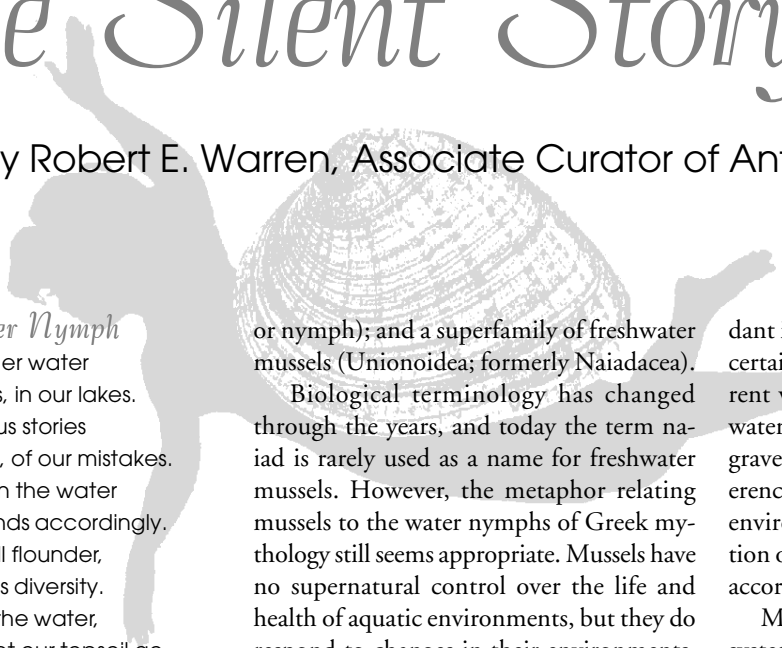
Illinois Mussels

The Silent Storytellers

by Robert E. Warren, Associate Curator of Anthropology



The Water Nymph

A nymph lives under water
in our rivers, in our lakes.
It is mute but tells us stories
of our past, of our mistakes.
For it sees what's in the water
and responds accordingly.
It will thrive or it will flounder,
adjusting its diversity.
When we pollute the water,
when we let our topsoil go,
The nymph will keep a record.
If we read it, we will know.
It has lived here through the ages,
since before the dawn of man.
Can it survive another decade?
With your help, perhaps it can.
When you look into the water
of the stream flowing to sea,
Ask yourself: Is this a healthy place
for a water nymph to be?
Who is this nymph I speak of?
It is the naiad *Unio*.
A bivalve with a pearly shell,
has one foot, but no toes.

In Greek mythology, the world was inhabited by nymphs of various kinds. They were feminine divinities of nature, often portrayed as beautiful maidens, which dwelled in the mountains, forests, meadows, and waters. Each was responsible for giving life and perpetuity to its own domain. The nymphs presiding over lakes, rivers, springs, and fountains were called *Naiades* (Greek: ;"YU*,H).

Biologists have applied the name "naiad" to several types of plants and animals, all of which inhabit aquatic environments. These include a family of aquatic plants (Naiadaceae); an aquatic larval stage of dragonflies, mayflies, and other insects (naïad or nymph); and a superfamily of freshwater mussels (Unionoidea; formerly Naiadacea).

Biological terminology has changed through the years, and today the term naiad is rarely used as a name for freshwater mussels. However, the metaphor relating mussels to the water nymphs of Greek mythology still seems appropriate. Mussels have no supernatural control over the life and health of aquatic environments, but they do respond to changes in their environments. Old mussel shells provide a record of how our rivers and lakes have changed; they tell the story of aquatic environments, past and present. Mussel communities have documented changes in the Illinois River from prehistoric to modern times.

Mussels are invertebrate animals in one of the most diverse phyla in the animal kingdom, the phylum Mollusca. Other mollusks include solenogasters, tuskshells, chitons, snails, slugs, clams, scallops, squids, and octopuses.

Mussels have soft inner bodies and hard outer shells consisting of two valves, one on the left side and one on the right. The shells are joined by an elastic ligament that stretches across a hinge at the top. The shells of different species vary in size, shape, thickness, color, and in the presence or absence of sculpturing (ridges or bumps) on the outer surface of the shell. The morphology of the hinge is also diagnostic; some species have interlocking "teeth" that ensure proper alignment of the valves, while in other species the hinge teeth are reduced or absent.

Mussels live in a variety of aquatic environments, including rivers, creeks, lakes, and ponds. Of interest is the fact that many species have specific habitat preferences. Some prefer large rivers, others are found only in small streams, and still others are most abundant in lakes. They also have preferences for certain water depths (shallow or deep), current velocities (swiftly moving or standing water), and substrate compositions (coarse gravel or fine mud). Given the habitat preferences of different species, when an aquatic environment changes, the species composition of the local mussel community changes accordingly.

Mussels play several key roles in the ecosystem. As filter feeders they help clarify water and concentrate impurities in their shells and soft tissues. They also serve as a food resource for raccoons, muskrats, the freshwater drum fish, and other aquatic and semi-aquatic animals. In prehistory, mussels were used by Native Americans as both a source of food and as a raw material for the manufacture of shell tools, utensils, and ornaments. Mussels were also important historically—as sources of pearls during the late 1800s and in the lucrative shell-button industry from 1890 to 1950. A new market for mussel shell came into being in about 1960. Shells are now being exported to Japan, where they are made into small spheres and then implanted into living oysters to create cultured pearls.

Historically, mussels were diverse and abundant in the Illinois River. Forty-eight species have been documented in it. By 1910 it had become the most productive stream (per river mile) in the early history of the shelling industry. However, when William C. Starrett of the Illinois Natural History Survey conducted an extensive survey of mussels in the river in 1966, only 23 species remained. These numbers represent an alarming 52% decline in species diversity in a span of little more than 50 years. In some segments of the river the devastation has been especially severe. The upper

Table 1. Freshwater Mussels from the Illinois River

Scientific name	Common name	Prehistoric mussels (Nancy's Point Site)	Modern mussels (La Grange Pool, 1966)	Modern status[1]
Subfamily Anodontinae				
Anodonta suborbiculata	Flat floater	—	1	●
Arcidens confragosus	Rock-pocketbook	2	16	●
Lasmigona complanata	White heelsplitter	—	5	●
Lasmigona costata	Fluted-shell	5	—	○
Pyganodon grandis	Giant floater	—	29	●
Strophitus undulatus	Squawfoot	21	—	○
Utterbackia imbecillis	Paper pondshell	—	2	●
Subfamily Ambleminae				
Amblema plicata	Threeridge	147	363	●
Elliptio crassidens	Elephant-ear	24	—	○
Elliptio dilatata	Spike	981	—	○
Fusconaia ebena	Ebonyshell	20	—	○
Fusconaia flava	Wabash pigtoe	51	1	●
Megalonaias nervosa	Washboard	5	23	●
Pleurobema coccineum	Round pigtoe	10	—	○
Pleurobema rubrum	Pyramid pigtoe	17	—	○
Quadrula nodulata	Wartyback	2	5	●
Quadrula pustulosa	Pimpleback	20	13	●
Quadrula quadrula	Mapleleaf	4	86	●
Tritogonia verrucosa	Pistolgrip	4	—	○
Subfamily Lampsilinae				
Actinonaias ligamentina	Mucket	63	—	○
Ellipsaria lineolata	Butterfly	2	—	○
Epioblasma triquetra	Snuffbox	3	—	○
Lampsilis siliquoidea	Fatmucket	2	2	●
Lampsilis teres	Yellow sandshell	1	8	●
Leptodea fragilis	Fragile papershell	2	21	●
Ligumia recta	Black sandshell	1	—	○
Obliquaria reflexa	Threehorn wartyback	17	1	●
Obovaria olivaria	Hickorynut	3	—	○
Potamilus alatus	Pink heelsplitter	10	1	●
Potamilus ohiensis	Pink papershell	—	12	●
Toxolasma parvus	Lilliput	10	—	○
Truncilla donaciformis	Fawnsfoot	34	—	○
Truncilla truncata	Deertoe	89	2	●
Total		1550	591	

[1]Conservation status in 1966: ● = Present in Illinois River; ○ = Rare or Absent in Illinois River (data from Starrett 1971).

portion (above Starved Rock) had a rich mussel fauna in the 1870s, but until very recently, no living mussels had been found there since 1912.[1] Unfortunately, the disappearance of mussels in the Illinois River parallels national trends; more than 70% of North American mussel species are now considered endangered, threatened, or of special concern.

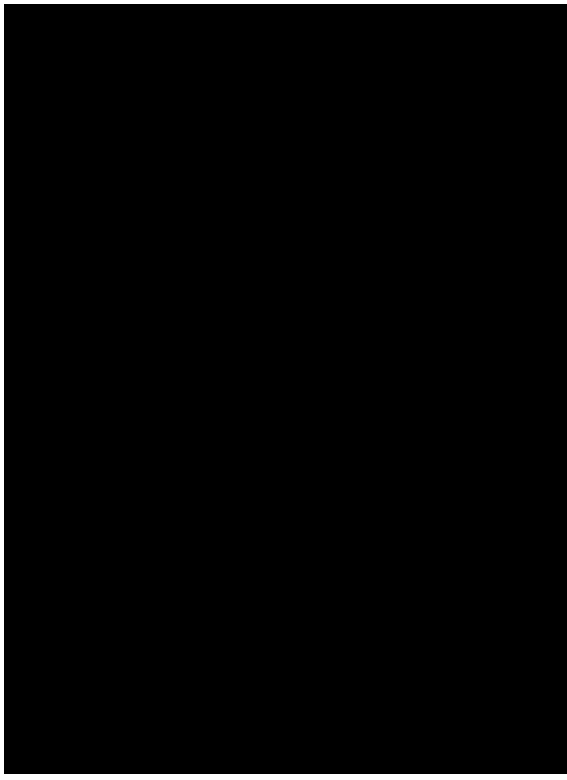
Why are they dying? We have altered our rivers and lakes so extensively—through pollution, siltation, and commercial development—that many species can no longer survive in places where they once thrived. It is difficult to say which causes are most important, as many interacting factors may be involved.

One kind of evidence that deserves attention is the testimony of the mussels themselves. In what ways have mussel communities changed? Also, can we learn anything by comparing the habitat preferences of modern communities with communities that lived in the past?

William Starrett's survey provides good information on the modern composition of mussel communities in the central Illinois River (the La Grange Pool). Collections of old shells from archaeological and geological sites provide useful data on earlier communities. One such collection is that recovered from the Nancy's Point site, a prehistoric occupation located on the west bank of the river in Fulton County. The site is marked by an extensive bed of shells that runs along the beach and covers a nearby natural levee. Prehistoric artifacts have been found in association with the shells and many of the latter have been discolored by fire. The high incidence of charred shell (14%) and the absence of any shell artifacts suggest that the mussels were collected as a food resource and then discarded as garbage. Artifacts dating to the Early Woodland cultural period (2100–2550 years ago) occur on the site, although they are not necessarily associated with the shells. We do not yet know the shell bed's antiquity, although we can be certain that it predates the modern era.

Thirty-three species of mussels are represented in the prehistoric and modern collections (Table 1). The prehistoric collection (28 species) is considerably more diverse than the modern sample (18 species). This drop-off in diversity is probably related to the recent decline of mussel populations during the 20th century. Although 13 species found in the prehistoric collection are still common in the Illinois River, four species are rare and 11 others have been eliminated (extirpated) from the river.

But which species have been extirpated?

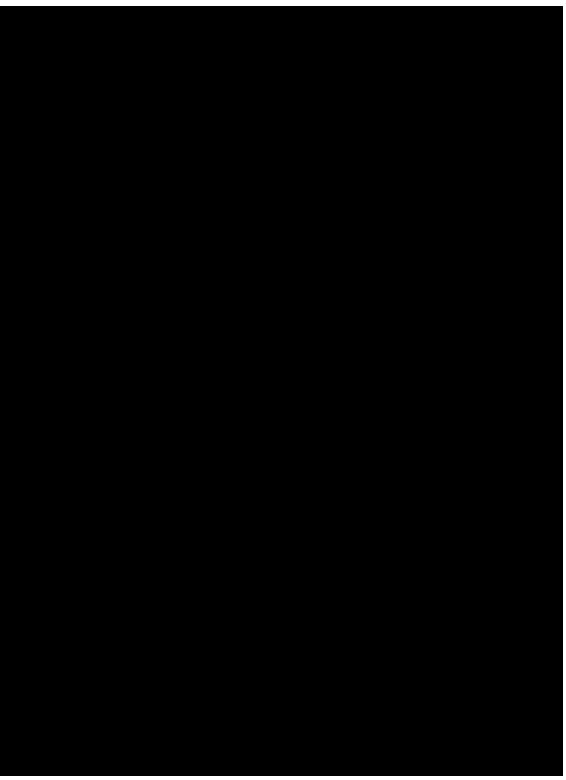


*Prehistoric freshwater mussels from the Nancy's Point site, length = 94 mm); Lower, threeridge mussel (*Amblema *the most abundant species at Nancy's Point, but they no tolerant of pollution and silt, and are the most abundant*

1. The long absence of mussels in the upper section of the river may have been part of a massive, progressive mussel die-off caused by the diversion of untreated Chicago sewage and industrial wastes into the Des Plaines and Illinois rivers after the opening of the Chicago Sanitary and Ship Canal in 1900.

*First row (left to right): slippershell mussel (*Alasmidonta viridis*); rainbow (*Villosa iris*); hickorynut (*Obovaria olivaria*). Second row (left to right): plain pocketbook (*Lampsilis cardium*); mucket (*Actinonaias ligamentina*). Shown here 0.60 actual size. Photo by Marlin Roos.*

Just the rare ones that may have disappeared due to chance or because of minor changes in the river environment? The numbers of identified shells from the Nancy's Point site indicate that species from throughout the prehistoric abundance spectrum have been eliminated—the abundant, the common, and the rare. Two of the four most common species in the Nancy's Point collection have disappeared: the spike (*Elliptio dilatata*), which ranks first in abundance (63% of the total), and the mucket (*Actinonaias ligamentina*), which ranks fourth (4% of the total).[2] Overall, more than three-fourths of the prehistoric shells (77%) are species rare or absent in the Illinois River today.



*Illinois. Upper, spike mussel (*Elliptio dilatata*; right valve;* plicata*; right valve; length = 91 mm). Spike mussels were longer live in the Illinois River. Threeridge mussels are more species in the Illinois River today. Photo by Robert Warren.*

In comparison, the modern collection from the Illinois River is dominated by the threeridge (*Amblema plicata*). This species accounts for 61% of the live mussels documented by Starrett in the La Grange Pool, and it was the most common species in many of the areas he sampled. Other common species include the mapleleaf (*Quadrula quadrula*) and the giant floater (*Pyganodon grandis*).

To compare the environmental adaptations of the prehistoric and modern mussel faunas, I analyzed the shells using a computer program that I had previously developed called UNIO. (*Unio* is a Latin word meaning "pearl." It has been used as a genus name for many species of freshwater mussels in Europe and North America.) UNIO accounts for habitat preferences of different mussel species in various waterbody types, water depths, current velocities, and substrate types and it produces general "habitat scores" for the collections analyzed.

The habitat scores derived during this analysis reveal major differences between the prehistoric and modern mussel faunas. The prehistoric mussels signify a large river with relatively shallow water, a swift current, and a coarse gravelly substrate. This is the classic signature of a big-river shoal or riffle, in which many mussel species adapted to smaller streams live in the shallow water alongside mussels that live primarily in big rivers. In contrast, the habitat scores of the modern fauna indicate a more specialized big-river mussel community adapted to deeper water, a slower current, and a finer muddy substrate (Table 2).

Clearly, significant changes in mussel habitat have occurred along the central Illinois River. The mussels seem to be telling us that they have lost an important habitat type, the big-river shoal, which may have been crucial for the survival of many species. What were the main causes of this loss? Two factors are implicated. First, the construction of locks and dams along the Illinois River has increased water depths and slowed current velocities. Second, erosion from agricultural runoff has deposited millions of tons of silt in our streams. The mussels' message seems to be that by taming our shoals and muddying our waters, we have eliminated an environment where many of them once thrived.

And what of the future? Illinois mussels are still threatened by pollution, siltation, impoundments, and other old enemies. But they also face a new threat from their distant east-European cousins, the zebra mussels (*Dreissena polymorpha*). These foreign invaders crossed the Atlantic Ocean in ships and gained a foothold in the eastern Great Lakes about 1987. Since then, the aliens have expanded throughout the Great Lakes

Table 2. Changes in Mussel Faunas Reflect Changes in the Central Illinois River Environment

Habitat	Prehistoric mussels[1]	Modern mussels[2]
Water-body type	Large River	Large River
Water depth	Shallow	Deep
Current velocity	Swift	Moderate
Substrate composition	Gravelly	Muddy

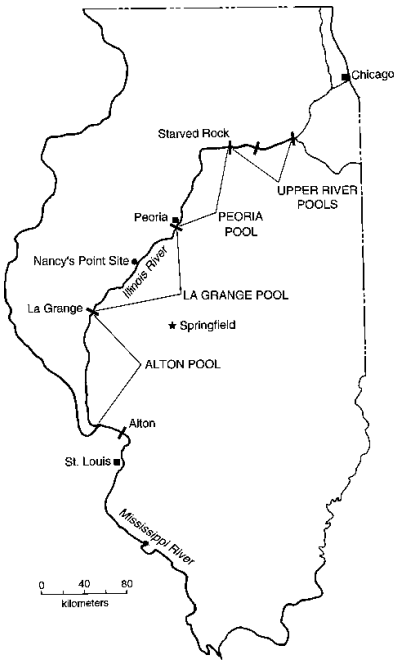
[1]Nancy's Point site fauna
[2]La Grange Pool fauna, 1966

2. Recent collections by the Illinois Natural History Survey indicate the mucket may be making a comeback in some sections of the Illinois River.

Dr. Warren examining some specimens in the ISM's collections of fresh water mussels at the Research and Collections Center, Springfield. Photo by Marlin Roos.

and much of the Mississippi River system. They have become a costly headache for swimmers, boaters, municipal utilities, and native aquatic wildlife.

Zebra mussels were first detected in the Illinois River in 1991, and by 1993 they had attained peak densities of up to 94,000 individuals per square meter. They formed dense colonies on the shells of native mussels, limiting their mobility and robbing them of oxygen and food. By the autumn of 1994, up to 90% of some native mussel species had been killed at some locations. Some zebra-mussel populations also crashed in 1994, but are expected to rebound before they crash again. If the native mussels can survive these dramatic fluctuations, perhaps the zebra mussels will eventually stabilize at a tolerable level. We can only hope that the next chapter in the water-nymph's saga is one of conflict and survival, rather than extinction. ☺



Map of the Illinois River, showing the locations of the Nancy's Point site and the La Grange Pool.

Invading colony of zebra mussels attached to a native mussel. Zebra mussels pose a new threat to the survival of native mussel species. Photo by Scott D. Whitney, Illinois Natural History Survey.

Additional Reading

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Top Row: Slipperheel, Rainbow, Hickory Nut
Bottom Row: Plain Pocketbook, Mucket

Above: *Elliptio Dilatata* (Spike)

Below: *Emblema plicata* (Three-ridge)

Row 1: fanshell *(Cyprogenia stegaria)*; yellow sandshell (*Lampsilis teres)*; butterflly *(Ellipsaria lineolata)*; spike *(Elliptio dilatata).*
Row 2: kidneyshell *(Ptychobranchus fasciolaris);* snuffbox *(Epioblasma triquetra);* fawnsfoot *(Truncilla donaciformis);* threehorn wartyback *(Obliquaria reflexa);* purple wartyback (Cyclonaias tuberculata).
Row 3: plain pocketbook *(Lampsilis cardium)*; paper pondshell *(Utterbackia imbecillis)*; mapleleaf *(Quadrula quadrula)*; deertoe *(Truncilla truncata)*; sheepnose *(Plethobasus cyphyus).*
Row 4: pistolgrip *(Tritogonia verrucosa)*; pimpleback *(Quadrula pustulosa)*; wavy-rayed lampmussel *(Lampsilis fasciola)*; rabbitsfoot *(Quadrula cylindrica).*