

## Catalogue of American Amphibians and Reptiles.

KARLSTROM, E. L. 1973. *Bufo canorus*.*Bufo canorus* Camp  
Yosemite toad

*Bufo canorus* Camp, 1916:59. Type-locality, "Porcupine Flat, 8100 feet, Yosemite National Park, Mariposa Co., California." Holotype, Mus. Vert. Zool., Univ. California, Berkeley 2129, adult female collected by C. L. Camp July 1, 1915 (examined by author).

• CONTENT. The species is monotypic.

• DEFINITION AND DIAGNOSIS. A small to medium-sized *Bufo*, snout length of adults, 32–71 mm. Similar to *B. boreas* in general habitus but smaller as adults, skin smoother both over and between warts and snout more rounded in profile. The round to subovate parotoid glands are usually broader and lower than those of *boreas* and often merge with smaller warts. Interparotoid distance is narrow, approximately the width of the gland. The tympanum is  $\frac{1}{3}$  to  $\frac{1}{2}$  size of eye opening. Cranial crests are absent except for an occasional large adult, and the tarsal fold is weakly developed. The hind toes are partly webbed,  $\frac{3}{4}$  of the fourth toe being free of web.

The degree of sexual dichromism is unusual among anurans: females with black spots or blotches edged with whitish or cream color, on a ground color of gray, tan, or brown, central areas of warts brown to yellowish, the latter color most prominent on parotoid glands and upper eyelids and scattered over flanks and surfaces of hindlimbs, black spots or irregular bars prominent on legs; males with uniform dorsal ground color of yellow-green to olive drab of darker greenish brown, warts rust to brown-colored, generally darker than rest of dorsum. Dorsal melanin tends to decrease as males age; in females it become more prominent. If present in males, melanin appears as irregular small spots or edging surrounding the warts or is scattered over the head and upper surfaces of the limbs.

• DESCRIPTION. Detailed descriptions of adults have been published by Storer (1925:182–184), Wright and Wright (1949:160–162), Stebbins (1951:245–246), Karlstrom (1962:57); egg masses and larvae by Karlstrom and Livezey (1955:221–227); larvae by Stebbins (1951:247). The eggs of *canorus* are larger (ovum diameter 1.7 to 2.7 mm; Karlstrom, 1962:6) than those of ten species of North American *Bufo* reported by Livezey and Wright (1947).

In contrast to the eggs of *Bufo boreas*, which are laid in long strings, *canorus* eggs occur often in clusters. Eggs and larvae of *canorus* are extremely melanistic, more than those of related *boreas*.

Camp (1916:62) described the call of male *canorus* as a long-sustained melodious trill. Karlstrom (1962:30–34) analyzed tape-recorded calls of the Yosemite toad and the release

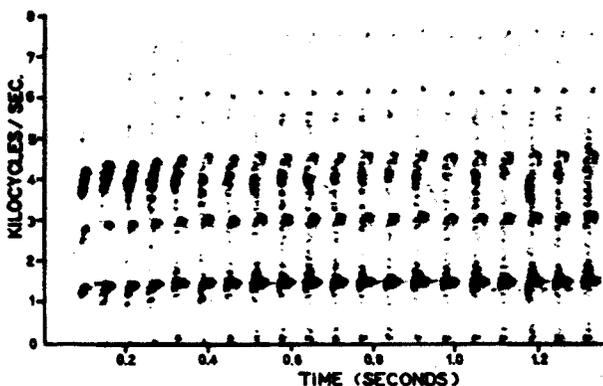


FIGURE. Audiospectrogram of mating call of *Bufo canorus*: Kaiser Pass Meadow, Fresno County, California, 27 May 1954; body temperature 24°C (recording by Karlstrom, spectrogram courtesy of W. F. Blair).

notes of *Bufo boreas halophilus* from the same region. Selected *canorus* calls and field chorus are included in the recording "Sounds of North American Frogs" and briefly analyzed by Bogert (1958).

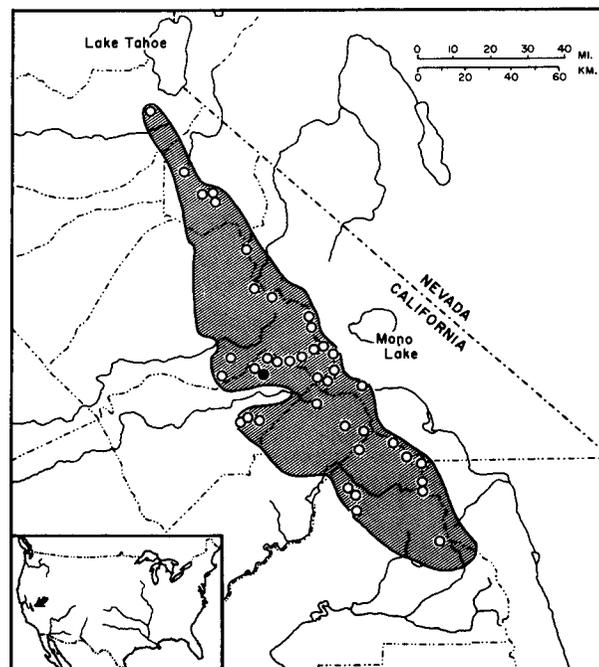
• ILLUSTRATIONS. High quality color illustrations of both sexes are available: photographs in Karlstrom (1962) and Basey (1969) and a watercolor in Stebbins (1966: plate 9). For black and white drawing or photographs, see Pickwell (1947:104), Wright and Wright (1949:161), Bogert (1958: fig. 6) and Karlstrom (1962:103). For drawings of eggs and larvae see Karlstrom and Livezey (1955:223,226). Karlstrom (1962:5,8), and Stebbins (1966:209,212). A photograph of tadpoles in natural habitat is in Karlstrom (1962:100); other photographs show developmental stages for females from metamorphosis to adult stage (p. 103).

• DISTRIBUTION. *Bufo canorus* is restricted to California, in the boreal zone of the central Sierra Nevada range, a section approximately 150 miles long (NW by SE) and 35 miles wide (NE by SW) (Karlstrom, 1962:3). It occurs in Eldorado and Alpine counties in the north (Mullally and Powell 1958:31), the Alpine County site its only known point of sympatry with *Bufo boreas* which has a range generally encircling that of *canorus* (Karlstrom, 1958:152). Southward it extends on the west side of the range to Kaiser Pass and on the east to Evolution Lake in Kings Canyon National Park. The species has not been reported south of Kings River in Kings Canyon National Park, but south of here it is replaced by *B. boreas halophilus* which goes to high elevations (Camp, 1916; Stebbins, 1951:245).

*Bufo canorus* ranges from 6,400 to 11,300 feet, but the majority of locality records fall within 8,500–10,000 feet (Karlstrom, 1962:3). Its total zonal range is from the lower Canadian to the beginning of the Arctic-Alpine life-zones or the entire subalpine belt of Dice (1943). Adults frequent wet, relatively open montane meadows, utilizing shallow pools for breeding but retiring to rodent burrows or adjacent forest cover to avoid night time freezing at higher elevations.

• FOSSIL RECORD. No fossils are known.

• PERTINENT LITERATURE. Storer (1925) gave good descriptions of *B. canorus*, its range and life-history. Later summaries were given by Wright and Wright (1949) and Stebbins (1951). Camp (1917:289) first suggested, on the basis of skull char-



MAP. The solid circle marks the type-locality; open circles indicate other records; cross-hatched area estimates total range.

acters, that *canorus* and *B. boreas* form a group separate from other North American *Bufo*. More recently Tihen (1962a, 1962b) generally supported this view through study of the whole skeleton. Using evidence from general morphology and distribution, Myers (1942), Stebbins (1951), Mullally (1956), Savage (1959), Karlstrom (1962), and Schuierer (1963) suggest close relationship between *boreas* and *canorus*. Blair (1959) used voice analysis to establish a *B. boreas* group comprised of *B. alvarius*, *B. boreas*, and *B. canorus* and later (1963, 1964) reached similar conclusions from hybridization experiments. However, also on the basis of calls, Flindt and Hemmer (1972) suggested a relationship to the Holarctic *viridis* group. Stebbins (1951) suggested that *canorus* may be a high mountain differentiate of *B. boreas*. Karlstrom (1962) summarized existing knowledge of *B. canorus* and added information on the ecology of *canorus* and *boreas* in the Sierra Nevada region as well as the systematic relations and evolutionary trends of the *boreas* complex *sensu lato* (*canorus*, *b. boreas*, *b. halophilus*, *b. exsul*, *b. nelsoni*) throughout western North America. Data on thermal relationships of adults were given by Mullally (1953), Mullally and Cunningham (1956), Cunningham (1963), and Brattstrom (1963, 1968), and on larval aggregations by Brattstrom (1962). Eggs were first described by Karlstrom and Livezey (1955), larvae by Stebbins (1951). Savage and Schuierer (1961) compared eggs of the *boreas* group. Mullally (1953) observed dragonfly nymphs feeding on *canorus* tadpoles. Grinnell and Storer (1924) and Mullally (1953) described some items of insect diet of *canorus*.

Camp (1916), Storer (1925), Bogert (1958), and Karlstrom (1962) described vocalizations. Witschi (1933) included *canorus* in his study of Bidder's organs in toads. Wolton (1941) noted helminth worms. Karlstrom (1957) pioneered application of radioactive tracking of amphibians during a field study of *canorus*. For distributional data see Camp (1916), Grinnell & Camp (1917), Storer (1925), Wiggins (1943), Walker (1946), Livezey (1955), Richards (1958), Mullally and Powell (1958), and Karlstrom (1962).

• REMARKS. Toads within the *Bufo boreas* complex exhibit a wide geographical and altitudinal distribution in western North America, and some montane populations of *B. boreas* appear to show convergent patterns of evolution with *canorus* or could be relicts of a *canorus* type. Black (1970, 1971) reports *Bufo* taken at higher elevations in Glacier Park, Montana which appear similar to the Yosemite toad.

• ETYMOLOGY. The name *canorus* is Latin for "tuneful" and refers to the melodious trill uttered by the male.

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Primary editor for this account, Richard G. Zweifel.

Published 30 August 1973 by the SOCIETY FOR THE STUDY OF AMPHIBIANS AND REPTILES.