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Boreal Toad

Erin Muths and Paul Stephen Corn

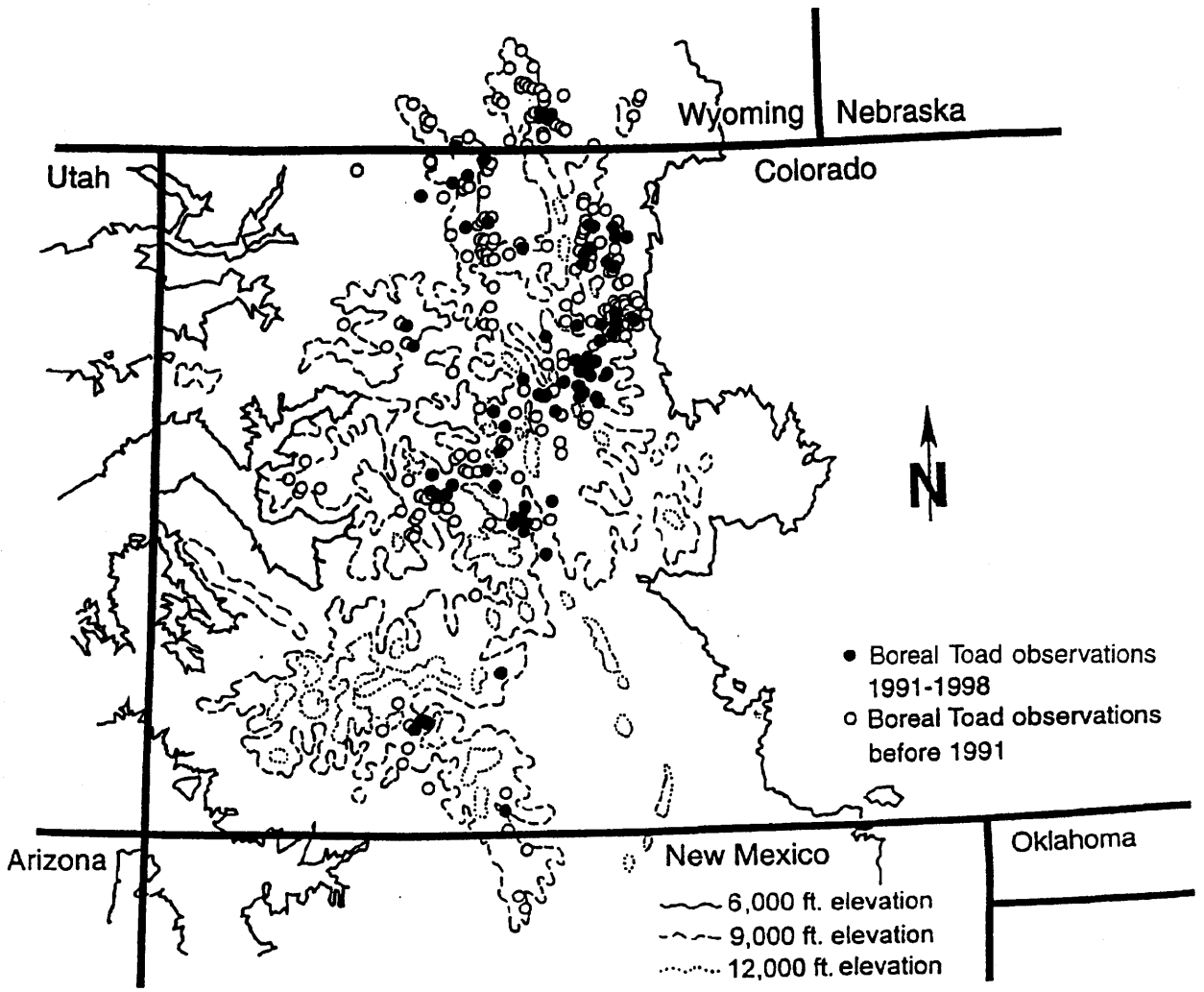
Common name: boreal toad
Scientific name: *Bufo boreas boreas*
Order: Anura
Family: Bufonidae
Status: The Southern Rocky Mountain Population (SRMP) of the boreal toad is Endangered in Colorado and New Mexico and has been ruled "warranted but precluded" by the U.S. Fish and Wildlife Service (USFWS 1995).
Threats: Causes of the decline have not been identified with certainty, but stress and decreased resistance to disease such as "redleg" (*Aeromonas* bacterial infections) may play a role (Carey 1993).
Habitat: In the southern Rocky Mountains, boreal toads are found in alpine and subalpine zones between 2,300 and 3,700 m in elevation.
Distribution: The boreal toad occurs along the western coast of North America from Alaska to central California and in the Rocky Mountains from Alberta to New Mexico (Stebbins 1985). Another subspecies, the California toad (*B. b. halophilus*) occurs in southern California; three sibling species, the Yosemite toad (*B. canorus*), black toad (*B. exsul*) and Amargosa toad (*B. nelsoni*), occur in California and Nevada with restricted or relict distributions.

DESCRIPTION

Adult male boreal toads are identified by the presence of nuptial pads (dark, cornified patches that help hold on to the female while mating, or in amplexus) on the dorsal surfaces of the first two digits of the front feet or by vocalization when handled. Boreal toads are dimorphic (differ by gender) in size. In Rocky Mountain National Park, males averaged 71.5 mm snout-vent length (SVL; $N = 1255$, range 52–86 mm) and 39 g mass ($N = 980$, range 21–74 g). Adult females, captured during the breeding season, averaged 82.9 mm SVL ($N = 183$, range 62–101.2 mm) and 68 g mass ($N = 120$, range 26–142 g). Like most toads, boreal toads have glandular skin with prominent parotoid glands behind the eyes. Cranial crests are absent. Boreal toads are light brown or gray to black on the dorsal surface and lighter with black spots on the ventral surface. Coloration is variable, especially on the ventral surface. A light-colored dorsal vertebral stripe is usually present, but it may be broken or very faint.

Analysis of mitochondrial DNA from toads throughout the range of *B. boreas* revealed significant variation (Goebel 1996), such that the Southern

Figure 2. Boreal Toad Observations



Rocky Mountain Population may warrant recognition as a distinct species. At present, the Southern Rocky Mountain Population is considered an evolutionarily significant unit (Goebel 1998).

NATURAL HISTORY

Boreal toads were formerly thought to be common in the mountainous areas of southern Wyoming, Colorado, and northern New Mexico (Figure 2), but significant declines have been documented in the last 10 to 15 years (Carey 1993; Corn 1994; Stuart & Painter 1994; Corn et al. 1997). Despite the recent declines, boreal toads still occur in all ranges of the southern Rocky Mountains, except the Grand Mesa in western Colorado. They occur in the Medicine Bow Mountains in southeastern Wyoming and possibly in one county in New Mexico. Surveys in 1996 and 1997 identified 33 breeding sites in Colorado and one in Wyoming (Loeffler 1998; Figure 2), but no breeding has been observed in New Mexico since 1986 (Stuart & Painter

1994). Boreal toads in Utah and southeastern Idaho were not included in the original petition for listing but are genetically related closely to toads in Colorado and should be considered part of the Southern Rocky Mountain population (A. Goebel et al. personal communication).

Toads breed in beaver ponds, glacial kettle ponds, large drainage lakes, and other ephemeral water sources (Stebbins 1954; Hammerson 1992; Corn et al. 1997). Adults use willow and upland forests (e.g., Engelmann spruce) after the breeding season (Jones 1997; Corn & Muths unpublished data). Campbell (1970a) observed boreal toads overwintering in rock-lined chambers in a stream bank. Toads also use ground squirrel burrows as hibernacula, or places to hibernate.

Boreal toads are long-lived amphibians (probably longer than 15 years). Males and females generally do not breed until they are 3 and 4 years old, respectively. The timing of spring breeding relates to snowmelt and can be as early as April or as late as July depending on elevation (Corn et al. 1997). Occasionally toads produce egg masses in late July or August, well after the normal breeding activity peak for their populations (Livo & Fetkavich 1998). Males aggregate at pond margins to wait for females where they emit a soft chirping call, sometimes referred to as a "release" call if they are clasped mistakenly by another male. Males do not produce a chorusing vocalization as do other male toads found in the Rocky Mountains, such as Woodhouse's toad (*Bufo woodhouseii*).

Eggs are laid in the water in long, single strands, often wound around pond vegetation. Development and growth of eggs, tadpoles, and juvenile toads are temperature dependent. Typically in the Colorado mountains, eggs are laid in late May and early June and hatch in 1 to 2 weeks. Tadpoles feed on algae and metamorphose in 3 to 7 or more weeks. Juvenile and adult toads eat a variety of insects and other invertebrates (Campbell 1970b).

Vulnerable lifestages of boreal toads include tadpoles, metamorphs, and recently metamorphosed toadlets. Reproductive failure occurs frequently in high elevation populations when tadpoles fail to metamorphose before the onset of winter. Tadpoles are somewhat unpalatable but face numerous predators including garter snakes, aquatic insects, tiger salamanders, and birds (Beiswenger 1981; Livo 1998; Livo & Jones personal communication). Metamorphosis brings reduced swimming and locomotive ability and increased risk of predation (Arnold & Wassersug 1978). Recently metamophosed toadlets are vulnerable to desiccation and must find a place to overwinter where they are protected from desiccation and freezing. Adult toads are somewhat protected from predation by poisonous secretions from their skin glands, but ravens can be important predators (Olson 1989; Corn 1993). Raccoons, domestic dogs, and foxes have been identified as occasional predators. The extent and impact on toad populations from predators is unknown, but Olson (1989) observed 20% of breeding adults at one aggregation killed by ravens in Oregon. A high

rate of predation could be a serious problem in populations that have already declined (Corn 1993).

CONFLICTING ISSUES

Several potential causes for the decline of boreal toads have been investigated. Blaustein et al. (1994) found that ambient ultraviolet-B radiation decreased the hatching success of boreal toad eggs in Oregon, but Corn (1998) did not observe any UV-B related mortality in a similar study conducted in Rocky Mountain National Park, Colorado, and further showed greater than 100% variation in ambient UV-B from year to year (Corn 1998). Kiesecker and Blaustein (1995) observed a synergism between the water fungus *Saprolegnia ferax* and UV-B radiation, but *Saprolegnia* has not been studied in the southern Rocky Mountains.

Acid precipitation is not thought to have contributed to declines of boreal toads (Corn & Vertucci 1992; Vertucci & Corn 1996). Habitat destruction has not been identified as a cause of significant declines in the southern Rocky Mountains but is of concern as development expands, encroaching on potential boreal toad habitat.

Because the boreal toad is not a federally listed endangered species, most of the money available for research and management is controlled by the Colorado Division of Wildlife (CDOW) and comes primarily from the Great Outdoors Colorado monies, generated from state lottery dollars. This allows CDOW some flexibility in administration, but it also potentially constrains other work proposed by other state or federal entities.

An interagency recovery team was formed in 1994. Declines had been documented and very few breeding sites were known (Carey 1993). Initial recovery plan documents were written under circumstances that dictated aggressive action to save the toad. Over the last 5 years, more effort has gone into surveys and research. Surveys have yielded more than 30 breeding sites in 12 counties (Loeffler 1998). This increase in knowledge has influenced the goals and direction of the Recovery Team but has also provided a basis for disagreement.

There is general agreement on recovery goals but continued discussion on the means of obtaining these goals. Is intensive management, perhaps including aggressive reintroduction and translocation, required? Or should management be more cautious, with continued emphasis on research? Because it is still not known why toads have declined, we tend to favor the latter approach.

To date, the Boreal Toad Recovery Team has worked through differences of opinion and focused on compromise with an agenda that benefits toad recovery in the state. Although various disagreements continue to recur and delay action, the toads are not suffering a rapid decline. This suggests that crisis management and disagreements can sometimes lead to alternative solutions to problems.

One issue that has been debated within the Recovery Team is whether or not, and when, to use translocation as a management tool. Translocation has been debated in the literature for a number of years (e.g., Griffith et al. 1989; Burke 1991; Dodd & Seigel 1991; Reinert 1991; Thomas & Whitaker 1994). The State of Colorado is responsible for the boreal toad and wants to avoid federal listing. The State is interested in proactive management actions such as translocation. The scientific advisors on the recovery team, taking into account genetic considerations, the potential for introduction of disease, and the fact that more breeding populations are found each year, have recommended a more conservative approach: no additional translocations unless known conditions deteriorate significantly. Several small-scale translocations have taken place in the past and have provided useful information about effective methods.

After some debate and a re-evaluation of the current situation of the Southern Rocky Mountain Population of the boreal toad, the Recovery Team reached a compromise. In general, translocations will not be used unless existing toad populations decline precipitously. However, a well-monitored experimental translocation project on the Grand Mesa has been initiated with a 3-year commitment to pre-translocation surveys of the habitat and surrounding area. Surveys in the last decade have yielded no toads on the relatively isolated Grand Mesa, although it is a historic locality for *B. boreas*. If no toads are found, a well-designed, experimental translocation of multiple age classes (eggs, tadpoles, and metamorphs) will ensue. This project is designed to (1) identify which life stage survives most successfully following translocation, and (2) determine the length of time before the translocated population is self-sustaining.

FUTURE AND PROGNOSIS

Additional problems and conflicts are possible because there is little specific information about habitats required by toads away from breeding sites. This lack of information promotes management decisions that may or may not be beneficial for maintaining toad populations. The problem is exacerbated because the lack of federal listing allows states with different philosophies to manage toads differently, and federal agencies can choose to ignore Recovery Team recommendations. Although federal listing would result in more uniform application of management decisions, such listing may not be necessary and could potentially derail the current recovery efforts owing to delays in producing a new recovery plan as directed by the ESA. A conservation agreement between federal land management agencies and CDOW, signed in 1998, may alleviate some of the problems of multiple managers. Improved communication and cooperation among states that

provide habitat to the Southern Rocky Mountain Population of boreal toads are also necessary to promote recovery.

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