

# Status of the Snuffbox Mussel *Epioblasma triquetra* (Rafinesque) in Illinois: a Functionally Extirpated Species

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## ABSTRACT

Within Illinois, the state-endangered snuffbox mussel *Epioblasma triquetra* (Rafinesque) is currently found only in a small stretch of the Embarras River in Douglas and Coles counties and is considered one of the rarest freshwater mussels in the state. To assess the current population status of *E. triquetra* in Illinois, I estimated density, length frequency, and sex ratio of the Embarras River population. I also examined the status of the snuffbox mussel's host fish, the logperch *Percina caprodes* (Rafinesque), to determine if the fish was present in this area. Seven sites in the Embarras River were sampled for freshwater mussels and fishes during the summers of 2007 and 2008 using common sampling protocols. Only five adult (>55 mm) *E. triquetra* males were collected from two sites, suggesting this species is functionally extirpated in Illinois. Although *P. caprodes* was collected at five sites including the two that housed *E. triquetra*, it occurred at low densities. It seems unlikely that *E. triquetra* can recover naturally in Illinois, and carefully planned translocation or augmentation methods might be required to restore the species.

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## INTRODUCTION

Freshwater mussels (Bivalvia) are the most imperiled group of organisms in North America (Williams et al., 1993). Of the approximate 300 species native to North America, nearly two-thirds are extinct, federally-listed as endangered or threatened, or are in need of conservation. This reduction also is evident in Illinois. Of the 80 historical species known to inhabit the state, 19 are extirpated from Illinois, 16 are state-endangered, eight are state-threatened, and only 22 are considered to have relatively stable populations within Illinois (DeWalt et al., 2009). Factors responsible for the decline in freshwater mussels include habitat destruction, environmental contamination, and invasion of exotic species (Williams et al., 1993).

One of the rarest species in Illinois is the snuffbox mussel *Epioblasma triquetra* (Rafinesque), which is listed as state-endangered (IESPB, 2005). Historically, *E. triquetra* was found in 14 drainages in the state but currently is found only in a small stretch (<40 km)

of the Embarras River (Tiemann et al., 2007; DeWalt et al., 2009). The logperch *Percina caprodes* (Rafinesque) is the predominant host fish for *E. triquetra* (Zanatta and Murphy, 2008 and references therein), and the mussel has evolved a unique strategy of capturing the fish to infest it with glochidia (Barnhart et al., 2008). Both the unionid and its host fish inhabit medium to large streams in clear, sand/gravel riffles (Smith, 1979; Cummings and Mayer, 1992). Concurrent with the disappearance of *E. triquetra*, the logperch might be declining in portions of its range in Illinois (Smith, 1979). The objectives of this study were to estimate the population demographics (e.g., density, length frequency, and sex ratio) of *E. triquetra* in Illinois to note its current status in the state, and examine the occupancy of *P. caprodes* in the portion of the Embarras River where *E. triquetra* is extant to determine if the host fish is present in this area.

## STUDY AREA

The Embarras River basin drains approximately 6,200 km<sup>2</sup> of east-central Illinois (Page and Smith, 1970; Page et al., 1992). The river originates in Champaign, Champaign County, and meanders nearly 290 km south-southeast before emptying into the Wabash River near Billett, Lawrence County. The Embarras River basin historically supported 47 species of freshwater mussels (Tiemann et al., 2007) and at least 14 species of darters (Page and Smith, 1970). Even though the Embarras River has experienced anthropogenic disturbances (e.g., industrial and agricultural pollution, channelization, and impoundments), the middle section of the Embarras River, which is in Coles and Douglas counties, has been described as one of the outstanding streams in Illinois based on a wide variety of habitats and rich species diversity (Smith, 1968; Smith, 1971; Page et al., 1992). The dominant stream substrates in this area include sand and gravel bars, rubble riffles, and silt bottomed pools (Page and Smith, 1970; Page and Smith, 1971).

## METHODOLOGY

Seven sites were established in a 40 km<sup>2</sup> portion of the Embarras River basin in Douglas and Coles counties, Illinois (Table 1). Sites included the most recent known locations of *E. triquetra* in the state, along with those sites where valves had been found during previous surveys (data taken from INHS Mollusk Collection, Champaign). The aforementioned surveys utilized timed-searches, which is a quick, cost effective method used for obtaining information on species richness (Strayer and Smith, 2003; Tiemann et al., 2009 and references therein); however, none of the previous surveys used quadrats. Area searches (e.g., quadrats) are better suited than timed-searches for determining densities and length frequencies of freshwater mussels (Strayer and Smith, 2003; Tiemann et al., 2009 and references therein), thus 1-m<sup>2</sup> quadrats were used in this study. At each site, at least five transects were uniformly spaced 5-m apart, perpendicular to the river channel along a sandy-gravel riffle / run, and up to five points were evenly established 0.5-m apart along the length of each transect. At each point, a quadrat was placed on the streambed and the substrate within the quadrat was examined for live unionids by searching tactilely and excavating the substrate. A total of 30 points were sampled at each site. Upon completion of a site, individuals were identified to species, counted, measured to the nearest millimeter, and then returned to the stream. Fishes were collected bi-monthly from May-September 2007 and May-September 2008 by kick-seining, which is a quantitative method used to collect benthic fishes including darters (Tiemann, 2008). A

transect-point method similar to that used for unionids also was implemented for fishes. However, instead of using quadrats, fishes were collected from a 4.5 m<sup>2</sup> area at each point by kicking the substrate 3-m upstream from a stationary 1.5-m wide, 3-mm mesh seine and proceeding downstream to the seine in a back and forth path covering the width of the seine. To minimize disturbance, transects were sampled from downstream to upstream and points were sampled near shore to far shore. A total of 30 points were sampled at each site. Fishes were identified to species, counted, and then returned to the stream. Funding and landowner permission prevented additional sites from being sampled.

## RESULTS / DISCUSSION

Snuffbox mussel densities varied from 0 – 0.13 indiv/m<sup>2</sup> per site (mean = 0.02 ± 0.05 indiv/m<sup>2</sup>). Five *E. triquetra* males were collected from two sites during the course of the study (Table 1). Length frequency data (58, 59, 63, 68, and 71 mm) suggests that these individuals were all adults. The lack of smaller size classes indicates that *E. triquetra* is not reproducing in Illinois as no small and presumably young individuals were collected. These findings suggest that *E. triquetra* might be functionally extirpated in Illinois.

Logperch were captured at five of the seven sites, including the two sites where *E. triquetra* was collected (Table 1). The site with the greatest number of *E. triquetra* also had the greatest number of *P. caprodes*. Although the host fish was present, relatively few individuals were collected. Monthly site *P. caprodes* densities varied from 0 – 0.052 indiv/m<sup>2</sup> (mean = 0.006 ± 0.010 indiv/m<sup>2</sup>). It is unknown what density of logperch is required to support a viable population of *E. triquetra*. My data only show that *P. caprodes* is present in the area. Because *P. caprodes* might be declining in portions of its range (Smith, 1979), it cannot be ruled out that the host fish's abundance is a limiting factor in *E. triquetra* recruitment.

The snuffbox mussel has been collected only at two sites in Illinois since 1985 (data taken from INHS Mollusk Collection, Champaign). Site 4 was sampled using timed-search techniques ten times between 1986 and 2008, whereas Site 5 was sampled three times during this same time period. The number of live *E. triquetra* collected at Site 4 during those surveys is as follows: 1986 (2), 1992 (2), 2001 (1), 2002 (2), and 2005 (1); no live individuals were collected in 1988, 1990, 1991, 1994, or 2008. Seven live individuals were found at Site 5 in 1986, but none were located in 1992 or 2005. The amount of effort during these surveys varied from one to four person-hours. Notes from some of the surveys indicated that only adults were collected, strengthening the argument that *E. triquetra* is not reproducing in the state.

The physical habitat (e.g., sand/gravel riffles) in this area of the Embarras River appeared suitable for *E. triquetra*. Chemical measurements were not taken, but water quality in this portion of the river in the 1960s was reported to be high and pollution minimal (Page and Smith, 1970). However, the Wabash River drainage has experienced significant physical and biological changes as a result of anthropogenic disturbances during the past century (Simon, 2006), and the Embarras River basin is no exception (Smith, 1968; Smith, 1971). Human induced modifications include draining of wetlands, dredging of streams, pollution from agriculture and industrial sources, removal of riparian areas, development of

floodplains, and impounding of streams. My study was not designed to determine if anthropogenic disturbances are responsible for the reduction of *E. triquetra* in Illinois, but these factors have been shown to cause alterations in both freshwater mussel and fish assemblages (Smith, 1971; Cummings, 1991).

### MANAGEMENT CONSIDERATIONS

Although a small, isolated reproducing population could exist in unsampled areas, the data from this survey and prior surveys suggest that *E. triquetra* may be functionally extirpated in Illinois. Because many populations have been greatly reduced or have disappeared completely, the species is currently under status review for potential listing under the United States Endangered Species Act (Zanatta and Murphy, 2008). For over two decades, qualitative and quantitative surveys within the last refuge for snuffbox in Illinois have consistently recorded very low numbers of individuals and no sign of recent recruitment (data taken from INHS Mollusk Collection, Champaign). It seems unlikely that *E. triquetra* can recover naturally in Illinois given that it might be isolated from adjacent populations due to impoundments and habitat alterations (Zanatta and Murphy, 2008), and darters (e.g., host fish) tend to have limited dispersal capabilities (McLain and Ross, 2005; Roberts et al., 2008). To recover *E. triquetra*, natural resource agencies should determine why the species is not reproducing (e.g., whether host fish densities or physicochemical issues are limiting *E. triquetra*). Once the problem is rectified, agencies could implement recovery efforts in Illinois by either translocation to existing snuffbox mussel habitats or propagation to establish new populations in other basins with suitable host fishes, substrate, and physicochemical parameters.

If natural resource agencies implement a recovery plan, stocking rates should be modeled after streams that have viable, reproducing populations and genetic diversity should be maintained (Crabtree and Smith, 2009). If the population from a particular region has been extirpated or is too small to propagate then brood stock should be taken from the nearest viable population based on riverine distance and known genetic profile (Zanatta and Murphy, 2008). Reproducing populations of snuffbox mussel are still found within the Wabash River drainage in Indiana (Fisher, 2006); therefore, *E. triquetra* brood stock could come from within the Wabash River drainage to help preserve the genetic integrity of the species. Additional funding needs to be secured to allow natural resource agencies to work with landowners on sampling additional areas / establishing recovery sites and on propagating / translocating individuals. In the meantime, the snuffbox mussel should remain listed as state-endangered, and all efforts should be taken to protect the last population of *E. triquetra* in Illinois.

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Table 1. Sampling locations and total number of snuffbox mussel and logperch collected during the 2007-2008 survey in the Embarras River basin, Illinois; stream includes Embarras River (ER) and North Fork Embarras River (NFER).

Site	Stream	County	Common location	# <i>E. triquetra</i>	# <i>P. caprodes</i>
1	ER	Douglas	0.5 mi SE Hugo, CR 1725E	0	0
2	ER	Douglas	2 mi SE Hugo, CR 1900E	0	0
3	ER	Douglas	3 mi NW Oakland, CR 2200E	0	3
4	ER	Douglas	2 mi W Oakland, IL Rte 133	4	15
5	ER	Coles	3 mi SW Oakland, ford	1	3
6	ER	Coles	6 mi SSW Oakland, ford	0	6
7	NFER	Coles	4 mi S Oakland, CR 1500N	0	6

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