COPE

Triannual Unionid Report

Report No. 2

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

Compiled by

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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.

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Number of NC unionid species: approximately 70

North Carolina's Endangered & Threatened Unionids

SPECIES	NC/FED. STATUS	# NC POPULATIONS
Dwarf wedgemussel (Alasmidonta heterodon)	E/E	13
Appalachian elktoe (Alasmidonta raveneliana)	E/proposed E	2
Triangle floater (Alasmidonta undulata)	T	17
Slippershell mussel (Alasmidonta viridis)	E	1
Brook floater (Alasmidonta varicosa)	T/C2	7
Yellow lance (Elliptio lanceolata)	T/C2	6
Roanoke slabshell (Elliptio roanokensis)	T	10
Tar spinymussel (Elliptio steinstansana)	E/E	5
Tennessee pigtoe (Fusconaia barnesiana)	E	1
Atlantic pigtoe (Fusconaia masoni)	T/C2	15
Yellow lampmussel (Lampsilis cariosa)	T/C2	14
TN heelsplitter (Lasmigona holstonia)	E/C2	1
Carolina heelsplitter (Lasmigona decorata)	E/E	3
Savannah lilliput (Toxolasma pullus)	T/C2	4

North Carolina's Endangered & Threatened Unionids (cont.)

SPECIES	NC/FED. STATUS	# OF NC POPULATIONS
Little-wing pearlymussel (Pegias fabula)	E/E	1
Pistolgrip (Tritigonia verrucosa)	E	1
Waccamaw spike (Elliptio wac-camawensis)	T/C2	2
Squawfoot (Strophitus undulatus)	T (expect downlisting)	
Waccamaw fatmucket (Lampsilis fullerkati)	T/C2	1

Eleven other species are listed as state Special Concern.

OTHER NOTES:

- William F. Adams, Chairman of the NC Mollusk Scientific Council, has asked members to update the status of state listed and unlisted mollusks.

- A biological inventory of plants, plant communities, terrestrial and aquatic mollusks, crayfish, other aquatic macroinvertebrates, fish, amphibians, reptiles, birds, and mammals has been completed for the Swift Creek Subbasin. A 133 page report has now been completed for this project. Together with a threat analysis prepared for Swift Creek's Tar spinymussel population, this report will help focus future conservation efforts in the subbasin.

- With funding from the USFWS, the NCWRC will complete status surveys for the Savannah lilliput in GA and SC during the next two years.

  With similar funding during the recent past, a status survey for the Atlantic pigtoe was completed by the NCWRC in GA and NC. In GA, only one population of the species was found in a tributary creek of the Ogeechee River. (Dr. Eugene Keferl completed a status survey for this species in SC. According to Keferl, no extant populations were found.) Is a status report from VA forthcoming?

- The yellow lance (Elliptio lanceolata) is now known from the Neuse River Basin. However, the two populations will probably be extirpated in the **very** near future.

- Dr. Alan Stiven, UNC-Chapel Hill, has started his second year of research studying site effects and genetic similarities for certain mussel species in North Carolina: lanceolate elliptios, Elliptio roanokensis, Elliptio congaraea, and others.

- The NCWRC is continuing its efforts to designate Critical Habitats for state (and federally) listed Endangered and Threatened aquatic mollusks. Ultimately, the goal is to have these areas designated as High Quality Waters, which receive special protection from the state's Environmental Management Commission.

- With funding from the US Forest Service and the NC Recreation and Natural Heritage Trust Fund, the NCWRC has initiated inventories for mammals, crayfish, and mollusks on the Uwharrie and Croatan National Forests. The USFS will use the results to better manage significant habitats in the future.

- Dr. Keferl, your suspicions were correct. Villosa vaughaniana is a distinct species and should not be synonymized with V. delumbis. Gravid females of both species were found during the first week of April in a Uwharrie Mountains creek. Villosa vaughaniana has completely white margined marsupia. V. delumbis has a band of black pigment along the marsupia. As you know, shell characteristics are also distinct.

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ZEBRA MUSSELS

As of July 1993, recent TVA diver inspections of lock and dams on the Tennessee River report new zebra mussel sightings in Chickamauga, Watts Bar, and Fort Loudoun lock and dams. The most previous upstream distribution of zebra mussels was in Nickajack lock and dam near Chattanooga, Tennessee. Zebra mussels are now present in all mainstem lock and dams on the Tennessee River.

UPPER CHICKAMAUGA RESERVOIR (TENNESSEE RIVER) MUSSEL STUDY

Three mussel beds located on the Tennessee River at miles 520, 526, and 528 have been monitored since 1983 to determine the existing status of mussel communities in the vicinity of Watts Bar Nuclear Plant. Studies were designed to provide baseline data on occurrence, relative abundance, distribution, and condition of mussel species. Recent quadrat excavations and sieving of substrate for evidence of reproduction produced only three small specimens of Anodonta imbecillis. All thick-shelled mussel species are apparently old and eroded, with no evidence of reproduction. All three mussel beds appear terminal and specimens of the four most abundant species will be thin-sectioned and aged. Positive age identifications will determine what year each specimen was produced and will add support to the fact that little or no recruitment has occurred since the closure of Watts Bar Dam in 1942.

Add

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Title: Relocation of Candidate Unionids in the Apalachicola River, Florida.
Authors: Hannah Hamilton, Jayne Brim Box, James D. Williams, Ricardo Lattimore

Relocation trials are being conducted by the National Fisheries Research Center in Gainesville, FL. (NFRC-G), to determine the survivorship of relocated candidate mussels. Mussels were removed from a gravel bar on the Apalachicola River, below Jim Woodruff Dam. This site will be dredged for barge traffic in the fall of 1993. Factors which may affect survival and growth, including sediment type, feeding, and water quality are being investigated. Mussels are held at the NFRC-G, as well as in corrals in the Apalachicola River. In the laboratory, specimens are in 2,300 gallon tanks, in either gravel substrate or suspended in baskets. These mussels are supplied with a mix of fertilized pond water and well water. A starvation trial is also being conducted to evaluate survivorship without feeding. In the river, transplanted unionids have been placed in four sediment types: limestone/sand, silt/sand, gravel, and mud. This project will be conducted in five phases, beginning in the summer of 1993 and ending in the fall of 1994. All activities will be conducted in the area below the Jim Woodruff Dam at river mile 100.

320 reloc

Title: Survey of the Freshwater Mussels of the Ochlockonee River, Florida and Georgia.
Authors: Jayne Brim Box, James D. Williams, and Ricardo Lattimore

The Ochlockonee River lies entirely within the coastal plain of Florida and Georgia. The unionid fauna of this drainage is poorly known, although about 20 species have been reported from the basin. Three species of freshwater mussels, *Alasmidonta wrightiana* (Walker, 1901), *Lampsilis subangulata* (I. Lea, 1840), and *Elliptoides sloatianus* (I. Lea, 1840), are included in the U.S. Fish and Wildlife Service Animal Notice of Review (1991). In 1993, the NFRC-G completed a survey of the freshwater mussels of the Ochlockonee River and its tributaries. Collections were made, using SCUBA divers, at over 70 sites in the basin. The current distribution and abundance were determined for candidate species, as well as for other unionids in the system. A manuscript describing the survey results is in preparation. Several species which were unknown from the Ochlockonee River were found. Two of the candidate species will be proposed for listing, based on survey results. In addition, several other species will be designated as new candidates for listing.

Title: Mussel Culture Program
Author: Anne E. Keller

A mussel culture program was initiated at the Gainesville lab in June with the hiring of Dr. Anne E. Keller. Anne completed her dissertation in 1989, by developing new techniques for mussel culture and toxicity testing with juveniles, and then worked for the TVA and the St. Johns River Water Management District (Florida). The first priority has been to set up the lab. Orders for new equipment have been placed and a significant portion has arrived. However, several key items are still enroute. We anticipiate that the work will begin in earnest by the middle of September. Initially, the emphasis will be placed on culturing glochidia through transformation. Then we will expand into several other areas. These include: culturing glochidia both <u>in vitro</u> and <u>in vivo</u> to compare survivability and sensitivities to pollutants; defining specific culture requirements for various species; determining food requirements of juveniles; developing techniques to force spawning of adults; and long-term maintenance of adults.

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Non-destructive tissue sampling from unionids

Physiological ecology and systematic studies of unionids may require obtaining tissue samples; protocols that typically involve sacrificing the animals. Consequently, such studies are precluded for endangered or threatened species or studies where repeated sampling is desired. We are developing and testing a non-destructive method of obtaining tissue samples from unionids. In May and June we initiated two separate experiments to determine the effect of clipping a small piece of mantle tissue on long-term survival in two species of unionids. In the Licking River, Kentucky we marked and took tissue from 104 Actinonaias ligamentina, marked 102 individuals for use as controls, and returned all to the stream. In Kentucky Reservoir, Tennessee River, we marked 92 treatment animals and 94 controls using Quadrula quadrula. Sites will be revisited in September/October and again in the spring of 1994 to assess survival in the two groups. Preliminary laboratory results show that a piece of tissue of the size obtained in this study will be useful in systematic and physiological ecology studies. Thirteen enzyme systems have been resolved from a single tissue sample using cellulose acetate electrophoresis. A tissue sample of this size should be sufficient for DNA analyses as well glycogen assays and other biochemical measures. This study is funded by the Mussel Mitigation Trust Fund.

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Characterization of community structure, fish host use, and development of monitoring protocols for freshwater mussels in Bankhead National Forest, Alabama

Bankhead National Forest in northern Alabama encompasses headwater streams of the Mobile Basin that support diverse, healthy communities of unionids. Among the dominant species in these communities are four federally endangered or threatened Mobile basin endemic species (Lampsilis perovalis, Pleurobema furvum, Medionidus acutissimus, and Ptychobranchus greeni). We are characterizing species composition, density, and demographic structure of these communities and sampling fish populations to document infestation by glochidia. The 1993 field season represents the first year of a two year study, but some preliminary results are available. There seems to be a distinct longitudinal trend in species composition. Upstream stations are dominated by lampsilines and Strophitus subvexus, but there is a gradual downstream increase in numbers of amblemines. Recruitment seems to be taking place at all of our sites. We have found juveniles of L. perovalis, M. acutissimus, P. furvum, Villosa vibex, and Tritogonia verrucosa, as well as several unidentified juveniles. We have found encysted glochidia on Coosa bass, Micropterus coosae, and Alabama hog sucker, Hypentelium etowanum. We have two goals for this project: 1) to develop simple but objective monitoring protocols that can be used by forest and other resource managers to assess real trends in unionid populations on lands under their care, and 2) to come to a better understanding of ecological processes in relatively undisturbed mussel communities.

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Canadian Journal of Fisheries and Aquatic Sciences 50:13-19

Reduced Survival and Fitness in Native Bivalves in Response to Fouling by the Introduced Zebra Mussel (*Dreissena polymorpha*) in Western Lake Erie

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Haag, W. R., D. J. Berg, D. W. Garton, and J. L. Farris. 1993. Reduced survival and fitness in native bivalves in response to fouling by the introduced zebra mussel (*Dreissena polymorpha*) in western Lake Erie. Can. J. Fish. Aquat. Sci. 50: 13–19.

Fouling by the recently established zebra mussel (*Dreissena polymorpha*) causes differential effects among bivalve communities. In 3-mo experiments and surveys conducted in western Lake Erie during 1990, two native bivalves, *Lampsilis radiata* and *Amblema plicata*, showed consistent differences in mortality and biochemical indices of fitness in response to fouling by *D. polymorpha*. *Lampsilis radiata* was very sensitive to fouling, experiencing high mortality and reduced fitness in experiments and natural populations. In field experiments, female *L. radiata* suffered higher mortality and lower fitness than males. *Amblema plicata* was less sensitive to fouling; fitness was reduced in experimentally fouled *A. plicata*, but mortality and fitness in natural populations were not affected by *D. polymorpha*. Six species of native bivalves showed marked differences in mortality rates at three sites surveyed in western Lake Erie. Mortality was higher in the subfamilies Anodontinae and Lampsilinae (including *L. radiata*) than in Ambleminae (including *A. plicata*) at all three sites, suggesting that differences in life history strategy and shell morphology among subfamilies may be responsible for differential responses to fouling. These data suggest that fouling by *D. polymorpha* will result in profound changes in native bivalve community structure.

Unionidae of the Ohio River in Pennsylvania - M.P. 34.9-35.5

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and

Tom Proch. Pennsylvania. Department Of Environmental Resources (DER), 400 Waterfront Drive, Pittsburgh, PA 15222-4745

As part of the continuing resource investigations of the Ohio River Islands National Wildlife Refuge, the first authors sampled the area around Phyllis Island for unionids on August 11-12, 1993. Sampling included brailling and handpicking shorelines. In all, 6 species were found, 5 of them alive. Two of the species, *Leptodea fragilis* and *Quadrula quadrula,* have not been collected in Pennsylvania's riverine system since before 1950. These same species have been proposed by the Pennsylvania Biological Survey as extirpated from riverine systems. Previous studies by Tolin (1987) of the Ohio River failed to locate any unionids, and he concluded that "mussels do not presently exist in the mainstem Ohio River...". In light of these findings, further studies by the DER endeavor to evaluate these populations.

The species found were:

Anodonta grandis
*Leptodea fragilis**
Anodonta imbecillis
Lampsilis siliquoidea
Quadrula quadrula
Lasmigona costata

* *shell only*

Reference

Tolin, W. A. 1987. A Survey of the Freshwater Fauna, Unionidae, in the mainstem of the Ohio River, the lower Monongahela River and the lower Allegheny River. Planning Aid Report for the Pittsburgh Corps of Engineers.

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Report: On June 28, 1993, Region 3 of the U.S. Fish and Wildlife Service issued a likely jeopardy biological opinion for the Higgins' eye pearly mussel (*Lampsilis higginsi*) under section 7 of the Endangered Species Act. The opinion was issued for a proposed project in the East Channel of the Mississippi River at Prairie du Chien, Wisconsin. The project is a combined private barge terminal expansion (application for Corps of Engineers permit) and Corps Federal channel maintenance. The basis of likely jeopardy was chronic impacts from increased barge traffic on *L. higginsi* in the largest, most vital, of seven "essential habitat" areas identified in the *L. higginsi* recovery plan. Alternatives include suspended maintenance dredging and barge facility relocation.

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Triannual Unionid Report Submission
Dwarf Wedge Mussel Survey

New Jersey's Endangered & Nongame Species Program is currently conducting a survey of the federally endangered dwarf wedge mussel, Alasmidonata heterodon. The project objective is to locate and inventory dwarf wedge mussel populations which still exist in New Jersey. Areas of historic occurrences (upper Delaware River Drainage, and the Passaic & Hackensack rivers) will be examined, along with areas with habitat parameters suitable to sustain dwarf wedge mussel populations (i.e. Wallkill). Areas containing suspected host fish species (i.e. tessellated darter, Etheostoma olmstedi) will also be searched. Once dwarf wedge mussel populations have been identified, monitoring and recovery efforts will be initiated to ensure that water and habitat quality remain suitable for the continued survival and growth of this species.

To date, sections of the following water bodies have been searched:

	County	Species Located
(1990)		
Pequest River	Warren	None
Buckhorn Creek	Warren	None
Pophandusing Brook	Warren	None
Delawanna Creek	Warren	None
Paulins Kill	Warren	None
Dunfield Creek	Warren	None
(1992)		
Pequest River	Warren	*Elliptio complanata*
Big Flat Brook	Sussex	None
(1993)		
Stony Brook	Mercer	*Elliptio complanata* *Anodonta implicata*
Del. River near Colombia	Warren	*Elliptio complanata*
Del. River above Water Gap near Minisink Island	Sussex	*Elliptio complanata*
Del. River , Pennsauken Ck.	Burlington	*Corbicula fluminea*
Del. River, Newbold Island	Burlington	*Lampsilis cariosa* *Anodonta implicata* *Corbicula fluminea* *Ligumia nasuta* *Elliptio complanata*

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Report: Region 3 of the U.S. Fish and Wildlife Service (Service) anticipates fiscal year 1994 publication in the *Federal Register* a notice of availability for the technical/agency review draft of the recovery plan for the winged mapleleaf mussel (*Quadrula fragosa*). The mussel, formerly occurring in streams in 11 states, now occurs only in one short segment of the St. Croix River, between Minnesota and Wisconsin. The draft recovery plan focuses on the need to determine the instream flow requirements of the species, identification of its glochidial host fish, reintroductions to establish separate populations, and clarification of its taxonomic classification.

The Service solicits information and comments on this draft during the comment period which will be announced in the notice of availability. The draft will be available for inspection during normal business hours in the Endangered Species Division office of the Service in the Bishop Henry Whipple Federal Building, 1 Federal Drive, Ft. Snelling, Minnesota 55111-4056, telephone 612/725-3276. Copies of the draft may be requested from the Chief of the Division of Endangered Species, at the above address.

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Life history and pollution tolerance of *Lampsilis rafinesqueana*.

The Neosho mucket (*Lampsilis rafinesqueana*) is a large lampsiline species which is endemic to streams of the Ozark Plateaus region and which is classified as threatened. During the past year we have found live Neosho muckets at 7 of 15 sites surveyed in the Spring and Elk river drainages in southwest Missouri. Mature glochidia were obtained in late July and in August, and gravid/displaying females have previously been reported in September and October. We are currently performing tests to determine suitable host fish species. Parts of the Spring River drainage are impacted by effluents from lead and zinc mining, and we are testing the sensitivity of the glochidia to metals. We hope to extend these toxicity tests to juveniles when suitable host fish have been identified and juveniles have been produced.

Marian E. Havlik, Malacological Consultants, 1603 Mississippi Street, La Crosse, Wisconsin 54601-4969. Phone: 608-782-7958.

ARE UNIONID TRANSLOCATIONS A VIABLE MITIGATION TECHNIQUE? THE WOLF RIVER EXPERIENCE, COUNTY A BRIDGE, SHAWANO, WI, AUGUST 1992.

Prior to demolition of two bridge piers, unionid mollusks were collected by divers from a 730.2 m^2 area by means of longitudinal, qualitative transects. Preliminary sampling at the transplant site yielded a mean density of 20.7 unionids/m^2 from 10 m^2 quadrats, including two young, Wisconsin threatened Alasmidonta viridis (Rafinesque, 1829). The translocation site was permanently marked on the substrata, and latitude and longitude calculations were taken with GPS. Preliminary mussel densities from 10 m^2 quadrats in a 7.62 m buffer zone around each pier yielded mean densities of 9.7/m^2. The expected population was 7084 unionids. Depths ranged from two to 3.5 m. The substrata was sand, gravel, cobble, and detritus.

Mussels were hand translocated from County A bridge, Wolf River, N of Shawano, WI, 17 - 26 August 1992, into a similar habitat 300 m upstream of the new bridge. Over 14% more mussels were collected than anticipated (8120), representing a mean density of 10.8/m^2 and 14 taxa. Mussels were marked with a hash mark on each valve's anterior end to facilitate recovery during anticipated followup survival studies. All mussels were out of water for only the few minutes needed to sort, identify, and mark specimens. To avoid stress, unionids were placed in mesh bags and hung in the Wolf River before and after processing, and were translocated the same day. Thirty-three Wisconsin threatened unionids were translocated, or 0.43% of the total. Fifteen Simpsonaias ambigua (Say, 1825), 8 to 17 years of age, and 18 A. viridis, 8 to 13 years of age, were measured and aged, but these small shells were eroded and fragile, so they were not checked for sex or gravidity. At least 0.05% of the marked, hand planted mussels were unable to re-establish themselves at the relocation site since marked specimens were found 300 m downstream between the bridge piers. About 2% of unionids at a special quadrat site were also unable to immediately re-establish themselves when merely placed on the substrata. In one area downstream of the East Pier there were 110 and 152 mussels respectively in two 0.25 m^2 samples, mostly Elliptio dilatata (Rafinesque, 1820); E. dilatata dominated the fauna at over 71%. A total of 8336 mussels were identified in the project area, for a project mean density of 11.3 unionids/m^2. This, and similar studies, have helped formulate our definition of a mussel bed at 5 to 10 unionids/m^2. We recommend hand relocation from May - September, and at a time when gravid special status species will not be stressed. Translocation goals should be to transplant the total mussel population into a similar nearby mussel bed, based on preliminary quantitative sampling at both the donor and recipient sites, with followup survival studies.

Unfortunately, as of mid-1993, there is apparently no WI DOT or other funding to followup on this large unionid translocation.

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USE OF GPS DURING A UNIONID MOLLUSK BRAIL/DIVE SURVEY, LOWER OHIO RIVER MILE 938.9 TO 981.0, PADUCAH, KENTUCKY, TO CAIRO, ILLINOIS.

Latitude and longitude (Lat/Long) calculations were taken from the Global Positioning System (GPS) with a Trimble Pathfinder Basic at beginning and end points of 367 brail runs and 60 dive sites during a unionid mollusk survey in lower Ohio River areas affected by maintenance dredging and riverine disposal. The focus of this paper is on problems encountered with the use of GPS during river research. Without Lat/Long on navigation charts it is difficult to "know where you are" in order to determine if satellite Selective Availability (SA) is causing GPS errors at a particular time and/or location. Topographic maps are difficult to use in the field. Recording and averaging multiple data points per site may solve some GPS problems, however obtaining exactly the same location in a boat is difficult due to wind and current. If a reading is wrong due to satellite discrepancies, additional readings presumably will also be in error. We had difficulty daily in obtaining GPS readings in the 3D mode when four satellites were available. In one area, GPS readings for two brail runs at 11:30 a.m. fell correctly on large scale maps, but plots for brail runs 20 minutes later, fell on dry land, over 500' from the Ohio River. Researchers must become knowledgeable about Lat/Long to determine if SA is causing problems.

Color coded site results were plotted on 41 large maps (300' = 1"), and mussel beds were outlined. About 10% of 800 sites had location errors, even when plotted by ArcInfo software. Questionable readings were confirmed by computer downloads of data, and hand plotted data points. Sorting data points by Longitude at East/West river sites (or by Latitude at North/South river sites) helped locate hand recorded errors. Since GPS location problems may continue, reports should also have a set of enlarged navigation maps to show where the researcher "believes" sites were located. GPS technology enhances river research, but in addition to a GPS field unit and base station, Lat/Long should be added to navigation charts. Data should be hand-written and downloaded frequently. State of the art hardware and software is needed, such as GPS units with field plotters.

Over 25 miles of unionid beds were identified; 81% near the Illinois shoreline, and 19% along the Kentucky shoreline. Based on reported brail efficiencies, 4 mussels/brail run, and 2 mussels/dive site equaled densities of 1/m^2. Nearly 1/3 of 427 sites yielded unionids, with 24 species among 653 specimens. An endangered Plethobasus cooperianus (Lea, 1834) was marked, measured, and returned to Ohio River Mile 949.2, 37° 11" 17.2' N and 88° 49" 6.2' W. This site represented an upstream extension of the known Ohio River range of the species. No Dreissena polymorpha (Pallas, 1771) were found.

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DOCUMENTATION OF AVAILABLE DATA: LAMPSILIS HIGGINSI (Lea, 1857), PRAIRIE DU CHIEN, WI, MISSISSIPPI R. M. 628 TO 646, 1972 - 1990.

Large maps display all available information on 3243 living and dead Lampsilis higginsi found in the Prairie du Chien, WI area, 1972 to 1990. Database, done for USFWS, Office of Endangered Species, Twin Cities, MN, gives date, collector, locale to 0.1 Mississippi River Mile (MRM), sex, age, condition, length, height, width, color, specimen disposition, and comments. Information was available for 468 living L. higginsi: 215 males (45.9%), 88 females (18.8%), 13 juveniles 4 years of age or under (2.8%), and 152 of unknown sex (32.5%). Of the 2775 specimens represented by empty shells, 499 (18%) were fresh-dead; the remainder were worn-dead, or condition was unknown. Most of the shells have been deposited at The Ohio State University Museum of Biological Diversity; the remainder of the retained specimens are in similar institutions. The majority of empty specimens collected and retained after 1987 have age, sex, measurements, color, and condition information. Specimens locations were nearly equally divided between downstream (1689) and upstream (1554) of the Prairie du Chien City Dock, MRM 635.0. Only 112 were found alive downstream of the City Dock, while 356 were found alive upstream of the Dock. The higher number of living specimens upstream of the City Dock directly reflects more diving research efforts in that area, while more intense shoreline/shallow water collections occurred downstream of the Dock. This indicates shoreline collections can be an important indicator of endangered unionid populations.

Information was transferred to 3 aerial maps. The scale for two maps was 400 feet/inch, while the smaller map (Prairie du Chien inset) was 200 feet/inch. Each living L. higginsi was represented by color-coded dots for 5 collector categories: M. Havlik, WDNR and H. Mathiak, COE, FWS, and A. Clarke. Dots, listing sex (if known), collection year, and number etched on shell, were placed as close as possible to sites where living L. higginsi were found. L. higginsi records represented by empty shells were summarized, by year, and placed on the shore adjacent to the site, regardless of whether the specimen had been found on the shoreline or in the middle of the river. Dots summarize all empty shells collected per year, and the number of fresh-dead versus worn-dead. Thus '88 and 10/20, meant 10 fresh-dead and 20 worn-dead L. higginsi were collected in 1988 from a specific area, and '87, #151, M, meant a living male found in 1987 was marked 151 on valves before being returned to the river. Other color-coded shapes depict sites where damaged shell were found, 1976 dredge cuts and disposal areas, 1981 proposed dredge cuts, river miles, East Channel buoys, capacity of barge fleeting sites, and sites proposed for a new Prairie du Chien Harbor.

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EFFECTS OF A COMMERCIAL HARBOR ON A UNIONID MOLLUSK POPULATION AT PRAIRIE DU CHIEN, WISCONSIN, EAST CHANNEL, MISSISSIPPI RIVER

A unionid mollusk study in the Mississippi River, Mile 634.7 - 635.2, East Channel, near the City Dock, Prairie du Chien, WI, was conducted 19-22 October 1990, sponsored by the Midwest Sierra Club. Six 90 m transects, corresponding to 1987 USFWS transects, were established perpendicular to the east shore. A seventh transect was extended to 120 m to cross the barge channel. Unionids were sampled by SCUBA divers who collected two 0.25 m^2 quadrats every 15 m on each transect. In addition, one specimen was collected every meter on both sides of each transect line as qualitative samples. All live specimens were measured, visually inspected for damage, and aged twice by counting annular rings. Our study covered the same area as a portion of the 1987 USFWS study area, but we sampled more sites both quantitatively and qualitatively.

A total of 3,308 unionids representing 34 species were collected and identified. Maximum density of living unionids was 116/m2; mean density was 39.4/m2. The 1,240 living specimens comprised 28 species, including five Federally endangered Lampsilis higginsi (Lea, 1857). Twice as many (10) living L. higginsi were reported from the same area by the 1987 USFWS study. A 1980 WDNR study indicated L. higginsi was even more abundant then, since a single 1.5 m^2 quadrat contained 3 living L. higginsi, with 2 more found immediately outside the quadrat frame. In a 1980 1.5 m^2 quadrat near the City Dock, WDNR collected 102 living unionids; in 1990 we found only 4 in a similar quadrat. At one transect downstream of the City Dock, the 1987 study revealed 404 unionids. We found only 203 live unionids in the same area. No live specimens were found in 15.9% of the 94 quadrats sampled, mostly near the City Dock. Of the 73 females among the sexually-dimorphic species, 62 were gravid. Despite continuing commercial harvest of Amblema plicata (Say, 1817), this species increased in relative abundance from 52.9% in 1980 to 60.9% in 1990, though it declined in actual abundance. In 1990 14% of the A. plicata were of legal height (67 mm); 25% of the Magnonaias nervosa (Rafinesque, 1820) were over 89 mm, but none were over the legal height of 102 mm. Only 3.18% of the A. plicata were less than 35 mm long; those 24 ranged in age from 2 - 7 years. Not all individuals grew at the same rate; two A. plicata from the same quadrat, both 67 mm long, were 8 and 23 years old. Length data for A. plicata showed a typical bell curve, however age data showed a bimodal distribution with a decline in the 14 year age class; this birth year corresponded to the 1976 channel maintenance dredging. Regression analyses of age versus measurements of 754 A. plicata and 104 M. nervosa showed that length yielded a slightly higher R^2, 0.71 and 0.79 respectively, than height or width. This indicates length is a better indicator of age than is height or width. Some unionid shells had damage which might be attributable to barge traffic.

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Assessing the Fitness and Genetic Variability of Lake Erie Unionids Following Encrustation by Zebra Mussels (*Dreissena polymorpha*)

The spread of the zebra mussel throughout North America has caused concern about the effects of this exotic species on the region's unionid fauna. We proposed determining fitness (glycogen and lipid reserves, cellulase activity) and genetic structure of unionid populations that should be heavily encrusted with zebra mussels. This project is designed as a supplement to a larger project that will develop and assess biochemical tools for examining fitness and genetic structure of unionid populations before they are significantly harmed by zebra mussels. At the present time, we have found only a single live unionid (a small *Amblema plicata*)in surveys of two sites in the western basin of Lake Erie. These sites are located at Put-in-Bay, OH and Kelley's Island, OH. Both sites contained large numbers of unionids when surveyed in 1990, although most individuals were heavily encrusted with zebra mussels. Based on our recent surveys and work by others, it appears that the western basin unionid fauna is severely threatened and well on the way to extirpation. This project is funded by the Ohio Sea Grant Development Fund.

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Assessing the Health and Genetic Variability of Ohio River Basin Unionids Prior to Encrustation by Zebra Mussels (*Dreissena polymorpha*)

This project will develop and assess biochemical tools for examining health (glycogen and lipid content, cellulase activity) and genetic variability (allozyme electrophoresis) of mussel populations. Traditional approaches (primarily population surveys) cannot determine whether populations are stressed or vulnerable and likely to be stressed by anthropogenic factors. Work is being conducted at four sites in the basin utilizing *Amblema plicata* and *Quadrula pustulosa*. We will measure the health and genetic diversity of these populations, determine whether genetic diversity is correlated with health and evaluate the usefulness of genetic diversity as a means for assessing health of unionid populations. This project will provide baseline data on health and genetic variability of unionid populations before zebra mussel encrustations become heavy. This work is funded by the Mussel Mitigation Trust Fund.

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Population genetics of *Amblema plicata*

This study is designed to examine genetic diversity within and among populations of *Amblema plicata* using starch and cellulose acetate gel electrophoresis. We will determine genetic structure within populations while also comparing among populations. We will also be able to detect any geographic patterns in gene frequency and population structure that may exist in this relatively ubiquitous species. Initial results show little differentiation among populations from the Mississippi and Great Lakes drainages. A single population from the Sipsey River, Alabama (Gulf Coast drainage) shows considerable genetic distance from the Mississippi River and Great Lakes populations.

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Report: Using physiological measurements to establish water quality criteria for freshwater mussels

This project is being funded by the U.S. Fish and Wildlife Service to define the levels of dissolved oxygen (DO) at which freshwater mussels are unable to maintain normal physiological functions. These data will then be used to establish draft criteria for appropriate DO levels in streams and rivers with mussels. The approach is to measure the rate of aerobic respiration over an array of DO concentrations so that the critical DO can be defined for test species. This critical DO will be the level below which normal respiration ceases and anaerobic metabolism begins, with accumulation of harmful end products. Ph.D. candidate Li-yen Chen will be conducting this research for his dissertation.

Development of a diet for raising recently metamorphosed juvenile freshwater mussels. C. M. Gatenby (M.S.) , R. J. Neves, and B. P. Parker. Virginia Tech.

This project began in June of 1992 as a component of fish host and propagation studies of endangered freshwater mussels at Virginia Tech. As mentioned in the prior tri-annual report, the objectives are to determine the influence of silt on cultured juveniles, develop a diet for rearing newly metamorphosed juveniles, and compare growth and survival of juveniles produced from host fishes raised on various diets.

To date 16 different treatments from three separate experiments were tested in triplicate using *Villosa iris* (rainbow mussel) and *Pyganodon grandis* (giant floater). It appears that the major role of silt is to provide a substrate for colonizing food materials, however, silt does provide some nutritional qualities to the juvenile diet as indicated by growth and survivorship from a silt -only treatment. After 60 days, this silt only treatment showed poorer growth when compared to other treatments using silt plus tri-algal diets. Mean survivorship at 102 days for my most recent trial using *V. iris* is approximately 35%, with a mean length of 1190µm for the tri-algal diet with silt.

Survivors from the first two experiments have been maintained and their age/ length statistics are being monitored. I have maintained*V. iris* post metamorphosis for 272 days, with a mean length of 2968 µm and maximum length of 4520 µm. Only 10 individuals remain after 272 days. These 10 survivors are from 47 individuals that were subsampled at day 60 from static systems containing algae with silt and placed in downwellers with silt (plus a tri-algal diet). At day 179, these downweller survivors were placed in a new whirlpool system. I have maintained *P. grandis* for 201, days with a mean length of 4877µm and a maximum length of 7846µm. Approximately 135 individuals out of an initial population of 1400 individuals remain. These 135 survivors are derived from 4 different treatments, with each replicate within a treatment beginning with 200 juveniles. At day 137 the survivors from the four different treatments were placed in whirlpools and will continue to be monitored.

Margaret Mulvey and Charles Lydeard, University of Georgia, Savannah River Ecology Laboratory, P.O. Drawer E, Aiken, SC 29802 and George M. Davis, Academy of Natural Sciences of Philadelphia, 19th and The Parkway, Philadelphia, PA 19103

Our work began with surveys of the unionids of the DOE Savannah River Site. This work demonstrated that there are more species of *Elliptio* on the SRS than previously reported. Of particular interest was the previously described "Mill Creek *Elliptio*" which Britton and Fuller (1977) suggested might be a species of special concern in South Carolina. Our work indicates that there is a morphologically and genetically distinct species, *Elliptio hepatica*, found in the Upper Three Runs drainage (including Mill Creek). We have undertaken a survey of South Carolina to determine the status of species of *Elliptio* with special emphasis on *E. hepatica*.

These studies involve molecular genetics techniques (protein electrophoresis and DNA sequencing) as well as conchology, morphometrics and breeding conditions (marsupial conditions/glochidia). A National Environmental Research Park Publication on the status of the "Mill Creek *Elliptio*" has recently been submitted.

We are currently expanding these studies to examine evolutionary relationships within and among unionid species. This work will evaluate genetic differentiation (allozyme and DNA) at specific and generic levels and provide background data against which to assess differentiation for rare and endangered species.

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The following list describes major activities performed under the commercial musseling project conducted by the TWRA through August 1993.

Commercial Harvest Survey: On Kentucky Reservoir (Tennessee River), 75 musselers have been interviewed with a total catch of 13,843 mussels weighing 5329.59 pounds. The average individual weight of these mussels is 0.39 lbs. down from the 1992 individual average of 0.46 lbs. This decrease is due to an increase in the number of ebony shell (*Fusconaia ebena*) being bought by commercial shell dealers.

Population Surveys: Samples are being collected from sites on the Tennessee and Cumberland Rivers. So far, 2,843 mussels have been collected from 18 sites on the Tennessee River (29 species) and 4 sites on the Cumberland (11 species). Individual weight and size data are collected from mussels in these samples and will be analyzed along with age data at the end of the sampling year. Density is measured at selected sites by collecting at least 10 0.5 m^2 samples. Densities have ranged from 4 to 38.2 mussels per square meter. Endangered mussels encountered thus far: *Lampsilis abrupta* TRM 197.3, TRM 517.9, CRM 264.0 and *Cyprogenia stegaria* TRM 170.2.

Zebra Mussel: The zebra mussel has been collected by TWRA biologist in the Tennessee River at miles 101 (Benton County) and 197.3 (Hardin County). Both collections were of one individual adult. Commercial mussel divers have periodically reported sightings of zebra mussels in Kentucky Reservoir. These encounters normally involve 1 to 3 zebra mussel adults that have probably been dislodged from populations which exist on barges navigating the river. One musseler collected 15 zebra mussel adults at approximately mile 107 (Benton County) during a one week period.

Bruce S. Lieberman
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ENVIRONMENTAL CHANGE AND EVOLUTION IN FRESHWATER MOLLUSKS

My study will consider how climate change and the formation of new habitats effect species evolutionarily using the aquatic molluscan fauna of the Great Lakes and their tributaries. This fauna invaded the Great Lakes from southern refugia after the retreat of the ice sheets about 12,500 b.p. Phylogenetic analysis of DNA sequences will be used to deduce the evolutionary relationships of populations of species of gastropods and unionid bivalves from several different habitats and geographic locales. In conjunction, morphometrics will be used to discern the relationship between morphological change, ecophenotypic effects and evolutionary change in species.

To study these effects on a shorter time scale I will analyze populations from the Erie Canal, which was opened in 1825 and subsequently invaded by organisms.

Changes at the end of the Pleistocene profoundly altered the distribution of the freshwater molluscan fauna of North America. Major environmental events have been hypothesized to play an important role in either mediating the stability of species or directing their change, and this study will test this. Studying how species responded to profound environmental changes in the past will also help us predict their response to the equally profound changes in the environment wrought by humans.

This work is being funded by an NSF grant and I will be working with Elisabeth Vrba at Yale University as a postdoctoral fellow. The unionid taxa I will be concentrating on are Amblema plicata (Rafinesque, 1820) and Lasmigona costata (Rafinesque, 1820) and the prosobranch gastropod is the pleurocerid Elimia livescens (Menke, 1830). I would like to sample localities of each of these species from throughout their range in the Ohio-Missippi River Drainage System and in the Erie Canal, and I hope to do a substantial amount of collecting in the upcoming year. Thus far Lasmigona costata has been collected along with about five other unionid species from Ulster County, New York. In addition, species of Lampsilis and Elliptio have been recovered from the Finger Lakes.

I would be very appreciative if any scientists in the course of their collecting might be able to collect specimens of these taxa from any localities and freeze them, if they happen to come across any. In addition, I would be glad to pick up specimens of any taxa that anyone else is interested in during the course of my collecting. Moreover, if anyone knows of any particularly rich localities for these taxa I would be grateful if they could let me know.

In vitro culture of *Lemiox rimosus* at the Aquatic Resources Center

Jeffrey T. Garner and Tiffany Pingston
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In the first Triannual Unionid Report we submitted the preliminary results of our work toward the development of an artificial diet suitable for the maintenance and growth of juvenile unionids. Juveniles for these experiments are produced with *in vitro* techniques developed at the Tennessee Valley Authority during the early 1980's. We have since received federal and state permission to culture the endangered Birdwing Pearly Mussel, *Lemiox rimosus*. Glochidia were obtained from adult *L. rimosus* from the site below Lillard Mill on the Duck River, Marshall Co., Tennessee (DRM 179).

Glochidia were removed without sacrificing the adult by flushing sterile unionid ringers solution through the marsupia with a syringe. The glochidia were collected in a beaker of sterile unionid ringers solution. This method of removal proved to be much more efficient than sacrificing the adult. The process produces fewer fragments of gill tissue in the glochidial suspension, making it easier to remove contaminants. Thus, we now use this method for all cultures and have fewer problems with contamination.

Transformation was achieved on the first attempt at culturing *L. rimosus*. However, the success of the culture was difficult to evaluate because transformation occurred over an extended period. The first signs of transformation (ciliated structures) were seen on the 25th day after the culture was initiated, but only in a few individuals. It was not until day 28 that individuals with a fully developed, ciliated foot were observed. However, many individuals in the culture did not show signs of being fully transformed (ciliated foot extended from the shell valves). The glochidia/juveniles were left in culture medium until day 36. By that date, many of the juveniles were dead. The mortality was presumably in those individuals which were the first to transform, as we have found in the past that leaving juveniles in culture medium for an extended period after transformation can cause mortality.

The juveniles were transferred to a water circulation system on day 36 and given an artificial diet composed of dissolved nutrients. All juveniles were dead after 3 days in the circulation system.

The deviation in transformation rates that were observed in the *L. rimosus* culture have not been seen in cultures of other species. The glochidia for the culture were removed from two adult *L. rimosus* and combined. This could be a factor in the observed deviation. The short period of time in which the juveniles survived on artificial diet in the circulation system also differs from past results with other species. Juveniles typically live much longer in the system. We suspect that the juveniles were possibly stressed from their extended incubation period. These problems will be addressed in future cultures. The second *L. rimosus* culture is in incubation as of the writing of this report.

In addition to the work with *L. rimosus*, ARC staff also successfully cultured *Cyclonaias tuberculata* to the juvenile stage using *in vitro* techniques.

We anticipate the culture program at ARC to cease when the current cultures are finished. Termination of the program is due to lack of funding. Funds to continue the program are being sought from a number of agencies, though no encouraging results have come from our efforts as of the writing of this report.

Malacology Section
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25 August 1993

Dr. Richard C. Biggins
U.S. Fish and Wildlife Service
Asheville Field Office
330 Ridgefield Court
Asheville, NC 28806

Dear Dr. Biggins:

We have received your request for a submission for the September unionid report.

I trust you received my mailing that reported Clif Coney's death on 22 May of this year. I will be preparing an obituary that will list his publications.

You can report that his paper on anesthetization and fixation in unionids is being published in October in the Veliger. I enclose a copy of the first page of the proof, which gives the complete reference. Reprints will be available from me. Perhaps your mailing list would be the way to distribute them? If that would be possible please let me know. 100 copies have been ordered.

Perhaps you will hear separately from Paul Hartfield or Art Bogan regarding efforts to salvage some of Clif's work in progress.

We no longer have any fresh water bivalve expertise on our museum staff, but Clif left the collection in good shape and it is available for study or loan.

Sincerely yours,

James H. McLean
Curator of Mollusks

The Veliger 36(4) 00-00 (October 1, 1993)

THE VELIGER

An Empirical Evaluation of Various Techniques for Anesthetization and Tissue Fixation of Freshwater Unionoida (Mollusca: Bivalvia), with a Brief History of Experimentation in Molluscan Anesthetization

by

C. CLIFTON CONEY[1]

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Abstract. The successful anesthetization and fixation of freshwater bivalves is necessary for study of their anatomy and fine structure. This need is further underscored by the possible elimination of many of the indigenous North American unionacean fauna by the introduced zebra mussel *Dreissena polymorpha* (Pallas, 1771). A number of techniques are empirically tested. The results of some of the various methodologies are compared using scanning electron microscopy. Optimal methods are suggested, with an additional primary treatment recommended for those genera that are difficult to anesthetize successfully. The literature on molluscan anesthetization methodology, exclusive of Cephalopoda, is reviewed.

INTRODUCTION

The preservation of the soft anatomy of mollusks is essential to taxonomists for correct systematic placement of the more problematic molluscan taxa. This is especially true in non-marine mollusks in which convergence of shell morphologies is exhibited in a number of rapidly evolving genera of the freshwater bivalve families Unionidae and Mycetopodidae. The need for careful preservation methodology of soft anatomy has been documented for the preservation of land snails by EMBERTON (1989) and is further accentuated by the work of DAVIS *et al.* (1981), who demonstrated convergence in shell morphologies among genetically distinct species of the bivalve genus *Elliptio*.

Students of the comparative anatomy of freshwater bivalve unionid mollusks should anesthetize specimens to relax the tissues to their natural appearance, and follow up by proper tissue fixation with buffered glutaraldehyde in order to preserve lifelike anatomical specimens of freshwater bivalves. The techniques of anesthetization and tissue fixation recommended here are highly useful in the lifelike preservation of unionid bivalves for use in anatomical investigations of both gross comparative anatomy and for the exploration and documentation of microanatomy via scanning electron microscopy. Further tissue fixation using osmium tetroxide is required should anatomical analysis via transmission electron microscopy be desired. However, these techniques are not appropriate for molecular genetics studies requiring mitochondrial DNA extraction.

There is some degree of urgency in adopting effective techniques. Since its introduction into the lower Great Lakes in 1985, the zebra mussel *Dreissena polymorpha* (Pallas, 1771) has spread rapidly and has been predicted to invade nearly all of the freshwater systems of North America (STRAYER, 1991). HUNTER & BAILEY (1992) predicted that the effect of the zebra mussel upon freshwater unionids may possibly result in the virtual elimination of the indigenous North American unionid fauna.

The history of experimentation with the anesthetization of various molluscan taxa, exclusive of the Cephalapoda,

[1] Published posthumously. Proofs read by Dr. James H. McLean.

MEETINGS

1993 Meeting of the Society of Environmental Toxicology and Chemistry (SETAC) in Houston

For those attending the meeting who are interested in mussels: Stop by Anne Keller's poster on Tuesday a.m., November 16, 1993 to plan a dinner/discussion for mussel-heads.1994 NABS Special Sessions

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1994 NABS Special Sessions

Sediment Toxicity and Benthic Organisms-Anne Keller, moderator

Anthropogenic contaminants accumulated in aquatic sediments can adversely affect fauna long after the overlying water becomes non-toxic. Since sediment infauna, benthic feeders, and benthic spawners (e.g. unionid mussels, fish, insects) are usually the most impacted groups, this special session will feature field and laboratory studies documenting the responses of such groups to contaminated sediments. Anyone interested in presenting a paper in the session should contact Anne Keller at the U. S. Fish and Wildlife Service, National Fisheries Research Center in Gainesville, FL (904) 378-8181.

Status of Native Freshwater Mussels of North America-Ricardo Lattimore, moderator

This session will begin with an overview paper on the current conservation status of freshwater mussels in North America. Other topics will include the conservation status of endangered and threatened unionids, as well as the habitat requirements, life history, reproductive biology, and regional (drainage/watershed) distribution of freshwater mussels. Anyone interested in presenting a paper in the session should contact Jayne Brim-Box at the U.S. Fish and Wildlife Service, National Fisheries Research Center in Gainesville, FL (904) 378-8181.

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The following list of unpublished Unionid survey reports dealing with Indiana's East Fork White River tributaries are available upon request. These surveys have been funded by the Indiana Department of Natural Resource's Nongame and Endangered Wildlife Program.

Harmon, J.L. 1990. Survey of the Freshwater Mussels (Bivalvia: Unionidae) of Sugar Creek, East Fork White River Drainage, in Central Indiana. Final report prepared for the Indiana Department of Natural Resources, Division of Fish & Wildlife. iv + 68pp.

Harmon, J.L. 1991. Survey of the Freshwater Mussels (Bivalvia: Unionidae) of Brandywine Creek. Final report prepared for the Indiana Department of Natural Resources, Division of Fish & Wildlife. iv + 53pp.

Harmon, J.L. 1992. Survey of the Freshwater Mussels (Bivalvia: Unionidae) of Big Creek and Quantitative Evaluation of State Listed Mussel Species in Big and Graham Creeks. Final report prepared for the Indiana Department of Natural Resources, Division of Fish & Wildlife. iv + 53pp.

Harmon, J.L. 1992. Survey of the Freshwater Mussels (Bivalvia: Unionidae) of the Vernon Fork of the Muscatatuck River with Emphasis on the Impact Area of Proposed Structure 42, a Water Supply Reservoir. Final report prepared for the Indiana Department of Natural Resources, Division of Fish & Wildlife. iv + 44pp.

Dr. G. Thomas Watters

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We will begin setting up a laboratory in the near future to investigate the host-parasite relationships of *Pleurobema clava* and *Epioblasma torulosa rangiana*, as well as other rare Ohio species. Work will start next spring. Experiments also have begun on relocating mussels. Of particular interest is determining the survivorship of various species under closely monitored conditions.

The importance of mussels as monitors of stream health has only recently begun to be appreciated. Indices using mussels along the line of fish IBI hold great potential. One hurdle that must be overcome before such a metric can be devised is a standardized method of collecting. We have developed a computer model to address this problem. Field tests of the model in the past month have been conducted in the Big Darby Creek system. Results have been encouraging, and tests will be expanded to include other drainages. Along similar lines, we are investigating the impact of dams on the distribution of mussels and their hosts through computer simulations.

We have begun an ambitious project using the Big Darby Creek system as a base. Distributional data for mussels and fishes, as well as physiographic and water quality data, are being analyzed. We hope to get an idea of the factors involved in the changes in unionid populations on a system-wide basis. Only this system has sufficient data for such a study. This type of project has not been attempted before now.

Respondents to the Freshwater Mussel Reproduction and Propagation Questionnaire have been sent a compilation of responses. We hope they are of use to workers in that field. The annotated bibliography is being considered for publication by the Ohio Biological Survey, and should be available early next year. Respondents will receive their copy at that time. If you can't wait, contact me for a draft copy.

Publications:

Watters, G. T. 1986. A survey of the unionid molluscs of the Big Darby Creek System in Ohio. *Final Report to The Nature Conservancy.* 149 pp.

Watters, G. T. 1988a. The naiad fauna of selected streams in Ohio. I. Stillwater River of Miami River. II. Stream systems of south central Ohio from the Little Miami River to the Hocking River, excluding the Scioto River proper. *Final Report to the Division of Wildlife, Ohio Department of Natural Resources.* 440 pp.

Watters, G. T. 1988b. A survey of the freshwater mussels of the St. Joseph River system, with emphasis on the federally endangered White Cat's Paw Pearly Mussel. *Final Report to the Division of Fish and Wildlife, Indiana Department of Natural Resources.* 127 pp.

Watters, G. T. 1990. 1990 Survey of the unionids of the Big Darby Creek system. *Final Report to The Nature Conservancy.* 229 pp.

Watters, G. T. (compiler) 1993. *Responses to the Freshwater Mussel Reproduction and Propagation Survey.* Division of Wildlife, Ohio Department of Natural Resources, Columbus, OH. 40 pp.

Watters, G. T. (in press) Some aspects of the functional morphology of the shell of infaunal bivalves. *Malacologia.*

Watters, G. T. (in press) The unionid fauna of the Big Darby Creek system in Ohio. *Malacological Review.*

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Appeal for assistance with tissue samples from endangered unionids.

We need assistance in salvaging tissue samples from endangered unionid species in the eastern United States. These tissue samples will be used in mitochondrial DNA sequencing to determine the phylogenetic relationships of these species and their relationships with other taxa in the same genus. This information will be useful in further conservation efforts. We ask that while conducting surveys, you look for shells of endangered species with tissue remaining in them in muskrat middens. We are not asking for the sacrifice of any live animals but the salvaging of tissue samples from dead specimens. Dead specimens found in muskrat middens containing adductor muscle, mantle tissue or bodies are important. The method of preservation is to put the whole animal, shell and all into 100% ethanol or as close as possible to 100% and let it stand for several hours and then pour off the used alcohol and replace with fresh ethanol. DO NO USE FORMALIN! Please notify either of us and we will contact the appropriate state agency for a state permit to salvage dead specimens. Thank you for your assistance.

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Freshwater bivalves of the Monongahela River Basin and direct tributaries to the Ohio River in Pennsylvania

The unionid fauna of the Monongahela River Basin is known almost solely from the records reported by Ortmann (1919). Thirty-four species of unionids were known historically from the Monongahela River Basin in Pennsylvania and seven species were known from four creek basins tributary to the Ohio River in southwestern Pennsylvania. The total unionid fauna reported from the Monongahela River Basin in Pennsylvania, based on all available information including the archaeological record, totaled 40 native species and 3 recently introduced species.

These two areas were surveyed for the U.S. Fish and Wildlife Service during July, 1993, to record the unionid fauna and determine if any of the five federally listed endangered unionid species, *Cyprogenia stegaria*, *Epioblasma torulosa rangiana*, *Hemistena lata*, *Lampsilis abrupta* and *Pleurobema clava* reported from the Monongahela River Basin and *Pleurobema clava* reported from Raccoon Creek, still occurred there. Ninety-six collecting sites were examined in the Monongahela River Basin and 37 sites were examined in the 8 drainage basins which are direct tributaries to the Ohio River in Southwestern Pennsylvania.

Many of the streams surveyed were heavily impacted by acid mine drainage. The bright point of this survey was the unionid species diversity found in Dunkard Creek. This creek straddles the Pennsylvania/West Virginia border. There were 20 species identified as having been present in the basin, of the 16 species reported by this survey, 12 species were found alive. This stream has the second most diverse unionid fauna found in any of the tributaries in the upper Ohio River Basin in western Pennsylvania.

Five species were collected in the Monongahela River Basin which are of interest. Tanner (1970) reported *Lasmigona compressa* for the first time from the Monongahela River Basin in the Tenmile Creek Basin and this record was confirmed during this survey. *Simpsonaias ambigua* has not been found in Pennsylvania but was reported by Zeto (1982) from Dunkard Creek and it was again collected in the West Virginia portion of the Creek during this survey. It should also occur in the Pennsylvania portion of this creek. *Tritogonia verrucosa* was not found in the recent survey of the Allegheny River Basin but occurred in Dunkard Creek. *Fusconia flava* was found only once in the Allegheny River Basin and was found in two of the creeks tributary to the Monongahela River and dead shells were found in Buffalo Creek, a direct tributary to the Ohio River. *Utterbackia imbecillis* was listed by Ortmann (1919) as occurring in Lake Erie and Allegheny River drainages and a single specimen is reported here from Dunkard Creek.

Eight stream basins tributary to the Ohio River in southwestern Pennsylvania were examined during this survey. Only four had unionids reported from them in the historic literature. Three of the eight basins examined had a unionid fauna. Two species collected in the Buffalo Creek Basin are new distribution records: *Lasmigona complanata* was listed by Ortmann (1919) only from the French Creek Basin in the Allegheny River Basin in western Pennsylvania; *Utterbackia imbecillis* was listed by Ortmann (1919) as occurring in Lake Erie (Presque Isle), Conneauttee Lake (Lake Erie Drainage) and Lebeouf Creek (Allegheny River Drainage). Ten unionid species are reported from these basins.

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I am currently conducting status surveys on three of the seven endemic species of mussels in the Altamaha River. The three species are Elliptio spinosa (Lea, 1836), Elliptio shepardiana (Lea, 1834) and Alasmidonta arcula (Lea, 1838). Georgia has been in drought conditions all summer. The low water conditions have been ideal for these surveys. The mussel populations in the upper Altamaha River and lower Ocmulgee River appear to be in excellent condition with a few exceptions. Mussel population in the Little Ocmulgee River and Ohoopee River are still good, but have declined since I last observed them in the late 1970's and early 1980's. construction, lumbering and increased recreational use probably are some of the causes. Logging up to the stream banks has certainly deteriorated some of the prime mussel habitat in the Little Ocmulgee River near Towns.

The preliminary results of the surveys indicate that E. shepardiana is quite common in many substrates and A. arcula is not uncommon if you select the right habitat. Elliptio spinosa is not common in any of the places surveyed. Only 18 living specimens have been found out of over 8,500 living mussels observed. In comparison, E. shepardiana comprises almost 13% and A. arcula 1.3% of the living mussels observed.

Only one specimen of Toxolasma pullus (Conrad, 1838) has been found in the Ohoopee River. The population in the Ohoopee River has declined drastically in the last 10 years. I have found only three new populations of Toxolasma pullus out of over one thousand sites sampled in Georgia, South Carolina and North Carolina.

Food for thought - I have found two specimens of what appears to be Elliptio arctata (Conrad, 1834) from the Altamaha River. One specimen was fresh dead with dried up adductor muscle. The number of Elliptio species in the Altamaha River system probably exceeds 12 since the headwaters fauna is different from the larger rivers, and the headwaters of the Ohoopee River are different from those in the Little Ocmulgee River.

Evaluation of the Mussel Fishery in Wheeler Reservoir, Tennessee River

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ABSTRACT: We evaluated the freshwater mussel fishery on Wheeler Reservoir, a 27,155 hectare mainstream impoundment of the Tennessee River in Alabama. During July 1991 through June 1992 we conducted a roving creel survey. We conducted 285 interviews over 57 weekdays and 12 weekend days and estimated total harvest during the 12-month survey period to be 570 metric tons, including 15 species. The most frequently harvested species were the washboard, Megalonaias nervosa, Ohio pigtoe, Pleurobema cordatum, and butterfly, Ellipsaria lineolata. Harvest peaked in June at 290,414 mussels. Among collection techniques, total estimated effort was highest for divers (71,160 musseler-hours). The total estimated value of the 12-month mussel harvest (in terms of money paid to harvesters) from Wheeler Reservoir was US$2,119,921. We estimated musseler expenditures for gas, food, and lodging during the 12-month period to be $312,568; expenditure per hour of fishing effort averaged $2.59.

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A Survey of the Sipsey River, Alabama for Quadrula stapes (Lea, 1831) and Pleurobema taitianum (Lea, 1934)

The primary purpose of this study was to determine the current status and distribution of Quadrula stapes (stirrupshell) and Pleurobema taitianum (heavy pigtoe) in the Sipsey River system of Alabama. A secondary objective was to evaluate the present status of the freshwater mussel fauna in the Sipsey River main channel. The Sipsey is an unimpounded major tributary to the upper Tombigbee River and flows through Fayette, Tuscaloosa, Greene and Pickens counties in west-central Alabama.

The bad news is that no Quadrula stapes were found during the survey and a single weathered dead Pleurobema taitianum was observed. The good news is that the Sipsey is supporting a diverse Mobile basin unionid fauna. A total of 31 species of freshwater mussels was collected during this study.

This survey was funded by the U. S. Fish and Wildlife Service Endangered Species Office in Jackson, Mississippi.

A Survey of the Mussel Fauna in the Talladega National Forest, Alabama

Thirty-two localities were searched for evidence of freshwater mussels (June - October 1992). Collection sites were within or adjacent to U. S. Forest Service lands in the Shoal Creek and Talladega Ranger Districts of the Talladega National Forest. All streams sampled were located in the Coosa River system of the Mobile River basin in portions of Clay, Talladega, Calhoun and Cleburne counties in eastern Alabama.

Nine species of freshwater mussels were collected including the threatened fine-lined pocketbook (Lampsilis altilis) and the endangered southern pigtoe (Pleurobema georgianum). Another record worthy of note was the collection of 87 specimens (most released) of the Tennessee heelspitter (Lasmigona holstonia) at two sites (Shoal and Terrapin Creeks). The Tennessee heelspitter is usually considered uncommon in the Coosa River system of Alabama.

This study was funded by the U. S. Department of Agriculture, Forest Service, Montgomery, Alabama.

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The following two projects were either initiated or provided additional funds during the last four months.

1. We have increased the funding level for the long-term mussel holding project at the Virginia Cooperative Fish and Wildlife Research Unit. The aim of this project is to develop the technology to hold mussels for use in artificial propagation and use holding technology to preserve stocks of mussels threatened by zebra mussel infestations.

2. We initiated a mussel oxygen project to examine the oxygen needs of mussels. This project is being conducted by the Virginia Cooperative Fish and Wildlife Research Unit (See report by Neves in this newsletter). We recently secured an additional $17K for this project from our Region 5 office. If more funds become available, we will expand the project to look at the oxygen requirements of a variety of species and then focus on other parameters.

The Appalachian elktoe (Alasmidonta raveneliana) was officially proposed for Federal listing as endangered on September 3, 1993. This species was once fairly widely distributed throughout the upper Tennessee River basin in western North Carolina and eastern Tennessee. Presently, the species is known to be surviving in only two locations--one population in the Little Tennessee River in Swain and Macon Counties, North Carolina and another in the Nolichucky River, Yancey and Mitchell Counties, North Carolina and Unicoi County, Tennessee that extends a short distance up the North Toe River in Yancey and Mitchell Counties, North Carolina and the Cane River in Yancey County, North Carolina.

A final rule officially designating the Carolina heelsplitter (Lasmigona decorata) as endangered was published on June 30, 1993. The Carolina heelsplitter is presently known to be surviving in only four streams--Waxhaw Creek (Catawba River system) Union County, North Carolina; Goose Creek (Pee Dee River system), Union County, North Carolina; Lynches River (Pee Dee River system), Chesterfield, Lancaster and Kershaw Counties, South Carolina; and Flat Creek (Pee Dee River system) a tributary to the Lynches River in Lancaster County, South Carolina.

New (1993) records for federally listed and candidate mussels in NC & SC

Tar Spinymussel (Elliptio stienstansana) - Endangered

Little Fishing Creek (Tar River system), Halifax County, NC. (Found by John Alderman and Christopher McGrath, North Carolina Wildlife Resources Commission [NCWRC], 1993.)

Shocco Creek (Tar River system), Warren and Franklin Counties, NC. (Found by Alderman and McGrath, NCWRC; and John Fridell, FWS, 1993.)

Dwarf Wedge Mussel (Alasmidonta heterodon) - Endangered

Shelton Creek (Tar River system), Franklin County, NC.
(Found by Alderman and McGrath, NCWRC, 1993.)

Shocco Creek (Tar River system), Warren and Franklin County line, NC.
(Found by Alderman and McGrath, NCWRC; and Fridell, FWS, 1993.)

Fox Creek (Tar River system), Franklin County, NC.
(Found by CZR, Inc., Environmental Consultants, 1993.)

Ruin Creek (Tar River system), Henderson County, NC.
(Found by CZR, Inc., 1993.)

Rocky Swamp Creek (Tar River system), Halifax County, NC.
(Found by CZR, Inc., 1993.)

Atlantic Pigtoe (Fusconaia masoni) - Category 2 Candidate

Little Fishing Creek (Tar River system), Halifax County, NC.
(Found by Alderman and McGrath, NCWRC, 1993.)

Shocco Creek (Tar River system), Warren and Franklin County line, NC.
(Found by Alderman and McGrath, NCWRC; and Fridell, FWS, 1993.)

Caraway Creek (Uwharrie River system), Randolph County, NC.
(Found by Alderman and McGrath, NCWRC, 1993.)

Savannah Lilliput Pearly Mussel (Toxolasma pullus) - Category 2 Candidate

Little River (Neuse River system), Montgomery County, NC.
(Found by Alderman and McGrath, NCWRC; and Fridell, FWS, 1993.)

Yellow Lance Mussel (Elliptio lanceolata) - Category 2 Candidate

Shocco Creek (Tar River system), Warren and Franklin Counties, NC.
(Found by Alderman and McGrath, NCWRC; and Fridell, FWS, 1993.)

Fishing Creek (Tar River system), Warren County, NC.
(Found by Tim Savage, NC Dept. of Transportation, 1993.)

Brook Floater (Alasmidonta varicosa) - Category 2 Candidate

Rocky Creek (Little River system), Montgomery County, NC.
(Found by Alderman and McGrath, NCWRC, 1993.)

Caraway Creek (Uwharrie River system), Randolph County, NC.
(Found by Alderman and McGrath, NCWRC, 1993.)

Rediscovered in Steven's Creek basin (Savannah River system),
Edgefield County, SC.
(Alderman and McGrath, NCWRC; and Fridell, FWS, 1993.)