Documentation of *Cryptobranchus alleganiensis alleganiensis* (Eastern Hellbender) Predation on Nest-Associate Stream Fishes

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Documentation of *Cryptobranchus alleganiensis alleganiensis* (Eastern Hellbender) Predation on Nest-associate Stream Fishes

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Abstract - The covert habits of *Cryptobranchus alleganiensis alleganiensis* (Eastern Hellbender) make direct field observations of their behavior difficult. Here I provide the first video documentation of in situ predation by a hellbender on a spawning aggregation of stream fishes. Both targeting fish and diurnal activity are behaviors rarely documented among hellbenders. The present observation, however, supports previously described patterns of elevated diurnal activity in late spring hypothesized to be associated with increased foraging-activity to meet higher energy-demands. The observation demonstrates that Eastern Hellbenders will modify behavior to exploit stream fishes when prey are easily captured.

Introduction. *Cryptobranchus alleganiensis* (Daudin) (Hellbender) is a charismatic representative of North America's rich temperate freshwater fauna with 2 recognized subspecies: *C. a. alleganiensis* (Daudin) (Eastern Hellbender) and *C. a. bishopi* (Grobman) (Ozark Hellbender). This fully aquatic species typically inhabits structurally complex stream areas, which makes direct study of behavior difficult. Knowledge of the biology of Hellbenders is increasingly critical due to their distribution-wide decline leading to both state and federal conservation listings (Burgmeier et al. 2011, Foster et al. 2009, Quinn et al. 2013, Unger et al. 2013, Wheeler et al. 2003).

The ecology of Hellbenders complicates direct study in the wild. Field observations of Hellbenders indicate that individuals are highly nocturnal and prefer to seek cover under large rocks during the day (Hillis and Bellis 1971, Humphries and Pauley 2000, Smith 1907). Similarly, Noeske and Nickerson (1979) observed peak activity by captive Hellbenders 2.5 h after sunset and a lesser peak associated with sunrise. However, Hellbenders are known to have heightened overall activity from late spring through early fall (Ball 2001, Bishop 1941, Burgmeier et al. 2011, Smith 1907). Further, elevated diurnal activity in late spring may be associated with greater feeding activity by females due to increased energy demands in preparation for the mating season in late summer and early fall (Ball 2001, Humphries 2007, Humphries and Pauley 2000).

Dietary studies of Hellbenders are limited to analyses of stomach contents from euthanized individuals. These studies have usually found that crayfish are the dominant food in Hellbender diets (Netting 1929, Peterson et al. 1989, Smith 1907), and crayfish abundance has even been correlated with the distribution of Eastern Hellbenders in West Virginia (Keitzer et al. 2013). Hellbenders also consume fish, non-crayfish macroinvertebrates, Hellbender eggs, and trash (Bishop 1941, Peterson et al. 1989, Smith 1907, Swanson 1948). Peterson et al. (1989) found that fish were the second-most prevalent food item within Eastern Hellbender stomach contents. Fish were present in the stomachs of 20% of the 108 Eastern Hellbenders that Peterson et al. (1989) sampled, comprising 13% of the annual dietary biomass. Previously identified fishes within the stomach contents of Hellbenders include *Cottus* spp. (sculpin), *Oncorhynchus mykiss* (Walbaum) (Rainbow Trout), *Campostoma anomalum* (Rafinesque) (Central Stoneroller), and lamprey (family Petromyzontidae;

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Nickerson et al. 1983, Peterson et al. 1989). However, active predation of fish by Hellbenders has never been directly documented in the wild.

The goal of this paper is to report documentation of an Eastern Hellbender targeting, capturing, and consuming individuals within an aggregation of fishes spawning on the nest (mound) of *Nocomis platyrhynchus* (Lachner and Jenkins) (Bigmouth Chub). Several fish species, principally those in the genus *Nocomis,* are ecosystem engineers that create nests by redistributing sediment (gravel and pebble) into unembedded mounds of substrate (Balon 1975). Several other fish species, hereafter referred to as nest-associate fishes, use chub mounds from mid-spring through early summer as spawning habitat; therefore, chubs likely influence the population dynamics and assemblage structure of nest-associate fishes through the creation of critical habitat (Johnston 1999, Peoples et al. 2011). Although limited in scope, my novel observation expands upon the known activity and feeding behavior of Eastern Hellbenders and may provide further support for the importance of *Nocomis* chubs to stream-community dynamics.

Observations. I made my observation in a river located in southeastern West Virginia on 3 June 2011 at 1330 h while conducting underwater surveys for an imperiled stream-fish. The 4th-order river has a moderate gradient and predominately drains land within a national forest. The river has a semi-confined channel (mean width = ~15 m), with alternating sequences of shallow run and riffle channel-units. The chub mound at the observation point consisted of unembedded pebble–cobble substrate within a run that was ~0.4 m deep in moderate flow. At the time of the observation, water clarity was high (1.22 NTU) and the stream temperature was 17.7 °C.

I documented predation by an Eastern Hellbender in 4 short video-clips totaling 10:36 min that I recorded 1.5 m away from the nest with a Sanyo Xacti WH1 underwater camcorder. I observed the Eastern Hellbender for ~20 min, but the duration of the behavior lasted beyond the observational period. Both the Eastern Hellbender and the spawning aggregation of fishes had dispersed by 1900 h when I revisited the site. The spawning aggregation consisted of dozens of individual fish representing the following 5 species of minnows (family Cyprinidae), listed in decreasing abundance: *Chrosomus oreas* (Cope) (Mountain Redbelly Dace), *Notropis micropteryx* (Cope) (Highland Shiner), Central Stoneroller, *Clinostomus funduloides* (Girard) (Rosyside Dace), and Bigmouth Chub. Over the course of the observation period, an adult Eastern Hellbender positioned itself directly in the middle of the nest mound (Fig. 1) and stayed still until an individual fish came

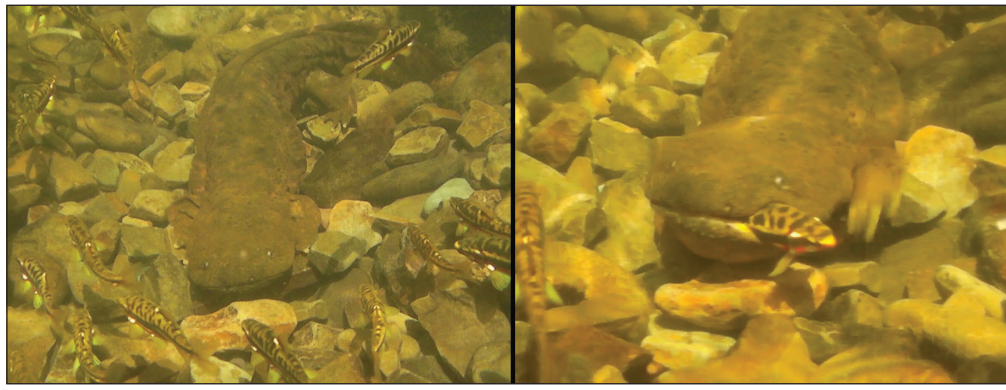

Figure 1. Left: an adult *Cryptobranchus alleganiensis alleganiensis* (Eastern Hellbender) surrounded by stream fishes associated with the nest of *Nocomis platyrhynchus* (Bigmouth Chub). Right: still frame from video of an Eastern Hellbender capturing *Chrosomus oreas* (Mountain Redbelly Dace).

within striking distance, which corroborates observations of feeding behavior by captive Hellbenders (Smith 1907). The Eastern Hellbender initially attempted several unsuccessful strikes until it finally captured 2 Mountain Redbelly Dace on separate strikes (Fig. 1; see Supplemental File 1, available online at http://www.eaglehill.us/NENAonline/suppl-files/n23-3-N1456-Dunn-s1, and for BioOne subscribers, at http://dx.doi.org/10.1656/N1456.s1). In total, the Eastern Hellbender attempted 19 strikes and captured 2 individuals.

Discussion. This is the first documentation of feeding behavior by Eastern Hellbenders in the field, and it complements results from existing lab studies of Hellbender activity and feeding habits. Unfortunately, there is insufficient data available on the Eastern Hellbender diet to confirm or refute whether they frequently target nest-associate fishes in late spring. In the most comprehensive examination of diet contents of Eastern Hellbenders (total = 108 Eastern Hellbenders, May–June = 14 Eastern Hellbenders), Peterson et al. (1989) did not observe an increase in nest-associate fishes or fish biomass during late spring in Missouri despite the presence of *Nocomis* chubs in both regions.

It is unclear if diurnal activity, specifically daytime feeding, is a common behavior of Eastern Hellbenders during certain periods. The present observation corroborates the results of Humphries and Pauley (2000), who observed an overall increase in female activity by Eastern Hellbenders from May–June in a West Virginia stream. Similarly, Humphries (2007) documented a positive relationship between stream temperature and heightened diurnal activity by Eastern Hellbenders from May–September in North Carolina. However, with the exception of the highly active members of the North Carolina population, Humphries (2007) noted only 2 daytime observations of Eastern Hellbenders despite 300 person-hrs of survey time in Georgia and West Virginia streams. Similarly, this was my only observation of an Eastern Hellbender during 6 d of snorkeling in the vicinity during spring and summer. I noticed particularly heightened spawning activity by nest-associate fishes on the day of the observation, and it is possible that the benefit of greater prey susceptibility outweighed potential risks of exposure for the Eastern Hellbender. Other observations of daytime feeding behavior, specifically targeting nest-associate fishes, would help clarify if the observed behavior was specific to this individual Eastern Hellbender or an approach generally used by this species under favorable conditions.

Finally, mound-building fishes (e.g., *Nocomis* chubs) are increasingly viewed as important contributors to the overall freshwater community (Peoples et al. 2011). The present observation demonstrates that in addition to providing clean spawning substrate, mound-building chubs can potentially influence community interactions including predator–prey dynamics, and may facilitate the availability of an exploitable food source for high-level predators in freshwater ecosystems.

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