NORTHERN ROACH

***Lavinia mitrulus* (Snyder)**

***Note:*** *This account is part of a statewide assessment of California fishes, which follows a standard format for determining conservation status. It is essential to read the methods section at the beginning of this report to understand how scores were awarded and conclusions were reached.*

**Status: High Concern.** This species appears to have just a few isolated populations in California which could decline rapidly and disappear in many areas as the result of alterations to streams, the introduction of alien fishes and water withdrawal for agriculture, in combination with changes in climate.

**Description:** Northern roach are small (adult size typically 50-100 mm) bronzy cyprinids. They have a robust body, deep caudal peduncle, short snout and short rounded fins. They are dark on the upper half of the body, light below and very similar in appearance to the Central California roach. Northern roach differ from Central California roach in having short rounded fins and “cup-like” scales (see Snyder 1913 for more detail on scale morphology). Snyder (1908a) published morphometric data on 20 fish from Drews Creek (among them the type specimen of the species) and all individuals had 8 dorsal rays and 7 fin rays. Averaged counts of fin rays from a larger collection could not be found. Snyder found that male roach had longer larger fins than did females, especially pectoral fins; and that the sexes could be differentiated by the ratio of pectoral fin length to body length. These differences in the relative fin length between the sexes led Snyder to publish one of the first accounts of general sexual dimorphism in cyprinid fishes.

See the Central California roach account, this volume, for a more in-depth description of general roach morphology.

**Taxonomic Relationships:** Northern roach were first collected in 1898 by C. Rutter (1908), who recognized them as *Rutilus symmetricus* (Baird and Girard 1854a). Speaking of the specimens collected on this trip, Rutter (1908 p. 139) says *“We have but few small specimens of this form, the longest being but 3 inches long. They were taken in North Fork Pitt (sic) River near Alturas and at the mouth of Joseph Creek, several hundred miles from where any other specimens of* symmetricus *have been taken. The form may prove to not to be* symmetricus*, but we can not identify it otherwise with the material at hand.”*

In 1904 John O. Snyder surveyed broadly in northeastern California and southeastern Oregon, collecting in the upper Pit River, and the Goose Lake, Summer, Abert, Harney and Warner basins of Oregon but only found roach in the tributaries to Goose Lake, Lake County, Oregon (Snyder 1908a). In 1913, Snyder erected a new genus, *Hesperoluecus,* and described six new species based on locality, isolation and morphological differences. Among the new species was the northern roach, *Hesperoleucus mitrulus,* from “Drew (sic) Creek, Muddy Creek and Cottonwood Creek, Lake County, Oregon.” Snyder also reported that the species had **not** been recorded from Goose Lake itself or from the high-gradient Californian streams that flow into the Lake from the Warner Mountains to the east. There is no indication that he was aware of the previous collection of roach in the Pit River by Rutter.

Northern roach, were classified as a distinct species of *Hesperoleucus* by subsequent workers (Evermann and Clark 1931, Shapovalov and Dill 1950, Shapovalov et al. 1959) but Miller (1945a p. 197) suggested the “Preliminary analysis of the forms of *Hesperoleucus* shows that many if not all, of those described as species are geographic subspecies of *H. symmetricus*.” Murphy (1948c), in an unpublished master’s thesis, proposed that all coastal forms be demoted to subspecific status and be submerged into *H. symmetricus*. Murphy (1948c) did not study of samples of the northern roach, nor did he suggest that his subspecific diagnosis should be applied to *H. mitrulus*. However, it appears that when Murphy’s (1948c) subspecific diagnosis for *H. parvipinnis, H. Navarroensis, H. venustus and H. subtitus* was adopted by subsequent workers (Hopkirk 1973, Moyle 1976, Hubbs et al. 1979) subspecies status was erroneously applied to *H. mitrulus* as well. For a thorough discussion of the debate over the specific status of all roach forms please see the Central California roach account, this volume.

The first inclusion of roach from the Pit River in *mitrulus* was by Hubbs et al. (1979 p. 11), who used the common name “upper Pit” roach” when referring to *H. mitrulus*. While no mention is made of a range extension for the taxon, it is assumed that this change was precipitated by the 1934 collection of 19 roach in the North Fork Pit river near Alturas, Modoc County (unpublished field notes and collections of Carl Hubbs at the University of Michigan as reported in Reid et al. 2003). The California Department of Fish and Game (Shapovalov et al. 1981) subsequently applied the common name “upper Pit” roach to *H. symmetricus* but, like Hubbs et al. (1979), did not publish distributional information. Moyle et al. (1995) and Moyle (2002), list the “Pit” roach (i.e. *mitrulus)* as being native to the upper Pit River system, as well as to Oregon tributaries of Goose Lake.

Northern roach are reciprocally monophyletic for mtDNA haplotypes and show strong differentiation from all other roach populations based on nuclear microsatellites (Aguilar et al 2009). Based on mtDNA sequence diversion, Aguilar et al., estimate that the northern populations of roach have been isolated for 8 million years.

# In light of (1) the recent genetic analysis (nuclear and mtDNA) that corroborates the distinctiveness of the northern roach as described by Snyder (1913) and (2) the fact that Snyder’s original species were never properly submerged (i.e. through formal publication of an analysis in the peer-reviewed literature), the northern roach is a valid full species. The subspecies name, *Lavinia s. mitrulus* (Hopkirk 1973) is pre-occupied by *Lavinia mitrulus* (Snyder 1913). Many variations of the common name “upper Pit” or “Pit River” have been applied to *mitrulus*; however, because the range consists of multiple isolated basins and because the type locality is in Lake County, Oregon, we prefer Snyder’s original name for the taxon, the “northern roach”.

**Life History:** Northern roach presumably share much of their life history with the Central California roach but their life history has not been studied so this cannot be verified.

**Habitat Requirements:** Northern roach tend to be associated with habitats unlike those where roach are found in the rest of California, especially spring pools and swampy stream reaches (S. Reid, pers. comm. 2009). Thus, in Ash Creek and Rush Creek, Lassen and Modoc Counties, roach are found in small numbers inhabiting the weedy margins of streams and, in one case, an isolated spring pond (Moyle and Daniels 1982, S. Reid, pers. comm. 2009). They do not often occupy intermittent streams in the Pit system, as is usual with roach in the rest of their range. Instead speckled dace (*Rhinichthys osculus*) dominate these habitats.

Moyle and Daniels (1982) found that 94% of the fish species that co-occurred with Northern roach were also native. The most common associates were speckled dace (*Rhinichthys osculus*), Sacramento sucker (*Catostomus occidentalis*) and Pit sculpin (*Cottus pitensis*). The fact that roach occur as part of a predominately native fish assemblage has been observed elsewhere (Moyle and Nichols 1973, Leidy 1984, Brown and Moyle 1993, Leidy 2007). Moyle (2002) attributes the uncommon co-occurrence of roach with alien species to the tendency for roach to be easily displaced by invasive fish species, especially centrarchids.

**Distribution:** In California, Northern roach are restricted to several tributaries of the Upper Pit River. It is likely that they once inhabited the meandering valley floor reaches of the Pit River in Big Valley, Modoc County, but this area is now completely dominated by alien species (Moyle and Daniels 1982). Roach have not been recorded from Goose Lake itself or from the high-gradient Californian streams that flow into the Lake from the Warner Mountains to the east. However, roach found in the northern tributaries of Goose Lake in Lake County, Oregon are also included in *H. mitrulus*. In a recent comprehensive sampling of the Oregon portion of the Goose Lake watershed, the Oregon Department of Fish and Wildlife (ODFW) found northern roach to be widespread and relatively abundant (>80 fish) in Dry, Drews, Hay, Dent, Muddy, and Augur Creeks (Heck et al. 2008).

Roach populations in the terminal lake basins adjacent to Goose Lake in the high desert of Eastern Oregon may also belong to this species but distributional records are spotty and taxonomic relationships among these populations remain uncertain.

Pit River Falls, located five miles downstream of the town of Fall River Mills, Shasta County, divides the Pit River Basin into upper and lower drainages. The falls are, at least partially, a barrier to fish movement. Historically, they represented the northern range limit for some Sacramento River fish, such as the tule perch (Moyle 2002). Only roach found above Pit River Falls are considered northern roach, *L. mitrulus*. Roach found below the falls would have historically had unimpeded access to Sacramento River system and are assumed to be *L. s. symmetricus*. However, genetic studies have not been conducted and relationships remain uncertain.

Historical collecting trips to the Upper Pit River system captured only a few specimens (Rutter 1908, Hubbs et al. 1934, from field notes and collections at the University of Michigan as reported in Reid et al. 2003) or none at all (Snyder 1908a). In the most comprehensive sampling of the Pit system to date, Moyle and Daniels (1982) found roach, at only 8% of 261 collection sites. Above Pit River Falls, roach were found in only three drainages: (1) Ash–Rush–Willow Creek drainage, Lassen and Modoc counties, (2) Bear Creek, tributary to the Fall River, Shasta County and (3) Beaver Creek, Lassen County.

**Trends in Abundance:** Historically, roach were probably much more widely distributed in the upper Pit River drainage (e.g., Big Valley) but modern surveys have found that they have disappeared from reaches where they previously occurred (reviewed in Reid et al. 2003). Reid et al. (2003), in the only known survey of the Upper Pit Drainage since 1978, surveyed 12 sites in the North Fork, South Fork and upper mainstem Pit River (between Alturas and Rose Canyon) without collecting roach. The following is a history of roach occurrence in the upper Pit River basin:

*North Fork Pit River.* Rutter (1908), collecting in 1898, captured “a few small specimens” of roach. Snyder (1908), collecting in 1904 near the same location, did not capture any roach, while Hubbs and others collecting in the North Fork near Alturas in 1934 captured only 19 (from field notes and collections at the University of Michigan as reported in Reid et al. 2003). Subsequent collectors have found green sunfish but not roach (Moyle and Daniels 1982, Reid et al. 2003).

*South Fork Pit River*- Three historic sampling trips found roach in the South Fork. Modern collecting trips have not collected any (from information in Reid et al. 2003)

*Mainstem Pit River, Alturas to Pit River Falls.* The only known record of capture is a single specimen taken by R.R. Miller in 1961 (from field notes and collections University of Michigan as reported in Reid et al. 2003). This is the reach flowing through Big Valley which has been highly altered and contains mainly alien species (Moyle and Daniels 1982). However, roach remain common in the Ash Creek drainage (S. Reid pers. com. 2009).

**Nature and Degree of Threats:** Factors with the greatest impact on persistence of northern roach are (1) agriculture, (2) grazing, (3) logging, (4) transportation, (5) fire, (6) and alien species. These impacts are not necessarily listed in order of importance and do not operate independently but instead must be viewed in aggregate, along with other less pressing, threats (Table 1) as cumulative watershed impacts.

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|  | **Rating** | **Explanation** |
| Major dams | Intermediate | There are really no major dams in the upper Pit although there are numerous small dams and diversions. |
| Agriculture | High | Diversions and return water have altered hydrology and water quality; channels have been altered. |
| Grazing | High | Most streams have been heavily grazed |
| Rural Residential | Low | Residential water withdrawal may cause decreased summer flows in many small streams |
| Urbanization | Low | Urban areas occupy only a small portion of the watershed |
| Instream mining | Low | Effects unknown |
| Mining | Low | No known threats from mining |
| Transportation | Intermediate | Much of the river is bordered by paved roads, while logging and ranch roads contribute to siltation, channelization, and habitat loss |
| Logging | High | Logging is a major land use in the higher elevation parts of the watershed |
| Fire | Intermediate | Fires may cause local extirpation. |
| Estuarine alteration | N/A |  |
| Recreation | Low | Recreation results in little direct threat except through off road vehicle use and similar activities. |
| Harvest | N/A |  |
| Hatcheries | N/A |  |
| Alien species | High | Intolerant of introduced predatory fish, especially centrarchids such as green sunfish |

**Table 1.** Major anthropogenic factors threatening, or potentially threatening, viability of populations of northern roach in California, where a factor rated “high” is a major threat, a factor rated “intermediate” is a threat that has the potential to be a major limiting factor but has had only a moderate effect so far on population viability, and a factor rated “low” has a low or unknown effect on population viability. Certainty of these judgments is moderate. See methods section for explanation of rating procedures.

*Agriculture.* Agricultural alteration of the Pit Basin has a long history. The earliest fish survey of the region (1898) already described the South Fork Pit as being “almost drained by irrigation ditches” (Rutter 1908, p. 110). The low gradient areas favored by roach are also areas in which extensive pasture, hay, and other types of farming occur. For example much of Big Valley, through which the Pit River flows, is devoted to growing alfalfa, pasture, and potatoes. It is likely that the river in this region was once habitat for roach, but agricultural alteration combined with abundant alien species has made it unsuitable habitat. Many tributary streams in this region are channelized to reduce spring flooding of pasture and ag land; a practice which destroys roach habitat (Moyle 1976). The relationship between water withdrawal for irrigation and stream flow is not documented in the region, but Pit River flows are low and polluted with agricultural return water between Alturas and Fall River Mills as evidenced by the Pit River being listed as impaired by high temperature, nutrients and low dissolved oxygen content under The Clean Water Act section 303(d) (US EPA 2006).

*Grazing.*  Grazing by livestock is pervasive along streams in the Pit River watershed. When grazing becomes too heavy, riparian vegetation is removed, stream banks collapse, pools fill in with sediment, pollution from animal wastes is high, and there is little cover or shade. Under these conditions roach tend to disappear from the streams, despite their high tolerance of adverse conditions. An additional problem is the presence of stock ponds, which can divert water from streams and support populations of non-native predatory fishes high in the watershed. These fish (e.g. green sunfish, largemouth bass) may move upstream and downstream from the ponds during wet periods when ponds are hydrologically connected to streams, eliminating roach populations but then dying out themselves when conditions become too severe.

*Transportation*. Streambeds with adjacent roads and road crossings tend to have reduced roach habitat. Roach presence vastly diminishes when severe channelization of small stream occurs. Culverts and other road crossing also form barriers to upstream fish movement which can lead to the isolation of stream reaches and localized absence of roach.

*Logging*. Most of the watershed that is not devoted to agriculture is covered with dry forestland, which is logged and grazed. A major contribution of logging to low gradient streams is increased siltation.

*Fire*. Fire has been a natural part of the Pit River watershed for thousands of years. However, fire effects are more severe because of human land management practices and changes to the landscape. Thus more severe wildfires may reduce roach habitat or possibly extirpate small populations from tributary streams.

*Alien species.* Roach cannot coexist with large populations of alien fishes, especially centrarchids such as green sunfish (*Lepomis cyanellus*) and largemouth bass (*Micropterus* spp.). Green sunfish, largemouth bass and bluegill are found together and often dominate the fish biomass in warm, slow, turbid reaches of the mainstem Pit River (Moyle and Daniels 1982). These stretches of river are now dispersal barriers to roach, further isolating small populations in tributary steams. Roach populations in refuge tributary watersheds are also threatened by escape of alien fishes from stock ponds (treated above under grazing), located higher in these watersheds.

**Effects of Climate Change:** Northern roach are well adapted to the warm, arid conditions of northeastern California. However, their dependence upon spring pools in late summer and swampy headwaters suggests that they are also particularly susceptible to decreases in dry season flows. While their ability to persist in small bodies of water bodes well for roach in a future of dwindling in-stream water supplies, it also suggests that they are likely to be extirpated from streams that may soon dry completely under the dual strains of the increased aridity associated with climate change and increasing local surface water diversions and ground water withdrawal for rural residential homes and for agricultural irrigation.

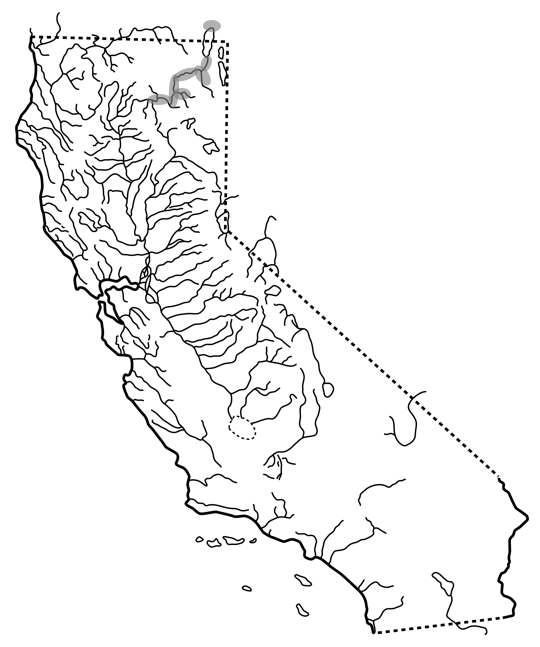
**Status Score = 2.2. Species of High Concern.** Although apparently not in immediate danger of extinction, populations could decline rapidly and disappear in many areas as the result of alterations to streams, the introduction of alien fishes, and water withdrawal for agriculture, in combination with changes in climate. The northern roach (formerly Pit roach) is listed by the American Fisheries Society as “vulnerable” (Jelks et al. 2008) and by NatureServe as “G5T2, Imperiled” and by the Oregon Department of Fish and Wildlife as “sensitive- peripheral”.

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| Metric | Score | Justification |
| Area occupied | 1 | California range confined to widely separated tributaries to the Upper Pit River |
| Estimated adult abundance | 2 | Populations are small and uncertain |
| Intervention dependence | 3 | Annual monitoring and protection of most populations is needed. |
| Tolerance | 4 | Remarkably resilient fish but preferred habitat in system is in short supply |
| Genetic risk | 3 | Uncertain genetic relationships between small populations; effects of isolation likely |
| Climate change | 1 | Highly vulnerable in combination with watershed changes |
| Anthropogenic threats analysis | 2 | See Table 1 |
| Average | 2.2 | 15/7 |
| Certainty (1-4) | 2 | Relatively little recent information |

**Table 2.** Metrics for determining the status of northern 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 explanation of scoring procedures.

**Management Recommendations:** The first step in the management of the native fishes of the Pit River watershed is to conduct a thorough survey to find out how many populations still exist and where they are located. Once that information is in place, basin-wide monitoring every five years should be established to determine status and trends of the fishes and their habitats and to detect alien fishes that might be a threat. Another important step is to conduct a comprehensive genetic investigation of basin fishes, including roach (*Lavinia* species), tui chub (*Siphateles* species) and suckers (*Catostomus* species) in order to sort out the confusing relationships of populations from different parts of the region in Oregon and California. A key to making the above steps successful is to develop an education program for watershed residents, especially agricultural water users, to develop cooperative ventures to restore watershed function in ways that benefit fish. High priority measures would include establishing one or more streams as protected areas for roach populations.

The water quality standards recommended by state and federal agencies should be adopted and vigorously enforced, including finding ways to reduce sediment loads (e.g., reducing the impact of roads of all types). Water rights in the entire watershed need to be adjudicated and a minimum flow left in all streams at all time, including late summer, to protect the fish.



**FIGURE 23.** Distribution of the Northern roach, *Lavinia mitrulus* (Snyder), in California and Oregon.