WESTERN RIVER LAMPREY
Lampetra ayresi

Status: Moderate Concern. Very little is known about the western river lamprey in California but it is uncommon in the state and potentially in decline.

Description: The western river lamprey is a small, predatory, species. Spawning adults reach a maximum size of about 17-18 cm TL. The oral disc is at least as wide as the head. The 'teeth' (horny plates) in the oral disc are conspicuous and pointed; however, they can be blunt in spawning individuals. The middle cusp of the transverse lingual lamina has three large lateral (circumoral) plates on each side; the outer two have two distinct cusps, while the middle one has three. The supraoral plate has only two cusps that often appear as separate teeth, while the infraoral plate has 7-10 cusps. The eye width is 1 to 1.5 times the distance from the posterior edge of the eye to the anterior edge of the first branchial opening. The number of trunk myomeres averages 68 in adults and 67 (65-70) in ammocoetes. Adult river lampreys are dark on the back and sides and silvery to yellow on the belly with a darkly pigmented tail. Ammocoetes have somewhat pale heads, a prominent line behind the eye spot, and a tail in which the center tends to be lightly pigmented (Richards et al. 1982).

Taxonomic Relationships: The western river lamprey was described in 1855 by William O. Ayres, from a single specimen collected in San Francisco Bay, as *Petromyzon plumbeus*. Because that name had already been given to a European lamprey, it was renamed *P. ayresi* in 1870. A careful redescription of the river lamprey by V.D. Vladykov and W.I. Follett (1958) demonstrated its distinctiveness. The Pacific brook lamprey (*L. richardsoni*) and Kern brook lamprey (*L. hubbsi*) apparently evolved independently from river lampreys. See the Kern brook lamprey account in this report for further discussion of taxonomic relationships.

Life History: Western river lampreys have not been studied in California (Moyle 2002); therefore, the information in this account is based on studies in British Columbia (Roos et al.1973, Beamish and Williams 1976, Beamish 1980, Beamish and Youson 1987).

Larval river lampreys (ammocoetes) begin transformation into adults when they are about 12 cm TL, during summer months. Metamorphosis may take 9-10 months, the longest known for any lamprey. Newly metamorphosed lampreys may aggregate immediately upriver from salt water and enter the ocean in late spring. Adults apparently only spend 3-4 months in salt water where they grow rapidly, reaching 25-31 cm TL.

River lampreys prey on fishes in the 10-30 cm TL size range; the most common prey appear to be herring and salmon. Unlike other species of lamprey in California, river lampreys typically attach to the back of the host fish, above the lateral line, where they feed on muscle tissue. Feeding continues even after death of the prey. River lamprey predation may negatively affect prey populations if both prey and predator are concentrated in small areas (Beamish and Neville 1995). River lampreys can apparently feed in either salt or fresh water.

Adults migrate back into fresh water in the fall and spawn during the winter or spring months in small tributary streams, although the timing and extent of migration in California is poorly known. While maturing, river lampreys can shrink in length by about 20 percent. Adults create saucer-shaped depressions in gravelly riffles for spawning by moving rocks with their mouths. Fecundity estimates for two females from Cache Creek, Yolo Co., were 37,300 eggs

from one 17.5 cm TL and 11,400 eggs for one 23 cm TL (Vladykov and Follett 1958). It is assumed that adults die after spawning, although this life history attribute has not been carefully documented in California. Ammocoetes remain in silt-sand backwaters and eddies and feed on algae and microorganisms. River lampreys spend an unknown amount of time as ammocoetes (probably 3-5 years), so the total life span is likely 6-7 years.

Habitat Requirements: The habitat requirements and environmental tolerances of spawning adults and ammocoetes have not been studied in California. Presumably, like other lampreys, adults need clean, gravelly riffles in permanent streams for spawning, while ammocoetes require sandy to silty backwaters or stream edges in which to bury themselves, where water quality is continuously high and temperatures do not exceed 25°C.

Distribution: Western river lampreys occur in coastal streams from just north of Juneau, Alaska, south to San Francisco Bay. In California, they have been recorded from the Sacramento and San Joaquin Delta while migrating, tributaries to the San Francisco Estuary (Napa River, Sonoma Creek, Alameda Creek), and tributaries to the Sacramento and San Joaquin rivers (e.g. Tuolumne River, Stanislaus River, Cache Creek). A land-locked population may exist in upper Sonoma Creek (Wang 1986). There are no recent records of river lamprey in Oregon and most older records are for the Columbia River basin (Kostow 2002). Likewise, they are known only from two large river systems in British Columbia in the center of their range (Beamish and Neville 1992).

Trends in Abundance: Western river lamprey population trends are unknown in California but it is likely that they have declined, concomitant to degradation and fragmentation of suitable spawning and rearing habitat in rivers and tributaries throughout their range in the state, along with declines in prey species (e.g., Chinook and coho salmon, steelhead trout, etc.). River lamprey are abundant within a limited geographic area of British Columbia, at the center of their range, but there are relatively few records from California, which comprises the southern end of their range.

Nature and Degree of Threats: The western river lamprey has become uncommon in California; it is likely that populations are declining because the Sacramento, San Joaquin and Russian rivers, along with their tributaries, have been severely altered by dams, diversions, development, agriculture, pollution, and other factors. They spawn and rear in the lower reaches of rivers and are, thus, highly vulnerable to alteration from agriculture and urbanization, as well as pollution. Two tributary streams where spawning has been recorded in the past (Sonoma and Cache creeks) are both severely altered by channelization, urbanization, and other impacts. See the Pacific lamprey account in this report for more specific information on stressors that negatively affect anadromous lamprey abundance.

	Rating	Explanation
Major dams	Medium	Most rivers within range are regulated by major dams
Agriculture	Medium	Lower stream reaches are impacted by diversions and impaired water quality
Grazing	Low	Present along most rivers; impacts likely minimal in large river systems
Rural residential	Low	Rural development is increasing rapidly across species' range; direct effects unknown but habitat degradation and reduced instream flows likely contribute to declines
Urbanization	Medium	Known range in Central Valley mostly urbanized
Instream mining	Low	Gravel mining common in preferred spawning streams
Mining	Low	Impacts unknown
Transportation	Medium	Roads, bridges, and ship canals alter habitats and are sources of pollutants
Logging	Low	Impacts to lower portions of larger river systems likely minimal
Fire	n/a	
Estuary alteration	Medium	Extent of estuary utilization unknown; estuaries likely constitute important feeding habitats that have been heavily altered and degraded throughout the state
Recreation	n/a	
Harvest	n/a	
Hatcheries	n/a	
Alien species	Low	May be prey for some alien species; may also prey upon certain alien species (e.g., American shad)

Table 1. Major anthropogenic factors limiting, or potentially limiting, viability of western river lamprey populations 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 to the taxon under consideration. Certainty of these judgments is low. See methods section for descriptions of the factors and explanation of the rating protocol.

Effects of Climate Change: With so little known about this species, climate change effects are hard to predict. Nevertheless, the fact that California marks the southern end of its range, combined with its presence in the lower reaches of just a few large, regulated rivers, suggests that altered flow regimes and temperatures could further reduce or eliminate populations. Moyle et al. (2013) considered river lamprey to be "highly vulnerable" to climate change mainly because of its limited distribution and likely small populations, coupled with lack of knowledge about its basic biology in California.

Status Determination Score = 3.6 – Moderate Concern (see Methods section Table 2). Very little is known about this species in California but, given its dependence on lower reaches of large, regulated rivers, the river lamprey may be vulnerable to altered flows, altered habitats through urbanization, urban and agricultural pollutants, and similar factors (Table 2). Jelks et al. (2008) list it as being 'vulnerable' to extinction due to habitat changes, while NatureServe calls it "apparently secure" over its entire range.

Metric	Score	Justification
Area occupied	4	Known from at least 5 watersheds
Effective population size	3	This rating is likely high based on limited catches in sampling programs
Intervention dependence	5	Populations appear self-sustaining; habitat improvements may benefit populations in some areas
Tolerance	3	Presumed similar to brook lamprey
Genetic risk	4	Gene flow among populations not known
Climate change	3	Poorly understood because distribution and environmental tolerances are largely unknown; score assumes reduced habitat suitability and higher water temperatures will negatively affect river lamprey populations
Anthropogenic threats	3	See Table 1
Average	3.6	25/7
Certainty (1-4)	1	Little information available

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

Management Recommendations: The western river lamprey cannot be properly managed until more is known about its biology. Studies and field surveys to assess the river lamprey's distribution, abundance, life history and habitat requirements in California should to be implemented. The lower portions of the Sacramento and San Joaquin rivers, along with portions of the Bay Delta, should be targeted for initial studies and surveys since migratory river lampreys are caught in the Delta on a regular basis in various sampling programs. Presumably, restoring natural flow regimes and reducing inputs of pollution and sediment to its spawning streams will benefit the river lamprey but, given that so little is known about its tolerances and requirements, specific restoration actions and management recommendations cannot be developed without further study.

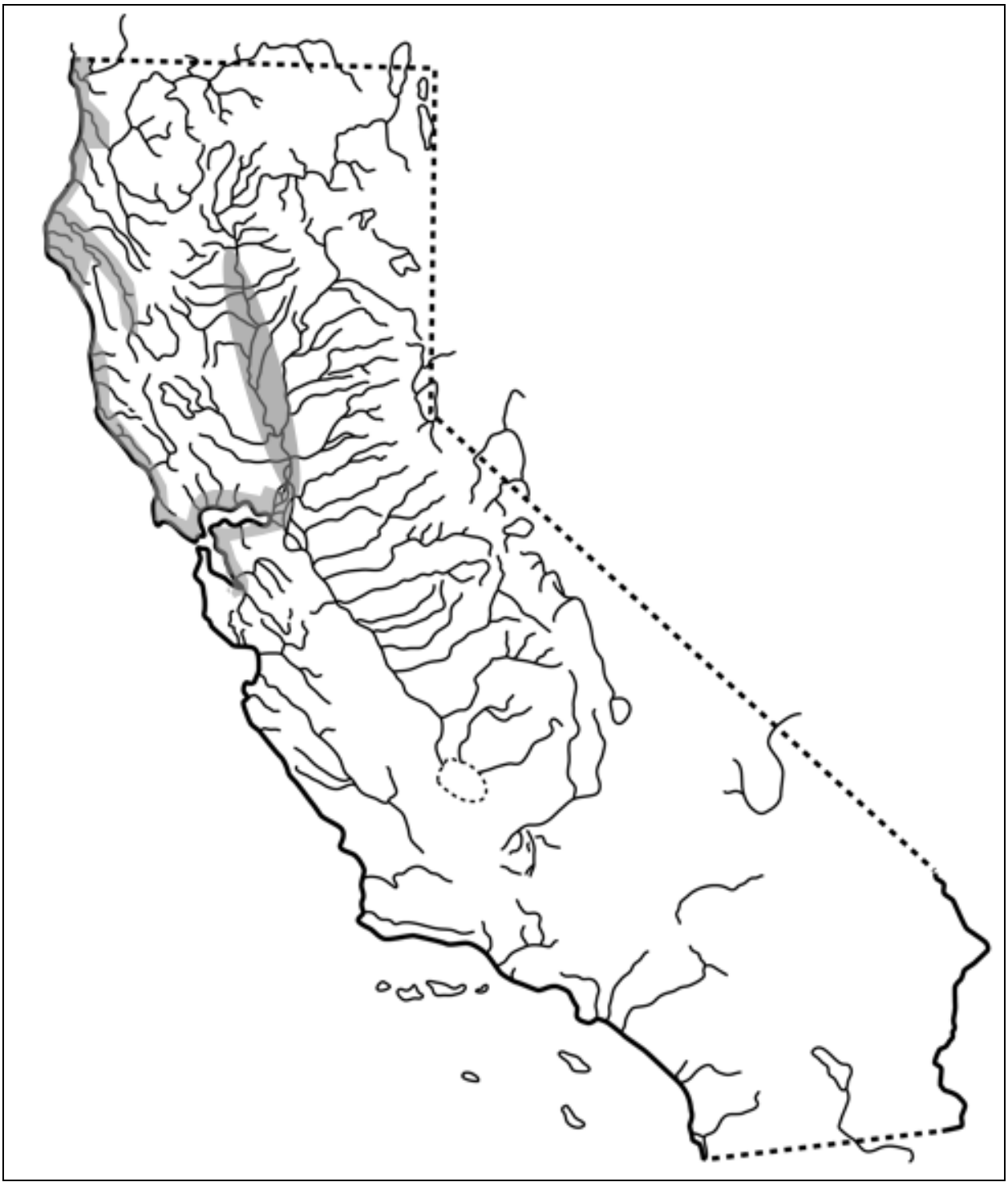

Figure 1. Presumed distribution of western river lamprey, *Lampetra ayresi*, in California. Distribution along the north coast is based on available passage to suitable habitats, rather than actual collection records.