Abnormalities in the Ozark Hellbender, *Cryptobranchus alleganiensis bishopi*

Benjamin A. Wheeler* and **Malcolm L. McCallum**
Environmental Sciences Ph. D. Program
Arkansas State University
P.O. Box 847
State University, AR 72467-0847

Stanley E. Trauth
Department of Biological Sciences
Arkansas State University
P. O. Box 599
State University, AR 72467-0599

*Corresponding Author

Declines in eastern hellbender, *Cryptobranchus alleganiensis alleganiensis*, populations have been reported in the scientific literature for over 50 years (Swanson, 1948). Nickerson and Mays (1973) provided state-by-state status reviews of the hellbender across its range. These state-level status reviews were updated by Williams et al. (1981). Since then, further reports of declining hellbender populations have occurred throughout the range of the species (Gates et al., 1985; Pfingsten, 1990). Only recently, have population declines in the Ozark hellbender, *C. a. bishopi*, been reported (Trauth et al., 1992; Wheeler et al., 2003).

There have been many putative reasons suggested for the decline of Ozark hellbender populations; among these are over-collection, habitat alteration, fishing, chemical spills, a 100-year flood, lowered dissolved oxygen levels, eutrophication, and water pollution due to industrial, municipal and recreational discharge (Federal Registry, 2001; Trauth et al.,1992; Wheeler et al., 2003). These and other similar studies combined with the limited range of this species have led to the Ozark hellbender being listed as a Federal Endangered Species Candidate (Federal Registry, 2001).

During the data collection for the initial status survey by Trauth et al. (1992) and subsequent studies (Wheeler and Trauth, unpubl. data), occasional notes were recorded regarding the body condition of individual salamanders. A review of these field notes indicated that many of these salamanders had abnormalities (e.g., missing toes, feet, limbs; Fig.1A). Some individuals possessed exposed bones in these regions (Fig. 1B), indicating recent injuries.

From 1990 to 2002, we recorded abnormalities on 8% (17 of 215) of the hellbenders examined. Because we made no consistent effort to record all abnormalities during this time period, this frequency reflects the minimum rate of abnormalities for the Ozark hellbenders examined. This rate exceeds the expected background abnormality rate of >2% (Johnson et al., 1999, Kaiser, 1999). Missing toes, feet, and limbs account for 60% (10 of 17) of the abnormalities we observed. This is comparable to an eastern hellbender population studied in Ohio (Pfingsten, 1990) that reported a 25% overall abnormality rate, in which 80% were related to missing toes, feet, or limbs.

Three peculiar abnormalities were found during our field studies: a hellbender with multiple tumors, a hellbender with a bifurcated hind limb, and a blind hellbender. The hellbender with tumors was found in the Spring River, Arkansas during a 1992 survey (see Trauth et al., 1992). This animal was collected and examined histologically (see Trauth et al. 2002; Harshbarger and Trauth, 2002).

The Ozark hellbender (472 mm total length, TL) with a bifurcated hind limb (Fig. 1C) was found in the North Fork of the White River, Missouri, during our ongoing demographic study. Examination of the field notes revealed this animal was probably the same animal captured at that location during a previous survey (Wheeler, 1999). Split limbs are normally thought to occur during embryonic development, as a result of parasites, chemical contaminants, and resulting interactions between the two (Kiesecker, 2002). Although split limb abnormalities reduce activity in some amphibians (McCallum, 1999), this hellbender appeared unaffected, as it was observed using the anteriorly-positioned leg segment (see Fig. 1C) during normal movements.

A large Ozark hellbender (467 mm TL, 416 g) from the Eleven Point River was determined to be blind. The orbit of the left eye lacked an eyeball, and skin had grown into the empty socket (Fig. 1D). In addition, the right socket was partially covered by skin-covered tissue, and no eyeball was evident. There was no evidence of scar tissue or other markings around either socket to suggest a possible cause of this abnormality. The eyes of the hellbender are small, and little is known about their utility during activity. They presumably have a limited role in foraging (Reese, 1905); however, Beck (1965) and Green (1933) reported hellbenders being caught on artificial lures, and Smith (1907) and Nickerson and Mays (1973) found that food items were taken if moved along the side of the head in front of the eyes. The size of this blind hellbender and the lack of evidence indicating recent injury supported the idea of the lateral line system playing a major role in foraging (Oliver, 1955 cited in Nickerson and Mays, 1973).

Investigation of amphibian abnormalities may elicit hypotheses regarding population declines (McCallum and Trauth, in press); however, distinguishing between unnatural and natural abnormalities can be problematic.

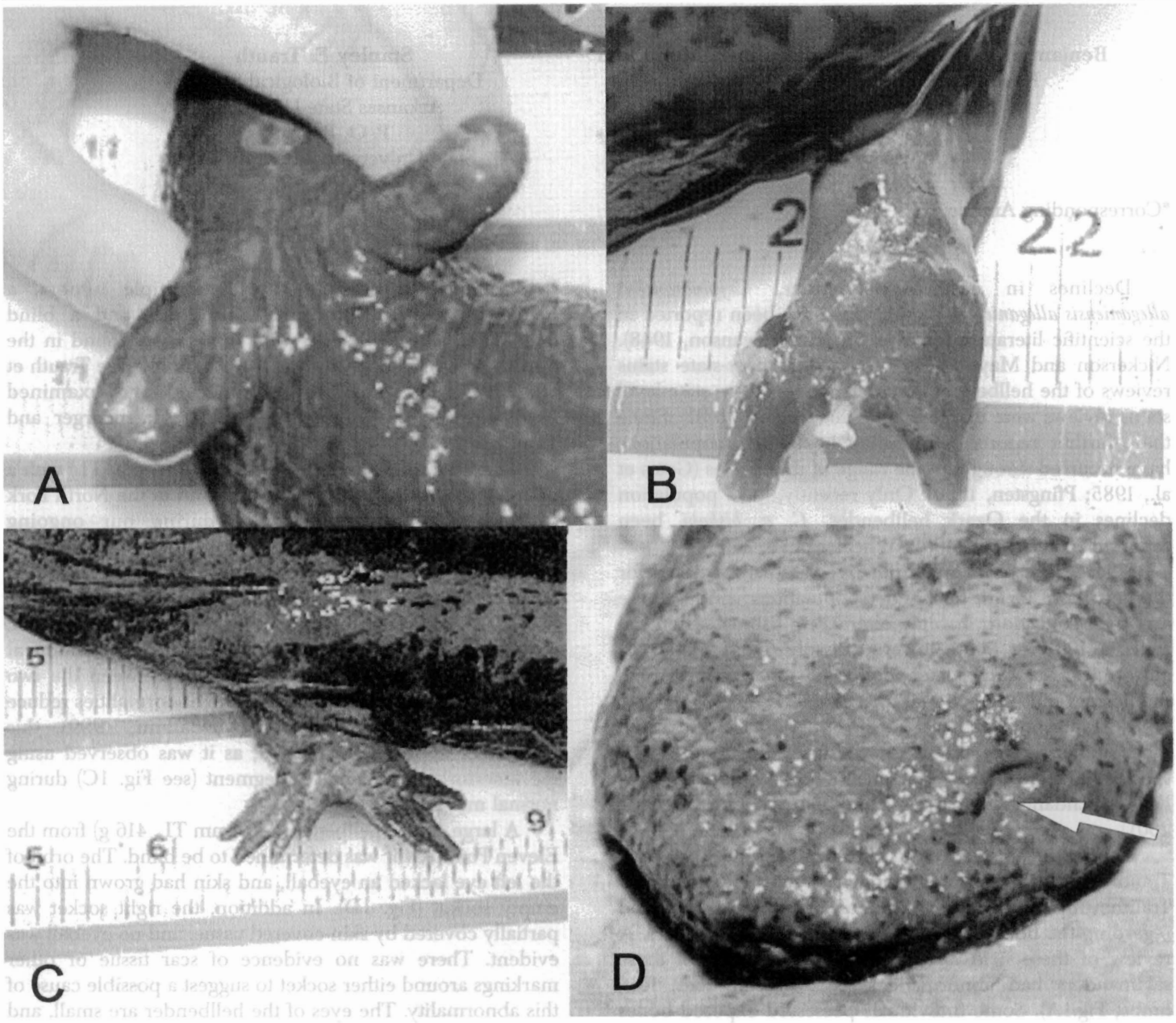

Fig. 1. Photographs of the Ozark hellbender showing abnormalities. A. Feet missing--specimen from the Spring River. B. Exposed bone within digit--specimen from the Eleven Point River. C. Bifurcated limb--specimen from the North Fork of the White River. D. Empty eye socket (see arrow)--specimen from the Eleven Point River.

Intraspecific aggression (Nickerson and Mays, 1973) may account for a high rate of limb abnormalities we observed. One can only assume the limb bifurcation and lack of eyes are two abnormalities that occurred during development.

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