NOTES ON *BUFO BOREAS* (B. AND G.) FROM THE GOTHIC REGION OF COLORADO

W. LESLIE BURGER, JR., and ARTHUR N. BRAGG
University of Oklahoma, Norman

In the period from July 15 to August 20, 1946, numerous collections of the tadpoles and adults of *Bufo boreas* (B. and G.) were made by the senior author in the vicinity of the Rocky Mountain Biological Laboratory, Gothic, Gunnison County, Colorado. Since (1) the taxonomic status and geographic distribution of the different races of *Bufo boreas* are still problematical, (2) the life history of these forms is imperfectly known, and (3) the tadpoles of none of them have as yet been described in sufficient detail, an account of field observations on, and descriptions of developmental stages of, this toad should constitute a valuable contribution.

HABITAT

The adults of *Bufo boreas* were frequently found in moist meadows and thickets up to an altitude of about 10,000 feet. They were especially numerous around bodies of water (beaver ponds, glacial kettle ponds, and streams) both in the shallow water and in the vegetation in the low areas on the shore.

Tadpoles and recently metamorphosed young were found at five different locations. Consideration of these places indicates that *Bufo boreas* in this region

exercises little discrimination in its selection of breeding sites. Any body of water without a strong current and with gradually descending banks at some point on its margin fulfills the qualifications. Tadpoles were found in a roadside puddle with approximate dimensions of 3 feet by 6 inches and in Taylor Reservoir, the largest lake in Colorado. They were found in beaver ponds and glacial kettle ponds alike. The greatest number observed at any one time was found at the base of a travertine cliff near Cement Creek in a pond fed by a warm spring. *Bufo boreas* exhibits remarkable versatility in choice of breeding site as well as in the normal habitat of the adults.

BEHAVIOR

When disturbed the adults of *Bufo boreas* try frantically to escape, but their hops are short and their pace is thus very slow. They usually jump into any nearby water but were never seen to dive beneath the surface or to venture farther than two or three feet beyond shallow water. Of the several dozen adults for which attempts at capture were made only one toad succeeded in escaping alcoholic immortality. This individual swam out of reach under the travertine cliff near Cement Creek.

The tadpoles in the three cases in which they were carefully observed in nature were resting on the bottom in two to six inches of water. Occasionally a tadpole would swim to the surface, take a gulp of air, swim along just beneath the surface for a short distance, and sink slowly to its former position. They could be carefully scooped up in a net or in a small bottle without being disturbed in the least until stranded in the dry net or until jarred about in the bottle. They could even be collected by gently edging one's cupped hand under them, raising it slowly to the surface, and allowing the water to escape between the fingers. The complete lack of timidity in the tadpoles of *Bufo boreas* is in marked contrast to the behavior of the tadpoles of the leopard frog with which they were occasionally found associated.

An unpublished term report by Mr. Wayne Randel lists the following items found in an examination of the stomach contents of fifteen adults: moths, grasshoppers, ants, deer flies, mosquitoes (*Theobaldia* sp.) and various beetles (Staphylinidae, *Dytiscus*, and others).

TADPOLES

The tadpoles of the earliest collection (July 24) ranged in length from 11 mm at which size the hind limbs were represented by ovoid buds to 27 mm at which the hind limbs were well formed and the fore limbs beginning to develop under the skin. These tadpoles were collected in a roadside ditch at an altitude of about 9000 feet. Tadpoles collected in another pond at about 9850 feet were at about the same stage of development.

The collection of tadpoles from the pond at Cement Creek made on August 5 was part of the remnant of a large population of tadpoles most of which had already transformed. The young toads which swarmed in the shallow water and in the vegetation at the water's edge will be described in the proper place. The smallest tadpoles in this collection range from 25 to 30 mm in length; thus, they overlap in size the largest specimens of the previously described collection and correspond closely to them in development. If a lower altitude and a higher water temperature have any effect on the development of the tadpoles of *Bufo boreas* it is only in allowing earlier breeding of the adults and/or in increasing the rate of development of the tadpoles. The supposition that a higher water temperature results in a precocious development of the tadpoles is supported by a local report that the tadpoles in a nearby, warmer pond had already transformed. No difference either in coloration or body proportions could be found between the smallest

specimens (about 11 mm in length) and the largest (about 37 mm). Since the tadpoles of *Bufo boreas* have never been adequately described the following description of the fully developed tadpoles is given.

Body small, reaching a maximum total length before metamorphosis of 34-37 mm; tail tapering to a blunt tip; dorsal fin extending anteriorly a short distance past anus and disappearing onto body; spiracle sinistral, directed backward and upward at an angle of about 40 degrees; opening of spiracle distinctly oval with longest dimension vertical, located below lateral axis, with edge free from body in anterior, dorsal, and ventral portions but attached posteriorly; eyes dorsal to lateral axis, slightly nearer to lateral margin than to middorsal line and posterolaterad of nostrils on a line forming a 45 degree angle with longitudinal axis when viewed from above; anus ventromedian, opening from a tube (circumference about 0.9 mm) directed backward and slightly downward and projecting about 1 mm from surface of body—the tube being formed by forking of ventral tail fin immediately before it joins body between bases of hind limbs.

In alcoholic specimens body and hind limbs heavily colored above with a dark-brown pigment, often having a bluish tinge; ventrum of body slate colored with lighter blue blotches that tend to form transverse bands on each side of abdomen; median ends of these bands more or less fused to form two lines that converge posteriorly and enclose an immaculate slate-colored wedge-shaped central area; area beneath head anterior to level of eyes and ventral surfaces of hind limbs also light blue in color; musculature of tail opaque with a yellow tinge, densely flecked with large dark-brown chromatophores so as to give a brown granular effect; dorsal and ventral tail fins semitransparent and with scattered small dark-brown chromatophores, dorsal fin appearing more densely pigmented in preserved material because of presence of more coagulated blood.

Labial teeth 2/3. Papillary fringe extending from edge of upper labium around angles of mouth mediad along lower labium about one-fifth of its total width on each side; fringe mostly single but double on lower labium; a few extra papillae scattered inside fringe at ends of rows of labial teeth; an irregular row of papillae extending from fringe toward but not reaching upper mandible. Outer series of upper labial teeth lining inner edge of upper labium and arranged in a row which varies from a flat crescent to a broad truncate U consisting of three approximately equal, straight portions, the outer two forming angles of about 150 degrees with the central portion. Inner series of upper labial teeth corresponding in arrangement to outer row, the pattern being interrupted medially by a space a little narrower than one-half length of either part. Upper mandible broadly truncate-U shaped, its external edge finely denticulate. Lower mandible broadly V shaped with the two ends passing under upper mandible at its corners. Lower series of labial teeth usually all three entire—inner series frequently rising to a medial point directed toward lower mandible but occasionally interrupted medially by a short space; ends of inner and middle series converging; outer series following middle series in shape but shorter by about one-tenth on each side. Measurements made of a sample of ten fully developed tadpoles gave the following ranges and means in mm: Total length, 32.2-36.9 (34.2); body length, 14.6-16.9 (15.7); body depth, 7.8-9.1 (8.4); body width, 9.2-10.6 (9.6); tail length, 16.5-20.3 (18.5); tail depth, 6.3-7.7 (7.1); musculature of tail, 2.9-3.2 (3.0); spiracle to snout, 7.0-8.6 (7.7); spiracle to vent, 8.0-9.7 (8.8); spiracle to eye, 3.7-4.8 (4.3); eye to snout, 3.0-4.0 (3.4); eye to nostril, 0.9-1.4 (1.1); nostril to snout, 1.1-1.9 (1.6); mouth width, 2.6-3.0 (2.8); interorbital distance, 3.1-3.7 (3.4); internasal distance, 1.2-1.7 (1.5). The average length of these tadpoles, 34 mm, is intermediate between the length recorded by Wright (1942) for *Bufo boreas boreas* (27 mm) and for *Bufo boreas halophilus* (55 mm).

In metamorphic stages which have passed the point of maximum tadpole length marked changes appear. There would be no advantage in describ-

ing in detail the train of events by which the tadpole of *Bufo boreas* is transformed into the young toad. By comparing the foregoing description of the fully developed tadpoles with the description of the recently metamorphosed toads, a general conception may be had of the transformation.

Young, recently transformed, specimens were collected at the edge of two ponds—a large number around the pond near Cement Creek on August 10 and a single specimen at the edge of a kettle pond 3 miles south of Gothic on August 14. The following description of the coloration of *Bufo boreas* shortly after transformation is an adaptation of notes taken on live material in the field.

Dorsum light fawn to brownish black in ground color, with about 30 small irregular black spots that are very distinct on lighter specimens but inconspicuous on darker ones; gross ground color on closer examination seen to consist of numerous light-yellow flecks on a black field; black spots on dorsum each enclosing one or more small brown warts, which are often so close together that the brown fuses to form a single brown spot within a black area (or, stated differently, the numerous small brown warts occur mostly in clusters that are usually outlined with black); a pair of large oblong diagonal spots often present on sides of posterior part of back, directed posteroventrad and terminating just anterior to bases of hind legs; spots becoming more numerous toward sides where they fuse irregularly and gradually merge with ground color and fade toward ventrum; coloration on head similar to that of rest of dorsum, with five to seven bar-like spots along upper jaw; ground color fading to white on sides of upper jaw.

Ventrum bluish white with a very fine, more or less continuous, black midventral line and usually with irregular black blotches, most numerous on sides; ventrum granular in appearance because of numerous small pits each situated at apex of a small tuberosity; seat varying in color from light gray to black; pits on seat grouped into clusters on large light-yellow tuberosities; chin occasionally immaculately white but usually marked with a few black spots beneath its point, with a fine black midventral line, and with several spots located just anterior to the midpoint of a line between bases of forelimbs.

Coloration of dorsal surfaces of legs similar to that of body except that ground color is usually lighter; spots number 2-4 on fore legs, 7-9 on hind legs; color of under surfaces of limbs usually an immaculate bluish white, occasionally interrupted by edges of spots from dorsal surfaces; pads on digits and soles of fore and hind legs light orange; tips of digits bright reddish orange.

A detailed morphological description of the recently metamorphosed young of *Bufo boreas* will not be undertaken. In brief, individuals of this stage differ from the adult toads in the following points: Body uniformly subcylindrical from head almost to hind legs, jaws not protruding, legs proportionately smaller, parotid glands not externally apparent, warts not well developed, pores with their individual tuberosities uniformly and thickly distributed.

The dorsal coloration of the adult specimens of *Bufo boreas* collected in the Gothic region is darker than that of typical specimens of *Bufo boreas boreas* examined from the Pacific northwest. In the former specimens the skin between the warts is smoother and the warts are less pronounced. The parotid gland is larger, more oblong, and not so elevated as in the latter specimens. The dark markings on the ventrum which are more numerous and more irregular than in typical *boreas* tend to coalesce irregularly. The head is proportionately larger and broader. There is also a marked discrepancy in size, for the maximum length of the Gothic specimens was 83 mm in contrast to the 125-mm maximum recorded for *Bufo boreas boreas*.

Many more specimens of *Bufo boreas* from throughout its range would be required to clarify the status of the population of the Gothic region of Colorado. Cursory examination of a few specimens indicates that the Gothic population is as different from *Bufo boreas boreas* (B. and G.) as is *Bufo boreas halophilus* (B. and G.). In some characters the Gothic toad shows variation from *Bufo boreas boreas* in the direction of *Bufo exsul* Myers. No specimens of *Bufo boreas nelsoni* Stejneger were available for comparison, but a close similarity is suggested by the descriptions of *nelsoni*. The need for a careful study of the subspecies of *Bufo boreas* and the supposedly related species *B. exsul* and *B. canorus* is very apparent.

The series of tadpoles, young, and adults of *Bufo boreas* from the vicinity of Gothic upon which this study is based has been deposited in the Museum of Zoology of the University of Oklahoma.

LITERATURE CITED

Myers, G. S. 1942. The black toad of Deep Springs Valley, Ingo County, California. Occas. Papers Mus. Zool., Univ. Mich. *460*: 1-13.

Wright, A. A., and A. H. Wright. 1942. Handbook of frogs and toads. Ithaca (N. Y.): Comstock Publishing Co.