

placed in vials of 70% ethanol and deposited in the United States National Parasite Museum (USNPC), Beltsville, Maryland as *Megalodiscus microphagus* (93429–30), *Gyrinicola batrachiensis* (93431), *Neoechinorhynchus rutili* (93432); tadpoles were deposited in the herpetology collection of the Natural History Museum of Los Angeles County as LACM 155028–35. Prevalence of infection (number infected tadpoles/number tadpoles examined)  $\times$  100 and mean intensity of infection (mean number of infected individuals)  $\pm$  1 SD and range were: *M. microphagus* (33%, 17.6  $\pm$  27.3 SD, 1–65); *G. batrachiensis* (53%, 9.3  $\pm$  7.1 SD, 2–22); *N. rutili* (7%, 2).

*Megalodiscus microphagus* was described originally from *Bufo boreas* from northern California by Ingles (1936. Trans. Amer. Microsc. Soc. 55:73–92) and has been reported in *R. aurora* from Oregon (Macy 1960. J. Parasitol. 48:662) and British Columbia, Canada (Efford and Tsumura 1969. Amer. Midl. Nat. 82:197–203). Our record is the first report of *M. microphagus* in *R. aurora* from California.

*Gyrinicola batrachiensis* is known from a variety of anurans (bufonids, hylids, ranids) from eastern North America (Baker 1987. Mem. Univ. Newfoundland, Occas. Pap. Biol. 11:1–325). It apparently only occurs in tadpoles (Adamson 1981. Can. J. Zool. 59:1368–1376). *Rana aurora* represents a new host record for *G. batrachiensis*. California is a new locality record.

*Neoechinorhynchus rutili* has been reported from numerous fish species of the northern hemisphere (Van Cleave and Lynch 1950. Trans. Am. Microsc. Soc. 69:156–171). It is also known from *Rana esculenta* in Europe (Walton 1942. Contrib. Biol. Lab. Knox College 79:1–16) and *R. catesbeiana* from Canada (McAlpine and Burt 1998. Can. Field-Nat. 112:50–68). *Rana aurora* represents a new host record for *N. rutili*. California is a new locality record.

Tadpoles were collected under scientific collecting permit 803031-05 issued by the California Department of Fish and Game.

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**RANA AURORA DRAYTONII** (California Red-legged Frog). **MICROHABITAT.** Little has been reported on microhabitat use by California red-legged frogs (*Rana aurora draytonii*). Cook (1997. MS Thesis, Sonoma State Univ., 23 pp.) investigated the utilization of microhabitats within marshes. Use of upland and other non-aquatic habitats have been reported by others (USFWS 2003. Recovery Plan for the California Red-legged Frog; Rathbun et al. 1997. Herpetol. Rev. 38:85–86). Here I report the use of an atypical, non-aquatic microhabitat by *R. a. draytonii*.

Five annual surveys were conducted between 1998 and 2002 on 90 managed ponds in the upper Kellogg Creek Watershed, Contra Costa County, California. Ponds were surveyed throughout the year or until they dried during the summer months. During sur-

veys conducted from 1998 to 2002, *R. a. draytonii* were observed utilizing all 90 ponds.

In September 2000, I walked across the bottom of a dry pond. The pond had been dry (no surface water) since the previous survey 4 weeks earlier. Pond bottom substrate consisted of a silt/clay mix that was completely dry, leaving deep (>50 cm) desiccation cracks. While walking across this pond bottom, a single adult *R. a. draytonii* was observed within a deep crack in the dry pond (Fig. 1). The frog was resting at the bottom of the crack facing skyward. Closer investigation revealed apparent soil moisture in the deepest reaches of the cracks. In October 2000, 7 adult and 22 subadult *R. a. draytonii* were observed using similar cracks in two other ponds. There was no apparent standing water, and the ponds were otherwise considered dry. During pond surveys throughout 2001 and 2002, five additional dry ponds were found in which frogs were utilizing cracks several weeks after all surface water was gone. Frogs were found deep (>30 cm) within desiccation cracks where soil moisture was still apparent.

Many authors have reported the ability of amphibians to obtain moisture from damp soil (e.g., Stebbins 1945. Copeia 1945:25–28). These *R. a. draytonii* might also be avoiding predation, direct solar exposure, and evaporative water loss by remaining below the surface. The utilization of this microhabitat might enable this species to remain in the area of the pond until more favorable conditions exist for movement (i.e., rain events, higher humidity).

Observations of *R. a. draytonii* using this type of microhabitat are significant for several reasons: this species is federally listed as threatened by the U. S. Fish and Wildlife Service; *R. a. draytonii* occurs in areas where its aquatic habitat is often ephemeral; and lands upon which the species occurs might be managed and its aquatic habitat might be altered through dredging.

In the course of conducting U.S. Fish and Wildlife protocol-level surveys, observers should not assume that a recently dried pond signifies the absence of this species from the site. The importance of documenting the presence of this frog is vital to understanding the range of the species and in promoting the recovery of *R. a. draytonii*. In some cases, searching the deep cracks of recently dried ponds might reveal the presence of this frog.

Stock ponds, where this species might occur, are often dredged to remove built-up silt loads (pers. obs.). Typically, dredging oc-



FIG. 1. Desiccation cracks in a (dry) pond bottom in which California red-legged frogs were observed utilizing as refugia in east Contra Costa County California.

curs after ponds have dried, following the assumption that frogs have retreated from the site. This practice might result in a high level of mortality to an already threatened species.

I recommend that biologists conducting surveys for *R. a. draytonii*, and land managers who may be dredging “dry” ponds, consider the use of this microhabitat by *R. a. draytonii*. Further, searching this microhabitat should be a part of investigations where there is a potential for the occurrence of *R. a. draytonii*.

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**RANA AURORA DRAYTONII** (California Red-legged Frog). **PREDATION.** Herein we report on predation of California Red-legged Frogs observed during the course of a radio-telemetry study at Point Reyes National Seashore, Marin County, California, USA.

*Rana aurora draytonii* is federally listed as a threatened species; hence, there is considerable interest in learning more about its ecology and life history. During January 2000, we had 19 *R. aurora* outfitted with radiotransmitters (Rathbun and Murphey 1996. *Herpetol. Rev.* 27:187–189). Two of these frogs were captured at a breeding pond on 12 Jan 2000, fitted with a transmitter, PIT tagged, and released at the capture site. On 14 Jan, both frogs were still present in the pond. On 18 Jan, we attempted to relocate the frogs and found that the signal was originating 400 m north of the pond, along a small, unnamed tributary to Olema Creek. As we approached the creek, a great blue heron (*Ardea herodias*) took flight. We noticed that the transmitter signal immediately changed, and after switching the receiver to the second frequency, confirmed that both transmitters were inside the heron.

The transmitters continued to function, and we were able to radio-track the heron for three days. During that time, the heron spent most of its time within 2 km of the breeding pond. On 24 Jan, we recovered both transmitters in a California blackberry (*Rubus ursinus*) thicket below a dead red alder (*Alnus rubra*) snag along Olema Creek, 1200 m from the pond.

The *R. aurora* were both adult males (6.5 cm SVL and 33.7 g; 7.4 cm SVL and 41.7 g). Because we did not observe the predation event, it is not possible to determine the time of day that the frogs were eaten. Normally, *R. aurora* are nocturnal, but it is not unusual to find a few *R. aurora* floating at the water surface or sitting on the bank during the middle of the day (pers. obs.).

There are no published reports of herons or other waterbirds feeding on adult red-legged frogs. The Recovery Plan for the California Red-legged Frog (*Rana aurora draytonii*) (U.S. Fish and Wildlife Service, 2002, Portland, Oregon) discusses predation, but it focuses on non-native predators such as fish and bullfrogs (*Rana catesbeiana*). The plan mentions Raccoons (*Procyon lotor*), Great Blue Herons, American Bitterns (*Botaurus lentiginosus*), Black-crowned Night Herons (*Nycticorax nycticorax*), Red-shouldered Hawks (*Buteo lineatus*), and garter snakes (*Thamnophis* spp.) as predators on adult *R. aurora*, but only the hawk predation is supported by a published report (Rathbun and Murphey, *op. cit.*).

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**RANA CAPITO** (Florida Gopher Frog). **DEFENSIVE BEHAVIOR.** About 2100 h on 17 July 1970 I collected a small (60 mm SVL) gopher frog (*Rana capito*) in southern Leon County, Florida, USA. The frog, sitting in the mouth of a gopher tortoise burrow, immediately became rigid, bent its head downward while arching its back, and placed its hands up over its closed eyes, palms up. I could hold the rigid frog in my hand and flip it like a coin without causing it to abandon its rigid posture. More recently (1996–2003), I observed this same behavior on numerous occasions while handling *Rana capito* at a drift fence encircling a temporary pond in southern Leon County, Florida. Then, between 7 Feb and 4 March 2003, every one of 14 immigrating frogs displayed this behavior to varying degrees when I scratched its head with my fingernail.

The behavior described herein is similar to the “unken reflex” reported in *Boophis albilabris* (Andreone 2003. *Herpetol. Rev.* 33:300–301), but differs in some respects. In *R. capito* (Fig. 1), just the hands are raised over the head, the back is flexed upwards rather than downwards, and the head is bent down. No bright coloration is exposed nor is a release call or other sound emitted while individuals displayed this behavior. A bitter-tasting, frothy secretion possessing a musty smell was produced when the skin of the back or head was rubbed. The eye-covering behavior, musty smell, and bitter taste or tingling of the human tongue has been noted in wild caught specimens throughout the range of the species from southern Alabama, panhandle Florida, central Florida, Georgia, and North Carolina (Mark Bailey, Paul Moler, Richard Franz, John Jensen, Alvin Braswell, pers. comm.).

The unken reflex has not been reported for any species in the family Ranidae and no warning coloration or sounds are involved so the behavior described here may not be aposematic and might have evolved independently in *R. capito* for a specific purpose.

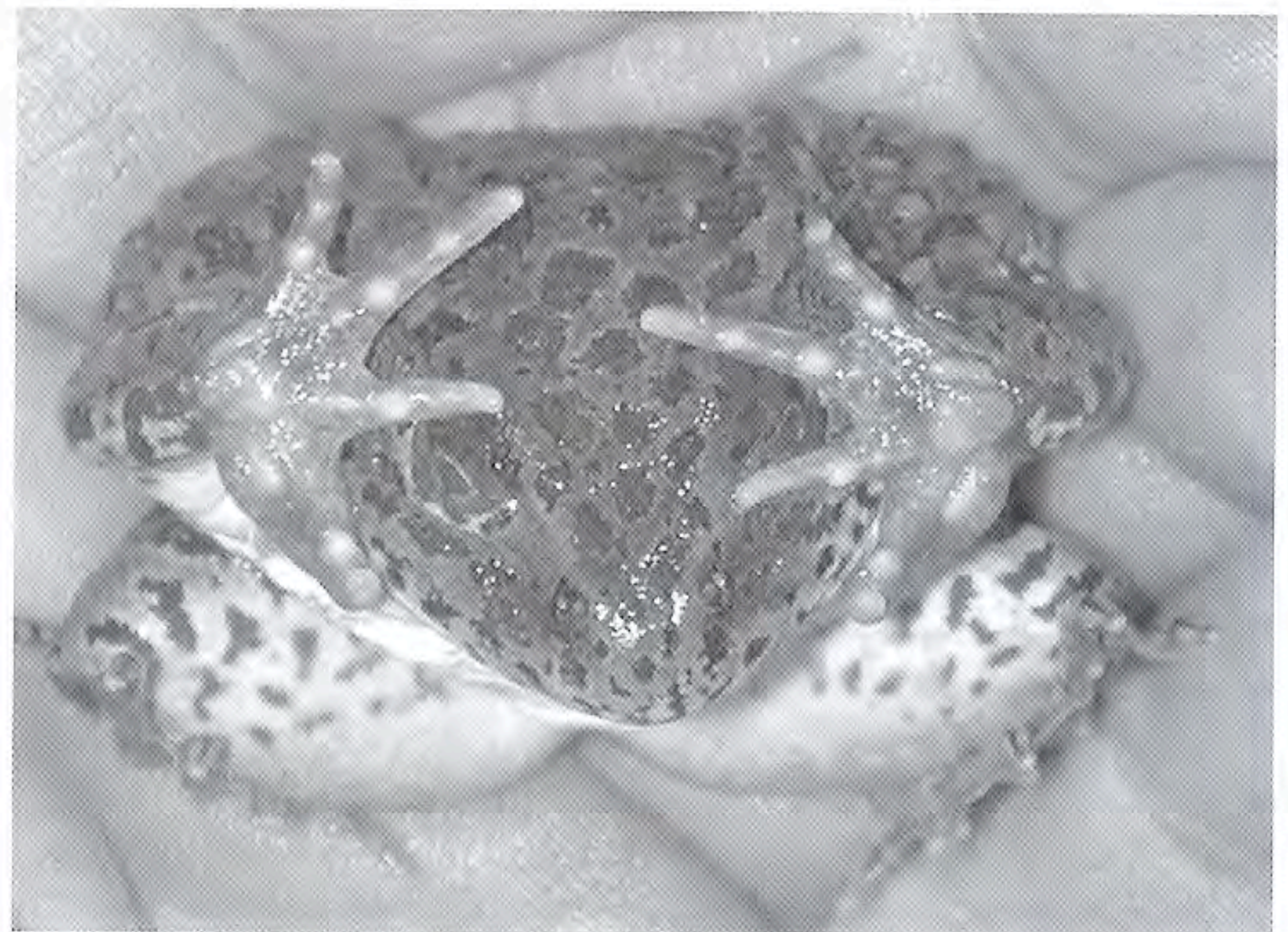


FIG. 1. Adult male *Rana capito* exhibiting “hands-up” defensive behavior. The body was so rigid that the frog could be held in an upright sitting position. Photographed in the field in southern Leon County, Florida.