

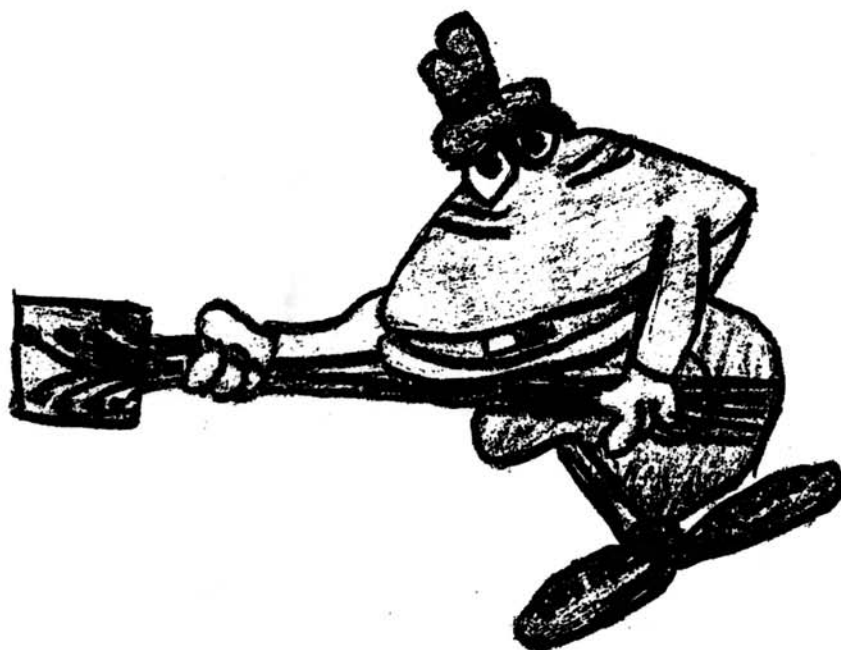
COPE

Triannual Unionid Report

Report No. 10

September 1996

A forum for the informal exchange of information
on the status of
North American unionid research, management, and conservation



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NOTE: The intent of this report is to expedite the exchange of information in an informal format. Report submissions were solicited from individuals and agencies involved in unionid conservation. The submissions were not edited. They were copied as received and assembled into the report.

COVER: THE MUSSEL OF THE COVER WAS DRAWN BY AN ELEMENTARY SCHOOL STUDENT AS PART OF A CONTEST TO DESIGN THE CHARACTER "RUSSELL THE MUSSEL" HELD BY THE TENNESSEE AQUARIUM, CHATTANOOGA, TENNESSEE.



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More about *Margaritifera auricularia*

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As reported in the last issue of the Triannual Unionid Report, a large sampling program has been undertaken in order to assess the status of the endangered naiad *Margaritifera auricularia* at its last known stronghold, the Ebro River. Effective September 7th, the species has been catalogued by the Spanish Government as "endangered", and thus given the highest legal protection.

From April to June, forty kilometers of the Ebro's lower course have been studied in detail, and a map of naiad densities has been elaborated. The methods used involved direct search when and wherever possible, as well as the use of dredging machinery in deeper waters. The large amount of data collected on the species' distribution and reproduction are now being analyzed.

The population of *Margaritifera auricularia* exhibits a very heterogeneous spatial distribution. Overall, it appears to be numerous and viable. However, it is restricted to the main river channel, being thus vulnerable to pollution and water level fluctuations. Only juvenile naiads were found in the upper third of the study area, probably indicating an incipient recolonization of this stretch after industrial pollution further upstream has been controlled.

Two other populations of *M. auricularia* have been located in Spain. One, apparently consisting of few old individuals, has been found in an irrigation channel adjoining the middle course of the Ebro. The second, known only from a few fresh shells collected twelve years ago, is probably still living in the Guadiana basin.

This species is not yet in the critical stage we all thought a few months ago. It can and should be reintroduced to other large European rivers where it became recently extinct. The studies now in progress should provide the necessary information for such conservation plans.

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During the week of August 26, 1996, 600 spiny river snails (*Io fluviatilis*) were collected by snorkeling and hand-picking in the Clinch River at Kyles Ford and Wallend Bend. Specimens were measured in millimeters using a dial caliper and tagged with a plastic number that was glued to the shell. Individuals were placed in insulated coolers containing river water where they readily attached to the sides of the cooler. River water was changed out in the late evening prior to transport in the morning. Specimens were divided equally (300 each site) and transported to the upper Holston River at Surgoinsville, and the next day, to the lower French Broad River at Campbell Island. Both sites are located considerable distances downstream from TVA tributary dams and TVA's River Operations provided reduced flows for snail placement. Individuals slated for the French Broad River were held overnight at TVA's Aquatic Biology Lab in Norris, Tennessee. No mortality was observed. Specimens were hand-placed onto smooth, rocky substrata in riffles, which is their preferred habitat. Snails were observed to immediately attach and start grazing.

Spiny river snails occurred historically in both the Holston and French Broad Rivers around the turn of the century. The species was probably extirpated because of uncontrolled point source pollution and later impoundment of both rivers. Because of continued improvements in water quality, largely the result of the Clean Water Act and TVA's efforts at improving water quality releases below dams (increased oxygen and minimum flows), biological faunas have responded favorably to these changes. Fish and benthic species have shown a marked increase in the last 15 years. Both sites contain healthy populations of native snails but, native mussels are largely extirpated from both rivers. The success of the spiny river snail transplants would be encouraging for restoration of other aquatic species extirpated from these rivers.

Funding for this project was provided by the USFWS, Endangered Species Field Office, Asheville, North Carolina. The project was featured in the Knoxville News Sentinel by outdoor writer Morgan Simmons, and was filmed by TV station WBIR (The Heartland Series). The following agencies and personnel made these efforts a success: USFWS (Dick Biggins, Roberta Hilton, Jim Widlak, Gale Heffinger), TVA (Gary Brock, Ed Scott), TVA contractors Fish & Wildlife Assoc. (Chris Underwood, Mike Hansbrough), Tennessee Wildlife Resources Agency (Dave McKinney, Bob Hatcher, Mark Fagg, Richard Kirk, Pete Wyatt, David Yound, Bruce Anderson), The Nature Conservancy (Leslie Colley), Americorp (Cassie Schaefer), USGS (Brenda Rashleigh, Rick Treece, Jeff Powell).

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On 19 August, I began work as a riparian lands restoration facilitator in the Service's Asheville, NC, Field Office (FO). This newly created position will work towards establishing (by developing partnerships with The Nature Conservancy (TNC), governmental agencies, grass roots organizations, etc.) and overseeing Service involvement in river protection projects. Federally listed mussels, fishes, and other aquatic organisms will primarily drive my focus. My area of coverage encompasses major drainages in parts of six states: AL, GA, KY, NC, SC, and TN. Included is the Cumberland, most of the Tennessee, Ohio River tributaries in KY, and drainages in the Southern Appalachian Ecosystem (upper portions of the New, Pee Dee, Santee, Savannah, Altamaha, Chattahoochee, Tallapoosa, Coosa, and Tennessee rivers).

Existing projects that I will be involved with include the Clinch, Conasauga, Little Tennessee, and Paint Rock rivers, and Horse Lick Creek in KY. With the aid of Service funds, the KY Chapter of TNC is gearing up for a project along 108 miles of the middle Green River in KY. Potential projects will also be sought in the Duck and Etowah rivers, in TN and GA, respectively. In addition, the Asheville FO has funded and I will oversee production of stream restoration literature (with NC State University) and a stream restoration video (with VPI-SU) to facilitate our protection efforts in imperiled watersheds.

I would be interested in hearing about restoration projects in other areas, especially potential funding sources, partners, outreach materials, success (and horror) stories, and other trials and tribulations associated with these complex projects. I look forward to working with some of you in the protection of imperiled aquatic resources.

MUSSEL REFUGE PROJECT INITIATED IN THE
ST. CROIX NATIONAL SCENIC RIVERWAY

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Under the direction of the National Biological Service (Drs. Greg Cope and Diane Waller) and funded by the National Park Service, 450 native mussels were relocated during the week of July 29, 1996 as part of a study to assess relocation of mussels into system-specific, *in situ* refugia in the National Park Service managed zone of the St. Croix River, in Minnesota and Wisconsin. The purpose of the project is to refine mussel relocation protocols and to serve as a conservation measure for protecting the mussel fauna of the St. Croix from zebra mussel infestation. Two federally-endangered mussel species, the Higgins' Eye (*Lampsilis higginsii*) and the Winged Mapleleaf (*Quadrula fragosa*) and fifteen state-listed species reside in the St. Croix River, which supports one of the most diverse communities of native mussels in the Upper Mississippi River Basin. The information derived in this study will be utilized nationally to assist in establishing appropriate methods for conducting mussel relocation projects, based upon long-term monitoring results which are currently unavailable.

Two species of unionids representing the subfamily Ambleminae (Pimpleback, *Quadrula pustulosa* and Spike, *Elliptio dilatata*) and one representing the subfamily Lampsilinae (Higgins' Eye Pearly mussel) were collected from the lower St. Croix river, near Lakeland Minnesota, by divers and relocated to three underwater 5 x 5 meter study grids, two of which were located in the experimental refuge, 40 miles upstream, near Franconia, Minnesota, and to one which served as a source-site control grid located within the collection area of the lower St. Croix. The upstream location supports an existing diverse population of mussels, including the only known population of the Winged Mapleleaf. The refuge site is located upstream of a navigation control point, which was established to regulate boat traffic to vessels which have not been operating in zebra mussel infested waters. A quantitative assessment of mussel survival, recovery, growth, and substrate characteristics will be made annually for a minimum of two years.

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THE UNIONID MOLLUSKS OF THE SMOKEY HILL RIVER SYSTEM OF WESTERN, KANSAS

The unionid mollusks of the Smokey Hill River and its major tributaries, the Saline River and the Solomon River, has been relatively unstudied, and published references on the bivalves of this region are limited. As a part of a larger study to document the bivalve distributions of the central plains, a survey of this area was conducted in 1983 and 1985. A total of 125 sites were sampled in those years in the Smokey Hill River, and its tributaries.

The presense or former presense of 20 unionids was documented for the region. Eleven unionids: Anodonta g. grandis, Anodonta imbecillis, Anodontoides ferussacianus, Lasmigona complanata, Quadrula quadrula, Quadrula p. pustulosa, Fusconaia flava, Unio merus tetralasmus, Leptodea fragilis, Potamilus ohioensis, and Toxolasma parvus were collected live or as fresh empty shells during the survey. In addition, a large live population of Corbicula f. fluminea was discovered in an area reservoir.

The remaining nine unionids were represented only by weathered shells, indicating a possible loss of almost half of the region's original bivalve diversity. The species recovered only as weathered shells were Strophitus u. undulatus, Tritogonia verrucosa, Amblema p. plicata, Obovaria olivaria, Truncilla donaciformis, Ligumia subrostrata, Lampsilis t. teres, Lampsilis radiata luteola and Lampsilis ventricosa.

Species diversity was heavily concentrated in the eastern portion of the study area, and most sites in this area were productive. Unionids were rarely encountered in the western third of the basin, due to a near total absense of stream flow in this region. Dewatering and over-grazing of riparian habitat are significant factors restricting bivalve distributions in the region.

ANNOUNCEMENT

A special session entitled "Reproductive biology and physiology of freshwater bivalves" will be held during the 89th Annual Meeting of the National Shellfish Association (NSA) from April 20-24 1997 at Fort Walton Beach, Florida. Details of the meeting will be forthcoming in the Late Summer Newsletter of NSA, which can be found electronically on the INTERNET, website <http://www.shellfish.org>.

The freshwater bivalve special session will cover applied and basic research, including propagation and culture of freshwater mussels, and biology of other freshwater bivalves. Presently, only a half-day session has been scheduled for the annual meeting, but if enough response is generated, a full-day session could be arranged. A poster session also will be held in conjunction with the NSA poster session.

The goal of this session is to bring together biologists from freshwater and marine disciplines so that we can benefit from each others experience and generate new ideas and techniques for conducting our research. Anyone interested in culture and propagation of freshwater mussels generally turns to the mariculture literature for information on filtration rates, culture systems, and nutritional requirements. Thus, attendance at the National Shellfisheries Annual Meeting would provide the opportunity to speak with and learn from persons conducting "cutting-edge" research on the biology and culture of marine bivalves. Last years NSA meeting included sessions on genetics, biotechnology, oyster pathology, feeding and nutrition, and included papers presenting video of *in vivo* endoscopic visualization of particle selection and partitioning on bivalve gills.

A call for papers will be forthcoming in the Late Summer NSA Newsletter. If after reading this announcement, you think you would like to present a paper at the freshwater session of the 1997 meeting, contact Catherine Gatenby before August 26, 1996, or as soon as you can. This would allow me to determine if a full-day or half day session is appropriate. Inquiries and intentions can be sent to:

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A Unionid Mollusk Translocation From an Area Infested With Dreissena polymorpha (Pallas, 1771), Mississippi River Mile 697.5, Hwy 14/16/61 Bridge, La Crosse, WI

In July/August 1996, prior to routine riprap placement around bridge piers, 12670 unionids (27 species) including five Lampsilis higginsii (Lea, 1857), and 550 other Wisconsin special status unionids, such as Ellipsaria lineolata (Rafinesque, 1820), Arcidens confragosus (Say, 1829), and Pleurobema sintoxia (Rafinesque, 1820), were translocated mainly from about 900 m² around each of two piers (a third pier had few unionids). The final mean densities at each pier were 0.1, 2.8, and 10.6/m² respectively. All 27 species were found at one pier site, in very strong currents with a gravel, cobble, and sand substrata. Twenty-three species were found at the second pier, and 12 species at the third pier.

Recent living records for the Upper Mississippi River included three Alasmodonta marginata Say, 1818 and four Lasmigona costata (Rafinesque, 1820) from depths of six to nine m, probably records for these two generally small stream species. The most suitable translocation area for special status unionids was four miles upstream. A nearby site was also used as the translocation site for some common species. Amblema p. plicata was 40% of the fauna.

This translocation was one of the first to have been conducted in an area seriously impacted by Dreissena polymorpha. Some unionids, mainly from sand substrata, were devoid of D. polymorpha, although many of these specimens showed evidence of previous D. polymorpha attachment (byssal threads). At two of the piers there were a small number D. polymorpha on many unionids, but at the third pier, 300 m downstream of a barge loading facility, the river substrata was blanketed with D. polymorpha, with up to 120 adults on over 80% of the individual unionids. These numbers greatly slowed unionid recovery by experienced divers, and the removal of D. polymorpha increased processing time. Although many unionids were nearly covered with D. polymorpha, few appeared to have been killed by this exotic. The saving factor may be the considerable current at that pier area, which was on outside of a large, river bend. All visible D. polymorpha were hand stripped from unionids before each specimen was marked or numbered on both lower anterior valves. The local waste management company required D. polymorpha debris to be bagged, and advance disposal notice given to facilitate immediate landfill burial. Several species reported nearby by Havlik (1983) were not found including Tritogonia verrucosa (Rafinesque, 1820), and Anodonta suborbiculata Say, 1831, however habitat at the bridge site was not typical for the latter species.

MODIFIED BRAIL DESIGN TO REDUCE FOULING

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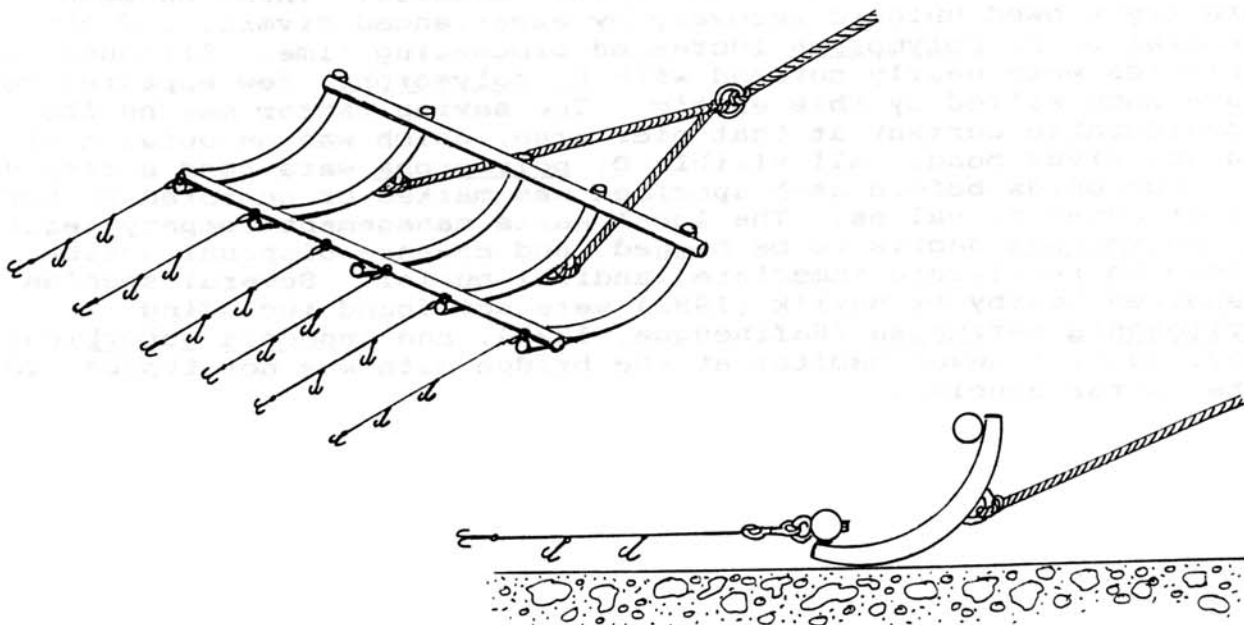
Brails and crowfoot hooks have been used for both commercial and scientific harvest of freshwater mussels since at least the late 1800s. However, fouling on stumps, rocks, and other substrate snags makes this gear difficult to use at some locations. When Texas Parks and Wildlife Department began its first sampling efforts using a standard bail in 1993, it quickly became apparent extensive snags at some sites precluded efficient bail use and incurred frequent damage to the gear. Ultimately a modified design was developed and dubbed the "cowcatcher bail." In experimental use, the new bail design did catch mussels, but it was not until January 1996 that both the standard and cowcatcher designs were fished together at a location with both an abundance of mussels and snags.

Unlike standard, single-bar brails, the cowcatcher bail design employed two horizontal bars connected by a series of parallel, curved bars between (Fig. 1). It was bridled just above center on two of the curved bars. Our design was constructed with 0.75-in. (I.D.) galvanized water pipe and was 1.0 m in width with a space of 0.5 m between the horizontal bars. Because weight of the cowcatcher design was about three times that of a similar-length standard bail, pipe ends were sealed to create an air pocket and reduce weight while fishing. The lower horizontal bar was fitted with eyebolts. Crowfoot-hook arrays were attached to the eyebolts with snap-swivels. These arrays could then be removed and bagged separately for tangle-free transport.

In use, the cowcatcher design did appear to more successfully ride over stumps, logs, and rocks than the standard bail. However, the forward-turned crowfoot hooks used on both brails readily snagged on trotlines. Substitution of dove-tailed, beaded tip design hooks would likely reduce this problem. Both brails captured a variety of unionid species in similar numbers (5-8 living specimens/m²).

This modified design may offer improved bail catches in areas where snags regularly interrupt tows and damage gear. Its major disadvantage is in the increased weight of the unit.

Figure 1. Cow-catcher bail design.



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Status of unionacean bivalve research, management and conservation in New Mexico

Only five native unionid bivalves are known from the Canadian (*Unio merus tetralasmus* and *Utterbackia imbecillis*) and Pecos (*Cyrtonaias tampicosensis*, *Megaloniais nervosa* and *Popenaias popeii*) river basins of New Mexico. While Metcalf (1982) reported on fossil bivalves from the lower Pecos River of New Mexico, no recent systematic survey of unionids native to the state has been conducted. Statewide freshwater mussel inventories commenced in summer 1995 to assess the current distribution and status of unionids from the Canadian and Pecos river basins of New Mexico. These surveys were initiated in cooperation with the New Mexico Natural Heritage Program and the Texas Parks and Wildlife Department (Heart of the Hills Research Station) under federal funds provided by the National Biological Service (State Partnership Program) and the U. S. Fish and Wildlife Service (Endangered Species Act-Section 6). Unionid species of special concern in New Mexico include *U. imbecillis* (state Endangered) and *P. popeii* (federal Species of Concern).

A total of 130 localities have been sampled in the Canadian River Basin since September 1995. The introduced *Pyganodon grandis* represents the only unionid species taken as live specimens from lacustrine habitats of Canadian River mainstem impoundments (Conchas Lake and Ute Reservoir). Fossil *U. tetralasmus* and *U. imbecillis* were found with fossil sphaeriid bivalves and aquatic pulmonate gastropods from deep (i.e., 1.5-2.0m) exposed sediments overlying coarse alluvium of a first order perennial stream (Conchas River); suggesting a native unionid fauna that once inhabited palustrine habitats during wetter periods of the mid to late Holocene. No live or sub-fossil specimens of either species have been located from riverine habitats of the Canadian River basin. Fresh valves of *U. imbecillis* were collected from Conchas Lake by Taylor (1981) and from Ute Reservoir (1995 inventory). The status of *U. imbecillis* populations from mainstem impoundments, as native or introduced, of the Canadian River is problematic considering the documented extirpation of riverine populations, the species' reproductive biology, and its widespread introduction throughout the eastern United States. Any information of unionid collections from the Canadian River (New Mexico or Texas) would prove insightful for the status assessment *U. imbecillis* in New Mexico. The exotic Asian clam (*Corbicula fluminea*) was common throughout the middle and lower reaches of the Canadian River.

Historically, *P. popeii* populations of the Pecos River occurred as far north as Roswell, New Mexico. A 1996 Pecos River drift collection documented a fragmented half valve of *P. popeii*, which extends the historic distribution of this native unionid northward to the Salt Creek Wilderness area of Bitter Lake National Wildlife Refuge. Unionid surveys of the lower Pecos River tributaries are ongoing where recent collections of fresh valves along the Pecos and Delaware rivers of Eddy County imply the potential occurrence of relict *P. popeii* populations.

Zebra mussels have not been reported in New Mexico waters.

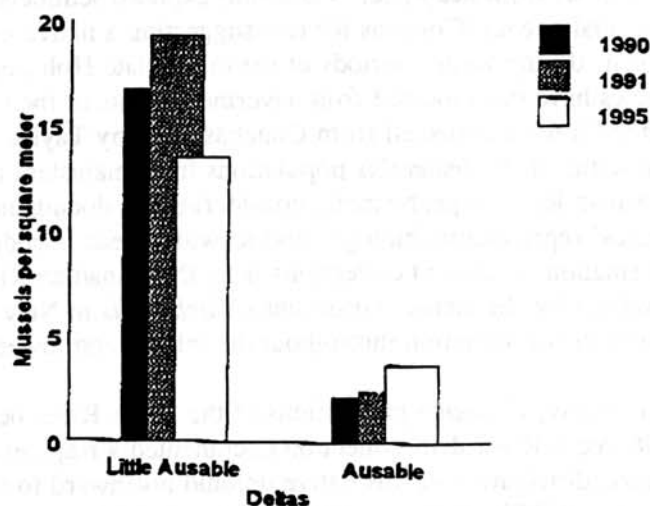
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ASSESSMENT OF MUSSEL POPULATIONS FOLLOWING LAMPRICIDE APPLICATION

Introduction Bayer 73 is used to control infestations of sea lamprey (*Petromyzon marinus*) ammocetes in delta areas on Lake Champlain. Previous studies on the Ausable and Little Ausable River Deltas (Gruendling and Bogucki 1992) indicated that mussel populations were also affected by Bayer 73. The deltas' mussels did not rebound to pre-treatment levels one year after treatment in the fall of 1991. This study assessed the Ausable and Little Ausable deltas four years after treatment. Additionally, this study assessed potential lake-wide implications of the ongoing sea lamprey treatment program by determining if the mussel species in the Ausable and Little Ausable deltas are found in other locations in Lake Champlain.

Methods Intensive surveys were conducted on the Ausable and Little Ausable deltas over 100-meter transects using SCUBA in a cooperative effort with U.S. Fish and Wildlife Service divers from the Ohio River Islands National Wildlife Refuge. Fifty additional littoral sites dispersed throughout the Lake were surveyed less intensively in a cooperative effort with personnel from Vermont Department of Environmental Conservation using snorkeling gear.

Results We collected four native mussel species in the Ausable and Little Ausable deltas; Eastern ellipio (*Elliptio complanata*), Eastern lampmussel (*Lampsilis radiata*), Eastern floater (*Pyganodon cataracta*), and giant floater (*Pyganodon grandis*), compared with only two species (Eastern ellipio and Eastern lampmussel) collected in the earlier study. We also noted zebra mussels (*Dreissena polymorpha*), first reported in Lake Champlain in 1993. Mussel density differences from pre-treatment levels were not statistically significant. Comparisons at the species level were not possible because pre-treatment species composition data were lost. A few young mussels were collected, indicating recruitment occurred since the 1991 Bayer 73 treatment. All mussel species found in the Ausable and Little Ausable Deltas were found in other locations throughout Lake Champlain.



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Development of a Working Group to Design and Implement Native Mussel Programs on an Ecosystem Level.

Lake Champlain borders New England and the mid-continent prairie states. Consequently, many of Lake Champlain's mussel species are at the eastern most extent of their range. Although sporadic research has been done on the Lake Champlain mussels, no extensive survey has been conducted in a number of years.

Zebra mussels were discovered in Lake Champlain in 1993. Since that time, zebra mussels and/or veligers have been found in all areas of the lake. Because of the vulnerability of our native mussels to zebra mussel infestation, State and Federal agencies have accelerated their efforts to evaluate the current status of native mussel populations and develop methods to conserve the unique mussel populations of Lake Champlain.

The Lake Champlain Native Mussel Working Group was formed to address the current issues in the Lake Champlain drainage. This Working Group is comprised of biologists from the U.S. Fish and Wildlife Service, the Vermont Fish and Wildlife Endangered Species Division, the Vermont Department of Environmental Conservation, the Vermont Nature Conservancy, the New York Natural Heritage Program, and the New York Department of Environmental Conservation.

The responsibilities of the Working Group have been to develop priorities and work plans to address those priorities. Some of the tasks identified are:

- to prioritize areas to inventory within Lake Champlain basin that historically have unique and diverse mussel communities.
- to locate areas that have not been colonized by zebra mussels and may be used as refugia for native mussels.
- to develop methods of moving and maintaining imperiled unique mussel species (e.g. host fish species work, quarantine facilities and methods, outreach activities aimed at maintaining mussel beds) within the Lake Champlain basin.

The Lake Champlain Mussel Working Group is providing a strong cooperative effort directed to information sharing, partnership opportunities and funding potentials. This type of teamwork is critical to the continued existence of local native mussel populations.

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The New Jersey Division of Fish, Game and Wildlife's Endangered and Nongame Species Program performed extensive surveys of major streams in the northern third of the state throughout the entire 1996 field season. The objective of the 1996 Unionid survey was two fold. First, to determine the status of the dwarf wedgemussel, *Alasmodonta heterodon*, in New Jersey; and second, to determine the diversity of Unionid species in the Northern New Jersey waterways (mainly the Delaware Drainage System).

Last year, nine valves plus 11 partial shells and relics of *A. heterodon*, which was considered extirpated in New Jersey, were found in a 3.5 mile section of the Pequest River, Warren County. The shell material was estimated to be 10 years old or younger. No live specimens were recorded last season. This season, *A. heterodon* surveys were concentrated in this section and other upstream sections of the Pequest River. From June to September 1996, nine valves and 10 individual remains (partial shells or fragments) were found within the aforementioned area. No live *A. heterodon* specimens were found at this or any survey site.

In addition to the *A. heterodon* valves, three live Unionid species: *Elliptio complanata*, *Strophitus undulatus* and *Anodonta* spp. were recorded. Four species, *E. complanata*, *Anodonta* spp., *Strophitus undulatus* and *Alasmodonta undulata* were recorded in the Paulins Kill (Warren County) and the Ramapo River (Bergen County). Live specimens of all four species were found in the Paulins Kill. Live *E. complanata* along with valves and relics of the other three species were recorded in the Ramapo River. The survey sites along the Delaware River produced three species: *E. complanata* (live and remains found at all sites in Warren and Sussex Counties), *A. undulata* (one live specimen at Tocks Island, Warren County) and *Anodonta* spp. (live specimens and valves found at Depue Island, Warren County).

Two Unionid species were recorded in the Musconetcong and Wallkill Rivers. Live specimens, shells and relics of *E. complanata* and *Alasmodonta varicosa* (brook floater) were recorded in the Musconetcong River, Warren County. The Wallkill River (Sussex County) site produced live specimens and remains of *E. complanata* and *Anodonta* spp.

E. complanata alone (live and remains) were found in the North Branch Raritan River (Hunterdon County), Passaic River (Morris County), Hibernia Brook (Morris County) and Bear Creek (Warren County). In Great Brook (Morris County), relics of *E. complanata* were recorded. No live specimens were found in Great Brook. There were no indication of Unionids at Beaver Brook, Morris County.

Host Fishes for Two Federally Endangered Species of Mussels

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The current status of the freshwater mussel fauna (Bivalvia: Unionoidea) is in serious peril. Of the 297 taxa recognized in North America, Williams et al. (1993) recommended that 213 (72%) be considered endangered, threatened, or of special concern. Current efforts are underway at Virginia Tech to develop culture protocols for juvenile mussels to augment existing populations of rare mussels and even reintroduce them back into their historical ranges. However, the number of glochidia-host relationships that have been identified is lacking. Hoggarth (1992) implicated 92 species of fish as hosts for a total of 63 species of freshwater mussels, which identifies glochidia-host relationships for only about 25% of the unionid fauna of North America. Without this crucial information, laboratory propagation will not be possible. This research identifies host fishes for the federally endangered *Epioblasma florentina walkeri* (tan riffleshell) and *Villosa perpurpurea* (purple bean). Procedures followed were largely those of Zale and Neves (1982). Trials were conducted at 21.5-24.5°C.

The following table summarizes the results as of September 1, 1996. Suitable hosts are those that produced transformed juvenile mussels; non-suitable hosts (NSH) are those which sloughed all the glochidia and no juvenile mussels were produced. A question mark (?) identifies a species in which all the specimens died before the transformation period could be completed, but microscopic examination of the gills found no glochidial encystment. A dash (-) identifies a species that was not infested with glochidia from that particular mussel species. Ew = *Epioblasma florentina walkeri*; Vp = *Villosa perpurpurea*; a = accidental mixed batch; b = all specimens died before the transformation period was complete.

	Ew	# juveniles	Vp	# juveniles
<i>Ambloplites rupestris</i>	NSH		NSH	
<i>Cottus</i> sp. (<i>bairdi</i> and/or <i>carolinae</i> ^a)	Host	95	Host	147
<i>Etheostoma blennioides</i>	Host	247	Host	101
<i>Etheostoma flabellare</i>	Host	1180	Host	199
<i>Etheostoma rufilineatum</i>	Host	106	NSH	
<i>Etheostoma simoterum</i>	Host	43 ^b	-	
<i>Hypentelium nigricans</i>	?		?	
<i>Ictalurus punctatus</i>	NSH		-	
<i>Lepomis auritus</i>	NSH		NSH	
<i>Lepomis macrochirus</i>	NSH		NSH	
<i>Micropterus salmoides</i>	NSH		NSH	
<i>Moxostoma cervinum</i>	?		-	
<i>Nocomis leptocephalus</i>	?		-	
<i>Noturus insignis</i>	NSH		NSH	

Hoggarth, M. A. 1992. An examination of the glochidia-host relationships reported in the literature for North American species of Unionacea (Mollusca: Bivalvia). *Malacology Data Net* 3(1-4): 1-30.

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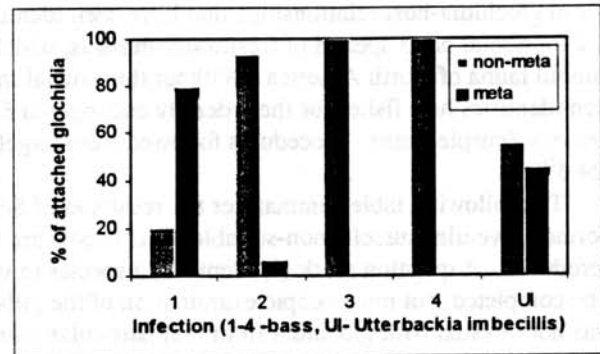
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1. And immunity for all...

In 1919, Reuling proposed that acquired immunity to one mussel species imparted immunity to all. This has not been substantiated. In the largemouth bass / *Lampsilis cardium* association, we are able to achieve 100% immunity in three exposures, each separated by approximately 45 days. In this experiment, a hatchery raised bass was exposed four times. At the end of the fourth exposure, the bass was infected with *Utterbackia imbecillis*. As shown in the figure, the bass had no immunity to this new mussel. Because anodontines are only distantly related to lampsilines, it is possible that the host's immune system does not recognize them. We are investigating whether congeners, such as *Lampsilis radiata luteola*, are able to parasitize an otherwise immune host.



2. Hosts for the Northern Riffle Shell (*Epioblasma torulosa rangiana*)

Thirty-three species of fishes and amphibians were tested as hosts for the federally endangered Northern Riffle Shell. Fishes were infected in the laboratory and held at 23° C. Four species were found to be hosts: Banded Darter; Bluebreast Darter; Brown Trout; and Banded Sculpin. Transformation required from 27 to 33 days. This study was funded by the US Fish & Wildlife Service.

Fishes not acting as hosts:

Smallmouth Bass	Orangespotted Sunfish	Bluegill	Stonecat
Tippecanoe Darter	Goldfish	Rainbow Darter	River Chub
Bowfin	Creek Chub	White Sucker	Logperch
Spotfin Shiner	Sand Shiner	Leopard Frog	Quillback
Siamese Fighting Fish	Stoneroller	Silverjaw Minnow	Common Carp
Northern Hogsucker	Saugeye	Greenside Darter	Bigeye Chub
Mimic Shiner	Rosyface Shiner	Channel Catfish	Largemouth Bass
Bluntnose Minnow			

3. ClamNation - the first year

In July, 1995, we began two experiments to study the relationship between water temperature and glochidial release, and the feasibility of mussel reproduction and recruitment under 'natural conditions' in a hatchery setting. Twenty individuals of *Lampsilis radiata luteola* and twenty hatchery-raised largemouth bass (a known host) were placed in an outdoor 3028 liter pool. Another pool contained 20 *Amblema plicata* and bass. Mussels were supplied with substrate and the pools inoculated with a tri-algal colony. Bass were fed trout chow. No effort was made to control water chemistry or temperature, except that pools were placed on flow-through in winter to prevent complete freeze-down. Glochidia were collected from the bottom of the pools every two days using special samplers.

Differences in how and when glochidia are released by the two mussel species are apparent. Although there are 10 female *Lampsilis*, the number of female *Amblema* is not known, but it is unlikely that there is only a single female among the twenty. An estimated 102 metamorphosed juveniles were produced in the *Lampsilis* pool (arrows), or 0.75% of all glochidia recovered. This indicates that recruitment in a hatchery setting is possible using passive methods - without handling of fishes or mussels. If tens of thousands of mussels are to be 'stored' in hatcheries away from zebra mussels, this method could be used to produce juveniles while in captivity with little effort. No metamorphosed juveniles were produced in the *Amblema* pool. So far, two *Amblema* and a single *Lampsilis* have died.

We will continue this study at least another year to determine if the mussels have spawned and successfully reproduced. Additional pools containing *Leptodea fragilis* and *Pyganodon grandis* have been added. This study is funded by the Ohio River Mussel Mitigation Trust Fund.

