RUSSIAN RIVER ROACH
Lavinia symmetricus ssp.

Status: Moderate Concern. Although apparently in no danger of extinction, Russian River roach populations could decline or become extirpated from large portions of their range as result of alterations to streams, changes in climate, water withdrawal for urbanization and rural residential development, as well as water demands and pollutant runoff associated with rapidly expanding viticulture.

Description: Russian River roach are a small (adult size typically 50-120 mm), bronzy minnow (cyprinid), which are very similar to the Central California roach. However, they differ in having a trim, slender body, a somewhat pointed snout, a slender caudal peduncle and long fins. Russian River roach have a mean of 8.7 dorsal fin rays and 8.1 anal fin rays (Hopkirk 1973). Individuals rarely exceed 120 mm; the largest roach captured during a 2007 survey in Austin Creek, a tributary to the Russian River (Sonoma County), was 116 mm and weighed 20.5 g (Figure 1). The following account of roach morphology is based on information from roach populations outside the Russian River watershed.

Roach are small, stout-bodied, minnows with a narrow caudal peduncle and a deeply forked tail. Fish rarely achieve lengths greater than 100 mm total length. The head is large and conical. The eyes are large and the mouth is subterminal and slants at a downward angle. The dorsal fin is short (7-9 rays) and is positioned behind the insertion point of the pelvic fin. The anal fin has between 6-9 rays. The pharyngeal teeth (0,5-4,0) have curved tips with overhanging grinding surfaces of moderate size. Roach are usually dark on the upper half of their bodies, ranging from a shadowy gray to a steel blue, while the lower half of the body is much lighter, usually a dull white/silver color. The scales are small, numbering 47-63 along the lateral line and 32-38 before the dorsal fin. Roach exhibit general (non-nuptial) sexual dimorphism (Snyder 1908d, Murphy 1943). Snyder (1905, 1908d) demonstrated that the sexes could be differentiated by the ratio of pectoral fin length to body length. Males exhibit a ratio of $\geq$.21, while females have pectoral fins between .16 and .20 the length of their body. Both sexes exhibit bright orange and red breeding coloration on the operculum, chin and the base of the paired fins. Males may also develop numerous small breeding tubercles (pearl organs) on the head (Murphy 1943).

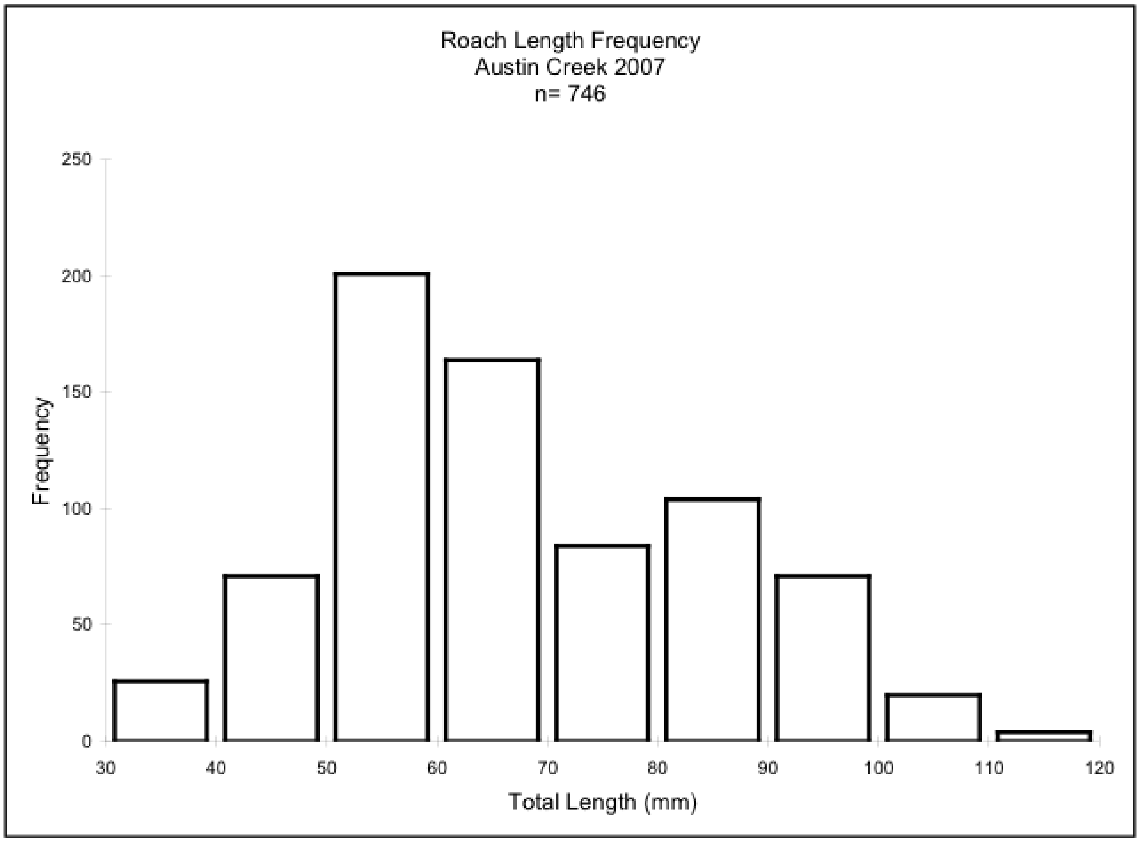

Figure 1. Length frequency of Russian River roach greater than 30mm, from Austin Creek, Sonoma County, February 15–June 15, 2007. J. Katz, unpublished data.

Taxonomic Relationships: Russian River roach were first collected by Snyder (1908d, p. 175) who recognized them as *Rutilus symmetricus* and found them to be "alike in all respects" to *R. symmetricus* from the Napa River and to "agree closely with representatives from the streams tributary to San Francisco Bay." In 1913, Snyder revised the systematics of roach, describing six species and erecting a new genus, *Hesperoleucus*, to house them. True to his initial assessment, Snyder placed Russian River roach into the species *H. venustus* along with roach from the streams entering San Pablo, Suisun, and San Francisco bays. In a footnote from a paper on hybridization between hitch (*Lavinia exilcauda*) and roach in the Monterey basin, Miller (1945) suggested that Snyder's roach species should be treated as geographic subspecies. In an unpublished M.S. thesis, Murphy (1948) agreed with Miller and concluded that all coastal species of roach should be reduced to subspecific status of *H. symmetricus*. Although critical of Murphy's reasoning, Hopkirk (1974) agreed with the diagnosis of placing all roach within one species. He reached different conclusions, however, as to which roach populations belonged to which subspecies. It is worth noting that Hopkirk (1974) asserted that roach from the Russian River were more closely related to those from the Navarro River than they were to populations from the San Francisco Bay region. Roach from the Russian River are presumed to be the parent stock of roach in the Gualala and Navarro rivers, to which they were likely transferred by headwater stream capture.

Based on the morphological evidence presented by Hopkirk (1973), Moyle et al. (1995) moved roach from the Russian River into *L. s. navarroensis*. However, subsequent genetic analysis (Jones 2001), using mitochondrial DNA (mtDNA), found that roach from the Russian River were more closely related to roach from Clear Lake than they were to those from the Navarro River, leading Moyle (2002) to propose grouping roach from the Russian River and Clear Lake roach as a new subspecies. The most recent genetic analysis (Aguilar and Jones 2009) used both mtDNA and nuclear DNA microsatellites (nDNA). The mtDNA analysis found that a number of mtDNA haplotypes were shared by fish from the Russian River and Clear Lake, adding support to their grouping as a common lineage. The microsatellite analysis, on the other hand, suggested that roach from the two basins should be treated as separate taxonomic entities.

As the mixed results suggest, there is considerable confusion regarding the interpretation of genetic information in the roach/ hitch species complex (Avise 1975, Avise and Ayala 1976, Jones 2001, Aguilar and Jones 2001). In light of remaining uncertainties, the precautionary approach is to treat the Russian River roach and Clear Lake roach as distinct and separately managed taxa until sufficient evidence is presented to determine otherwise.

Interestingly, Murphy (1948c) noted that roach from Austin Creek were the most morphologically divergent of all roach populations sampled from the watershed. No genetic studies have included roach from Austin Creek so the distinctiveness of this population has not been verified. However, Murphy's morphometric evidence suggests that the Russian River, like the Central Valley, may contain distinct roach populations endemic to tributary watersheds. An additional biogeographical consideration is the fact that Austin Creek shares a watershed boundary with the Gualala River, which contains a genetically divergent roach population. The geographic proximity of these two basins and the distinctive nature of their respective roach populations highlights the need for a thorough taxonomic study of all coast range roach populations.

See the Central California roach account in this report for a general description of roach systematics in California

Life History: The life history of the Russian River roach is largely unstudied. It is reasonable to assume that its life history is similar in most respects to that of the similar Central California roach, presented in this report.

Russian River roach spawn in spring and early summer, after water temperatures exceed 16°C, although spawning activity has been observed well into July (Moyle 2002). Length frequencies (Figure 1) suggest that they rarely live more than three years. They are presumably omnivorous, similar to other populations of California roach although, in Austin Creek, roach were observed taking mayflies at the surface, much like rising trout (J. Katz, pers. obsv.).

Habitat Requirements: Roach are found in a wide variety of habitats in the Russian River, including the main river where there is cover (e.g. fallen trees) to protect them from predators. They are most abundant, however, in tributaries. Pintler and Johnson (1958) found that roach accounted for between 45% and 60% (average 54%) of numeric fish abundance). Likewise, Price and Geary (1978, 1979) found that Russian River roach were frequently the dominant fish in small (0.025-0.10 m^2/sec summer flows) tributary streams with clear, well oxygenated, water, dominant substrates of cobble and boulder, and shallow depths (average 10-50 cm) with pools up to 1 m deep. Temperatures in these tributaries rarely exceed 25°C because they are well shaded. Roach and Sacramento suckers were the primary fishes documented in pools created by recreational summer dams on these tributaries (Cox 1984).

In the Russian River mainstem, roach are most common around the mouths of tributaries (Pintler and Johnson 1958). In beach seine surveys, Cook et al. (2003-2007) found that the fish assemblage at the confluence of Austin Creek was dominated by steelhead, tule perch, and roach, in order of abundance. Hopkirk et al. (1980) found that roach constituted a minor part of the large schools of juvenile cyprinids and Sacramento suckers (*Catostomus occidentalis*), which were numerous in the shallow side-channels of the mainstem in spring. It is possible that the distribution and abundance of roach in the Russian River is limited by the presence of alien predators, mainly smallmouth bass (*Micropterus dolomieui*) and green sunfish (*Lepomis cyanellus*).

Distribution: Russian River roach are restricted to the Russian River and its tributaries. They are among the dominant species in the middle sections of many tributary creeks, including Mark West and Santa Rosa creeks (Chase et al. 2005), Maacama Creek (Merrit Smith Consulting 1995, 2003), Austin Creek (Katz et al. 2006, 2007) and Big Sulphur and Pieta creeks (Price and Geary 1978, 1979).

In the mainstem Russian River, they account for only a small percentage of the fish assemblage in the middle and lower reaches (Pintler and Johnson 1958, Chase et al. 2001-2005, Cook et al. 2005). Roach become increasingly rare in the lower sections of the main river, where their downstream limit appears to be the upper portions of the estuary near Duncans Mills. However, Goodwin et al. (1993) found that roach tended to move down into the main body of the estuary and Willow Creek marsh during the summer and return to upstream habitats in the fall.

Trends in Abundance: Little is known about Russian River roach abundance trends since few survey data exist. As such, there is no indication that they are less abundant now than in the past; however, population monitoring is needed in order to establish baseline abundance and trend information.

Nature and Degree of Threats: Although resilient, Russian River roach may be negatively impacted in streams that are: (1) dewatered for residences, vineyards, pasture and other uses, (2) heavily altered by channelization, and (3) invaded by alien predators such as green sunfish (*Lepomis cyanellus*).

Agriculture. In the Russian River basin, the high rate of conversion of forestland to vineyards is a principal threat to native fishes. Forestland conversion to viticulture (hillside vineyards in particular) directly impacts flow in small streams. Deitch et al. (2009a,b) showed that vineyard irrigation and frost protection significantly reduce in-stream flow in Russian River tributaries and a regulatory process has been implemented to mitigate impacts. In spite of mitigation measures, widespread alteration to basin hydrology and aquatic ecosystems from vineyard conversion may remain an ongoing threat. Marijuana cultivation may also pose a threat to the fishes of the Russian River drainage, although no studies to demonstrate potential impacts have been performed in this area.

	Rating	Explanation
Major dams	Low	Dams control flows in the Russian River, altering the natural hydrograph and water quality
Agriculture	Medium	Water demands increasing for viticultural irrigation and frost protection
Grazing	Medium	Grazing is a major landscape use with negative effects on small streams
Rural Residential	Medium	Diversions or pumping from shallow wells can reduce flows or dewater streams
Urbanization	Medium	Santa Rosa and surrounding communities contribute to water withdrawal, pollution and altered aquatic habitats
Instream mining	Medium	Gravel mining in the main river simplifies habitat and increases turbidity
Mining	Low	Legacy effects from past mining plus hardrock mining for aggregate
Transportation	Medium	Watershed heavily roaded; associated impacts from siltation, channelization and habitat loss
Logging	Low	Mostly legacy effects; current timber harvest levels greatly reduced from past
Fire	Low	Fire frequency and intensity may increase with land use alterations and climate change
Estuary alteration	n/a	
Recreation	Low	Heavy recreational use; little direct threat
Harvest	n/a	
Hatcheries	n/a	
Alien species	High	Intolerant of introduced predatory fishes, especially centrarchids (e.g., smallmouth bass)

Table 1. Major anthropogenic factors limiting, or potentially limiting, viability of populations of Russian River roach. 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.

Grazing. Livestock grazing is a major land use of the Russian River watershed and heavy grazing by cattle can cause stream bank sloughing, stream incision, loss of riparian vegetation, and may contribute to reduced flows or earlier drying of tributary streams.

Rural residential. Residences are scattered throughout the watershed and diversions or pumping from shallow wells can dewater streams or reduce flows. Septic tank effluent may be a localized impact in some portions of the watershed.

Urbanization. Santa Rosa and surrounding communities are growing rapidly with increased water demand, associated alteration to streams and aquatic habitats, and pollution through urban run-off.

Instream mining. Gravel mining has long been a contentious practice in the Russian River, although gravel is increasingly mined outside of the stream channel. Gravel mining in the main river simplifies habitat and increases turbidity, which may reduce habitat suitability for roach and other fishes.

Transportation. Much of the Russian River and its tributaries are bordered by roads, potentially resulting in increased siltation, channelization, pollutant input, and habitat loss or degradation.

Alien species. Non-native fishes are increasingly common in the Russian River watershed, especially in ponds and reservoirs. Long-established smallmouth bass populations are likely restricting roach distribution in the main river. Invasions of green sunfish have the potential to eliminate roach from small streams, as has been documented elsewhere in California (Moyle 2002).

Effects of Climate Change: Russian River roach are well adapted to the warm, arid conditions of California’s Mediterranean climate but their restriction to intermittent pools during drought periods suggests that they may be particularly susceptible to increasing aridity associated with climate change. Roach are one of the few native fishes that are able to endure life in isolated summer pools in intermittent streams, where temperatures increase, dissolved oxygen levels drop, and most other fishes die. John O. Snyder (1905) observed roach were able to persist when “nothing remains of the stream but a few small disconnected pools.” While such tenacity bodes well for roach in a future of dwindling in-stream water supplies, it also suggests that they may be extirpated from streams which may dry completely under the dual strains of decreased precipitation and increased human water demand, including surface and ground water withdrawal for vineyard expansion and rural residential development. The increasingly stressful conditions likely to be found in the Russian River and its tributaries, as the result of climate change acting in concert with urban and agricultural development, led Moyle et al. (2013) to rate the Russian River roach as “highly vulnerable” to extinction as the result of climate change, if present trends continue.

Status Determination Score = 3.3 - Moderate Concern (see Methods section Table 2). Russian River roach do not appear to be in danger of extinction, although gradual loss of tributary populations, combined with changes to the main river itself that have largely eliminated connectivity between tributaries, may limit distribution, reduce abundance, and impede or prohibit natural recolonization. The Russian River roach is listed as “G5T2T3, Imperiled” by NatureServe, where it is included in a taxon described as the Clear Lake-Russian River roach subspecies.

Metric	Score	Justification
Area occupied	3	Widespread in the Russian River and its tributaries
Estimated adult abundance	5	Populations large and numerous
Intervention dependence	3	Protection of small streams (tributaries) needed
Tolerance	4	Remarkably resilient fish
Genetic risk	3	Little threat to genetic integrity if assumed to be a single taxon, although may be multiple taxa
Climate change	3	Complete drying of intermittent streams may extirpate roach from tributary watersheds
Anthropogenic threats	2	See Table 1
Average	3.3	23/7
Certainty (1-4)	2	Little published information

Table 2. Metrics for determining the status of Russian River roach, 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: A comprehensive survey of the Russian River watershed is needed in order to determine Russian River roach distribution and abundance. In particular, streams that have been previously surveyed should be resurveyed to establish trend information. Further genetic studies are needed in order to clarify taxonomic relationships. Streams with intact habitats and minimal stressors should be selected as refuges for native fishes and amphibians and managed accordingly. Opperman and Merenlender (2004) studied Russian River tributaries and provided management recommendations, including maintaining live trees (live woody debris) in riparian zones and in stream channels to create pool habitats that roach prefer.

Understanding the relationship between groundwater withdrawal and stream flow in Russian River tributaries is of prime importance to the management of native fishes in the basin. Merenlender et al. (2008) developed GPS-based water resource analysis tools designed to quantify and balance water needs and water resources on a watershed scale. These tools were created to aid in sustaining instream flow while simultaneously enhancing water security for local landowners and vineyard operators. Applications include evaluation of various water-policy scenarios, estimation of the cumulative effects of water extraction methods on the natural hydrograph across a large spatial scale (including temporal variation), and deriving information for watershed-level planning required to recover environmental flows. If utilized in conjunction with quantitative surveys of streamflow and groundwater withdrawal, these analytical tools may be of great value in the Russian River watershed (and others) where human water demand may exceed supply and reduction in instream flows may be exacerbated by predicted climate change impacts.

Figure 2. Distribution of Russian River roach, *Lavinia symmetricus* ssp., in California.