

Taxonomy

Camp (1917) described the mountain yellow-legged frog as two subspecies of *Rana boylei*: *R. b. sierrae* in the Sierra Nevada, and *R. b. muscosa* in southern California. On the basis of the similar morphological (body structure) characteristics of the two subspecies, the small number of sites where both were found, and breeding experiments, *R. b. muscosa* and *R. b. sierrae* were split from the *R. boylei* group and combined under a single species, *R. muscosa* (Zweifel 1955). Genetic studies also have concluded that *R. muscosa* and *R. boylei* are distinct species (Case 1978; Davis 1986; Green 1986a, 1986b; Hillis and Davis 1986; Macey *et al.* 2001).

Description

The body length (snout to vent) of the mountain yellow-legged frog ranges from 40 to 80 millimeters (mm) (1.5 to 3.25 inches (in)) (Jennings and Hayes 1994). Females average slightly larger than males and males have a swollen, darkened thumb base (Wright and Wright 1949; Stebbins 1951; Zweifel 1955, 1968). Dorsal (upper) coloration in adults may be variable, exhibiting a mix of brown and yellow, but it also can be grey, red, or green-brown, and usually patterned with dark spots (Stebbins 1985; Jennings and Hayes 1994). These spots may be large (6 mm (0.25 in)) and few, smaller and more numerous, or a mixture of both (Zweifel 1955). Irregular lichen or moss-like patches (to which the name *muscosa* refers) also may be present on the dorsal surface (Zweifel 1955; Stebbins 1985). The belly and undersurfaces of the hind limbs are yellow or orange, and this pigmentation on the abdomen may extend forward to the forelimbs (Wright and Wright 1949; Stebbins 1985). This species may produce a distinctive mink or garlic-like odor when disturbed (Wright and Wright 1949; Stebbins 1985). Although the species lacks vocal sacks, it can make both terrestrial and underwater vocalizations, which have been described as a flat clicking sound (Zweifel 1955; Stebbins 1985; Ziesmer 1997). The mountain yellow-legged frog has smoother skin, generally heavier spotting and mottling dorsally, and darker toe tips than the foothill yellow-legged frog (*R. boylei*) (Zweifel 1955; Stebbins 1985).

Eggs of the mountain yellow-legged frog are laid in globular clumps, which are often somewhat flattened, roughly 2.5 to 5 cm (1 to 2 in) across (Stebbins 1985). When eggs are close to hatching, egg mass volume may average 198 cubic cm (78 cubic in) (Pope 1999a). Eggs

have three firm jelly-like transparent envelopes surrounding a grey-tan or black vitelline (egg yolk) capsule (Wright and Wright 1949).

The larvae (tadpoles) of this species generally are mottled brown in dorsal coloration with a golden tint and a faintly-yellow venter (underside) (Zweifel 1955; Stebbins 1985). Total tadpole length reaches 72 mm (2.8 in), its body is flattened, and the tail musculature is wide, about 2.5 centimeters (cm) (1 in) or more, before tapering into a rounded tip (Wright and Wright 1949). The mouth has a maximum of 7 labial (lip) tooth rows (2–3 upper and 4 lower) (Stebbins 1985). Larvae often take 2 to 4 years or more to reach metamorphosis (transformation from larvae to frogs) (Wright and Wright 1949; Cory 1962b; Bradford 1983; Bradford *et al.* 1993; Knapp and Matthews 2000).

Range

The mountain yellow-legged frog is restricted to two disjunct areas in California and a portion of Nevada. One area is in the Sierra Nevada and the other area is in the San Gabriel, San Bernardino, and San Jacinto mountain ranges of southern California (Los Angeles, San Bernardino, Riverside, and San Diego counties) (Zweifel 1955; Jennings and Hayes 1994). The southern California population is isolated from the Sierra Nevada population by the Tehachapi mountain range, with a distance of about 225 kilometers (km) (140 miles (mi)) between the two populations.

In the Sierra Nevada, the historic distribution of the mountain yellow-legged frog was more or less continuous from the vicinity of La Porte in southern Plumas County southward to Taylor and French Joe Meadows in southern Tulare County (Jennings and Hayes 1994). Records for this species in the Sierra Nevada document its occurrence on the east and west sides of the crest in all major drainages from Plumas to Tulare counties, with a single record from Kern County (Zweifel 1955; Jennings and Hayes 1994; Knapp 1996). Except for historic populations in extreme western Nevada in Washoe and Douglas counties, on Mt. Rose near Lake Tahoe, possibly Edgewood Creek, and elsewhere around Lake Tahoe, the species is confined to California (Zweifel 1955). The elevational range for the mountain yellow-legged frog in the Sierra Nevada ranges from approximately 1,370 meters (m) (4,500 feet (ft)) at San Antonio Creek, near Dorrington in Calaveras County, to over 3,650 m (12,000 ft) at Desolation Lake in Fresno County, though populations

typically are encountered in the upper half of that elevation range (Zweifel 1955; Mullally and Cunningham 1956; Stebbins 1985).

Habitat Requirements

Mountain yellow-legged frogs rarely are found more than 1 m (3.3 ft) from water (Stebbins 1951; Mullally and Cunningham 1956; Bradford *et al.* 1993). At the lower elevations in the Sierra Nevada, the species usually is associated with rocky stream beds and wet meadows surrounded by coniferous forest (Zweifel 1955; Zeiner *et al.* 1988). At higher elevations, the species occupies lakes, ponds, tarns, and streams (Zweifel 1955; Mullally and Cunningham 1956; Stebbins 1985). The borders of alpine (above treeline) lakes and montane (mountain) meadow streams used by mountain yellow-legged frogs are frequently grassy or muddy; this differs from the sandy or rocky shores that are inhabited by the amphibian in lower elevation streams (Zweifel 1955). Adults typically are found sitting on rocks along the shoreline, usually where there is little or no vegetation (Mullally and Cunningham 1956). Although the species may use a variety of shoreline habitats, both larvae and adults are less common at shorelines which drop abruptly to a depth of 60 cm (2 ft) than at open shorelines that gently slope up to shallow waters of only 5–8 cm (2–3 in) deep (Mullally and Cunningham 1956; Jennings and Hayes 1994). Mountain yellow-legged frogs also use stream habitats, especially in the northern part of their range. Streams utilized by adults vary from those having high gradients with numerous pools, rapids, and small waterfalls, to those with low gradients with slow flows, marshy edges, and sod banks (Zweifel 1955). Aquatic substrates vary from bedrock to fine sand, rubble (rock fragments), and boulders (Zweifel 1955). Mountain yellow-legged frogs seem to be absent from the smallest creeks, probably because these have insufficient depth for adequate refuge and overwintering habitat (Jennings and Hayes 1994).

Both adults and larvae overwinter for up to 9 months in the bottoms of lakes that are at least 1.7 m (5.6 ft) deep; however, overwinter survival may be greater in lakes that are at least 2.5 m (8.2 ft) deep, under ledges of stream or lake banks, or in rocky streams (Bradford 1983; Vredenburg *et al.* (in press)). In some instances, frogs have been found to overwinter in underwater bedrock crevices between 0.2 m (0.7 ft) and 1 m (3.3 ft) below the water surface (Matthews and Pope 1999) and the use