

**RED HILLS ROACH**  
*Lavinia symmetricus* ssp.

**Status: High Concern.** Red Hills roach have an extremely limited range in habitats that can easily become dewatered. Continued monitoring is needed to ensure their persistence, with a rescue plan in place if their streams are threatened with drying.

**Description:** The Red Hills roach is a small, bronzy minnow. In Horton Creek, the average length of adult specimens was 52 mm SL (Brown et al. 1992). They can be differentiated from neighboring populations of *Lavinia* by their shallower body profile, smaller interorbital distance, and fewer pectoral and pelvic fin rays (Jones et al. 2002). Red Hills roach exhibit a much higher frequency of a cartilaginous projection on the lower lip referred to as a “chisel lip” than any other roach population known (Brown et al. 1992). However, there appears to be substantial temporal variation in frequency of the chisel lip condition (Jones et al. 2002). Brown et al. (1992) suggested that the flattened body morphology of the Red Hills roach is reminiscent of that of speckled dace.

Spawning coloration is as follows: “The body is dark brown to brassy above, dark black lateral band, and brilliant white below, splashed with black blotches on the sides. Dorsal and caudal fins [are] dark olive-brown to reddish-brown, with the rays often deep-olive and with the nearly clear interradiation membranes faintly flushed with brassy color; pectoral fins [are] yellowish with orange-red axils and very strong orange coloration at base; anal and pelvic fins [are] bright orange-red at the base with lessening coloration towards the rays. Cheeks and operculars with strong gilt reflections; strong orange coloration is found on the edges of the mouth (especially in males) with some blending into the upper mouth region. Lateral line [is] more strongly gilt than adjacent parts of body, thus often obscuring the lateral line. In females, the coloration is similar but less intense except for the orange coloration at the base of the paired fins that appears equally intense in both sexes. Males can be distinguished primarily by breeding tubercles on the top of the head.” (W. J. Jones, pers. comm. 2009).

**Taxonomic Relationships:** A morphological analysis of *Lavinia symmetricus* (Brown et al. 1992) first suggested the existence of an unrecognized taxon of *Lavinia* in Horton Creek, a tributary to Don Pedro Reservoir on the Tuolumne River, Tuolumne County. A multivariate analysis of fifteen morphological characters found Red Hills roach to diverge significantly from populations in eight tributary drainages of the San Joaquin River, as well as from other populations in the Tuolumne watershed (Brown et al. 1992). Subsequent studies found Red Hills roach to be reciprocally monophyletic for the mitochondrial DNA (mtDNA) haplotypes assayed and distinct from adjacent populations in both the Stanislaus and Tuolumne river drainages (Jones et al. 2002). Additional morphometric analysis also found roach from all tributaries to Six Bit Gulch, including Horton Creek, to group together and to differ significantly from all adjacent populations (Jones et al. 2002). Mitochondrial evidence suggests past exchange between Red Hills roach populations and roach in Becca B, Hatch and Second creeks (now separated from Six Bit Gulch by Don Pedro Reservoir), but Red Hills roach have been isolated for, at minimum, 200 years (Jones et al. 2002). Moyle et al. (1995) and Moyle (2002) treat the Red Hills roach as an undescribed subspecies.

**Life History:** No life history studies of the taxon have been conducted. Their basic life history is presumably most similar to that of Central California roach, from which they likely differentiated. See the Central California roach account in this report for a generalized life history description.

**Habitat Requirements:** The Red Hills region is characterized by one of the largest outcroppings of serpentine rock in the Sierra Nevada. Serpentine soils contain high concentrations of iron and magnesium and, as a result, are inhabited by predominantly endemic organisms which have evolved tolerances for such conditions. Red Hills roach occur in the spring-fed intermittent creeks of Six Bit Gulch, which is the primary drainage of the Red Hills (Jones et al. 2002). Red Hills roach are found in several pools and perennial stream reaches fed by springs (W. Jones pers. comm. 2009; field observations by authors, 2010). During summer, roach are confined to these few localities of perennial water but, during higher spring flows, they move upstream to spawn (W. J. Jones pers. comm. 2009).

Other fishes that can co-occur with Red Hills roach include native Sacramento sucker, *Catostomus occidentalis*, rainbow trout, *Oncorhynchus mykiss*, and introduced western mosquitofish, *Gambusia affinis*. W. Jones (pers. comm. 2009) has also documented large numbers of introduced green sunfish, *Lepomis cyanellus*, in lower Six Bit Gulch.

**Distribution:** The Red Hills roach is confined to Six Bit Gulch and its tributary streams; Amber Creek, Horton Creek, Minnow Creek and Poor Man's Gulch (Jones et al. 2002). Six Bit Gulch enters a western arm of Don Pedro Reservoir on the Tuolumne River, near Sonora, Tuolumne County. In July, 2010, roach were observed in three discontinuous wetted reaches of Horton Creek, which covered approximately 500 meters in total wetted length (P. Moyle, unpublished observations). However, only the lower reach, which extends about 200 meters upstream from the confluence with Six Bit Gulch, appeared to be perennial as indicated by lush growth of sedge and other riparian vegetation. A natural fish barrier approximately 1.2 km upstream from the confluence likely inhibits roach from accessing upper Horton Creek. Roach were also observed in Six Bit Gulch where it is forded by Six Bit Ranch Road and in a pool in Roach Creek.

**Trends in Abundance:** Jones et al. (2002) estimated total abundance at 200-500 individuals. More recent abundance estimates have not been performed.

**Nature and Degree of Threats:** The small, intermittent streams that comprise the entirety of Red Hills roach habitat are acutely vulnerable to human alteration. While some protection is offered by the 7,100 acre Red Hills Area of Critical Environmental Concern (ACEC, Bureau of Land Management), the protected area excludes most streams, with much of the Six Bit Gulch watershed on private land. Red Hills roach are threatened by a combination of land use practices and introduced fishes. These factors, in conjunction with the complete isolation of Six Bit Gulch from other roach populations and predicted outcomes of climate change, threaten Red Hills roach with extinction.

*Dams.* The construction of Don Pedro Dam in 1923 created Don Pedro Reservoir

and flooded the lower portion of Six Bit Gulch. The reservoir is thought to be a barrier to long-distance roach dispersal and, therefore, effectively isolates Red Hills roach from all other roach populations. The reservoir also fragments Red Hills roach populations by isolating Poor Man's Gulch from Six Bit Gulch.

*Grazing.* The Red Hills are poor grazing lands because of the unique serpentine soils and sparse vegetation communities but even limited grazing can damage aquatic habitats because cattle concentrate around scarce water sources. Observations in July, 2010, indicated that grazing impacts were minimal but even a few head of cattle could have a major impact on the limited riparian and aquatic habitats available to Red Hills roach. Grazing may cause stream bank collapse, pool sedimentation, eutrophication from animal wastes, and reduction or elimination of already scarce cover and shading. Impacts from grazing would likely be particularly acute in summer and fall months, when perennial aquatic habitats are restricted to a few isolated pools.

*Rural residential development.* The foothills of the Sierra Nevada are being rapidly developed for dispersed rural residences and private lands in the Red Hills watershed are vulnerable to development, in spite of the unique landscape that features poor soils, few trees, and shortage of water. Tuolumne County is one of California's fastest growing counties and much of the Red Hills region is threatened by development. Residential development can threaten roach through water diversion during low-flow periods, pollutants (especially inflow from septic tanks), siltation from roads, and loss of complex habitat through bank stabilization projects.

*Transportation.* Most of the stream courses within the Red Hills roach range are lined by roads, which may contribute to increased sedimentation, channelization and pollution input.

*Mining.* Historic placer mining in the Red Hills region dramatically altered the hydrology and geomorphology of streams and introduced vast amounts of sediment into the Tuolumne River and its tributaries. However, the legacy effects of landscape-scale alteration to the watershed are unknown.

*Recreation.* Off-road vehicle use and other human recreational activities that damage banks and streambeds or reduce riparian vegetation around Red Hills roach summer habitat are particularly serious threats (B. Quelvog, CDFW, pers. comm. 1995). Off-road vehicle use is banned in the BLM ACEC but not on private lands, which surround much of the Red Hills roach's perennial habitats.

*Fire.* The Red Hills area is regarded as a region of high fire risk because of naturally high flammability of the vegetation and heavy recreational use. Large fires occurred in the area in 1982 and 1997. The effects of wildfire today tend to be more frequent and severe than in the past due to human alterations to the landscape and increasingly dry conditions associated with climate change. Red Hills roach may be particularly affected by catastrophic fire, due to their limited distribution in a fire-prone region.

*Alien species.* The presence of green sunfish in Six Bit and Poor Man's gulches is a potentially severe threat because roach populations in other locations have been extirpated by alien fishes such as green sunfish and black basses. See the Central California roach account in this report for more detailed coverage of roach interactions with alien fishes.

	Rating	Explanation
Major dams	High	Don Pedro Reservoir isolates Red Hills roach from other populations and blocks dispersal
Agriculture	n/a	
Grazing	Medium	Little current grazing but concentrated damage potential high
Rural residential	Medium	Rural development increasing rapidly in Tuolumne Co.
Urbanization	n/a	
Instream mining	Medium	Ponds created by past instream mining provide habitat for green sunfish and other invasive fishes
Mining	Low	Legacy effects (e.g. contaminants, stream bed alteration) from past large-scale mining may continue to negatively affect roach
Transportation	Medium	Roads and off-road vehicles are both potential contributors to habitat degradation
Logging	n/a	
Fire	Medium	Increased isolation of roach populations and more frequent and/or intense fires may lead to localized extirpation
Estuary alteration	n/a	
Recreation	Medium	Portions of range now protected (BLM ACEC) but off-road vehicles use and other activities on private lands may pose threats
Harvest	n/a	
Hatcheries	n/a	
Alien species	High	Intolerant of predatory fishes, especially centrarchids

**Table 1.** Major anthropogenic factors limiting, or potentially limiting, viability of populations of Red Hills 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.

**Effects of Climate Change:** Because they persist in isolated pools during low flow periods, Red Hills roach are particularly susceptible to increasing aridity associated with climate change predictions. Springs that provide pool habitats may be altered by human land use practices or naturally dry if the climate becomes more arid. While roach are one of the few native fishes in California that can persist in isolated pools in intermittent streams, they may become extirpated from Red Hills streams by predicted decreases in precipitation and increasing temperatures, along with increasing demand for human water use. Moyle et al. (2013) rated the Red Hills roach as “critically vulnerable” to extinction from the effects of climate change, in combination with other factors that threaten it.

**Status Determination Score = 2.1 – High Concern** (see Methods section Table 2). Red Hills roach have an extremely limited distribution and persist in isolated summer pools fed by springs of indeterminate source. Their persistence is threatened by fire, depleted stream flows, lack of protections on private lands, and, especially, invasive fishes. While some habitat is protected in the Red Hills ACEC, much is on private land and remains unprotected. The Red Hills roach is listed by the American Fisheries Society as “Vulnerable” (Jelks et al. 2008), by NatureServe as “G5T1, Critically Imperiled” and by the Bureau of Land Management as “Sensitive”.

Metric	Score	Justification
Area occupied	1	Restricted to a single, small, fragmented, and intermittent drainage
Estimated adult abundance	1	Populations small and fragmented
Intervention dependence	3	Isolation limits recolonization after local extinctions occur and may necessitate deliberate reintroductions from nearby populations
Tolerance	5	Broad environmental tolerances
Genetic risk	2	Genetic risks from fragmentation, genetic drift, and isolation
Climate change	1	Increased aridity and decreased precipitation in the region could dry streams and standing pools completely
Anthropogenic threats	2	See Table 1
Average	2.1	15/7
Certainty (1-4)	3	Good documentation but little recent (since 2002) information

**Table 2.** Metrics for determining the status of Red Hills 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:** The Bureau of Land Management recognized the ecological values of the area in which Red Hills roach occur and set aside 7,100 acres as the BLM ACEC to provide habitat for “the unique flora of the region, habitat for ...the Red Hills roach and to protect Bald Eagle wintering habitat.” [http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/folsom/gis\\_pdf\\_maps](http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/folsom/gis_pdf_maps). Unfortunately, most roach habitat is not in the ACEC but, rather, is on private land along roads. Therefore, the main drainage of the Red Hills region, Six Bit Gulch, in addition to the majority of Horton Creek, has no formal protection. The most important conservation action to protect Red Hills roach is to expand the ACEC to include these drainages.

Other management recommendations include:

- Decommission roads that run along stream courses in the area.
- Develop and implement a plan to systematically remove alien fishes from streams and build barriers to prevent re-invasion from downstream reaches.
- Develop a monitoring program for fish populations (abundance, distribution, trends), stream flows, habitat quality and dry season habitat extent, in order to

- develop recommendations to improve management of roach populations.
- Develop an emergency plan, including identification of refuge sites or captive rearing options, in the event population levels become critically low.
  - Conduct studies of Red Hills roach life history, habitat requirements, and general ecology.
  - Publish a formal description of the Red Hills roach as a distinct taxon so targeted conservation actions and associated funding can be identified and implemented.
  - Engage stakeholders (especially private land owners) to develop collaborative conservation measures that will protect and enhance Red Hills roach habitats. Consider development of conservation agreements or identify funding for acquisition of lands from willing landowners utilizing conservation easements.
  - Improve enforcement to reduce damage to streams, particularly on public lands within the ACEC.



**Figure 1.** Distribution of Red Hills roach, *Lavinia symmetricus* ssp., in California.