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WESTERN TOAD, *BUFO BOREAS*, IN SOUTHERN UTAH: NOTES ON A SINGLE POPULATION ALONG THE EAST FORK OF THE SEVIER RIVER

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**Key words:** Bufo boreas, population size, potential prey, potential predator.

Amphibian species, including the North American western toad, *Bufo boreas*, are declining worldwide (Blaustein and Wake 1990). This decline may be related to a number of factors including human interference and habitat degradation (Blaustein and Olson 1991), indirect effects of "stress" leading to diseases such as “red-leg” (Carey 1993), mineral toxins in water that kill tadpoles (Porter and Hakanson 1976), predation on juveniles and adults (Beiswenger 1981, Olson 1989), and pathogenic fungal infections of eggs (Blaustein et al. 1994).

Ross et al. (1995) summarized the status of *B. boreas* in Utah, mapped distributions of many disjunct populations, and cited evidence for possible declines in populations within the northern part of the state. These authors stressed that surveys need to be expanded and continued, especially in southern Utah, to clarify the status of these toads and to identify factors that might affect their populations.

Recent reports of *B. boreas* at 3 new montane localities (2500–3030 m elevation) in southern Utah noted adults, egg strings, and metamorphs (Ross et al. 1995). Although no exact date was given for the presence of adults and egg strings, metamorphs were reportedly observed in July at 2 of the 5 ponds surveyed earlier in the year. These are the only reports on the ecology of *B. boreas* in southern Utah. Consequently, we chose to study the natural history of a single population of *B. boreas* in this area, initially focusing on questions concerning population size and structure.

We located boreal toads at a new locality in Garfield County, Utah, along the East Fork of the Sevier River, not far from a site previously reported by Ross et al. (1995). The site is in the bottom of a long canyon with a winding, slow-moving stream whose bed is an impermeable layer of Kaiparowits clay underlain with Claron limestone. The riparian zone is dominated by the introduced Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*) and native wire grass (*Juncus balticus*). Present vegetation contrasts with the natural cover in the early 1900s, which consisted of various types of willows (E. L. Boshell personal communication). A weir on the east slope of the canyon creates a small pond about 30 m in diameter. Native stands of Engelmann spruce (*Picea engelmannii*) mixed with blue spruce (*P. pungens*) and Douglas-fir (*Pseudotsuga menziesii*) rise above the riparian zone. Adjacent areas were clearcut in the 1930s and later replanted with ponderosa pine (*Pinus ponderosa*). Access to the site is by an unimproved road running parallel to the stream.

We visited the study site on 23 June, 6 and 21 July, 4, 17, and 31 August, and 7 September 1996, usually from mid-morning to mid-afternoon. As we slowly walked along the main stream, its branches, and the moist slopes on either side of the road, we located toads and captured them by hand. Snout-vent length (SVL) in millimeters and weight (WT) in grams were measured for each toad before it was released at the exact point of capture. Wart patterns on the head and dark blotches on the throat and lower left leg were sketched for each individual. Suspected recaptures were later identified by comparisons with these drawings. Using the Petersen method, we estimated population size, and we tested equal catchability using a zero-truncated Poisson test (Fortran programs PETERSEN and ZERO, 1Department of Biology, Southern Utah University, Cedar City, UT 84720. ²Author to whom correspondence should be addressed.
respectively, in Krebs 1989). Potential prey types were identified from sweeps of the vegetation using insect nets, and inferences on feeding were obtained from palpation of toad stomachs. Potential competitor and predator species were noted.

Forty-six toads were observed; unique captures represented 35 adult toads, 17 males and 18 females. Neither tadpoles in the stream, its tributaries, or the small pond above the weir, nor newly metamorphosed toadlets or potential young-of-the-year were observed. Most toads were recorded in June (N = 11) and July (N = 27), with fewer observations in August (N = 6) and September (N = 2).

Males (N = 16) were smaller than females (N = 18) in both length and weight (ANCOVA: mean SVL for males = 86.8 mm, range 75-98 mm; mean WT for males = 64.6 g, range 52-80 g; mean SVL for females = 96.3 mm, range 81-111 mm; mean WT for females = 92.9 g, range 52-115 g; F = 20.87; df = 1.32; P < .001).

We compared the 25 non-recaptured toads observed during the first 2 visits with those 8 recaptured and 10 non-recaptured toads observed during the last 5 visits to estimate population size. The Petersen estimate, with replacement, was 53 adult toads (95% CL = 38-99). A goodness-of-fit test of observed and expected values for the zero-truncated Poisson test of equal catchability could not reject the null hypothesis (χ² = 1.21; df = 3, P > .8).

A null hypothesis, no difference between male (N = 4) and female (N = 6) growth in mm/day, was accepted (Mann-Whitney test, U = 4.0, Z = 1.7, 2-tailed P value = 0.09). Combined recaptures for males and females allowed an average estimate of 0.17 mm/day (95% CL = 0.09-0.25) growth in SVL during the study period.

We swept five 10-m transects with a 40-cm-diameter insect net in the vicinity of captured toads. The 169 arthropods caught in these sweeps represented 7 orders: Homoptera (27%), Coleoptera (25%), Diptera (18%), Orthoptera (17%), Hymenoptera (8%), Hemiptera (4%), and Arachnida (1%). Orthopterans (N = 29) had much larger average body lengths (20.1 mm, 95% CL = 18.7-21.5) than those (N = 140) of all other taxa (2.8 mm, 95% CL = 2.4-3.1). All toad stomachs examined by palpation in July and early August contained large prey (>2.8 mm).

Two dead adult toads were found under a clump of dried grass in a burrow also occupied by 4 live juvenile northern water shrews (Sorex palustris). Although we examined the partially dried carcasses, we could not determine that the toads were killed by shrews, although it is suspected that shrews were feeding on them (Fig. 1). Numerous wandering garter snakes (Thamnophis elegans vagrans) were observed in the area. All were too small (SVL < 0.5 m) to swallow any of the toads we measured, although they could definitely prey on juveniles and tadpoles. The only other amphibian species observed at the study site was the leopard frog, Rana pipiens, whose numbers appeared fewer than B. boreas (only 6 were observed during the study period).

A population of B. boreas in southern Utah, studied during summer 1996, contained only large, presumably old adults, with no indication of size-age structure that would suggest juvenile recruitment. The estimated population size of 53 adults is based on individuals that were recaptured at random; however, sample sizes were uneven for the period of study, and this number relies on the assumption that grouping data into 2 samples does not bias the true estimate of population size. We also assumed no recruitment from migration of adult toads into or out of the study area because of the widely separated populations in this area. Growth rates estimated from a very small sample of recaptures over a relatively short period of time probably do not accurately reflect annual growth rates. A femur from 10 concentric layers of bone in each osteon may indicate an old adult toad. However, sections of bone from toads of various sizes are needed to verify this notion. Toads were not observed feeding, but their stomachs appeared to contain large insects (possibly orthopterans). Because grasshoppers are the largest but not most abundant potential prey, toads may be selectively feeding on them. Dead toads can be eaten by shrews, but whether shrews kill toads is not known. Numerous wandering garter snakes may prey on tadpoles and small toads but are too small to swallow adult toads in this population. There appear to be few, if any, competitors to B. boreas for food and habitat space. R. pipiens and B. boreas occur together along the water courses, perhaps suggesting that critical resources for
Fig. 1. Venter of a dead western toad (Bufo boreas) found in the burrow of a northern water shrew (Sorex palustris) in southern Utah; note the jagged, apparently chewed edge near the head end of the dried carcass.

survival are either different for both species or, if similar, are not limiting.

Toads appear to be clumped along water courses or in wet seepage areas with abundant grasses and sedges, habitat similar to those previously described for the species in other areas (e.g., Campbell 1970). From previous descriptions by Black and Brunson (1971), the pond above the weir at this study site appears ideal for breeding aggregations of toads.

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