A Review of the Fishes and Freshwater Mussels of the Tippecanoe River Basin in Indiana, with Comments on Freshwater Mussel Life History

Jeremy S.Tiemann and Bernadette L. Tiemann

(JST) Illinois Natural History Survey, 607 E. Peabody Dr., Champaign, IL 61820, jtiemann@inhs.uiuc.edu
(BLT) First School, 1403 E. Oak St., Mahomet, IL 61853

On 30 April - 2 May 2004, several NANFA members with family and friends participated in a field trip to the Tippecanoe River basin, Indiana. The weather was cool (high ~50°F and low ~35°F) with rain throughout the weekend. People started trickling in Friday afternoon, ready for a weekend of collecting. We sampled three sites on Saturday in Pulaski County and one site on Sunday in Fulton County. Saturday morning, we collected 28 species, including the state-endangered gilt darter (*Percina evides*) with its radiant red and blue colors, at a site three miles south of Winamac at the canoe access point beneath the US Hwy 35 Bridge (Fig. 1, near Dot 15).[1] Some local kids came down to the river to watch what we were doing and were amazed at the diversity of fishes in their own backyard. At Saturday's second site in Pulaski at the canoe access point (Fig. 1, near Dot 18), we collected 14 species, including the state-endangered bluebreast (*Etheostoma camurum*), Tippecanoe (*E. tippecanoe*), and gilt darters in their vibrant reddish-orange and bluish-green colors. Although we didn't sample for freshwater mussels, we found two live giant floaters (*Pyganodon grandis*) in a raccoon midden. It also was at this site where Todd Crail believed he found the state-endangered spotted darter (*E. maculatum*) on Friday during a reconnaissance outing.

Several people departed for home later that afternoon, either due to time constraints, wet waders, a lack of spare dry clothes, or colder weather moving in. Those that remained collected 17 species Saturday evening five miles north of Winamac at the Canoe Camp access in the Tippecanoe River State Park (Fig. 1, near Dot 14; Fig. 2). Still more people left Saturday night, but those that spent the night collected 17 species in Rochester at Mill Creek (Fig. 1, near Dot 8) on Sunday morning.

All told, we collected 50 fish species that weekend using two eight-foot seines and two dipnets (Table 1). As Todd Crail said, "In good weather with a motivated crew, 60-plus species over a weekend is completely obtainable, which is just incredible for the Midwest and eight-foot seines! Imagine if we could get into other habitats with other gear."

And that's exactly what some of us did. On 11 May 2004, the senior author, along with several other NANFA members, attended an Indiana Chapter of the American Fisheries Society (IN-AFS) darter workshop, where the field trip portion was at the Tippecanoe River five miles west of Delphi at the IN Rte. 18 bridge in Carroll County. We used two backpack shockers for one hour each in all available habitats, collecting 27 species, including four we did not collect during our earlier NANFA trip (Table 1).

The Tippecanoe River and Some of its Aquatic Fauna

The Tippecanoe River has been described as "an outstanding Midwestern stream" that is "a valuable aquatic resource" (Carney et al., 1993). It contains one of the richest aquatic assemblages in the upper Midwest. The Tippecanoe River

[1] During a 1986 NANFA outing led by Lawrence M. Page, 63 species were caught at this site using only seines.

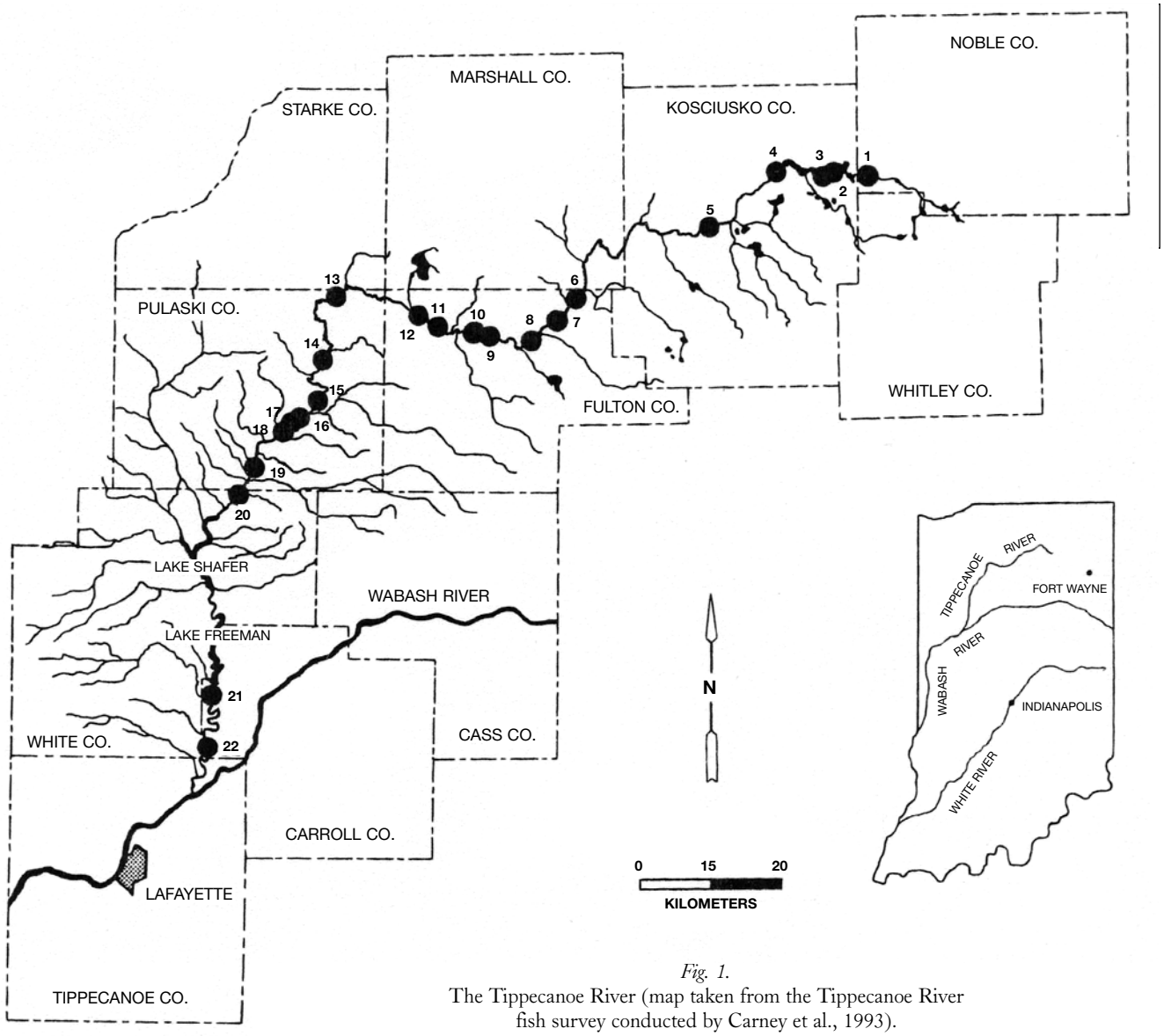

Fig. 1.
The Tippecanoe River (map taken from the Tippecanoe River fish survey conducted by Carney et al., 1993).

basin is approximately 4,900 km^2 located in northern and west-central Indiana (Fig. 1), and occurs within the Northern Lakes Natural Region, the Kankakee Sands Section of the Grand Prairie Natural Regions, and the Tipton Till Plain Section of the Central Till Plain Natural Region. Several glacial lakes and wetlands exist in the upper portions of the basin. The headwaters originate in Nobel and Whitley counties, and the river flows west-southwest for nearly 110 km before emptying into the Wabash River just northeast of Lafayette in Tippecanoe County. The river's banks are mostly wooded despite the fact that most of the tributary streams have been channelized for agricultural drainage. Two reservoirs (Lake Shafer and Lake Freeman) have been constructed on the lower portions of the river, and residential and recreational development is common throughout the basin. The substrates in the basin include primarily clean sand and gravel/pebble with some cobble and boulders present in various reaches and moderate silt deposits near stream margins.

The Tippecanoe River basin has highly diverse fish and freshwater mussel assemblages despite the fact that the basin has experienced drastic changes, including expanding urban populations, intensive farming practices, and construction of the two reservoirs (Carney et al., 1993). At least 92 fish species, including six state-listed species, are known from the basin (Table 1). Also known from the basin are at least 52 freshwater mussel species, with 18 being listed at the federal and/or state level (Table 2). Several of these fish and freshwater mussel species are rare or declining throughout their historic

Table 1. Some of the historic fishes of the Tippecanoe River basin, Indiana (data from Carney et al., 1993; Fisher et al., 1998; and the Illinois Natural History Survey Fish Collection, Champaign). Species collected at the NANFA field trip are marked with an "x" while those collected at the IN-AFS darter workshop are marked with an asterisk (*). EXT = globally extinct. SE = Indiana state-endangered. SSC = Indiana state-special concern.

FAMILY	SCIENTIFIC NAME	COMMON NAME	COLLECTED BY NANFA/IN-AFS
Petromyzontidae	*Ichthyomyzon bdellium*	Ohio lamprey	
	Ichthyomyzon unicuspis	silver lamprey	
	Lampetra appendix	American brook lamprey	
Lepisosteidae	*Lepisosteus oculatus*	spotted gar	
	Lepisosteus osseus	longnose gar	
Clupeidae	*Dorosoma cepedianum*	gizzard shad	
	Dorosoma petenense	threadfin shad	
Hiodontidae	*Hiodon tergisus*	mooneye	
Cyprinidae	*Campostoma anomalum*	central stoneroller	x
	Cyprinella spiloptera	spotfin shiner	x *
	Cyprinella whipplei	steelcolor shiner	x *
	Ericymba buccata	silverjaw minnow	x
	Erimystax dissimilis	streamline chub	x *
	Erimystax x-punctata	gravel chub	
	Hybopsis amblops	bigeye chub	x *
	Luxilus chrysocephalus	striped shiner	x
	Macrhybopsis aestivalis	speckled chub	*
	Macrhybopsis storeriana	silver chub	
	Nocomis biguttatus	hornyhead chub	x *
	Nocomis micropogon	river chub	x *
	Notemigonus crysoleucas	golden shiner	x
	Notropis atherinoides	emerald shiner	x
	Notropis blennius	river shiner	
	Notropis buchanani	ghost shiner	
	Notropis rubellus	rosyface shiner	x *
	Notropis stramineus	sand shiner	x *
	Notropis volucellus	mimic shiner	x
	Phenacobius mirabilis	suckermouth minnow	
	Pimephales notatus	bluntnose minnow	x *
	Pimephales vigilax	bullhead minnow	
	Rhinichthys atratulus	blacknose dace	x
	Semotilus atromaculatus	creek chub	x *
Catostomidae	*Carpiodes carpio*	river carpsucker	
	Carpiodes cyprinus	quillback	
	Catostomus commersonii	white sucker	
	Erimyzon oblongus	creek chubsucker	
	Erimyzon sucetta	lake chubsucker	
	Hypentelium nigricans	northern hogsucker	x *
	Ictiobus bubalus	smallmouth buffalo	
	Minytrema melanops	spotted sucker	x
	Moxostoma anisurum	silver redhorse	
	Moxostoma duquesnei	black redhorse	*
	Moxostoma erythrurum	golden redhorse	
	Moxostoma lacerum	harelip sucker EXT	
	Moxostoma macrolepidotum	shorthead redhorse	*
Ictaluridae	*Ameiurus natalis*	yellow bullhead	x
	Ictalurus punctatus	channel catfish	
	Noturus eleutherus	mountain madtom	*
	Noturus flavus	stonecat	x *
	Noturus gyrinus	tadpole madtom	x
	Noturus miurus	brindled madtom	x
	Pylodictis olivaris	flathead catfish	
Esocidae	*Esox americanus*	grass pickerel	

Table 1. Continued.

FAMILY	SCIENTIFIC NAME	COMMON NAME	COLLECTED BY NANFA/IN-AFS
Umbridae	*Umbra limi*	central mudminnow	x
Aphredoderidae	*Aphredoderus sayanus*	pirate perch	x
Fundulidae	*Fundulus dispar*	starhead topminnow	x
	Fundulus notatus	blackstripe topminnow	x
Atherinidae	*Labidesthes sicculus*	brook silverside	x
Cottidae	*Cottus bairdii*	mottled sculpin	x *
Moronidae	*Morone chrysops*	white bass	
Centrarchidae	*Ambloplites rupestris*	rock bass	x *
	Lepomis cyanellus	green sunfish	x *
	Lepomis gibbosus	pumpkinseed	x
	Lepomis gulosus	warmouth	x
	Lepomis humilis	orangespotted sunfish	x
	Lepomis macrochirus	bluegill	x *
	Lepomis megalotis	longear sunfish	x *
	Micropterus dolomieu	smallmouth bass	x *
	Micropterus punctulatus	spotted bass	
	Micropterus salmoides	largemouth bass	x
	Pomoxis nigromaculatus	black crappie	
Percidae	*Ammocrypta pellucida*	eastern sand darter SSC	x
	Etheostoma blennioides	greenside darter	x *
	Etheostoma caeruleum	rainbow darter	x *
	Etheostoma camurum	bluebreast darter SE	x *
	Etheostoma exile	Iowa darter	
	Etheostoma flabellare	fantail darter	x
	Etheostoma maculatum	spotted darter SE	x
	Etheostoma microperca	least darter	
	Etheostoma nigrum	johnny darter	x
	Etheostoma spectabile	orangethroat darter	x
	Etheostoma tippecanoe	Tippecanoe darter SE	x *
	Perca flavescens	yellow perch	
	Percina caprodes	logperch	x
	Percina evides	gilt dater SE	x
	Percina maculata	blackside darter	
	Percina phoxocephala	slenderhead darter	
	Percina sciera	dusky darter	x *
	Percina shumardi	river darter	
	Sander canadense	sauger	
	Sander vitreum	walleye	

ranges. The fish and freshwater mussel assemblages in the Tippecanoe River basin appear less affected by habitat degradation than is commonly observed in other Midwestern streams, perhaps as a result of the basin retaining a variety of instream habitats and suitable water quality (Carney et al., 1993). The basin should therefore be protected from further disturbances.

Freshwater Mussel Life History

One thing often overlooked by those involved in native fishes is the freshwater mussel. This lack of interest is disappointing because fish and freshwater mussels have a unique relationship. Freshwater mussels (a.k.a. clams, or naiades) have a complex reproductive cycle (see cover illustration) in which they rely on specific hosts for the development of mussel larvae. These hosts are usually certain fish species (e.g., minnows or sunfishes), but in the case of the salamander mussel (*Simpsonaias ambigua*), it is the mudpuppy (*Necturus maculosus*) (Cummings and Mayer, 1992).

Because freshwater mussels are primarily immobile, fertilization is literally a shot in the dark. Males release sperm into the water, and females filter the sperm through their incurrent siphon and into their gill chambers. The fertilized eggs then are incubated in the females' gills until they develop into larvae called glochidia that must attach themselves to the gills or fins of their specific hosts. To attract these hosts, the

Table 2. Some of the historic native freshwater mussels (family Unionidae) of the Tippecanoe River basin, Indiana (data from Cummings and Berlocher, 1990; Myers-Kinzie et al., 2001; and the Illinois Natural History Survey Mollusk Collection, Champaign). FE = U.S. federally-endangered. SX = Indiana state-extinct. SE = Indiana state-endangered. SSC = Indiana state-special-concern.

SUBFAMILY	SCIENTIFIC NAME	COMMON NAME
Anodontinae	*Alasmidonta marginata*	elktoe
	Alasmidonta viridis	slippershell mussel
	Anodonta suborbiculata	flat floater
	Anodontoides ferussacianus	cylindrical papershell
	Lasmigona complanata	white heelsplitter
	Lasmigona compressa	creek heelsplitter
	Lasmigona costata	flutedshell
	Pyganodon grandis	giant floater
	Simpsonaias ambigua	salamander mussel SSC
	Strophitus undulatus	creeper
	Utterbackia imbecillis	paper pondshell
Ambleminae	*Amblema plicata*	threeridge
	Cyclonaias tuberculata	purple wartyback
	Elliptio crassidens	elephant-ear
	Elliptio dilatata	spike
	Fusconaia flava	Wabash pigtoe
	Fusconaia subrotunda	longsolid SE
	Plethobasus cyphyus	sheepnose SE
	Pleurobema clava	clubshell FE SE
	Pleurobema cordatum	Ohio pigtoe SSC
	Pleurobema plenum	rough pigtoe FE SE
	Pleurobema rubrum	pyramid pigtoe
	Pleurobema sintoxia	round pigtoe
	Quadrula cylindrica	rabbitsfoot SE
	Quadrula metanevera	monkeyface
	Quadrula pustulosa	pimpleback
	Quadrula quadrula	mapleleaf
	Tritogonia verrucosa	pistolgrip
Lampsilinae	*Actinonaias ligamentina*	mucket
	Cyprogenia stegaria	fanshell FE SE
	Epioblasma obliquata	catspaw FE SE
	Epioblasma rangiana	northern riffleshell FE SE
	Epioblasma triquetra	snuffbox SE
	Hemistena lata	crackling pearlymussel FE SX
	Lampsilis cardium	plain pocketbook
	Lampsilis fasciola	wavyrayed lampmussel SCC
	Lampsilis siliquoidea	fatmucket
	Lampsilis teres	yellow sandshell
	Leptodea fragilis	fragile papershell
	Ligumia recta	black sandshell
	Ligumia subrostrata	pondmussel
	Obovaria olivaria	hickorynut
	Obovaria retusa	ring pink FE SX
	Obovaria subrotunda	round hickorynut SCC
	Potamilus alatus	pink heelsplitter
	Ptychobranchus fasciolaris	kidneyshell SSC
	Toxolasma lividus	purple lilliput SSC
	Toxolasma parvus	lilliput
	Truncilla donaciformis	fawnsfoot
	Truncilla truncata	deertoe
	Villosa fabalis	rayed bean SSC
	Villosa iris	rainbow

females of certain species of freshwater mussels have developed "lures" from their mantles, while others have developed small packages called conglutinates that are released in the water. These "lures" and conglutinates resemble small fishes, crayfishes, insects, or worms that entice the hosts to strike, which releases the glochidia. The free-floating larvae clamp onto their hosts (typically no harm is done to their hosts) and develop for several days or weeks before developing into juveniles. While clamped, the glochidia are transported by their hosts; therefore, freshwater mussel species' distribution is directly related to their hosts' distribution, which can be hindered by impoundments among other things. So, typically, whatever happens to the fishes happens to the mussels as well. When mature, the juveniles release from their hosts and drop to the streambed or lakebed as free-living mussels. If the habitat is sufficient, the freshwater mussels will mature and repeat the cycle.[2]

Freshwater mussels belong to the Phylum Mollusca (the same phylum as limpets, cowries, conchs, snails, slugs, octopuses, and squids) and Class Bivalvia (the same class as oysters and scallops). Freshwater mussels exhibit a variety of shapes, sizes and colors. They live in the sediments of streams and lakes, often in multi-species aggregates called mussel beds. An individual eats and breathes by drawing in water through its incurrent siphon and filtering out organic matter (e.g., algae, bacteria, protozoans) and oxygen with its gills. It then expels the water from its excurrent siphon. An individual mussel can move by extending its muscular foot into the substrate and then contracting it. By repeating this action, the mussel slowly pulls itself along the stream or lake bottom.

North America contains approximately 300 species of freshwater mussels with the highest diversity occurring in the southeastern United States (similar to fishes). Freshwater mussels can act as indicators of aquatic ecosystems due to their sensitivity to disturbances. They are hampered by, among other things, habitat degradation (e.g., point and non-point source pollution, sedimentation, altered flows), over-harvest, and competition with exotic species such as the zebra mussel (*Dreissena polymorpha*). As a result of these disturbances, freshwater mussels are one of the most imperiled groups of organisms in North America. In fact, nearly 72% are considered endangered, threatened, or of special concern (Myers-Kinzie et al., 2001). Propagation facilities specializing in mussels are currently are being used to help re-establish some of the most imperiled species in the wild.

Table 3. Selected freshwater mussel field guides. Others can be found on the FMCS's webpage (ellipse.inhs.uiuc.edu/FMCS/index.html).

Cicerello, R.R. and G.A. Schuster. 2003. *A guide to the freshwater mussels of Kentucky*. Kentucky State Nature Preserves. Commission Scientific and Technical Series Number 7.
Couch, K. 1997. *An illustrated guide to the unionid mussels of Kansas*. Couch Publications.
Cummings, K. S., and C.A. Mayer. 1992. F*ield guide to freshwater mussels of the Midwest*. Illinois Natural History Survey, Manual 5.
Howells, R. G., R. W. Neck, and H. D. Murray. *Freshwater mussels of Texas*. Texas Parks and Wildlife Department, Inland Fisheries Division.
Oesch, R. D. 1995. *Missouri naiades: a guide to the mussels of Missouri*. Missouri Department of Conservation.
Parmalee, P. W., and A. E. Bogan. 1998. *The freshwater mussels of Tennessee*. University of Tennessee Press.
Nedeau, E. J., M. A. McCollough, and B. I. Swartz. 2000. *The freshwater mussels of Maine*. Maine Department of Inland Fisheries and Wildlife.
Nedeau, E. J., and J. Victoria. *A field guide to the freshwater mussels of Connecticut*. Connecticut Department of Environmental Protection, Bureau of Natural Resources, Wildlife Division.
Sietman, B. E. 2003. *Field guide to the freshwater mussels of Minnesota*. Minnesota Department of Natural Resources.
Strayer, D. L., and K.J. Jirka. 1997. *The pearly mussels of New York state*. New York State Museum Memoirs 26.
Watters, T. 1995. *A guide to the freshwater mussels of Ohio.* Division of Wildlife, Ohio Department of Natural Resources.

Freshwater mussels play an important role in aquatic ecosystems. They provide a source of food for many animals, including muskrats (*Ondatra zibethicus*), raccoons (*Procyon lotor*), and various fishes, including redear sunfish (*Lepomis microlophus*) and freshwater drum (*Aplodinotus grunniens*). Mussel valves provide habitat for algae, aquatic insect larvae, and nests and refuges for certain species of fishes, such as madtoms (*Noturus*). In addition, freshwater mussels may help stabilize stream substrate against the scouring effects of flowing water (Sietman, 2003).

For more information on freshwater mussels (e.g. collecting methods, shell anatomy, species accounts, distribution maps, glossary, and historic uses), consult any of the field guides listed in Table 3, or contact local department of natural resource agencies for collecting regulations. Hayes (2000) listed some suggestions on what one can and should not do to save our freshwater mussels. Other ideas can be found on the Freshwater Mollusk Conservation Society's (FMCS) webpage:

`ellipse.inhs.uiuc.edu/FMCS/index.html`

The FMCS seeks to reinforce the mussel-fish connection and present a better understanding of the relationship between the two faunas. In so doing, the FMCS advocates the conservation

[2] For species-specific interactions between freshwater mussels and fishes, see the Ohio State University, Division of Molluscs webpage at www.biosci.ohio-state.edu/~molluscs/OSUM2 and click on "Host Database."

Fig. 2.
Canoe Camp access at the Tippecanoe River, five miles north of Winimac, 1 May 2004. Photo by Todd Crail.

of freshwater mollusk resources; serves as a conduit for information about freshwater mollusks; endorses science-based management of freshwater mollusks; and promotes and facilitates education and awareness about freshwater mollusks and their function in freshwater ecosystems.

Acknowledgments

We thank the following people: K. S. Cummings for helpful comments and use of figures; the Indiana Department of Natural Resources for issuing a scientific collecting permit to JST; the 30 April-2 May 2004 NANFA field trip participants (Mark Binkley and brothers, Todd and Sarah Crail, Ryan DePauw, Rob Everhart, Bill and Shawn Flowers, Autumn Hatten, Donnie Jones, Jamie Ladonski, Sajjad Lateef, Bill Veenstra, and Nick and Linda Zarlinga); and the 11 May 2004 IN-AFS darter workshop participants and hosts, especially Brant Fisher and Tom Simon.

Literature Cited

Carney, D. A., L. M. Page, and T. M. Keevin. 1993. Fishes of the Tippecanoe River, Indiana: an outstanding Midwestern stream. *Proceedings of the Indiana Academy of Science* 101: 201-219.

Cummings, K. S. and J. M. K. Berlocher. 1990. The naiades or freshwater mussels (Bivalvia: Unionidae) of the Tippecanoe River, Indiana. *Malacological Review* 23: 83-98.

———, and C. A. Mayer. 1992. *Field guide to freshwater mussels of the Midwest*. Illinois Natural History Survey, Manual 5.

Fisher, B. E., S. P. Wente, T. P. Simon, and A. Spacie. 1998. The fishes of Tippecanoe County, Indiana. *Proceedings of the Indiana Academy of Science* 107: 151-166.

Hayes, T. 2000. Our native freshwater mussels. *American Currents* 26 (4): 21-22.

Myers-Kinzie, M., S. P. Wente, and A. Spacie. 2001. Occurrence and distribution of freshwater mussels in small streams of Tippecanoe County, Indiana. *Proceedings of the Indiana Academy of Science* 110: 141-150.

Sietman, B. E. 2003. *Field guide to the freshwater mussels of Minnesota*. Minnesota Department of Natural Resources.

"I would like to thank all of you on the Tippecanoe weekend for making my son's time with NANFA enjoyable. He is still talking about all the mussels that were found. Of course, he went to school yesterday and told everyone about all the fish he saw. He is not sure if the teacher believed him . . ." *Bill Flowers, Mooresville, IN*

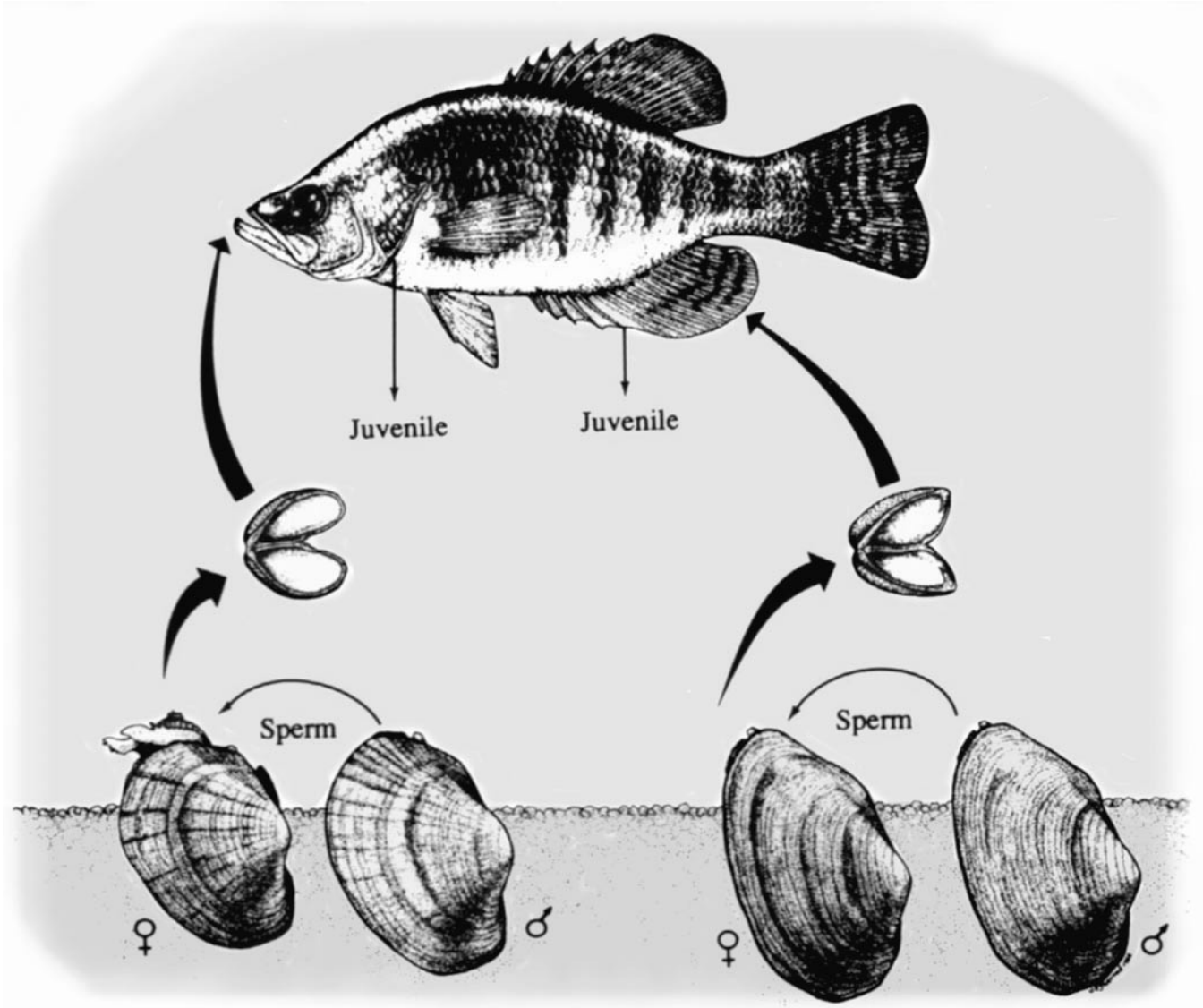

Illustration showing the reproductive cycle of two freshwater mussel species. The mussel on the left is the plain pocketbook (Lampsilis cardium). The mussel on the right is the giant floater (Pyganodon grandis). Both species use the white crappie (Pomoxis annularis) as a host. L. cardium uses internal hookless glochidia on the gills, whereas P. grandis uses external hooked glochidia on the fins. Both mussels can also use largemouth bass (Micropterus salmoides), bluegill (Lepomis macrochirus), and yellow perch (Perca flavescens) as hosts. See the article on pp. 7-10 for a description of the mussel-fish relationship. Illustration from Cummings, K. S., and C. A. Mayer. 1992. Field guide to freshwater mussels of the Midwest. Illinois Natural History Survey, Manual 5. Used with permission.