas not essential to the conservation of the lynx.

While reviewing our original critical habitat proposal published on November 9, 2005 (70 FR 68294), we determined that habitat in the GYA contained the physical and biological features essential to the conservation of lynx; in addition, the GYA has a long history of lynx presence and reproduction, and its geographic location connects lynx populations in Canada to lynx habitat in Colorado and Utah. However, we designated areas within the GYA that contain the physical and biological features essential to lynx in sufficient quantity and spatial arrangement as demonstrated by their consistent use by lynx. The entire GYA may be permanently or intermittently occupied by lynx. Lynx may expand into Grand Teton National Park and additional areas in southwestern Wyoming not in the current critical habitat designation, but we have no indication that the habitat contains the physical and biological features essential to the species in necessary quantities to support populations of lynx.

The methodology we used in defining areas for lynx critical habitat did not mirror that used for the lynx recovery outline, but did reflect the biological concepts considered in the recovery outline. We used the best scientific information available in determining which areas contained the features essential for the conservation of lynx. As explained on pages 10869 to 10871 of the proposal to revise critical habitat (February 28, 2008; 73 FR 10860), the areas we determined to be essential for the conservation of lynx do not include all the areas identified in the recovery outline. The criteria we used for determining areas essential to the conservation of lynx for the revised critical habitat designation are based on the critical habitat requirements of the Act, which are more selective than those used for delineating the recovery areas in the lynx recovery outline. The recovery outline more broadly encompasses older records of lynx and gave less weight to direct connectivity with Canada, although in the recovery outline it was recognized that maintaining connectivity with Canadian lynx populations was important. Furthermore, the areas in the recovery outline were mapped conceptually, include substantial areas that do not contain the physical and biological features essential for lynx or are both unoccupied and not essential for lynx conservation, and therefore do not meet the definition of critical habitat. We refined our mapping for the purposes of designating critical habitat in order to meet the statutory requirements associated with critical habitat. As a result, areas determined to be essential to the conservation of lynx for the purposes of critical habitat did not include all the areas delineated in the recovery outline.

The Kettle Range in north-central Washington historically supported lynx populations (Stinson 2001, pp. 13–14), and boreal forest habitat within the Kettle Range appears to contain habitat for lynx; however, there is no evidence that the Kettle Range is currently occupied by a reproducing lynx population (Koehler 2005 entire); therefore, it did not meet the methodology we used for determining occupancy (see Criteria Used To Identify Critical Habitat in the proposed rule, February 28, 2008; 73 FR 10860). In addition, while the Kettle Range contains physical and biological features important to lynx, its spatial configuration and quantity of habitat do not appear to be sufficient to support a breeding population of lynx.

In the Southern Rockies, it is still uncertain whether a self-sustaining lynx population will become established as a result of Colorado's reintroduction effort (Shenk 2007, p. 18). We recognize that this reintroduction has been an effort to recover the lynx in Colorado; however, the Southern Rockies contain marginal habitat, are on the southern limit of the species' range, and have not been shown to support a breeding population of lynx. Therefore, we find that habitat in Colorado is not essential to the conservation of species.

(3) Comment: Some peer reviewers commented that wildfire prevention and suppression activities would not be precluded by critical habitat designation and that areas occurring within the wildland-urban interface (WUI) should not be excluded or exclusions should be limited to narrowly defined areas in the immediate vicinity of structures. Some general comments stated that WUI areas should be included in critical habitat because urban interface concerns could be used as an excuse to allow developmental sprawl and meet timber harvest quotas. Commenters raised concerns that lynx habitat management would increase wildfire risk to forests and communities and requested that WUI areas be excluded from critical habitat designation. Other commenters noted that recent forest fires eliminated PCEs in some areas, so removal of those lands from critical habitat designation is justified. Other commenters requested that additional critical habitat be designated as buffers against fire-produced habitat loss.

Our response: Areas within the WUI are designated as lynx critical habitat as described in this rule. Wildfire is not thought to be a threat to lynx, and often results in beneficial effects when burned areas regenerate into lynx foraging habitat. As described in the final rule listing the lynx (March 24, 2000, 65 FR 16052), natural fire plays an important role in creating the mosaic of vegetation patterns, forest stand ages, and structure that provide good lynx and snowshoe hare habitat, particularly in the western Great Lakes region and in the western mountain ranges of the United States (Agee 2000, pp. 47–56).

Currently, WUI areas are defined by a variety of methods varying from the defensible space immediately surrounding structures out into forest areas within several miles of communities. The designation of critical habitat will not prohibit protection of defensible space around homes or the WUI. The regulatory provisions of critical habitat affect actions on Federal lands or with a Federal nexus. We expect that a majority of urban interface fuels projects would occur under the authority of the U.S. Forest Service (USFS). The Northern Rockies Lynx Management Direction (NRLMD) amending the National Forest's management plans to protect lynx addresses additional fuels reduction projects in areas within the WUI. In our analysis of the NRLMD (USFWS 2007, pp. 67–68) during section 7 consultation with the USFS, we determined that even with additional fuels reduction, the management in the NRLMD would provide for the recovery of lynx in these areas. Areas burned may still contain the physical and biological features essential to lynx; those areas still represent boreal landscapes supporting a mosaic of differing successional forest stages.

We are designating all habitat that meets the criteria for critical habitat, i.e., known to be occupied at the time of listing and containing the physical and biological features essential to the conservation of the species. Neither the

Act nor the implementing regulations provide for designating additional areas as buffers.

(4) Comment: Some peer reviewers suggested that the proposed revised rule incorrectly characterized lynx foraging habitat, particularly in the western critical habitat units, by failing to highlight the importance of mature, multistoried forest stands for lynx in this area.

Our response: Recent studies have shown that mature, multistoried stands are important foraging habitat for lynx in Unit 3, and they are likely important in Units 4 and 5 as well. We have added language to clarify this in the final rule.

(5) Comment: Some peer reviewers felt that statements in the proposed revised rule concerning the low sensitivity of lynx to forest management practices were misleading.

Our response: The statement in the proposed revised rule raised by commenters relates to ''matrix habitat,'' which is habitat that surrounds patches of foraging and denning habitat. Matrix habitat, by definition, is habitat that is crucial for preserving the ability of lynx to move between foraging and denning areas. However, the vegetative condition and structure of matrix habitat is not relevant to its value. For this reason, we do not foresee the need for prescriptive management for lynx in matrix habitat beyond maintaining the ability for lynx to move through this habitat to access other habitat types within a home range. We do recognize that lynx are sensitive to forest management practices in foraging and denning habitat and that forest management activities can have significant positive and negative impacts on lynx depending on the nature and timing and activities.

(6) Comment: Some commenters expressed that seasonal differences in lynx habitat preference is poorly articulated in the proposed revised rule. One commenter pointed out that lynx starvation in northwestern Montana during late winter-early spring is tied to the abundance and quality of winter habitat (mature, multistoried forest) and is the primary issue for lynx conservation in this area.

Our response: Lynx use a variety of habitat types and conditions during the year, which is why we drew the boundaries of the critical habitat units to include entire landscapes of boreal forest in a variety of successional stages that account for year-round habitat needs.

(7) Comment: Several peer reviewers and other commenters noted the important role that private lands play in lynx conservation and stated that the final rule should better define the degree to which private lands contribute to lynx persistence.

Our response: Through the process of developing our proposed revised rule and subsequent modifications, we determined which lands contain features essential to the conservation of lynx. Private lands were included because of their value for lynx conservation. The relative contribution of private lands to lynx conservation varies between the five revised critical habitat units. Unit 1 is almost entirely comprised of private land, and therefore private lands provide almost the entire lynx habitat in this area. Conversely, Units 4 and 5 have relatively little private land, with Federal lands providing the bulk of lynx habitat. Units 2 and 3 have a mix of private, Federal, and State lands. We recognize the essential nature of private lands for lynx conservation where we are designating those lands as critical habitat. We have retained private lands in this final designation in all cases except where we determined, under section 4(b)(2) of the Act, that the benefits of excluding specific areas were greater than the benefits of including those areas in the designation (see Application of Section 4(b)(2) of the Act for more information).

(8) Comment: Some peer reviewers indicated that the statement in the proposed revised rule that snowshoe hares must be present over a large proportion of the landscape in order for that landscape to support lynx is incorrect. Reviewers cited the presence of lynx in the GYA and Northern Rockies as examples of lynx populations that exist despite the landscape not being dominated by forest types supporting snowshoe hares.

Our response: While we still highlight that the proportion of the landscape that supports snowshoe hares is important, we acknowledge that the proportion of the landscape that must support snowshoe hares in order to support lynx is not known with certainty. Lynx populations may persist in some mountainous areas despite snowshoe hares occurring in relatively small and isolated patches. We have clarified this point in this final rule.

(9) Comment: One peer reviewer recommended that the primary constituent element (PCE) identified for lynx be broadened to include multistoried stands of mature conifers with boughs that touch the snow surface, as these are important foraging habitats in Montana and elsewhere in the West.

Our response: We agree, and we have provided clarification to that portion of the PCE in this final designation.

(10) Comment: One peer reviewer stated that the definition of denning habitat in the proposed revised rule was not broad enough to capture all of the den sites used by lynx in Montana.

Our response: The description of denning habitat in the proposed revised rule captures the type of habitat most used by lynx for denning in the contiguous United States. We believe that our description adequately captures lynx denning habitat for the purposes of delineating critical habitat in Montana and in other critical habitat units.

(11) Comment: Several peer reviewers and one commenter provided views on the relative importance of Tribal lands for lynx conservation. Some thought we should have included some Tribal lands in the proposed revised rule. We received several comments, primarily from Tribes, recommending that all Tribal lands be excluded.

Our response: In accordance with Secretarial Order 3206, ''American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act'' (June 5, 1997); the President's memorandum of April 29, 1994, ''Government-to-Government Relations with Native American Tribal Governments'' (59 FR 22951); Executive Order 13175 ''Consultation and Coordination with Indian Tribal Governments;'' and the relevant provision of the Departmental Manual of the Department of the Interior (512 DM 2), we believe that fish, wildlife, and other natural resources on Tribal lands are better managed under Tribal authorities, policies, and programs than through Federal regulation wherever possible and practicable. Such designation is often viewed by Tribes as an unwanted intrusion into Tribal self governance, thus compromising the government-to-government relationship essential to achieving our mutual goals of managing for healthy ecosystems upon which the viability of threatened and endangered species populations depend.

We contacted all Tribes potentially affected by the proposed revised designation and met with some of them to discuss their ongoing or future management strategies for lynx. Several Tribes subsequently submitted letters requesting exclusion based on their sovereign rights and concerns about the economic impact and effects on their ability to manage natural resources. As described in our proposed revised rule, we believe that conservation of lynx can be achieved without including Tribal lands within the revised critical habitat units. We determined that these lands are not essential to the conservation of lynx, but also, many of the Tribes have

management plans that provide for lynx habitat needs. The Tribal lands included in the proposed revised designation are found only in the Maine, Minnesota, and Montana units and the size of the areas are relatively small (approximately 223, 187, and 898 km^2, respectively [86, 72, and 347 mi^2]). We are excluding these Tribal lands from this final designation under section 4(b)(2) of the Act. See Exclusions Under Section 4(b)(2) of the Act for a discussion of why these lands have been excluded.

(12) Comment: Some peer reviewers and commenters recommended we use lynx analysis unit (LAU) boundaries as defined by some agencies to define the critical habitat boundaries, because they used habitat-based processes to identify the best lynx habitat.

Our response: We agree. After receiving numerous comments to this effect, we solicited lynx habitat data and LAU boundary data from Federal and State agencies, as well as private companies in and around the proposed revised critical habitat in Units 2, 3, 4, and 5. We then revised the critical habitat boundary to more closely reflect where lynx habitat occurs and followed LAU boundaries to the extent practicable (e.g., where doing so would not leave out significant lynx habitat or include significant areas of non-lynx habitat). These potential modifications were announced to the public when we announced the availability of the DEA and the draft environmental assessment (73 FR 62450) on October 21, 2008.

(13) Comment: Some peer reviewers questioned the need to consider climate change in a critical habitat designation. Other peer reviewers and commenters stated the need to designate critical habitat in high elevation habitats that are currently unsuitable for lynx occupancy but may become suitable with climate changes. Other commenters stated that climate change will render some proposed areas unsuitable; therefore, these areas should not be included in the designation. One commenter requested an analysis of climate change effects on each of the microclimes included in the Minnesota proposed critical habitat.

Our response: We acknowledge that climate change could change the suitability of lynx habitat in the future. However, we are required to designate critical habitat based upon the best available scientific and commercial data at the time that we finalize the designation. At this point in time, reliable projections of future climate in lynx habitat in the contiguous United States are not available. However, for mountain-dwelling species like lynx, we conclude that higher elevation habitat is likely to become increasingly important in the face of climate changes. Designated critical habitat units include the highest-elevation habitat in the areas, and these areas would likely become more important to the extent lynx distribution and habitat shift upward in elevation as temperatures increase. High elevation habitat was included in the proposed designation, and we have determined it is appropriate to include these areas in the final designation.

General Issues and Responses

(1) Comment: We received numerous comments concerning possible restrictions imposed by critical habitat designation on economic, recreation, forest management, predator control, infrastructure, and energy transmission activities on private and public lands. Some commenters are concerned the designation provides a mechanism for increased third party litigation, and some asserted the designation of critical habitat constitutes an uncompensated taking of private property and is therefore illegal.

Our response: Critical habitat has a direct regulatory impact on the actions of Federal agencies only. Therefore, a critical habitat designation on private land has no regulatory impact on actions carried out by landowners unless they seek Federal funding or a Federal permit to carry out those actions. For example, if landowners must obtain a permit from the U.S. Army Corps of Engineers (Corps) under section 404 of the Clean Water Act (33 U.S.C. 1251 *et seq.*) to carry out an action on their land, the Corps must consult under section 7 to evaluate the effects that the permitted activity may have on critical habitat. Even then, the designation may only have a substantial impact on the activity if it is likely to result in the destruction or adverse modification of the critical habitat. It is the responsibility of the Federal agency, not the private landowner, to initiate the consultation with the Service.

The Act prohibits Federal agencies from carrying out actions that would destroy or adversely modify critical habitat. A Federal action (e.g., winter recreation, energy transmission, mining, or road construction) that is not likely to cause destruction or adverse modification of lynx habitat may not be materially affected by a critical habitat designation. Federal action agencies must evaluate the potential effects of each action on its own merits. If a Federal action would result in destruction or adverse modification of lynx habitat, the Service would suggest reasonable and prudent alternatives to avoid the destruction or adverse modification of critical habitat.

Section 4(a)(3) of the Act requires that critical habitat be designated for listed species. The designation of critical habitat for lynx may increase the number of lawsuits brought forward by citizens opposed to certain actions. Although this is possible, these lawsuits may only have merit if the Federal agency that is funding, authorizing, or carrying out the action does not adequately consider its potential effects to critical habitat, or consult, as appropriate, with the Service in making its final decision.

The promulgation of a regulation does not take private property unless the regulation denies the property owners all economically beneficial or productive use of their land. Further, in accordance with Executive Order 12630 (Government Actions and Interference with Constitutionally Protected Private Property Rights), we analyzed the potential takings implications of designating critical habitat for the lynx in a takings implications assessment (TIA), which is available on request. The conclusion in the TIA was that the possibility for take of private property due to designation of critical habitat for lynx is remote.

(2) Comment: We received several comments stating that the proposed critical habitat designation area should be smaller, or that no critical habitat should be designated. These comments contained little explanation to support the recommendations. Other comments indicated that the area designated for critical habitat in Minnesota was too small to be significant to lynx survival.

Our response: Section 4(a)(3) of the Act requires that critical habitat be designated for listed species. The lynx was listed as a threatened species under the Act on March 24, 2000 (65 FR 16052). Under section 4(b)(2), the Act requires that a critical habitat designation be made on the basis of the best scientific data available and after taking into consideration the economic impact and any other relevant impact of specifying any particular area as critical habitat. In order for us to consider excluding a particular area from a critical habitat designation based on economic or other relevant impacts, we need geographic specificity and supporting documentation that can be analyzed. The comments did not provide this information, making analysis for exclusion or explanation of inclusion impossible. In general, after considering the data available, we proposed areas for critical habitat that represented the breadth of ecological settings and sufficient number of

populations to satisfy the biological requirements of the lynx and the statutory requirements of the Act.

We believe that the 8,200 mi² (21,238 km²) of land in Minnesota proposed for critical habitat is a significant part of the designation. The high-quality lynx habitat proposed in the Minnesota unit comprises 20 percent of the total area proposed for critical habitat in the contiguous United States. In addition, the Minnesota unit is the only area in the Great Lakes region with strong, long-term evidence of the persistence of lynx populations. As we explained in detail in the Criteria Used To Identify Critical Habitat section in the proposed rule, the inclusion of the Minnesota unit is important in applying the conservation principles of representation, resiliency, and redundancy to the critical habitat designation for lynx. Focusing lynx conservation efforts, including critical habitat designation, on areas with a long-term presence of reproducing lynx and connectivity to populations in Canada has the greatest chance of ensuring the continued persistence of lynx in the contiguous United States.

(3) Comment: One commenter indicated that indirect effects of State and local regulations may follow critical habitat designation.

Our response: We recognize that State and local governments have the authority to promulgate regulations or local rules related to a critical habitat designation. However, listed species and their habitats are protected by the Act regardless of whether they are in areas designated as critical habitat. The draft economic analysis (DEA) addressed the potential for newly promulgated regulations or rules resulting from our critical habitat designation; none were anticipated. Therefore, we do not anticipate additional regulatory restrictions as a result of State or local regulations.

(4) Comment: Comments included concerns about increased threats to lynx and lynx habitat due to development, vegetation management by Federal agencies that destroys snowshoe hare habitat, and the introduction and proliferation of wolves.

Our response: Critical habitat designation identifies the specific areas within the geographical area occupied by the species that contain the physical and biological features essential to the conservation of the species, and which may require special management considerations or protection. Designation of critical habitat helps focus conservation and recovery activities. The designation of critical habitat by itself does not achieve conservation or recovery of a species, nor does it prohibit development or forest management activities that alter snowshoe hare habitat. The Act does not automatically restrict all uses of critical habitat, but only imposes restrictions under section 7(a)(2) on Federal agency actions that may result in destruction or adverse modification of critical habitat. Each Federal action, including development, permitting, funding, and forest management, would be evaluated by the involved Federal agency, in consultation with the Service, in relation to its impact on the critical habitat. If, after evaluation and consultation, it is concluded that a proposed action is likely to result in the destruction or adverse modification of critical habitat, the Service is required to suggest reasonable and prudent alternatives to the action that would avoid the destruction or adverse modification of critical habitat.

To a private property owner, the designation of critical habitat becomes important only when undertaking an activity that is authorized, funded, or completed by a Federal agency. Conservation actions, however, are not limited to Federal agencies. Lynx are protected on Federal and non-Federal lands through prohibitions and constraints of section 9 of the Act, regardless of critical habitat designation. Although consultation with the Service is not specifically stated in the Act, non-Federal activities, including development and forest management, may require permitting by the Service if an action would result in a taking of the species as described under section 9 of the Act.

Other predator species could affect lynx negatively by competing for resources, direct predation of lynx, or both. Lynx are vulnerable to competition for prey because of a selective diet that relies heavily on snowshoe hare. Wolf prey competition is unlikely based on the minor inclusion of small mammals in their diet. Wolves could have a positive influence on lynx by killing coyotes that compete with lynx for rabbits and hares. Predation of lynx by wolves has not been identified as a threat to the species.

(5) Comment: We received several comments requesting additional hearings, public meetings, or an extension of the public comment period. Some commenters stated that public participation was precluded by not adequately notifying landowners about the proposal and not having a completed economic analysis at the time the proposed rule was published. Some commenters felt that access to listing documents, including maps, was not convenient and that the **Federal Register** was an inadequate mechanism for notifying the public of the proposal.

Our response: We made a concerted effort to provide public notice of this rulemaking. Because of the large scope of the proposed designation it was not possible to contact each landowner. However, we issued a widely-disseminated news release regarding our proposal, and published legal notices in major newspapers in areas involved in the proposal. We published **Federal Register** notices, including the critical habitat proposal, reopening of the comment period, and notice of availability of draft documents. We sent hundreds of letters, cards, and e-mails to State and Federal agencies, Tribal governments, local governments, private individuals, private companies, non-government organizations, and elected officials announcing the proposal, document availability, and public meetings and hearings. We also issued press releases concurrent with **Federal Register** notice announcements. A web page of lynx critical habitat materials and information has been maintained at *http://mountain-prairie.fws.gov/species/mammals/lynx/criticalhabitat.htm.*

We received several requests for public hearings during the initial comment period for the proposed rule. Hearings were conducted as required under section 4(b)(5)(E) of the Act. Public hearings on the published proposal were held on November 7, 2008, in Kalispell, Montana, and November 13, 2008, in Cody, Wyoming. Open houses and meetings on the published proposal were held on March 25, 2008, Duluth, Minnesota; April 23, 2008, Bloomington, Minnesota; May 20, 2008, Grand Marais, Minnesota; March 25, 2008, Twisp, Washington; and April 2, 2008 and November 10, 2008, Old Town, Maine. In the proposed rule we provided contact information for four Service Field Offices for anyone seeking further information on the proposed revised critical habitat designation. Therefore, we believe that we made a conscientious effort to reach all interested parties and provide avenues for them to obtain information concerning our proposal and supporting documents.

We recognize the scale of the maps published in the **Federal Register** made it difficult to accurately identify whether particular parcels of land were included within the proposed designation. However, the descriptions that began on page 10881 of the proposed rule (73 FR 10860; February 28, 2008) were provided to assist the public in understanding exactly which lands were proposed as critical habitat.

We acknowledge that a draft economic analysis (DEA) was not available to the public at the time of publishing the proposed rule in the **Federal Register**. We considered it important to release the proposed rule to the public for review and comment as soon as possible. The DEA was released for public review as soon as it was completed. The comment period was then reopened for 30 days, and the public had an opportunity to submit comments on both the proposed rule and the accompanying DEA.

(6) Comment: A commenter stated that the proposed critical habitat rule misrepresented the legal boundaries of Cook County townships in Minnesota leading to a lack of citizen participation. A commenter stated that we misrepresented critical habitat effects on private property, specifically that designation imposes a take permit system for non-Federal activities on private land, thereby limiting public participation and violating the National Environmental Policy Act (NEPA) (42 U.S.C. 4321 *et seq.*).

Our response: We disagree on both issues. We believe that detailed and sufficient information was provided to the public that clearly delineated boundaries for critical habitat. The proposal included a statement on page 10882 that critical habitat does not include towns or populated areas as they now exist. The term ''now exist,'' is a function of the municipal boundaries that are not delineated by the Service but established, in most cases, by non-Federal, local entities. Numerous areas in Minnesota, including in Cook County, are not included in the critical habitat area. More detailed information on the boundaries of the proposed critical habitat was included on pages 10881 through 10895, with specific delineations for Minnesota on pages 10886 and 10887.

Regulatory implications for private lands were clearly stated in the proposed rule. The designation of critical habitat for the lynx does not affect land ownership or establish a conservation area, does not allow the government or public to access private lands, and does not require (although it encourages) implementation of restoration, recovery, or enhancement measures by a landowner for the lynx. In situations where a landowner seeks Federal agency funding or authorization of an activity that may affect the lynx or its critical habitat, the Federal agency is responsible for complying with section 7 of the Act to determine the impacts of its action on the lynx and its critical habitat. If Federal authorization or funding of the proposed private action is likely to result in the destruction or adverse modification of lynx critical habitat, the Service and the Federal action agency, in coordination with the landowner as an applicant, would cooperate in the development of a reasonable and prudent alternative that avoids that outcome and meets other specific criteria set forth in the regulations. The designation of critical habitat does not institute a permit requirement for the private landowner whose activity results in the take of a listed animal species. Any appropriate permitting became necessary at the time the lynx was listed in 2000.

As stated in the response to Comment 5, we made a conscientious effort to reach all interested parties and provide avenues for them to obtain information, including an environmental assessment for NEPA compliance, and submit comments concerning our proposal.

(7) Comment: Many commenters did not believe that the lynx qualified as a threatened species. Some commenters thought the species should be delisted, and others thought it should be listed as endangered. Some commenters believe that designation of critical habitat is necessary to recover lynx, but that designation of critical habitat prior to completion of a lynx recovery plan or other lynx conservation guidance is premature. Other commenters were concerned about the effectiveness of critical habitat designation and the ineffectiveness of single species management. Commenters stated that critical habitat designation was in conflict with Federal mining laws, and that other Federal agencies were not complying with the Endangered Species Act, Multiple-use Sustained-yield Act of 1960 (16 U.S.C. 528 *et seq.*), and others. Some commenters stated that the 2005 critical habitat rule was supported by the record and should not be changed.

Our response: The lynx was listed as a threatened species under the Act on March 24, 2000 (65 FR 16052). Section 4(a)(3) of the Act requires that critical habitat be designated for listed species. This rule addresses the required critical habitat designation; listing actions are not part of the critical habitat rule.

On January 15, 2008, the U.S. District Court for the District of Columbia ordered the Service to complete a final rule for revised critical habitat by February 15, 2009. A recovery plan need not be completed before critical habitat is designated, but is useful in guiding the designation if one exists. The drafting and finalization of a recovery plan for lynx has not been feasible due to work load and economic constraints. However, the lynx recovery outline was used to guide the proposed revised lynx critical habitat designation. The areas we considered in our methodology for defining critical habitat for the lynx did not mirror the exact areas identified in the recovery outline, but did reflect the biological concepts considered important in the recovery outline. We used the best science available in determining areas that contained the features essential for the conservation of lynx. Designation of critical habitat does not in itself bring about recovery, but designation of critical habitat can help focus conservation and recovery activities for listed species by identifying areas essential to conserve the species. Specific management recommendations for areas designated as critical habitat are most appropriately addressed in subsequent recovery and management plans.

We agree that research is important, and that managing for a single species may not provide the maximum benefit for a biological community or an ecosystem as a whole. The purpose, however, of the this rulemaking is to comply with a directive of the Act to designate areas with the biological and physical features necessary for the conservation of the lynx.

An analysis of the possible contradictions of statutes or the compliance of Federal agencies with relevant or unrelated laws is not within the purview of this critical habitat rule.

While some believe that our previous designation was satisfactory, we reviewed the previous critical habitat rule for the lynx (71 FR 66007; November 9, 2006) after questions were raised about the integrity of the scientific information used and whether the decision made was consistent with the appropriate legal standards. We determined that it was necessary to revise the critical habitat designation based on that review.

(8) Comment: Some commenters questioned the presence of primary constituent elements (PCEs) for lynx in specific areas proposed as critical habitat, and recommended that the proposal be refined. Specific areas cited included the shore of Lake Superior, State of Wyoming, existing and proposed mining areas, and matrix habitat. Other commenters asserted that the boundaries we used (such as the 4,000-foot (ft), 1,219-meter (m)) elevation contour or highways were arbitrary and overly broad.

Our response: We reviewed available maps, peer and public comments, and biological information received during the public comment period. Subsequently, portions of units that did not contain the PCE or where

development was concentrated were removed from the final designation. Any developed areas and the land on which structures are located inside critical habitat boundaries are excluded from critical habitat designation as is described in this final rule. In some areas, unit boundaries were expanded to incorporate adjacent lynx habitat that had been inadvertently left out of the proposed critical habitat.

Designated critical habitat areas in Wyoming (Greater Yellowstone Area (GYA)—Unit 5) have confirmed records of reproducing lynx and contain lynx habitat similar to the Northern Rockies. Lynx are generally associated with the Rocky Mountain Conifer Forest vegetation class in Wyoming, which is dominated by subalpine fir, Engelman spruce, and lodgepole pine. As described in detail in the proposed rule on page 10866, lynx habitat in the GYA is typically found in a widely scattered mosaic of matrix habitat. Individual lynx adjust their home range to incorporate land that is not typical lynx foraging habitat, but is used primarily for travel. The need for matrix habitat designated as critical habitat is most pronounced in the GYA, but matrix habitat is important in all designated areas to retain unimpeded movement of lynx between patches of suitable foraging and denning habitats.

Roads and other human-made structures were used as boundaries for critical habitat where they clearly delineated areas with confirmed records of lynx reproduction and the presence of PCEs. In the Washington State Unit, the 4,000-ft (1,219-m) elevation contour is used to delineate the critical habitat boundary because the features essential to the conservation of lynx, the majority of lynx records, the evidence of reproduction, and the boreal forest types are found above 4,000 ft in Washington State.

(9) Comment: Comments were received questioning why changes were made from the previous (2005) rule. Specific changes noted were the identification of lands requiring special management; inclusion in the current proposed rule of lands previously exempted under sections 4(b)(2) and 3(5)(a) of the Act; and the expansion of critical habitat beyond the boundaries of Voyageurs National Park and the Boundary Waters Canoe Area in Minnesota.

Our response: As explained in the "Previous Federal Actions" section on page 10863 of the February 28, 2008 proposed rule, we determined that it is necessary to revise the November 9, 2006, final critical habitat rule as a result of questions that were raised about the integrity of scientific information used in the 2006 designation and whether the decision made was consistent with the appropriate legal standard. As a result, we reconsidered all the lands that were designated, lands that were not designated under section 3(5)(a) of the Act, and lands excluded under section 4(b)(2) of the Act in the 2006 designation.

(10) Comment: Some commenters indicated that designation provides little or no additional benefit beyond the listing itself, and that critical habitat is not necessary because conservation occurs through other existing means such as the Lynx Conservation Assessment and Strategy (LCAS), National and State Forest Plans, and other actions. Other commenters expressed their support for critical habitat because the designation provides for educational and research opportunities, recreation, and economic and forest management benefits.

Our response: Compliance with section 4(a)(3) of the Act necessitates that critical habitat be designated for listed species. It is true that a species and habitat upon which it depends are protected under provisions of the Act whether critical habitat is designated or not. However, a critical habitat designation identifies lands on which are found the physical and biological features essential to the conservation of the species that may require special management considerations, and areas outside the geographical area occupied by the species at the time of listing that are essential to the conservation of the species. The identification of these essential areas is important to guide management and provide for the recovery of the species.

As explained in detail in the Benefits of Designating Critical Habitat section of this final rule, the consultation provisions under section 7(a) of the Act constitute the regulatory benefits of critical habitat. Federal agencies must consult with the Service on discretionary actions that may affect a listed species, and in addition, analyze the effects of an action to critical habitat. The analysis of the effects to critical habitat is a separate and different analysis from that of the effects to the species, and may provide greater regulatory benefits to the recovery of a species than listing alone.

Since the lynx was proposed for listing in 1999, the U.S. Forest Service (USFS), Bureau of Land Management (BLM), and National Park Service (NPS) have been instrumental partners with the Service in conservation and recovery of the lynx, and in the development of the Lynx Conservation and Assessment Strategy (LCAS) (Reudiger *et al.* 2000). The LCAS constitutes the best available information on conserving lynx, and identifies potential risk factors to lynx and lynx habitat and management guidance to reduce these risks. The Service and USFS are signatories to an agreement protecting lynx on national forest lands until all Land Resource Management Plans (LRMPs) for the relevant forests are amended to include the direction consistent with the LCAS. The National Forests in Units 2, 3, and 5 have all amended their forest plans, and the Okanogan-Wenatchee National Forest in Unit 4 is in the process of amending its LRMP. No Federal lands are included in the critical habitat designation in Unit 1.

During the critical habitat designation process, we evaluated national forest areas to determine if they meet the definition of critical habitat (i.e., if they contain physical or biological features essential to conservation of the lynx and if these essential features may require special management or protection). National forest lands included in this final rule were found to have the essential features for lynx. The essential features on lands covered by management programs or plans that have been revised or amended to adopt the LCAS do require special management or protection, and therefore meet the definition of critical habitat in section 3(5)(A) of the Act.

Lands proposed as critical habitat can be excluded from a final critical habitat designation under section 4(b)(2) of the Act where conservation is addressed by existing protective actions and the benefit of exclusion outweighs the benefit of inclusion, unless the failure to designate such area will result in the extinction of the species concerned. The "Benefits of Excluding Non-Federal lands with Conservation Partnerships" section in this rule details our analysis of excluding or including non-Federal lands.

Critical habitat designation serves to educate the public and State and local governments regarding the potential conservation value of certain areas. Clearly delineating areas helps focus and promote conservation direction and actions. Critical habitat educational benefits, in general, may be redundant with other actions requiring significant public involvement, e.g., habitat conservation plans (HCPs). It is not possible to state broadly that research, recreation, and economies are benefitted by critical habitat designation. A listing under the Act itself focuses research on the species and habitat needs.

Recreation benefits are relative to the type of activity and location. Recreation or aesthetic benefits may come in the form of unquantifiable personal enjoyment or satisfaction. Ancillary benefits and costs to local economies were considered and described in the DEA to the extent data were available.

(11) Comment: Some commenters questioned the adequacy of the Environmental Assessment (EA) and other aspects of our compliance with NEPA. They felt that the draft EA is lacking information, does not address recovery, and does not address the full range of alternatives. Some recommended an alternative that includes all core areas. Some felt that we should prepare an Environmental Impact Statement (EIS) on this action.

Our response: We have complied with the requirements of NEPA for this critical habitat designation for lynx. An EIS is required only in instances where a proposed Federal action is expected to have a significant impact on the human environment. We prepared a draft EA and a DEA of the effects of the proposed designation to determine whether designation of critical habitat would have significant impacts. A notice of availability for public review of the draft EA and DEA was published on October 21, 2008 (73 FR 62450). The draft documents have been available since that date on our Web site and by request from the Service's Montana Field Office. We accepted public comment for 30 days after the posting. Following consideration of public comments, we prepared a final EA and determination that critical habitat designation does not constitute a major Federal action having a significant impact on the human environment. That determination is documented in our Finding of No Significant Impact (FONSI). Both the final EA and FONSI are available on our Web site (see **ADDRESSES** section of this rule).

The EA was prepared for this rule to identify alternatives, identify and analyze significant issues, and determine whether additional analysis was required in an EIS. Two alternatives were considered in the EA: the No Action (Baseline) Alternative and the Proposed Action. Two other alternatives were considered but not brought forward for analysis. The two alternatives not considered further were: (1) Critical habitat designation of all areas within the geographic range of the lynx in the contiguous United States, and (2) designation of all recovery areas (including core areas) as described in the lynx recovery outline. These alternatives were not carried forward because the Act specifies that, except in circumstances determined by the Secretary, critical habitat shall not include the entire geographic area that can be occupied by the species, and the recovery outline was not analyzed as an alternative because it did not meet the criteria for critical habitat defined in the proposed rule. For example, the recovery outline identified the Kettle range in Washington State as a core area, but the area has no recent, verified evidence of the presence of a breeding lynx population, and does not meet the criteria as defined in the proposed rule. We developed the proposed alternative using the best available scientific information to reflect the biological concepts considered important in the recovery outline, and included identified core areas that have verified records of long-term lynx occupation and reproduction.

The designation of critical habitat itself is not a recovery action, but identifies geographic areas that have the primary biological and physical elements necessary for conservation of lynx and that may require special management. We recognize that designation of critical habitat may not include all of the habitat area that may eventually be determined to be necessary for the recovery of a species. Critical habitat designations made on the basis of the best available information will not control the direction and substance of future recovery plans or planning efforts.

(12) Comment: We received a request to clarify that reservoir water bodies are not included in the critical habitat designation.

Our response: The clarification that reservoirs are not included in the designation has been included in the final rule.

(13) Comment: Several commenters recommended that we work with Canada to limit trapping in Canada to conserve lynx and preclude the need for critical habitat designation.

Our response: We agree that, where applicable, international cooperation on conservation issues is important. Lynx, as listed in the contiguous United States, are considered a unique conservation entity. At this time, the lynx is not listed as an endangered or threatened species in Canada. Lynx are harvested in Canada, and managed under local and provincial game laws that include quotas determined by the population status. At the time of listing in 2000, a lack or inadequacy of regulatory mechanisms and habitat alteration were considered the primary risks to the persistence of lynx in the contiguous United States. Overutilization by trapping and hunting was not considered a major threat to the species (65 FR 16078), and limiting trapping would not preclude the need to designate critical habitat.

(14) Comment: According to the Maine Department of Inland Fisheries and Wildlife, the Maine Unit was defined using many unverified records. Some lynx locational information given to the Service by the Department did not meet the accepted verification criteria as stated in the proposed critical habitat rule (page 10870). The critical habitat designation in Maine would be smaller if only verified records were used.

Our response: As we explained on pages 10869–10870 of the proposed rule (73 FR 10860, February 28, 2008), we used snow track records to determine the area occupied by lynx in Maine, which are considered unverified records, in addition to other types of verified records, because of the stringent protocols used in confirming the tracks as lynx and the minimal number of species in Maine with which lynx tracks could be misidentified (McCollough 2006).

(15) Comment: Some commenters thought that the Lynx Conservation Assessment and Strategy (LCAS) (Ruediger *et al.* 2000), Northern Rockies Lynx Management Direction, and the Southern Rockies Lynx Management Direction are inadequate as conservation tools and therefore should not be used as a justification to exclude these areas from the designation. Specifically, the LCAS does not provide for landscape continuity.

Our response: Lands covered by the LCAS are not being excluded from critical habitat designation. The LCAS (Reudiger *et al.* 2000) assists Federal agencies in planning activities and projects in ways that benefit lynx or avoid adverse impacts to lynx and lynx habitat. Conservation agreements between the Service and the USFS and BLM commit the land management agencies to using the LCAS in determining the effects of actions on lynx until Management Plans are amended or revised to adequately conserve lynx. At the time it was written, the LCAS provided the highest level of management and protection for lynx. Since the LCAS was written, new information has become available and research continues that should be taken into account by land managers. Some of this new information was taken into account by the USFS in revising plans under programmatic plan amendments (Northern and Southern Rocky Mountain Lynx Amendments). All National Forests in the critical habitat designation, except the Okanogan-Wenatchee in Washington State,

amended their LRMPs to include the newer lynx direction. The amendment process for the Okanogan-Wenatchee is under way. We analyzed the amendment actions and determined that the management under them would provide for the recovery of lynx in the geographic areas covered (USFWS 2007, entire).

The identified National Forest lands in the final rule were found to have the essential features for lynx. The essential features, on lands covered by management programs or plans that have been revised or amended to adopt the LCAS, do require special management or protection, and therefore meet the definition of critical habitat pursuant to section 3(5)(A) of the Act. In addition, the consultation provisions under section 7(a) of the Act constitute the regulatory benefits of critical habitat. Federal agencies must consult with the Service on discretionary actions that may affect a listed species, and, in addition, analyze the effects of an action to critical habitat. The analysis of the effects to critical habitat is a separate and different analysis from that of the effects to the species, and considers the effects of an action on the larger landscape scale of the critical habitat unit as a whole.

(16) Comment: Some commenters indicated that the proposal is based on past survey results and not on biological or ecological principles. In addition, some indicated that past records of lynx presence are insufficient in identifying occupied areas, and that lynx survey results are inconsistent from State to State and from agency to agency.

Our response: As required by section 4(b)(2) of the Act, we base our critical habitat designations on the best scientific data available. Our criteria for determining the areas occupied by lynx are described in the ''Criteria Used To Identify Critical Habitat'' section on pages 10869–10870 of the proposed rule. We used available data providing verified evidence of the occurrence of lynx and evidence of the presence of breeding lynx populations as represented by records of lynx reproduction. We find that evidence of breeding populations is the best way to verify that the PCEs are present in sufficient quantity and spatial configuration to meet the needs of the species, and qualify as critical habitat. We focused on records since 1995 to ensure that the critical habitat designation is based on the data that most closely represents the current status of lynx in the contiguous United States and the geographic area occupied by the species. We restricted the available lynx occurrence dataset by accepting only verified recent lynx records, because we wanted reliable data for the purposes of evaluating areas and features for critical habitat designation. As described in our response to Comment 14, above, in Maine we also accepted unverified records in the form of snow tracks because of the stringent protocols used in confirming the tracks as lynx and the minimal number of species from which lynx tracks could be misidentified in Maine.

(17) Comment: We received comments requesting clarification of the criteria used for determining a ''self-sustaining population'' in the proposed rule, and why definitions for ''self-sustaining populations'' differ from our Environmental Assessment for the rule and other Federal agency conservation strategies such as the LCAS and National Forest Plans.

Our response: Our use of the term ''self-sustaining population'' in the proposed rule relates to populations that are able to maintain a stable or naturally oscillating population structure composed of breeding individuals derived from wild mating and births (rather than introduced animals). A population that has demonstrated robustness to natural fluctuations in prey abundance is a key to determining that it is established. Our use of the term ''self-sustaining'' may differ from other agencies' use due to the different objectives for conservation strategies. The draft environmental assessment contained a section on Criteria for Defining Essential Habitat that deferred to the proposed critical habitat rule; a definition of ''self-sustaining'' or ''occupied'' was not provided in that document. The objective of the LCAS is to achieve conservation of the species on USFS lands while maintaining other uses of forest lands important to the mission of the USFS. The objective of critical habitat is to identify the habitat that is occupied by the species or essential to its conservation, that contains the physical and biological features essential to the species, and that may require special management considerations or protection.

(18) Comment: Some commenters thought that private or State lands should be included or excluded based on conservation and management agreements.

Our response: We determined that the benefit of excluding State lands in Washington that are managed under the Washington Department of Natural Resource's (DNR) Lynx Habitat Management Plan and lands in Maine that are enrolled under the Healthy Forest Reserve Program (HFRP) outweighs the benefit of designating them as critical habitat, as allowed under section 4(b)(2) of the Act. As we describe in detail in the Exclusions Under section 4(b)(2) section of this rule, the Washington DNR Lynx Habitat Management Plan and the HFRP in Maine provide certainty that the physical and biological features essential to the conservation of lynx will be conserved. These programs are in place, funding has been committed, and the specific intent of both programs is the conservation and management of lynx; as a result we have a high degree of certainty that both programs will be implemented and that they will be effective in conserving lynx habitat.

We are not excluding any other areas from the designation except Tribal lands, which we are excluding pursuant to Secretarial Order Number 3206, as described in the proposed rule. We have determined that no other lands will be excluded. We considered exclusions for industrial forest lands in Maine and Montana included in draft conservation agreements, lands owned by Plum Creek Timber Company in Maine and Montana, and private and county lands in Minnesota. We value the partnerships we have with these various landowners, and recognize that their cooperation will be necessary to achieve recovery of the lynx. We are not excluding these lands due to the lack of certainty that the plans would effectively conserve the physical and biological features essential to lynx. Additionally, a possibility exists that section 7(a)(2) consultation on a future project having a Federal nexus on any of these lands might result in a determination that an action would result in the destruction or adverse modification of lynx critical habitat.

We are not excluding Montana Department of Natural Resources and Conservation lands in Montana that are under a draft Habitat Conservation Plan for lynx and other listed species, nor are we excluding Plum Creek lands in Maine that are part of the proposed Moosehead Lake Concept Plan, because both of these efforts are still in development and there is a lack of certainty that either effort will be completed. However, we recognize the extensive planning and development that have already been invested in both of these efforts to achieve conservation of lynx and other species.

(19) Comment: Linkage corridors are important to protect.

Our response: We agree that providing protection for travel and dispersal are important for maintaining lynx populations over time. Critical habitat is

designated for the conservation of the primary constituent element (PCE) essential to the conservation of the lynx and necessary to support lynx life history functions. The PCE comprises the essential features of the boreal forest types that provide, for example, prey, reproduction and denning habitat, and snow conditions that give lynx their competitive advantage. Critical habitat provides habitat connectivity for travel within home ranges, and exploratory movements and dispersal within critical habitat units.

Critical habitat in the final rule was delineated to encompass occupied areas with verified reproduction and containing features essential to the conservation of the lynx to provide connectivity within the particular regional unit and to maintain direct connectivity with lynx populations in Canada. Lynx populations in the contiguous United States are influenced by lynx population dynamics in Canada, and many of these populations in Canada are directly interconnected with U.S. populations; therefore, retaining connectivity with the larger lynx population in Canada is important to ensuring long-term persistence of lynx populations in the United States.

(20) Comment. At a public meeting for the lynx critical habitat in Spokane, the Service stated that the actual ''core'' for lynx is in Canada. This contravenes our proposal that there are at least five ''critical'' or ''core'' areas in the northern United States.

Our response: The bulk of the lynx population is in Canada, which can be considered the ''core'' of its range. However, in the lynx recovery outline (Service 2005), we use the term ''core'' to define the areas with the strongest long-term evidence of the persistence of lynx populations in the contiguous United States. The recovery outline, however, was not meant to address critical habitat designation and did not identify the primary constituent element for lynx that require special management. For the purposes of critical habitat designation, we refrained from using the term ''core areas'' to avoid confusion with the definitions used in the recovery outline (see the Relationship to Recovery Outline section). In the Criteria Used to Identify Critical Habitat section of the final rule, we clarified how the areas proposed were determined. We referred to the recovery outline to identify the different geographic areas important to the persistence of reproducing populations of lynx in the contiguous United States. We then focused our strategy on boreal forest landscapes of sufficient size to encompass the temporal and spatial changes in habitat and snowshoe hare populations to support interbreeding lynx populations or metapopulations over time. We also considered the need for connectivity among habitat patches within a geographical area, and connectivity with the larger, more robust Canadian lynx populations. Based on the defined criteria for critical habitat, the units roughly coincide with five of the six ''core'' areas identified in the recovery outline.

(21) Comment: Plum Creek Timber Company requested that their properties in Montana and Maine be excluded from the designation based on multiple legal and policy grounds, including: (1) Landowner conservation agreements that Plum Creek is party to provide habitat protections beyond what would be achieved by critical habitat designation; (2) economic impacts to Plum Creek warrant exclusion under Section 4(b)(2) of the Act; and (3) technical and legal reasons, such as that some of the Plum Creek lands in the designation are not lynx habitat or do not exhibit the primary constituent element (PCE), and therefore were erroneously included in the proposed rule.

Our response: We respond to Plum Creek's comments in a number of different places in this rule. We analyzed the benefits of exclusion and inclusion of Plum Creek lands based on their proposed participation in private lands draft agreements (Maine Forest Products Council and Montana Partnership) in the Exclusions under Section 4(b)(2) of the Act section of this rule. We determined that the benefits of exclusion do not outweigh the benefits of inclusion of Plum Creek lands, and that the lands should remain in the critical habitat designation. Our economic analysis found no basis for excluding Plum Creek lands due to economic factors, including impacts associated with development at Moosehead Lake in Maine. Little economic impact, to Plum Creek and other private landowners, would exist due to the designation of critical habitat. Significant economic impacts to Plum Creek existed due to the listing of lynx; however these impacts would occur regardless of critical habitat designation. Our specific responses to Plum Creek's comments on our economic analysis can be found in comments #14, 15, 20, 21, and 32 below.

We also evaluated Plum Creek's request to exclude lands based on its willingness to develop a habitat conservation plan for its proposed Moosehead Lake development. We acknowledge that Plum Creek has experience creating and implementing conservation plans, but this experience does not justify an exclusion where the State of Maine's re-zoning has yet to be completed and no specific subdivision or development plans have been submitted to us for review. Given that the development of a habitat conservation plan and an incidental take permit has not been completed, we cannot rely on it as a basis for exclusion. Finally, we note that Plum Creek, like others who have requested exclusions, participates in forest certification programs, such as Sustainable Forestry Initiative (SFI). Although participation tends to demonstrate a commitment to resource stewardship, we were not provided with required endangered species or lynx management plans for review. Therefore, we were unable to determine, with reasonable certainty or specificity, the degree to which land management practices currently being employed benefit the lynx or its habitat.

Plum Creek asserts that some of their land does not contain the PCE for lynx, does not qualify for critical habitat protection, and has been erroneously included in the critical habitat designation. Plum Creek specifically mentioned the Olney Block, a property in northwestern Montana, as having too little lynx habitat to be considered essential to the species. Plum Creek has real estate development plans for this area and fears that designation would have a negative impact on their plans. In considering the suitability of the Olney Block property, we referred to our criteria for identifying the PCE for lynx. Boreal forest habitats are the landscapes characterizing PCE for lynx. Individual areas within a boreal forest system may contain one or more of the following:

(a) Presence of snowshoe hares and their preferred habitat conditions, which include dense understories of young trees, shrubs or overhanging boughs that protrude above the snow, and mature multistoried stands with conifer boughs touching the snow surface;

(b) Winter snow conditions that are generally deep and fluffy for extended periods of time;

(c) Sites for denning that have abundant coarse woody debris, such as downed trees and root wads; and

(d) Matrix habitat (e.g., hardwood forest, dry forest, non-forest, or other habitat types that do not support snowshoe hares) that occurs between patches of boreal forest in close juxtaposition (at the scale of a lynx home range) such that lynx are likely to travel through such habitat while accessing patches of boreal forest within a home range.

Lynx are a species that uses habitat at a landscape scale, relying on a landscape of interconnected habitats to travel long distances. For example, lynx home ranges often encompass well over 100 square kilometers (39 square miles). Within this home range, lynx may have to traverse between multiple patches of habitat that provide suitable prey density and denning areas. An individual may have to cross ''matrix'' habitats that do not provide foraging or denning opportunities, which is why, in the critical habitat designation, we consider matrix habitat to be essential to lynx. Matrix habitat holds a potential lynx home range together. Lynx occupancy of an area cannot be achieved without the potential for the establishment of a home range.

In Plum Creek's habitat analysis, they assert that the Olney Block and other areas do not contain a high enough percentage of ''lynx habitat'' to be considered essential (they do not define lynx habitat in a way that would allow us to determine if they are using our definition of occupied habitat). Plum Creek did not assess how the habitat within the Olney Block interacts with habitat outside of the parcel on adjacent State land to provide for the potential for lynx occupancy. We characterize habitat within the Olney Block, that does not provide high prey densities or denning habitat, as matrix, and consider it essential to the conservation of lynx that live there, because it provides connectivity of foraging and denning habitat across a large area. Therefore, we are including Plum Creek lands in the final designation.

Economic Issues and Responses

General Comments on Methodology and Scope

(1) Comment: One commenter expressed concern regarding the validity of the DEA because its conclusions are inconsistent with the August 2006 DEA of Critical Habitat Designation for the Canada Lynx. A comment highlighted that, while the 2006 DEA estimates impacts of $175 million to $889 million, the 2008 DEA quantifies impacts of only $2.82 million for just the administrative costs of section 7 consultation. Because impacts are significantly greater in the 2006 analysis, the commenters assert that the 2008 analysis understates economic impacts.

Our response: The 2006 DEA quantified present value impacts of $99.5 million to $259 million in areas proposed for critical habitat designation, applying a 7 percent discount rate; the $175 million to $889 million estimate refers to undiscounted impacts and is therefore not directly comparable to the present value impacts in the 2008 DEA. There are several reasons why the values in the 2006 and 2008 analyses differ. First, the impact estimates being compared across the reports in this comment are associated with differing scopes of lynx conservation efforts. The 2006 DEA aggregated and presented the estimated impacts of all future impacts of lynx conservation, including both listing and critical habitat related conservation, as ''coextensive'' impacts. Coextensive impacts of $99.5 million to $259 million in the 2006 analysis also included impacts associated with overlapping protective measures of other Federal, State, and local laws that aid habitat conservation. The 2008 DEA separately measures: (a) The baseline (without critical habitat) impacts of lynx conservation; and (b) the incremental impacts specifically associated with the critical habitat designation. The present value incremental impacts expected to result solely from the critical habitat designation are estimated to be approximately $1.49 million and are associated with administrative effort for section 7 consultations. All other lynx conservation impacts are estimated to occur regardless of critical habitat designation. The commenter's description of estimated administrative consultation costs in the 2008 DEA of $2.82 million is incorrect; that estimate does not appear in the 2008 DEA. Other differences between the 2006 and 2008 DEA are described in Chapter 1, on pages 1–1 through 1–3, of the 2008 analysis.

(2) Comment: One commenter expressed concern about the potential for critical habitat to increase delays on the processing and environmental review of Federal permits: for example, projects that require a 404 permit under the Clean Water Act.

Our response: Section 2.3.2 of the DEA describes the potential for critical habitat designation to result in time delays for permit applications. In the case that critical habitat triggers a delay, it would be considered an incremental impact of the critical habitat designation. The DEA does not, however, forecast that this will be an outcome of the critical habitat designation. To the extent that the presence of critical habitat does result in time delays for projects, the DEA understates the incremental impacts of the critical habitat designation.

(3) Comment: Multiple comments provided on the DEA stated that it acknowledges the potential for the designation to have indirect effects, such as the enforcement of State and local laws, but fails to quantify the associated costs. One commenter stated that, because the DEA does not quantify such indirect costs, the conservation benefits of these indirect regulatory methods should not be used in the analysis of the overall benefit of critical habitat designation. One commenter asserted that a critical habitat designation can increase attention and concern regarding potential environmental impacts of a project and may lead other permitting agencies to examine a proposal more carefully and take restrictive action that they otherwise would not. Another commenter stated that the DEA acknowledges the potential for a ''stigma'' effect but does not quantify associated impacts, which would have a greater impact on private landowners than the direct effects.

Our response: Section 2.3.2 notes that, in some cases, a critical habitat designation may trigger lynx conservation under other State or local laws. The section goes on, however, to describe that no State or local laws were identified in the study area for which critical habitat would trigger additional compliance. As described in Sections 5.1 and 5.5, planning departments in counties containing critical habitat were surveyed to assess whether the designation would affect permitting of development activities. Section 2.3.2 also recognizes that, in some cases, public perception of critical habitat designation may result in limitations of private property uses above and beyond those associated with anticipated project modifications and uncertainty related to regulatory actions. Public attitudes regarding the limits or restrictions of critical habitat can cause real economic effects to property owners, regardless of whether such limits are actually imposed. To the extent that potential stigma effects on real estate markets are probable and identifiable, these impacts are considered indirect, incremental impacts of the designation. It is unknown, however, whether lynx critical habitat will result in long-term stigma effects to property owners; as the public becomes aware of the true regulatory effect imposed by critical habitat, any impact of the designation on property values would be expected to decrease.

(4) Comment: One commenter stated that assumptions about future behavior based on past performance in the DEA are not accurate. The commenter suggests that a small sampling of private property owners to explore their aspirations for future land use would provide a reality check to the

assumptions made in the economic analysis.

Our response: The DEA does not rely solely on historic trends to forecast future behavior of landowners. Private landowners were contacted to discuss their ongoing and forecast land management; a list of private landowners that provided information to inform the analysis is included in the References section of the DEA.

(5) Comment: One commenter stated that the DEA describes 36 percent of the proposed critical habitat in Koochiching County, Minnesota, as being of unknown ownership. The commenter notes that, according to the Koochiching County Assessor, there is no land within the county of unknown ownership. Another commenter stated that the DEA identifies over 1 million acres of third-party-certified county-tax-forfeit forest land as being of unknown ownership in northeast Minnesota. The commenter asserts that the designation of critical habitat without first understanding the economic impacts of such a designation should not be allowed.

Our response: As described in the landowner type categories of Exhibit 1–2 of the DEA, no land is categorized as being of unknown ownership. Exhibit 5–2 misleadingly included a category ''area under unknown ownership.'' This label is corrected in the final rule to clarify that these lands are considered as being under private ownership, although the specific landowners are not identified. Regarding the tax forfeit land in northeast Minnesota, Exhibit 1–2 identifies 753,327 acres of land identified as ''Local Public Ownership.'' These are tax-forfeit public lands owned by the State and managed at the county level. A significant portion of these lands are managed for timber and are analyzed as such in the DEA.

(6) Comment: One commenter stated that the DEA ignores that private land rights are eroding through partial regulatory takings and assumes that there is no risk that regulatory infrastructure will be used to further diminish private land values.

Our response: The DEA considers the extent to which lynx conservation may affect private land values. Chapter 5 of the DEA describes impacts to private land values associated with avoiding or minimizing impacts to the lynx and its habitat of proposed development projects. Specifically, as described in Section 5.5, the analysis assumes that where development is limited for the purposes of lynx conservation, a portion of the value of the parcel associated with its potential for future development is lost. As noted in the DEA, however, only one forecast project was identified (the Moosehead Lake Land Use Concept Plan in Maine) for which information on both the scope and scale of the development and on potential lynx conservation recommendations were available to forecast impacts on land values.

(7) Comment: According to one commenter, the DEA assumes that the only costs imposed on private landowners by critical habitat designation result from administrative effort in conducting section 7 consultation. This assumption ignores future costs for lynx management activities resulting from section 7 consultation. Further, the DEA quantifies costs of lynx management activities already under way and assumes that these plans will be models for conservation efforts in the remaining proposed habitat. The analysis does not, however, quantify costs of implementing these management plans on the 40 percent of habitat that is not covered by existing plans.

Our response: As described on page ES–2, the DEA quantifies only administrative costs associated with section 7 consultation as incremental impacts of the critical habitat designation. While future consultations are forecast to result in project modifications across the land use activities considered in the report, these project modifications are expected to occur regardless of the critical habitat designation. The Service has not described additional project modifications that may be solely attributable to the designation of critical habitat. With regard to the 40 percent of lands not covered by existing lynx management plans, the DEA does not consider it reasonably foreseeable that all landowners across the areas proposed for critical habitat will adopt lynx management plans following a designation of critical habitat. As described in Chapter 4, the analysis considers where lynx management plans may be applied in the future. Specifically, Section 4.3.3 highlights the potential conservation efforts of future lynx management guidelines for private lands in Maine. These potential guidelines differ significantly from the conservation efforts described in existing lynx management plans (e.g., the LCAS and NRLMD), evidencing that these private lands would not necessarily apply existing lynx management plans.

(8) Comment: A commenter stated that the DEA described ancillary benefits of lynx critical habitat that are considered to the extent they result in observable impacts on markets. However, the analysis does not quantify these impacts. For example, while reduced economic welfare to snowmobilers associated with increased crowding on trails is quantified as a cost, the analysis doesn't quantify welfare gains to participants in non-motorized recreation associated with reduced noise and air pollution.

Our response: Section 6.2 considers welfare impacts associated with restrictions on snow mobile trail expansions. Scenario 2 of this analysis assumes that limiting future trail expansions increases crowding on existing trails resulting in decreased utility per snowmobile trip. As such, the analysis does not assume there is a net decrease in snowmobiling but a change in the distribution of the occurrence of snowmobiling. As a result, while some participants engaged in non-motorized recreation in some areas may experience welfare gains (i.e., areas where trails are precluded), others may experience welfare losses (areas in which the existing trails are more crowded). Further, data regarding the distribution of non-motorized recreators in these areas were not available.

(9) Comment: One comment from the Confederated Salish and Kootenai Tribes of the Flathead Nation stated that the DEA lacked specific information for areas proposed for exclusion from the critical habitat designation.

Our response: The DEA separates any costs anticipated to occur on areas proposed for exclusion from critical habitat designation. Sections 4.4, 4.5, and 8.5 quantify the pre- and post-designation administrative costs of section 7 consultations on these lands proposed for exclusion, and Section 4.4 quantifies the post-designation baseline impacts to the Passamaquoddy Tribe related to their involvement in the Maine Healthy Forest Reserve Program (Unit 1).

Comments on Timber Issues

(10) Comment: One commenter stated that the DEA predicts 142 lost jobs due to restrictions on pre-commercial thinning from the designation of critical habitat for the lynx. The comment asserts that this estimate fails to take into account the ancillary employment that will be lost in related markets, such as housing, sawmills, and local retail.

Our response: As described in Section 4.4.1, the analysis employs a regional economic modeling tool, IMPLAN, to estimate the number of jobs lost in the regional economy due to reduced pre-commercial thinning levels. IMPLAN translates the lost revenues associated with reduced pre-commercial thinning levels into changes in demand for goods and services in related economic sectors

in the regional economy. Thus, the estimated 142 lost jobs in proposed critical habitat unit 4 (presented in Exhibit 4–10) represents the effect of reduced pre-commercial thinning on the regional economy and not just pre-commercial thinning jobs. Additionally, reductions in pre-commercial thinning levels are baseline lynx conservation efforts; no further reductions in pre-commercial thinning levels are estimated to occur due to the designation of critical habitat for the lynx.

(11) Comment: Two commenters questioned why the Washington Department of Natural Resources (WDNR) foregone revenue impacts are high relative to those of other timber managers. Out of the $13.5 million in foregone timber revenue estimated in the DEA, $11.3 million is associated with WDNR, although it covers a relatively small portion of the critical habitat area. Further, logging is precluded on a considerable portion of the WDNR lands, because the timber rights were purchased for conservation. The commenter questions whether non-lynx-related logging restrictions on the WDNR lands, such as stream buffers, HCPs, and a log import ban, were included in the foregone revenue estimates.

Our response: Economic impacts associated with public land were based on communication with the landowners regarding the specific conservation efforts they are applying and the resulting economic implications. Post-designation baseline impacts specifically associated with WDNR lands are described in Section 4.5.2 of the analysis. According to the WDNR, lynx conservation efforts on their land in proposed critical habitat resulted in removing land from active timber management. Specifically, 30 percent of the approximately 105,000 acres of WDNR land in proposed critical habitat is removed from active timber management, resulting in economic impacts of $1.06 million annually. While other public landowners implementing lynx management plans have employed lynx conservation efforts, such as restricting pre-commercial thinning, they have not removed land completely from timber production for the purposes of lynx conservation. As a result, the economic impacts of lynx conservation on WDNR lands are greater than on other lands implementing lynx management plans.

(12) Comment: F.H. Stoltze Land and Lumber commented that it provided information on the potential indirect and direct impacts of critical habitat designation on their lands in previous comment periods but none of that information was used in the DEA.

Our response: The potential direct and indirect impacts of critical habitat designation provided by F.H. Stoltze Land and Lumber Company (Stoltze) during the public comment period for the proposed rule are summarized in subsection 4.3.6 of the DEA. The section further describes that Stoltze's assumptions regarding how the Service may regulate their lands for the purposes of lynx conservation are not consistent with the assumptions made in the DEA. First, Stoltze quantifies the impacts of the enforcement of lynx conservation on their lands similar to that described in the Lynx Conservation Assessment and Strategy (LCAS). There is no precedent for the Service to request these types of lynx conservation efforts on private lands, nor has the Service indicated it intends to do so in the future. Second, ongoing negotiations regarding lynx management guidelines between the Service and private timber landowners indicates that lynx conservation guidelines for private landowners may differ significantly from the LCAS (see Section 4.3.3 of the analysis which describes the Service's recommendations with respect to lynx management guidelines on private timberland in Maine). Further, Stoltze assumes the Service may regulate their land management via section 7 consultation regarding 404 permits or fire hazard mitigation projects in critical habitat. To date, no consultations have taken place regarding these activities. All section 7 consultations on private timberlands in Unit 4 have been for special use permits and none has required any lynx conservation efforts or denied access to private lands. The Service has not indicated that this is expected to change following a critical habitat designation of these lands.

(13) Comment: One commenter asserted that the DEA does not consider that private forestland owners will be forced to seek alternative uses, Federal lands will lose valuable management tools, and Montana will lose its forest products infrastructure to lynx habitat.

Our response: The assertion that private timberland owners may have to seek alternate land uses due to lynx conservation is predicated on the assumption that these landowners would be required to implement conservation efforts for the lynx similar to those specified in the LCAS. For the reasons described in Section 4.3.6, the DEA does not assume this is a reasonably foreseeable assumption. The DEA does, however, consider the economic impacts of restricting the pre-commercial thinning management tool on Federal lands, where section 7 consultation requirements apply, in subsection 4.4.1, and the effect on the regional forest products industries.

(14) Comment: A comment from Plum Creek provided information on the costs of its ongoing and forecasted lynx conservation efforts. In the baseline, Plum Creek stated that absent critical habitat designation they expect to continue to conduct experimental pre-commercial thinning on approximately 200 ac (81 ha) per year at a present value cost of $230,000 (assuming an internal rate of return of 8 percent and a 15 percent discount rate). The company also intends to continue to contribute to research in Maine and Montana for lynx and snowshoe hare whether or not critical habitat is designated, at a cost of $150,000 ($10,000 per year discounted at 3 percent). Plum Creek further expects to implement mitigation measures for road construction at a cost of between $110,000 and $250,000 per year absent critical habitat. In addition, slower speed limits are expected to result in social welfare impacts to motorists. The commenter noted that not enough information is available, however, to quantify these costs.

Our response: While Section 4.3.6 of the DEA summarized Plum Creek's 2006 economic impacts estimates, impact estimates provided in their comment on the October 2008 DEA are different. As a result, these baseline impacts as estimated by Plum Creek are new information on their baseline lynx conservation efforts and are provided in the final economic analysis. The impacts described by Plum Creek are not entirely additive with the baseline impacts as quantified in the DEA. The DEA does include impacts associated with private landowner funding of lynx-related research in the baseline. The analysis does not, however, break out the fraction of those costs borne specifically by Plum Creek. Because of this, and because Plum Creek's estimated impacts are not broken down by their land ownership in Maine and Montana, the final economic analysis provides this information to decision makers but does not update its estimate of baseline impact. This comment does not, however, change the estimated incremental economic impacts associated with the critical habitat designation.

(15) Comment: Plum Creek further commented that the Montana and Maine Lynx Agreements would only be implemented on private lands in the absence of critical habitat designation. The implementation of these plans would cost approximately $230,000 for

distributing information, hosting annual workshops, and supporting lynx research and monitoring. The associated benefits to the lynx of implementing these plans would be lost in the case that critical habitat is designated on these lands and should therefore be considered incremental costs of the critical habitat designation.

Our response: As private landowners have funded lynx conservation research in the past, the DEA includes impacts of this continued funding as baseline impacts of lynx conservation. In the case that the critical habitat designation results in private landowners ceasing to fund lynx-related research, baseline impacts are overestimated in the DEA and any benefits associated with these investments in lynx-related research would be foregone. Information is not available, however, to describe benefits or improvements in lynx conservation resulting specifically from the investments of these private landowners in lynx-related research.

Comments on Development Analysis

(16) Comment: A comment on the DEA stated that the value of private property should not be based on that of similar properties as landowners may have differing objectives for their land use. The comment further states that the DEA understates or ignores the cost of environmental measures on private land ownership.

Our response: As described in Section 5.3.2, the analysis assumes that privately-owned property values within critical habitat include silvicultural rents, the growth premium, and the option value for future development. Where future development is precluded from a parcel, the reduction in land value equals the sum of growth premium and option value (i.e., the property value is reduced to its silvicultural rents). The associated land values for these properties described in the analysis were determined by assessors and consider the potential future uses of the property; they are not based on comparison to land use decisions on other properties.

(17) Comment: One commenter stated that the DEA shows a 49 percent increase in the building permits from 2000 to 2007 in Koochiching County, Minnesota, a county with declining population. The commenter asserts that this is an inaccurate portrayal of building activity. In fact, before this time, the county was operating an under-funded inspection and permitting system. The county hired an additional appraiser who instructed owners of existing, un-permitted structures to obtain building permits in this time period. Building permits issued in this period are therefore not indicative of actual construction activity.

Our response: Correspondence with the Koochiching County Assessor's Office has confirmed that two additional appraisers were hired between 2000 and 2007 and that these hires resulted in an unknown number of additional un-permitted structures obtaining permits in 2007. The 2000 and 2007 building permit figures in Exhibit 5–2 of the DEA may therefore not be representative of development activity during those years in Koochiching County. In fact, development activity is likely less than that described in the analysis. Section 5.5.2 of the final economic analysis therefore indicates that development pressure in Koochiching County is anticipated to be minimal.

(18) Comment: According to one comment, the baseline impacts of lynx conservation associated with the proposed development at Moosehead Lake, Maine, are overestimated as some level of development restriction would occur even in the absence of lynx protections, as the DEA notes on page ES–3.

Our response: Section 2.3.1 of the DEA describes the baseline as "the existing state of regulation, prior to the designation of critical habitat, which provides protection to the species under the Act, as well as under other Federal, State and local laws and guidelines." Regarding the proposed Moosehead project, the analysis only quantified impacts of the Service's conservation recommendations related to the lynx, although a portion of these may be implemented even absent the lynx. Impacts of these conservation efforts are appropriately assigned to the baseline in the analysis. Conservation associated with the Moosehead project that did not overlap potential lynx conservation recommendations is not quantified in the DEA.

(19) Comment: One commenter stated that the DEA mischaracterizes the easements under the 1964 Forest Roads and Trails Act. The commenter suggested removing this language, as this information is mistaken and not relied upon in the DEA. Specifically, the commenter asserted that the analysis describes that the U.S. Department of Agriculture has proposed to change language in the 1964 Forest Roads and Trails Act broadening the scope of the Act to include road uses for residential and commercial development. In fact, they are considering a draft amendment to certain easements owned by Plum Creek that would simply clarify, not change, the scope of those easements as they already cover road use for residential and commercial development. Because there is no expansion of access rights, just a clarification, the matter should have no economic impacts that affect the DEA.

Our response: Given this information on the 1964 Forest Roads and Trails Act, and the fact that this does not change the assumptions made or the estimated economic impact, the language involving the Forest Roads and Trails Act is removed in the final economic analysis.

(20) Comment: One private landowner, Plum Creek, commented that the critical habitat is likely to affect development in Maine and Montana. In the case that Maine's Land Use Regulatory Commission (LURC) treats the critical habitat area as if it were a Fish and Wildlife Protection Subdistrict, proposed developments within critical habitat would require an additional permit. Furthermore, meeting LURC's burden of proof that proposed developments will not harm the natural environment may prohibit these developments. Additionally, if Clean Water Act section 404 permits are required for development in Maine critical habitat areas, development projects may be modified or precluded as a result of section 7 consultation. Plum Creek commented that if critical habitat is designated, they will likely abandon their Land Use Concept Plan at Moosehead Lake (Moosehead Lake Plan). Lands in the Concept Plan are valued at $189.6 million to Plum Creek and the conservation easements were valued at $469,000 in benefits for the local residents and $9.2 million in benefits for Maine residents. In total, public benefits of the balance easement were quantified at between $10.8 and $19.2 million. These benefits would be foregone in the case that critical habitat is designated.

Our response: As described in Section 5.5.1, the DEA quantifies impacts related to two scenarios. At the low end, lynx conservation related to the Moosehead Lake Plan in Maine is assumed to follow LURC's written recommendations; at the high end, the analysis assumes lynx conservation will follow more stringent recommendations provided by the Service. The DEA did not consider a scenario in which Plum Creek abandons the Moosehead Lake Plan entirely. The final economic analysis therefore provides the information regarding potential economic impacts of this scenario. While there are costs (foregone benefits) to Plum Creek and to the public of abandoning the plan, there may also be an economic benefits Plan that offsets the cost estimates presented by Plum

Creek. The alternative use scenario of these lands absent the Moosehead Lake Plan is largely uncertain. As a result, it is difficult to predict what sorts of economic costs and benefits would be associated with the alternative uses of the land. These issues are discussed in greater depth in the final economic analysis.

(21) Comment: Plum Creek commented that designation of critical habitat in Montana may prompt local land use agencies to impose minimum lot sizes on subdivision developments. According to Plum Creek's analysis, requiring that future Plum Creek developments in proposed critical habitat have lot sizes greater than 20, 160, and 640 acres would result in losses of $0.44 million, $74.2 million, and $243.1 million, respectively. Plum Creek bases their lot size assumptions on existing growth policies for counties in Montana. Specifically, at the high end, Missoula County's Seeley Lake Regional Plan identifies lynx as a species of concern and recommends a land use density of one dwelling per 640 acres.

Our response: With regard to development in Montana, Section 5.5.3 of the DEA describes that, although no modifications to development projects have occurred in the past to benefit the lynx, it is possible that future permitting requirements may become more stringent as a result of critical habitat designation. Communication with Montana county planners, however, indicated that few are likely to modify their minimum lot size requirements in response to critical habitat designation. Further, it is unclear whether any minimum lot size requirements would be baseline or related to critical habitat. The Seely Lake Regional Plan example is an existing (baseline) protection and already imposes its minimum lot size. This would therefore not be considered an incremental impact of critical habitat designation in the DEA. As such, the final economic analysis presents the results of Plum Creek's study of impacts to development on their Montana lands, but does not include these estimates in the total impacts of the critical habitat designation as they are considered too speculative.

Other Comments on the Draft Economic Analysis

(22) Comment: A comment on the DEA asserted that impacts to recreation were underestimated because the analysis did not take into consideration that congested trails, resulting from the closure of 29 miles of trails, may decrease winter tourism and recreation. This will increase pressure on local police and hospitals and reduce the amount of jobs in the tourism industry.

Our response: Section 6.2 describes impacts to snowmobiling activities due to potential restrictions on trail use and new trail construction. The analysis does not state that 29 miles of trail in Loomis State Forest within Unit 4 will be closed; only that 29 miles of the Washington State's 3,000 to 3,500 miles of snowmobile trails fall within the Loomis State Forest. With respect to costs from increased snowmobile congestion, under a high-bound estimate, the DEA assumes the cost of lost social welfare of $109,000 for Unit 4 due to increased trail congestion. These impacts are considered baseline as part of Okanogan-Wenatchee National Forest's implementation of the LCAS. In addition, though implementing the LCAS will preclude the creation of new trails, most snowmobile riding in the Loomis area occurs on ungroomed trails.

(23) Comment: According to one comment, the incremental impact to mining activity in Unit 2 of $10,900 is not credible because of the size and economic contribution of this industry in this region.

Our response: The taconite mining industry, and more recently the non-ferrous mining industry, has been significant contributors to the local and regional economy in northern Minnesota. Lynx-related conservation efforts associated with mining activities are assumed to occur regardless of critical habitat designation and are therefore appropriately assigned to the baseline. That is, incremental impacts are low because the critical habitat is not expected to affect mining activity beyond the existing level of lynx conservation.

(24) Comment: According to one comment, the DEA underestimates impacts to grazing activities by failing to take into consideration that farmers with allotments on public lands may have to either decrease the number of cows they graze, or overgraze land adjacent to the critical habitat designation. These changes in grazing activity would in turn cause job losses in the regional retail and service industries.

Our response: As stated in paragraph 320 of the DEA, we found "no evidence that grazing (is) a factor threatening lynx." Section 7 consultations for grazing activities under the LCAS have resulted in few conservation recommendations and no project modifications. Paragraph 360 further states that, "(o)pportunity for grazing has not been affected by the implementation of the lynx management plans and conservation recommendations made during section 7 consultation." Therefore, the DEA assumes that, beyond the costs of consultation, grazing activities will not be affected by critical habitat.

(25) Comment: One comment stated that hunting, as an economic activity, seems to have been overlooked in the DEA. Road construction in wetlands requires consultation and road access is fundamental to the economy of Northern Minnesota's recreational hunting industry. The commenter further asserted that the value of land as deer hunting property seems to have been similarly overlooked.

Our response: Impacts to hunting and trapping activities are included in section 6.4 of the analysis and are primarily costs associated with establishing education programs and enforcing trapping regulations to avoid incidental take of lynx. The DEA assumes that the opportunity to hunt will not be diminished due to critical habitat. With respect to road construction in wetland areas and road access in northern Minnesota, a section 7 consultation may require modifications to a road project (i.e., culverts and other habitat crossing measures), however, critical habitat designation will not preclude road access.

(26) Comment: A comment provided on the DEA stated that the analysis does not mention boating as a potentially affected activity although Unit 2 contains most of Minnesota's 17,000 lakes of over one acre. Construction of boat docks, for example, is likely to trigger a section 7 consultation.

Our response: The Service does not list boating, or construction of boat docks, as a threat to the lynx or its habitat in any of its lynx management documents, nor has this activity been the subject of consultation in the past. There is therefore no indication that this activity will be affected by lynx conservation in the future.

(27) Comment: The Small Business Administration (SBA) commented that the Initial Regulatory Flexibility Analysis (IRFA) is inadequate to provide a factual basis for certifying that the proposed critical habitat designation will not have a significant impact on a substantial number of small entities. First, the IRFA does not provide sufficient information to adequately forecast costs associated with section 7 consultations involving small entities. In the case that critical habitat is designated, past section 7 consultations initiated by small entities to avoid jeopardy must then be re-opened to account for newly designated critical

habitat. Second, the IRFA only considers the administrative costs of re-opening past consultations and fails to consider costs small entities could face if required to modify projects to avoid adverse modification of critical habitat. In addition, the IRFA incorrectly assumes that no new section 7 consultations will occur as a result of the proposed critical habitat because the critical habitat designation only covers areas currently occupied by the species. Finally, the SBA stated that the IRFA does not provide any estimates of costs of consultations with private landowners under section 10 of the ESA to obtain an incidental take permit that may result from critical habitat designation. The SBA further stated that the Service must prepare a Final Regulatory Flexibility Analysis (FRFA) if it finalizes the critical habitat designation for the lynx.

Our response: The DEA does include costs of project modifications associated with forecast section 7 consultations. These project modifications are all expected to be recommended regardless of the critical habitat and are therefore assigned to the baseline impacts quantified in the analysis. Further, the DEA does forecast new consultations (not just re-openings) following the designation of critical habitat; however, these new consultations are expected to occur regardless of whether critical habitat is designated. The lynx conservation quantified is expected to occur regardless of the critical habitat designation because, as described on page ES–2 of the draft economic analysis and in the activity-specific chapters, of the broad scope and scale of existing lynx conservation that already occurs across the study area even absent critical habitat. First, the Service does not expect the conservation direction of existing lynx management plans, which cover 60 percent of the proposed critical habitat, to be altered following a critical habitat designation. Second, the Service has not identified any additional project modifications that it may recommend via section 7 consultation following a critical habitat designation above and beyond what has been recommended in the past to address potential jeopardy issues. As a result, the Service has not indicated that any regulatory changes would occur due to critical habitat designation. In terms of potential indirect impacts of critical habitat designation, the draft economic analysis notes in the Foreword (Section 1.1) that significant uncertainty is associated with the analysis due to the dynamic nature of land use planning, ongoing discussion regarding lynx conservation with private timberland owners, and whether particular land use activities are risk factors. As described in Appendix A, the IRFA is based on the incremental impacts expected to be generated specifically by the designation of critical habitat. As a result, the baseline impacts of forecast section 7 project modifications are not relevant to the IRFA because they are not engendered by the critical habitat rulemaking. In addition, critical habitat does not necessarily increase the need for section 10 incidental take permits. In surveying landowners and land managers, the economists who wrote the DEA did not identify any basis for assuming critical habitat designation would result in landowners developing habitat conservation plans, which are typically associated with the issuance of section 10(a)(1)(B) incidental take permits. We completed a FRFA and it is made available with the final economic analysis concurrently with this final rule.

(28) Comment: Multiple commenters stated that the DEA is unbalanced because it focuses almost exclusively on the economic costs of critical habitat designation but does not analyze expected benefits. One commenter asserted that the protection of critical habitat would likely provide broader ecological benefits for myriad other species and ecosystem functions. One commenter stated the analysis should consider the property value benefits as a result of the creation of open space areas. Another commenter stated that the DEA should be considered a cost analysis only, because it focuses only on one side of the total impacts.

Our response: Where sufficient information is available, the DEA attempts to measure the net economic effects of species conservation efforts. The analysis does not attempt to measure net costs of broader social benefits that may result incidentally from species conservation. The primary purpose of the rulemaking is the potential to contribute to the conservation of the lynx. The direct benefits of the rule are primarily biological; weighing these benefits to lynx conservation against the expected cost impacts is part of the requirement of section 4(b) of the Act. Therefore, we use cost estimates from the DEA as one factor against which biological benefits are compared during the section 4(b)(2) weighing process. We are also interested in weighing indirect benefits of critical habitat designation, if they can be verified (we know they will occur), measured economically, and built into a net DEA. However, many potential indirect benefits resulting from critical habitat designation cannot be verified or measured economically. In future, as economic reports of conservation benefits to people and communities are completed, we may be better able to analyze this type of data.

(29) Comment: One commenter requested that the Service consider the on-the-ground benefits of the Montana Lynx Conservation Agreement in comparison with the benefits of critical habitat designation. The commenter asserted that the outreach, education, research, and implementation activities proposed under the agreement provide greater lynx conservation than any actions achievable by the Service through critical habitat designation.

Our response: We analyzed the benefits of inclusion of lands included in the Montana Partnership Conservation Agreement against benefits of exclusion (see Exclusions Under Section 4(b)(2) of the Act section; Unit 3). We found that these lands should be included in the critical habitat designation, mainly because of uncertainty of implementation and effectiveness of commitments included in the agreement (which is still a draft), and because the agreement provided no commitment to implement on-the-ground habitat management of habitat for lynx.

(30) Comment: One commenter stated that the DEA did not consider the Southern Rockies habitat area and therefore the Service has not fulfilled the requirement to show that the benefits of excluding the Southern Rocky Mountains outweigh the benefits of designating habitat in the region.

Our response: The Southern Rockies did not meet our criteria for defining critical habitat. The areas we determined to be essential for the conservation of lynx (see Criteria Used to Identify Critical Habitat section of this rule) contain the physical and biological features essential to lynx and have relatively recent (post-1995) records and evidence of breeding lynx populations. The Southern Rockies were not included in the proposed critical habitat, and therefore, no consideration was given to excluding those lands from critical habitat.

(31) Comment: One commenter stated that the Service has not issued any regulations or other binding documents regarding how to approach the ESA 4(b)(2) balancing in assessing whether stimulating private conservation agreements has greater conservation benefits than designating certain private lands as critical habitat.

Our response: In designating critical habitat, we are bound by the Act, and

regulations at 50 CFR 424.12. We agree that we have not issued new regulations regarding how to approach section 4(b)(2) critical habitat exclusion analysis. However, we are currently following our February 12, 2008, Draft Critical Habitat Exclusions Guidance. This guidance was developed in response to critical habitat case law, which documents the Courts' interpretations of the requirements of the Act. This rule is also consistent with the October 3, 2008, opinion from the Solicitor titled, "The Secretary's Authority to Exclude Areas from a Critical Habitat Designation under Section 4(b)(2) of the Endangered Species Act."

(32) Comment: According to one comment, the Service cannot lawfully maintain that the designation of critical habitat would not result in any incremental economic impacts because recent court decisions, *Gifford Pinchot Task Force* v. *FWS* (9th Cir. 2004) and *Arizona Cattle Growers Association* v. *Kempthorne* (D. Az. 2008), and an October 2008 Solicitor's Opinion, indicate that critical habitat is a more stringent ESA Section 7 compliance standard than the jeopardy standard.

Our response: The DEA weighs the economic effects of critical habitat designation separately from effects of listing of the species. This separation of effects is termed an "incremental" analysis. The DEA includes analysis of known effects resulting from critical habitat designation, including those related to potential adverse modification of critical habitat.

Summary of Changes From Proposed Rule

We did not propose changes to 50 CFR 17.11(h) in the proposed rule because we were not proposing any substantive changes to the entry for Canada lynx on the List of Threatened and Endangered Wildlife. However, in this final rule, we are revising the entry for Canada lynx at 50 CFR 17.11(h) to correct some typographical errors; the current entry includes Colorado and Idaho twice in the "Historic Range" column.

In preparing the revised final critical habitat designation for the lynx, we reviewed and considered comments from the public and peer reviewers on the proposed revised designation of critical habitat published on February 28, 2008 (73 FR 10860). We published a notice announcing the availability of the DEA and draft environmental assessment on October 21, 2008 (73 FR 62450). As a result of comments received on the proposal, comments received on the DEA, comments received on the draft environmental assessment, we made the following changes in our final designation:

(1) We reevaluated the proposed revised critical habitat units based on peer review, public comments, and biological information received during the public comment period. Collectively, we excluded approximately 4,468 km^2 (1,725 mi^2) of land from this revised final critical habitat designation. Table 1 provides differences in the amount of area proposed for designation and the areas designated in this final rule. We excluded Tribal lands per Executive Order 3206 (see Tribal Lands Excluded from Lynx Critical Habitat section below), and non-Federal lands with existing, implemented, and effective lynx management plans (see Exclusions Under Section 4(b)(2) of the Act section below).

(2) We removed portions of units that did not contain the primary constituent element (PCE), and areas where existing development was concentrated, from the final designation based on available maps. In some areas, unit boundaries were expanded to incorporate adjacent lynx habitat that had been inadvertently left out of the proposed boundary. These changes from the proposed boundary were noted in the notice of availability of the DEA and draft environmental assessment published in the **Federal Register** (73 FR 62450, October 21, 2008).

(3) We have clarified the primary constituent element to reflect the importance of mature multistoried forest stands with conifer boughs that touch the snow surface. These mature stands are especially important as lynx habitat in the northern Rocky Mountains.

(4) We have modified the textual description of areas that are not included in critical habitat.

Critical Habitat

Critical habitat is defined in section 3 of the Act as:

(i) The specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features

(a) Essential to the conservation of the species and

(b) That may require special management considerations or protection; and

(ii) Specific areas outside the geographical area occupied by a species at the time it is listed, upon a determination that such areas are essential for the conservation of the species.

Conservation, as defined under section 3 of the Act, means the use of all methods and procedures that are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to the Act are no longer necessary. Such methods and procedures include, but are not limited to, all activities associated with scientific resources management such as research, census, law enforcement, habitat acquisition and maintenance, propagation, live trapping, and transplantation, and, in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved, may include regulated taking.

Critical habitat receives protection under section 7 of the Act through the prohibition against Federal agencies carrying out, funding, or authorizing the destruction or adverse modification of critical habitat. Section 7(a)(2) of the Act requires consultation on Federal actions that may affect critical habitat. The designation of critical habitat does not affect land ownership or establish a refuge, wilderness, reserve, preserve, or other conservation area. Such designation does not allow the government or public to access private lands. Such designation does not require implementation of restoration, recovery, or enhancement measures by private landowners. Where a landowner requests Federal agency funding or authorization for an action that may affect a listed species or critical habitat, the consultation requirements of section 7(a)(2) would apply.

For inclusion in a critical habitat designation, the habitat within the geographical area occupied by the species at the time of listing must contain the physical and biological features that are essential to the conservation of the species, and be included only if those features may require special management consideration or protection. Critical habitat designations identify, to the extent known using the best scientific data available, habitat areas that provide essential life cycle needs of the species (i.e., areas on which are found those physical and biological features essential to the conservation of the species, as defined at 50 CFR 424.12(b)). Under the Act, we can designate critical habitat in areas outside of the geographical area occupied by the species at the time of listing only when we determine that those areas are essential for the conservation of the species.

Section 4 of the Act requires that we designate critical habitat on the basis of

the best scientific and commercial data available. Further, our Policy on Information Standards Under the Endangered Species Act, published in the **Federal Register** on July 1, 1994 (59 FR 34271), the Information Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Pub. L. 106–554; H.R. 5658)), and our associated Information Quality Guidelines provide criteria, establish procedures, and provide guidance to ensure that our decisions represent the best scientific data available. They require our biologists, to the extent consistent with the Act and with the use of the best scientific data available, to use primary and original sources of information as the basis for recommendations to designate critical habitat.

When determining which areas should be designated as critical habitat, our primary source of information is generally the information developed during the listing process for the species. Additional information sources may include the recovery outline or the recovery plan for the species, articles in peer-reviewed journals, conservation plans developed by States and counties, scientific status surveys and studies, biological assessments, or other unpublished materials and expert opinion or personal knowledge.

Habitat is often dynamic, and species may move from one area to another over time. Furthermore, we recognize that critical habitat designated at a particular point in time may not include all of the habitat areas that we may later determine are necessary for the recovery of the species. For these reasons, a critical habitat designation does not signal that habitat outside the designation is unimportant or may not promote the recovery of the species.

Areas that support populations, but are outside the critical habitat designation, will continue to be subject to conservation actions implemented under section 7(a)(1) of the Act. They are also subject to the regulatory protections afforded by the section 7(a)(2) jeopardy standard, as determined on the basis of the best available information at the time of the Federal agency action. Federally funded or permitted projects affecting listed species outside their designated critical habitat areas may still result in jeopardy findings in some cases. Similarly, critical habitat designations made on the basis of the best available information at the time of designation will not control the direction and substance of future recovery plans, habitat conservation plans, or other species conservation planning efforts if new information available to these planning efforts calls for a different outcome.

Primary Constituent Elements

In accordance with section 3(5)(A)(i) of the Act and regulations at 50 CFR 424.12, in determining which areas occupied by the species at the time of listing to designate as critical habitat, we consider the physical and biological features that are essential to the conservation of the species and that may require special management considerations and protection. We consider the physical and biological features to be the primary constituent elements (PCEs) laid out in the appropriate quantity and spatial arrangement for the conservation of the species. These include, but are not limited to:

1. Space for individual and population growth and for normal behavior;
2. Food, water, air, light, minerals, or other nutritional or physiological requirements;
3. Cover or shelter;
4. Sites for breeding, reproduction, and rearing (or development) of offspring; and
5. Habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

Boreal Forest Landscapes (Space for Individual and Population Growth and Normal Behavior)

Lynx populations respond to biotic and abiotic factors at different scales. At the regional scale, snow conditions, boreal forest and competitors (especially bobcat) influence the species' range (Aubry *et al.* 2000, p. 378–380; McKelvey *et al.*, 2000b pp. 242–253; Hoving *et al.*, 2005 p. 749). At the landscape scale within each region, natural and human-caused disturbance processes (e.g., fire, wind, insect infestations and forest management) influence the spatial and temporal distribution of lynx populations by affecting the distribution of good habitat for snowshoe hares (Agee 2000, pp. 47–73; Ruediger *et al.* 2000, pp. 1–3, 2–2—2–6, 7–3). At the stand-level scale, quality, quantity, and juxtaposition of habitats influence home range size, productivity, and survival (Aubry *et al.* 2000, pp. 380–390; Vashon *et al.* 2005a, pp. 9–11). At the substand scale, spatial distribution and abundance of prey and microclimate influence movements, hunting behavior, den, and resting site locations.

All of the constituent elements of critical habitat for lynx are found within large landscapes in what is broadly described as the boreal forest or cold temperate forest (Frelich and Reich 1995, p. 325, Agee 2000, pp. 43–46). In the contiguous United States, the boreal forest is more transitional rather than true boreal forest of northern Canada and Alaska (Agee 2000, pp. 43–46). This difference is because the boreal forest is at its southern limits in the contiguous United States, where it transitions to deciduous temperate forest in the Northeast and Great Lakes and subalpine forest in the west (Agee 2000, pp. 43–46). We use the term "boreal forest" because it generally encompasses most of the vegetative descriptions of the transitional forest types that comprise lynx habitat in the contiguous United States (Agee 2000, pp. 40–41).

At a regional scale, lynx habitat is within the areas that support deep snow for extended periods and that support boreal forest vegetation types (see below for more detail). In eastern North America, lynx distribution was strongly associated with areas of deep snowfall and 100-km^2 (40-mi^2)) landscapes that had been previously treated with herbicides and had a high proportion of regenerating forest (Hoving 2001, pp. 75, 143). Hoving *et al.* (2004, p. 291) concluded that the broad geographic distribution of lynx in eastern North America is most influenced by snowfall, but within areas of similarly deep snowfall, measures of forest succession become more important factors in determining lynx distribution. In the Rockies, lynx habitat relationships appear to be less tied to early successional forest stages, with high use, especially in the critical winter season, in mature multistoried forest stands where conifer branches reach the snow surface and thereby provide hare forage (Squires *et al.* 2006).

Boreal forests used by lynx are generally cool, moist, and dominated by conifer tree species, primarily spruce and fir (Agee 2000, pp. 40–46; Aubry *et al.* 2000, pp. 378–382; Ruediger *et al.* 2000, pp. 4–3, 4–8—4–11, 4–25—4–26, 4–29—4–30). Boreal forest landscapes used by lynx are a heterogeneous mosaic of vegetative cover types and successional forest stages created by natural and human-caused disturbances (McKelvey et al. 2000a, pp. 426–434). In many places periodic vegetation disturbances stimulate development of dense understory or early successional habitat for snowshoe hares (Ruediger et al. 2000, pp. 1–3—1–4, 7–4—7–5). In Maine, lynx were positively associated with landscapes altered by clearcutting 15 to 25 years previously (Hoving *et al.* 2004, p. 291). In other places, such as the northern Rocky Mountains, mature

multistoried conifer forests as well as dense regenerating conifer stands provide foraging habitat for lynx (Squires *et al.* 2006).

The overall quality of the boreal forest landscape and juxtaposition of stands in suitable condition within the landscape is important for both lynx and snowshoe hares in that it can influence connectivity or movements between suitable stands, availability of food and cover and spatial structuring of populations or subpopulations (Hodges 2000b, pp. 184–195; McKelvey *et al.* 2000a, pp. 431–432; Walker 2005, pp. 79). For example, lynx foraging habitat must be near denning habitat to allow females to adequately provision dependent kittens, especially when the kittens are relatively immobile. In north-central Washington, hare densities were higher in landscapes with an abundance of dense boreal forest interspersed with small patches of open habitat, in contrast to landscapes composed primarily of open forest interspersed with few dense vegetation patches (Walker 2005, p. 79). Similarly, in northwest Montana, connectivity of dense patches within the forest matrix benefited snowshoe hares (Ausband and Baty 2005, p. 209). In mountainous areas, lynx appear to prefer flatter slopes (Apps 2000, p. 361; McKelvey *et al.* 2000d, p. 333; von Kienast 2003, p. 21, Table 2; Maletzke 2004, pp. 17–18).

Individual lynx require large portions of boreal forest landscapes to support their home ranges and to facilitate dispersal and exploratory travel. The size of lynx home ranges is believed to be strongly influenced by the quality of the habitat, particularly the abundance of snowshoe hares, in addition to other factors such as gender, age, season, and density of the lynx population (Aubry *et al.* 2000, pp. 382–385; Mowat *et al.* 2000, pp. 276–280). Generally, females with kittens have the smallest home ranges while males have the largest home ranges (Moen *et al.* 2005, p. 11, Burdett *et al.* 2007, p. 463). Reported home range sizes vary greatly from 31 km^2 (12 mi^2) for females and 68 km^2 (26 mi^2) for males in Maine (Vashon *et al.* 2005a, p. 7), 21 km^2 (8 mi^2) for females to 307 km^2 (119 mi^2) for males in Minnesota (Moen *et al.* 2005, p. 12), and 88 km^2 (34 mi^2) for females and 216 km^2 (83 mi^2) for males in northwest Montana (Squires *et al.* 2004b, pp. 15–16).

Forest Type Associations

Maine

Lynx were more likely to occur in 100 km^2 (40 mi^2) landscapes with regenerating forest, and less likely to occur in landscapes with recent clearcut or partial harvest, (Hoving *et al.* 2004, pp. 291–292). Lynx in Maine select softwood-dominated (spruce and fir) regenerating stands (Vashon *et al.* 2005a, p. 8). Regenerating stands used by lynx generally develop 15–30 years after forest disturbance and are characterized by dense horizontal structure and high stem density within a meter of the ground. These habitats support high snowshoe hare densities (Homyack 2003, p. 63; Fuller and Harrison 2005, pp. 716, 719; Vashon *et al.* 2005a, pp. 10–11). At the stand scale, lynx in northwestern Maine selected older (11- to 26-year-old), tall (4.6 to 7.3 m (15 to 24 ft)) regenerating clearcut stands and older (11- to 21-year-old) partially harvested stands (A. Fuller, University of Maine, unpubl. data).

Minnesota

In Minnesota, lynx primarily occur in the Northern Superior Uplands Ecological Section of the Laurentian Mixed Forest Province. Historically, this area was dominated by red pine (*Pinus resinosa*) and white pine (*P. strobus*) mixed with aspen (*Populus* spp.), paper birch (*Betula papyrifera*), spruce, balsam fir (*A. balsamifera*) and jack pine (*P. banksiana*) (Minnesota Department of Natural Resources [Minnesota DNR] 2003, p. 2).

Preliminary research suggests lynx in Minnesota generally use younger stands (less than 50 years) with a conifer component in greater proportion than their availability (R. Moen, University of Minnesota, unpubl. data). Lynx prefer predominantly upland forests dominated by red pine, white pine, jack pine, black spruce (*P. mariana*), paper birch, quaking aspen (*P. tremuloides*), or balsam fir (R. Moen, unpubl. data).

Washington

In the North Cascades in Washington, the majority of lynx occurrences were found above 1,250 m (4,101 ft) (McKelvey *et al.* 2000b, p. 243, 2000d, p. 321; von Kienast 2003, p. 28, Table 2; Maletzke 2004, p. 17). In this area, lynx selected Engelman spruce (*P. engelmanii*)-subalpine fir (*A. lasiocarpa*) forest cover types in winter (von Kienast 2003, p. 28, Maletzke 2004, pp. 16–17, Koehler *et al.* 2008, p. 1518). Lodgepole pine (*P. contorta*) is a dominant tree species in the earlier successional stages of these climax cover types. Seral (intermediate stage of ecological succession) lodgepole stands contained dense understories and therefore received high use by snowshoe hares and lynx (Koehler 1990, pp. 847–848; McKelvey *et al.* 2000d, pp. 332–335). Douglas-fir, ponderosa pine forests, openings, recent burns, open canopy and understory cover, and steep slopes were all avoided habitat types (Koehler *et al.* 2008, p. 1518).

Northern Rockies

In the Northern Rocky Mountains, the majority of lynx occurrences are associated with the Rocky Mountain Conifer Forest or Western Spruce-Fir Forest vegetative class (Kuchler 1964, p. 4; McKelvey *et al.* 2000b, p. 246) and occur above 1,250 m (4,101 ft) elevation (Aubry *et al.* 2000, pp. 378–380; McKelvey *et al.* 2000b, pp. 243–245). The dominant vegetation that constitutes lynx habitat in these areas is subalpine fir, Engelman spruce and lodgepole pine (Aubry *et al.* 2000, p. 379; Ruediger *et al.* 2000, pp. 4–8—4–10). Mature multi-storied stands are used preferentially in winter (Squires *et al.* 2006). As in the Cascades, lodgepole pine is an earlier successional stage of subalpine fir and Engelman spruce climax forest cover types.

a. Snowshoe Hares (Food)

Snowshoe hare density is the most important factor explaining the persistence of lynx populations (Steury and Murray 2004, p. 136). A minimum snowshoe hare density necessary to maintain a persistent, reproducing lynx population within the contiguous United States has not been determined, although Ruggiero *et al.* (2000, pp. 446–447) suggested that at least 0.5 hares per hectare (ha) (0.2 hares per acre (ac)) may be necessary. Steury and Murray (2004, p. 137)) modeled lynx and snowshoe hare populations and predicted that a minimum of 1.1 to 1.8 hares per ha (0.4 to 0.7 hares per ac) was required for persistence of a reintroduced lynx population in the southern portion of the lynx range.

The boreal forest landscape is naturally dynamic and usually contains a mosaic of forest stand successional stages. In some areas, particularly in the eastern portion of the DPS, stands that support high densities of snowshoe hares are of a young successional stage and are in a constant state of transition to other more mature stages. Conversely, if the vegetation potential (or climax forest type) of a particular forest stand is conducive to supporting abundant snowshoe hares, it likely will also go through successional stages that are unsuitable as lynx foraging (snowshoe hare habitat) or lynx denning habitat (Agee 2000, p. 62–72; Buskirk *et al.* 2000b, pp. 403–408) as part of a natural forest succession process. For example, a boreal forest stand where there has been recent disturbance, such as fire or timber harvest, resulting in little or no understory structure is unsuitable as

snowhoe hare habitat for lynx foraging. That temporarily unsuitable stand would regenerate into suitable snowshoe hare (lynx foraging) habitat within 10 to 25 years, depending on local conditions (Ruediger *et al.* 2000, pp. 1–3—1–4, 2–2—2–5). This continuation of this natural dynamism exhibited in boreal forest succession is crucial for lynx survival due to their dependence on intermediate successional stages in many areas. In places where lynx are dependent on mature forest stages, forest stand turnover still occurs, but on a longer time scale requiring the ability to recruit new mature forest stands as others are lost to fire, insect infestation, or human activities.

Forest management techniques that thin the understory may render the habitat unsuitable for hares and, thus, for lynx (Ruediger *et al.* 2000, pp. 2–4—3–2; Hoving *et al.* 2004, pp. 291–292). Stands may continue to provide suitable snowshoe hare habitat for many years until woody stems in the understory become too sparse, as a result of undisturbed forest succession or management (e.g., clearcutting or thinning). Thus, if the vegetation potential of the stand is appropriate, a stand that is not currently in a condition that is suitable to support abundant snowshoe hares for lynx foraging or coarse woody debris for den sites would develop into suitable habitat for snowshoe hares (and thus lynx foraging) with time. Therefore, we consider those forest areas with the potential, through natural succession, to produce high quality snowshoe hare habitat to be lynx habitat, regardless of the stage of forest succession that area is currently in.

As described previously, snowshoe hares prefer boreal forest stands that have a dense horizontal understory to provide food, cover and security from predators. Snowshoe hares feed on conifers, deciduous trees, and shrubs (Hodges 2000b, pp. 181–183). Snowshoe hare density is correlated to understory cover between approximately 1 to 3 m (3 to 10 ft) above the ground or snow level (Hodges 2000b, p. 184). Habitats most heavily used by snowshoe hares are stands with shrubs, stands that are densely stocked, and stands at ages where branches have more lateral cover (Hodges 2000b, p. 184). In Maine, the snowshoe hare densities were highest in stands supporting high conifer stem densities (Homyack 2003, p. 195, Robinson 2006, p. 69). In north-central Washington, snowshoe hare density was highest in 20-year-old lodgepole pine stands where the average density of trees and shrubs was 15,840 stems per ha (6,415 stems per ac) (Koehler 1990, p. 848). In Montana, lynx use in winter corresponded to stands with a high number of large mature trees with branches that reached the snow surface (Squires *et al.* 2006, p. 15). Generally, earlier successional forest stages support a greater density of horizontal understory and more abundant snowshoe hares (Buehler and Keith 1982, p. 24; Wolfe *et al.* 1982, pp. 668–669; Koehler 1990, pp. 847–848; Hodges 2000b, pp. 184–191; Griffin 2004, pp. 84–88); however, sometimes mature stands also can have adequate dense understory to support abundant snowshoe hares (Griffin 2004, p. 88). In Montana, lynx favor multistory stands, often in older-age classes, where the tree boughs touch the snow surface but where the stem density is low (Squires *et al.* 2006, p. 15).

In Maine, the highest snowshoe hare densities were found in regenerating softwood (spruce and fir) and mixed-wood stands with high conifer stem densities (Fuller and Harrison 2005, pp. 716, 719, Robinson 2006, p. 69). In the north Cascades, the highest snowshoe hare densities were found in 20-year-old seral lodgepole pine stands with a dense understory (Koehler 1990, pp. 847–848). In montane and subalpine forests in northwest Montana, the highest snowshoe hare densities in summer were generally in younger stands with dense forest structure, whereas in winter, snowshoe hare densities were as high or higher in mature stands with dense understory forest structure (Griffin 2004, p. 53).

Habitats supporting abundant snowshoe hares must be present in a sufficient proportion (though not necessarily the majority) of the landscape to support a viable lynx population. Broad-scale snowshoe hare density estimates are not available for the areas being designated as lynx critical habitat. Available snowshoe hare density estimates are helpful in determining where snowshoe hares exist, but each estimate is specific to both a location and a point in time. Due to intrinsic, rapid fluctuations often seen in snowshoe hare populations, density estimates can not be considered definitive for any particular area. If enough data were gathered for a specific area over several years, these data could be used to calculate an average density (with margins of error included).

b. Snow Conditions (Other Physiological Requirements)

Snow conditions also determine the distribution of lynx and snowshoe hares. Deep, fluffy snow conditions likely restrict potential competitors such as bobcat or coyote from effectively encroaching on or hunting in winter lynx habitat. Snowfall was the strongest predictor of lynx occurrence at a regional scale (Hoving *et al.* 2005, p. 746, Table 5). In addition to snow depth, other snow properties, including surface hardness or sinking depth, are important factors in the spatial, ecological, and genetic structuring of the species (Stenseth *et al.* 2004, p. 75).

In the northeastern United States, lynx are most likely to occur in areas with a 10-year mean annual snowfall greater than 268 cm (105 in) (Hoving 2001, p. 75). The Northern Superior Uplands section of Minnesota receives more of its precipitation as snow than any section in the State, has the longest period of snow cover, and the shortest growing season (Minnesota DNR 2003, p. 2). Mean annual snowfall from 1971 to 2000 in this area was generally greater than 149 cm (55 in) (University of Minnesota 2005 webpage).

Information on average snowfall or snow depths in mountainous areas such as the Cascades or northwest Montana is limited because there are few weather stations in these regions that have measured snow fall or snow depth over time. An important consideration is that the topography strongly influences local snow conditions. For example, in the Cascades, at the Mazama station, average annual snowfall from 1948 to 1976 was 292 cm (115 in) (Western Regional Climate Center 2005 webpage). In Montana, at the Seeley Lake Ranger Station, average annual snowfall from 1948 to 2005 was 315 cm (124 in), while at the Troy station the average total snowfall from 1961 to 1994 was 229 cm (90 in) (Western Regional Climate Center 2005 webpage).

c. Denning Habitat (Sites for Reproduction and Rearing of Offspring)

Lynx den sites are found in mature and younger boreal forest stands that have a large amount of cover and downed, large woody debris. The structural components of lynx den sites are common features in managed (logged) and unmanaged (e.g., insect damaged, wind-throw) stands. Downed trees provide excellent cover for den sites and kittens and often are associated with dense woody stem growth.

Sub-stand characteristics were evaluated for 26 lynx dens from 1999 to 2004 in northwest Maine. Dens were found in several stand types. Modeling of den site variables determined that tip-up mounds (exposed roots from fallen trees) alone best explained den site selection (J. Organ, Service, unpubl. data). Tip-up mounds may purely be an index of downed trees, which were

abundant on the landscape. Horizontal cover at 5 m (16 ft) alone was the next best performing model (J. Organ, unpubl. data). Dead downed trees were sampled, but did not explain den site selection as well as tip-up mounds and cover at 5 m (16 ft). Lynx essentially select dense cover in a cover-rich area for denning.

In the North Cascades, Washington, lynx denned in mature (older than 250 years) stands with an overstory of Engelman spruce, subalpine fir, and lodgepole pine with an abundance of downed woody debris (Koehler 1990, p. 847). In this study, all den sites were located on north-northeast aspects (Koehler 1990, p. 847). In northwest Montana, the immediate areas around dens were in a variety of stand ages but all contained abundant woody debris including downed logs, blowdowns, and rootwads, and dense understory cover (Squires *et al.* 2004b, Table 3). Information on den site characteristics in Minnesota has not yet been reported (Moen *et al.* 2005, p. 8).

Primary Constituent Element for the Canada Lynx

Within the geographical area occupied by the lynx at the time of listing, we must identify the physical and biological features that are essential to the conservation of the species and that may require special management considerations or protections. The physical and biological features are primary constituent elements (PCEs) laid out in a specific quantity and spatial arrangement to be essential to the conservation of the species.

Based on the above needs and our current knowledge of the life history, biology, and ecology of the species, we have determined that the primary constituent element for lynx critical habitat is:

1. Boreal forest landscapes supporting a mosaic of differing successional forest stages and containing:

a. Presence of snowshoe hares and their preferred habitat conditions, which include dense understories of young trees, shrubs or overhanging boughs that protrude above the snow, and mature multistoried stands with conifer boughs touching the snow surface;

b. Winter snow conditions that are generally deep and fluffy for extended periods of time;

c. Sites for denning that have abundant coarse woody debris, such as downed trees and root wads; and

d. Matrix habitat (e.g., hardwood forest, dry forest, non-forest, or other habitat types that do not support snowshoe hares) that occurs between patches of boreal forest in close juxtaposition (at the scale of a lynx home range) such that lynx are likely to travel through such habitat while accessing patches of boreal forest within a home range.

This critical habitat designation is designed for the conservation of the physical and biological features essential to the conservation of the lynx and necessary to support lynx life history functions. The physical and biological features, described in the PCE defined above, comprise the essential features of boreal forest that (1) provide adequate prey resources necessary for the persistence of local populations and metapopulations of lynx through reproduction; (2) act as a possible source of lynx for more peripheral boreal forested areas; (3) enable the maintenance of home ranges; (4) incorporate snow conditions for which lynx are highly specialized that give lynx a competitive advantage over potential competitors; (5) provide denning habitat; and (6) provide habitat connectivity for travel within home ranges, exploratory movements, and dispersal within critical habitat units. Lynx use habitat at a landscape scale, which means that no single locality (small scale) contains all of the required habitat elements that lynx need to ensure survival and reproduction. Therefore, individual portions of each unit (for example, an individual forest stand) may not contain all of the PBFs listed above, however, each unit, as a landscape, does contain each of the PBFs and it is the landscape as a whole that contains the PCE.

Special Management Considerations or Protections

When designating critical habitat, we assess whether the areas occupied by the species at the time of listing contain the physical and biological features that are essential to the conservation of the species, and whether these features may require special management considerations or protections.

Lands within the revised critical habitat will require some level of management to address the current and future threats to the lynx and to maintain and protect the physical and biological features essential to the conservation of the species. In all units, special management will be required to ensure that boreal forest landscapes provide a mosaic of forest stands of various ages to provide abundant prey habitat, denning habitat, and connectivity within the landscape. The designation of critical habitat does not imply that lands outside of critical habitat do not play an important role in the conservation of the lynx. Federal activities that may affect areas outside of critical habitat, such as forest management, development, and road construction, are still subject to review under section 7 of the Act if they may affect lynx, because Federal agencies must consider effects to lynx and effects to critical habitat independently. The take prohibitions of section 9 of the Act (e.g., harm, harass, capture, kill) also continue to apply both inside and outside of designated critical habitat.

Special management direction for lynx has been applied to public lands in much of the lynx DPS. The U.S. Forest Service (USFS), Bureau of Land Management (BLM), National Park Service (NPS), and the Service developed a Lynx Conservation Assessment and Strategy (LCAS) (Ruediger *et al.* 2000, entire) using the best available science at the time specifically to provide a consistent and effective approach to conserve lynx and lynx habitat on Federal lands (Ruediger *et al.* 2000). The overall goals of the LCAS are to recommend lynx conservation measures, to provide a basis for reviewing the adequacy of USFS and BLM land and resource management plans with regard to lynx conservation, and to facilitate conferencing and consultation under section 7 of the Act. The LCAS identifies an inclusive list of 17 potential risk factors for lynx or lynx habitat that may be addressed under programs, practices, and activities within the authority and jurisdiction of Federal land management agencies. The risks identified in the LCAS are based on effects to individual lynx, lynx populations, or to lynx habitat. Potential risk factors the LCAS addresses, that may affect lynx productivity, include: Timber management, wildland fire management, recreation, forest/backcountry roads and trails, livestock grazing, and other human developments. Potential risk factors the LCAS addresses, that may affect lynx mortality, include: Trapping, predator control, incidental or illegal shooting, and competition and predation as influenced by human activities and highways. Potential risk factors the LCAS addresses, that may affect lynx movement, include: Highways, railroads and utility corridors, land ownership pattern, and ski areas and large resorts. Other potential large-scale risk factors for lynx addressed by the LCAS include: Fragmentation and degradation of lynx refugia, lynx movement and dispersal across shrub-steppe habitats, and habitat degradation by nonnative and invasive plant species.

The LCAS used the best available information in 2000 to ensure that the appropriate mosaic of habitat is provided for lynx conservation on Federal lands. Although the LCAS was written specifically for Federal lands, many of the conservation measures could be pertinent to non-Federal lands. To facilitate project planning and allow for the assessment of the potential effects of a project on an individual lynx, the LCAS directs Federal land management agencies to delineate Lynx Analysis Units (LAUs). The scale of an LAU approximates the size of area used by an individual lynx (25 to 50 mi^2 (65 to 130 km^2)). The LCAS recognizes that LAUs will likely encompass both lynx habitat and other areas (e.g., lakes, low elevation ponderosa pine (*Pinus ponderosa*) forest, and alpine tundra). Habitat-related standards the LCAS provides to address potential risks include:

1. If more than 30 percent of lynx habitat in an LAU is currently in unsuitable condition, no further reduction of suitable condition shall occur as a result of vegetation management activities by Federal agencies;
2. Within an LAU, maintain denning habitat in patches generally larger than 5 ac (2 ha), comprising at least 10 percent of lynx habitat;
3. Maintain habitat connectivity within and between LAUs;
4. Management actions (e.g., timber sales, salvage sales) shall not change more than 15 percent of lynx habitat within an LAU to an unsuitable condition within a 10-year period;
5. Pre-commercial thinning will only be allowed when stands no longer provide snowshoe hare habitat; and
6. On Federal lands in lynx habitat, allow no net increase in groomed or designated over-the-snow routes and snowmobile play areas by LAU.

With the listing of the lynx in 2000, Federal agencies across the contiguous United States range of the lynx were required to consult with the Service on actions that may affect lynx. The LCAS assists Federal agencies in planning activities and projects in ways that benefit lynx or avoid adverse impacts to lynx or lynx habitat (Ruediger *et al.* 2000). If projects are designed that fail to meet the standards in the LCAS, the biologists using the LCAS would arrive at an adverse effect determination for lynx.

A Conservation Agreement between the USFS and the Service (U.S. Forest Service and U.S. Fish and Wildlife Service 2000) and a similar Agreement between the BLM and the Service (Bureau of Land Management and U.S. Fish and Wildlife Service 2000) committed the USFS and BLM to use the LCAS in determining the effects of actions on lynx until Forest Plans were amended or revised to adequately conserve lynx. A programmatic biological opinion pursuant to section 7 of the Act confirmed the adequacy of the LCAS and its conservation measures to conserve lynx, and concluded that USFS and BLM land management plans, as implemented in accordance with the Conservation Agreements, would not jeopardize the continued existence of lynx (U.S. Fish and Wildlife Service 2000).

In 2005, the USFS and the Service renewed the conservation agreement (U.S. Forest Service and U.S. Fish and Wildlife Service 2005) because the original agreement had expired. In the 2005 agreement, the parties agreed to take measures to reduce or eliminate adverse effects or risks to lynx and its occupied habitat pending amendments to Forest Plans. The LCAS is a basis for implementing this agreement (U.S. Forest Service and U.S. Fish and Wildlife Service 2005). The 2005 agreement was renewed on October 20, 2006, and expires December 31, 2010, unless renewed. The BLM continues to adhere to their original agreement although it expired in December 2004.

Lynx conservation depends on management that supports boreal forest landscapes of sufficient size to encompass the temporal and spatial changes in habitat and snowshoe hare populations to support interbreeding lynx populations or metapopulations over time. At the time it was written, the LCAS provided the highest level of management or protection for lynx. The LCAS conservation measures address risk factors affecting lynx habitat and lynx productivity and were designed to be implemented at the scale necessary to conserve lynx. This level of management is appropriate for Federal lands, because they account for the majority of high-quality habitat in the United States, and also because the inadequacy of regulatory mechanisms to conserve lynx on these lands was the primary reason for listing the lynx as a threatened species under the Act. New information has become available since the LCAS was written, and should be taken into account by land managers. Kolbe *et al.* (2007) and Bunnell *et al.* (2006) published information on the effects of snowmobiling on lynx, and Squires *et al.* (2006) documented the importance of multilayered stands as snowshoe hare habitat. Ongoing research in Minnesota and Maine has resulted in information that contributes to our understanding of lynx and snowshoe hares (e.g., Moen *et al.* 2004; Hoving *et al.* 2005; Homyack *et al.* 2007; Fuller *et al.* 2007). In some regions of Wyoming, Washington and Maine, research continues. As new information becomes available, it should be added to that in the LCAS.

The USFS considered some of the new information discussed above when it proposed to revise 18 Forest Plans under a programmatic plan amendment called the Northern Rocky Mountain Lynx Amendment (NRLA) (U.S. Forest Service 2007). Some of the LCAS standards were changed to guidelines because the Service determined that some risk factors were not negatively affecting the contiguous U.S. DPS of lynx as a whole. Since publication of the LCAS, lynx studied in the United States have been shown to use a variety of sites and conditions for denning. Lynx denning sites are not believed to be a limiting factor in Montana and Maine study areas (Service 2007, pp. 48–49). Earlier assessments also concluded that, in most geographic areas, denning habitat was not likely limiting to lynx, and existing forest plan direction would not result in adverse effects (Hickenbottom *et al.* 1999). After evaluating Bunnell *et al.* (2006, entire) and Kolbe *et al.* (2007, entire), we determined that the best information available did not indicate that compacted snow routes increase competition from other species to levels that adversely impact lynx populations in the NRLA area (Service 2007, pp. 55). Since the LCAS was written, new information revealed the importance of multi-storied stands for lynx (Squires *et al.* 2006). On the basis of the above information, the USFS included a standard for conserving multi-storied stands in the NRLA. This LCAS does not contain this standard.

In addition to diverging from the standards in the LCAS because of new information, the NRLA also deviated from the LCAS by allowing additional fuels reduction projects in areas within the wildlands-urban-interface (WUI). In our analysis of the NRLA, we determined that the management in the NRLA area would provide for the recovery of lynx in these areas by addressing the major reason we listed the lynx in 2000—the lack of guidance for conservation of lynx in Federal land management plans. Consultation under section 7 of the Act was completed for the NRLA in 2007, and it is now official land management direction for the National Forests that adopted it.

In Maine, lynx populations occur in extensive boreal forest landscapes where large, contiguous stands of young, regenerating spruce-fir habitat

are prevalent and support high densities of snowshoe hares. Historically, habitat was likely created by natural forest disturbances, fire, insects and disease, and windthrow. Most of the lynx in Maine occur on private, industrial forest lands. Large-scale, industrial forest management has created the current habitat, and future forest management that produces extensive stands supporting high hare densities is needed to support lynx populations. The Service developed *Canada Lynx Habitat Management Guidelines for Maine* (McCollough 2007, entire). These guidelines specify the special management—recommendations on land use, forest conditions, landscape conditions, and silviculture requirements—needed to support lynx populations based on the best available science (see discussion of Healthy Forest Reserve Program for further details).

Criteria Used To Identify Critical Habitat

As required by section 4(b)(2) of the Act, we used the best scientific data available to designate critical habitat. In order to determine those specific areas occupied by the species at the time it was listed on which are found those physical or biological features essential to the conservation of the species, as required by section 3(5)(a)(i) of the Act, we reviewed the approach to the conservation of the lynx provided in a recovery outline (Service 2005, entire); information from State, Federal and Tribal agencies; and information from academia and private organizations that have collected scientific data on lynx.

The focus of our strategy in considering lands for designation as critical habitat was on boreal forest landscapes of sufficient size to encompass the temporal and spatial changes in habitat and snowshoe hare populations to support interbreeding lynx populations or metapopulations over time. These factors are included in the PCE for lynx. According to the recovery strategy, areas that meet these criteria are considered ''core habitat areas'' for lynx (USFWS 2005, p. 4); however, for critical habitat, we have refined areas based on evidence of breeding populations. As stated in the proposed rule, the areas we consider essential to the conservation of lynx have the physical and biological features essential to lynx in sufficient quantity and spatial arrangement, as evidenced by consistent occupancy and reproduction by lynx. We focused on consistency of lynx presence and reproduction, because areas with these characteristics represent resiliency during population lows, which is key to the species' survival. Areas that meet these criteria contrast with areas that may serve as temporary habitat for unsuccessful dispersers during population highs, but do not support lynx reproduction, and therefore are not likely to play a role in lynx conservation. Individual lynx maintain large home ranges; the areas identified as having features essential to the conservation of the lynx are large enough to encompass multiple home ranges. A secondary consideration is that, in addition to supporting breeding populations, these areas provide connectivity among patches of suitable habitat (e.g., patches containing abundant snowshoe hares), whose locations in the landscape shift through time. Areas that have historical records of lynx, but no record of reproduction, and that support lynx during dispersal movements, are considered ''secondary areas'' (USFWS 2005, p. 4). Areas outside core and secondary areas that have sporadic records of lynx are considered ''peripheral areas'' (USFWS 2005, p. 4).

We reviewed available information that pertains to the habitat requirements of this species and its principal prey, the snowshoe hare. This information included data in reports submitted by researchers holding recovery permits under section 10(a)(1)(A) of the Act; research published in peer-reviewed articles, presented in academic theses, agency reports and unpublished data; and various Geographic Information System (GIS) coverages (e.g., land cover type information, land ownership information, snow depth information, topographic information, locations of lynx obtained from radio-or GPS-collars and locations of lynx confirmed via DNA analysis or other verified records).

In designating critical habitat for the lynx we used the best scientific data available to evaluate areas that possess the physical and biological features essential to the conservation of the species and that may require special management considerations or protection. In evaluating areas as critical habitat, we first conducted a two-part analysis: (1) We relied on information used during listing of the species, and any available newer information, to delineate the geographic area occupied by the species at the time of listing, and (2) used the best available scientific information to determine which occupied areas contain the physical and biological features essential to the conservation of the lynx.

In determining the geographic area occupied by the species, we utilized data providing verified evidence of the occurrence of lynx and evidence of the presence of breeding lynx populations as represented by records of lynx reproduction. We find that evidence of breeding populations is the best way to verify that the physical and biological features essential to lynx are present in sufficient quantity and spatial configuration to meet the needs of the species, and qualify as critical habitat. We eliminated areas from consideration in two ways: (1) Areas outside the known historical range and (2) data older than 1995 were not considered valid to our assessment of occurrence and reproduction of lynx. We used data on the known historical range of the lynx (e.g., McKelvey *et al.* 2000b, pp. 207–232; Hoving *et al.* 2003, entire) to eliminate areas outside the historical range of the species.

We then focused on records since 1995 to ensure that this critical habitat designation is based on the data that most closely represents the current status of lynx in the contiguous United States and the geographical area known to be occupied by the species at the time of listing. Although the average lifespan of a wild lynx is not known, we assumed that a lynx born in 1995 could have been alive in 2000 or 2003, when the final listing rule and the clarification of findings were published. Data after 1995 were considered valid. Recent verified lynx occurrence records were provided by Federal research entities, State wildlife agencies, academic researchers, and private individuals or organizations working on lynx (K. Aubry, Pacific Northwest Research Station, unpubl. data; S. Gehman, Wildthings Unlimited, unpubl. data; S. Gniadek, Glacier National Park, unpubl. data; S. Loch, Independent Scientist, and E. Lindquist, Superior National Forest, unpubl. data; K. McKelvey, Rocky Mountain Research Station; unpubl. data; Minnesota DNR 2005 Web site; R. Moen, University of Minnesota, Natural Resources Research Institute, unpubl. data.; J. Squires, Rocky Mountain Research Station, unpubl. data; J. Vashon, Maine Department of Inland Fisheries and Wildlife, unpubl. data).

We used only verified lynx records, because we wanted to rely on the best available data to evaluate specific areas and their features for critical habitat designation. The reliability of lynx occurrence reports can be questionable because the bobcat, a common species, can be confused with the lynx, which is similar in appearance. Additionally, many surveys are conducted by snow tracking in which correct identification of tracks can be difficult because of variable conditions affecting the quality

of the track and variable expertise of the tracker. Our definition of a verified lynx record is modified from McKelvey *et al.* (2000b, p. 209)—(1) an animal (live or dead) in hand or observed closely by a person knowledgeable in lynx identification, (2) genetic (DNA) confirmation, (3) snow tracks only when confirmed by genetic analysis (e.g., McKelvey *et al.* 2006, entire) or (4) location data from radio or GPS-collared lynx. Documentation of lynx reproduction consists of lynx kittens in hand, or observed with the mother by someone knowledgeable in lynx identification, or snow tracks demonstrating family groups traveling together, as identified by a person highly knowledgeable in identification of carnivore tracks. However, we made an exception and accepted snow track data from Maine because of the stringent protocols used in confirming tracks as lynx and the minimal number of species in the area with which lynx tracks could be misidentified (McCollough 2006, entire).

To define critical habitat according to section 3(5)(A) of the Act, we then delineated, within the geographical area currently occupied by the species at the time of listing, areas containing physical and biological features essential to the conservation of the lynx. The physical and biological features (as defined above under Primary Constituent Elements) were determined by including recent lynx records, evidence of breeding lynx populations, the boreal forest type that is currently occupied by lynx in that particular region, and direct connectivity with lynx populations in Canada. Lynx populations in the contiguous United States are influenced by lynx population dynamics in Canada (Thiel 1987; McKelvey *et al.* 2000a, p. 427, 2000c, p. 33). Many of these populations in Canada are directly interconnected with United States populations and are likely a source of emigration into the contiguous United States; lynx from the contiguous United States are known to move into Canada. Therefore, we assume that retaining connectivity with larger lynx populations in Canada is important to ensuring long-term persistence of lynx populations in the United States. We assume that, regionally, lynx within the contiguous United States and adjacent Canadian provinces interact as metapopulations. Where available, data on historic average snow depths and bobcat harvest provided additional insight for refining and delineating appropriate boundaries for consideration as critical habitat.

In the North Cascades and Northern Rockies, the features essential to the conservation of lynx, the majority of lynx records, evidence of reproduction, and the boreal forest types are typically, though not always, found above 4,000 feet (ft) (1,219 meters [m]) in elevation (McKelvey *et al.* 2000b, pp. 243–245; McAllister *et al.* 2000, entire). Thus, we limited the delineation of critical habitat to lands above this elevation unless we had habitat data indicating that suitable habitat exists below this elevation. Additionally, in the North Cascades, features essential to the conservation of the lynx and the majority of the lynx records and evidence of reproduction occur east of the crest of the Cascade Mountains.

Based on comments received, the availability of better maps and inspection of aerial photos, we adjusted some boundaries of the areas proposed for critical habitat to better reflect the distribution of lynx habitat. The boundaries are modified in Units 2 (Minnesota), 3 (northern Rockies), and 5 (GYA) to better reflect the location of the PCE through the use of new habitat mapping data obtained from State and Federal agencies and private industry. Boundaries in Units 1 (Maine) and 4 (Washington) remained the same with the exception of 4(b)(2) exclusions (discussed in Exclusions Under Section 4(b)(2) of the Act section below).

Given the scale of the critical habitat units, it was not feasible to completely avoid inclusion of water bodies, including lakes, reservoirs and rivers, grasslands, or human-made structures such as buildings, paved and gravel roadbeds, parking lots, and other structures that lack the PCE for the lynx. These areas, including any developed areas and the land on which such structures are located, that exist inside critical habitat boundaries, are excluded by text and are not designated critical habitat. Therefore, Federal actions limited to these areas would not trigger section 7 consultation, unless they affect the species or primary constituent element in adjacent critical habitat.

When considering what areas to include as critical habitat, we focused closely on areas with reliable evidence of lynx occurrence and reproduction since 1995. For example, because there is no verified evidence of lynx occupation or reproduction in New Hampshire or western Maine since 1995, we did not consider these areas to have the physical and biological features essential to lynx. In addition, while evaluating information for the critical habitat proposal, we received bobcat harvest data for Minnesota showing abundant bobcat harvest and a lack of lynx presence in the area west of the critical habitat unit in Minnesota, which suggests the western portion of the area preliminarily delineated as core habitat in Minnesota may not be of high quality for lynx.

We determined that the Kettle Range in north-central Washington does not contain the physical and biological features essential to lynx in viable quantity and spatial arrangement, and therefore we did not include it in our proposed or final revised critical habitat rules. The Kettle Range historically (through the 1970s) supported lynx populations (Stinson 2001, pp.13–14). However, although boreal forest habitat within the Kettle Range appears to contain high quality habitat for lynx, there is no evidence that the Kettle Range is currently occupied by a reproducing lynx population (Koehler 2005 entire). In particular, while we continue to receive sporadic reports from the area, we have no information to suggest a lynx population has occupied the Kettle range since 1995, so it did not meet our criteria for consideration as critical habitat. Therefore, we did not include the Kettle Range in our critical habitat designation.

Native lynx were extirpated from their historic range in Colorado and southern Wyoming in the Southern Rocky Mountains by the time the lynx was listed in 2000. In 1999, the State of Colorado began to reintroduce lynx. Subsequent to the release, lynx have dispersed to many areas of varying habitat quality, such as to the Great Plains in Nebraska, the Wasatch Range in Utah, and San Juan Mountains of New Mexico. Although it is too early to determine whether the Colorado introduction will result in a self-sustaining population, the reintroduced lynx produced kittens in the early years of the program. Over the last several years, reproduction has been very low, suggesting that the population may not be viable (Shenk 2007, p. 1) and that absent ingress from Canadian populations to the north, viability of any of the contiguous U.S. lynx populations may be suspect (Murray *et al.* 2008). Due to the distances lynx must cover to reach the southern Rockies from other occupied and reproductive populations, we are still unable to conclude that this region has the necessary habitat to maintain a lynx population. We determined that the marginal habitat in the Southern Rockies, and habitat not within the historical range of lynx where these animals have dispersed outside of Colorado, are not essential to the conservation of lynx because they likely lack the quantity and spatial arrangement of physical and biological features essential to the species.

Many areas within the contiguous United States have one or more individual lynx records with no evidence of persistent, reproducing lynx populations. It is possible, though unlikely, that some of these areas may support undocumented persistent populations of lynx. However, most of these records are likely a result of wide-ranging dispersal events, occur in habitat that is less suitable for lynx than in the core areas, and are mostly disjunct from areas that contain persistent lynx populations. We consider these areas as secondary or peripheral (as defined in the Recovery Outline), and their role in sustaining persistent lynx populations is unclear; such areas may provide habitat to dispersing lynx, especially when populations are at a cyclic high. The areas we consider essential to the conservation of lynx have the PCE, which provide for the ability to maintain and produce lynx during population lows. Due to their lack of demonstrated ability to provide the PCE for conservation of the species, we do not believe that secondary and peripheral areas meet the definition of critical habitat for lynx.

Secondary and peripheral areas contain only periodic records of lynx over time, and they lack evidence of reproducing lynx populations. Habitat suitability for lynx has not been assessed throughout the secondary and peripheral areas, so we are not certain whether the essential features (i.e., PCE) are present. However, the relative lack of lynx records over time, and, in particular the lack of evidence of reproducing populations, may suggest that habitat (snowshoe hare densities, in particular) has not been adequate historically, nor is it currently adequate, to support reproducing lynx populations. Additionally, some of the peripheral areas are naturally disjunct and support few historical records of lynx.

Critical Habitat Designation

We are designating five units as critical habitat for the lynx (Table 1). The critical habitat units described below constitute our best assessment at this time of areas: (1) We determined to be occupied at the time of listing, (2) that contain the physical and biological features (i.e., the primary constituent element in the appropriate spatial arrangement and quantity) essential for the conservation of the species, and (3) that may require special management considerations or protection. The five areas designated as critical habitat are Unit 1 in northwestern Maine, Unit 2 in the Arrowhead region of Minnesota, Unit 3 in Montana and Idaho, Unit 4 in the North Cascades of Washington, and Unit 5 in the Greater Yellowstone Area of Wyoming, Montana, and Idaho. To further understand the location of these designated areas, please see the associated maps found within this final rule (also available at our Web site: *http://mountain-prairie.fws.gov/species/mammals/lynx/*). Table 1 shows the critical habitat unit areas, area that was proposed for designation, approximate area being excluded from the designation, land ownership, and the approximate area being designated as critical habitat.

TABLE 1—CRITICAL HABITAT UNITS DESIGNATED FOR THE LYNX

Critical habitat units	Area proposed for designation km² (mi²)	Excluded area km² (mi²)	Land ownership	Area designated km² (mi²)
Unit 1: Maine	27,539.1 (10,632.9)	2,884.0 (1,113.5)	Private, State, Federal	24,597.5 (9,497.2)
Unit 2: Minnesota	21,305.4 (8,226.1)	202.6 (78.2)	Federal, Private, State	20,888.4 (8,065.1)
Unit 3: Northern Rocky Mountains (MT and ID)	29,276.5 (11,303.7)	956.6 (369.4)	Federal, Private, State	26,162.9 (10,101.6)
Unit 4: North Cascades	5,179.7 (1,999.9)	424.7 (164.0)	Federal, Private	4,755.0 (1,835.9)
Unit 5: Greater Yellowstone Area	27,427.4 (10,589.8)	0 (0)	Federal, State, Private	24,606.1 (9,500.5)
Total	110,728.1 (42,752.4)	4,467.9 (1,725.1)		101,009.9 (39,000.3)

We provide a brief description of all units, and reasons why they meet the definition of critical habitat for the Canada lynx. The section that follows explains our decision to exclude certain lands pursuant to Section 4(b)(2) of the Act.

Unit 1: Northern Maine—24,597 km² (9,497 mi²)

Unit 1 is located in northern Maine in portions of Aroostook, Franklin, Penobscot, Piscataquis, and Somerset Counties. This area was occupied by the lynx at the time of listing and is currently occupied by the species. Lynx in northwestern Maine have high productivity: 91 percent of available adult females (greater than 2 years) produced litters, and litters averaged 2.83 kittens (Vashon *et al.* 2005b, pp. 4–6). This area contains the physical and biological features essential to the conservation of the lynx as it is comprised of the primary constituent element and its components laid out in the appropriate quantity and spatial arrangement. This area is also important for lynx conservation because it is the only area in the northeastern region of the lynx's range within the contiguous United States that currently supports breeding lynx populations and likely acts as a source or provides connectivity for more peripheral portions of the lynx's range in the Northeast. Timber harvest and management is the dominant land use within the unit; therefore, special management is required depending on the silvicultural practices conducted (68 FR 40075; July 3, 2003). Timber management practices that provide for a dense understory are beneficial for lynx and snowshoe hares. In this area, other habitat-related threats to lynx are lack of an International conservation strategy for lynx, traffic, and development (68 FR 40075).

Unit 2: Northeastern Minnesota—20,888 km² (8,065 mi²)

Unit 2 is located in northeastern Minnesota in portions of Cook, Koochiching, Lake, and St. Louis Counties, and Superior National Forest. In 2003, when we last formally reviewed the status of the lynx,

numerous verified records of lynx existed from northeastern Minnesota (68 FR 40076, July 3, 2003). The area was occupied at the time of listing and is currently occupied by the species. Lynx are currently known to be distributed throughout northeastern Minnesota, as has been confirmed through DNA analysis, radio- and GPS-collared animals, and documentation of reproduction (Moen *et al.* 2004, entire; Minnesota DNR 2005, entire; S. Loch, unpubl. data; Minnesota Department of Natural Resources, unpubl. data). This area contains the physical and biological features essential to the conservation of the lynx as it is comprised of the primary constituent element and its components laid out in the appropriate quantity and spatial arrangement. This area is essential to the conservation of lynx because it is the only area in the Great Lakes region for which we have evidence of recent lynx reproduction. It likely acts as a source or provides connectivity for more peripheral portions of the lynx's range in the region. Timber harvest and management is a dominant land use (68 FR 40075). Therefore, special management is required depending on the silvicultural practices conducted. Timber management practices that provide for a dense understory are beneficial for lynx and snowshoe hares. In this area, lack of an International conservation strategy for lynx, fire suppression or fuels treatment, traffic, and development are other habitat-related threats to lynx (68 FR 40075).

Specific sections of land encompassing a mining district in Minnesota known as the Iron Range are not included in this revised designation because they do not contain the physical and biological features essential to the conservation of lynx. In much of the Iron Range, mining has removed all vegetation and much of this area was subsequently flooded. Areas that are still vegetated and not flooded are extensively fragmented by the mined areas and haul roads. We used the "GAP Land Cover—Tiled Raster" dataset (Minnesota Department of Natural Resources 2002) to identify sections that are heavily influenced by mining activities. Areas described as "Barren" and "Mixed Developed" in the GAP dataset seemed to correspond to areas that were mined or extensively disturbed by mining-related activities (e.g., service roads), based on aerial photos (National Agricultural Imagery Program 2003). Further inspection of aerial photos indicates that additional sections exist with extensive effects of mining, beyond that indicated by the GAP data, which is based on 10–15-year-old satellite imagery. These disturbed areas are not included in this final designation and are reflected in the final maps provided with the rule and in the unit boundary description.

Unit 3: Northern Rocky Mountains 26,163 km² (10,102 mi²)

Unit 3 is located in northwestern Montana and a small portion of northeastern Idaho in portions of Boundary County in Idaho and Flathead, Glacier, Granite, Lake, Lewis and Clark, Lincoln, Missoula, Pondera, Powell and Teton Counties in Montana. It includes National Forest lands and BLM lands in the Garnet Resource Area. This area was occupied by lynx at the time of listing and is currently occupied by the species. Lynx are known to be widely distributed throughout this unit and breeding has been documented in multiple locations (Gehman *et al.* 2004, pp. 24–29; Squires *et al.* 2004a, pp. 7–10 and 2004b, pp. 8–10). This area contains the physical and biological features essential to the conservation of the lynx as it is comprised of the primary constituent element and its components laid out in the appropriate quantity and spatial arrangement. This area is essential to the conservation of lynx because it appears to support the highest density lynx populations in the Northern Rocky Mountain region of the lynx's range. It likely acts as a source for lynx and provides connectivity to other portions of the lynx's range in the Rocky Mountains, particularly the Yellowstone area. Timber harvest and management is a dominant land use (68 FR 40075); therefore, special management is required depending on the silvicultural practices conducted. Timber management practices that provide for a dense understory are beneficial for lynx and snowshoe hares. In this area, fire suppression or fuels treatment, lack of an International conservation strategy for lynx, traffic, and development are other habitat-related threats to lynx (68 FR 40075).

Unit 4: North Cascades 4,755 km² (1,836 mi²)

Unit 4 is located in north-central Washington in portions of Chelan and Okanogan Counties, and includes BLM lands in the Spokane District. This area was occupied at the time lynx was listed and is currently occupied by the species. This unit supports the highest densities of lynx in Washington (Stinson 2001). Evidence from limited recent research and DNA shows lynx distributed within this unit, with breeding being documented (von Kienast 2003, p. 36; K. Aubry, Pacific Northwest Research Station, unpubl. data; B. Maletzke, Washington State University, unpubl. data). Although there appear to be fewer records in the portion of the unit south of Highway 20, few surveys have been conducted in this portion of the unit. This area contains boreal forest habitat and the components essential to the conservation of the lynx. Further, it is contiguous with the portion of the unit north of Highway 20, particularly in winter when deep snows close Highway 20. The northern portion of the unit adjacent to the Canadian border also appears to support few recent lynx records; however, it is designated wilderness, so access to survey this area is difficult. This northern portion contains extensive boreal forest vegetation types and the components essential to the conservation of the lynx. Additionally, lynx populations exist in British Columbia directly north of this unit (E. Lofrothe, British Columbia Ministry of the Environment, unpubl. data).

This area contains the physical and biological features essential to the conservation of the lynx as it contains the primary constituent element and its components laid out in the appropriate quantity and spatial arrangement. This area is essential to the conservation of lynx because it is the only area in the Cascades region of the lynx's range that is known to support breeding lynx populations. Timber harvest and management is a dominant land use; therefore, special management is required depending on the silvicultural practices conducted. Timber management practices that provide for a density understory are beneficial for lynx and snowshoe hares. In this area, Federal land management plans have not been amended to incorporate lynx conservation. The lack of an International conservation strategy for lynx, traffic, and development are other habitat-related threats to lynx (68 FR 40075).

Unit 5: Greater Yellowstone Area 24,606 km² (9,500 mi²)

Unit 5 is located in Yellowstone National Park and surrounding lands in southwestern Montana and northwestern Wyoming. Lands in this unit are found in Gallatin, Park, Sweetgrass, Stillwater, and Carbon Counties in Montana, and Park, Teton, Fremont, Sublette, and Lincoln Counties in Wyoming. This area was occupied by lynx at the time of listing and is currently occupied by the species. The area contains the physical and biological features essential to the conservation of the lynx. The GYA is

naturally marginal lynx habitat with highly fragmented foraging habitat. For this reason lynx home ranges in this unit are likely to be larger and incorporate large areas of non-foraging matrix habitat. In this area, fire suppression or fuels treatment, lack of an International conservation strategy for lynx, traffic, and development are other habitat-related threats to lynx (68 FR 40075). Therefore, special management is required depending on the fire suppression and fuels treatment practices conducted and the design of highway development projects.

Effects of Critical Habitat Designation

Section 7 Consultation

Section 7 of the Act requires Federal agencies to ensure that actions they fund, authorize, or carry out are not likely to jeopardize the continued existence of a listed species or destroy or adversely modify critical habitat. Decisions by the Fifth and Ninth Circuit Court of Appeals have invalidated our definition of ''destruction or adverse modification'' (50 CFR 402.02) (see *Gifford Pinchot Task Force* v. *U.S. Fish and Wildlife Service* 378 F.3d 1059 (9th Cir 2004) and *Sierra Club* v. *U.S. Fish and Wildlife Service et al.*, 245 F.3d 434, 442F (5th Cir 2001)), and we do not rely on our regulatory definition when analyzing whether an action is likely to destroy or adversely modify critical habitat. Under the Act, we determine destruction or adverse modification on the basis of whether, with implementation of the proposed Federal action, the affected critical habitat would remain functional (or retain the current ability for the PCEs to be functionally established) to serve its intended conservation role for the species.

Under section 7(a)(2) of the Act, if a Federal action may affect a listed species or its critical habitat, the responsible Federal agency (action agency) must analyze the effects of their action on the listed species. If the action may adversely affect listed species, the Federal agency must enter into consultation with us. As a result of this consultation, we may document compliance with the requirements of section 7(a)(2) through our issuance of:

1. A concurrence letter for Federal actions that may affect, but are not likely to adversely affect, listed species or critical habitat; or

2. A biological opinion for Federal actions likely to adversely affect listed species or critical habitat.

When we issue a biological opinion concluding that a project is likely to jeopardize the continued existence of a listed species or destroy or adversely modify critical habitat, we also provide reasonable and prudent alternatives to the project, if any are identifiable. We define ''Reasonable and prudent alternatives'' at 50 CFR 402.02 as alternative actions identified during consultation that:

- Can be implemented in a manner consistent with the intended purpose of the action,
- Can be implemented consistently with the scope of the Federal agency's legal authority and jurisdiction,
- Are economically and technologically feasible, and
- Would, in the Director's opinion, avoid jeopardizing the continued existence of the listed species or destroying or adversely modifying critical habitat.

Reasonable and prudent alternatives can vary from slight project modifications to extensive redesign or relocation of the project. Costs associated with implementing a reasonable and prudent alternative are similarly variable.

Regulations at 50 CFR 402.16 require Federal agencies to reinitiate consultation on previously reviewed actions in instances where we have listed a new species or subsequently designated critical habitat that may be affected and the Federal agency has retained discretionary involvement or control over the action (or the agency's discretionary involvement or control is authorized by law). Consequently, Federal agencies may sometimes need to request reinitiation of consultation with us on actions for which formal consultation has been completed, if those actions with discretionary involvement or control may affect subsequently listed species or designated critical habitat.

Federal activities that may affect the lynx or its designated critical habitat will require section 7(a)(2) consultation under the Act. Activities on State, tribal, local, or private lands requiring a Federal permit (such as a permit from the U.S. Army Corps of Engineers under section 404 of the Clean Water Act (33 U.S.C. 1251 *et seq.*) or involving some other Federal action (such as funding from the Federal Highway Administration, the Federal Aviation Administration, or the Federal Emergency Management Agency) or a permit from us under section 10(a)(1)(B) of the Act) will also be subject to the consultation process under section 7(a)(2) of the Act. Federal actions not affecting listed species or critical habitat, and actions on State, tribal, local or private lands that are not Federally funded, authorized, or carried out, do not require section 7(a)(2) consultations.

Application of the ''Adverse Modification Standard''

The key factor related to the adverse modification determination is whether, with implementation of the proposed Federal action, the affected critical habitat would remain functional (or retain the current ability for the PCEs to be functionally established) to serve the intended conservation role for the species. Activities that may destroy or adversely modify critical habitat are those that alter the physical and biological features to an extent that appreciably reduces the conservation value of critical habitat for lynx. Generally, the conservation role of lynx critical habitat units is to support viable core area populations.

Section 4(b)(8) of the Act requires us to briefly evaluate and describe, in any proposed or final regulation that designates critical habitat, activities involving a Federal action that may destroy or adversely modify such habitat, or that may be affected by such designation.

Activities that, when carried out, funded, or authorized by a Federal agency, may affect critical habitat, and therefore, should result in consultation, include, but are not limited to:

1. Actions that would reduce or remove understory vegetation within boreal forest stands on a scale proportionate to the large landscape used by lynx. Such activities could include, but are not limited to, forest stand thinning, timber harvest, and fuels treatment of forest stands. These activities could significantly reduce the quality of snowshoe hare habitat such that the landscape's ability to produce adequate densities of snowshoe hares to support persistent lynx populations is at least temporarily diminished.

2. Actions that would cause permanent loss or conversion of the boreal forest on a scale proportionate to the large landscape used by lynx. Such activities could include, but are not limited to, recreational area developments; certain types of mining activities and associated developments; and road building. Such activities could eliminate and fragment lynx and snowshoe hare habitat.

3. Actions that would increase traffic volume and speed on roads that divide lynx critical habitat. Such activities could include, but are not limited to, transportation projects to upgrade roads or development of a new tourist destination. These activities could reduce connectivity within the boreal forest landscape for lynx, and could

result in increased mortality of lynx within the critical habitat units, because lynx are highly mobile and frequently cross roads during dispersal, exploratory movements, or travel within their home ranges.

In matrix habitat, activities that change vegetation structure or condition would not be considered an adverse effect to lynx critical habitat unless those activities would create a barrier or impede lynx movement between patches of foraging habitat and between foraging and denning habitat within a potential home range, or if they would adversely affect adjacent foraging habitat or denning habitat. For example, a pre-commercial thinning or fuels reduction project in matrix habitat would not adversely affect lynx critical habitat, and would not require consultation. However, a new highway passing through matrix habitat that would impede lynx movement may be an adverse effect to lynx critical habitat, and would require consultation. The scale of any activity should be examined to determine whether direct or indirect alteration of habitat would occur to the extent that the value of critical habitat for the survival and recovery of lynx would be appreciably diminished.

If you have questions regarding whether specific activities may constitute destruction or adverse modification of critical habitat, contact the Supervisor of the appropriate Ecological Services Field Office (see list below).

State	Address	Phone number
MAINE	1168 Main Street, Old Town, Maine 04468	(207) 827–5938
MINNESOTA	4101 East 80th Street, Bloomington, Minnesota 55425	(612) 725–3548
MONTANA	585 Shepard Way, Helena, Montana 59601	(406) 449–5225
WASHINGTON AND IDAHO	11103 E. Montgomery Drive, Spokane, Washington 99206	(509) 893–8015
WYOMING	5353 Yellowstone Road, Suite 308A, Cheyenne, Wyoming 82009	(307) 772–2374

All of the units designated as critical habitat, as well as specific areas that have been excluded, contain features essential to the conservation of the lynx. All units are within the geographical range of the species, and all are currently occupied by the species based on based on surveys and research documenting the presence and reproduction of lynx (68 FR 40076, July 3, 2003). Under section 7 of the Act, Federal agencies already consult with us on activities in areas currently occupied by the lynx, or if the species may be affected by the action, to ensure that their actions do not jeopardize the continued existence of the lynx.

Application of Section 4(a)(3) of the Act

The Sikes Act of 1997 (Sikes Act) (16 U.S.C. 670a) required each military installation that includes land and water suitable for the conservation and management of natural resources to complete an integrated natural resource management plan (INRMP) by November 17, 2001. An INRMP integrates implementation of the military mission of the installation with stewardship of the natural resources found on the base. Each INRMP includes:

- An assessment of the ecological needs on the installation, including the need to provide for the conservation of listed species;
- A statement of goals and priorities;
- A detailed description of management actions to be implemented to provide for these ecological needs; and
- A monitoring and adaptive management plan.

Among other things, each INRMP must, to the extent appropriate and applicable, provide for fish and wildlife management; fish and wildlife habitat enhancement or modification; wetland protection, enhancement, and restoration where necessary to support fish and wildlife; and enforcement of applicable natural resource laws.

The National Defense Authorization Act for Fiscal Year 2004 (Pub. L. 108–136) amended the Act to limit areas eligible for designation as critical habitat. Specifically, section 4(a)(3)(B)(i) of the Act (16 U.S.C. 1533(a)(3)(B)(i)) now provides: ''The Secretary shall not designate as critical habitat any lands or other geographical areas owned or controlled by the Department of Defense, or designated for its use, that are subject to an integrated natural resources management plan prepared under section 101 of the Sikes Act (16 U.S.C. 670a), if the Secretary determines in writing that such plan provides a benefit to the species for which critical habitat is proposed for designation.''

There are no Department of Defense lands with a completed INRMP within the critical habitat designation, and therefore, no analysis of potential exclusions under section 4(a)(3) of the Act is necessary.

Application of Section 4(b)(2) of the Act

Section 4(b)(2) of the Act states that the Secretary must designate or revise critical habitat on the basis of the best available scientific data after taking into consideration the economic impact, national security impact, and any other relevant impact of specifying any particular area as critical habitat. The Secretary may exclude an area from critical habitat if he determines that the benefits of such exclusion outweigh the benefits of specifying such area as part of the critical habitat, unless he determines, based on the best scientific data available, that the failure to designate such area as critical habitat will result in the extinction of the species. In making that determination, the statute, as well as the legislative history, is clear that the Secretary has broad discretion regarding which factor(s) to use and how much weight to give to any factor.

Under section 4(b)(2) of the Act, in considering whether to exclude a particular area from the designation, we must identify the benefits of including the specific area in the designation, identify the benefits of excluding the specific area from the designation, and determine whether the benefits of exclusion outweigh the benefits of inclusion. If, based on this analysis, we determine that the benefits of exclusion would outweigh the benefits of inclusion of an area, we can then exclude the area only if such exclusions would not result in the extinction of the species.

Under section 4(b)(2) of the Act, we must consider all relevant impacts, including economic impacts. We consider a number of factors in a section 4(b)(2) analysis. For example, we consider whether there are lands owned or managed by the Department of Defense (DOD) where a national security impact might exist. We also consider whether the landowners have developed any conservation plans for the area, or whether there are conservation partnerships that would be encouraged by designation of, or exclusion from, critical habitat. In addition, we look at any tribal issues, and consider the government-to-government relationship of the United States with tribal entities.

We also consider any social impacts that might occur because of the designation.

We determined that lands managed under the Maine Healthy Forest Reserve Program and lands managed by the State of Washington Department of Natural Resources (WADNR) should be excluded from the final designation based on the management plans that govern activities on these lands. Tribal lands have also been excluded from the final designation based on Secretarial Order 3206, ''American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act'' (June 5, 1997).

Benefits of Designating Critical Habitat

The process of designating critical habitat as described in the Act requires that the Service identify those lands on which are found the physical or biological features essential to the conservation of the species that may require special management considerations or protection, and those areas outside the geographical area occupied by the species at the time of listing that are essential to the conservation of the species. In identifying those lands, the Service must consider the recovery needs of the species, such that, on the basis of the best scientific and commercial data available at the time of designation, the habitat that is identified, if managed, could provide for the survival and recovery of the species.

A critical habitat designation may be beneficial—identification of areas that are essential for the conservation of the species can, if managed, provide for the recovery of a species. The process of proposing and finalizing a critical habitat rule provides the Service with the opportunity to determine the physical and biological features essential to the conservation of the species within the geographical area occupied by the species at the time of listing, as well as to determine other areas essential for the conservation of the species. The designation process includes peer review and public comment on the identified physical and biological features and essential areas. This process is valuable to land owners and managers in developing conservation or management plans for identified areas, as well as any other occupied habitat or suitable habitat that may not have been included in the Service's determination of essential habitat.

A critical habitat designation may provide a regulatory benefit. The consultation provisions under section 7(a)(2) of the Act constitute the regulatory benefits of critical habitat. As discussed above, Federal agencies must consult on discretionary actions that may affect critical habitat and must avoid destroying or adversely modifying critical habitat. Federal agencies must also consult on discretionary actions that may affect a listed species and refrain from undertaking actions that are likely to jeopardize the continued existence of such species. The analysis of effects to critical habitat is a separate and different analysis from that of the effects to the species. Therefore, any difference in outcomes of these two analyses represents the regulatory benefit of critical habitat. For some species, and in some locations, the outcome of these analyses will be similar, because effects on habitat will often also result in effects on the species. However, the regulatory standard of impacts to the species, and impacts to critical habitat, are different.

An analysis of effects on the species requires a determination of whether the impact will jeopardize the species' survival; an analysis of effects to critical habitat requires a determination of whether the impact will adversely modify the habitat in a way that will affect both the conservation of the species, and its recovery. This difference in regulatory standards was emphasized in the Ninth Circuit's decision in *Gifford Pinchot Task Force* v. *FWS* (9th Cir. 2004). Therefore, critical habitat designations may provide regulatory benefits additional to the listing of a species that focus on recovery of the species.

Two limitations to the regulatory effect of critical habitat exist. First, a section 7(a)(2) consultation is required only where an action is authorized, funded, or carried out by any Federal agency; if there is no Federal action, the designation of private lands as critical habitat does not restrict any actions that destroy or adversely modify critical habitat. Second, the designation only limits destruction or adverse modification. By its nature, the prohibition on adverse modification is designed to ensure that the conservation role and function of those areas that contain the physical and biological features essential to the conservation of the species or of unoccupied areas that are essential for the conservation of the species are not appreciably reduced. Critical habitat designation alone, however, does not require property owners to undertake affirmative actions to promote the recovery of the species.

Once an agency determines that consultation under section 7(a)(2) of the Act is necessary, the process may conclude informally if a proposed Federal action is not likely to adversely affect critical habitat. However, if it is determined through informal consultation that adverse impacts are likely to occur, the Federal agency initiates formal consultation. Formal consultation concludes when we issue a biological opinion on whether the proposed Federal action is likely to result in destruction or adverse modification of critical habitat, or result in jeopardy to the species.

A biological opinion that concludes no destruction or adverse modification of critical habitat will occur as a result of the action may contain discretionary conservation recommendations to minimize adverse effects to the physical and biological features essential to the conservation of the species. We only suggest reasonable and prudent alternatives to the proposed Federal action only when our biological opinion results in an adverse modification determination.

As stated above, the designation of critical habitat does not require that any management or recovery actions take place on the lands included in the designation. Even in cases where consultation has been initiated under section 7(a)(2) of the Act, the end result of consultation is to avoid jeopardy to the species and/or adverse modification of its critical habitat, but not necessarily to manage critical habitat or institute recovery actions on critical habitat. Conversely, voluntary conservation efforts implemented through management plans institute proactive actions over the lands they encompass and are often put in place to remove or reduce known threats to a species or its habitat; therefore implementing recovery actions.

We believe that, in many instances, the benefit of critical habitat designation is low compared to the conservation benefit that can be achieved through conservation efforts or management plans, especially when the likelihood of a Federal action occurring is low. The conservation achieved through implementing Habitat Conservation Plans (HCPs), Safe Harbor Agreements, or experimental populations established under section 10 of the Act or other habitat management plans or agreements is typically greater than what we achieve through multiple project-by-project, section 7(a)(2) consultations involving consideration of critical habitat. Management plans may commit resources to implement long-term management and protection to particular habitat for at least one and possibly additional listed or sensitive species. Section 7(a)(1) commits Federal agencies to utilizing their authorities in furtherance of the purposes of the Act,

and in carrying out conservation of listed species. Beyond that, Section 7(a)(2) consultations commit Federal agencies to preventing adverse modification of critical habitat caused by a particular project, and not to providing conservation or long-term benefits to areas not affected by the proposed project. Implementation of an HCP, management plan, or agreement that considers enhancement or recovery as the management standard may often provide as much or more benefit than a consultation for critical habitat designation.

Critical habitat designation may provide educational benefits. Designation of critical habitat serves to educate landowners, State and local governments, and the public regarding the potential conservation value of an area. This helps focus and promote conservation efforts by other parties by clearly delineating areas of high conservation value for the affected species. In general, critical habitat designation always has educational benefits; however, in some cases it may be redundant with other educational effects. For example, HCPs have significant public input and may largely duplicate the educational benefits of a critical habitat designation. Including lands in critical habitat also would inform State agencies and local governments about areas that could be conserved under State laws or local ordinances.

Benefits of Excluding Non-Federal Lands With Conservation Partnerships

Most federally listed species in the United States will not recover without the cooperation of non-Federal landowners. More than 60 percent of the United States is privately owned (National Wilderness Institute 1995), and at least 80 percent of endangered or threatened species occur either partially or solely on private lands (Crouse *et al.* 2002, p. 720). Stein *et al.* (1995, p. 400) found that only about 12 percent of listed species were found almost exclusively on Federal lands (90 to 100 percent of their known occurrences restricted to Federal lands) and that 50 percent of federally listed species are not known to occur on Federal lands at all.

Given the distribution of listed species with respect to land ownership, conservation of listed species in many parts of the United States is dependent upon working partnerships with a wide variety of entities and the voluntary cooperation of many non-Federal landowners (Wilcove and Chen 1998; Crouse *et al.* 2002; James 2002). Building partnerships and promoting voluntary cooperation of landowners are essential to our understanding the status of species on non-Federal lands, and necessary for us to implement recovery actions such as reintroducing listed species and restoring and protecting habitat.

Many non-Federal landowners derive satisfaction from contributing to endangered species recovery. We promote these private-sector efforts through the Department of the Interior's Cooperative Conservation philosophy. Conservation agreements with non-Federal landowners (e.g., HCPs, safe harbor agreements) enhance species conservation by extending species protections beyond those available through section 7(a)(2) consultations. In the past decade, we have encouraged non-Federal landowners to enter into conservation agreements, based on the view that we can achieve greater species conservation on non-Federal land through such partnerships than we can through regulatory methods (61 FR 63854, December 2, 1996).

Many private landowners, however, are wary of the possible consequences of attracting endangered species to their property. Mounting evidence suggests that some regulatory actions by the Federal Government, while well-intentioned and required by law, can (under certain circumstances) have unintended negative consequences for the conservation of species on private lands (Wilcove *et al.* 1996; Bean 2002; Conner and Mathews 2002; James 2002; Koch 2002; Brook *et al.* 2003). Many landowners fear a decline in their property value due to real or perceived restrictions on land-use options where threatened or endangered species are found. Consequently, harboring endangered species is viewed by many landowners as a liability. This perception results in anti-conservation incentives, because maintaining habitats that harbor endangered species represents a risk to future economic opportunities (Main *et al.* 1999; Brook *et al.* 2003).

According to some researchers, the designation of critical habitat on private lands significantly reduces the likelihood that landowners will support and carry out conservation actions (Main *et al.* 1999; Bean 2002; Brook *et al.* 2003). The magnitude of this outcome is greatly amplified in situations where active management measures (such as reintroduction, fire management, control of invasive species) are necessary for species conservation (Bean 2002). We believe that the judicious exclusion of specific areas of non-federally owned lands from critical habitat designations can contribute to species recovery and provide a superior level of conservation.

The purpose of designating critical habitat is to contribute to the conservation of threatened and endangered species and the ecosystems upon which they depend. The outcome of the designation, triggering regulatory requirements for actions funded, authorized, or carried out by Federal agencies under section 7(a)(2) of the Act, can sometimes be counterproductive to its intended purpose on non-Federal lands. Thus, the benefits of excluding areas that are covered by effective partnerships or other conservation commitments can often be high.

Benefits of Excluding Lands With HCPs or Other Management Plans From Critical Habitat

The benefit of excluding lands with approved HCPs from critical habitat designation includes relieving landowners, communities, and counties of any additional regulatory burden that might be imposed by critical habitat. Many HCPs take years to develop, and upon completion, are consistent with recovery objectives for listed species that are covered within the plan area. Many conservation plans also provide conservation benefits to unlisted sensitive species. Imposing an additional regulatory review as a result of the designation of critical habitat may undermine conservation efforts and partnerships designed to proactively protect species to ensure that listing under the Act will not be necessary. Our experience in implementing the Act has found that designation of critical habitat within the boundaries of management plans that provide conservation measures for a species is a disincentive to many entities which are either currently developing such plans, or contemplating doing so in the future, because one of the incentives for undertaking conservation is greater ease of permitting where listed species will be affected. Addition of a new regulatory requirement would remove a significant incentive for undertaking the time and expense of management planning. In fact, designating critical habitat in areas covered by a pending HCP or conservation plan could result in the loss of some species' benefits if participants abandon the planning process, in part because of the strength of the perceived additional regulatory compliance that such designation would entail. The time and cost of regulatory compliance for a critical habitat designation do not have to be quantified for them to be perceived as an additional Federal regulatory burden

sufficient to discourage continued participation in developing plans targeting listed species' conservation.

A related benefit of excluding lands covered by approved HCPs from critical habitat designation is the unhindered, continued ability it gives us to seek new partnerships with future plan participants, including States, counties, local jurisdictions, conservation organizations, and private landowners, which together can implement conservation actions that we would be unable to accomplish otherwise. We have found that potential participants are not inclined to participate in such management plans when we designate critical habitat within the area that would be covered by such a management plan, thus having a negative effect on our ability to establish new partnerships to develop these plans, particularly plans that address landscape-level conservation of species and habitats. By excluding these lands, we preserve our current partnerships and encourage additional conservation actions in the future.

We also note that permit issuance in association with HCP applications require consultation under section 7(a)(2) of the Act, which would include the review the effects of all HCP-covered activities that might adversely impact the species under a jeopardy standard, including possibly significant habitat modification (see definition of "harm" at 50 CFR 17.3), even without the critical habitat designation. In addition, all other Federal actions that may affect the listed species would still require consultation under section 7(a)(2) of the Act, and we would review these actions for possibly significant habitat modification in accordance with the definition of "harm" referenced above.

Tribal Lands Excluded From Lynx Critical Habitat

Tribal lands included in the proposed designation were those of the Houlton Band of Maliseet Indians, Aroostook Band of Micmac Indians, Passamaquoddy Tribe, and Penobscot Indian Nation in Maine (Unit 1), Grand Portage Indian Reservation and Vermillion Lake Indian Reservation in Minnesota (Unit 2), and the Flathead Indian Reservation in Montana (Unit 3). In the proposed rule, we requested comments on whether Tribal lands in the Northern Rockies, Maine, and Minnesota need to be included pursuant to Executive Order 3206. The amount of Tribal lands proposed was relatively small in size (totaling approximately 224 km^2 (86.3 mi^2) in Maine, 203 km^2 (78.2 mi^2) in Minnesota, and 957 km^2 (369.4 mi^2) in Montana). We contacted and met with a number of Tribes to discuss the proposed designation, and we also received comments from numerous Tribes requesting that their lands not be designated as critical habitat because of their sovereign rights, in addition to concerns about economic impacts and the effect on their ability to manage natural resources.

Benefits of Inclusion

The primary benefit of including Tribal lands in the lynx critical habitat designation would be education that could be exchanged on land management methods that would benefit the species.

Potentially, some activities could be authorized, funded, or carried out by a Federal agency, which would require consultation and perhaps action modification to ensure that the physical and biological features essential to lynx are not destroyed or adversely modified.

Benefits of Exclusion

Tribal lands are small in size relative to the large landscape required to sustain the lynx population in these areas. The larger landscape in Maine is comprised of lands managed for commercial forestry, and in Minnesota and Montana the larger landscape is managed by the USFS, which revised its forest plans to address the needs for lynx. Therefore, although these Tribal lands support lynx habitat and the PCE, they have a minor role in lynx conservation compared to the commercial forestlands in Maine and National Forest lands in Minnesota and Montana. Due to the management plans and practices that are designed to avoid adverse effects to lynx and lynx habitat, and that are already in place on Tribal lands, it is highly unlikely that activities approaching the threshold of adverse modification of critical habitat would occur.

Secretarial Order 3206, "American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act" (June 5, 1997) states that, "Critical habitat shall not be designated in such areas unless it is determined essential to conserve a listed species". The President's memorandum of April 29, 1994, "Government-to-Government Relations with Native American Tribal Governments" (59 FR 22951); Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments;" and the relevant provision of the Departmental Manual of the Department of the Interior (512 DM 2) also emphasize that Tribal lands should be evaluated to determine whether their inclusion in a critical habitat designation is essential to the species. Therefore, we believe that fish, wildlife, and other natural resources on Tribal lands are better managed under Tribal authorities, policies, and programs than through Federal regulation wherever possible and practicable. Such designation is often viewed by Tribes as an unwanted intrusion into Tribal self governance, thus compromising the government-to-government relationship essential to achieving our mutual goals of managing for healthy ecosystems upon which the viability of threatened and endangered species populations depend.

Exclusion of Tribal lands may be warranted because Tribes are already committed to conserving lynx. Through Federal grant programs, the Passamaquoddy Tribe is conducting surveys and habitat models for lynx and snowshoe hare, the Houlton Band of Maliseet Indians is conducting lynx surveys, the Grand Portage Tribe is assessing lynx habitat on reservation lands, and lynx habitat is protected through a comprehensive conservation plan on the Flathead Reservation in Montana. Information from these efforts will be used to inform management plans or strategies to promote the conservation of lynx on Tribal lands. Additionally, we received general comments from Tribes voicing their commitment to ensuring that lynx remain a viable part of the ecosystem.

Benefits of Exclusion Outweigh Benefits of Inclusion

We believe that conservation of lynx can be achieved on Tribal lands within the critical habitat units through the cooperation of Tribes, and without designating them as critical habitat. The large area of the lynx critical habitat designation is sufficient to conserve the species without the addition of Tribal lands. Therefore, Tribal lands are not essential to the conservation of the species, and Tribal lands in Units 1, 2, and 3 have not been designated as critical habitat pursuant to section 4(b)(2) of the Act.

In addition to the fact that Tribal lands are not essential to lynx, the management plans and activities being implemented on Tribal lands are likely to ensure continued conservation of lynx. Given the importance of our government-to-government relationship with Tribes, the benefit of maintaining our commitment to the Executive Order by excluding these lands outweighs the benefit of including them in critical habitat.

Exclusion of Tribal lands from the final designation of critical habitat for the lynx will not result in the extinction of the species because the Houlton Band

of Maliseet Indians, Aroostook Band of Micmac Indians, Passamaquoddy Tribe, Penobscot Indian Nation, Grand Portage Indians, Vermillion Lake Indians, and Flathead Indian Reservation Tribes implement programs for the conservation of the species, and physical and biological features essential to it, on occupied areas. Moreover, the jeopardy standard of section 7(a)(2) of the Act and routine implementation of conservation measures through the section 7 process also provide assurances that the species will not go extinct. The protections afforded to the lynx under the jeopardy standard will remain in place for the areas proposed for exclusion from revised critical habitat.

Exclusions Under Section 4(b)(2) of the Act

The Secretary can consider the existence of conservation agreements and other land management plans with private, State, and Tribal entities when making decisions under section 4(b)(2) of the Act. The Secretary may also consider voluntary partnerships and conservation plans, and weigh the implementation and effectiveness of these against that of designation. Consideration of relevant impacts of designation or exclusion under section 4(b)(2) may include, but is not limited to, any of the following factors: (1) Whether the plan provides specific information on how it protects the species and the physical and biological features, and whether the plan is at a geographic scope commensurate with the species; (2) whether the plan is complete and will be effective at conserving and protecting of the physical and biological features; (3) whether a reasonable expectation exists that conservation management strategies and actions will be implemented, that those responsible for implementing the plan are capable of achieving the objectives, that an implementation schedule exists, and that adequate funding exists; (4) whether the plan provides assurances that the conservation strategies and measures will be effective (i.e., identifies biological goals, has provisions for reporting progress, and is of a duration sufficient to implement the plan); (5) whether the plan has a monitoring program or adaptive management to ensure that the conservation measures are effective; (6) the degree to which the record supports a conclusion that a critical habitat designation would impair the benefits of the plan; (7) the extent of public participation; (8) NEPA compliance; (9) demonstrated track record of implementation success; (10) level of public benefits derived from encouraging collaborative efforts and encouraging private and local conservation efforts; and (11) the effect designation would have on partnerships. Our analysis of exclusions that landowners requested is included below.

Unit 1 (Maine)

Maine Healthy Forest Reserve Program

In 2003, Congress passed the Healthy Forest Restoration Act. Title V of this Act designates a Healthy Forest Reserve Program (HFRP) with objectives to: (1) Promote the recovery of threatened and endangered species, (2) improve biodiversity, and (3) enhance carbon sequestration. In 2006, Congress provided the first funding for the HFRP, and Maine, Arkansas, and Mississippi were chosen as pilot states to receive funding through their respective Natural Resources Conservation Service (NRCS) State offices. NRCS and the Service determined that the most efficient way to complete Section 7 consultations and to deliver regulatory assurances required by the HFRP was by developing programmatic biological opinions for each of the participating States. A programmatic biological opinion provides a framework for determining effects of the action and quantifying incidental take, and describes baseline conditions, the net conservation benefit, and terms and conditions when reviewing projects selected for future funding. Based on a successful pilot program, in 2008, the HFRP was reauthorized as part of the Farm Bill.

In 2006 and 2007, NRCS offered the HFRP to landowners in the proposed Canada lynx critical habitat unit in Maine to promote development of Canada lynx forest management plans. The value of such planning to lynx recovery is identified in the Service's Canada Lynx Recovery Outline (USFWS 2005):

- *Objective 1:* Retain adequate habitat of sufficient quality to support the long-term persistence of lynx populations within each of the identified core areas and Recovery Action; and
- *Recovery Action 1.* Establish management commitments in core areas that will provide for adequate quality and quantity of habitat such that there is a reasonable expectation that persistent lynx populations can be supported in each of the core areas for at least the next 100 years. On non-Federal lands in the core areas, develop and implement best management practices and long-term management agreements for lynx with key State, private, or Tribal forest managers.

Five landowners are enrolled in the HFRP—the Passamaquoddy Tribe (27,414 ac; 11,094 ha), The Nature Conservancy (182,086 ac; 73,688 ha), the Forest Society of Maine as conservation easement holder for the Merriweather LLC-West Branch Project (284,276 ac; 115,042 ha), Katahdin Forest Products (136,550 ac; 55,260 ha), and Elliotsville Plantation Inc. (54,327 ac; 21,985 ha). Collectively, the landowners have signed contracts (with NRCS) committing to developing lynx forest management plans on 684,653 ac (277,069 ha), which is 10 percent of the 6.8 million ac (2.7 million ha) of the proposed critical habitat in Maine. Lynx maintain large home ranges; therefore, forest management plans at large landscape scales will provide substantive recovery benefits to lynx.

NRCS requires that lynx forest management plans must be based on the Service's "Canada Lynx Habitat Management Guidelines for Maine" (McCollough 2007, entire). These guidelines were developed from the best available science on lynx management for Maine and have been revised as new research results became available. The guidelines require maintenance of prescribed hare densities that have resulted in reproducing lynx populations in Maine. The guidelines are:

1. Avoid upgrading or paving dirt or gravel roads traversing lynx habitat. Avoid construction of new high speed/high traffic volume roads in lynx habitat. Desired outcome: Avoid fragmenting potential lynx habitat with high traffic/high-speed roads.
2. Maintain through time at least one lynx habitat unit of 35,000 ac (14,164 ha) (~1.5 townships) or more for every 200,000 ac (80,937 ha) (~9 townships) of ownership. At any time, about 20 percent of the area in a lynx habitat unit should be in the optimal mid-regeneration conditions (see Guideline 3). Desired outcome: Create a landscape that will maintain a continuous presence of a mosaic of successional stages, especially mid-regeneration patches that will support resident lynx.
3. Employ silvicultural methods that will create regenerating conifer-dominated stands 12–35 ft (3.7–10.7 m) in height with high stem density (7,000–15,000 stems/ac; 2,800–6,000 stems/ha) and horizontal cover above the average snow depth that will support greater than 2.7 hares/ac (1.1 hares/ha). Desired outcome: Employ silvicultural techniques that create, maintain, or prolong use of stands by high populations of snowshoe hares.

4. Maintain land in forest management. Development and associated activities should be consolidated to minimize direct and indirect impacts. Avoid development projects that occur across large areas, increase lynx mortality, fragment habitat, or result in barriers that affect lynx movements and dispersal. Desired outcome: Maintain the current amount and distribution of commercial forest land in northern Maine. Prevent forest fragmentation and barriers to movements. Avoid development that introduces new sources of lynx mortality.

5. Encourage coarse woody debris for den sites by maintaining standing dead trees after harvest and leaving patches (at least .75 ac; .30 ha) of windthrow or insect damage. Desired outcome: Retain coarse woody debris for denning sites.

Notably, HFRP forest management plans must provide a net conservation benefit for lynx, which will be achieved by employing the lynx guidelines, identifying baseline habitat conditions, and meeting NRCS standards for forest plans. Plans must meet NRCS HFRP criteria and guidelines and comply with numerous environmental standards. NEPA compliance will be completed for each plan. NRCS held public informational sessions about the HFRP and advertised the availability of funds. Plans must be reviewed and approved by NRCS with assistance from the Service. The details of the plans are proprietary and will not be made public per NRCS policy.

Plans must be developed for a forest rotation (70 years) and include a decade-by-decade assessment of the location and anticipated condition of lynx habitat on the ownership. Some landowners are developing plans exclusively for lynx, and others are combining lynx management (umbrella species for young forest) with pine marten (umbrella species for mature forest) and other biodiversity objectives. There will be broad public benefits derived from these plans, including benefits to many species of wildlife that share habitat with the lynx. Most landowners are writing their own plans. The Nature Conservancy, however, contracted with the University of Maine, Department of Wildlife Ecology to develop a lynx-pine marten plan that will serve as a model for lynx/biodiversity forest planning, and be shared with other northern Maine landowners.

Landowners who are enrolled with NRCS commit to a 10-year contract. Landowners must complete their lynx forest management plans within 2 years of enrollment. The first plans will be completed in fall 2009. The majority (50 to 60 percent) of HFRP funds are withheld until plans are completed. By year 7, landowners must demonstrate on-the-ground implementation of their plan. NRCS will monitor and enforce compliance with the 10-year contracts. At the conclusion of the 10-year cost share contract, we anticipate that Safe Harbor Agreements or other agreements to provide regulatory assurances will be developed by all landowners as an incentive to continue implementing the plans.

We completed a programmatic biological opinion for the HFRP in 2006, that assesses the overall effects of the program on lynx habitat and on individual lynx, and provides the required incidental take coverage. Separate biological opinions will be developed under this programmatic opinion for each of the five enrollees. These tiered opinions will document environmental baseline, net conservation benefits, and incidental take for each landowner. If additional HFRP funding is made available to Maine in the future, new enrollees will be tiered under this programmatic opinion. This programmatic opinion will be revised as new information is obtained, or if new rare, threatened, or endangered species are considered for HFRP funding.

Commitments to the HFRP are strengthened by several other conservation efforts. The Nature Conservancy (TNC) land enrolled in the HFRP is also enrolled in the Forest Stewardship Council (FSC) forest certification program, which requires safeguards for threatened and endangered species. The Forest Society of Maine is under contract to manage a conservation easement held by the State of Maine on the Katahdin Forest Management lands, which is also enrolled in the HFRP. This easement requires that threatened and endangered species be protected and managed. The Forest Society of Maine also holds a conservation easement on the Merriweather LLC—West Branch property, which contains requirements that threatened and endangered species be protected and managed. These lands are also certified under the Sustainable Forestry Initiative (SFI) and FSC, which require that there be programs for threatened and endangered species. The Eliotsville Plantation, Inc. lands enrolled in the HFRP are held in a trust, which specifies the lands preserve wildlife species. The Passamaquoddy enrolled lands are managed as trust lands by the Bureau of Indian Affairs, and projects occurring on those lands are subject to NEPA review and section 7 consultation.

Benefits of Inclusion

The primary benefit of including an area within a critical habitat designation is the protection provided by section 7(a)(2) of the Act, which directs Federal agencies to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a threatened or endangered species and do not result in the destruction or adverse modification of critical habitat. Consultation has already occurred on these lands, and it included consideration of lynx habitat. The regulatory benefit of designating critical habitat on the HFRP lands would be minimal because there are few Federal actions to trigger the consultation provisions under section 7(a)(2) of the Act. Forestry activities are exempt from the Clean Water Act, and few landowners in Maine obtain Federal funding for projects on their lands. Since the lynx was listed in 2000, there have been two formal consultations on lynx in Maine (the HFRP biological opinion and a highway project) and about 73 informal consultations; however, there have been no consultations on Federal actions on The Nature Conservancy, West Branch Project, Elliotsville Plantation, Inc., and Katahdin Forest Management lands. The Passamaquoddy Tribe, through the Bureau of Indian Affairs, has informally consulted with the Service on four timber sales during this time period, resulting in determinations that the projects were not likely to adversely affect lynx because the harvests would create early successional habitat beneficial to lynx. Consultations in northern Maine have been mostly on small Federal actions (less than 15 ac; 6 ha) that have few consequences to lynx, which require large landscapes of 35,000 ac (14,164 ha) or more; therefore, the results of these informal consultations were that the projects would have no effect on lynx or would not likely adversely affect lynx.

A potential benefit of critical habitat designation would be to signal the importance of these lands to Federal agencies, scientific organizations, State and local governments, and the public to encourage conservation efforts to benefit the lynx and its habitat. By publication of the proposed rule, we are educating the public of the location of core lynx habitat and areas most important for the recovery of this species. In addition, designation of critical habitat on HFRP enrollee lands could provide some educational benefit through the rulemaking process.

Benefits of Exclusion

A Federal nexus on HFRP lands is rare, and development is unlikely because conservation easements exist on many of these lands. Section 7(a)(2) review will not provide benefits to the physical and biological features essential to the conservation of lynx, because most Federal projects in northern Maine are small and will not benefit habitat at a geographic scale meaningful for lynx conservation. Therefore, the regulatory protection provided through the section 7(a)(2) process for critical habitat would minimal. The HFRP goes beyond the standard of adverse modification to provide a net conservation benefit. The conservation measures for the lynx included in the HFRP plans are affirmative obligations that address the physical and biological features, represent the best available science, and provide a net conservation benefit to the species by ensuring the quality and quantity of unfragmented lynx habitat on the landscape.

Excluding these 684,653 acres of HFRP lands from critical habitat designation would help strengthen partnerships and promote other aspects of recovery for the lynx. Since the lynx was listed in 2000, it has been difficult for us to effectively address lynx conservation across the forest landscape in northern Maine because of the numerous private industrial forest landowners with whom coordination is required. HFRP contracts will contribute to the conservation of the physical and biological features essential to the conservation of the lynx in approximately 10 percent of the proposed critical habitat unit. Proactively developing conservation programs for lynx across large ownerships can be a more effective recovery strategy than project-by-project planning in a landscape where a section 7 is rarely applicable. Lynx require large home ranges, and lynx and snowshoe hare habitat occurs in a habitat mosaic across the landscape that changes with time and space as the forests age or disturbances occur (e.g., insect outbreaks or timber management). The HFRP plans address landscape-level planning and actions for forestry-related activities within the context of lynx-specific guidelines, which can facilitate lynx recovery. The HFRP contracts operate under a programmatic biological opinion under section 7(a)(2), enabling a coordinated, multi-landowner approach to lynx conservation on private lands.

HFRP contracts build on the ongoing partnership between the Service, Maine Department of Inland Fisheries and Wildlife, and the HFRP enrollees. The contracts provide assurances to the Service that individual landowners will address the habitat requirements of lynx and facilitate the consideration and implementation of lynx conservation needs at a broad landscape scale. Although the HFRP contracts are for 10 years, lynx plans are required to address forest management for the next 70 years. Several incentives encourage enrollees to continue their plans after the conclusion of the 10-year contract:

- Enrollees will be offered Safe Harbor Agreements or other mechanisms to extend incidental take coverage and regulatory assurances beyond the 10 year period. Most of the enrollees are in forest certification programs and have conservation easements.
- HFRP plans meet the requirements of certification programs and easement requirements to document how they will manage for federally listed species.
- Future HFRP funding may be available to promote continued management on these lands.
- Landowners may be reimbursed at a graduated rate of up to 100 percent for land put under conservation easements of 30-year and 99-year duration.

Most HFRP enrollees have a long track record of conservation in Maine. The Nature Conservancy has been working with us and other conservation partners since the 1970s. The Forest Society of Maine is a conservation easement holder in northern Maine, and has been working with us since the late 1990s. We have a long partnership with the Passamaquoddy Tribe that includes consulting on Tribal silvicultural projects, cooperative research, review of forest management plans, and implementation of Service conservation recommendations. Many of the HFRP enrollees contribute as members to the University of Maine Cooperative Forest Research Unit (CFRU). The CFRU has funded numerous lynx and snowshoe hare studies that have advanced our understanding of lynx population dynamics and habitat relationships. Landowners have facilitated research and surveys by allowing access to their lands and logistical support. The positive experiences from HFRP enrollment will promote continued support for funding and continued lynx research.

Some of the enrolled lands could be sold, and it may be argued that new owners may not participate in long-term lynx management. However, new landowners could benefit from the incidental take coverage offered by HFRP or future Safe Harbor Agreements as a result of HFRP plans. Lands under conservation easements would require planning for federally listed species, and new landowners would have an incentive to continue to implement plans to meet their easement requirements. Many of the owners have SFI or FSC certifications, which have similar requirements for State and federally listed species planning. Therefore, substantial incentives exist for a new landowner to honor existing lynx management plans.

Some landowners do not trust that the regulatory effect of critical habitat designation is limited, and they do not want an additional layer of Federal regulation on their private property. They are concerned that additional State regulations or local restrictions may be imposed as a result of the designation of critical habitat. HFRP enrollees are some of the largest landowners in Maine. We need the cooperation and partnership of these landowners to achieve recovery of lynx in Maine. If designation causes their alienation, it would be counterproductive to designate on their lands.

Benefits of Exclusion Outweigh Benefits of Inclusion

We believe there would be minimal benefit in designating lands enrolled in the HFRP as critical habitat for the lynx within Unit 1. We evaluated the proposed exclusion of approximately 684,653 ac (277,069 ha) of lands enrolled in the HFRP. Inclusion of these lands would result in few benefits; minimal consultation under section 7, and minimal education related to lynx conservation would be realized.

The HFRP lynx management plans will be effective and directly address the physical and biological features essential to lynx by incorporating the Service's lynx conservation guidelines. These conservation actions and management for the lynx and the physical and biological features essential to it within large landscapes exceed any conservation value provided as a result of regulatory protections that have been or may be afforded through critical habitat designation. The exclusion of these lands from critical habitat will help preserve partnerships developed with the landowners. Most of the HFRP enrollees have a demonstrated track record of working with the Service and helping to fund lynx research. The HFRP plans will have a high probability of implementation due to the 10-year contract with NRCS and significant incentives (e.g., Safe Harbor, requirements of forest certification and conservation easements, continued funding and possibly additional funds),

and could continue for a 70-year period. Funding is assured because development of lynx forest management plans and initial implementation is being paid for by NRCS. HFRP plans provide a high degree of public benefit for lynx and other wildlife that share their habitat.

The benefits of excluding HFRP lands from critical habitat outweigh the benefits of retaining these lands as critical habitat. Educational benefits can be realized by designation of critical habitat designation, which informs the public via the rulemaking process. However, education has already been realized through the HFRP. The best scientific information regarding the long-term conservation of lynx is being used and shared with landowners to assist in the development of their plans. We participate in the delivery of this information. We will continue to review Federal actions under Section 7(a)(2) of the Act, although the only likely Federal action we foresee on the lands enrolled in HFRP will be on the consultation required for development of the individual plans. A programmatic biological opinion has already been prepared and it addresses lynx habitat in detail.

The HFRP provides an opportunity for us to work in partnership with five landowners across several landscape scales and ownerships. The HFRP demonstrates that our lynx management guidelines are a flexible, outcome-based approach to addressing lynx recovery in northern Maine that can be adapted to a variety of landowner types and landscapes. The HFRP lynx forest management plans will employ state-of-the-art habitat mapping, apply the best available science, and have a high likelihood of being carried out. We believe that the benefits of excluding HFRP enrollee lands outweigh the benefits of inclusion, particularly because these landowners have committed to developing long-term lynx habitat plans and on-the-ground management affecting large landscapes.

Exclusion Will Not Result in Extinction of the Species

Exclusion of 684,653 ac (277,069 ha) from Unit 1 of this revised critical habitat designation will not result in the extinction of the species, because the HFRP plans provide for the conservation of the species and the physical and biological features essential to it. The jeopardy standard of section 7(a)(2) of the Act and routine implementation of conservation measures through the section 7 process also provide assurances that the species will not go extinct. The protections afforded the lynx under the jeopardy standard will remain in place for the areas excluded from revised critical habitat.

Maine Forest Products Council Conservation Partnership Agreement

The Maine Forest Products Council (MFPC) is a trade organization representing the Maine forest products community, whose 350-member companies include landowners, loggers, truckers, paper mills, and lumber processors. The MFPC advises its members on Federal and State regulatory issues. The 28 MFPC private commercial forest landowners in the area of critical habitat own 74 percent of the lands proposed for lynx critical designation in Maine. Other participants in the partnership include Maine Department of Inland Fisheries and Wildlife (MDIFW) and the Service. Beginning with our first proposal to designate critical habitat for lynx in 2006, MFPC submitted draft conservation agreements with the intent to document its members' ongoing partnership with wildlife agencies responsible for lynx management and conservation.

We assessed the benefits of inclusion and the benefits of exclusion of MFPC members' lands, based on the most recently submitted draft conservation agreement, and determined that these lands do not meet our criteria for exclusion from critical habitat. Our analysis follows below.

The MFPC and its landowner members have supported lynx recovery by allowing researchers from MDIFW, the Service, and the University of Maine (UMaine) access to their private property to conduct lynx surveys and research, and by providing logistical assistance (e.g., lodging, field maps) to the lynx researchers. Thirteen of the 28 landowners are contributing members to UMaine's Cooperative Forestry Research Unit (CFRU). Since 2000, the CFRU members have contributed more than $515,000 to support 9 research projects assessing the effects of forest management on snowshoe hares and Canada lynx. We have supported many of these projects, which form a large part of the scientific basis for lynx recovery in Maine. This partnership reinforces MFPC member funding and support for continued lynx research through CFRU.

Under a draft partnership agreement, the MFPC would encourage funding for the UMaine CFRU to complete landscape-level lynx habitat mapping across MFPC member lands using satellite imagery and state-of-the art lynx and hare habitat models developed by UMaine. MFPC would also encourage funding for updates to the habitat maps, and members would assist with verification of the mapping product. At this time, high-quality maps of lynx habitat across mixed ownerships do not exist. Mapping of this quality would enable landscape-level habitat analyses and planning for lynx, snowshoe hare and many other species. Mapping would document the shifting mosaic of habitat, guide opportunities for management, and project future habitat conditions under different silvicultural scenarios.

The Draft MFPC Agreement would enable the MFPC, MDIFW and the Service to collaboratively develop multi-species landscape-scale planning guidelines that would assist in the development of management recommendations for lynx in relation to other wildlife species. MFPC participation is important to ensure that guidelines are acceptable to forest industries. These guidelines would be a useful resource for the land managers to inform their management decisions for the conservation of lynx and other wildlife.

The Draft MFPC Agreement would provide educational benefits by establishing mechanisms to broaden the understanding of lynx habitat management and disseminating the best available scientific information on lynx throughout all levels of the forest products industry. Existing training programs for foresters, loggers, and land managers would be expanded to include lynx education components. Web sites, newsletters, professional meetings and forums would provide information on lynx research and management. The Draft MFPC Agreement would document a management process to review research results and facilitate dissemination of results to Maine's forest managers. The Draft MFPC Agreement would create an annual lynx conservation workshop and experimental testing of silvicultural techniques. An annual report would be provided to all partners summarizing lynx conservation activities and achievements. This form of education and training is anticipated to result in a substantial improvement in the understanding of lynx habitat requirements among members of the forest products industry. Education is generally considered a benefit of designating critical habitat in that it educates the public and others about the potential conservation value of an area.

The Draft MFPC Agreement could help achieve lynx recovery, as identified in the Service's Canada Lynx Recovery Outline (USFWS 2005); however,

actions not made mandatory in the Draft Agreement would have to be completed to realize some of the conservation benefits identified in the Recovery Outline, which include:

- Objective 1: Retain adequate habitat of sufficient quality to support the long-term persistence of lynx populations within each of the identified core areas and Recovery Action, and
- Recovery Action 1. Establish management commitments in core areas that will provide for adequate quality and quantity of habitat such that there is a reasonable expectation that persistent lynx populations can be supported in each of the core areas for at least the next 100 years. On non-Federal lands in the core areas, develop and implement best management practices and long-term management agreements for lynx with key State, private, or Tribal forest managers.
- Recovery Action 2. Maintain baseline inventories of lynx habitat in each core area, monitoring changes in structure and the distribution of habitat components.
- Recovery Action 4. Identify habitat facilitating movement between each core area and lynx populations in Canada.
- Recovery Action 6. Identify population and habitat limiting factors for lynx in the contiguous United States. Continue and complete studies necessary to gather basic information on the ecological requirements, distribution, population size, and trends in each of the core areas and as possible for secondary areas. Identify the risk to lynx populations posed by forest management techniques and human induced mortality from factors such as roads, trapping, and hunting. Address these factors as necessary to ensure the long-term persistence of lynx populations in core areas.

Under the Draft MFPC Agreement, the parties would work collaboratively to improve lynx habitat management on industrial forest lands based on scientific research. Such measures might include development of landscape-scale habitat maps; experiments to evaluate the feasibility, practicality, and effectiveness of research recommendations; and development of multi-species landscape-scale planning guidelines. The Draft Agreement does not prescribe measures, however, for directly managing or protecting the physical and biological features essential to the conservation of lynx. The MFPC would work to support the implementation of management measures based on research if recommendations are operationally feasible, economically viable, and biologically meaningful.

Benefits of Inclusion

The primary benefit of including the area addressed by the Draft MFPC Agreement within a critical habitat designation is the protection provided by section 7(a)(2) of the Act, which directs Federal agencies to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a threatened or endangered species, and do not result in the destruction or adverse modification of critical habitat. The regulatory benefit of designating critical habitat in Maine is currently low, because few Federal actions trigger the consultation provisions under section 7(a)(2) of the Act. Forestry activities are exempt from the Clean Water Act, and few industrial forest landowners engage in activities that involve Federal funding or authorization. Since the lynx was listed in 2000, there have been two formal consultations on lynx in Maine (the HFRP biological opinion and a highway project) and about 73 informal consultations. Consultations in northern Maine have been mostly on small Federal actions (less than 15 ac; 6 ha) that have few consequences to lynx, which require large landscapes of 35,000 ac (14,164 ha) or more; therefore, the results of these informal consultations were that the project would have no effect on lynx or would not likely adversely affect lynx.

At this time, we are aware of two proposals that may affect large landscapes on MFPC member lands and will trigger consultation under section 7(a)(2). In 2008, we initiated consultation with the Army Corps of Engineers on a large wind power project. In 2007, we provided comments as requested by the Maine Land Use Regulation Commission on a large-scale development project that would occur on a MFPC member's land in Unit 1—Plum Creek's Moosehead Concept Plan. This project included a request for a zoning change to allow development of approximately 1,000 house lots, 2 large resorts, and possibly wind power projects on up to 2,023 ha (5,000 ac) in critical habitat Unit 1. As mitigation, Plum Creek is offering a combination of fee title sale and a conservation easement on 174,015 ha (430,000 ac) of undeveloped lands. The easement would require that threatened and endangered species conservation be addressed as part of Plum Creek's Sustainable Forestry Initiative certification program. Aspects of wildlife and special areas management would be overseen by a Management Advisory Team, which would include representation from the Service. If the concept plan is approved by the State, projects requiring Federal permitting would likely be initiated within several years. We would review the Plum Creek projects under the concept plan through Section 7 consultation with Army Corps of Engineers or other Federal permits or funding.

Federal actions have occurred on MFPC lands, and because of this, it is possible that section 7 consultations will occur in the future. Although a Federal nexus on projects in this area is rare, designation of critical habitat could provide a conservation benefit for lynx habitat.

A potential benefit of critical habitat designation would be to signal the importance of designated lands to Federal agencies, scientific organizations, State and local governments, and the public to encourage conservation efforts to benefit the lynx and its habitat. Critical habitat designation educates the public about the location of core lynx habitat and areas most important for the recovery of this species.

The Draft MFPC Agreement could encourage members to support a 5-year position at UMaine and CFRU (about $50,000 annually). The person in this position would help complete habitat mapping, which would require $300,000 to $500,000 of additional funds. This person would also coordinate the outreach and research specified in the Draft Agreement. However, this funding is not assured. CFRU dues paid by member landowners are needed to support the research commitments of the Draft MFPC Agreement, and not all MFPC members within critical habitat Unit 1 are contributing members of the CFRU. Plum Creek is the only MFPC member to potentially pledge funds ($6,000 annually for the next 5 years). None of the other MFPC member companies have made funding commitments. No certainty exists for implementation of important aspects of the Draft MFPC Agreement.

The Draft Agreement does not require specific land management actions to be taken by landowners. The MFPC landowners each manage their properties differently, and own different amounts of property in different stand conditions. The MFPC is an umbrella organization with no authority over its members, and can only encourage its members to voluntarily act to meet the guidelines in the Draft Agreement. Individual landowners would not be actual parties to the agreement. No commitment would be made through

the agreement to allow the Service access to member lands in order to monitor lynx or effects of management on lynx, and existing easements that MFPC relies on were not provided for review during this analysis. All of these factors indicate that benefits to lynx by excluding these lands are very speculative.

We compared the HFRP, which we found met our criteria for exclusion under section 4(b)(2), with the MFPC Draft Agreement, which we found did not meet our criteria for exclusion. For instance, both conservation vehicles adopt a 10-year timeframe for required contracts; however contracts under the HFRP are binding and ramifications for breach exist, and the MFPC Agreement is voluntary with no consequences for termination, which could happen at any time. Additionally, the HFRP contemplates conversion of the 10-year contract to an easement, as discussed earlier. Participants in HFRP, like many MFPC members, are enrolled in forest certification programs. We find that participation in the certification programs demonstrates some commitment to responsible resource management; however, we were not provided with endangered species or lynx management plans, which are required under forest certification programs, to review. We could not evaluate the efficacy of the programs or potential benefits to the lynx or its habitat. The HRFP commitment is that contractually-bound parties will likely meet their obligations to provide lynx management plans. Because neither the MFPC, nor its Draft Agreement commit or bind its members in any manner, participation in a certification program, though laudable, is less relevant for our evaluation.

Benefits of Exclusion

The Draft MFPC Agreement would commit partners to monitoring lynx habitat, contributing to lynx research, developing lynx management guidelines, promoting education, and conducting outreach across the lands of 28 corporate forest landowners. These commitments would strengthen partnerships and promote other aspects of recovery for the lynx. The Draft Agreement would have a duration of 10 years (extendable in 5-year increments); however, it would allow for unilateral termination. MFPC would prepare an annual report summarizing the actions taken to implement the agreement.

Since the lynx was listed in 2000, it has been difficult for us to effectively address lynx conservation across the forest landscape in northern Maine because of the numerous private industrial forest landowners with whom coordination is required. It is important to proactively develop conservation programs for lynx across large landscapes. Lynx require large home ranges, and lynx and snowshoe hare habitat occurs in a habitat mosaic across the landscape that changes over time and space as the forests ages or disturbances occur to forest stands (e.g., insect outbreaks or timber management). Conservation easements (that restrict development) exist on approximately 809,374 ha (2,000,000 ac) in the area covered by the Draft MFPC Agreement. Some of the landowners have requirements to manage for federally listed species under forest certification programs.

The Draft MFPC Agreement covers 2,036,378 ha (5,032,000 ac), 74 percent of critical habitat Unit 1—an area larger than the State of New Jersey. The Draft Agreement could enable a coordinated, multi-landowner approach to lynx conservation on these private lands. This opportunity would not occur under typical consultation scenarios. The Draft Agreement would provide an opportunity to engage nearly all of the large private landowners in a dialogue concerning the recovery needs of the lynx. The Draft MFPC Agreement could facilitate the consideration of voluntary lynx conservation actions at a landscape scale across land ownership boundaries.

The conservation measures for lynx included in the Draft MFPC Agreement would support research needed to understand the effects of forest management in Maine on the physical and biological features essential to the conservation of lynx, provide a means to assess and monitor habitat, and provide an opportunity to develop management strategies for lynx and other wildlife species.

The Draft MFPC Agreement could build on the ongoing partnership between the Service, MDIFW, UMaine, CFRU and other partners. The Draft MFPC Agreement would be in place for 10 years, but could be renewed. Several incentives, for MFPC landowners to maintain this partnership for a longer period of time, include:

- The Service (at considerable cost) could designate critical habitat if landowners did not live up to the terms of the Agreement or if the physical and biological features essential to lynx began to diminish.
- Some landowners cite the Draft MFPC Agreement as part of their lynx conservation program in order to meet the requirements of certification programs and easement requirements for managing for Federally listed species.
- Funding (e.g., HFRP) may be available as an incentive to promote development of individual lynx forest management plans.

Some MFPC landowners have a track record of partnership with State and Federal conservation agencies in Maine. About half of the 28 landowners contribute as members to the CFRU. MFPC landowners have enabled this research by allowing access to their lands and logistical support; access is crucial and could be terminated by landowners if critical habitat is designated on their lands. This Draft Agreement could reinforce the continued support of MFPC landowners for funding and continued lynx research through CFRU.

Forest management on MFPC lands must meet the requirements of the Maine Forest Practices Act. This Act has resulted in the forest products industry changing to forestry methods (e.g., partial harvesting) that may be detrimental to creation of habitats that support high snowshoe hare densities. We are working with landowners and the Maine Forest Service to discuss the problems of the Maine Forest Practices Act and to encourage conservation measures that will benefit lynx.

Some landowners do not trust that the regulatory effect of critical habitat designation is limited, and they do not want an additional layer of Federal regulation on their private property. They are concerned that additional State regulations or local restrictions may be imposed as a result of the designation of critical habitat. MFPC landowners manage the largest forest acreage in Maine; several own more than 404,686 ha (1 million ac). Maintaining the cooperation of these landowners would be helpful in achieving recovery of lynx in Maine. The MFPC has indicated that they will not provide many of the benefits described in their Draft Agreement if critical habitat is designated on their members' lands.

As discussed in more detail in our final economic analysis, Plum Creek submitted a public comment indicating that they will likely abandon the Moosehead Concept Plan if critical habitat is designated in Maine. A report submitted with Plum Creek's public comments describes the economic impacts to the public and to Plum Creek in terms of potential economic benefits lost if the project is abandoned. In their public comment, Plum Creek summarized the economic impacts that would result from abandoning the Concept Plan (see page 5–19 of the final economic analysis). Plum Creek stated that a recent report valued lands in the Concept Plan at $189.6 million to Plum

Creek. Conservation easements were valued at $469,000 in benefits for the local residents and $9.2 million in benefits for Maine residents. In total, public benefits of the balance easement were quantified at between $10.8 and $19.2 million. Our final economic analysis does not sum Plum Creek's estimated impacts with the incremental impacts of critical habitat designation because the 2007 conservation recommendations from LURC and the Service with regard to the Moosehead Concept Plan are unlikely to be affected by the designation of critical habitat, there is uncertainty regarding whether these costs will be realized, and there may also be economic benefits of not going forward with the Moosehead Concept Plan that offset the cost estimates presented by Plum Creek. If Plum Creek abandons the Concept Plan, the alternative uses of the land are largely uncertain, and we, therefore, have not predicted what sorts of economic costs and benefits would be associated with those uses. The final economic analysis estimates the potential post-designation baseline economic impacts of lynx conservation efforts in Unit 1 to range from $8.6 to $9.5 million at a 7 percent discount rate on an annualized basis.

Benefits of Inclusion Outweigh Benefits of Exclusion

We find that the benefits of including MFPC lands in the designation outweigh the potential benefits of exclusion. Despite the lynx conservation benefits that might arise from the partnerships that could be built or strengthened through the Draft MFPC Agreement, it provides no commitment to implement on-the-ground habitat management to conserve the physical and biological features essential to the conservation of lynx, nor is there certainty that funding will be committed for research and landscape-level lynx habitat mapping across MFPC member lands.

Section 7(a)(2) consultation on future, unforeseen projects within MFPC member lands, that are authorized, funded, carried out by Federal agencies, might result in a determination that the action will result in the destruction or adverse modification of lynx critical habitat.

Overall, the MFPC Agreement is a draft document that lacks funding, does not identify funding necessary to complete commitments (such as research projects), lacks concrete management measures, and only commits to voluntary actions. While we recognize that there is great partnership potential promised through this Draft Agreement, we find that excluding 74 percent of a critical habitat unit based on this potential does not meet our criteria for exclusion.

Although potential economic impacts associated with the Moosehead Concept Plan have been provided to us by Plum Creek, based on our final economic analysis and because of the uncertainty regarding whether Plum Creek will abandon the project and what economic costs and benefits would be associated with alternative uses of the land, we do not believe that this final designation will result in any substantial and disproportionate economic impacts. The Secretary is not excluding MFPC lands from critical habitat based on economic impacts.

We recognize that designating MFPC member lands as critical habitat may weaken existing partnerships between the Service and MFPC and its member landowners; however, we will continue to work with private landowners to further lynx conservation.

Unit 3 (Northern Rockies—Montana and Idaho)

Montana Partnership Conservation Agreement

Subsequent to publication of the proposed rule, a consortium of private lands timber companies partnered to develop the Montana Partnership Conservation Agreement (MPCA). Partners to the agreement include F.H. Stoltze Land and Timber Company, Plum Creek Timber Company, Inc., and Stimson Lumber Company, Inc. The finalized agreement would be signed only if private lands in Montana were not included in the lynx critical habitat designation, and would affect lands in critical habitat Units 3 and 5.

We assessed the benefits of inclusion and the benefits of exclusion of these lands, and determined that these lands do not meet our criteria for exclusion from critical habitat. Our analysis follows below.

The landowners involved in the MPCA have supported lynx recovery by allowing researchers from USFS, Rocky Mountain Research Station, University of Montana, and others access to their private property to conduct lynx surveys and research and by providing logistical assistance (e.g., lodging, field maps) to lynx researchers. Plum Creek Timber Company has supported lynx research by donating funds to specific projects. We supported many of these projects, which form a large part of the scientific basis for lynx recovery in the mountain west. The Draft MPCA Agreement would reinforce MPCA funding and support for continued lynx research. There is no assurance that MPCA funding and logistical support for lynx and snowshoe hare research will continue if critical habitat is designated on MPCA member lands.

The Draft MPCA Agreement calls for member landowners and the Service to collaboratively develop habitat management best management practices that would assist in the development of management recommendations for lynx in relation to other wildlife species. As the land managers, MPCA participation is important to ensure that guidelines will be accepted. These guidelines would be a useful resource to inform management decisions for the conservation of lynx and other wildlife.

The Draft MPCA Agreement documents a management process for reviewing research results and facilitating dissemination of results to Montana's private forest managers. The Draft Agreement includes creation of an annual lynx conservation workshop during which information exchange would occur between MPCA landowners, the Service, and other industrial and small-lot forest owners and forest products producers. An annual report would be provided to all partners summarizing lynx conservation activities and achievements.

The Draft Agreement would provide educational benefits by establishing mechanisms to broaden the understanding of lynx habitat management and disseminating the best available scientific information on lynx throughout all levels of the forest products industry. Existing training programs for foresters, loggers, and land managers would be expanded to include lynx education components. Web sites, newsletters, professional meetings and forums would provide information on lynx research and management. The MPCA signatories would coordinate an annual lynx workshop to discuss research results and identify actions that may contribute to the conservation of lynx habitat while preserving Montana's working forest; the workshop would serve to inform the Service on changes in the industry and landowner forest management practice trends. This form of education and training could result in an improved understanding of lynx habitat requirements among members of the forest products industry.

Under the Draft Agreement, participating parties would work collaboratively to improve lynx habitat management on industrial forest lands based on sound science and education of forest managers and others. Such measures might include development of landscape-scale habitat maps; experiments to evaluate the feasibility,

practicality, and effectiveness of research recommendations; and development of habitat management guidelines. However, the Draft Agreement would not prescribe measures for directly managing or protecting the physical and biological features essential to the conservation of lynx. The MPCA would support the implementation of management measures based on research if recommendations are operationally feasible, economically viable, and biologically meaningful.

The Draft Agreement would commit participating parties for at least 10 years (extendable in 5-year increments). The landowner signatories would prepare an annual report summarizing the actions taken to implement the agreement.

Benefits of Inclusion

The primary benefit of including an area within a critical habitat designation is the protection provided by section 7(a)(2) of the Act, which directs Federal agencies to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of a threatened or endangered species and do not result in the destruction or adverse modification of critical habitat. The regulatory benefit of designating critical habitat on lands subject to the Draft MPCA Agreement in Montana is currently low, because few Federal actions trigger the consultation provisions under section 7(a)(2) of the Act. Since the lynx was listed in 2000, there has been one formal consultation on lynx on private lands in Montana. This formal opinion covered activities under the USDA Natural Resources and Conservation Service's Forest Stand Improvement Practices program. Under this programmatic formal consultation, five second-tier site-specific consultations have occurred. In addition, approximately two informal consultations occurred in Montana for private lands activities, involving road access requests across USFS lands to private lands.

Federal actions have occurred on MPCA lands, and because of this, it is possible that section 7 consultations will occur in the future. Although a Federal nexus on projects in this area is rare, designation of critical habitat could provide a conservation benefit for lynx habitat.

A potential benefit of critical habitat designation would be to signal the importance of designated lands to Federal agencies, scientific organizations, State and local governments, and the public to encourage conservation efforts to benefit the Canada lynx and its habitat.

The Draft Agreement would not require specific land management actions to be taken by landowners. The MPCA landowners each manage their properties differently and own different amounts of property in different stand conditions. The MPCA can only serve as a vehicle to promote partnerships and educate forest owners so that they may voluntarily act to fulfill the conservation objective of the Draft Agreement. Individual MPCA landowners' land management decisions or activities to fulfill the Agreement are voluntary. No commitment would be made through the agreement to allow Service access to member lands in order to monitor lynx or effects of management on lynx. All of these factors indicate that benefits to lynx by excluding these lands are very speculative.

Benefits of Exclusion

The Draft MPCA Agreement would commit partners to developing voluntary lynx management guidelines and conducting education and outreach across private timberlands in Montana. These commitments would strengthen partnerships in lynx recovery and could result in better management of the physical and biological features essential to lynx.

The Draft Agreement would enable a coordinated approach to landowner education and conservation. This opportunity might not occur under section 7 consultation. The Draft Agreement would provide an opportunity to engage several large private landowners and many small wood products companies in a dialogue concerning the recovery needs of the lynx. The Draft Agreement could facilitate the consideration of voluntary lynx conservation actions at a landscape scale across land ownership boundaries.

The MPCA signatory landowners are the three largest landowners in the critical habitat Units 3 and 5 in Montana, and collectively own approximately 35 percent of the critical habitat area in Montana. Designating critical habitat might provide additional protection for lynx, because some actions are known to trigger consultation through the Section 7(a)(2) process. The actions included in the Draft Agreement provide an opportunity to develop management strategies for lynx.

One MPCA landowner (Plum Creek) has a long track record of partnership with State and Federal conservation agencies in Montana. The Draft Agreement would reinforce MPCA landowners' continued support for funding and continued lynx research.

Some Montana forest landowners have a negative perception of critical habitat, and believe that designating critical habitat on their lands would result in negative consequences to them. They do not want an additional layer of Federal regulation over their private property. They are concerned that additional state regulations or other local restrictions may be imposed as a result of the designation of critical habitat. Designation on MPCA lands could make working cooperatively or effectively on lynx conservation with landowners more difficult. If MFPC members' lands are designated, the Draft Agreement would not be implemented and commitments to education and lynx guidelines would be no longer be offered.

Plum Creek Timber Company and F.H. Stoltze Land and Lumber Company submitted public comments containing their own economic analysis of critical habitat designation for the lynx (see pages 5–26 of our final economic analysis for more details). Although the economic analyses provide valuable information on potential development impacts in Unit 3, they cannot be incorporated into our final economic analysis because their assumptions differ from those applied in our analysis. Stoltze's economic analysis estimates the lost development option value on its land, assuming that critical habitat designation would preclude future development, to be $120 million. Plum Creek's economic analysis estimates that the greatest impact of critical habitat designation will be a reduced ability to develop their lands in the future. Assuming that Plum Creek would sell its land over a 20-year period, it estimates the total value at risk associated with the designation of critical habitat to be approximately $138 million (discounted at 7 percent). Plum Creek also submitted technical comments providing information on the locations and extent of Plum Creek land holdings and anticipated development projects within Unit 3. Although there may be increased regulatory stringency in certain Montana Counties as a result of critical habitat designation, the locations, size, and value of future development proposals is uncertain, as is the frequency with which they will occur in future years. Absent additional information on the specific land use restrictions that may be imposed, the cost of those restrictions, and their relation to lynx conservation, no impacts to development activities are quantified for Unit 3.

Benefits of Inclusion Outweigh Benefits of Exclusion

We find that the benefits of including MPCA lands in the designation outweigh the potential benefits of exclusion. Despite the lynx conservation benefits that might arise from the partnerships that could be built or strengthened through the Draft MPCA Agreement, it provides no commitment to implement on-the-ground habitat management to conserve the physical and biological features essential to the conservation of lynx, nor is there certainty that funding will be committed for research and landscape-level lynx habitat mapping across MPCA member lands.

Section 7(a)(2) consultation on future, unforeseen projects within MPCA member lands, that are authorized, funded or carried out by Federal agencies, might result in a determination that the action will result in the destruction or adverse modification of lynx critical habitat.

Overall, the MPCA Agreement is a draft document that lacks funding, does not identify funding necessary to complete commitments (such as research projects), lacks concrete management measures, and only commits to voluntary actions. While we recognize that there is great partnership potential promised through this Draft Agreement, we find that excluding a significant portion (33 percent) of one critical habitat unit (and a small portion of another) based on this potential does not meet our criteria for exclusion.

Although potential economic impacts associated with lands owned by Plum Creek and Stoltze have been provided, based on our final economic analysis and because of the uncertainty regarding the specific land use restrictions that may be imposed, the cost of those restrictions, and their relation to lynx conservation, we do not believe that this final designation will result in any substantial and disproportionate economic impacts. The Secretary is not excluding MPCA lands from critical habitat based on economic impacts.

We recognize that designating MPCA member lands as critical habitat may weaken existing partnerships between the Service and MPCA and its member landowners; however, we will continue to work with private landowners to further lynx conservation.

Unit 4 (North Cascades—Washington)

Washington Department of Natural Resources Lynx Habitat Management Plan for DNR-Managed Lands

The Washington Department of Natural Resources Lynx Habitat Management Plan for DNR-managed Lands (WDNR LHMP) encompasses 126,212 ac (197 mi^2) (51,076 ha/511 km^2) of WDNR-managed lands distributed throughout north-central and northeastern Washington in areas delineated as Lynx Management Zones in the Washington State Recovery Lynx Plan (Stinson 2001, p. 39; WDNR 2006, pp. 5–13). The WDNR LHMP was finalized in 2006, and is a revision of the lynx plan that WDNR has been implementing since 1996 (WDNR 1996, entire). The 1996 plan was developed as a substitute for a species-specific critical habitat designation required by Washington Forest Practices rules in response to the lynx being State-listed as threatened (WDNR 2006, p. 5). The 2006 WDNR LHMP provides further provisions to avoid the incidental take of lynx (Martin 2002, entire; WDNR 2006, p. 6). WDNR is committed to following the LHMP until 2076, or until the lynx is delisted (WDNR 2006, p. 6). WDNR requested that lands subject to the plan be excluded from critical habitat.

The WDNR LHMP contains measures to guide WDNR in creating and preserving quality lynx habitat through its forest management activities. The objectives and strategies of the LHMP are developed for multiple planning scales (ecoprovince and ecodivision, Lynx Management Zone, Lynx Analysis Unit (LAU), and ecological community), and include:

1. Encouraging genetic integrity at the species level by preventing bottlenecks between British Columbia and Washington by limiting size and shape of temporary non-habitat along the border and maintaining major routes of dispersal between British Columbia and Washington;

2. Maintaining connectivity between subpopulations by maintaining dispersal routes between and within zones and arranging timber harvest activities that result in temporary non-habitat patches among watersheds so that connectivity is maintained within each zone;

3. Maintaining the integrity of requisite habitat types within individual home ranges by maintaining connectivity between and integrity within home ranges used by individuals and/or family groups; and

4. Providing a diversity of successional stages within each LAU and connecting denning sites and foraging sites with forested cover without isolating them with open areas by prolonging the persistence of snowshoe hare habitat and retaining coarse woody debris for denning sites (WDNR 2006, p. 29).

The LHMP identifies specific guidelines to achieve the objectives and strategies at each scale; it also describes how WDNR will monitor and evaluate the implementation and effectiveness of the HMP (WDNR 2006, pp. 29–63). WDNR has been managing for lynx for over a decade, their management strategies appear to be effective.

Benefits of Inclusion

On WDNR State lands, it is uncommon for an action with a Federal nexus that triggers consultation under section 7 of the Act to occur; therefore, little benefit would be realized through section 7 consultation if these lands were included in the designation.

Some educational benefits to designating critical habitat for lynx on WDNR managed lands may exist. However, we believe there is already substantial awareness of the lynx and conservation issues related to the lynx through the species being listed both under the Act and Washington State law; through the public review process for the WDNR HMP, Washington's Lynx Recovery Plan and the revision of the Okanogan-Wenatchee National Forest Management Plan; lynx and snowshoe hare research being conducted by the USFS Pacific Northwest Research Station, Washington State University, University of Washington, and the University of Montana; surveys being conducted by Washington Department of Fish and Wildlife and the USFS; and State of Washington Web sites (e.g., *http://wdfw.wa.gov/wlm/diversty/soc/recovery/lynx/lynx.htm, http://www.dnr.wa.gov/htdocs/amp/sepa/lynx/1_toc.pdf*).

Benefits of Exclusion

The WDNR LHMP should provide substantial protection of features essential to the conservation of lynx on WDNR lands, and should provide a greater level of management for the lynx on these State lands than designation of critical habitat. The measures contained in the WDNR LHMP exceed any measures that might result from critical habitat designation, because the LHMP provides lynx-specific objectives and strategies for different planning scales, guidelines to meet the objectives, and monitoring to evaluate implementation and effectiveness. As a result, we do not anticipate any actions on these lands that would destroy or adversely modify the areas.

The exclusion of WDNR lands from critical habitat would help preserve the partnerships that we have developed with them through development and implementation of the 2006 LHMP and the original 1996 lynx plan, both of

which provide for long-term lynx conservation.

Benefits of Exclusion Outweigh Benefits of Inclusion

We evaluated the proposed exclusion of approximately 126,212 ac (51,076 ha) of lands managed by the WDNR. Including WDNR areas in the final designation would likely not lead to any changes in WDNR management (to further avoid destroying or adversely modifying that habitat), and therefore the benefits of inclusion are low.

We determined that the benefits of excluding these lands in Unit 4 outweigh the benefits of including these lands as critical habitat. Based on the above considerations, and consistent with the direction provided in section 4(b)(2) of the Act, we find that greater benefits to lynx exist by excluding WDNR lands from the final designation.

We find that few additional conservation benefits would be realized through section 7 of the Act, because Federal actions are uncommon on this State land. The habitat conservation measures addressing the features essential to conservation of the lynx are already being implemented on WDNR lands under the WDNR HMP, have been proven to be effective, will be in place until at least 2076, and are providing for physical and biological features essential to the conservation of the species.

Exclusion Will Not Result in Extinction of the Species

We do not believe that the exclusion of 126,212 ac (51,076 ha) from Unit 4 of this revised critical habitat designation will result in the extinction of the species, because the WDNR plans provide for the conservation of the species and the physical and biological features essential to it. The jeopardy standard of section 7(a)(2) of the Act and routine implementation of conservation measures through the section 7 process also provide assurances that the subspecies will not go extinct. The protections afforded to the lynx under the jeopardy standard will remain in place for the areas excluded from revised critical habitat.

Economic Analysis

Section 4(b)(2) of the Act requires us to designate critical habitat on the basis of the best scientific information available and to consider the economic and other relevant impacts of designating a particular area as critical habitat. We may exclude areas from critical habitat upon a determination that the benefits of such exclusions outweigh the benefits of specifying such areas as critical habitat. We cannot exclude such areas from critical habitat when such exclusion will result in the extinction of the species concerned.

Following the publication of the proposed revised critical habitat designation, we conducted an economic analysis to estimate the potential economic effect of the designation. The draft analysis was made available for public review on October 21, 2008 (73 FR 62450). We accepted comments on the draft analysis until November 20, 2008.

The primary purpose of the economic analysis is to estimate the potential economic impacts associated with the designation of critical habitat for the lynx. This information is intended to assist the Secretary in making decisions about whether the benefits of excluding particular areas from the designation outweigh the benefits of including those areas in the designation. This economic analysis considers the economic efficiency effects that may result from the designation, including habitat protections and conservation efforts that may be co-extensive with the listing of the species. It also addresses distribution of impacts, including an assessment of the potential effects on small entities and the energy industry. This information can be used by the Secretary to assess whether the effects of the designation might unduly burden a particular group or economic sector.

This analysis focuses on the direct and indirect costs of the rule. However, economic impacts to land use activities can exist in the absence of critical habitat. These impacts may result from, for example, local zoning laws, State and natural resource laws, and enforceable management plans and best management practices applied by other State and Federal agencies. Economic impacts that result from these types of protections are not included in the analysis, as they are considered to be part of the regulatory and policy baseline.

As discussed in the October 21, 2008, notice announcing the availability of the draft economic analysis (73 FR 62450), the draft analysis estimates quantifiable discounted future incremental costs of the critical habitat designation to be $2.09 million over 20 years ($140,000 annually) using a 3 percent discount rate, or $1.48 million over 20 years ($139,000 annually) using a 7 percent discount rate. The EA also acknowledges that there may be additional costs, particularly to landowners, but these costs are too speculative to quantify at this time.

After taking into consideration public comment on the proposal, the draft economic analysis was finalized, and we evaluated whether any area of proposed critical habitat should be excluded due to economic impacts (refer to Exclusions Under Section 4(b)(2) of the Act section above). The Secretary is not excluding any lands from critical habitat based on economic impacts. We do not believe that this final designation will result in any substantial and disproportionate economic impacts.

A copy of the draft and final economic analysis with supporting documents are included in our administrative record and may be obtained by contacting U.S. Fish and Wildlife Service, Montana Field Office (see **ADDRESSES** section) or from the Internet at *http://mountain-prairie.fws.gov/species/mammals/lynx/criticalhabitat.htm.*

Required Determinations

Regulatory Planning and Review

The Office of Management and Budget (OMB) has determined that this final rule is significant and has reviewed it under Executive Order 12866 (E.O. 12866). OMB bases its determination upon the following four criteria:

a. Whether the rule will have an annual effect of $100 million or more on the economy or adversely affect an economic sector, productivity, jobs, the environment, or other units of the government.

b. Whether the rule will create inconsistencies with other Federal agencies' actions.

c. Whether the rule will materially affect entitlements, grants, user fees, loan programs, or the rights and obligations of their recipients.

d. Whether the rule raises novel legal or policy issues.

OMB has determined that this rule is significant because it raises novel legal or policy issues.

Regulatory Flexibility Act (5 U.S.C. 601 et seq.)

Under the Regulatory Flexibility Act (5 U.S.C. 601 *et seq.*), as amended by the Small Business Regulatory Enforcement Fairness Act (5 U.S.C. 802(2)), whenever an agency is required to publish a notice of rulemaking for any proposed or final rule, it must prepare and make available for public comment a regulatory flexibility analysis that describes the effect of the rule on small entities (i.e., small businesses, small organizations, and small government jurisdictions). Although no regulatory flexibility analysis is required if the head of the agency certifies the rule will not have a significant economic impact on a

substantial number of small entities, we completed a final regulatory flexibility analysis, and our final economic analysis determines that this final rule does not result in a significant economic impact on a substantial number of small entities.

According to the Small Business Administration (SBA), small entities include small organizations, such as independent nonprofit organizations and small governmental jurisdictions, including school boards and city and town governments that serve fewer than 50,000 residents, and small businesses (13 CFR 121.201). Small businesses include manufacturing and mining concerns with fewer than 500 employees, wholesale trade entities with fewer than 100 employees, retail and service businesses with less than $5 million in annual sales, general and heavy construction businesses with less than $27.5 million in annual business, special trade contractors doing less than $11.5 million in annual business, and agricultural businesses with annual sales less than $750,000. To determine if potential economic impacts to these small entities are significant, we considered the types of activities that might trigger regulatory impacts under this designation as well as types of project modifications that may result. In general, the term ''significant economic impact'' is meant to apply to a typical small business firm's business operations.

To determine if this final revised designation of critical habitat for the Canada lynx would affect a substantial number of small entities, we considered the number of affected small entities within particular types of economic activities (e.g., timber harvesting, livestock grazing, residential and related development, recreation activities, mining, and transportation). We considered each industry or category individually. In estimating the numbers of small entities potentially affected, we also considered whether their activities have any Federal involvement. Critical habitat designation will not affect activities that do not have any Federal involvement; designation of critical habitat affects activities conducted, funded, permitted, or authorized by Federal agencies.

In our final economic analysis of this final revised critical habitat designation, we evaluated the potential economic effects on small business entities from conservation actions related to the listing of the Canada lynx and revised designation of the species' critical habitat. The activities affected by Canada lynx conservation efforts may include land development, transportation and utility operations, and conservation on public and tribal lands. The following is a summary of the information contained in the final economic analysis:

a. Development

According to the final economic analysis, Canada lynx development-related costs account for less than 1 percent of forecast incremental costs, and are estimated at $8,130 (in 2008 dollars) over 20 years. The costs consist of administrative costs of conducting consultations under section 7 of the Act on development projects. As a result of this information, we determined that the final revised designation is not anticipated to have a significant economic impact on a substantial number of small businesses with respect to development activities.

b. Forest Management

Potential costs to forest management in designated habitat account for another 16 percent of forecast costs. Undiscounted costs are estimated at $233,000 (in 2008 dollars) over 20 years. The costs consist of administrative costs of conducting consultations under section 7 of the Act on forest management. These costs are expected to be borne by Federal and State governments, private timber landowners, tribal landowners, and other private landowners across the units of the designation. The administrative costs would be divided among many entities and projects over a 20-year period. As a result of this information, we have determined that the final revised designation is not anticipated to have a significant economic impact on small forest management businesses.

c. Recreation

Future costs associated with managing recreation account for an additional 19 percent of forecast costs. Costs are estimated to be $285,000 (in 2008 dollars) over 20 years. The costs consist of administrative costs of conducting consultations under section 7 of the Act associated with managing recreation (i.e., reductions of snowmobile opportunities) in Unit 4 (North Cascades). Incremental costs would be incurred by State and Federal agencies. As a result of this information, we have determined that the final revised designation is not anticipated to have a significant economic impact on a substantial number of small recreation businesses.

d. Lynx Management Plans

Future costs associated with development of lynx management plans account for approximately one percent of forecast costs. Costs are estimated to be $12,300 (in 2008 dollars) over 20 years. The costs consist of administrative costs of conducting consultations under section 7 of the Act on lynx management plans by Federal agencies. As a result of this information, we have determined that the final revised designation of critical habitat is not anticipated to have a significant economic impact on a substantial number of small businesses.

e. Mining/Oil and Gas

Future costs associated with mining and oil and gas exploration and development activities account for an additional 8 percent of forecast costs. Costs are estimated at $115,000 (in 2008 dollars) over 20 years. The costs consist of administrative costs of conducting consultations under section 7 of the Act on mining and oil and gas projects by Federal agencies in Units 2, 4, and 5. As a result of this information, we have determined that the final revised designation of critical habitat is not anticipated to have a significant economic impact on a substantial number of small mining or oil and gas businesses.

Executive Order 13211

On May 18, 2001, the President issued E.O. 13211 on regulations that significantly affect energy supply, distribution, and use. E.O. 13211 requires agencies to prepare Statements of Energy Effects when undertaking certain actions. As described above, this rule is considered a significant regulatory action under E.O. 12866 due to potential novel legal and policy issues. OMB's guidance in M–01–27 for implementing this Executive Order outlines nine outcomes that may constitute ''a significant adverse effect'' when compared to no regulatory action. The final economic analysis finds that none of these outcomes will result from the critical habitat designation for lynx (refer to Appendix B). Thus, based on the information in our economic analysis, no energy-related incremental impacts associated with Canada lynx revised critical habitat are expected other than administrative costs. Costs are estimated at $115,000 (in 2008 dollars) over 20 years. The costs consist of administrative costs of conducting consultations under section 7 of the Act on mining and oil and gas projects by Federal agencies in Units 2, 4, and 5. As such, the designation of critical habitat

is not expected to significantly affect energy supplies, distribution, or use and a Statement of Energy Effects is not required.

Unfunded Mandates Reform Act (2 U.S.C. 1501 et seq.)

In accordance with the Unfunded Mandates Reform Act (2 U.S.C. 1501), the Service makes the following findings:

a. This rule will not produce a Federal mandate. In general, a Federal mandate is a provision in legislation, statute or regulation that would impose an enforceable duty upon State, local, tribal governments, or the private sector and includes both ''Federal intergovernmental mandates'' and ''Federal private sector mandates.'' These terms are defined in 2 U.S.C. 658(5)–(7). ''Federal intergovernmental mandate'' includes a regulation that ''would impose an enforceable duty upon State, local, or tribal governments'' with two exceptions. It excludes ''a condition of Federal assistance.'' It also excludes ''a duty arising from participation in a voluntary Federal program,'' unless the regulation ''relates to a then-existing Federal program under which $500,000,000 or more is provided annually to State, local, and tribal governments under entitlement authority,'' if the provision would ''increase the stringency of conditions of assistance'' or ''place caps upon, or otherwise decrease, the Federal Government's responsibility to provide funding,'' and the State, local, or tribal governments ''lack authority'' to adjust accordingly. At the time of enactment, these entitlement programs were: Medicaid; AFDC work programs; Child Nutrition; Food Stamps; Social Services Block Grants; Vocational Rehabilitation State Grants; Foster Care, Adoption Assistance, and Independent Living; Family Support Welfare Services; and Child Support Enforcement. ''Federal private sector mandate'' includes a regulation that ''would impose an enforceable duty upon the private sector, except (i) a condition of Federal assistance or (ii) a duty arising from participation in a voluntary Federal program.''

The designation of critical habitat does not impose a legally binding duty on non-Federal government entities or private parties. Under the Act, the only regulatory effect is that Federal agencies must ensure that their actions do not destroy or adversely modify critical habitat under section 7. While non-Federal entities receiving Federal funding, assistance, or permits, or otherwise requiring approval or authorization from a Federal agency for an action, may be indirectly impacted by the designation of critical habitat, the legally binding duty to avoid destruction or adverse modification of critical habitat rests squarely on the Federal agency. Furthermore, to the extent that non-Federal entities are indirectly impacted because they receive Federal assistance or participate in a voluntary Federal aid program, the Unfunded Mandates Reform Act would not apply; nor would critical habitat shift the costs of the large entitlement programs listed above on to State governments.

b. We do not believe that this rule would significantly or uniquely affect small governments. The economic analysis discusses potential impacts of critical habitat designation for the Canada lynx on timber management, recreation, land development, mining, oil and gas development, and the development of management plans. The analysis estimates costs of the rule to be $2.11 million at present value over a 20-year period ($142,000 annualized) assuming a 3 percent discount rate, and $1.49 million ($141,000 annualized) assuming a 7 percent discount rate. Most of the impacts are expected to affect Federal agencies through administrative costs associated with consultations under section 7 of the Act. Impacts on small governments are not anticipated, or they are anticipated to be passed through to consumers. The SBA does not consider the Federal Government to be a small governmental jurisdiction or entity. Consequently, we do not believe that the designation of critical habitat for the Canada lynx will significantly or uniquely affect small government entities. As such, a Small Government Agency Plan is not required.

Takings

In accordance with Executive Order 12630 (''Government Actions and Interference with Constitutionally Protected Private Property Rights''), we have analyzed the potential takings implications of designating critical habitat for the lynx in a takings implications assessment. The takings implications assessment concludes that this designation of critical habitat for the lynx does not pose significant takings implications.

Federalism

In accordance with Executive Order 13132, the rule does not have significant Federalism effects. A Federalism assessment is not required. In keeping with Department of the Interior policy, we requested information from, and coordinated development of, the critical habitat designation with appropriate State resource agencies in Idaho, Maine, Minnesota, Montana, Washington, and Wyoming. We believe that this resulting final designation of critical habitat for the lynx will have little incremental impact on State and local governments and their activities. The designation may have some benefit to these governments in that the areas important to the conservation of the species are more clearly defined, and the primary constituent element of the habitat essential to the survival and conservation of the species is specifically identified. While making this definition and identification does not alter where and what federally sponsored activities may occur, it may assist these local governments in long-range planning (rather than waiting for case-by-case section 7 consultations to occur).

Civil Justice Reform

In accordance with Executive Order 12988, the Office of the Solicitor has determined that the rule does not unduly burden the judicial system and meets the requirements of sections 3(a) and 3(b)(2) of the Order. We have designated critical habitat in accordance with the provisions of the Act. This final designation uses standard property descriptions and identifies the primary constituent element within the designated areas to assist the public in understanding the habitat needs of the lynx.

Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.)

This final rule does not contain any new collections of information that require approval by OMB under the Paperwork Reduction Act. This rule will not impose recordkeeping or reporting requirements on State or local governments, individuals, businesses, or organizations. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number.

National Environmental Policy Act

We have undertaken a NEPA analysis for this critical habitat designation and notified the public of the availability of the draft environmental assessment for the proposed rule on October 21, 2008. The final environmental assessment, as well as a Finding of No Significant Impact (FONSI), is available upon request from the Field Supervisor, Montana Fish and Wildlife Office (see **ADDRESSES** section) or on our Web site at *http://mountain-prairie.fws.gov/*

species/mammals/lynx/criticalhabitat.htm

Government-to-Government Relationship With Tribes

In accordance with the President's memorandum of April 29, 1994, "Government-to-Government Relations with Native American Tribal Governments" (59 FR 22951), Executive Order 13175 "Consultation and Coordination with Indian Tribal Governments," and the Department of the Interior Manual at 512 DM 2, we readily acknowledge our responsibility to communicate meaningfully with recognized Federal Tribes on a government-to-government basis. Tribal lands determined to be essential to the conservation of the lynx have been excluded from this critical habitat designation. Please refer to our discussion of Tribal lands under the Relationship of Critical Habitat to Tribal Lands section of this final rule.

References Cited

A complete list of all references cited in this rulemaking is available on the Web site *http://mountain-prairie.fws.gov/species/mammals/lynx/* or upon request from the Field Supervisor, Montana Field Office (see **ADDRESSES**).

List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Regulation Promulgation

■ Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as set forth below:

PART 17—[AMENDED]

■ 1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 16 U.S.C. 1531–1544; 16 U.S.C. 4201–4245; Pub. L. 99–625, 100 Stat. 3500; unless otherwise noted.

■ 2. In § 17.11(h), revise the entry for "Lynx, Canada" under "MAMMALS" to read as follows:

§ 17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						
MAMMALS							
*	*	*	*	*	*		*
Lynx, Canada	*Lynx canadensis*	U.S.A. (AK, CO, ID, ME, MI, MN, MT, NH, NY, OR, UT, VT, WA, WI, WY), Canada, circumboreal.	CO, ID, ME, MI, MN, MT, NH, NY, OR, UT, VT, WA, WI, WY.	T	692	17.95(a)	17.40(k)
*	*	*	*	*	*		*

■ 3. In § 17.95(a), revise the entry for "Canada lynx (*Lynx canadensis*)" to read as follows:

§ 17.95 Critical habitat—fish and wildlife.

(a) *Mammals.*

* * * * *

Canada lynx (*Lynx canadensis*)

(1) Critical habitat units are depicted on the maps below for the following States and Counties:

(i) Idaho: Boundary County;

(ii) Maine: Aroostook, Franklin, Penobscot, Piscataquis, and Somerset Counties;

(iii) Minnesota: Cook, Koochiching, Lake, and St. Louis Counties;

(iv) Montana: Carbon, Flathead, Gallatin, Glacier, Granite, Lake, Lewis and Clark, Lincoln, Missoula, Park, Pondera, Powell, Stillwater, Sweetgrass, and Teton Counties;

(v) Washington: Chelan and Okanogan Counties; and

(vi) Wyoming: Fremont, Lincoln, Park, Sublette, and Teton Counties.

(2) Within these areas, the primary constituent element for the Canada lynx is boreal forest landscapes supporting a mosaic of differing successional forest stages and containing all of the following:

(i) Presence of snowshoe hares and their preferred habitat conditions, which include dense understories of young trees, shrubs or overhanging boughs that protrude above the snow, and mature multistoried stands with conifer boughs touching the snow surface;

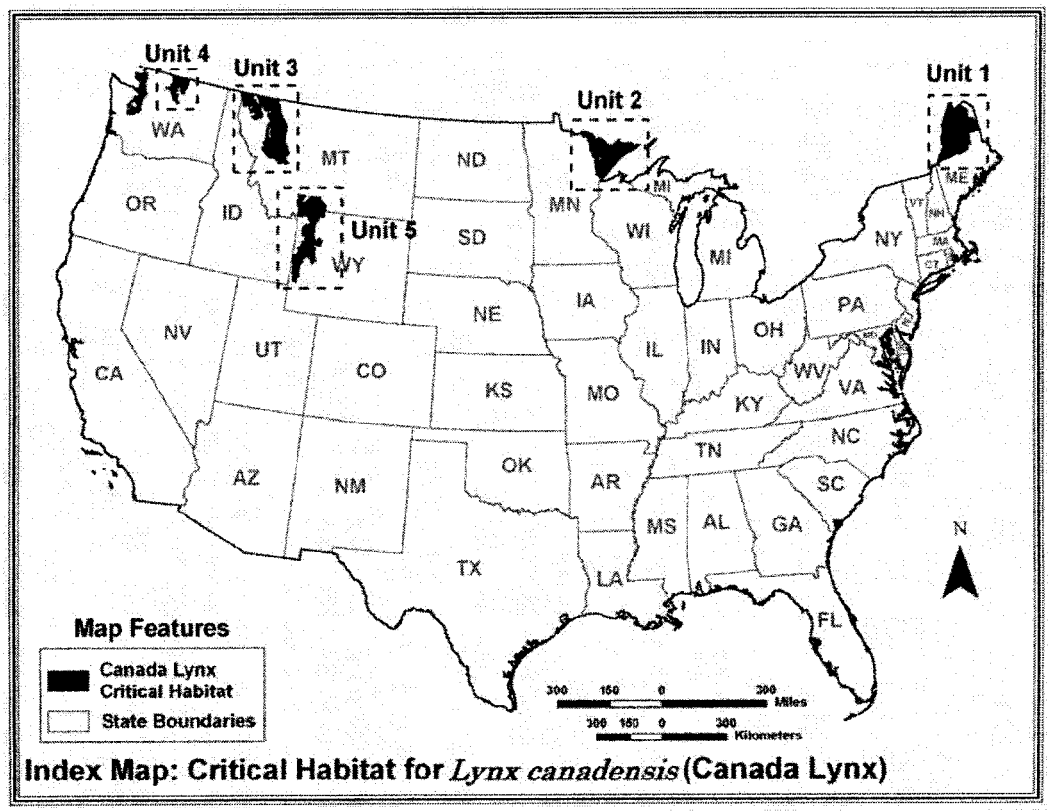
(ii) Winter snow conditions that are generally deep and fluffy for extended periods of time;

(iii) Sites for denning that have abundant coarse woody debris, such as downed trees and root wads; and

(iv) Matrix habitat (e.g., hardwood forest, dry forest, non-forest, or other habitat types that do not support snowshoe hares) that occurs between patches of boreal forest in close juxtaposition (at the scale of a lynx home range) such that lynx are likely to travel through such habitat while accessing patches of boreal forest within a home range.

(3) Critical habitat does not include waterbodies, including lakes, reservoirs, or rivers, or human-made structures existing on the effective date of this rule, such as buildings, paved and gravel roadbeds, and the land on which such structures are located.

(4) Index map for Canada lynx critical habitat follows:



Index Map: Critical Habitat for *Lynx canadensis* (Canada Lynx)

(5) *Unit 1: Northern Maine; Aroostook, Franklin, Penobscot, Piscataquis and Somerset Counties, Maine.*

(i) Coordinate projection: UTM, NAD83, Zone 19, Meters. Coordinate definition: (easting, northing).

(ii) Polygon bounded by the following coordinates: (416400, 5140154) (417029, 5140238) (417418, 5140057) (417516, 5139824) (417280, 5139090) (417041, 5139162) (416973, 5139038) (416958, 5138720) (416760, 5138840) (416786, 5138700) (416604, 5138778) (416353, 5138495) (416673, 5138152) (424087, 5138050) (424076, 5135061) (423015, 5134950) (422555, 5134407) (422442, 5133983) (422118, 5133876) (421865, 5133501) (421909, 5132984) (421694, 5132707) (421490, 5132692) (421522, 5132487) (421285, 5132267) (421388, 5131239) (420719, 5131112) (420703, 5130486) (420446, 5130180) (420573, 5129900) (420432, 5129976) (420390, 5129836) (420961, 5129391) (420829, 5128936) (420360, 5128635) (420352, 5128196) (414078, 5128211) (413903, 5108332) (403589, 5108497) (403617, 5108750) (403932, 5109105) (404247, 5110111) (404268, 5110701) (404508, 5111058) (404209, 5111354) (404212, 5111567) (404066, 5111434) (403957, 5111630) (403609, 5111674) (403663, 5111827) (403451, 5111946) (403518, 5112081) (403288, 5112396) (403079, 5112416) (402763, 5112946) (402350, 5113135) (402247, 5113629) (401376, 5114257) (400754, 5115173) (400783, 5115361) (400415, 5115421) (400462, 5115836) (400284, 5116128) (400789, 5116564) (401474, 5117485) (401556, 5117892) (401973, 5118262) (401934, 5118542) (401715, 5118681) (401781, 5118919) (402049, 5118946) (402247, 5119195) (402397, 5119661) (402279, 5119838) (402828, 5120402) (403043, 5121123) (402918, 5121345) (403324, 5122094) (403230, 5122163) (403576, 5122483) (403529, 5122817) (403300, 5123032) (403438, 5123597) (403662, 5123877) (403774, 5124476) (404200, 5125143) (404406, 5125136) (404473, 5125808) (405046, 5126411) (405129, 5127120) (406270, 5127456) (406267, 5127594) (406396, 5127512) (406630, 5127927) (407127, 5128052) (407126, 5129181) (407376, 5129679) (407052, 5130260) (407160, 5130835) (406942, 5131371) (407982, 5132610) (407978, 5132884) (408331, 5133381) (408268, 5133547) (409022, 5133818) (409768, 5134631) (410296, 5134423) (410631, 5134821) (410862, 5134619) (411028, 5134858) (411648, 5134571) (411943, 5134930) (412214, 5134957) (412206, 5135221) (412509, 5135706) (413132, 5135719) (413323, 5135871) (413239, 5136767) (413405, 5137044) (414114, 5137474) (414140, 5137786) (414321, 5137450) (414590, 5137555) (414493, 5137776) (414633, 5137695) (414661, 5137859) (414830, 5137733) (414664, 5138012) (414755, 5138132) (414897, 5138037) (414846, 5138271) (415306, 5138754) (415367, 5139219) (415520, 5139166) (415409, 5139429) (415616, 5139544) (415370, 5139635) (415817, 5139785) (415696, 5139861) (415875, 5139989) (415687, 5140124) (416292, 5140279) (416400, 5140154).

(iii) Polygon bounded by the following coordinates: (533825, 5057403) (529258, 5057508) (529477, 5058991) (528920, 5058991) (528554, 5059304) (527521, 5058377) (526106, 5058012) (524798, 5058004) (523967, 5061549) (513460, 5059043) (515203, 5052175) (514706, 5051830) (514403, 5050141) (513859, 5049105) (513289, 5048532) (512508, 5046559) (510879, 5043792) (509799, 5042887) (509161, 5042615) (508745, 5042102) (506180, 5040541) (462537, 5032002) (460414, 5042546) (453705, 5041122) (453207, 5041084) (453041, 5041247) (453005, 5041034) (453125, 5040998) (452703, 5040915) (452146, 5041594) (451850, 5042474) (452298, 5042612) (452098, 5042994) (452392, 5042931) (452263, 5043038) (452335, 5043321) (452107, 5043131) (452271, 5043471) (452719, 5043300) (452730, 5043550) (453133, 5043444) (453255, 5043674) (453558, 5043694) (453384, 5043924) (453805, 5043743) (454704, 5044291) (455038, 5043970) (455067, 5043675) (454816, 5043653) (455116, 5043137) (456199,

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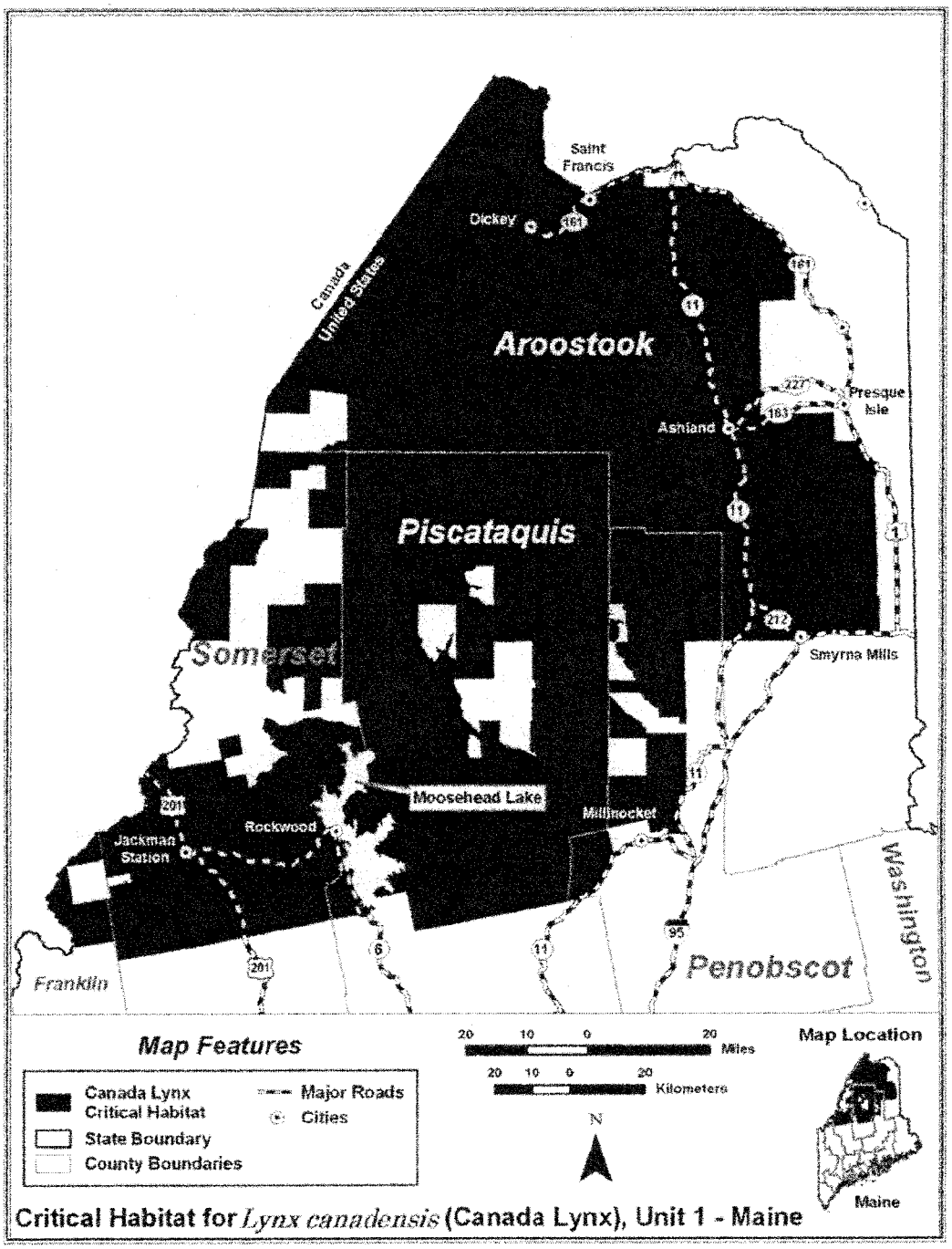
5062592) (531585, 5062178) (532238, 5060764) (532143, 5060093) (533165, 5058935) (533825, 5057403), excluding the island polygons bounded by the following coordinates: (523750, 5082709) (513700, 5082738) (513599, 5072853) (523768, 5072898) (523750, 5082709), b) (479953, 5077619) (479924, 5078543) (479761, 5078587) (479731, 5078996) (479866, 5079938) (479766, 5081621) (479488, 5082258) (479182, 5082685) (478506, 5083113) (477717, 5083220) (477550, 5083439) (476922, 5083400) (476986, 5082589) (476604, 5081545) (476766, 5080941) (476421, 5079210) (476937, 5077638) (479953, 5077619) (484820, 5087152) (484919, 5081791) (485890, 5081372) (485887, 5080973) (486695, 5081006) (487907, 5080395) (487910, 5080173) (487510, 5080036) (487456, 5080423) (486815, 5080578) (486744, 5080452) (486496, 5080634) (486711, 5080406) (486496, 5080580) (486496, 5080310) (485946, 5080384) (486844, 5080142) (487174, 5080202) (487669, 5079975) (487990, 5080154) (490035, 5080167) (494410, 5077771) (494314, 5078658) (493597, 5078752) (492876, 5079197) (492831, 5087037) (493279, 5087017) (493353, 5095938) (494485, 5095926) (494601, 5096246) (494440, 5096226) (494350, 5096864) (493908, 5097136) (493864, 5097841) (493365, 5098142) (493417, 5108089) (488853, 5108054) (488567, 5107824) (488051, 5107805) (486906, 5108008) (486338, 5107874) (485869, 5108035) (483292, 5108015) (483299, 5098222) (473357, 5098151) (473353, 5098914) (473161, 5098294) (472870, 5098030) (472861, 5096680) (473842, 5095069) (473899, 5094727) (474167, 5094572) (474536, 5093901) (474778, 5093935) (474657, 5093578) (475069, 5092937) (474618, 5091608) (474913, 5091112) (474728, 5090926) (474786, 5090772) (475369, 5089715) (475228, 5089418) (475228, 5088407) (475734, 5087767) (475741, 5087560) (476768, 5086912) (477208, 5086332) (477534, 5086260) (477572, 5085709) (478422, 5085245) (478450, 5085040) (479362, 5084434) (479645, 5083957) (479440, 5087274) (484820, 5087152), excluding the island polygons bounded by the following coordinates: (467820, 5103153) (468131, 5103309) (469054, 5105153) (468756, 5105539) (468580, 5105388) (468421, 5105469) (468159, 5106182) (468368, 5106469) (468239, 5106659) (468445, 5106719) (468970, 5106448) (469369, 5105831) (469834, 5105732) (470166, 5106029) (470451, 5105824) (470627, 5105912) (470778, 5107550) (471219, 5108431) (471588, 5108493) (471521, 5109030) (471951, 5109508) (471556, 5109524) (471656, 5109872) (471935, 5109988) (472017, 5109878) (471990, 5110102) (472474, 5110119) (472818, 5110442) (472827, 5110191) (472513, 5109801) (472002, 5109592) (472406, 5109318) (472287, 5108164) (472091, 5107929) (471791, 5106847) (471521, 5106589) (471228, 5105369) (471561, 5104469) (472181, 5103992) (472713, 5103914) (473346, 5103453) (473341, 5117800) (463623, 5117895) (463664, 5109846) (464395, 5109021) (464830, 5108057) (464273, 5107543) (464353, 5106869) (465334, 5105990) (465868, 5104563) (466148, 5104243) (466698, 5103841) (467171, 5104129) (467430, 5103471) (467820, 5103153), excluding the island polygons bounded by the following coordinates: (513717, 5116742) (513718, 5116540) (514376, 5116517) (514529, 5116386) (514380, 5116088) (513719, 5116170) (513718, 5115655) (514919, 5115604) (514765, 5115421) (514620, 5115487) (514565, 5115286) (513945, 5115325) (513699, 5115190) (513711, 5114024) (514843, 5114026) (515362, 5114145)

(515600, 5114386) (515533, 5113983) (515327, 5113966) (515267, 5113756) (515582, 5113670) (515884, 5114019) (516058, 5113854) (516994, 5113761) (517213, 5113486) (517532, 5113728) (517487, 5113372) (517656, 5113152) (517849, 5113163) (517863, 5112906) (517583, 5112667) (516876, 5113081) (516668, 5112974) (516709, 5112814) (516389, 5112925) (515935, 5112465) (515849, 5112210) (516477, 5112181) (516485, 5111960) (516777, 5111753) (516486, 5111452) (516586, 5111206) (516447, 5110863) (516340, 5111114) (516504, 5110541) (516299, 5109920) (516396, 5108705) (516077, 5108921) (516076, 5108549) (515915, 5108494) (515901, 5108814) (515836, 5108365) (515658, 5108258) (515711, 5108007) (513692, 5108005) (513670, 5098024) (521046, 5097931) (520991, 5098233) (520317, 5099019) (520426, 5099452) (520237, 5099969) (519460, 5100732) (519225, 5100795) (518258, 5102129) (517684, 5102188) (517681, 5102652) (517811, 5102611) (517693, 5103365) (517813, 5103517) (516534, 5104235) (516042, 5104351) (515949, 5104522) (516191, 5104509) (516158, 5104712) (515717, 5104699) (515672, 5104971) (516144, 5105068) (515879, 5105499) (515724, 5105422) (515864, 5105252) (515778, 5105118) (515612, 5105120) (515480, 5105384) (515778, 5105957) (515742, 5106525) (515448, 5107126) (515592, 5107646) (515804, 5107743) (515744, 5107967) (518793, 5107949) (518717, 5111938) (518324, 5111938) (518374, 5116237) (517498, 5116242) (517470, 5117924) (513720, 5117929) (513717, 5116742), excluding the island polygons bounded by the following coordinates: (480895, 5117922) (483208, 5117969) (483166, 5127993) (478242, 5128006) (478362, 5127510) (477921, 5127090) (477988, 5126692) (477876, 5126608) (476096, 5126601) (475632, 5126339) (475646, 5125802) (476020, 5124991) (475934, 5124131) (476289, 5124172) (476690, 5123507) (477318, 5123063) (478316, 5123062) (479020, 5122862) (479240, 5122962) (479189, 5122624) (479459, 5122600) (479490, 5122456) (480115, 5122576) (479912, 5122239) (479395, 5122059) (479041, 5121432) (478750, 5121537) (478881, 5121840) (478542, 5122287) (477539, 5122450) (477039, 5122326) (476943, 5120118) (479311, 5119464) (479779, 5118849) (480469, 5118367) (480792, 5118318) (480895, 5117922), and excluding the island polygons bounded by the following coordinates: (371100, 5047834) (372416, 5040243) (372542, 5040170) (372542, 5039535) (382353, 5041114) (381765, 5044067) (384623, 5044630) (384594, 5044960) (384801, 5044665) (385302, 5044899) (385457, 5044904) (385397, 5044782) (386476, 5044994) (385969, 5045113) (385967, 5045303) (386306, 5045497) (386995, 5045096) (387743, 5045243) (387341, 5047432) (381308, 5046305) (380368, 5051014) (370847, 5049328) (371100, 5047834).

(iv) Map of Unit 1, Northern Maine, follows:


Saint Francis
Dickey
Canada
United States
Aroostook
Presque Isle
Ashland
Piscataquis
Somerset
Smyrna Mills
Moosehead Lake
Millinocket
Jackman Station
Rockwood
Franklin
Penobscot
Washington
Map Features
Canada Lynx Critical Habitat
State Boundary
County Boundaries
Major Roads
Cities
20 10 0 20 Miles
20 10 0 20 Kilometers
N
Map Location
Maine
Critical Habitat for Lynx canadensis (Canada Lynx), Unit 1 - Maine

BILLING CODE 4310–55–P

(6) *Unit 2: Northeastern Minnesota; Cook, Koochiching, Lake, and St. Louis Counties.*

(i) Coordinate Projection: UTM, NAD83, Zone 15, Meters. Coordinate Definition: (easting, northing)

(ii) Polygon bounded by the following coordinates: (485851, 5386598) (487031, 5385449) (493478, 5385989) (501006, 5385538) (503370, 5386443) (503698, 5386277) (503742, 5383856) (505199, 5383680) (506669, 5382536) (507803, 5382385) (520034, 5376270) (525283, 5377047) (526934, 5376672) (527650, 5373939) (527629, 5373409) (527187, 5372687) (527496, 5372267) (526808, 5371864) (525551, 5372121) (525010, 5371520) (523215, 5371634) (522261, 5371345) (522081, 5370214) (521489, 5368900) (521544, 5368616) (521240, 5367800) (523065, 5365665) (524909, 5365241) (525502, 5364809) (531538, 5365306) (534244, 5366112) (536425, 5366133) (537774, 5364249) (538324, 5363977) (538811, 5362962) (540222, 5362390) (540234, 5361025) (538768, 5357770) (539282, 5355573) (540666, 5352664) (541724, 5350845) (542131, 5350375) (542525, 5350292) (543395, 5349087) (544997, 5345416) (545028, 5345058) (545323, 5344651) (545115, 5344603) (545106, 5344395) (545474, 5344442) (545592, 5344280) (545421, 5343871) (545491, 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5332882) (664995, 5332675) (665444, 5332472) (665682, 5331824) (666072, 5331643) (666666, 5329659) (667422, 5328858) (668164, 5329277) (671028, 5329525) (672252, 5330052) (675576, 5330496) (676629, 5331444) (677229, 5331445) (678166, 5331947) (679258, 5332147) (679331, 5332396) (680106, 5332893) (680460, 5332536) (681171, 5332780) (681634, 5332705) (681912, 5332177) (680907, 5331032) (681327, 5330152) (681905, 5329850) (684863, 5330321) (685363, 5330112) (685754, 5330400) (686416, 5330291) (686589, 5330599) (686881, 5330350) (687115, 5330365) (687593, 5330708) (687785, 5331078) (688241, 5331165) (688517, 5331489) (690021, 5330950) (690708, 5330442) (692753, 5331219) (693312, 5331243) (694581, 5330511) (694899, 5329958) (695478, 5329743) (695630, 5329782) (695566, 5330087) (696009, 5330178) (697733, 5330194) (698190, 5330414) (698261, 5330797) (698763, 5331117) (700232, 5331530) (701152, 5331217) (701547, 5330848) (701814, 5330865) (702893, 5331360) (704439, 5331310) (706548, 5332050) 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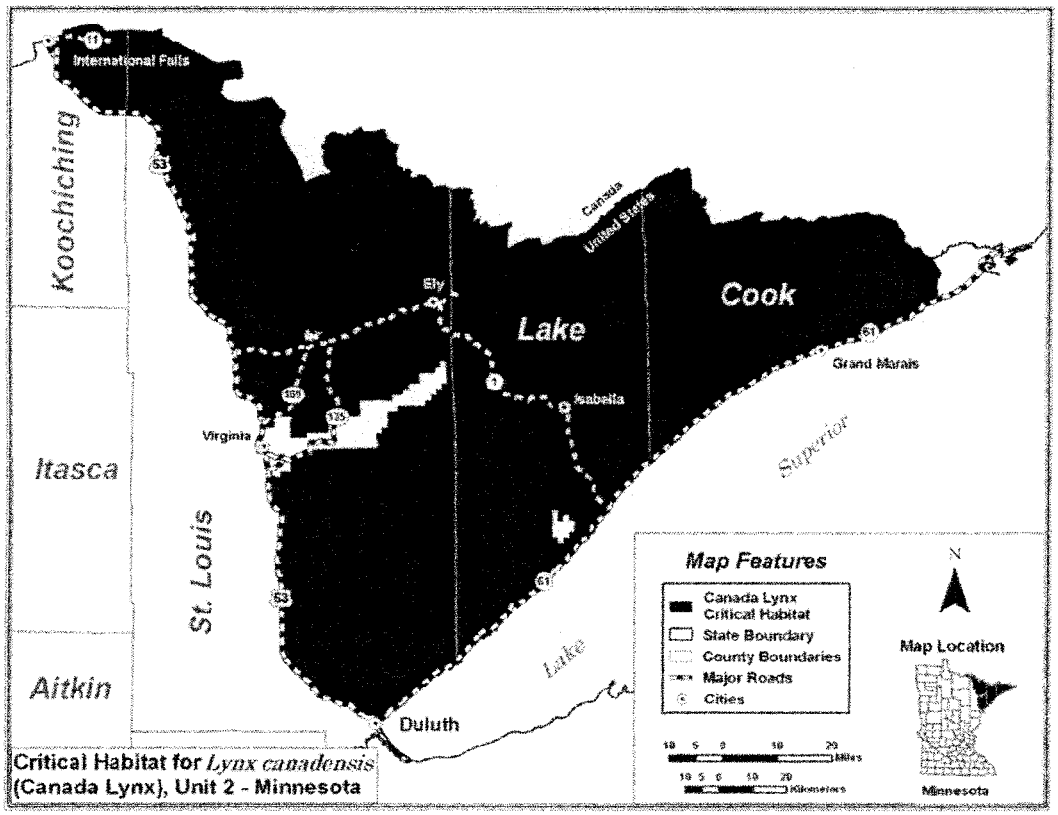
(iii) Map of Unit 2, Northeastern Minnesota, follows:

BILLING CODE 4310–55–P



(7) *Unit 3: Northern Rocky Mountains; Boundary County, Idaho; Flathead, Glacier, Granite, Lake, Lewis and Clark, Lincoln, Missoula, Pondera, Powell, and Teton Counties, Montana.*

(i) Coordinate Projection: UTM, NAD83, Zone 12, Meters. Coordinate Definition: (easting, northing).

(ii) Polygon bounded by the following coordinates: (122575, 5440417) (157217, 5438140) (157554, 5436275) (158180, 5436163) (158504, 5436804) (158713, 5436719) (159139, 5436012) (160089, 5436595) (160868, 5435079) (160974, 5434172) (160723, 5433948) (160290, 5434027) (159992, 5434612) (159608, 5434713) (159261, 5435273) (158988, 5435255) (158820, 5435026) (158258, 5435501) (157561, 5435545) (157729, 5433494) (157575, 5432844) (157008, 5433009) (156503, 5431934) (155967, 5431344) (155627, 5431823) (155481, 5432821) (155243, 5432481) (155020, 5432504) (154752, 5431851) (154170, 5432016) (153770, 5432907) (153555, 5432856) (152850, 5434062) (152528, 5434961) (152404, 5436295) (151760, 5436323) (151778, 5434749) (152216, 5433421) (152213, 5432441) (152439, 5432187) (152717, 5430211) (152610, 5429977) (151732, 5429741) (151989, 5429458) (152325, 5429500) (152608, 5429229) (152621, 5428818) (152205, 5427977) (152395, 5428199) (153103, 5428293) (153339, 5428221) (153721, 5427723) (154019, 5427834) (153888, 5428404) (154039, 5428965) (154428, 5429711) (154927, 5430009) (155449, 5429785) (155722, 5429395) (156561, 5429719) (156775, 5428869) (156621, 5428580) (155997, 5428207) (155890, 5427397) (156033, 5426939) (155935,

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(iii) Polygon bounded by the following coordinates: (186659, 5436276) (186882, 5435602) (186841, 5434804) (186367, 5433736) (186098, 5433685) (185655, 5434141) (184916, 5433557) (184407, 5433601) (184189, 5433886) (183498, 5433536) (182371, 5433774) (182676, 5433326) (182541, 5433096) (183135, 5433131) (184170, 5432794) (184649, 5432090) (184883, 5432465) (185373, 5432513) (186224, 5432036) (186519, 5431094) (186167, 5429769) (184779, 5428432) (185465, 5428323) (186932, 5428952) (187175, 5428882) (187574, 5428058) (188147, 5425814) (187946, 5424236) (187686, 5423653) (187225, 5423266) (186746, 5423248) (186518, 5422900) (186038, 5422623) (185049, 5422489) (184855, 5422160) (186618, 5421235) (186962, 5420884) (186956, 5420425) (186383,

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