LOWER KLAMATH MARBLED SCULPIN
***Cottus klamathensis polyporus* Daniels and Moyle**

Status: Moderate Concern. No immediate extinction risk exists for lower Klamath marbled sculpin. However, very little is known about this subspecies and it should be treated with moderate concern until information is available to demonstrate otherwise.

Description: All subspecies of marbled sculpin (*Cottus klamathensis)* have large, dorsally flattened heads with two chin pores; large, fan-like pectoral fins with four elements; and small pelvic fins that are positioned ventrally between the pectorals (Moyle 2002). Marbled sculpin are distinguished from other *Cottus* species by having 7-8 dorsal fin spines, joined dorsal fins, an incomplete lateral line with 15-28 pores, and relatively smooth skin (Daniels and Moyle 1984), although a few prickles can sometimes be felt below the lateral line. They also lack palatine teeth and have only one preopercular spine (Moyle 1976). Fin ray counts are: 18-22 in the second dorsal fin, 13-15 in the anal fin, 14-16 in the pectoral fin, and 11-12 (principal rays) in the caudal fin (Moyle 2002). All other sculpin species in California possess a split dorsal fin and more than 7 dorsal spines. Marbled sculpin are generally green-hued with a dark circular spot at the posterior end of the dorsal fin and alternating dark and light spots on the pectoral fin rays. Fish from the Klamath River are generally lighter and more marbled than those from the Pit River (Moyle 2002). Other marbled sculpin characteristics include: a wide interorbital region, a wide head and blunt snout, a maxillary rarely extending beyond the anterior half of the eye, and unjoined preoperculomandibular canals; however, these characteristics are shared with one or more other species (Daniels and Moyle 1984). Lower Klamath marbled sculpin are identified by 22-28 lateral line pores (Moyle 2002). Other marbled sculpin subspecies have 15-22 pores along the lateral line.

Taxonomic Relationships: *Cottus klamathensis* was first described by Gilbert (1898) from the Klamath River system. Rutter (1908) then described *Cottus macrops* from the Fall River, a large tributary to the Pit River, and noted that it closely resembled *C. klamathensis*. Robins and Miller (1957), upon review of specimens and recent collections, concluded that the two species were not sufficiently different to warrant separate species designations and considered *C. macrops* synonymous with *C. klamathensis*. Daniels and Moyle (1984), however, on the basis of meristic and mensural differences in fish from the Pit River and Klamath River systems, concluded that *C. klamathensis* could be divided into three subspecies: (1) *C. k. klamathensis* (upper Klamath marbled sculpin), the nominate subspecies found in rivers upstream of Klamath Falls and in the headwaters of the Lost River; (2) *C. k. polyporus* (lower Klamath marbled sculpin), found in the lower Klamath River downstream of Klamath Falls, in some of its larger tributaries, and possibly in the Trinity River system; and (3) *C. k. macrops* (bigeye marbled sculpin), found in the Pit River system downstream from the confluence of the Fall River to the Pit 7 Reservoir, and in three tributaries: Hat Creek (downstream of the Rising River system), Burney Creek (downstream of Burney Falls), and the Fall River system (with the exception of Bear Creek). Baumsteiger et al. (2012), using molecular techniques, confirmed that the three subspecies do represent three separate lineages.

Life History: Although specific data were not available, lower Klamath marbled sculpin life history likely mimics that of bigeye marbled sculpin in the Pit River. Bigeye marbled sculpin grow quickly, attaining 35% of their maximum length in their first year and live about five years (Daniels 1987). Growth occurs from spring to early autumn. Average sizes are 39 mm at the age of 1 year, 55 mm at 2 years, 62 mm at 3 years, 70 mm at 4 years, and 79 mm at 5 years. Although fish over 80 mm are rare, one specimen was recorded at 111 mm. Marbled sculpin attain sexual maturity after 2 years during the winter (Moyle 2002). Spawning occurs from late February to March. Adhesive eggs are deposited in clusters in nests under flat rocks. Eggs from different females may be present in the same nest. Nests are usually guarded by males (Daniels 1987). Embryos number from 826-2,200 per nest. Larvae measure 6-8 mm upon hatching, are benthic, and likely rear close to their nests (Moyle 2002).

Habitat Requirements: The habitat requirements of lower Klamath marbled sculpin are not well documented but they seem to occupy a wide variety of habitats, much like the upper Klamath marbled sculpin. Bond et al. (1988) found upper Klamath marbled sculpin were most likely to be collected in water with summer temperatures of 15-20°C, in coarse substrates (cobble and gravel) where water velocities ranged from slow to swift, in streams with widths greater than 20 m. Bond et al. (1988) characterized the marbled sculpin as a slow water species. Markle et al. (1996) noted that, while found in waters with temperatures ranging from 8-24°C, they appear to prefer temperatures of 10-15°C.

Distribution: Lower Klamath marbled sculpin are common in the Klamath River drainage from Iron Gate Dam downstream to the mouth of the Trinity River (Moyle 2002). They are apparently rare or absent in the Klamath River drainage downstream of the Trinity River and in the Trinity River itself, although Voight (2006) recorded them in McGarvey Creek, a tributary to the lower river.

Trends in Abundance: Although survey data do not exist, it is assumed that lower Klamath marbled sculpin are common throughout their native range (Moyle 2002).

Nature and Degree of Threats: Major anthropogenic factors that limit the viability of lower Klamath marbled sculpin populations are not described but factors known to affect stream-dwelling sculpins in the Klamath Basin appear in Table 1. Generally, any factors that alter water quality or cause sedimentation or compaction of substrates likely negatively affect this species. Thus, alteration of stream flow by dams and the effects of poor watershed management (logging, grazing, roads, water diversions) may have impacted lower Klamath marbled sculpin, although supporting data are largely absent.

	Rating	Explanation
Major dams	Medium	Six major dams have presumably resulted in reduced habitat quality and quantity
Agriculture	Low	Diversions a problem mainly in Shasta and Scott valleys
Grazing	Medium	Present throughout Klamath Basin
Rural residential	Low	Drainages where lower Klamath marbled sculpin occur are little developed
Urbanization	n/a	
Instream mining	Low	Changes to channel morphology and aquatic habitats are localized but unstudied
Mining	n/a	
Transportation	Low	Roads line most streams, delivering sediment, pollutants, etc.
Logging	Medium	Major land use in basin that may degrade habitat quality in streams
Fire	n/a	
Estuary alteration	n/a	The Klamath River estuary is assumed to be outside of their range
Recreation	n/a	
Harvest	n/a	
Hatcheries	n/a	
Alien species	Low	Introduced species (e.g., brown trout, bluegill, bullfrog) occur throughout their range and may prey on sculpin

Table 1. Major anthropogenic factors limiting, or potentially limiting, viability of populations of lower Klamath marbled sculpin 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 unlikely as a result; and a factor rated "no" has no known negative impact to the taxon under consideration. Certainty of these judgments is moderate. See methods section for descriptions of the factors and explanation of the rating protocol.

Major dams. Habitats and flows of the Klamath River have been altered by five mainstem dams and one on the Shasta River. Lower Klamath marbled sculpin appear to remain abundant below the lowest-most dam (Iron Gate) but, presumably, suitable habitat has been lost through creation of reservoirs and may be impaired in the interdam reaches (Moyle 2002). Like other native fishes, this sculpin may be negatively impacted by dam releases that do not closely mimic natural flow regimes.

Agriculture. Agriculture within lower Klamath marbled sculpin range is limited to valleys along the Shasta and Scott rivers. In these areas, flows and water quality (especially temperature) are impacted by agricultural diversions, with unknown but probably negative effects on sculpins.

Grazing. Grazing is present throughout the Klamath Basin. In riparian areas, grazing can degrade aquatic habitats by eliminating vegetation and associated shading, eroding stream banks, increasing sediment input and stream temperatures and adding fecal contamination, making these areas less suited for sculpins (Moyle 2002). Open range and allotment grazing are common throughout the range of the lower Klamath marbled sculpin.

Rural development and urbanization. Drainages where lower Klamath marbled sculpin occur are little developed. However, development in places like Yreka may affect local water quality, as may recreational developments (e.g., summer homes around upper Shasta River).

Instream mining. The Scott River (and other streams) now largely flows through an exposed channel surrounded by mining tailings, as a result of intensive historic mining. It is likely that average summer water temperatures are now higher and flows lower than they were prior to mining-related stream alteration. Suction dredging for gold, while currently banned in California, likely disrupted preferred riffle habitats throughout the basin. In both cases, potential effects on marbled sculpin are unstudied.

Logging. Logging on public and private lands is common throughout the range of lower Klamath marbled sculpin. Logging practices can degrade aquatic habitats by increasing sediment delivery to streams and removing riparian vegetation (Moyle 2002). Culverts along logging roads can prevent longitudinal movement, potentially isolating populations.

Alien species. Introduced species (e.g., brown trout, bullfrog) occur throughout their range and may prey on sculpin but, for the most part, alien species are not abundant in sculpin habitats and potential direct or indirect impacts remain unknown.

Effects of Climate Change: The predicted impacts of climate change on aquatic habitats in California include increases in water temperatures and changes to 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. However, specific impacts to lower Klamath marbled sculpin are unknown.

Elevated air temperatures associated with 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. Stream flow in the Klamath River basin is fed by snowmelt from the Cascade Mountains and springs primarily associated with the Shasta River. Flows in the Scott River, Salmon River, and other snowmelt-fed tributaries may be significantly reduced due to the low elevations (< 3000 m) of the Cascade Mountains in northern California (Hayhoe et al. 2004). Stream flows are predicted to increase in the winter and early spring and decrease in the fall and summer (Knox and Scheuring 1991, Field et al. 1999, CDWR 2006), perhaps changing the spawning ecology of fishes. If increased winter and spring flows make floodplain habitats accessible, spawning lower Klamath marbled sculpin may benefit from the additional productivity associated with floodplain habitats. However, if lower Klamath marbled sculpin continue to spawn in main channels, increased winter and spring flows may mobilize stream sediments to the detriment of nests and eggs. Effects to some lower Klamath marbled sculpin populations may be mitigated by dam releases (in the mainstem Klamath River) and spring inputs (Shasta River). Moyle et al. (2013) found the lower Klamath marbled sculpin to be "highly vulnerable" to climate change, but with a low degree of certainty.

Status Determination Score = 3.9 - Moderate Concern (see Methods section, Table 2)**.** NatureServe ranks marbled sculpin in California as apparently Secure (S4), although no specific status is noted for the lower Klamath subspecies. The rationale for this status determination is detailed in Table 2 and is driven by the fact that so little is known about this distinctive sculpin.

Metric	Score	Justification
Area occupied	5	Distributed in the Klamath River and tributaries from Iron Gate Dam to the mouth of the Klamath River
Estimated adult abundance	5	Apparently abundant although robust population and distribution estimates are not available
Intervention dependence	4	Restoration activities that improve salmonid stream habitats should improve conditions for this subspecies
Tolerance	3	Lower Klamath marbled sculpin appear to withstand some environmental fluctuation
Genetic risk	3	No information on genetic structure but some populations may be fragmented
Climate change	3	Reaches that are solely fed by snowmelt may have reduced habitat quantity and/or quality under predicted scenarios
Anthropogenic threats	4	See Table 1
Average	3.9	27/7
Certainty (1-4)	1	Little information specific to lower Klamath marbled sculpin is available

Table 2. Metrics for determining the status of lower Klamath marbled sculpin, 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: Management of lower Klamath marbled sculpin is challenged by the lack of data on abundance, environmental tolerance and population structure. Baseline surveys are needed to establish relative abundance of this subspecies within its range. Subsequent surveys (recommend every 5 years) will help determine general abundance trends. Studies are needed to establish the environmental tolerances of this subspecies, especially to factors likely affected by land use and climate change, including: temperature, turbidity, sedimentation, and water velocity. These studies would be complemented by a detailed investigation of the life history and genetic structure of meta- and sub-populations. Other recommendations are to protect and/or enhance aquatic habitats through active management of water and land use practices. For instance, changes in management of hydroelectric projects or actions to favor salmonids should take into account the needs of the native fauna, including lower Klamath marbled sculpin. Water releases from dams should mimic natural flow regimes in scale and periodicity. Also, buffers from grazing and logging activities should be established to protect stream habitats against nonpoint source pollution and stream bank destabilization.

Figure 1. Distribution of lower Klamath marbled sculpin, *Cottus klamathensis polyporus,* in California.