

Catalogue of American Amphibians and Reptiles.

ZWEIFEL, RICHARD G. 1968. *Rana muscosa*.***Rana muscosa* Camp
Mountain yellow-legged frog**

Rana boylei muscosa Camp, 1917:118. Type-locality "Arroyo Seco Cañon, at about 1300 feet altitude, near Pasadena [Los Angeles County], California." Holotype, Museum of Vertebrate Zoology (University of California) 771, adult female collected on 3 August 1903 by Joseph Grinnell (examined by author).

Rana boylei sierrae Camp, 1917:120. Type-locality "Matlack Lake, 10,500 feet altitude, two miles southeast of Kearsarge Pass, Sierra Nevada, Inyo County, California." Holotype, Mus. Vert. Zool. 3734, adult female collected on 26 June 1912 by H. S. Swarth (examined by author).

Rana boylei: Boulenger, 1919:415; 1920:469. Considered *muscosa* and *sierrae* as synonyms of *boylei*.

Rana boylei muscosa: Schmidt, 1953:84. Emendation of ending.

Rana boylei sierrae: Schmidt, 1953:84. Emendation of ending.

Rana muscosa: Zweifel, 1955:229. *R. boylei muscosa* considered a distinct species, with *R. b. sierrae* a synonym.

• CONTENT. The species is monotypic.

• DEFINITION AND DIAGNOSIS. A member of the *Rana boylei* species group (Zweifel, 1955) with both inner and outer metatarsal tubercles, but vocal sacs lacking in the male. There is no light band bisecting the eyelids and sharply demarcated from the color of the posterior part of the head. The ground color of the ventral surfaces is light yellow. The fully-developed larva has three upper and four lower rows of labial teeth.

Rana muscosa occurs sympatrically with three other native species of *Rana*. *Rana cascadae* and *R. aurora* have dark eye-mask markings on each side of the head and less extensive webbing on the hind feet, and *R. aurora* has red coloration on the undersides, particularly the hind legs. *Rana boylei* closely resembles *R. muscosa* but has a light band across the top of the head, white ventral ground color (but with yellow often prominent in the groin and on the hind legs), and vocal sacs in the male. The larva of *R. boylei* has more than 7 and up to 13 rows of labial teeth.

• DESCRIPTIONS. For descriptions of adults, eggs, and larvae, emphasizing characters distinguishing the species from *R. boylei*, see Zweifel (1955). Wright and Wright (1949:424-426; 429-430) gave detailed color notes on *R. muscosa* from southern California and the Sierra Nevada (*R. b. sierrae*). Camp (1917) described the holotypes of *R. b. muscosa* and *R. b. sierrae*, and discussed variation. Livezey and Wright (1945) described and illustrated the eggs.

Male *Rana muscosa* reach a maximum length of about 67 mm, females about 80 mm. Dorsolateral folds are present but often indistinct. The hind toes are fully webbed and the tips slightly expanded. The dorsal ground color rarely may be uniform brown, but usually it is yellowish brown with brown or black spots or lichen-like markings. The dark color of the toe tips is well differentiated from the light color immediately proximal. When irritated, the frogs produce a characteristic odor. Stebbins (1966:74) compared it to garlic, and Wright and Wright (1949:432) wrote: "They stink like minks or other weasels." This species is not known to have a mating call.

• ILLUSTRATIONS. Photographs of adult *R. muscosa* appear in works by Grinnell and Storer (1924), Storer (1925), Slevin (1928), Walker (1946), Wright and Wright (1949), Zweifel (1955), Sloan (1964), and Dixon (1967); Stebbins (1951, 1954, 1966) illustrated the species with drawings and (1966) with a color painting. For drawings of the skull and pectoral girdle, of the egg, and of the tadpole and its mouthparts, see Zweifel (1955). Livezey and Wright (1945, 1947) and Stebbins (1951) also illustrated the egg.

• DISTRIBUTION. Except for extreme western Nevada near Lake Tahoe, *Rana muscosa* is confined to California. It inhabits the Sierra Nevada at elevations from 4,500 to at least 12,000 feet (Mullally and Cunningham, 1956:190; Richards, 1958:122; Zweifel, 1955:237). An isolated northern

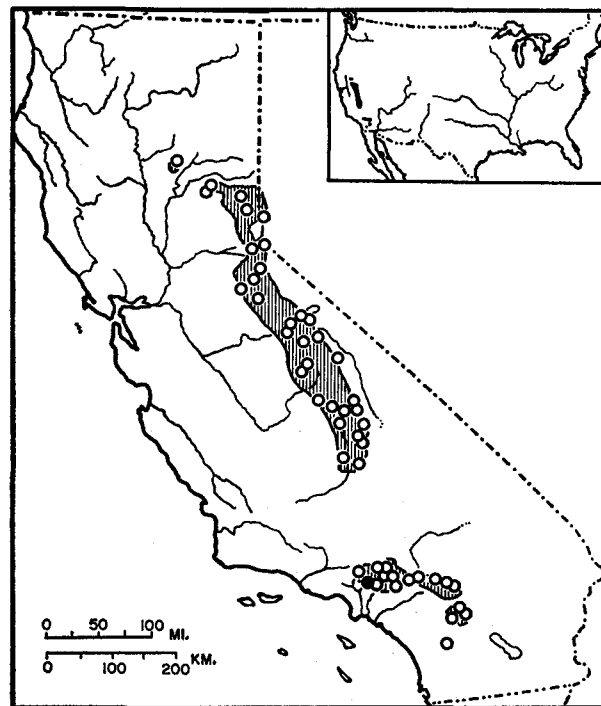
population in Butte County, California, is separated from the main body in the Sierra Nevada by the relatively low-lying Feather River Canyon. A record for *R. boylei sierrae* in the Lassen Park region of Tehama County, north of Butte County (Grinnell, Dixon and Linsdale, 1930:143) was based on *Rana cascadae* (Zweifel, 1955:323). South of the Feather River, the distribution is continuous from Plumas County to southern Tulare County. Richards (1958) gave locality records for "*Rana boylei sierrae*" and "*Rana boylei boylei*" in the Yosemite region of the Sierra Nevada. Judged from the elevations cited, almost all his records must pertain to *R. muscosa*.

In southern California, disjunct populations of *R. muscosa* inhabit the San Gabriel, San Bernardino, and San Jacinto Mountains in Los Angeles, San Bernardino, and Riverside counties at elevations from 1,200 to 7,500 feet (Zweifel, 1955; Mullally, 1959). Klauber (1929) reported the southernmost population at an elevation of 5,100 feet on Mount Palomar, San Diego County. A record for Ventura County (Slevin, 1928:141) presumably refers to *Rana boylei*. No additional southern populations are known.

In the Sierra Nevada, *R. muscosa* is most abundant in lakes formed in glaciated terrain, but it also occurs in streams. Where introduced trout have been established in the high lakes, frogs are rare or absent (Grinnell and Storer, 1924; Cory, 1963). In southern California this species evidently does not inhabit the few montane lakes there are, but is limited to streams (Mullally, 1959).

• FOSSIL RECORD. No fossils are known.

• PERTINENT LITERATURE. Zweifel (1955) summarized information on ecology, distribution and systematics. Mullally and Cunningham (1956) and Mullally (1959) contributed information in the ecology of the Sierran and southern Californian populations. Mullally (1953) noted that Sierran frogs were feeding largely on larvae of *Bufo canorus*. Grinnell and Storer (1924), under the heading *Rana boylei*, presented observations on the ecology of *R. boylei* and *R. muscosa* in the Yosemite region of the Sierra Nevada. In not all instances is it clear to which form they referred, though mention of frogs in high altitude lakes can refer only to *R. muscosa*. Brief, original observations on various aspects of ecology appear in works by Brattstrom (1963), Camp (1917), Ingles (1929), Linsdale (1940), Moore (1929), Storer (1925), Walker (1946),



MAP. The solid circle marks the type-locality, open circles indicate other localities. Shading estimates total range.

and Wright and Wright (1949). Childs (1955) described albino larvae from the Sierra Nevada. A series of abstracts by Cory (1962a, 1962b, 1963, 1966) reported studies of morphological variation, behavior and ecology of Sierran populations. Zweifel (1954) compared some skeletal elements of *R. muscosa* with those of other *Rana*, including a fossil species. Peabody and Savage (1958) included *R. muscosa* in their discussion of the biogeography of Californian amphibians and reptiles.

In addition to the references cited in this section and elsewhere in this account, *R. muscosa* is mentioned (generally as *R. boylei muscosa* or *R. b. sierrae*) in several checklists or other publications that include little or no new information. The Literature Cited is thought to include all scientifically pertinent literature on this species, excluding other editions of revised works.

• **NOMENCLATURE HISTORY.** The earliest reference to *Rana muscosa* was by Yarrow and Henshaw (1878:210), who "provisionally" assigned specimens from Lake Tahoe to *R. pretiosa*. Cope (1889:434) assigned these specimens to *R. temporaria pretiosa*. Stejneger (1893) examined much new material from the high Sierra Nevada and referred some specimens to *R. aurora*, others to *R. pretiosa*. Most authorities (e.g. Stejneger and Barbour, 1917) accepted Camp's (1917) description of *R. boylei muscosa* and *R. boylei sierrae*, and these names were in common use until Zweifel (1955) demonstrated the specific distinctness of *R. muscosa* and treated *R. boylei sierrae* as a synonym of that species. Prior to Zweifel's publication, only Boulenger (1919, 1920), who treated *R. b. muscosa* and *R. b. sierrae* as synonyms of *boylei*, disagreed with Camp's arrangement.

• **REMARKS.** The ranges of *Rana muscosa* and its close relative *Rana boylei* interdigitate along the western slope of the Sierra Nevada. Detailed studies of the local distribution of the two species in that region similar to that made by Zweifel (1955:239-240) at the only known area of sympatry (in San Gabriel Canyon, Los Angeles County) are needed. It would also be of interest to determine with greater precision the distributional limits of the population isolated in Butte County.

Camp (1917) regarded the frogs of the mountains of southern California as subspecifically distinct from those of the Sierra Nevada, which have longer legs and smoother tympana than the Sierran population. Zweifel (1955) confirmed the existence of slight differences but regarded them inadequate to justify taxonomic recognition.

• **ETYMOLOGY.** The name *muscosa* (Latin, *muscosus*) means "mossy," and derives from the "lichen-like dark patches" seen in the dorsal color pattern of some individuals (Camp, 1917:119).

COMMENT

Rana muscosa and *R. boylei* are quite similar, and preserved specimens may be difficult to identify; variation may give the superficial appearance of hybridization. Any suggestion of hybridization should be confirmed by demonstrating intermediacy in larval characters, particularly in the distinctly different mouthparts. Breeding experiments indicate a high degree of post-mating isolation (Zweifel, 1955).

LITERATURE CITED

- Boulenger, G. A. 1919. Synopsis of the American species of *Rana*. Ann. Mag. Nat. Hist. (ser. 9) 3 (16):408-416.
- 1920. A monograph of the American frogs of the genus *Rana*. Proc. Amer. Acad. Arts Sci. 55 (9):413-480.
- Brattstrom, Bayard H. 1963. A preliminary review of the thermal requirements of amphibians. Ecology 44 (2):238-255.
- Camp, Charles L. 1917. Notes on the systematic status of the toads and frogs of California. Univ. California Publ. Zool. 17 (9):115-125.
- Childs, Henry E., Jr. 1955. An incidence of albinism in yellow-legged frogs. Bull. Southern California Acad. Sci. 54 (3):126-127.
- Cope, E. D. 1889. The Batrachia of North America. U. S. Natl. Mus. Bull. (34):5-525.
- Cory, Brother Lawrence. 1962a. Patterns of geographic variation in Sierra Nevada ranids. Amer. Zool. 2 (4):401.
- 1962b. Life-history and behavior differences between ranids in isolated populations in the Sierra Nevada. *Ibid.* 2 (4):515.
- 1963. Effects of introduced trout on the evolution of native frogs in the high Sierra Nevada Mountains. Proc. XVI Internat. Congr. Zool., Washington 2:172.
- 1966. A morphologically unique frog population in an ecologically rigorous environment. Amer. Zool. 6 (4):532.
- Dixon, James R. 1967. Amphibians and reptiles of Los Angeles County, California. Los Angeles Co. Mus. (Sci. Ser. 23), Zool. (10):1-64.
- Grinnell, Joseph, Joseph Dixon, and Jean M. Linsdale. 1930. Vertebrate natural history of a section of northern California through the Lassen Peak region. Univ. California Publ. Zool. 35:v + 594 p.
- Grinnell, Joseph, and Tracy I. Storer. 1924. Animal life in the Yosemite. Univ. California Press, Berkeley. xviii + 752 p.
- Ingles, Lloyd G. 1929. The seasonal and associational distribution of the fauna of the upper Santa Ana River wash. J. Ent. Zool. 21 (1,2):1-96.
- Klauber, L. M. 1929. Range extensions in California. Copeia (170):15-22.
- Linsdale, Jean M. 1940. Amphibians and reptiles in Nevada. Proc. Amer. Acad. Arts Sci. 73 (8):197-257.
- Livezey, R. L., and A. H. Wright. 1945. Descriptions of four salientian eggs. Amer. Midland Nat. 34 (3):701-706.
- 1947. A synoptic key to the salientian eggs of the United States. *Ibid.* 37 (1):179-222.
- Moore, R. D. 1929. *Canis latrans lestes* Merriam feeding on tadpoles and frogs. J. Mammal. 10 (3):255.
- Mullally, Don P. 1953. Observations on the ecology of the toad *Bufo canorus*. Copeia 1953 (3):182-183.
- 1959. Notes on the natural history of *Rana muscosa* Camp in the San Bernardino Mountains. Herpetologica 15 (2):78-80.
- , and John D. Cunningham. 1956. Ecological relations of *Rana muscosa* at high elevations in the Sierra Nevada. Herpetologica 12 (3):189-198.
- Peabody, Frank E., and Jay M. Savage. 1958. Evolution of a coast range corridor in California and its effect on the origin and dispersal of living amphibians and reptiles. p. 159-186. In Zoogeography, Amer. Assoc. Adv. Sci.
- Richards, Lawrence P. 1958. Some locality records of Yosemite herps. Yosemite Nat. Notes 37 (9):118-126.
- Schmidt, Karl P. 1953. A check list of North American amphibians and reptiles. Sixth edition. Amer. Soc. Ichthyol. and Herpetol. viii + 280 p.
- Slevin, Joseph R. 1928. The amphibians of western North America. Occ. Papers California Acad. Sci. (16):1-152.
- Sloan, Allan J. 1964. Amphibians of San Diego County. Occ. Papers San Diego Soc. Nat. Hist. (13):1-42.
- Stebbins, Robert C. 1951. Amphibians of western North America. Univ. California Press, Berkeley. ix + 539 p.
- 1954. Amphibians and reptiles of western North America. McGraw-Hill Book Co., New York. xxiv + 528 p.
- 1966. A field guide to western reptiles and amphibians. Houghton Mifflin Co., Boston. xiv + 279 p.
- Stejneger, Leonhard. 1893. Annotated list of the reptiles and batrachians collected by the Death Valley Expedition in 1891, with descriptions of new species. North Amer. Fauna (7):159-228.
- , and Thomas Barbour. 1917. A checklist of North American amphibians and reptiles. Harvard Univ. Press, Cambridge. iv + 125 p.
- Storer, Tracy I. 1925. A synopsis of the Amphibia of California. Univ. California Publ. Zool. 27:1-307.
- Walker, M. V. 1946. Reptiles and amphibians of Yosemite National Park. Yosemite Nat. Notes 25 (1):1-48.
- Wright, Albert Hazen, and Anna Allen Wright. 1949. Handbook of frogs and toads of the United States and Canada. Third Edition. Comstock Publ. Co., Ithaca, New York. xii + 640 p.
- Yarrow, H. C., and H. W. Henshaw. 1878. Report upon the reptiles and batrachians collected during the years of 1875, 1876, and 1877, in California, Arizona, and Nevada. P. 206-226. In George M. Wheeler, Annual report upon the geographical surveys of the territory of the United States west of the 100th meridian . . . Appendix L.
- Zweifel, Richard G. 1954. A new *Rana* from the Pliocene of California. Copeia 1954 (2):85-87.
- 1955. Ecology, distribution, and systematics of frogs of the *Rana boylei* group. Univ. California Publ. Zool. 54 (4):207-292.

R. G. ZWEIFEL, THE AMERICAN MUSEUM OF NATURAL HISTORY, NEW YORK 10024.

Published 8 July 1968 by the American Society of Ichthyologists and Herpetologists. Publication is supported by National Science Foundation grant G24231.

Primary editor for this account, James D. Anderson.