

# Relocation of Two State-Listed Freshwater Mussel Species (*Epioblasma torulosa rangiana* and *Epioblasma triquetra*) in Michigan

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**Abstract.** Prior to 1988, the headwaters of the Black River drainage, located primarily in agriculturally dependent Sanilac County, were one of two known sites in Michigan that provided refuge for the state-endangered freshwater mussel *Epioblasma torulosa rangiana* (northern riffle shell). Precipitated by the massive flood of 1986, public and private pressure mounted in Sanilac County to have 25 miles of the Black River and one of its major tributaries (Elk Creek) dredged. The Clinton River in southeast Michigan harbors the state endangered freshwater mussel *Epioblasma triquetra* (snuffbox). A particular 4-mile reach of the river located in highly urbanized Oakland County may contain one of the largest populations of the snuffbox in the state. The Road Commission for Oakland County has proposed replacing the current two-lane bridge that spans this reach of the river with a modern four-lane structure. The policies and procedures implemented in the relocation of these freshwater mussel populations were compared. The results of this study demonstrated that relocation techniques combined with environmentally sound public policy can preserve and maybe even enhance state-listed freshwater mussel populations.

## Introduction

Eastern North America has the most diverse assemblage of freshwater mussels in the world (Simpson 1896, 1900). This unique biological resource is in serious jeopardy due to the advent of the agricultural and industrial revolution on this continent that greatly intensified anthropogenic perturbations on freshwater ecosystems (Stansbery 1970, Jorgenson and Sharp 1971, van der Schalie 1975, Biggins 1992). The freshwater mussel fauna of the rivers and streams of southeastern Michigan, Lake St. Clair, the Detroit River, and western Lake Erie combine to form the richest assemblage of these organisms within the St. Lawrence River drainage (e.g., see Goodrich and van der Schalie 1932, Clarke 1973, Clark 1977, Pugsley et al. 1985). Several of Michigan's rare, threatened, or endangered freshwater mussels have been reported from this area (Strayer 1979, 1980; Hoeh and Trdan 1985).

Sizeable populations of *Epioblasma torulosa rangiana* (northern riffle shell) were reported from the Black River and a major tributary (Elk Creek) of Sanilac County, Michigan, by Hoeh and Trdan (1985) and from the Detroit River by Pugsley et al. (1985) (see Figure 1). Prompted by a massive flood in the fall of 1986, residents of Sanilac County

petitioned the drain commissioner to have the headwaters of the Black River dredged.

*Epioblasma triquetra* (snuffbox) has been reported from the Clinton River by Strayer (1980) (see Figure 1). Collections made in the fall of 1991, by Trdan and Hoeh (unpublished data), suggested that a portion of the Clinton River in Oakland County, Michigan, may harbor the largest population of *E. triquetra* in the state. The Road Commission for Oakland County has filed for permits to replace an old bridge that spans this portion of the Clinton River with a larger structure.

Both of the civil engineering projects mentioned above posed grave threats to the continued existence of their respective freshwater mussel populations. Temporary relocation followed by replacement was chosen as the most viable means to mitigate the effects of mussel habitat destruction and to ensure the survival of these populations. The purpose of this report is to compare and contrast the policies and procedures, both scientific and governmental, employed in the Black River and Clinton River projects and to recommend steps that should be taken in similar situations to preserve our unique freshwater mussel fauna.

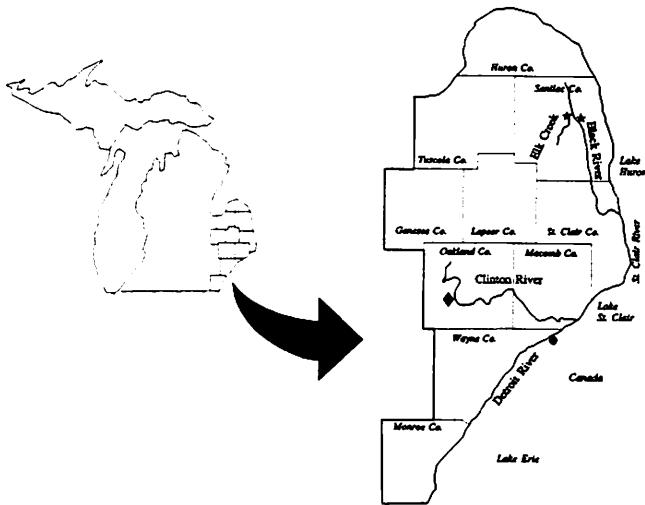


Figure 1. Principal collecting sites in southeastern Michigan for *Epioblasma* species. ★ = *E. torulosa rangiana*, ◆ = *E. triquetra*, and ● = both species present.

## Materials and Methods

Collection was accomplished primarily by "vacuuming" the substrate with a modified gold dredge (= mussel dredge) and secondarily by handpicking the shallows with the aid of glass-bottomed buckets. Freshwater mussels were collected from 12 July through 24 August 1988 from the Black River between Applegate and French Line roads, Sanilac County, Michigan (S23, R15E, T11N). Individuals of *E. t. rangiana* were held in a small wire cage immediately upstream from the collecting site. They were later marked and transferred to a large corral constructed on the bottom of the Detroit River in 20 ft of water near Belle Isle, Wayne County, Detroit, Michigan. In the spring of 1989, 1990, and 1991 the mussels were monitored, and the corral was cleaned of debris. The mussels' survival was documented by video recorder and 35-mm still camera. In the summer of 1992 the total contents of the enclosure were collected by mussel dredge.

Individuals of *E. triquetra* were collected from 1 October through 4 October 1992 from the Clinton River at Cooley Lake Road, Oakland County, Waterford Township, Michigan, and temporarily held in mesh bags immediately upstream of the collecting site until they were transferred to a more secure location farther upstream. Individual *E. triquetra* placed at the relocation site were marked but not housed in a corral. They were simply pushed into the substrate, and their location was noted. These mussels will be monitored in 1993 and are expected to be reintroduced to the bridge site in the fall of 1994.

## Results

### Black River

Table 1 shows the species composition and abundance of freshwater mussels from the Black River station. On average, 788 individuals were collected per day. A total of 118 live *E. t. rangiana* were collected during this study. The sex ratio was 41% female and 59% male. One hundred fourteen specimens ranged from 68 to 36 mm in length. Four small individuals (< 28 mm in length) were also collected. These individuals could not be sexed using standard shell morphology. Males had a mean length of 52 mm and females 48 mm. Three of the 118 individuals collected died prior to relocation. Monitoring and cleaning of the Detroit River corral was carried out in mid to late May of 1989, 1990, and 1991. Observation of female display behavior (Figure 2), which occurred during each of the May monitoring sessions, is consistent with the persistence of the relocated individuals. However, removal of the entire contents of the corral on 24 July 1992 revealed that none of the relocated individuals were alive. Monitoring sessions in 1989, 1990, and 1991 revealed no obvious zebra mussel (*Dreissena polymorpha*) encrustation of native freshwater mussels in or around the corral. However, heavy

Table 1. Live mussels collected from the Black River between Applegate and French Line roads, Sanilac County, Michigan.\*

Species	Total number collected	Percentage of collection
<i>Alasmidonta marginata</i>	17	0.21
<i>Alasmidonta viridis</i>	19	0.24
<i>Amblema plicata</i>	4,074	51.72
<i>Anodontoides ferussacianus</i>	12	0.15
<i>Elliptio dilatata</i>	28	0.36
<i>Epioblasma torulosa rangiana</i>	12 (118)**	0.15
<i>Fusconaia flava</i>	2,059	26.10
<i>Lampsilis cardium</i>	22	0.30
<i>Lampsilis fasciola</i>	1	0.01
<i>Lampsilis siliquoidea</i>	337	4.27
<i>Lasmigona complanata</i>	733	9.30
<i>Lasmigona compressa</i>	4	0.05
<i>Lasmigona costata</i>	333	4.23
<i>Pleurobema coccineum</i>	12	0.15
<i>Ptychobranchus fasciolaris</i>	70	0.90
<i>Pyganodon grandis</i>	47	0.60
<i>Strophitus undulatus</i>	60	0.80
<i>Villosa iris</i>	37	0.46
Total	7,877	100.00

\* Data are from 10 collecting days beginning 12 July and ending 24 August 1988.

\*\* Number in parentheses reflects 32 collecting days.

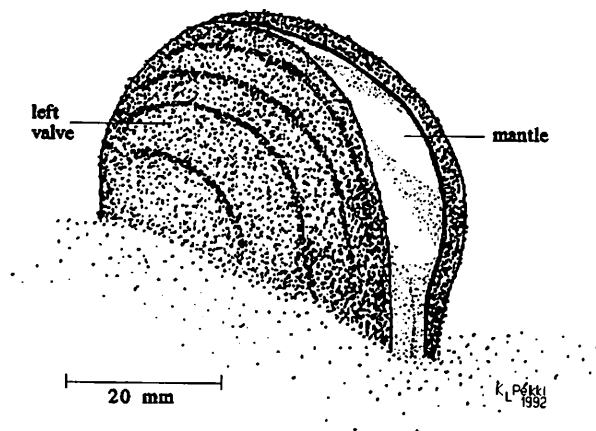


Figure 2. *Epioblasma torulosa rangiana* female displaying white mantle. This behavior is likely involved in glochidial release and sperm acquisition.

encrustations were apparent on all individuals removed from the corral in July 1992.

#### Clinton River

Table 2 shows the species composition and abundance of freshwater mussels from the Clinton River station. On average, 528 individuals were collected per day. A total of 804 live *E. triquetra* were collected from this locality. The sex ratio was 48% female and 52% male. Seven hundred ninety-nine specimens ranged from 67 to 29 mm in length. Five small individuals (< 26 mm in length) were also collected. These individuals could not be sexed using standard shell morphology. Males had a mean length of 48 mm and females 39 mm. Visual monitoring of the relocation site will be done in 1993, with the return of the individuals to the original location scheduled for the fall of 1994.

Table 2. Live mussels collected from the Clinton River at Cooley Lake Road, Oakland County, Michigan, 1–4 October 1992.

Species	Total number collected	Percentage of collection
<i>Elliptio dilatata</i>	318	15.1
<i>Epioblasma triquetra</i>	804	38.1
<i>Lampsilis fasciola</i>	2	0.1
<i>Lampsilis siliquoidea</i>	2	0.1
<i>Pleurobema coccineum</i>	101	4.8
<i>Ptychobranchus fasciolaris</i>	701	33.2
<i>Pyganodon grandis</i>	22	1.0
<i>Strophitus undulatus</i>	114	5.4
<i>Villosa fabalis</i>	26	1.2
<i>Villosa iris</i>	23	1.0
Total	2,113	100.0

## Discussion

### Collection Techniques

Preliminary surveys were done by handpicking mussels in the shallows with a glass-bottomed bucket. This method required minimal manpower and equipment, and therefore minimal expense. More importantly, handpicking allowed the collector to cover a relatively large area per given time period and to take advantage of collections made by natural mussel predators (e.g., muskrats and raccoons). However, these techniques have too many associated biases to be of much value as a reliable quantitative method (e.g., see Hanson et al. 1989).

Collection with the mussel dredge covered a relatively small area per given time period and required more personnel and equipment than handpicking. However, once the site was designated for mussel removal, this was the method of choice. It has the potential to collect all of the mussels within a defined area. The lower size limit of the retained mussels is determined by the mesh size of the sorting sieve. In addition to this technique's utility for relocation projects, it could be used to more accurately evaluate mussel densities, recruitment, sex ratios, and possible sex-specific behavior (e.g., are males located upstream of females just prior to spermatozoa release?). A negative aspect of this collection technique is the resultant massive disturbance of substrate structure and dislocation of inhabitants.

### Biological Considerations

The Black River collecting site harbored 18 species of freshwater mussels. Given that the major tributaries of the St. Clair River (i.e., the Black, Pine, and Belle rivers) contain 25 species (Hoeh and Trdan 1985), this locality displayed a very diverse fauna. The collecting area consisted primarily of a coarse gravel substrate mixed with sand. Water color was somewhat murky, especially after rainfalls, due principally to agricultural run-off.

The Clinton River mussel fauna consists of 31 species and, except for the Maumee River of Ohio, appears to have more species than any other stream in the Great Lakes drainage (Strayer 1980). The Cooley Lake Road bridge site contained 10 species. This site had extremely clear water. The presence of a number of lakes upstream of this site may account for this extreme clarity. The substrate consisted primarily of small rocks, gravel, cobble, and sand. The numerical rank within each mussel community and the amount of recent recruitment varied considerably between *Epioblasma torulosa rangiana* and *Epioblasma triquetra*. *E. t. rangiana* made up a small fraction (< 0.5%) of the mussels collected in the Black

River while *E. triquetra* was the dominant species (> 38%) at the Clinton River site. In terms of recruitment comparisons, *E. t. rangiana* displayed a very pronounced discontinuous size distribution. The vast majority of individuals were large (approximately 50 mm in length). A minute number were small (approximately 25 mm in length). In contrast, *E. triquetra* at the Clinton River site showed a continuous size distribution. There was a gradation from large (67 mm in length) to small (29 mm in length) individuals. These observations are consistent with the hypothesis that recruitment in the recent past has been consistently lower in the Black River *E. t. rangiana* population than in the Clinton River *E. triquetra* population.

The fact that some of the transplanted *Epioblasma torulosa rangiana* survived for three years while kept in a corral is encouraging. Despite problems of debris and silt building up on the upstream side of the corral, we are confident that many of the transplanted *E. t. rangiana* would be alive today if it weren't for the invasion of the Detroit River by *Dreissena polymorpha*.

#### Management and Protection Considerations

Before any major alteration of Michigan's freshwater habitat can occur (bridge construction, dam repair, marina development, etc.), state law requires notification of the Michigan Department of Natural Resources (MDNR), to which applications for appropriate permits are submitted. However, in the cleaning of designated county drains, the drain commissioner need only obtain local approval for the work to commence. Prior to the issuance of a permit, the MDNR is obligated, by the Michigan Endangered Species Act of 1974, to ensure the safety of state-listed organisms. The Michigan Natural Features Inventory (MNFI) maintains a database of historical and current localities of these species. The MDNR, in conjunction with the MNFI, notifies the applicant if state-listed species may be encountered during the project. The applicant, in turn, is required to hire professional consultants to survey the area in question and, if state-listed species are found, to develop a plan to ensure the organisms' survival. This plan may involve collection, relocation, and possible reintroduction of those species subsequent to completion of the project and stabilization of the site.

The Black River project was the MDNR's first attempt at the relocation of an endangered freshwater mussel population. Prior to this project, there was much confrontation between the MDNR, the public (i.e., mostly farmers), scientists, and the Sanilac County Drain Commissioner. The resulting chain of events was one of reaction instead of long-range planning. The project was initiated subse-

quent to the loss of a court case (MDNR vs. Sanilac County Drain Commissioner) that focused on (1) the appropriateness of requiring the Drain Commissioner to obtain a permit and (2) the response time by the MDNR to a permit application. The outcome is that Sanilac County now has 25 miles of drainage ditch. Swift-flowing, cool, relatively clean water has been replaced by shallow, warm, slow-moving stagnant water that is best utilized in growing algae, carp, and mosquitos. Riffles that once were fairly common along this reach of the river were eliminated. Channelization has led to the elimination of all known *E. t. rangiana* habitat. Even if the relocated *E. t. rangiana* had lived, returning them to the Black River in the foreseeable future would not have been a viable option.

Nonetheless, the project was not without its successes. We demonstrated that a population of an endangered mussel species could be collected and relocated if given adequate lead time. The tremendous amount of publicity that this project generated raised the consciousness of many Michigianians. The State of Michigan, particularly the MDNR, has been put on notice that responses to inquiries and permit applications must be addressed in a rapid and conscientious manner. Furthermore, in our opinion, county drain commissioners should (1) be required by law to contact the MDNR before authorizing the clean-out of any "drain" and (2) be required to work within the bounds of the Michigan Endangered Species Act.

In contrast to the Black River project, the Clinton River project, at least to this point in time, has been almost too good to be true. Local authorities in Oakland County have been overwhelmingly in support of our efforts to save valuable *E. triquetra* habitat and are eager to ensure successful collection, relocation, and reintroduction of these animals. We had numerous conversations and meetings with representatives of the Road Commission for Oakland County and the engineering firm responsible for designing the new bridge over the Clinton River. We have all agreed on what needs to be done before, during, and after construction. Permit applications for endangered species collection were submitted by the the commission to the MDNR after consultation with the authors as to the best time to collect and relocate mussels. Factors crucial to freshwater mussel survival, such as maintenance of present water flow patterns, replacement and addition of suitable substrate, minimizing siltation, and stabilization of the river bank after construction, were incorporated into the scope of the project. Local residents were kept apprised of the details of the operation through television interviews and newspaper articles.

We are convinced that many Michigianians have

come to realize that protection of valuable resources (in this case endangered freshwater mussels) and the need to maintain and upgrade the quality of human life need not be mutually exclusive. In fact, the Clinton River bridge project will be an excellent case in point. The new bridge will provide better traffic flow for the residents of Oakland County and at the same time possibly improve habitat for endangered freshwater mussels. The public was and should continue to be educated. Maintaining and improving mussel habitat not only saves endangered mussels but also acts to preserve the Clinton River ecosystem. The fisherman, the hunter, the canoeist, the wildlife photographer, and the person simply seeking solitude from the pressures of everyday life will be able to enjoy this valuable resource. It is our opinion that the greatest challenge to successful collection and relocation of endangered species, in this case freshwater mussels, may not be from our lack of knowledge or choice of methods, but from a public perception that doing so would delay projects, drive up costs, and ultimately cost jobs. All of those concerns certainly are valid, but with proper education of the public, well-planned and reasonable turnaround time in the permit process, and a thorough understanding of the project goals and objectives by all involved parties, a workable and mutually beneficial plan can be implemented in a timely manner. More needs to be done to assure continued success in our efforts to save endangered species. It is important that the kind of cooperation described for the Clinton River project becomes the norm not only in Michigan but throughout the United States and the world.

#### *Zebra Mussel Considerations*

Despite our best intentions and efforts, the preservation of much of our native freshwater mussel fauna may not be feasible due to the expected negative impact of zebra mussels (Hebert et al. 1989, Schloesser and Kovalak 1991, Biggins 1992). The last known Michigan population of *E. t. rangiana* (i.e., the Detroit River population) is in extreme peril. In the spring of 1991 only a very few *D. polymorpha* were found in and around the corral holding the relocated endangered mussels. There were large numbers of zebra mussels in the Detroit River while the corral was in place, but the vast majority were confined to the Canadian side of the river (Kovalak, personal communication). The corral, which was located on the United States side, became encrusted with zebra mussels during the summer of 1991. This coincided with dramatic increases in zebra mussel densities throughout the reach of the Detroit River from Lake St. Clair to Belle Isle (Kovalak and Schloesser,

personal communication). Removal of the entire contents of the corral in the summer of 1992 revealed that virtually every native mussel examined was encrusted with zebra mussels. All of the relocated *E. t. rangiana* were dead and found to be heavily colonized. Heavy infestation of native unionids by zebra mussels can lead to their deaths in less than one year (Schloesser, personal communication).

#### Summary

Comparison of the relocation plans for two of Michigan's endangered freshwater mussel species (*Epioblasma torulosa rangiana* and *E. triquetra*) demonstrated that, despite the many obstacles that had to be overcome, relocation was a viable option for protecting endangered freshwater mussel species. In at least one instance, relocated mussels persisted for over three years at the relocation site. We are convinced that discussions on proper mussel relocation procedures must include the scientific community, politicians, county, state and federal agencies, and the public. Collection of mussels for relocation was facilitated by the use of two complementary techniques: handpicking and mussel dredge. Use of the mussel dredge could be a great aid in future ecological research on freshwater mussels (e.g., recruitment studies). Our direct observation of the devastating effects of zebra mussels on *E. t. rangiana* adds to the urgency of obtaining increased funding for discussion and research to engender mitigation techniques.

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