KLAMATH LARGESCALE SUCKER
***Catostomus snyderi* (Gilbert)**

Status: Critical Concern. Klamath largescale sucker are found in isolated, restricted populations throughout their historic range. In California, they are reproducing in low numbers only in the Tule Lake sump, Clear Lake Reservoir, and the Lost River.

Description: Andreasen (1975) described this species as a generalized sucker, intermediate in most morphological characteristics between the Lost River sucker (*Deltistes luxatus*) and the shortnose sucker (*Chasmistes brevirostris*), with which it co-occurs. While it can reach 50 cm FL, the inferior mouth is comparatively small. The lips are papillose with a medial incision resulting in only one row of papillae extending across the lower lip (Moyle 2002). The narrow upper lip has 4 or 5 complete rows of papillae. The dorsal fin is short, with a basal length equal to or shorter than the longest dorsal ray and an insertion closer to the snout than to the caudal fin. There are 11 dorsal fin rays (may range from 11 to 12) and 7 anal fin rays. Scales are large: 67-81 along the lateral line, 11-14 scale rows above, and 8-12 rows below. Gill rakers number 30-35 but usually 32, in adults, and 25-28 in juveniles. Adults have gill rakers with well-formed processes (bony bumps). Their dorsal surface is green-hued, while their ventral surface is yellow-gold (Moyle 2002).

Taxonomic Relationships: *Catostomus snyderi* was first described from Upper Klamath Lake by Gilbert (1897). It is morphologically similar to *C. macrocheilus* of the Columbia River drainage to the north and to *C. occidentalis* of the Sacramento drainage to the south but, genetically, it is most closely related to other suckers found in the Klamath River basin; the Lost River, shortnose, and Klamath smallscale suckers (Tranah and May 2006). Hybridization among these species is so extensive that Klamath largescale and shortnose suckers from the Lost and upper Klamath rivers were found to be genetically indistinguishable (Tranah and May 2006). However, reproductive and ecological segregation between species has maintained distinct morphological identities (Moyle 2002, Ellsworth et al. 2009). Furthermore, Klamath largescale suckers in a tributary to upper Klamath Lake, the Sprague River (Oregon), appear to be genetically distinct from all other populations (Tranah 2001).

Life History: Detailed information is scant on the biology and life history of this species. Mature suckers collected during a spawning migration were aged at 5-8 years (Andreasen 1975) but these ages are probably underestimates, based on ages of similar-sized shortnose and Lost River suckers. Although growth rates have not been determined, they likely become mature at lengths of 20-30 cm FL, at ages of 4-6 years (Moyle 2002). One male was aged as 7 years old at 31 cm FL (Buettner and Scoppetone 1991). In Upper Klamath Lake, spawning migrations occur from March to May, peaking at the end of March, when ripe individuals of both sexes move up river in large numbers. Males migrate before females (Andreasen 1975). Initiation of reproduction was attributed to rising temperatures (range 5.5-19°C) and flow (Janney et al. 2007 in Ellsworth et al. 2009). In Oregon, spawning migration was initiated by water temperatures above 10°C and rising flows (Ellsworth et al. 2009). The fecundity of three females was

estimated as 39,697 (353 mm SL), 64,477 (405 mm SL), and 63,905 eggs (421 mm SL). In the Sprague and Williamson rivers (Oregon), larvae moved quickly from spawning to rearing areas (9-14.5 mm TL) as surface drift at night (Ellsworth et al. 2009). The uniformity of larval drift size suggested that drift only occurs during early swim-up phases.

Historically, adults likely occupied deep lake habitats while juveniles occupied streams or lake margins. A number of larger streams currently support reproducing populations (Scoppetone and Vinyard 1991). Adults have also been found during near-shore and offshore sampling of upper Klamath Lake, suggesting that they use habitats at different depths within the lake (Burdick et al. 2008). Like other large catostomids, Klamath largescale suckers are benthic grazers, preferring invertebrates and algae (Scoppetone and Vinyard 1991, Moyle 2002). Juveniles from upper Klamath Lake fed primarily on zooplankton (Scoppetone et al. 1995).

Habitat Requirements: Although the Klamath largescale sucker is known to inhabit both lentic and lotic habitats, it seems to be primarily adapted to a riverine existence (Andreasen 1975). Little additional information on its ecology is available. They are able to withstand temperatures as high as 32°C, dissolved oxygen concentrations as low as 1 mg/L, and pH levels higher than 10 for short periods of time (Falter and Cech 1991, Scoppetone and Vinyard 1991, Castleberry and Cech 1993). However, streams occupied by Klamath largescale suckers seldom reach water temperatures higher than 25°C (Moyle 2002).

Distribution: Klamath largescale suckers are native to the Lost River-Clear Lake and Klamath River systems in Oregon and California (Moyle 2002). Andreasen (1975) reported them from Upper Klamath Lake, the Clear Lake-Lost River system, the entire Sprague River, the lower 20 km of the Sycan River, and the lower and upper (above Klamath Marsh) Williamson River. In California, they are found in Clear Lake Reservoir, Tule Lake, and the portion of the Lost River between them (USFWS and NOAA 2004, Hodge 2008, Barry et al. 2009, Courter et al. 2010). They possibly occur in the Klamath River and its reservoirs upstream of Iron Gate Dam; however, there is no evidence of self-sustaining populations in this reach.

Trends in Abundance: Abundance estimates for Klamath largescale suckers are lacking. It is likely that their populations have declined in parallel with those of Lost River and Klamath shortnose suckers, with which they co-occur. Both Lost River and shortnose suckers are California Fully Protected Fish and were listed as federally endangered in 1988 (53 FR 27130) and have not recovered (69 FR 43554). Recent surveys of the Lost River (Shively et al. 1999), Clear Lake Reservoir (Barry et al. 2009) and Tule Lake sump (Courter et al. 2010) that focused on capturing the two endangered sucker species have shown Klamath largescale suckers to be present, but in much lower numbers than either of the two listed species.

Nature and Degree of Threats: Klamath largescale suckers in northern California and Oregon have multiple threats to different life stages, including: migration barriers, flow manipulation, pollution, habitat degradation (stream alteration, loss of habitat), harvest, and predation and competition with alien species (Cooke et al. 2005, Table 1). Largescale suckers hybridize with the listed Lost River suckers and shortnose suckers. Most Oregon populations of Klamath

largescale suckers appear stable, perhaps because they are largely stream dwelling (avoiding the polluted waters of upper and lower Klamath lakes) and can cross barriers if fish ladders are present. In contrast, California populations are confined to a reservoir, a highly polluted river, and sump for wastewater.

	Rating	Explanation
Major dams	Medium	Clear Lake Reservoir Dam presumably affects populations in Lost River, CA
Agriculture	High	Agriculture diverts water for irrigation and pollutes the Lost River with fertilizers, pesticides and warm return water
Grazing	Medium	Grazing has adversely impacted water quality in the Lost River watershed
Rural residential	Low	Areas within the range of Klamath largescale suckers are little developed
Urbanization	n/a	
Instream mining	Low	Instream mining has occurred and continues to occur but effects on suckers are unknown
Mining	n/a	
Transportation	Low	Impassible culverts, altered riverbanks, and siltation from roads may limit distribution
Logging	Low	Logging may continue to degrade stream habitats by causing temperature increases and siltation
Fire	Low	Wildfires are common in the Klamath River basin but specific impacts to suckers are unknown
Estuary alteration	n/a	
Recreation	n/a	
Harvest	Low	Past harvest contributed to the decline of suckers in Oregon but is largely absent today
Hatcheries	n/a	
Alien species	High	Predation by and competition with alien species (e.g. yellow perch) has most likely contributed to declines throughout their range

Table 1. Major anthropogenic factors limiting, or potentially limiting, viability of populations of Klamath largescale suckers in California. Factors were rated on a five-level ordinal scale where a factor rated "critical" could push a species to extinction in 3 generations or 10 years, whichever is less; a factor rated "high" could push the species to extinction in 10 generations or 50 years whichever is less; a factor rated "medium" is unlikely to drive a species to extinction by itself but contributes to increased extinction risk; a factor rated "low" may reduce populations but extinction is unlikely as a result. A factor rated "n/a" has no known negative impact. Certainty of these judgments is moderate. See methods section for descriptions of the factors and explanation of the rating protocol.

Dams. Dams in the upper Klamath basin may isolate populations from one another, inhibiting gene flow and recruitment. In California, Clear Lake Dam (which forms Clear Lake Reservoir) may negatively affect Klamath largescale sucker populations through habitat fragmentation, reduced flows, and potential increase of pollutants downstream of the dam. Klamath largescale suckers can become stranded in water diversion canals associated with major dams (Peck 2001, Gutermuth et al. 2000). A total of 432 Klamath largescale suckers were entrained by Link River (Oregon) Dam operations from 1997-1999 *(*Gutermuth et al. 2000*).*

Agriculture. The Lost River and Tule Lake sump are highly polluted with agricultural return water, reducing water quality apparently required by these riverine suckers. Water diversion for agriculture can decrease the amount and diversity of habitat available in the Lost River and often changes flow regimes. Spawning, as well as larval and juvenile drift, appears to be instigated by changes in flow and temperature. In Oregon, cyanobacteria blooms in Upper Klamath Lake are the result of anthropogenic eutrophication; these blooms adversely affect sucker adults and juveniles (due to high pH, low dissolved oxygen, high ammonia) (Bortleson and Fretwell 1993).

Grazing. Grazing has contributed to degraded water quality in the Clear Lake reservoir watershed, Lost River and Tule Lake sump, although studies directly linking grazing impacts to reductions in Klamath largescale sucker populations have not been performed.

Urbanization. Only minor urban development has occurred within their range.

Instream mining. Although impacts are unknown, mining has occurred and continues within their range.

Transportation. Klamath largescale sucker distribution may be limited by impassible culverts and habitat degradation associated with roads.

Logging. Logging continues to impact water quality in this region (increased water temperatures and sedimentation), although this is more a problem in Oregon than in California.

Fire. Wildfires frequently occur within their range but impacts to suckers are unknown.

Harvest. Harvest in Oregon historically contributed to the decline of suckers but is uncommon today.

Alien species. In California, the Lost River ecosystem has been altered by introduction of predatory alien fish species, including yellow perch (*Perca flavescens*) and Sacramento perch (*Archoplites interruptus*). Predation by such fishes on larval and juvenile suckers may have caused sucker declines in California, especially if their populations were already impacted by poor water quality, habitat fragmentation, or other factors. Likewise, competition from fathead minnows (*Pimephales promelas*), abundant in the Lost River and Tule Lake sump, may impact juvenile suckers.

Effects of Climate Change: The most noticeable and widespread impacts of climate change on aquatic habitats in California will be continued increases in water temperatures and changes in the frequency and timing of drought and flooding events. Water temperature increases may reduce the individual fitness of fishes by decreasing growth, decreasing reproductive potential and increasing susceptibility to disease (Moyle and Cech 2004). The Lost River is already a stressful system to suckers, in part because of high summer temperatures, so even small temperature increases may have dramatic impacts.

Climate change will change the periodicity and magnitude of peak and base flows in

streams due to a reduction in snow pack levels and seasonal retention. This may make streams less suitable for spawning and rearing and reduce flows in the Lost River, especially during extended periods of drought. Moyle et al. (2013) determined that Klamath largescale suckers were critically vulnerable to extinction as the result of climate change interacting with other stressors.

Status Determination Score = 1.9 - Critical Concern (see Methods section, Table 2). Klamath largescale suckers are the least abundant of the three large sucker species endemic to the upper Klamath River basin, at least in California. They have been classified as Vulnerable (S3) by NatureServe and as Threatened by the American Fisheries Society (Jelks et al. 2008) due to their restricted range, few populations, and other factors that make the species vulnerable to extirpation. Klamath largescale suckers are listed as a U.S. Forest Service Sensitive Species for Upper Klamath Lake and its tributaries and as a Species of Concern by the USFWS.

Metric	Score	Justification
Area occupied	1	Distribution in California restricted to the Lost River-Clear Lake basin and Tule Lake sump
Estimated adult abundance	2	Populations are likely smaller than the two already listed (endangered) suckers in the California portion of the Klamath basin
Intervention dependence	2	Persistence or re-establishment will require intervention
Tolerance	3	Can withstand high temperatures and pH and low dissolved oxygen concentrations for short periods of time but most abundant where water quality it high
Genetic risk	1	Dams isolate populations and hybridization with shortnose suckers can influence genetic diversity
Climate change	2	Flows in the Lost and Klamath rivers will likely be negatively impacted by climate change
Anthropogenic threats	2	See Table 1
Average	1.9	13/7
Certainty (1-4)	2	Very little information is available on their abundance and ecology in California

Table 2. Metrics for determining the status of Klamath largescale sucker in California, where 1 is a major negative factor contributing to status, 5 is factor with no or positive effects on status, and 2-4 are intermediate values. See methods section for further explanation.

Management Recommendations: Because so little is known about Klamath largescale suckers in California, more information is needed about their abundance, systematics, distribution, habitat requirements, and life history in the state. Management of flows and habitats in the Klamath River drainage should involve establishment of refuge locations for Klamath largescale suckers and other native fishes, preferably including the Lost River. It is quite likely that steps taken to benefit the two formally listed suckers of the upper Klamath basin will also benefit Klamath largescale sucker, but additional measures (such as protection of spawning grounds) are

also needed to specifically protect the species, given that it is rarest of the three upper Klamath sucker species in California. Cooke et al. (2005) recommended establishment of freshwater protected areas for spawning and rearing as critical habitat, restoration of degraded habitats, and fish bypass facilities that are sucker-friendly to protect sucker species in streams of the Pacific Northwest and lakes of the western U.S. Furthermore, they recommend protection of natural flow regimes and water quality, eradication of alien species, habitat restoration, and dam removal. These actions should be coupled with education and outreach programs that emphasize the important ecological role (grazer, nutrient cycler) that suckers play in the habitats where they occur.

Klamath largescale suckers should also be protected because they likely contribute to the evolutionary legacy of shortnose and Lost River suckers, species already listed as endangered (Tranah and May 2006). Protection and restoration of spawning and rearing habitats may be particularly important in maintaining genetic diversity and facilitating recovery of these species.

Figure 1. Distribution of Klamath largescale sucker, *Catostomus snyderi,* in the Klamath and Lost rivers systems in California. Distribution is fragmented within shaded areas.