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RECENT POPULATION CHANGES

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Distribution of *Bufo boreas* in Utah

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The Western Toad (*Bufo boreas*) has undergone severe reductions in population sizes and distribution in much of its geographic range (Carey 1993; Colorado Division of Wildlife 1997; Corn et al. 1989; Livo and Yeakley 1997). In the southern Rocky Mountains, which include portions of the states of Colorado, Wyoming, and New Mexico, *B. boreas* is a candidate species for federal listing under the United States Endangered Species Act. Federal listing is "warranted but precluded," however, because there are other species presently in greater need (Federal Register 2002). Because of declining populations, the states of New Mexico and Colorado listed *B. boreas* as endangered in 1976 and 1993, respectively (Colorado Division of Wildlife 1997). In Utah, *B. boreas* is considered a species of special concern because of declining populations (State of Utah Rule R657-48) and lack of knowledge on current distribution (Ross et al. 1995).

Only 70 *B. boreas* localities were documented in Utah prior to 1995 (Fig. 1). These localities were based on museum records, various databases, and survey efforts, however, it was not known how many historical sites still supported *B. boreas* or how well these sites represented the distribution of the species in the State of Utah. Ross et al. (1995) reported that the majority of the historical records for *B. boreas* in Utah were concentrated in northern Utah and a large number of these locations were in the Wasatch Mountains between Salt Lake City and Provo (Fig. 1). This distribution pattern may reflect increased survey effort in this part of the state. Between 1980 and 1994, *B. boreas* records were scattered and typically consisted of the presence of one to several adults. Twenty-six localities were documented during this timeframe and reproduction was observed at only five of these localities (Ross et al. 1995).

We report the results of surveys since 1995 by the Utah Division of Wildlife Resources (UDWR) to better determine the current distribution of *B. boreas* in Utah and determine the extent of occupancy in areas with detections. This effort has consisted primarily of daytime visual encounter surveys (Crump and Scott 1994) during the breeding season. Surveys were generally systematic as initial surveys were completed statewide at or near pre-1995 localities and expanded to suitable habitat near detection points to

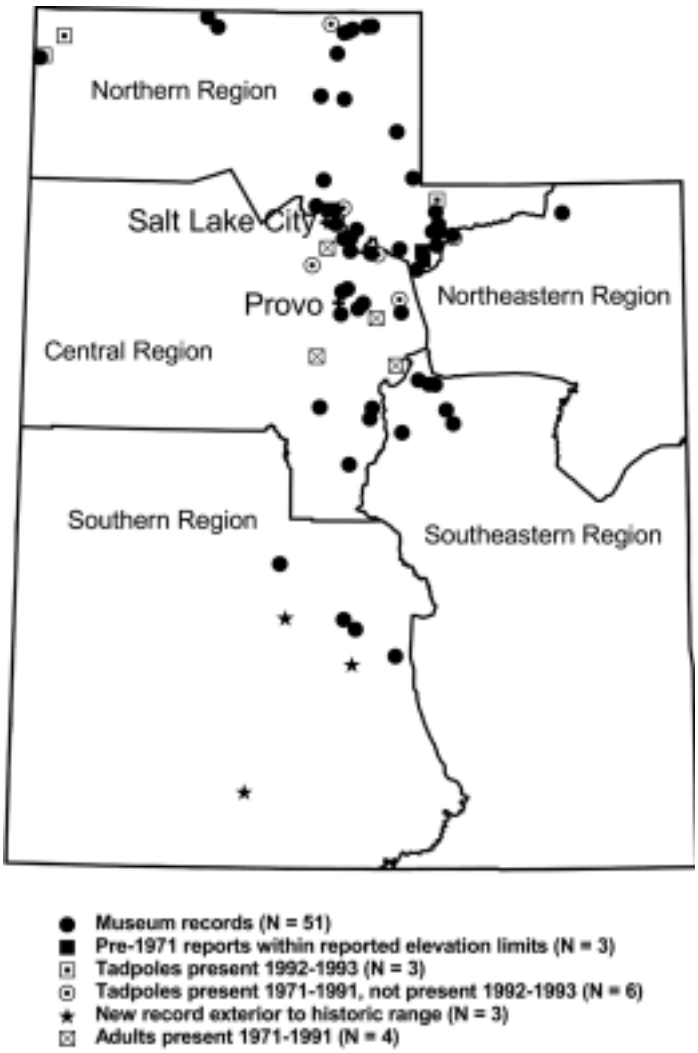

FIG. 1. Pre-1994 distribution of *Bufo boreas* in Utah (adapted from Ross et al. 1995).

delineate local populations. Fifty-eight of the 70 pre-1995 localities were revisited and surveyed. Survey effort varied because of the complexity of *B. boreas* habitat in Utah. In dry regions of the state, surveys were completed at springs as small as 10 m^2, while some surveys encompassed all habitats within portions of drainages (more than 0.5 km^2). Multiple visits were made in areas with detections, while areas where *B. boreas* were not observed generally were not revisited. No detections are not reported as one survey is not adequate to determine occupancy due to the temporal variability in amphibian populations.

Springs, streams, ponds, small lakes, and reservoirs were targeted for surveys. Effort was concentrated in springs, beaver (*Castor canadensis*) dam complexes, areas of shallow (less than 30 cm) open water with emergent and submerged vegetation, wet meadows adjacent to wetland habitat, and small mammal burrows upland from wetland sites. Surveys were conducted by searching the perimeter of all streams, ponds, and lakes, and conducting parallel transects to achieve 100% coverage of wet meadows and shallow ponds and marshes (Fridell et al. 2000). Some locality information, however, was collected from detection of single individuals in non-breeding habitat. Date, locality, observer, county, Universe Transverse Mercator (UTM) coordinates, and the number of each life stage (juvenile/adult, metamorph, tadpole, and egg strand) were recorded for all detection points. *Bufo boreas* captured during surveys were examined for clinical signs (e.g., loss of righting reflex, leg extension, failure to flee, skin tags, and subcutaneous hemorrhages) of infection of chytrid fungus (*Batrachochytrium dendrobatidis*).

Between 1995 and 2003, *B. boreas* were observed at 102 localities (Fig. 2) in more than 1100 discrete surveys. *Bufo boreas* were found at 84 previously undocumented localities and were present at 18 of 58 pre-1995 localities. Sites with *B. boreas* were clustered in 12 geographically distinct areas, likely representing discrete populations (Fig. 2). The majority of the *B. boreas* populations were found in two of the five UDWR management regions (Fig. 2).

FIG. 2. Distribution of *Bufo boreas* in Utah based on observations between 1995 and 2003.

Breeding (presence of egg strands and/or tadpoles) was observed in 54 locations within nine of 12 geographic areas (Fig. 2). Limited distributional information has been gathered on the three geographic areas (Strawberry Reservoir, Cottonwood Canyons, and North Horn Mountain) where *B. boreas* breeding has not been documented. In Cottonwood Canyons and North Horn Mountain, few adult *B. boreas* have been encountered, while 30 adults were encountered during 2003 surveys in the Strawberry Reservoir geographic area. Areas used by *B. boreas* for breeding are highly variable from year to year with spatial shifts corresponding to changes in habitat quality, water level, and vegetation. Since 1995, *B. boreas* breeding habitat has disappeared at one isolated breeding pond in northern Utah due to drying associated with drought. Additional breeding localities seemed to have shifted to more suitable habitat, when breeding habitats changed.

Consistent with Ross et al. (1995), we found *B. boreas* to primarily occupy montane habitats. In northwestern Utah, *B. boreas* were found primarily in lower elevation springs, which had been dredged and bermed to create small ponds for livestock watering; no fish were present in these habitats. The upland vegetation community varied from pinion-juniper/sage brush to aspen/mountain fir/mountain shrub. In higher elevations, *B. boreas* were found in wetlands and streams. *Bufo boreas* were found in eight streams containing native Bonneville cutthroat trout (*Oncorhynchus clarki utah*) and one stream containing brook trout (*Salvelinus fontinalis*). The upland vegetation community consisted of aspen/lodgepole pine. *Bufo boreas* were observed in northern Utah at elevations ranging from 1570 to 2800 m. In southern Utah, most *B. boreas* were found in wetlands associated with flowing streams, particularly in areas with recent *C. canadensis* activity (4 of 4 geographic areas). *Bufo boreas* were found in one stream containing brown trout (*Salmo trutta*), four streams with rainbow trout (*Oncorhynchus mykiss*), two streams with *S. fontinalis*, and four streams with *O. c. utah*. *Bufo boreas* were occasionally observed in off-channel wetlands, lakes, and ponds. The upland vegetation community varied from spruce fir/aspen to mountain fir/ponderosa pine. Populations were located at slightly higher elevations in southern Utah, ranging from 2390 to 3220 m.

Chytrid fungus was detected in one of 12 geographic areas during the survey effort. The diagnosis was confirmed when two *B. boreas* from the Paunsagunt Plateau tested positive according to the National Wildlife Health Center in August 2001. No other populations have been tested for chytrid fungus, however, no clinical symptoms have been observed to date.

Surveys between 1995 and 2003 have better defined the current distribution of *B. boreas* in Utah (Fig. 1). Ross et al. (1995) reported that very few recent localities, specifically breeding localities, were known to exist in Utah. Between 1995 and 2003, the UDWR documented the presence of *B. boreas* at 102 localities and 54 breeding areas within 12 geographically isolated populations (Fig. 2). *Bufo boreas* are widely distributed in Utah with populations persisting in northern and southern Utah (Fig. 2). Even though *B. boreas* were not detected in more than 1000 discrete surveys, temporal variability in amphibian populations coupled with the variability in survey effort among habitats does not indicate absence. Few *B. boreas* were found in the Wasatch Mountains between Salt Lake City and Provo, which could be attributed to the expanding human population along the Wasatch Front. Survey efforts in this part of the state, however, have not been as intensive. More surveys are needed to determine the distribution, population status, and factors influencing *B. boreas* distribution in these mountains. Future surveys may document *B. boreas* in additional geographic areas in Utah.

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HERPETOLOGICAL HUSBANDRY

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Captive Breeding of *Notophthalmus viridescens* Through Hormonal Manipulation

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Model organisms such as *Notophthalmus viridescens*, which possess regenerative ability, can offer great insight into the mechanisms of regeneration. Improved techniques for increasing the availability of embryos under laboratory conditions will allow comparative studies between development and regeneration and enable the manipulation of embryos to determine which genes are necessary for regenerative ability.

The effect of the environment, including temperature and photoperiod, on amphibian reproduction has been well documented. Photoperiod has proven to significantly affect spermatogenic cycles and ovarian development. It has also been shown that inappropriate temperatures can decrease gametogenesis (Duellman and Trueb 1986). Under laboratory conditions, inadequacies in environmental, social or nutritional cues necessitate the use of hormonal manipulation for the successful generation of large numbers of embryos (Whitaker 2001). A variety of hormones have been used in amphibian reproduction. These include Human Chorionic Gonadotropin (HCG), Luteinizing Hormone-Releasing Hormone (LH-RH), Follicle Stimulating Hormone (FSH), and Gonadotropin-Releasing Hormone (Gn-RH) (Whitaker 2001). Most of these studies have been done with anurans and there is very little information on urodeles.

Khan and Liversage (1995) developed a technique for spawning and rearing *Notophthalmus viridescens* embryos under laboratory conditions. Their method uses a combination of manipulation of photoperiod, temperature and hormones. Our current communication improves and simplifies the method for obtaining embryos by eliminating the need for manipulation of temperature and photoperiod or the selection of pre-conditioned animals.

Adult maintenance.—Adults in our colony are maintained under standard conditions (Foty and Liversage 1993) with some modifications. A bed of oak leaves (sterilized by autoclaving) is layered on the bottom of the tubs. The oak leaves provide shelter for the newts, and anecdotal evidence suggests that degradation products such as fulvic acid provide anti-bacterial and anti-microbial properties and help in the absorption of nutrients and minerals (www.fulvic.com). Pine or cedar products should not be used, as the compounds they release are harmful to many amphibian species (Barnett et al. 2001). Newts are fed twice weekly with live blackworms (*Lumbriculus variegates*), which are high in protein and live in the enclosure until they are eaten. The use of live prey decreases the amount of husbandry time by eliminating the need