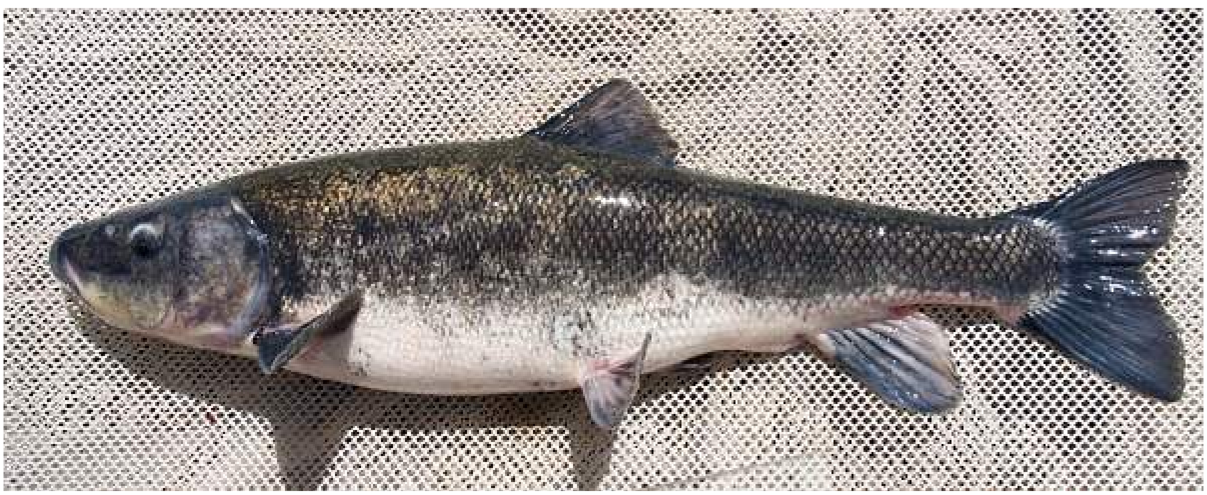
Shortnose Sucker
(*Chasmistes brevirostris*)

5-Year Review:
Summary and Evaluation



Credit: Ron Larson, USFWS

U.S. Fish and Wildlife Service
Klamath Falls Fish and Wildlife Office
Klamath Falls, Oregon

August 2013

5-YEAR REVIEW

Shortnose Sucker (*Chasmistes brevirostris*)

I. GENERAL INFORMATION

Purpose of 5-Year Reviews:

The U.S. Fish and Wildlife Service (Service) is required by section 4(c)(2) of the Endangered Species Act (Act) to conduct a status review of each listed species at least once every 5 years. The purpose of a 5-year review is to evaluate whether or not the species' status has changed since it was listed (or since the most recent 5-year review). Based on the 5-year review, we recommend whether the species should be removed from the list of endangered and threatened species, be changed in status from endangered to threatened, or be changed in status from threatened to endangered. Our original listing of a species as endangered or threatened is based on the existence of threats attributable to one or more of the five threat factors described in section 4(a)(1) of the Act, and we must consider these same five factors in any subsequent consideration of reclassification or delisting of a species. In the 5-year review, we consider the best available scientific and commercial data on the species, and focus on new information available since the species was listed or last reviewed. If we recommend a change in listing status based on the results of the 5-year review, we must propose to do so through a separate rule-making process defined in the Act that includes public review and comment.

Species Overview:

The shortnose sucker (*Chasmistes brevirostris*) is a fish in the Catostomidae family. This species is endemic to the upper Klamath River basin, including the Lost River and Lower Klamath Lake sub-basins, and inhabit a small number of natural lakes and reservoirs within these basins. Mature individuals of this species are relatively large (up to 65 centimeters or 2.1 feet) and for the majority of the year individuals are only found within the lakes and reservoirs. During the spring, adults migrate into tributaries of the lakes and reservoirs to spawn in small groups over the gravel substrate of rivers and streams. After hatching, larvae immediately float downstream into the lake habitat to mature. Sexual maturation occurs within four to six years, and adults will live on average approximately 7.4 years after reaching adulthood typically attempting to reproduce each year. Shortnose sucker predominantly feed on zooplankton and macroinvertebrates.

Methodology Used to Complete This Review:

This review was prepared by the Klamath Falls Fish and Wildlife Office staff, following Region 8 guidance. The *Revised Recovery Plan for the Lost River (*Deltistes luxatus*) and Shortnose sucker (*Chasmistes brevirostris*)* (Revised Recovery Plan; USFWS 2013), published reports, and personal communications with experts who have been monitoring various localities of this species were the primary sources of information used to update the species' status and threats. This 5-year review contains up to date information on the species' biology and threats, and an assessment of this information compared to the 2007 5-year review. We focus on current threats to the species that are attributable to the Act's five listing factors. This review synthesizes all this information to evaluate the listing status of the species and provide an indication of its progress towards recovery. Finally, based on this synthesis and the threats identified in the five-factor analysis, we recommend a prioritized list of conservation actions to be completed or initiated within the next 5 years.

Contact Information:

Lead Regional Office: Larry Rabin, Deputy Division Chief for Listing, Recovery, and Environmental Contaminants, Lisa Ellis, Fish and Wildlife Biologist, Region 8, California and Nevada; (916) 414-6464.

Lead Field Office: Josh Rasmussen, Fish Biologist, Klamath Falls Fish and Wildlife Office, Klamath Falls, Oregon; (541) 885-2509.

Federal Register (FR) Notice Citation Announcing Initiation of This Review:

A notice announcing initiation of the 5-year review of this taxon and the opening of a 60-day period to solicit information from the public was published in the Federal Register on May 25, 2011 (76 FR 30377). We received information from six individuals or groups in response to this request.

Listing History:

Original Listing
FR Notice: 53 FR 27130
Date of Final Listing Rule: July 18, 1988
Entity Listed: Shortnose sucker (*Chasmistes brevirostris*), a fish species
Classification: Endangered

State Listing
Shortnose sucker (*Chasmistes brevirostris*) was listed as State Endangered by the State of California January 10, 1974.

Shortnose sucker (*Chasmistes brevirostris*) was listed as Endangered by the State of Oregon in 1991.

Associated Rulemakings:

Critical habitat was proposed in 1994 (59 FR 61744), but not finalized. Critical habitat was again proposed in 2011 (76 FR 76337), and was finalized on December 11, 2012 (77 FR 73740).

Review History:

A 5-year review of shortnose sucker status was completed in 2007 and announced in the Federal Register (73 FR 11945). The listing and the 2007 5-year status review are the only formalized reviews of the status that contains a five-factor analysis and conclusions to date.

Species' Recovery Priority Number at Start of 5-Year Review:

The recovery priority number for *Chasmistes brevirostris* is 5C according to the Service's 2011 Recovery Data Call. This number is based on a ranking system where 1 is the highest-ranked recovery priority and 18 is the lowest (Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 FR 43098, September 21, 1983). The number 5 indicates that the taxon is a species that faces a high degree of threat of extinction and a low recovery potential. The "C" indicates conflict with construction or other development projects or other forms of economic activity.

Recovery Plan

Name of Plan: Revised Recovery Plan for the Lost River Sucker (*Deltistes luxatus*) and Shortnose Sucker (*Chasmistes brevirostris*).

Date Issued: A recovery plan for the Lost River sucker and the Shortnose sucker was finalized on March 17, 1993 (USFWS 1993). A draft revision of this plan was released October 18, 2011 (76 FR 64372), and the final plan was released April 16, 2013 (78 FR 22556).

II. REVIEW ANALYSIS

Application of the 1996 Distinct Population Segment (DPS) Policy

The Endangered Species Act defines "species" as including any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate wildlife. This definition of species under the Act limits listing as distinct population segments to species of vertebrate fish or wildlife. The 1996 Policy Regarding the Recognition of Distinct Vertebrate Population Segments under the Endangered Species act (61 FR 4722, February 7, 1996) clarifies the interpretation of the phrase "distinct population segment" for the purposes of listing, delisting, and reclassifying species under the Act. Shortnose suckers are not listed as a DPS, and there is no new information regarding the application of the DPS policy to this species.

Information on the Species and its Status

<u>Biology and Life History</u>

Shortnose suckers exhibit many adaptations characteristic of long-lived species. Juveniles grow rapidly until reaching sexual maturity sometime between four and six years (Perkins et al. 2000b). Adults tend to have high survival rates enabling populations to outlive unfavorable periods, such as droughts. Once shortnose suckers achieve adulthood, they are documented to live on average 7.4 years (D. Hewitt, U.S. Geological Survey, pers. comm., 2011). Thus, for those individuals surviving to adulthood, we expect an average total life span of approximately 11 - 13 years, based on the average time to maturity and average adult life spans, with maximum ages recorded of up to 24 years (Terwilliger et al. 2010).

Currently, the best available information indicates that the age distribution of adults in some populations is primarily comprised of older individuals because juveniles are not surviving to maturity. This is especially apparent in Upper Klamath Lake where the average length of spawning adults (a surrogate for age) of this species has been progressively increasing since 1999 (Hewitt et al. 2011). In contrast, populations of shortnose sucker in Clear Lake Reservoir appear to have a relatively diverse age distribution, suggesting that recruitment is recurrent to some degree. This type of long-term monitoring data is unavailable for all other populations.

River spawning runs from Upper Klamath Lake begin when river temperatures reach 12° C (54° F), typically mid-April. It appears that most adults spawn every year based on long term monitoring conducted by the U.S. Geological Survey (E. Janney, U.S. Geological Survey, pers. comm., 2011). Females are highly fecund, producing 18,000 to 72,000 eggs per female per year, of which only a very small percentage survive to become juveniles (National Research Council 2004). Females broadcast their unfertilized eggs typically in the company of two males (Andreasen 1975, Buettner and Scoppettone 1990), males fertilize the eggs, and then the fertilized eggs settle within the top few inches of the substrate. Eggs are deposited in gravel substrates in areas with water depths typically less than 1.3 meters (4.3 feet) (Buettner and Scoppettone 1990). Hatching occurs around one week later.

Approximately 10 days after hatching, larvae emerge out of the gravel (Coleman et al. 1988, Buettner and Scoppettone 1990). Larvae spawned in streams quickly drift downstream into lake habitat beginning in April through July. Downstream movement mostly occurs at night near the water surface (Klamath Tribes 1996, Tyler et al. 2004, Ellsworth et al. 2010). Shortnose sucker larvae tend to be associated with emergent vegetation habitat more than open water habitat (Burdick and Brown 2010). The term "emergent vegetation" refers to plants that are rooted in soil underwater, but with tops extending above the water. Cattails and bulrushes are common examples in this area. Larvae are typically completely transformed into juveniles by mid-July at about 25 millimeters (1 inch) total length, and progressively move into deeper water habitats. Larvae and small juveniles appear to consume predominantly surface-oriented objects (adult midges [flies] and pollen), but a shift to benthic (bottom of the lake) objects such as midge pupae and Cladocerans (freshwater crustaceans) occurs by the time the juveniles reach 30 mm (1.2 inches) standard length (length of fish from tip of snout to the end of the spinal column, excluding the tail fin) (Markle and Clauson 2006).

Adult shortnose suckers inhabit lake environments with water depths of 1 to 4.5 meters (3.2 to 14.7 feet), but appear to prefer depths from 1.5 to 3.4 meters (4.9 to 11.1 feet) (Peck 2000, Reiser et al. 2001, Banish et al. 2009). Adults can become densely congregated, such as during the summer to exploit areas with suitable water quality, or they may also be relatively uniformly distributed throughout portions of the lake in which they reside (Peck 2000, Banish et al. 2009). For example, adults tend to be spread throughout the northern half of Upper Klamath Lake during the summer if water quality permits (Banish et al. 2009) and in the western lobe of Clear

Lake Reservoir during the winter (D. Hewitt, USGS, pers. comm., 2011). Congregations also form in the spring prior to moving into tributaries for spawning (Janney et al. 2009).

Historically, shortnose suckers occurred with several fish species: Lost River suckers (*Deltistes luxatus*), Klamath largescale suckers (*Catostomus snyderi*), lamprey (*Lampetra* species), sculpin (*Cottus* species), chubs (*Gila* species), and several salmonids, including Klamath redband trout (*Oncorhynchus mykiss* sub-species), steelhead (*O. mykiss*), bull trout (*Salvelinus confluentus*), and Chinook salmon (*Oncorhynchus tshawytscha*; Hamilton et al. 2005). Many of these potentially interact with the species as predators or competitors. In addition, approximately 20 fish species have been accidentally or deliberately introduced into the range of these species, and a few of these now comprise a significant portion of the fish community, including fathead minnow (*Pimephales promelas*) and yellow perch (*Perca flavescens*) (Scoppettone and Vinyard 1991, National Research Council 2004). Several avian predators also occur in the system including bald eagles (*Haliaeetus leucocephalus*), American white pelicans (*Pelecanus erythrorhynchus*), and double-crested cormorants (*Phalacrocorax auritus*), as well as other species, such as grebes, terns, and mergansers, that consume smaller fish. Likewise, a number of pathogens or parasites have been identified from dying suckers, including anchor worm (*Lernaea* species; a parasitic copepod), *Trichodina* species (an external ciliate protozoan), and the bacterium *Flavobacterium columnare* (Holt 1997, Foott 2004, Foott et al. 2010).

Spatial Distribution

The shortnose suckers are endemic to the upper Klamath River basin, including the Lost River and Lower Klamath Lake sub-basins (Figure 1). It is difficult to know precisely which tributaries and bodies of water this species historically occupied because records are sparse, but shortnose suckers occurred in Upper Klamath Lake, Lower Klamath Lake, Tule Lake, and Clear Lake Reservoir as well as the major tributaries to these water bodies including the Sprague River, Wood River, Lost River, Willow Creek, and the Klamath River above Lower Klamath Lake. Prior to listing, significant amounts of suitable habitat were lost or modified due to conversion of wetlands to agricultural uses and development, which restricted its distribution. For example, approximately 150,700 acres (61,000 hectares) of habitat were lost by lowering Tule and Lower Klamath Lakes (National Research Council 2004). In addition, several migration barriers were constructed throughout the range of the species, including the Link River Dam (1921), Clear Lake Dam (1910), Wilson Diversion Dam (1912), Malone Diversion Dam (1921), Anderson-Rose Dam (1921), Chiloquin Dam (1914), and the railroad (1909), as well as many smaller structures (BOR 2000).

At the time of listing, the shortnose suckers occurred in Upper Klamath Lake and its tributaries and in a "substantial" population in Copco Reservoir on the Klamath River (Klamath Co., Oregon and Siskiyou Co., California, respectively) (53 FR 27130). Populations in J.C. Boyle Reservoir, Lake of the Woods (both in Klamath Co., Oregon), and Iron Gate Reservoir (Siskiyou Co., California) were believed to be very small or extirpated. The population in Clear Lake Reservoir (Modoc Co., California) was noted to be hybridized with Klamath largescale sucker in the listing rule. Additional evidence documenting the occurrence of shortnose suckers in Keno Reservoir (Lake Ewauna) along the Klamath River (Klamath Co., Oregon) (Kyger and Wilkens

2010), Tule Lake (Siskiyou Co., California), and Gerber Reservoir (Klamath Co., Oregon) has emerged since listing, but there are no changes in distribution since the last 5-year status review.

Nearly all shortnose sucker adults from Upper Klamath Lake exclusively utilize the lower Williamson and Sprague Rivers to spawn (Buettner and Scoppettone 1990, Tyler et al. 2004, Ellsworth et al. 2007). The Willow Creek drainage is the only known spawning habitat for shortnose suckers in Clear Lake Reservoir. The population in Gerber Reservoir is known to spawn in Ben Hall Creek and Barnes Valley Creek, which includes several tributaries as well. No other substantial spawning congregations are known to occur, but some minimal spawning may also occur throughout the Lost River, including the Big Springs area (near Bonanza, Klamath Co., Oregon), above Topsy Reservoir on the middle Klamath River, and above Malone Reservoir just downstream of Clear Lake Reservoir.

Two major improvements in habitat connectivity and availability have occurred since the 2007 five year review for this species. The first major improvement to habitat connectivity was the removal of the Chiloquin Dam in 2008, which particularly benefits migrating adults and larvae during the spawning period. Previous to removal of this dam, the approximately 120 kilometers (75 miles) of potential spawning habitat and migration corridor within the Sprague River could only be accessed by migrating adults by means of an impaired fish ladder. The second major improvement was the restoration of the freshwater marsh where the Williamson River entered Upper Klamath Lake, known as the Williamson River delta. Approximately 2,500 hectares (6,000 acres) of potential rearing habitat for larvae and juveniles were reconnected to the lake and river when levees were breached in 2008 and 2009.

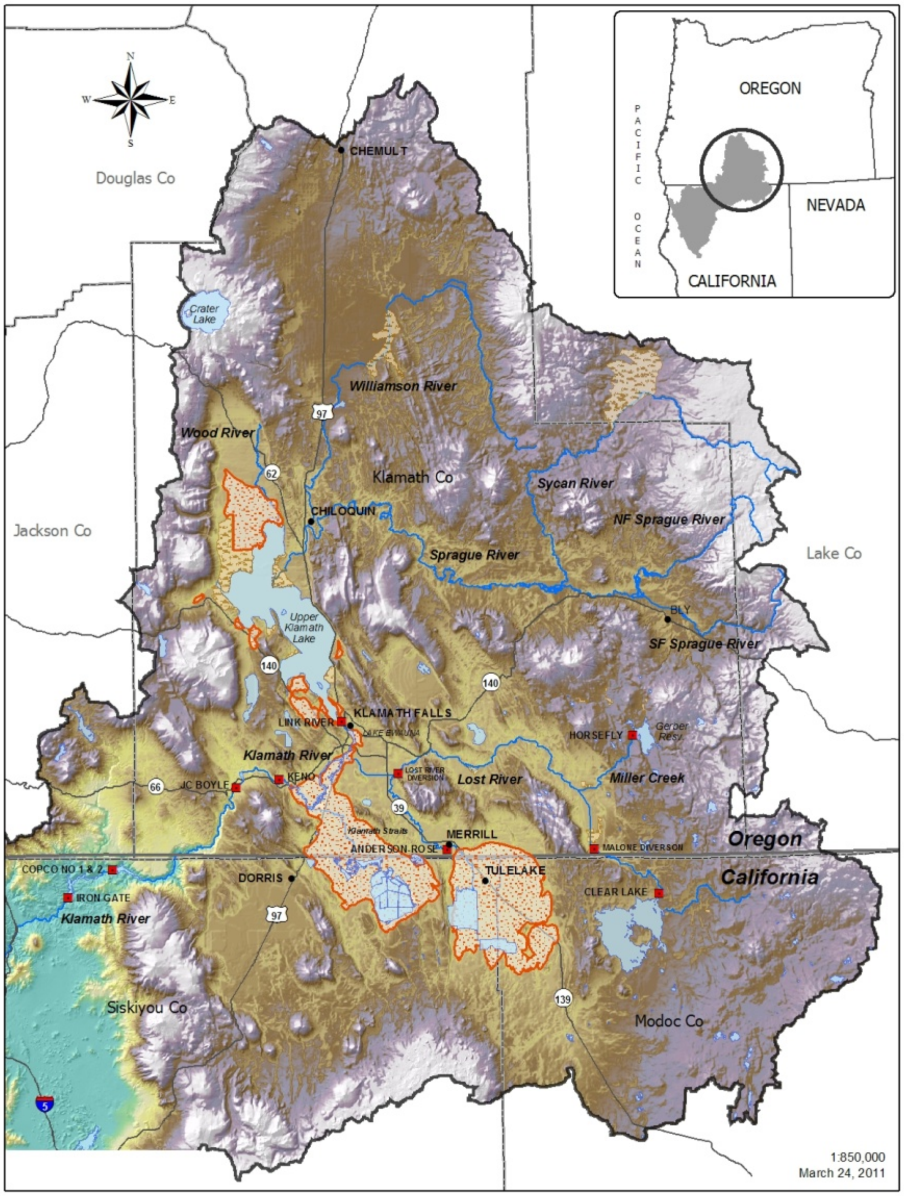


Figure 1 The upper Klamath River Basin. Orange shaded areas indicate portions of lost or altered aquatic habitat, including wetland habitat, in the upper Klamath River Basin that formerly provided habitat for the sucker. Red squares mark the locations of major dams, many of which impede sucker passage.

Abundance

In 1984, the shortnose sucker population moving out of Upper Klamath Lake to spawning areas was estimated to be approximately 2,700 individuals (53 FR 27130). This early estimate was probably inaccurate, because statistical assumptions necessary for modeling population size were likely not met. Nevertheless, after review of available data, a special committee of the National Research Council concluded that: "For purposes of [Endangered Species Act] actions, the critical facts, which are known with a high degree of certainty, are that the fish are much less abundant than they originally were and that they are not showing an increase in overall abundance" (National Research Council 2004:203).

Because of the generally dispersed distribution of shortnose sucker and the extensive habitat, accurate estimates of population size are extremely difficult to obtain. Additionally, most populations have not been monitored sufficiently to produce adequate data to even attempt a reasonable estimate of population size. In 2011, Upper Klamath Lake monitoring detected or captured approximately 6,000 tagged shortnose suckers participating in the annual spawning congregations and runs (Brian Hayes, USGS, pers. comm. 2011). Estimates of what proportion of the total population is tagged are unavailable, but data suggest that shortnose sucker number less than 25,000 in Upper Klamath Lake.

Long-term monitoring of shortnose sucker spawning populations in Upper Klamath Lake has revealed several trends in abundance and demography, including consistent annual declines in the number of individuals participating in the runs and an increasing trend in the average size (and therefore age) of spawning adults. Since the year 2001, the numbers of both males and females in shortnose sucker spawning congregations in Upper Klamath Lake have declined by approximately 60 percent (Figure 2) for the river-spawning subpopulation (Hewitt et al. 2011). Although these data extend back to 2001, this analysis was unavailable for the 2007 5-year status review (see USFWS 2011 Appendix II for a discussion of this analysis). Over this same period, the Upper Klamath Lake spawning populations have exhibited an increasing trend in length (approximately 8 mm increase in median length annually; Janney and Shively 2007, Janney et al. 2008, Hewitt et al. 2011) presumably because recruitment to the adult population is minimal and the monitoring is tracking the same individuals year after year as they age.

Data on other populations are extremely limited, but the minimal monitoring efforts completed for these populations imply very low numbers of individuals (Desjardins and Markle 2000, Shively et al. 2000b, Hodge and Buettner 2009). Although, mark-recapture monitoring has occurred on the Clear Lake Reservoir population for several years (Barry et al. 2007), capture rates of shortnose sucker are relatively low when compared to Upper Klamath Lake. Approximately 2,500 tagged shortnose suckers were detected during the 2011 spawning run up Willow Creek from Clear Lake Reservoir.

At the time of listing, the shortnose suckers were believed to have been extirpated from Tule Lake. However, during a three-year monitoring effort (2006 – 2008), approximately 200 individual shortnose suckers were captured here (Hodge and Buettner 2009). Historical Tule Lake (as seen in Figure 1) has been reduced to two irrigation sumps, in other words collection areas for drained water, which are connected by a canal and gates to manage water between them. In the 2006 – 2008 monitoring, shortnose suckers were only found in sump 1A (the northernmost of the two wetted sumps). Recent translocation experiments by the Service documented that suckers transported from sump 1A to 1B survived several months in sump 1B, but returned immediately to sump 1A when access was provided through the gates (Fish and Wildlife Service, unpublished data, 2012). It is unknown why sump 1A is preferred by suckers over sump 1B.

Although the source of shortnose suckers in Tule Lake has not been thoroughly investigated, it is likely that larval fish disperse from Upper Klamath Lake and Clear Lake Reservoir through the irrigation canals to Tule Lake which serves as a terminal sump for the Klamath Irrigation Project. The fact that shortnose suckers are found throughout the canal system of the Klamath Irrigation Project supports this assumption. When the irrigation canals are drained at the end of the irrigation season each fall, the Bureau of Reclamation salvages suckers from these canals and places them in sump 1A at Tule Lake thus supplementing the population here (Kyger and Wilkens 2011). Although a very low level of spawning by shortnose suckers at Tule Lake has been documented in the Lost River upstream of sump 1A, spawning success seems limited due to lack of suitable spawning habitat and at this time there is no evidence that the spawning that occurs there is sufficient enough to support a viable population. Nevertheless, the Tule Lake population is an important auxiliary to Clear Lake Reservoir within the Lost River subbasin, and the National Research Council concluded that "[f]rom the water quality perspective, it appears that the Tule Lake population is potentially closer to survival conditions than the Upper Klamath Lake population" (National Research Council 2004:134). That is, water quality in Tule Lake may not be adversely related to the survival of shortnose suckers to the same degree as it is in Upper Klamath Lake.

A similar effort to assess the population in Keno Reservoir (2008–2011) detected approximately 700 individual shortnose suckers (Kyger and Wilkens 2010). In 1999, sampling at 36 sites within the Lost River produced 87 shortnose suckers, most of which were found immediately above Harpold Dam (Shively et al. 2000b). Similarly, sampling within the reservoirs on the Klamath River downstream of Keno yielded approximately 200 adult shortnose suckers between 1997 and 1999 (Desjardins and Markle 2000).

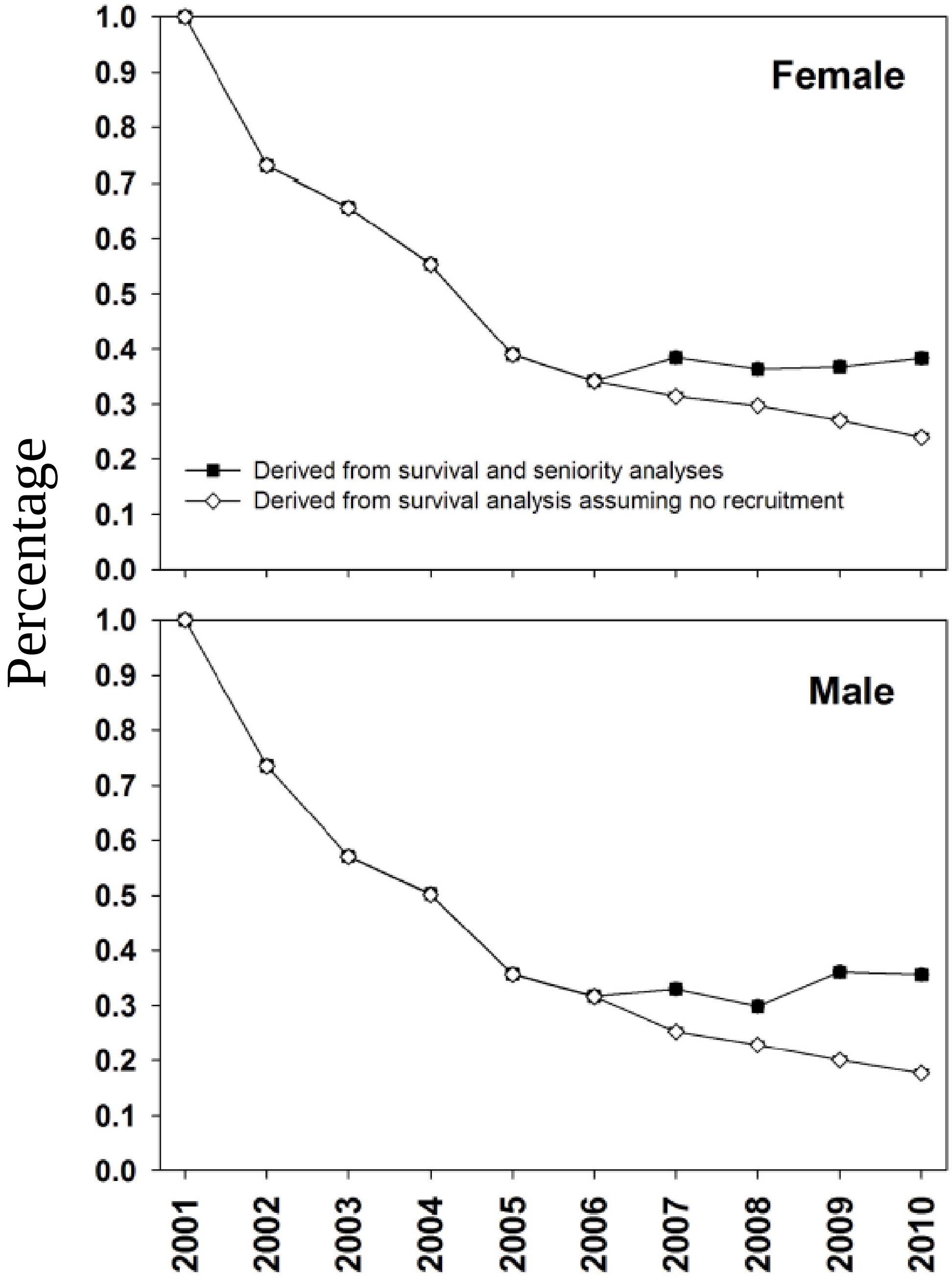


Figure 2 The percentage of shortnose suckers in the annual spawning run up the Williamson River from Upper Klamath Lake as compared to the number that was present in 2001 (Hewitt et al. 2012; page 36). The two lines represent different approaches to estimating the values, Hewitt et al. (2012) for details.

Habitat or Ecosystem

Shortnose suckers use a variety of aquatic habitats throughout their lives including lakes and reservoirs (Table 1), and rivers. Out-migrating larvae (those larvae that have hatched and begun to drift downstream), as well as spawn-ready adults, utilize river and stream habitat as a migration corridor, but specific habitat requirements during these migrations are unknown. In the lakes and reservoirs, larvae generally inhabit relatively shallow areas that are often associated with emergent vegetation (Klamath Tribes 1996, Cooperman 2004, Crandall 2004). In some locations, such as in Clear Lake Reservoir, emergent vegetation is lacking, but larvae still inhabit relatively shallow areas. It appears that submerged vegetation (rooted vegetation where the tops don't reach the water surface) is relatively unimportant as a structural habitat component for larvae, largely because it is not generally available early in the summer when larvae are present (Cooperman 2004).

As shortnose suckers mature they tend to utilize deeper, less vegetated habitats within the lakes and reservoirs they inhabit (Moyle 2002), although these areas are still relatively shallow. Adults and sub-adults use water depths between 1 to 4.5 meters (3.3 to 14.7 feet), but appear to prefer depths of 1.5 to 3.4 meters (4.9 to 11.2 feet) (NRC Reiser et al. 2001, 2004).

Adults are widely distributed in Upper Klamath Lake during fall and winter, but will congregate in the spring prior to moving into tributaries or shoreline areas with springs to spawn. Adults are generally restricted to the northern half of Upper Klamath Lake during the summer, at times becoming very congregated in spring dominated areas (specifically Pelican Bay) during periods of unsuitable water quality (Banish et al. 2009). In Clear Lake Reservoir, adult shortnose suckers utilize the western lobe of the reservoir during winter, but are generally dispersed throughout both the east and west lobes the rest of the year (D. Hewitt, U.S. Geological Survey, pers. comm., 2011), except for the brief period when they run up Willow Creek to spawn.

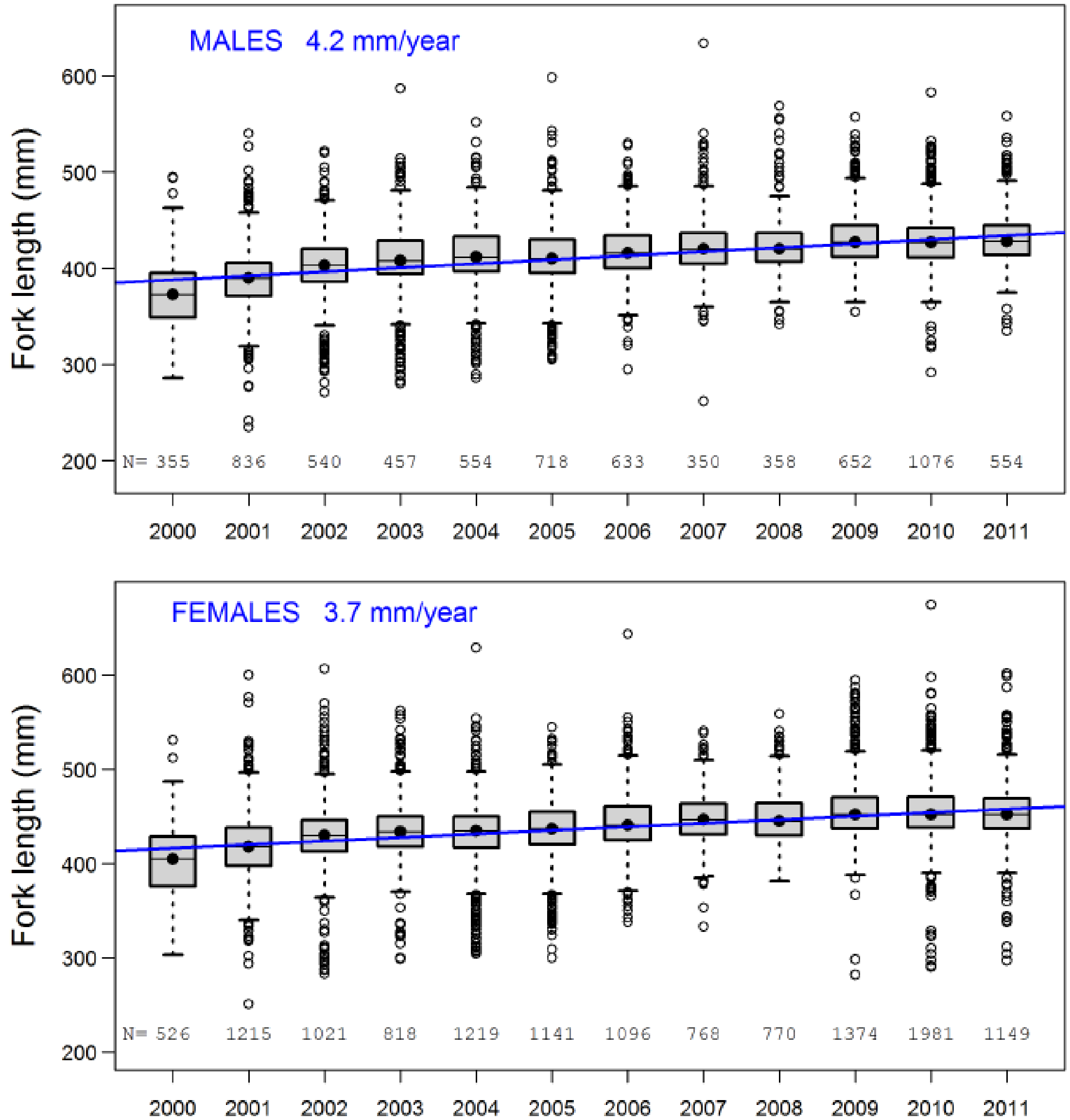


Figure 3 Boxplots of fork lengths of male (*top*) and female (*bottom*) shortnose suckers captured at pre-spawn staging areas in Upper Klamath Lake and in the Williamson and Sprague Rivers, 2000–2011. Dots in the boxes represent the medians and the boxes cover the central 75 percent of the data. The number of fish included in the boxplots for each year is given near the x-axis in each panel. The blue lines are simple linear regressions through the medians and the slope of the regression for each sex is reported as an average annual growth rate (Hewitt et al. 2012; page 37)

Little is known about the long-term water quality dynamics of much of the range of this species, but sufficient data do exist for Upper Klamath Lake and Keno Reservoir. Water quality conditions in Upper Klamath Lake are driven by high nutrient loads. The lake was highly productive or eutrophic prior to settlement by Europeans in the mid-19th century, but it has become hypereutrophic (characterized by an over-abundant accumulation of nutrients that support high productivity) from loading attributed to a combination of external (pumping of diked wetlands, farm/ranch run-off, and roads) and internal (lake sediments) sources (Snyder and Morace 1997, Boyd et al. 2002, Independent Multidisciplinary Science Team IMST 2003, Bradbury et al. 2004, Eilers et al. 2004, National Research Council 2004, Graham et al. 2005). Eilers et al. (2004) concluded that the lake sediments of Upper Klamath Lake were enriched with nutrients at higher rates than the historical norms because of anthropogenic land management practices during the early 1900s.

These very high nutrient loads stimulate excessive algal productivity, especially of a particular species of blue-green algae or cyanobacteria (*Aphanizomenon flos-aquae*; AFA) that dominates during most of the growing season. During the algal bloom dissolved oxygen levels can be extremely high during the day as the algae photosynthesizes and extremely low at night as the algae respires. Chronically low levels of dissolved oxygen that are detrimental or even fatal to most fish, including suckers, can also occur (Morace 2007). In years when the bloom crashes, the subsequent decomposition of the algae by bacteria can significantly deplete oxygen from the surrounding water. Concentrations of the toxic form of ammonia (un-ionized ammonia; NH_3) may also reach levels detrimental to shortnose suckers as nitrogenous compounds are produced during decomposition of the algae and altered by the pH of the water (Perkins et al. 2000a, Boyd et al. 2002, IMST 2003, National Research Council 2004, Wood et al. 2006, Jassby and Kann 2010). Many of these same processes occur in Keno Reservoir predominantly because Upper Klamath Lake also releases heavy organic and nutrient loads in downstream flows (Sullivan et al. 2008, Kirk et al. 2010, Sullivan and Rounds 2011). Likewise, the Sprague River, the primary spawning habitat for suckers in Upper Klamath Lake and the largest tributary to the Williamson River, is listed as water quality impaired for nutrients, temperature, sediment, and dissolved oxygen under section 303d of the Clean Water Act (Boyd et al. 2002). Lastly, another cyanobacterium species (*Microcystis aeruginosa*) within Upper Klamath Lake may produce toxins harmful to shortnose sucker liver tissue (Vanderkooi et al. 2010), but the role this toxin has on the status of shortnose suckers in Upper Klamath Lake are currently unknown.

In contrast, data on water quality are extremely sparse for lakes and reservoirs inhabited by all other populations of this species. Data collected during 1991 to 1995 near Clear Lake Dam and within the east and west lobes of the reservoir indicate that conditions are typically not at levels considered detrimental to fish. Dissolved oxygen levels rarely declined below 4 milligram/liter, and temperatures infrequently exceeded 26 degrees Celsius (79 degrees Fahrenheit; Hicks 2001).

Table 1 Basic information on the lakes and reservoirs of the upper Klamath Basin in which shortnose suckers are found, adapted from Table 3-1 from The National Research Council of the National Academies (2004:96). One hectare is equivalent to approximately 2.47 acres, 1 meter is equivalent to approximately 3.3 feet, and 1 kilometer is equivalent to 0.6 miles.

Lake Name	Size before 1900 (hectares) Minimum	Maximum	Size since 1960 (hectares) Minimum	Maximum	Volume[a] (acre-feet)	Mean Depth[b] (meters)
Lakes and reservoirs used for water storage and routing						
Upper Klamath[c]	31,600	44,900	22,700	27,100	603,000	2.7
Lower Klamath[d]	34,400	38,100	1,900	1,900	< 20,000	< 1.2
Clear Lake Reservoir[d]	6,100	6,100	3,400	10,400	527,000	6.1
Tule Lake[d]	22,300	44,500	3,800	5,300	50,000	1.2
Gerber Reservoir[d]	n/a	n/a	450	1,600	94,000	7.3
Reservoirs used for power production						
Keno[e,f]	n/a	n/a	1,000	1,000	18,500	2.1
J.C. Boyle[f]	n/a	n/a	170	170	1,700	1.2
Copco No. 1[f]	n/a	n/a	400	400	46,900	14.3
Copco No. 2[f]	n/a	n/a	16	16	70	0.6
Iron Gate[f]	n/a	n/a	380	380	58,800	18.9

[a] At current maximum depth. Historic volumes are not readily available.
[b] Mean depths are typically lower than shown in the table, which are based here on current maximum volume.
[c] Including Agency Lake, from Table 2-1 of Welch and Burke 2001(2001). Current maximum elevation is 4143.3. Area and volume data from U.S. Fish and Wildlife Service (2002).
[d] From Bureau of Reclamation (2001, Table 4.1)
[e] Including Lake Ewauna. Keno has no turbines.
[f] From Pacific Corp (2000), pp. 2-16 and 2-17.
Abbreviations: n/a, not applicable

Genetics

In a combined assessment of mitochondrial (mtDNA) and nuclear DNA, Dowling (2005) found that shortnose suckers are genetically indistinct (mtDNA) from Klamath largescale suckers across the very small fraction of the total genome that has been analyzed. Similarly, microsatellite markers also indicate that shortnose suckers regularly interbreed with Klamath largescale suckers (Tranah and May 2006). However, despite the apparent high rates of introgression (movement of genes) between these two species, shortnose suckers maintain their morphological distinctiveness to a large extent, although intermediate hybrid forms do occur (Markle et al. 2005). Dowling (2005) preliminarily concluded that given that hybridization is very common among suckers in the family Catostomidae, it is likely that some level of introgression has occurred even prior to human activity. Genetic variation of mtDNA among populations of shortnose suckers suggests that populations in the Lost River sub-basin and lower Klamath River reservoirs are somewhat genetically distinct from Upper Klamath Lake populations (Dowling 2005). There is no information relating to specific trends of genetic variation.

Species-specific Research and/or Grant-supported Activities

Research benefitting or targeting this species is completed or funded by several organizations. The Bureau of Reclamation currently funds long-term monitoring of adult populations and research to better estimate the rates of entrainment of larval shortnose suckers into Klamath Project facilities through contracts with the U.S. Geological Survey and Oregon State University. Entrainment is when individuals (most often larvae and juveniles in the case of shortnose suckers) are pulled along with the force of water, which often results in fish being trapped in water management structures (see Factor E for further detail). Entrainment may occur through natural features, such as a river corridor, or into irrigation canals or other similar structures, such as dams and hydroelectric facilities. In addition to this, Bureau of Reclamation is conducting radio telemetry work to determine spawning patterns within Clear Lake Reservoir. The Bureau of Reclamation is also funding research to better understand physiological dynamics of juveniles during summer in Upper Klamath Lake through collaboration with the Service. Several organizations, including the Service, also pursue active restoration programs within the upper Klamath River basin which often includes projects that can benefit shortnose suckers. Other research includes clarification of the distribution and dynamics of shortnose suckers in Clear Lake Reservoir, improvement of passage within the Lost River, clarification of the effects of microcystin (a toxin that affects suckers and is described in further detail under Factor E of the Five-Factor Analysis below) on individuals, and evaluation of methods for off-site rearing.

Five-Factor Analysis

The following five-factor analysis describes and evaluates the threats attributable to one or more of the five listing factors outlined in section 4(a)(1) of the Act.

FACTOR A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Loss of habitat was a major factor leading to the listing of the shortnose sucker (53 FR 27130). Historic habitat loss was especially pronounced in the Lost River–Tule Lake and Lower Klamath subbasins, where approximately 150,000 acres (approximately 77 percent) of habitat were lost when Tule Lake and Lower Klamath Lake were drained early in the 20^{th} century (53 FR 27130; NRC 2004). These lakes functioned as catchments for larval and juvenile suckers emigrating out of Upper Klamath Lake or drifting downstream from the Lost River. Loss of these habitats has reduced the viability of the species by reducing the number of healthy, viable populations (redundancy) and drastically decreasing the numbers of shortnose suckers range wide. Loss of these areas has restricted the species to only three populations that are able to achieve even marginal reproduction (Upper Klamath Lake, Gerber Reservoir and Clear Lake Reservoir). This puts the species at significant risk of catastrophic events, such as die-offs, given the lack of population redundancy that could be used to replenish affected populations. Access to important habitat areas for spawning, rearing, and other needs has also been greatly curtailed. About

70 percent of the original 50,000 acres of wetlands surrounding Upper Klamath Lake were diked and drained between 1889 and 1971, leaving about 16,000 acres in 1990 connected to the lake (Snyder and Morace 1997, Aquatic Science Resources 2005). These wetlands are important as rearing habitat for larval and juvenile suckers, and the loss of access to such habitats may cause utilization of unsuitable habitats by these life stages (Aquatic Science Resources 2005).

Adverse Water Quality

Lake suckers such as shortnose suckers are relatively tolerant of water quality conditions unfavorable for many other fishes, tolerating higher pH (more basic conditions), temperature, and un-ionized ammonia concentrations, and lower dissolved oxygen concentrations (Saiki et al. 1999). Nevertheless, many of the water bodies currently occupied by shortnose suckers periodically possess conditions that are potentially harmful or fatal to the species. Much of this is due to large amounts of dissolved nutrients which promote biological productivity, such as algal growth. Throughout the year, the dynamics of algal blooms affect dissolved oxygen levels (ranging between anoxic to supersaturated conditions), pH, and un-ionized ammonia, all of which can impact fish health and survival. These processes are particularly important in Upper Klamath Lake and Keno Reservoir. Upper Klamath Lake was naturally highly productive or eutrophic prior to European settlement, but it has since become even more productive or "hypereutrophic" (Boyd et al. 2002, Bradbury et al. 2004, Eilers et al. 2004). Nutrients driving biological production in Upper Klamath Lake originate from external sources (such as water pumped from diked wetlands and run-off from agriculture and roads) and internal sources (namely lake sediments) (Snyder and Morace 1997, Boyd et al. 2002, IMST 2003). The accumulation of nutrient-bearing sediments in Upper Klamath Lake has dramatically increased during the 20th century, and these "modern" sediments are higher in nitrogen and phosphorus than pre-settlement sediment (Eilers et al. 2001), suggesting that even though sediments are a natural source of nutrients, the current levels are probably higher than they would have been without anthropogenic (human-generated) influences.

In conjunction with this increased nutrient loading, significant alterations to shortnose sucker habitat in Upper Klamath Lake have occurred over the last century due to changes in the algal community. Core samples of bottom sediments indicate that the cyanobacterium AFA were not present in Upper Klamath Lake prior to the 1900s (Bradbury et al. 2004, Eilers et al. 2004). It now dominates the algal community, and because of the high concentrations of nutrients available (as well as its ability to fix nitrogen), it is able to reach seasonally high densities that cause degraded water quality (Boyd et al. 2002). *Aphanizomenon flos-aquae* often occur in massive blooms, constituting over 90 percent of the biomass of photosynthetic organisms in the lake during the summer (Boyd et al. 2002). High photosynthetic activity can supersaturate the water with dissolved oxygen (DO) during daylight hours, and subsequent respiration at night can deplete DO levels. Both supersaturation and depletion of DO can be detrimental to shortnose suckers.

In Upper Klamath Lake, these cyanobacteria blooms are subject to catastrophic population crashes. The subsequent decomposition of the large quantities of organic matter causes extreme

DO depletion in the water column and releases a potentially toxic by-product, ammonia which, in turn, increases the pH making the water more basic. As pH becomes more basic, the proportion of the more toxic form of ammonia (un-ionized ammonia) also increases. Furthermore, the nitrogen made available from the decay of the AFA may also temporarily spur the growth of other photosynthetic organisms, including the toxin-producing cyanobacterium *Microcystis aeruginosa*. The conditions associated with massive cyanobacteria blooms and crashes have been linked to mass fish mortality events in Upper Klamath Lake that have included adult shortnose suckers (Perkins et al. 2000a). Because all shortnose sucker life stages (larvae, juveniles, and adults) in the Upper Klamath Lake watershed are almost entirely confined to the lake during the summer when water quality is poor, the entire population in the watershed is vulnerable to alterations of the habitat due to poor water quality.

Data concerning specific water quality affecting other populations are limited. Clear Lake Reservoir appears to be less productive than Upper Klamath Lake (BOR 1994, Hicks 2001), and therefore does not experience similar blue-green algae blooms. Data collected during 1991 to 1995 in Clear Lake Reservoir indicate that dissolved oxygen levels rarely declined below 4 milligrams/liter, and temperatures rarely exceeded 26 degrees Celsius (79 degrees Fahrenheit; Hicks 2001), levels that may be considered stressful to shortnose suckers. Conversely, Keno Reservoir, downstream of Upper Klamath Lake, frequently and persistently experiences extremely poor water quality conditions (Sullivan et al. 2008, Kirk et al. 2010). Dissolved oxygen levels of less than 1 milligram/liter, well below levels typically considered detrimental to fish, occur regularly (Kirk et al. 2010). This is due, in large degree, to the considerable amounts of organic materials passing from Upper Klamath Lake to Keno Reservoir through the Link River. *Aphanizomenon flos-aquae* is relatively sensitive to jostling, and this downstream trip frequently kills the colonies which then begin the decomposition cycle mentioned above. In addition, the water passing from Upper Klamath Lake is relatively high in available nutrients that stimulate biological productivity. The Sprague River, the only substantial spawning habitat for shortnose suckers in Upper Klamath Lake, is listed as water quality impaired for nutrients, temperature, sediment, and dissolved oxygen under the section 303d of the Clean Water Act (Boyd et al. 2002). The Lost River and Klamath River downstream of Keno Reservoir have been listed as impaired for DO, ammonia toxicity, chlorophyll-a (a specific form of chlorophyll used in photosynthesis that is used to characterize bloom dynamics of AFA), and temperature related to a variety of identified pollutants and habitat modifications (Kirk et al. 2010).

In summary, adverse water quality is a critical threat to shortnose suckers, and substantial improvement is not expected in the near future. It is reasonable to expect that mortality events caused by poor water quality that significantly affect populations will continue to periodically occur in Upper Klamath Lake. Given the reduced numbers of individuals and populations of this species, these poor water quality events may represent a significant threat to the species.

Habitat Degradation

Approximately 400 habitat restoration projects have been recently completed or are being planned in the upper Klamath River basin. Because such efforts are relatively recent, population-level responses by shortnose suckers are not yet apparent. The foremost project that has occurred since the previous 5-year Status Review of this species is the restoration of the delta where the Williamson River enters Upper Klamath Lake. Shortnose suckers have been documented utilizing portions of the approximately 6,000 acres of potential larvae and juvenile rearing habitat that were restored in 2007 and 2008 (Erdman et al. 2011). Although more time will be needed for the area to recover to its previous natural state due to the subsidence from agricultural use, this is still a major advancement toward the recovery of shortnose sucker. Another significant recovery action that occurred in the past five years was the removal of Chiloquin Dam on the Sprague River in 2008. The dam was identified in the 1988 listing as a threat to shortnose suckers because it was thought to block access to upstream spawning areas (53 FR 27130). Removal effectively unblocks approximately 120 kilometers (75 miles) of the Sprague River for spawning and migration of adults and larvae. However, insufficient time has passed to completely assess the overall effects on the population.

<u>Summary of Factor A</u>

The threats discussed under Factor A continue to pose the greatest risk to the shortnose sucker. Restoration of the Williamson River Delta and removal of the Chiloquin Dam are significant milestones towards the recovery of the species, but significant threats from the destruction and alteration of aquatic habitat within the Klamath River Basin remain (for example, degraded water quality).

Despite these considerable losses of important habitats, the general trend of habitat loss, modification and curtailment has stabilized or is improving. Currently, most actions that would affect aquatic habitats inhabited by shortnose suckers are regulated under various State and Federal laws (see *Factor D – Inadequacy of regulatory mechanisms* for an analysis of the adequacy of regulations relative to shortnose sucker recovery), which ensure that effects of these actions on shortnose suckers are minimized during project planning and consultation.

FACTOR B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Shortnose suckers were not targeted by recreational fishing as were Lost River suckers prior to listing, but were often taken because of the indiscriminant method of harvest (53 FR 27130). In 1985, shortnose suckers comprised only 3 percent of the sport fishery catch (Bienz and Ziller 1987). Recreational harvest of shortnose suckers within the Klamath Basin has been prohibited since 1987. Regulated take of shortnose suckers for scientific purposes under section 10 of the Act is authorized for 10 individuals or organizations, including federal, state, tribal, academic and private entities, and although not considered a current threat to population status, the demographic effects of these collections need to be regularly evaluated. The purpose of this research is to support recovery by providing information for the recovery plan and reviews of the species' status. There is no evidence that overutilization is currently a threat to the species.

FACTOR C: Disease or Predation

Non-native fishes were identified as a potential threat at the time of listing through predation or as sources of exotic diseases/parasites, although no direct evidence was cited. Since then, controlled experiments have demonstrated that adult fathead minnows prey on sucker larvae (Markle and Dunsmoor 2007). In Upper Klamath Lake, higher fathead minnow abundance was negatively associated with shortnose sucker survival rates (Markle and Dunsmoor 2007). These data suggest that predation by highly-abundant fathead minnows may be an important threat to larval sucker survival, which may be exacerbated by the loss of emergent wetland habitat that provides cover for shortnose sucker larvae. Other non-native fishes may also pose a threat to shortnose suckers; however, little quantitative information exists to indicate their influence on shortnose sucker abundance and distribution.

Although not mentioned at the time of listing as a threat, several species of birds may prey on shortnose suckers, but the ultimate effect to the status of the species from these avian predators is currently unknown. In Clear Lake Reservoir, radio-tags and Passive Integrated Transponders (PIT tags, used for tracking) of individual shortnose suckers have been located on islands associated with nesting colonies of American white pelicans (*Pelecanus erythrorhynchus*), double-crested cormorants (*Phalacrocorax auritus*), and great blue herons (*Ardea herodias*) (U.S. Geological Survey Klamath Falls Field Station, unpublished data). Adult shortnose suckers are susceptible to avian predation during the spawning run when they are congregated within a small area (such as Willow Creek, the main spawning tributary to Clear Lake Reservoir) and occur in shallower water relative to larger bodies of water. Such predation on spawning adults may increase mortality rates of this crucial life stage, but it may also cause altered behavior during this critical period. For example, predation on adults at spawning sites may limit the amount of time spent on the spawning ground. Throughout the range of the species there are also numerous species of piscivorous birds, including terns, grebes, and mergansers, that can target juvenile and larvae shortnose suckers.

Parasites were also not identified as a threat at the time of listing, but information suggests they could be a threat to the suckers. Anchor worm parasitism on age-0 shortnose suckers appears to be highly variable from year to year in Upper Klamath Lake (ISRP 2005, Bottcher and Burdick 2010). From 1994-1996, the percent of age-0 suckers (all species) parasitized by anchor worms ranged from 0 percent to 7 percent, but during 1997 through 2000 it increased to between 9 and 40 percent. The term “age-0” refers to individuals that have lived less than one year, but is most often used in reference to juveniles. In 2008 only four percent of captured juvenile suckers were infected with external parasites, but this jumped to 18 percent in 2009 (Bottcher and Burdick 2010). Parasites can lead to direct mortality, provide a route for pathogens to enter fish (since they create a wound), or can make fish more susceptible to predation (Robinson et al. 1998). We currently do not have enough information to accurately assess the degree to which parasites negatively impact shortnose sucker survival and productivity.

Notwithstanding the uncertainty associated with the specific impacts of predation and disease to shortnose suckers, it is probable that these factors pose a threat to the species. The impacts can appear in the form of direct mortality, indirectly promoting higher mortality rates, or potentially altering behavior during critical periods. More research concerning these factors is required to better understand their role as threats to shortnose sucker.

Blue-green Algal Toxins

The potential impacts of the blue-green algal or cyanobacteria toxins Microcystin have recently come to light. Microcystin is a toxin produced by *Microcystis aeruginosa* that primarily affects the liver of suckers (all species) causing a variety symptoms, but it can also affect the intestines, kidneys, heart, spleen, and gills (Malbrouck and Kestemont 2006). In a 2007 survey, 49 percent of a sample of juvenile suckers (all species) from Upper Klamath Lake (n = 47) collected at 11 shoreline sites exhibited indications of microcystin exposure (Vanderkooi et al. 2010). One hypothesis is that the toxin is secondarily ingested when suckers consume midge larvae (Chironomidae), which feed on the algae (Vanderkooi et al. 2010). Further investigations are required to better understand the degree to which these toxins threaten the shortnose suckers within Upper Klamath Lake.

FACTOR D: Inadequacy of Existing Regulatory Mechanisms

In the listing rule for shortnose sucker, the analysis of regulatory mechanisms that could protect the species was limited to state (Oregon and California) Endangered Species Acts or provisions, but there are additional State and Federal laws and regulations in place that are pertinent to federally listed species, each of which may contribute in varying degrees to the conservation of the species.

Federal Regulations

The Endangered Species Act is the primary Federal law providing protection for this species. The Service's responsibilities include administering the Act, including sections 7, 9, and 10 that address take. Section 3(18) defines "take" to mean "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Service regulations (50 CFR 17.3) define "harm" to include significant habitat modification or degradation which actually kills or injures wildlife by significantly impairing essential behavioral patterns, such as breeding, feeding or sheltering. Harassment is defined by the Service as an intentional or negligent action that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Section 9 prohibits the taking of any federally listed endangered or threatened species. The Act provides for civil and criminal penalties for the unlawful taking of listed species. Incidental take refers to the taking of listed species as part of an otherwise lawful activity by a Federal agency or applicant (50 CFR 402.02). Section 7 consultations under the Act consider if the proposed action may adversely affect the species and may include reasonable and prudent measures for reducing impacts. Since listing of the shortnose sucker, the Service has analyzed the potential effects of Federal projects under section 7(a)(2), which requires Federal agencies to consult with the Service prior to authorizing, funding, or carrying out activities that may affect listed species. In May 2013, we issued a Biological Opinion addressing the effects of the Klamath Project, operated by the Bureau of Reclamation, on shortnose suckers and its designated critical habitat (NMFS and USFWS 2013). At that time we concluded that "the continued operation of the [Klamath] Project for a 10-year term is not likely to jeopardize the continued existence of LRS [Lost River sucker] and SNS [shortnose sucker] or result in the destruction or adverse modification of their critical habitat" (NMFS and USFWS 2013:196).

Biological opinions, the result of consultation under section 7 between the Service and another Federal agency, may exempt incidental take from the prohibitions of section 9, and may include reasonable and prudent measures that minimize the amount or extent of incidental take of listed species associated with a project. For projects without a Federal nexus that would likely result in incidental take of listed species, the Service may issue incidental take permits to non-Federal applicants pursuant to section 10(a)(1)(B). To qualify for an incidental take permit, applicants must develop, fund, and implement a Service-approved Habitat Conservation Plan (HCP) that details measures to minimize and mitigate the project's adverse impacts to listed species. PacifiCorp is also currently developing a Habitat Conservation Plan (HCP) that will identify actions to be taken by the company for the protection and recovery of listed species within the Klamath Basin, including shortnose suckers.

Under section 404 of the Clean Water Act, the U.S. Army Corps of Engineers (Corps or USACE) regulates the discharge of fill material into waters of the United States, which include navigable and isolated waters, headwaters, and adjacent wetlands (33 U.S.C. 1344). In general, the term "wetland" refers to areas meeting the Corps' criteria of hydric soils, hydrology (either sufficient annual flooding or water on the soil surface), and hydrophytic vegetation (plants specifically adapted for growing in wetlands). Any action with the potential to impact waters of the United States must be reviewed under the Clean Water Act, which would include consultation under section 7 of the Act if the action may affect a listed species or designated critical habitat. The Clean Water Act (33 U.S.C. 1251) also regulates the discharge of pollutants into waters of the United States and sets water quality standards for all contaminants in surface waters. Section 303(d) of the Clean Water Act requires that states identify water-bodies that do not meet those standards and develop water quality management plans to achieve standards and protect beneficial uses. As part of this process, Total Maximum Daily Loads have been developed for much of the range of the shortnose sucker, including the Upper Klamath Lake drainage (Boyd et al. 2002) and the Upper Klamath and Lost River subbasins (Kirk et al. 2010).

In addition, the National Environmental Policy Act (NEPA; 42 U.S.C. 4371 *et seq*.) provides some protection for listed species that may be affected by activities undertaken, authorized, or funded by Federal agencies. Prior to implementation of projects with a Federal nexus, NEPA requires the agency to analyze the project for potential impacts to the human environment, including natural resources. In cases where that analysis reveals significant environmental effects, the Federal agency must propose mitigation alternatives that would offset those effects (40 C.F.R. 1502.16). These mitigations usually provide some protection for listed species. However, NEPA does not require that adverse impacts be fully mitigated, only that impacts be assessed and the analysis disclosed to the public.

State Regulations

Shortnose suckers were listed as fully protected under the California Endangered Species Act in 1974 (California Code of Regulations Title 14, Section 670.5; CDFG 2006) under California Code section 5515(a)(3)(b)(4). Fully protected species may not be taken or possessed at any time, except for scientific research or recovery efforts. The California Environmental Quality Act (CEQA) requires review of any project that is undertaken, funded, or permitted by the State or a local governmental agency. If significant effects to a listed species are identified, the lead agency has the option of requiring mitigation through changes in the project or to decide that overriding considerations make mitigation infeasible (CEQA section 21002). Protection of listed species through CEQA is, therefore, dependent upon the discretion of the lead agency involved. Shortnose suckers may also receive benefits from the Lake and Streambed Alteration Program in California (California Fish and Game Code sections 1600-1616). This program provides a permitting process to reduce impacts to fish and wildlife from projects affecting important water resources of the State, including lakes, streams, and rivers. This program also recognizes the importance of riparian habitats to sustaining California's fish and wildlife resources, including state listed species, and helps prevent the loss and degradation of such habitats. The California North Coast Regional Water Quality Control Board, established in accordance with the Porter-Cologne Water Quality Control Act of California, has jurisdiction over water-bodies in portions of the Lost River subbasin concerning impacts to water quality.

Shortnose sucker were listed in 1991 as endangered under the Oregon Endangered Species Act of 1987 (Oregon ESA), as amended. The Oregon ESA prohibits the take (to kill, take possession of, or control) of shortnose suckers (Oregon Administrative Rules 635-100-001 through 0180). It requires State agencies to consult with the Oregon Department of Fish and Wildlife (ODFW) if their actions on State land would violate the survival guidelines developed for a listed species. ODFW can recommend reasonable and prudent alternatives that are consistent with the survival guidelines. Under Oregon Revised Statutes (ORS 196.795-990) most actions that will remove or add materials to wetlands and waterways within the state must be permitted by the Oregon Department of State Lands and are required to mitigate for any impacts to state waters (ODSL 2011). Prior to listing as endangered, shortnose suckers were regulated as a game species by the Oregon Department of Fish and Wildlife (Markle and Cooperman 2002); this would presumably resume upon recovery of the species.

Regulation of the quantity of water available in sucker habitats primarily involves the exercise of surface water rights for agriculture in both Oregon and California. The quantity of water available in sucker habitat is dependent on climatic patterns and its affect upon stream-flow and groundwater inputs, which are influenced by human uses of water, some of which are subject to state regulation. Water rights claims by agriculture and other users in the Upper Klamath Lake sub-basin were under adjudication by the Oregon Department of Water Resources since 1975. The State of Oregon released its final order on the process on March 7, 2013. This order maintained that The Klamath Tribes and the United States (through the Department of the Interior) held several senior water rights in the upper Klamath Basin. These rights are senior, dated time in memorial, and must remain instream to uphold tribal treaty rights to fish in these areas. Calls for water by The Klamath Tribes on junior water users (as occurred in 2013) will presumably benefit the Lost River suckers by increasing water levels in Upper Klamath Lake and base flows in its tributaries. However, in July 2013, congressional delegates for Oregon convened a task force to explore a possible agreement between The Klamath Tribes and junior water users along the tributaries above Upper Klamath Lake. These negotiations are related to implementation of the Klamath Basin Restoration Agreement. They could result in substantial ecosystem improvements that would provide direct benefits to suckers inhabiting these tributaries. However, it is unclear at this time whether the task force will indeed produce a settlement that impacts the water regulation of the upper Klamath Basin.

The State of Oregon, through the Groundwater Act of 1955, regulates groundwater use through groundwater removal permits (Oregon Revised Statutes Sections 537.505 to 537.795 and 537.992). Most California groundwater is unregulated, and the State has no comprehensive groundwater permit process to regulate ground water withdrawal (California State Water Code Section 1200).

In summary, the Endangered Species Act is the primary Federal law that provides protection for this species since its listing as endangered in 1988. Other Federal and State regulatory mechanisms provide protections for the species based on current management direction, but do not guarantee protection for the species absent its status under the Act, with the exception of the Endangered Species Acts for each state. In general, these regulatory mechanisms provide protections to the species by restricting take (state Endangered Species Acts), by requiring review of actions that may impact the species (CEQA and NEPA), and by providing broad-scale improvements to habitat (Clean Water Act) or other means that affect habitat (such as water regulations). Nevertheless, we continue to believe that other laws and regulations have limited ability to protect the species in absence of the Endangered Species Act.

FACTOR E: Other Natural or Manmade Factors Affecting Its Continued Existence

<u>Entrainment</u>

Movement of fish into irrigation systems through unscreened diversions was identified as a threat to the suckers at the time of listing (USFWS 1988). At that time thousands of suckers, including some adults, were entrained into the A-Canal, the largest diversion in the upper basin located near the Link River Dam. Although some of these fish were salvaged, many likely died (National Research Council 2004). The impact of entrainment into the irrigation system of the Klamath Project was reduced by construction of screening facilities over the A-Canal; although larvae are still at risk. Under the present design, fish screened from entering the A-Canal are returned via pipeline to Upper Klamath Lake at a point that is near the river gates of the Link River Dam (Marine and Gorman 2005). Further investigations are needed to determine the overall effects and stress on transferred fish and if fish expelled through the pipeline remain in Upper Klamath Lake or are subsequently entrained by flows through the Link River Dam (USFWS 2007a, b).

Substantial entrainment occurs at the river gates of the Link River Dam (Marine and Lappe 2009). Currently these gates have no structures to prevent drawing fish downstream, but the East Side and West Side hydroelectric diversion facilities (operated by PacifiCorp) are currently shutdown between July 15 and November 15 to reduce entrainment when vulnerable life stages of listed suckers are present. During the late summer of 2006, over 3,500 age-0 juvenile suckers were collected in the Link River just below the dam with intermittent sampling of a fraction of the channel (Tyler 2007). The Committee on Endangered and Threatened Fishes in the Klamath River Basin of the National Research Council recommended screening to prevent downstream losses at Link River Dam (National Research Council 2004). Gutermuth *et al.* (2000) also documented tens of thousands of young suckers entrained at the PacifiCorp hydropower canals and turbines associated with the Link River Dam. Nonetheless, further research is required to better quantify the threats these structures pose to recovery.

Until recently, most suckers that pass through the gates at Link River Dam, or that survive passage through the hydroelectric facilities, were believed to be entirely lost from the breeding population. It was assumed that these fish either die in poor summer water quality conditions in Keno Reservoir, or pass further downstream into reservoirs along the Klamath River, from which upstream passage is blocked. However, recent surveys by the Bureau of Reclamation have detected a relatively small population residing in Lake Ewauna (see Distribution Section) indicating that some percentage of suckers do persist following passage through the Link River Dam gates or the hydroelectric facilities. A new fish ladder was also constructed at Link River Dam in 2004 through which adult suckers have been documented (using PIT tag readers) moving upstream through Link River. As of 2008, only seven individuals had been documented as passing through the ladder (Korson et al. 2008); however, at least 20 individuals were documented in the ladder during 2010 and 2011 (T. Tyler, pers. comm. 2010). Since only PIT-tagged individuals that swim close enough to the PIT-readers' antennae (generally within a couple of feet) can be detected and the numbers of tagged suckers in Lake Ewauna are still extremely low, these values are probably underestimates of the total number using the ladder.

There are also significant unscreened diversion structures that divert water from Lake Ewauna, including the Lost River Diver Channel and Ady Canal, but we aren't aware of any data indicating the amounts of entrainment through these structures. In addition to major diversion points, several hundred small, typically unscreened diversions in tributary streams and rivers and the lakes proper may also affect shortnose sucker. In 2001, the Bureau of Reclamation reported 193 diversions within the Klamath Project that were "directly connected to endangered sucker habitat below Upper Klamath Lake," with only three of these diversions equipped with fish screens (Bureau of Reclamation 2001: 2). The Bureau also noted there are at least 24 large diversions outside of the Klamath Project Service area that have the potential of entraining suckers. The influence on sucker abundance and recovery of these diversions is unknown.

Since listing, private landowners, the Oregon Department of Fish and Wildlife, Bureau of Reclamation, the Natural Resource Conservation Service, the Service, and others have built or funded construction of many new fish screens in the upper basin (Table 2). As a result, the threat of entrainment (loss of fish as result of being drawn into water management structures) is now lower than at the time of listing. Recently-installed fish screens in the upper basin include the A-Canal (2003), Agency Lake Ranch (2002), Clear Lake Reservoir (2003), Miller Island (2003), Wood River Ranch (2004), and Geary Canal (2009). Various State and Federal screening and passage programs, coordinated in the upper basin through a working group led by Bureau of Reclamation, are addressing the need for additional screening and passage for suckers. The Bureau of Reclamation surveyed water diversion structures throughout the Klamath Project service area (which excluded non-project users) between 1997 and 2000. This survey documented approximately 200 diversions that were directly connected to shortnose sucker habitat. A few of these are very large and likely impact the species, but many are small and have minimal impacts. We do not believe that most of the small diversions pose a serious threat to shortnose sucker populations because these smaller diversions typically draw water from the streams and rivers, but most suckers are in the lakes when the diversions are in operation. Also, small diversions draw relatively moderate currents which are likely to only entrain larvae, which are produced in large numbers, naturally experience very high rates of mortality, and would not be benefitted by most screens which typically only effectively exclude fish that are larger than 30 mm in length.

Table 2 A summary of recent major entrainment reduction projects benefitting shortnose sucker populations. Many of these projects were cooperative efforts of many state and federal agencies, non-profit organizations, and private landowners.

Project	Year Completed	Potential Benefits
A-canal Screen	2002	Retain more larvae and juveniles in Upper Klamath Lake by limiting entrainment into the canal
Clear Lake Dam Screen	2003	Retain more larvae, juveniles, and adults in Clear Lake Reservoir by limiting entrainment into the canal
Modoc Irr. Dis. Williamson River Div. Screen	2007	Reduce larval mortality due to entrainment
Geary Canal Screen	2009	Retain more larvae and juveniles in Upper Klamath Lake by limiting entrainment into the canal

Climate

Climate variability, such as fluctuations between wet and dry periods, is part of natural processes; however, climatic models suggest that much of the recent trends in climate is driven by anthropogenic causes (Barnett et al. 2008). Since the 1950's, western North America generally has exhibited trends toward less snowfall, earlier snowmelt, and earlier peak spring runoff, much of which cannot be attributed to natural fluctuations (Hamlet et al. 2005, Stewart et al. 2005, Knowles et al. 2006). Furthermore, models indicate that these trends are likely to continue into the future (Barnett et al. 2008). More specifically, a suite of climate models predict that over the next 100 years the mean flow of the Sprague River will increase during winter months but decrease during the spawning period (Markstrom et al. 2012, Risley et al. 2012), a pattern which is likely to be exhibited throughout the upper Klamath Basin.

It is difficult to accurately predict how such climatic changes will affect the shortnose sucker. These species are adapted to withstand periodic droughts (Dicken and Dicken 1985, Negrini 2002), but given the current reduced state of the species, they may be negatively impacted if there is an increase in the intensity or frequency of droughts or a substantial shift in the timing of snowmelt and runoff. Likewise, detrimental changes in refugia availability or community composition may also accompany climate change (Dahm et al. 2003, Magoulick and Kobza 2003).

III. RECOVERY CRITERIA

Recovery plans provide guidance to the Service, States, and other partners and interested parties on ways to minimize threats to listed species, and on criteria that may be used to determine when recovery goals are achieved. There are many paths to accomplishing the recovery of a species and recovery may be achieved without fully meeting all recovery plan criteria. For example, one or more criteria may have been exceeded while other criteria may not have been accomplished. In that instance, we may determine that, overall, the threats have been minimized sufficiently, and the species is robust enough, to downlist or delist the species. In other cases, new recovery approaches and/or opportunities unknown at the time the recovery plan was finalized may be more appropriate ways to achieve recovery. Likewise, new information may change the extent that criteria need to be met for recognizing recovery of the species. Overall, recovery is a dynamic process requiring adaptive management, and assessing a species' degree of recovery is likewise an adaptive process that may, or may not, fully follow the guidance provided in a recovery plan. We focus our evaluation of species status in this 5-year review on progress that has been made toward recovery since the species was listed (or since the most recent 5-year review) by eliminating or reducing the threats discussed in the five-factor analysis. In that context, progress towards fulfilling recovery criteria serves to indicate the extent to which threat factors have been reduced or eliminated.

A recovery plan for the Lost River sucker and the shortnose sucker was finalized on March 17, 1993 (USFWS 1993). A combined plan was prepared for these species due to their similar biology, distribution, and threats, but no criteria for downlisting or delisting were provided in the first version of the Recovery Plan. A substantial amount of additional information has accumulated during the interim and the plan was revised to incorporate this new information as well as recovery criteria into the recovery program. The final Revised Recovery Plan for the shortnose sucker (USFWS 2013) was released in April 2013. With few exceptions, none of the criteria are close to being met at this time, primarily because the criteria will be achieved through future implementation of multiple actions just identified in the now-published plan. The criteria for assessing recovery of shortnose sucker from this plan are as follows, with associated actions that are currently being implemented:

Factor A – Downlisting Criteria

A.1 Current spawning and rearing habitat is maintained and improved access ensures annual use. Protections provided under the Act are helping to maintain spawning and rearing habitat that exists at this time, but no actions have been implemented yet to improve annual access to these areas.

A.2 A range-wide Spawning and Rearing Enhancement Plan has been developed and implemented. This plan shall identify and prioritize areas of potential spawning and rearing habitat for enhancement and/or restoration, including areas which are degraded or unavailable due to lack of connectivity or passage. Development of this plan has not been initiated yet because it was only recently identified in the revised Recovery Plan (April 2013).

A.3 Connectivity and access is assured to habitats that provide refuge to suckers to avoid poor water quality (particularly Pelican Bay) during the months of July, August, and September – Upper Klamath Lake Recovery Unit. Recent data indicates that depths into Pelican Bay may not be limiting for shortnose sucker access. However, further evaluation and checks of the data need to be completed to ensure its accuracy.

A.4 Restore natural vegetated wetland areas, including in-stream, wetland and riparian areas around the mouth of Willow Creek where it meets Clear Lake Reservoir – Clear Lake

Reservoir Management Unit. There are no actions being implemented yet under this criterion.

Factor C – Downlisting Criteria

C.1 Newly identified or clarified effects of predation and disease are minimized through implementation of recommendations from ongoing scientific research which clarifies the interaction of shortnose sucker with predators and pathogens. There are no actions being implemented yet under this criterion.

Factor E – Downlisting Criteria (Criterion E.2 from the final revised Recovery Plan is not included since it is specific to Lost River sucker)

E.1 An Entrainment Reduction Plan has been developed and implemented. This plan shall identify and prioritize screening of diversions throughout upper Klamath Basin, including the Klamath Project, and propose strategies for efficient reduction of entrainment. Development of this plan has not been initiated yet because it was only recently identified in the revised Recovery Plan (April 2013).

E.3 Development and implementation of a plan to assess, monitor, and improve juvenile and sub-adult vital rates and demography, including threats and negative impact reduction. This plan shall also designate specific demographic or vital rate targets, and strategies for achieving these targets, important for downlisting and delisting. Development of this plan has not been initiated because it was only recently identified in the revised Recovery Plan (April 2013).

E.4 The effects of detrimental water quality have been minimized through implementation of recommendations from ongoing scientific research which clarifies the relationship of these factors with sucker mortality – Upper Klamath Lake Recovery Unit. This criterion is not close to being met because it involves a complex mixture of many factors, such as landscape level nutrient dynamics and species life history and ecology, but the USFWS and the Bureau of Reclamation are conducting research to better clarify the relationship between water quality and shortnose sucker mortality.

Factor B – Delisting Criteria

B.1 The States of Oregon and California and the Klamath Tribes, collaboratively or separately, should prepare and finalize population management plan(s) for the species. Development of this plan has not been initiated yet because it was only recently identified in the revised Recovery Plan (April 2013).

Factor E – Delisting Criteria

E.5 After 25 years, the average annual rate of population change is greater than one and the number of spawning individuals is greater than what was present in the baseline years for the Upper Klamath Lake River and Upper Klamath Lake Spring Management Units. [See Appendix II of the draft revised recovery plan for descriptions and estimation procedures of these measures.] Twenty-five years equates to approximately three average adult life spans for shortnose sucker, and will enable assessment of the populations' response to cyclical threats, such as periodic die-offs and drought. 2001 will serve as the baseline years for shortnose sucker, since this is the first year in which estimates of this type are statistically valid. This criterion can be met at the earliest in 2026, based on the 25-year timeframe built into the criterion. In addition, the present trajectory of the species is in a direction not consistent with meeting this criterion.

IV. SYNTHESIS

Historically, shortnose suckers were extremely abundant throughout the upper Klamath River basin. However, as habitats were made unavailable or unsuitable through destruction, obstruction, modification, and introduction of non-native species, shortnose suckers declined to relatively low numbers. Between 2004 and 2012 substantial threats were reduced through construction of the A-canal screen and Link River Dam ladder, restoration of the Williamson River Delta, and removal of the Chiloquin Dam. Nevertheless, significant threats to the shortnose sucker remain, including extremely poor water quality in Upper Klamath Lake and other areas, fluctuations in available water quantity and drought, fragmentation of populations, and entrainment. These threats increase mortality rates, reduce reproduction, and inhibit natural metapopulation dynamics. Predation by overly-abundant fathead minnows may be an important threat to larval shortnose suckers survival and other non-native fishes may also pose a threat to shortnose suckers; however, little quantitative information exists to indicate their influence on sucker abundance and distribution. Further, climate change and drought is a potential threat to shortnose sucker throughout their range and the regional climatic patterns may pose a threat to shortnose sucker. Although, the individual impacts each of these threats, and the other potential impacts from predators and climate change, on the status of the species are poorly understood, the threat of extinction of this species remains a credible possibility. This is especially apparent given that only three populations exhibit any appreciable larval production, and only the Clear Lake Reservoir population appears to be able to complete its life cycle. Additionally, the largest and most important population, which is in Upper Klamath Lake, is estimated to be only 40 percent of the size that it was in 2001. All other areas support extremely small numbers of individuals due to unsuitable habitat and/or a complete lack of larval production. Given the magnitude of the threats, the drastic reduction numbers, and the apparent inability for most remaining populations to complete their life cycle we conclude that the shortnose sucker remain in danger of extinction throughout all or a significant portion of its range.

V. RESULTS

Recommended Listing Action:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (indicate reason for delisting according to 50 CFR 424.11):
    ____ *Extinction*
    ____ *Recovery*
    ____ *Original data for classification in error*
__X__ No Change

New Recovery Priority Number and Brief Rationale:

The shortnose sucker recovery number should remain “5C.” This number indicates a species that has a high degree of threats and a low recovery potential. The “C” indicates that the species is in conflict with construction or other development projects or other forms of economic activity.

VI. RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS

Given the cultural importance of these species to The Klamath Tribes, the relationship between this species and the local economy, and the number of State and Federal agencies involved in recovery, it is essential to efficiently implement recovery actions through coordination. The final Revised Recovery Plan for this species calls for the establishment of a Recovery Implementation Program to formalize this collaboration and ensure comprehensive stakeholder participation.

Establishment of a Recovery Implementation Team
The revised recovery plan for the Lost River and Shortnose sucker (USFWS 2013) identifies several actions that will promote recovery of this species. Among these is the establishment of a Recovery Implementation Team to coordinate and assess implementation of the plan. This is a very important step to ensure success of the plan.

Improving Recruitment
The most critical need for this species is to restore natural rates of recruitment to Upper Klamath Lake. Research is needed to clarify how adverse water quality (including algal toxins), entrainment, and habitat availability affect this lack of recruitment.

Auxiliary Populations
Given that shortnose suckers are steadily declining in the only three populations with any appreciable reproduction, the final Revised Recovery Plan calls for the establishment of auxiliary populations within the natural range of the species to guard against short-term extinction risks. This includes the reestablishment of spawning populations in the Upper Klamath Lake tributaries and springs.

VII. REFERENCES CITED

Andreasen, J. K. 1975. Systematics and status of the Family Catostomidae in southern Oregon. Ph.D. Thesis, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.

Aquatic Science Resources. 2005. Preliminary research on *Aphanizomenon flos-aquae* in Upper Klamath Lake, Oregon. Unpublished report submitted to U.S. Fish and Wildlife Service, Klamath Falls, Oregon.

Banish, N. P., B. J. Adams, R. S. Shively, M. M. Mazur, D. A. Beauchamp, and T. M. Wood. 2009. Distribution and habitat associations of radio-tagged adult Lost River suckers and shortnose suckers in Upper Klamath Lake, Oregon. Transactions of the American Fisheries Society 138:153-168.

Barnett, T. P., D. W. Pierce, H. G. Hidalgo, C. Bonfils, B. D. Santer, T. Das, G. Bala, A. W. Wood, T. Nozawa, A. A. Mirin, D. R. Cayan, and M. D. Dettinger. 2008. Human-induced changes in the hydrology of the western United States. Science 319:1080-1083.

Barry, P. M., B. S. Hayes, E. C. Janney, R. S. Shively, A. C. Scott, and C. D. Luton. 2007. Monitoring of Lost River (*Deltistes luxatus*) and shortnose (*Chasmistes brevirostris*) suckers in Gerber and Clear Lakes, 2005-2006, Klamath Falls, Oregon.

Barry, P. M., E. C. Janney, D. A. Hewitt, B. S. Hayes, and A. C. Scott. 2009. Population dynamics of adult Lost River (*Deltistes luxatus*) and shortnose (*Chasmistes brevirostris*) suckers in Clear Lake, California, 2006-2008: Open File Report 2009-1109. U.S. Geological Survey, Reston, Virginia.

Bienz, C. S. and J. S. Ziller. 1987. Status of three lacustrine sucker species (catostomidae). The Klamath Tribes and Oregon Department of Fish and Wildlife, Klamath Falls, Oregon.

BOR (Bureau of Reclamation). 1994. Biological assessment on long-term operations of the Klamath Project, with special emphasis on Clear Lake operations.

BOR. 2000. Klamath Project historic operation.*in* Klamath Basin Area Office, Bureau of Reclamation, U.S. Department of Interior, editor., Klamath Falls, Oregon.

BOR (Bureau of Reclamation). 2001. Biological assessment of the Klamath Project's continuing operations on the endangered Lost River sucker and shortnose sucker. Klamath Basin Area Office, Bureau of Reclamation, U.S. Department of Interior, Klamath Falls, Oregon.

Bottcher, J. L. and S. M. Burdick. 2010. Temporal and spatial distribution of endangered juvenile Lost River and shortnose suckers in relation to environmental variables in Upper Klamath Lake, Oregon: 2009 annual data summary, Open File Report 2010-1261. U.S. Geological Survey, Reston, Virginia.

Boyd, M., S. Kirk, M. Wiltsey, and B. Kasper. 2002. Upper Klamath Lake drainage total maximum daily load (TMDL) and water quality managment plan (WQMP). Department of Environmental Quality, State of Oregon, Portland, Oregon.

Bradbury, J. P., S. M. Colman, and R. L. Reynolds. 2004. The history of recent limnological changes and human impact on Upper Klamath Lake, Oregon. Journal of Paleolimnology 31:151-161.

Buettner, M. and G. Scoppettone. 1990. Life history and status of Catostomids in Upper Klamath Lake, Oregon: Completion report. Reno Field Station, National Fisheries Research Center, U.S. Fish and Wildlife Service, U.S. Department of Interior, Reno, Nevada.

Burdick, S. M. and D. T. Brown. 2010. Distribution and condition of larval and juvenile Lost River and shortnose suckers in the Williamson River Delta Restoration Project and Upper Klamath Lake, Oregon: 2009 Annual Data Summary: Open-file Report 2010-1216, Reston, Virginia.

Coleman, M. E., J. Kahn, and G. Scoppettone. 1988. Life history and ecological investiagations of Catostomids from the Upper Klamath Lake Basin, Oregon. National Fisheries Research Center, U.S. Fish and Wildlife Service, U.S. Department of Interior, Seattle, Washington.

Cooperman, M. S. 2004. Natural history and ecology of larval Lost River suckers and larval shortnose suckers in the Williamson River-Upper Klamath Lake System. Ph.D. Thesis, Department of Fisheries and Wildlife, Oregon State University, Corvallis, Oregon.

Coot, M. 1965. Occurrences of the Lost River sucker, *Deltistes luxatus* (Cope), and shortnose sucker, *Chasmistes brevirostris* (Cope), in northern California. California Fish and Game 51:68-73.

Cope, E. D. 1879. Fishes of Klamath Lake, Oregon. American Naturalist 13:784-785.

Courter, I., J. Vaughn, and S. Duery. 2010. 2010 Tule Lake sucker relocation report: Project summary. Unpublished report submitted to Klamath Basin Area Office, Bureau of Reclamation, Klamath Falls, Oregon.

Crandall, J. 2004. Williamson River Delta restoration Project Catostomid technical report. Unpublished report prepared by The Nature Conservancy, Portland, Oregon and Klamath Falls, Oregon.

Dahm, C. N., M. A. Baker, D. I. Moore, and J. R. Thibault. 2003. Coupled biogeochemical and hydrological responses of streams and rivers to drought. Freshwater Biology 48:1219-1231.

Desjardins, M. and D. F. Markle. 2000. Distribution and biology of suckers in lower Klamath Reservoirs. Unpublished report submitted to PacifiCorp, Portland, Oregon.

Dicken, S. N. and E. F. Dicken. 1985. The legacy of ancient Lake Modoc: a historical geography of the Klamath Lakes Basin Oregon and California.

Dowling, T. 2005. Conservation genetics of endangered Lost River and shortnose suckers. Unpublished report submitted to the U.S. Fish and Wildlife Service, U.S. Department of Interior, Klamath Falls, Oregon.

Eilers, J. M., J. Kann, J. Cornett, K. Moser, and A. St. Amand. 2004. Paleolimnological evidence of change in a shallow, hypereutrophic lake: Upper Klamath Lake, Oregon. Hydrobiologia 520:7-18.

Eilers, J. M., J. Kann, J. Cornett, K. Moser, A. St. Amand, and C. Gubala. 2001. Recent paleolimnology of Upper Klamath Lake, Oregon. Unpublished report submitted to the Bureau of Reclamation, U.S. Department of Interior, Klamath Falls, Oregon.

Ellsworth, C. M., T. J. Tyler, C. D. Luton, S. P. Vanderkooi, and R. S. Shively. 2007. Spawning migration movements of Klamath largescale, Lost River, and shortnose suckers in the Williamson River and Sprague Rivers, Oregon, prior to the removal of Chiloquin Dam. Klamath Falls Field Station, Western Fisheries Research Station, U.S. Geological Survey, U.S. Department of Interior, Klamath Falls, Oregon.

Ellsworth, C. M., T. J. Tyler, and S. P. Vanderkooi. 2010. Using spatial, seasonal, and diel drift patterns of larval Lost River suckers *Deltistes luxatus* (Cypriniformes:Catostomidae) and shortnose suckers *Chasmistes brevirostris* (Cypriniformes:Catostomidae) to help identify a site for a water withdrawl structure on the Williamson River, Oregon. Environmental Biology of Fishes 89:47-57.

Erdman, C. S., H. A. Hendrixson, and N. T. Rudd. 2011. Larval sucker distribution and condition before and after large-scale restoration at the Williamson River delta, Upper Klamath Lake, Oregon. Western North American Naturalist 71:472-480.

Foott, J. S. 2004. Health monitoring of adult Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*) in Upper Klamath Lake, Oregon, April - September 2003. Joint FWS and USGS project. California - Nevada Fish Health Center, U.S. Fish and Wildlife Service, U.S. Department of Interior, Anderson, California.

Foott, J. S., R. Stone, and R. Fogerty. 2010. FY2009 Technical Report: Health and energy evaluation of juvenile fish from Link R. trap and haul project and J-canal salvage. Anderson, California.

Golden, M. P. 1969. Oregon State Game Commission Central Region Administrative Report No. 1-69: The Lost River sucker *Catostomus luxatus* (Cope). Oregon State Game Commission.

Graham, S. A., C. B. Craft, P. V. McCormick, and A. Aldous. 2005. Forms and accumulations of soil P in natural and recently restored peatlands - Upper Klamath Lake, Oregon, USA. Wetlands 25:594-606.

Hamilton, J. B., G. L. Curtis, S. M. Snedaker, and D. K. White. 2005. Distribution of anadromous fishes in the upper Klamath River watershed prior to hydropower dams - A synthesis of the historical evidence. Fisheries 30:10-20.

Hamlet, A. F., P. W. Mote, M. P. Clark, and D. P. Lettenmaier. 2005. Effects of temperature and precipitation variability on snowpack trends in the western United States. Journal of Climate 18:4545-4561.

Hewitt, D. A., B. S. Hayes, E. C. Janney, A. C. Harris, J. P. Koller, and M. A. Johnson. 2011. Demographics and run timing of adult Lost River (*Deltistes luxatus*) and shortnose (*Chasmistes brevirostris*) suckers in Upper Klamath Lake, Oregon, 2009: Open-file Report 2011-1088. U.S. Geological Survey, Reston.

Hewitt, D. A., E. C. Janney, B. S. Hayes, and A. C. Harris. 2012. Demographics and run timing of adult Lost River (*Deltistes luxatus*) and shortnose (*Chasmistes brevirostris*) suckers in Upper Klamath Lake, Oregon, 2011. Klamath Falls Field Station, Western Fisheries Research Station, U.S. Geological Survey, U.S. Department of Interior, Reston, Virginia.

Hicks, L. A. 2001. Summary of Clear Lake Reservoir water quality, 1991-1995. Unpublished report submitted to the Bureau of Reclamation, U.S. Department of Interior, Klamath Falls, Oregon.

Hodge, J. and M. Buettner. 2009. Sucker population monitoring in Tule Lake and the lower Lost River, 2008. Unpublished report prepared by Klamath Falls Fish and Wildlife Office, U.S. Fish and Wildlife Service, Klamath Falls, Oregon.

Holt, R. 1997. Upper Klamath Lake fish disease exam report. Oregon Department of Fish and Wildlife, State of Oregon, Corvallis, Oregon.

IMST (Independent Multidisciplinary Science Team). 2003. IMST review of the USFWS and NMFS 2001 biological opinions on management of the Klamath Reclamation Project and related reports. Unpublished report submitted to the Governor, Senate President, and House Speaker of the State of Oregon.

ISRP (Independent Scientific Review Panel). 2005. Current risk of extinction of the Lost River and shortnose suckers. Unpublished report submitted to the U.S. Fish and Wildlife Service, U.S. Department of Interior, Klamath Falls, Oregon.

Janney, E. C., B. S. Hayes, D. A. Hewitt, P. M. Barry, A. Scott, J. Koller, M. Johnson, and G. Blackwood. 2009. Demographics and 2008 run timing of adult Lost River (*Deltistes luxatus*) and shortnose (*Chasmistes brevirostris*) suckers in Upper Klamath Lake, Oregon, 2008. U.S. Geological Survey, Reston, Virginia.

Janney, E. C. and R. S. Shively. 2007. An updated analysis on the population dynamics of Lost River suckers and shortnose sucker in Upper Klamath Lake and its tributaries, Oregon. Klamath Falls Field Station, Western Fisheries Research Station, U.S. Geological Survey, U.S. Department of Interior, Klamath Falls, Oregon.

Janney, E. C., R. S. Shively, B. S. Hayes, P. M. Barry, and D. Perkins. 2008. Demographic analysis of Lost River sucker and shortnose sucker populations in Upper Klamath Lake, Oregon. Transactions of the American Fisheries Society 137:1812-1825.

Jassby, A. and J. Kann. 2010. Upper Klamath Lake monitoring program: preliminary analysis of status and trends for 1990-2009. Unpublished report submitted to The Klamath Tribes, Chiloquin, Oregon.

Kirk, S., D. Turner, and J. Crown. 2010. Upper Klamath and Lost River subbasins total maximum daily loads (TMDL) and water quality management plam. Department of Environmental Quality, State of Oregon.
Klamath Tribes. 1996. A synopsis of the early life history and ecology of Catostomids, with a focus on the Williamson River Delta. Unpublished report prepared by, Chiloquin, Oregon.
Knowles, N., M. D. Dettinger, and D. R. Cayan. 2006. Trends in snowfall versus rainfall in the western United States. Journal of Climate 19:4545-4559.
Koch, D. L. and G. P. Contreras. 1973. Preliminary survey of the fishes of the Lost River system inlcuding Lower Klamath Lake and Klamath Strait Drain with special reference to the shortnose (*Chasmistes brevirostris*) and Lost River (*Catostomus luxatus*) suckers. Unpublished report prepared by Desert Research Institute, University of Nevada System, Reno, Nevada.
Korson, C., A. Wilkens, and D. Taylor. 2010. Klamath Project: A canal endangered sucker monitoring, 2010. Klamath Basin Area Office, Bureau of Reclamation, U.S. Department of Interior, Klamath Falls, Oregon.
Kyger, C. and A. Wilkens. 2010. Endangered Lost River and shortnose sucker distribution and relative abundance in Lake Ewauna, and use of the Link River dam fish ladder, Oregon: Annual Report 2010. Klamath Basin Area Office, Bureau of Reclamation, U.S. Department of Interior, Klamath County, Oregon.
Kyger, C. and A. Wilkens. 2011. Klamath Project: Endangered sucker salvage activities, 2008 - 2010. Unpublished report prepared by United States Bureau of Reclamation, Klamath Falls, Oregon.
Leal, J. J. 2007. Biological assessment for the potential effects of managing the Fremont-Winema National Forests in the Lost River section 7 watershed on Lost River and shortnose sucker and their proposed critical habitat. Fremont-Winema National Forests, U.S. Forest Service, U.S. Department of Agriculture, Lakeview, Oregon.
Logan, D. J. and D. F. Markle. 1993. Fish faunal survey of Agency Lake and northern Upper Klamath Lake, Oregon. Unpublished report submitted to the Bureau of Reclamation, U.S. Department of Interior, Klamath Falls, Oregon.
Magoulick, D. D. and R. M. Kobza. 2003. The role of refugia for fishes during drought: a review and synthesis. Freshwater Biology 48:1186-1198.
Malbrouck, C. and P. Kestemont. 2006. Effects of microcystins on fish. Environmental Toxicology and Chemistry 25:72-86.
Markle, D. F., M. R. Cavalluzzi, and D. C. Simon. 2005. Morphology and taxonomy of Klamath Basin suckers (Catostomidae). Western North American Naturalist 65:473-489.
Markle, D. F. and K. Clauson. 2006. Ontogenetic and habitat-related changes in diet of late larval and juvenile suckers (Catostomidae) in Upper Klamath Lake, Oregon. Western North American Naturalist 66:492-501.
Markle, D. F. and L. K. Dunsmoor. 2007. Effects of Habitat Volume and Fathead Minnow Introduction on Larval Survival of Two Endangered Sucker Species in Upper Klamath Lake, Oregon. Transactions of the American Fisheries Society 136:567-579.
Markstrom, S. L., L. E. Hay, C. D. Ward-Garrison, J. C. Risley, W. A. Battaglin, D. M. Bjerklie, K. J. Chase, D. E. Christiansen, R. W. Dudley, R. J. Hunt, K. M. Koczot, M. C. Mastin, S. Regan, R. J. Vigr, K. C. Vining, and J. F. Walker. 2012. Integrated watershed-scale

response to climate change for selected basins across the United States: Scientific Investigations Report 2011-5077. U.S. Geological Survey, Reston, Virginia.

Morace, J. L. 2007. Relation between selected water-quality variables, climatic factors, and lake levels in Upper Klamath and Agency Lakes, Oregon, 1990-2006: Scientific Investigations Report 2007-5117. U.S. Geological Survey, Reston.

Moyle, P. B. 2002. Inland fishes of California. University of California Press, Berkeley, California.

National Research Council (National Research Council of the National Academies). 2004. Endangered and threatened fishes in the Klamath River Basin: Cause of decline and strategies for recovery. The National Academies Press, Washington,D.C.

Negrini, R. M. 2002. Pluvial lake sizes in the northwestern Great Basin throughout the Quaternary Period. Pages 11-52 *in* Great Basin aquatic systems history, R. Hershler, D. B. Madsen, and D. R. Currey, editors. Smithsonian Institution Press, Washington,D.C.

NMFS and USFWS. 2013. Effects of proposed Klamath project operations from May 31, 2013, through March 31, 2023, on five federally listed threatened and endangered species. National Fisheries Research Center and U.S. Fish and Wildlife Service.

ODSL. 2011. A guide to the removal-fill permit process. Oregon Department of State Lands, Salem, Oregon.

PacifiCorp. 2000. Klamath Hydroelectric Project, First Stage Consultation Document, FERC [Federal Energy Regulatory Commission] Project No. 2082. Portland, Oregon.

Peck, B. 2000. Radio telemetry studies of adult shortnose and Lost River suckers in Upper Klamath Lake and tributaries. Klamath Basin Area Office, Bureau of Reclamation, U.S. Department of Interior, Klamath Falls, Oregon.

Perkins, D. L., J. Kahn, and G. G. Scoppettone. 2000a. The role of poor water quality and fish kills in the decline of endangered Lost River and shortnose suckers in Upper Klamath Lake. U.S. Geological Survey, Reno, Nevada.

Perkins, D. L. and G. G. Scoppettone. 1996. Spawning and migration of Lost River suckers (*Deltistes luxatus*) and shortnose suckers (*Chasmistes brevirostris*) in the Clear Lake Drainage, Modoc County, California. Reno Field Station, California Science Center, National Biological Service, Reno, Nevada.

Perkins, D. L., G. G. Scoppettone, and M. Buettner. 2000b. Reproductive biology and demographics of endangered Lost River and shortnose suckers in Upper Klamath Lake, Oregon. Unpublished report submitted to the Bureau of Reclamation, U.S. Department of Interior, Reno.

Reiser, D. W., M. Loftus, D. Chapman, E. Jeanes, and K. Oliver. 2001. Effects of water quality and lake level on the biology and habitat of selected fish species in Upper Klamath Lake. Unpublished report submitted to the Bureau of Reclamation, U.S. Department of Interior, Klamath Falls, Oregon.

Risley, J., L. E. Hay, and S. L. Markstrom. 2012. Watershed scale response to climate change - Sprague River basin, Oregon: Fact Sheet 2011-3120. U.S. Geological Survey.

Robinson, A. T., P. P. Hines, J. A. Sorensen, and S. D. Bryan. 1998. Parasites and fish health in a desert stream, and management implications for two endangered fishes. North American Journal of Fisheries Management 18:599-608.

Saiki, M. K., D. P. Monda, and B. L. Bellerud. 1999. Lethal levels of selected water quality variables to larval and juvenile Lost River and shortnose suckers. Environmental Pollution 105:37-44.

Scoppettone, G., S. Shea, and M. Buettner. 1995. Information on population dynamics and life history of shortnose suckers (*Chasmistes brevirostris*) and Lost River suckers (*Deltistes luxatus*) in Tule and Clear Lakes. Reno Field Station, Northwest Biological Science Center, National Biological Service, Reno, Nevada.

Scoppettone, G. and C. L. Vinyard. 1991. Life history and management of four lacustrine suckers. Pages 359-377 *in* Battle against extinction - native fish management in the American west, W. L. Minckley and J. E. Deacon, editors. University of Arizona Press, Tucson, Arizona.

Shively, R. S., M. F. Bautista, and A. E. Kohler. 2000a. Monitoring of Lost River and shortnose suckers at shoreline spawning areas in Upper Klamath Lake, 1999. Completion Report. U.S. Geological Survey, Klamath Falls, Oregon.

Shively, R. S., E. B. Neuman, A. E. Kohler, and B. J. Peck. 2000b. Species composition and distribution of fishes in the Lost River, Oregon. U.S. Geological Survey, Klamath Falls, Oregon.

Snyder, D. T. and J. L. Morace. 1997. Nitrogen and phosphorus loading from drained wetlands adjacent to Upper Klamath and Agency Lakes, Oregon: Water Resources Investigations Report 97-4059. U.S. Geological Survey, Portland, Oregon.

Sonnevil, G. 1972. Abundance and distribution of the Lost River sucker (*Catostomus luxatus*) and the shortnose sucker (*Chasmistes brevirostris*) in Boles and Willow Creek, Modoc County.

Stewart, I. T., D. R. Cayan, and M. D. Dettinger. 2005. Changes toward earlier streamflow timing across western North America. Journal of Climate 18:1136-1155.

Stine, P. A. 1982. Preliminary status report - Lost River sucker, Draft. Unpublished report prepared by.

Sullivan, A. B., M. L. Asbill, J. D. Kirshtein, K. Butler, R. W. Wellman, M. A. Stewart, and J. Vaughn. 2008. Klamath River water quality and acoustic doppler current profiler data from Link River Dam to Keno Dam, 2007: Open File Report 2008-1185. U.S. Geological Survey, Reston, Virginia.

Sullivan, A. B. and S. A. Rounds. 2011. Modeling hydrodynamics, water temperature, and water quality in the Klamath River upstream of Keno Dam, Oregon, 2006-09: Scientific Investigations Report 2011-5105. U.S. Geological Survey, Reston, Virginia.

Terwilliger, M., T. Reece, and D. F. Markle. 2010. Historic and recent age structure and growth of endangered Lost River and shortnose suckers in Upper Klamath Lake, Oregon. Environmental Biology of Fishes 89:239-252.

Tranah, G. J. and B. May. 2006. Patterns of intra- and interspecies genetic diversity in Klamath River Basin suckers. Transactions of the American Fisheries Society 135:306-316.

Tyler, T. J., E. C. Janney, H. A. Hendrixson, and R. S. Shively. 2004. Monitoring of Lost River and shortnose suckers in the lower Williamson River. Unpublished report submitted to the Bureau of Reclamation, U.S. Department of Interior, Klamath Falls, Oregon.

USFWS. 1993. Lost River and shortnose recovery plan. U.S. Fish and Wildlife Service, U.S. Department of Interior, Portland, Oregon.

USFWS. 2002. Biological/conference opinion regarding the effects of the U.S. Bureau of Reclamation's proposed 10-year operation plan for the Klamath Project and its effect on the endangered Lost River sucker (*Deltistes luxatus*), endangered shortnose sucker (*Chasmistes brevirostris*), threatened Bald Eagle (*Haliaeetus leucocephalus*), and proposed critical habitat for the Lost River and shortnose suckers.*in* Klamath Falls Fish and Wildlife Office, U.S. Fish and Wildlife Service, U.S. Department of Interior, editor., Klamath Falls, Oregon.

USFWS. 2011. Draft revised recovery plan for the Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California.

USFWS. 2013. Revised recovery plan for the Lost River sucker (*Deltistes luxatus*) and shortnose sucker (*Chasmistes brevirostris*). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California.

Vanderkooi, S. P., S. M. Burdick, K. R. Echols, C. A. Ottinger, B. H. Rosen, and T. M. Wood. 2010. Algal toxins in Upper Klamath Lake, Oregon: Linking water quality to juvenile sucker health. Fact-sheet 2009-3111. U.S. Geological Survey.

Welch, E. B. and T. Burke. 2001. Interim summary report: Relationship between lake elevation and water quality in Upper Klamath Lake, Oregon. Unpublished report submitted to the Bureau of Indian Affairs, U.S. Department of Interior, Portland, Oregon.

Wood, T. M., G. R. Hoilman, and M. K. Lindenberg. 2006. Water-quality conditions in Upper Klamath Lake, Oregon, 2002-04: Scientific Investigations Report 2006-5209. U.S. Geological Survey, Reston.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW

Shortnose sucker (*Chasmistes brevirostris*)

Current Classification: Endangered

Recommendation Resulting from the 5-Year Review:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
_X_ No change needed

Review Conducted By: Josh Rasmussen, Klamath Falls Fish and Wildlife Office, Klamath Falls, Oregon

Date Submitted to Region 8: ______________________

FIELD OFFICE APPROVAL:

Lead Field Supervisor, U.S. Fish and Wildlife Service

Approve ______________________ Date 8/12/2013

REGIONAL OFFICE APPROVAL:

Lead Assistant Regional Director, Ecological Services, U.S. Fish and Wildlife Service, Region 8
Acting

Approve ______________________ Date 8/22/13

Appendix 1 Historical and current occurrences of shortnose sucker.

Area	Occurrence	Reference
Upper Klamath Lake and Shoreline Springs		
Upper Klamath Lake	Currently Present	Cope (1879); numerous reports thereafter
Barkley Spring	Unsure if ever present	Perkins et al. (2000a)
Boulder Spring	Present in low numbers	Shively et al. (2000b); Barry et al. (2007); Janney et al. (2009)
Cinder Flats	Present in low numbers	Shively et al. 2000; Barry et al., 2007; Janney et al. 2009
Harriman Spring	Unsure if ever present	Andreasen (1975)
Odessa Spring	Unsure if ever present	Golden (1969)
Ouxy Spring	Present in low numbers	Andreasen (1975); Shively et al. (2000a); Janney et al. (2009)
Sliver Building Spring	Present in low numbers	Andreasen (1975); Shively et al. (2000a); Janney et al. (2009)
Sucker Springs	Present in low numbers	Andreasen (1975); Shively et al. (2000a); Janney et al. (2009)
Upper Klamath Lake Tributaries		
Crooked Creek	Unidentified larvae and adult suckers seen in 1991	Andreasen (1975); Stine (1982); Logan and Markle (1993)
Fort Creek	Unidentified suckers observed ca. 1990	Logan and Markle (1993)
Lake of the Woods	Extirpated in 1952	Andreasen (1975)
Lower Sycan River	Single radio-tagged individual was briefly detected.	Ellsworth et al. (2007)

Area	Occurrence	Reference
Lower Williamson River	Currently Present	Golden (1969); many recent reports by USGS but especially Ellsworth et al. (2007)
Sprague River		Golden (1969); many recent reports by USGS, but especially Ellsworth et al. (2007)
Upper Williamson River	No records	
Wood River	27 adults present in lower reaches in 1996; many adults present in Agency Lake near mouth in 1999 and 2000	BOR (2001)
Upper Klamath River		
Copco Reservoirs	Currently Present	Desjardins and Markle (2000)
Iron Gate Reservoir	Currently Present	Desjardins and Markle (2000)
J.C. Boyle Reservoir	Currently Present	Desjardins and Markle (2000)
Keno Reservoir/Lake Ewauna	Currently Present	Kyger and Wilkens (2010)
Link River	Historically significant runs, runs very small or extirpated	Golden (1969)
Lower Klamath Lake	Presumed Extirpated	Coot (1965)
Sheepy Creek	Presumed Extirpated	Coot (1965)
Lost River Sub-basin		
East Fork Lost River below Willow Valley Reservoir	Currently Present	Shively et al. (2000b)
Lost River - Clear Lake to Malone Reservoir	Currently Present	Shively et al. (2000b)
Lost River - Miller Creek Confluence to Tule Lake	Currently Present	Koch and Contreas (1973); Shively et al. (2000b)

Area	Occurrence	Reference
Malone Dam to Miller Creek confluence	Undetected	Shively et al. (2000b)
Tule Lake	Currently Present	Scoppettone et al. (1995); Hodge and Buettner (2009); Courter et al. (2010)
Clear Lake Reservoir and Tributaries		
Clear Lake Reservoir	Currently Present	Buettner and Scoppettone (1991); Barry et al. (2009)
Antelope Creek (lower reach)	Last observed in 1990	Koch et al. (1975); Buettner and Scoppettone (1991)
Avanzino Reservoir	Last observed in 1995	Perkins and Scoppettone (1996)
Bagley Creek	Undetected	Coot (1965); Sonnevil (1972); Buettner and Scoppettone (1991); Perkins and Scoppettone (1996)
Bayley Tank Reservoir	Last observed in 1990	Koch et al. (1975); Buettner and Scoppettone (1991); Perkins and Scoppettone (1996)
Boles Meadow Reservoir	Last observed in 1990	Koch et al. (1975); Buettner and Scoppettone (1991) ; Perkins and Scoppettone (1996)
Fletcher Creek	Last observed in 1990	Sonnevil (1972); Buettner and Scoppettone (1991); Perkins and Scoppettone (1996)
Lower Fourmile Reservoir	Last observed in 1990	Buettner and Scoppettone (1991)
Mowitz Creek	Last observed in 1995	Perkins and Scoppettone (1996)

Area	Occurrence	Reference
Telephone Flat Reservoir	Last observed in 1990	Buettner and Scoppettone (1991); Perkins and Scoppettone (1996)
Weed Valley Reservoir	Last observed in 1990	Buettner and Scoppettone (1991)
Wildhorse Reservoir	Last observed in 1990	Buettner and Scoppettone (1991); Perkins and Scoppettone (1996)
Willow Creek	Currently Present	Buettner and Scoppettone (1991); Barry et al. (2009)
Gerber Reservoir Tributaries		
Gerber Reservoir and drainage	Currently Present	Buettner and Scoppettone (1991)
Barnes Creek	Currently Present	BLM *unpublished data*; Leal (2007)
Barnes Valley Creek	Currently Present	Buettner and Scoppettone (1991); BLM *unpublished data*
Ben Hall Creek	Currently Present	BLM *unpublished data*; Leal (2007)
Dry Prairie Creek	Currently Present	BLM *unpublished data*; Leal (2007)
Lapham Creek	Currently Present	BLM *unpublished data*; Leal (2007)
Long Branch Creek	Currently Present	BLM *unpublished data*; Leal (2007)
Miller Creek	Currently Present	BLM *unpublished data*; Leal (2007)