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OVIPOSITION SITE OF THE SOUTHERN TORRENT SALAMANDER (*RHYACOTRITON VARIEGATUS*) IN NORTHWESTERN CALIFORNIA

NANCY E KARRAKER, LISA M OLLIVIER, AND GARTH R HODGSON

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Oviposition sites and reproductive ecology of the southern torrent salamander (*Rhyacotriton variegatus*) remain poorly documented. This species oviposits in cryptic locations making the detection of eggs difficult. Here we describe the discovery of 1 clutch of eggs of *R. variegatus* from northern California, which further expands our knowledge of their reproductive ecology.

Rhyacotriton variegatus inhabits northwestern California and western Oregon (Leonard and others 1993). Only 1 clutch of eggs, from Humboldt County, California, has previously been documented for this species (Karraker 1999). Moreover, only 5 other oviposition sites have been found for the 4 *Rhyacotriton* species, all of *R. kezeri* (Nussbaum 1969; Russell and others 2002). Details on previously located oviposition sites and clutches are given in Table 1.

On 4 October 1996, a *R. variegatus* oviposition site was found in Sweet Creek in Prairie Creek Redwoods State Park, Humboldt County, California. The site was located approximately 3.5 km inland of the Pacific Ocean and 425 m from Newton B. Drury Scenic Parkway (UTM Zone 10 414430 E, 4584290 N). Overstory vegetation at this location consisted of mature to late-seral coast redwood (*Sequoia sempervirens*) and Douglas-fir (*Pseudotsuga menziesii*); slope was 3%; aspect was 192°; and elevation was approximately 158 m. The eggs were located beneath a 42-cm-diameter (longest dimension) boulder, on loose gravel, in 1 to 2 cm of water, at the top of a step-run near the middle of the 0.5-m-wide channel. The primary substrate in the vicinity of the oviposition site was gravel, and flow ranged 0.11 to 0.15 m^3/sec. Water temperature at the site was 10.4°C at 1330. We found 8 white ova, each approximately 5 mm in diameter (excluding jelly layers), beneath the boulder and unattached to any substrate or each other. The eggs had been recently deposited, as no embryological development was evident. No adult *R. variegatus* attended the clutch, which was probably deposited by a single female. Twelve subadult *Dicamptodon tenebrosus*, 2 subadult *R. variegatus*, and 1 adult male *Ascaphus truei* were found within the 5-m reach in which the oviposition site was located.

Based on the limited available data, clutch sizes for *R. variegatus* and *R. kezeri* appear to be similar (Table 1). Timing of oviposition in *R. kezeri* is highly variable occurring from July through November (Russell et al. 2002), while both *R. variegatus* clutches were probably deposited from September to October (Karraker 1999).

Adults have been found at 3 (Karraker 1999; Russell et al. 2002) of the 7 reported oviposition sites of *Rhyacotriton* sp., yet it is unclear whether parental care occurs in *R. variegatus*. As 4 of 7 reported clutches of *Rhyacotriton* have been in well-protected locations, it is possible that disturbance of the sites permitted attending adults to escape undetected. Nussbaum (1969) and Karraker (1999) speculated that parental care in *Rhyacotriton* was unlikely given the relatively long embryonic period and the inability of *Rhyacotriton* species to defend eggs from larger potential predators such as *Dicamptodon* species. Although larvae of *R. variegatus* have been shown to be unpalatable to *Dicamptodon tenebrosus* (Rundio and Olson 2001), the palatability of eggs or adults has not been examined. If parental care occurs in *Rhyacotriton*, it is unlikely that males attend clutches, as females store spermatozoa and oviposition does not always coincide with mating (Nussbaum and Tait 1977).

Location of oviposition sites is especially critical to reproductive success in *Rhyacotriton*. Embryos develop through the winter period

TABLE 1. Summary of number of clutches (n), mean clutch size, timing, and microhabitat characteristics for oviposition sites of *Rhyacotriton* species (—indicates that data were not available). Substrate designations follow Platts and others (1983).

State	Species	n	Mean clutch size	Oviposition timing	Substrate covering site	Microhabitat	Water temp. (°C)	Source
CA	*R. variegatus*	1	11	mid- to late Sept.	boulder	riffle	—	Karraker (1999)
		1	8	late Sept. to early Oct.	boulder	step-run	10.4	This study
OR	*R. kezeri*	≈3	≈11.3	late Oct. to early Nov.	sandstone	water trickle through crack in sandstone	8.3	Nussbaum (1969)
		1	10	early to mid-July	boulder	headwater spring	8.9	Russell and others (2002)
		1	7	mid- to late July	gravel, sand, silt	mid-channel of stream	11.1	Russell and others (2002)
		1	11	mid- to late July	gravel	near headwater spring	9.7	Russell and others (2002)
WA	*R. kezeri*	≈8	≈9.4	mid-Aug.	sandstone	water trickle through crack in sandstone	9.1	Nussbaum (1969)

because of summer or fall timing of oviposition and embryological development periods of 193 to >229 d for *R. variegatus* (Karraker 1999) and about 200 d for *R. kezeri* (Nussbaum 1969). Clutches deposited beneath substrates on the surface of the streambed may be disturbed by high water conditions and scour. Metter (1968) reported that in the headwaters of a stream in southern Oregon a winter storm was strong enough to throw a 2 ft in diameter boulder 6 ft above the ground into the crotch of a forked tree. Given these conditions and that only 7 oviposition sites have been reported for all 4 *Rhyacotriton* species despite much amphibian research in the Pacific Northwest, it is likely that many clutches of *Rhyacotriton* are deposited in cryptic, well-protected locations.

All 4 species of *Rhyacotriton* possess some type of state, federal, or government agency conservation designation. *Rhyacotriton variegatus* is listed as a Federal and California Species of Special Concern and a Forest Service Sensitive Species. Yet, little information is available on the reproductive ecology of this species, including where courtship, mating, and oviposition occur. Without this information, protection of critical habitats for oviposition, such as the headwaters portions of streams in which some clutches have been found (Russell et al. 2002), may not occur. We do not recommend that efforts be specifically designed to locate oviposition sites because searches for well-protected sites can cause habitat destruction. However, we encourage recording more detailed descriptions of sites and surrounding habitats when oviposition sites are found in the general course of faunal surveys.

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USDA Forest Service, Pacific Southwest Research Station, Redwood Sciences Laboratory, 1700 Bayview Drive, Arcata, California 95521 USA. Present address (NEK): *Department of Environmental and Forest Biology, 350 Illick Hall, State University of New York, College of Environmental Science and Forestry, Syracuse, New York 13210 USA, nekarrak@syr.edu.* *Submitted 28 July 2004, accepted 30 September 2004. Corresponding Editor: RL Hoffman.*