

The Aquatic Mollusca of Illinois

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Illinois has historically supported a diverse aquatic molluscan fauna, numbering over 175 species and occupying almost every type of aquatic habitat from the Great Lakes to wetlands, temporary woodland ponds, seeps, springs, and streams. Two classes of mollusks are represented in the waters of Illinois: Bivalvia, which includes the clams and mussels, and Gastropoda, represented by the snails and limpets. The native bivalves of Illinois are members of three families: the Margaritiferidae and Unionidae (the freshwater mussels) and the Sphaeriidae (the fingernail clams and peaclams). The gastropods are divided into two subclasses, Prosobranchia and Pulmonata. The Prosobranchs or the operculated, gill-breathing snails are represented in Illinois by 37 species in six families. The Pulmonates or the nonoperculated, lung-breathing snails contain 37 species in four families. A list of the species for each of the families reported from the state is given on pages 435–438. For the unionids, aspects of their biology, commercial use, and status are discussed. Information on identification, distribution, and biology of the aquatic molluscan fauna of Illinois will appear in forthcoming publications. An excellent monograph on the freshwater snails of North America has been published (Burch 1989) and should be consulted for keys and figures of most of the species found in Illinois.

The list of the freshwater mussels of Illinois (pages 435–436) is based on the examination of specimens in collections housed in the following museums: Academy of Natural Sciences, Philadelphia; Chicago Academy of Sciences; Field Museum of Natural History; Illinois Natural History Survey; Illinois State Museum; Museum of Comparative Zoology, Harvard; Ohio State University Museum of Zoology; University of Illinois Museum of Natural History; University of Michigan Museum of Zoology; and the United States

National Museum. The list for Sphaeriidae and Gastropoda (pages 436–438) were compiled from the literature on Illinois Mollusca, primarily the publications of Baker (1900, 1901, 1902, 1906, 1922); Basch (1963); Burch (1989); Dexter (1956); Ulfers (1855); and Zetek (1918). Additional work is planned to verify the sphaeriid and gastropod lists by examining specimens in museum collections.

Nomenclature in this paper, with three exceptions, follows a list of common and scientific names of mollusks prepared by the Committee on Scientific and Vernacular Names of Mollusks of the Council of Systematic Malacologists, American Malacological Union (Turgeon et al. 1988). Subspecies are not recognized, nomenclature for members of the *Pleurobema cordatum* species complex follows Stansbery (1983), and nomenclature for the family Hydrobiidae follows Hershler and Thompson (1987) and Hershler et al. (1990).

The aquatic mollusks of Illinois have been studied for over 150 years. Thomas Say, the first scientist to work on mollusks in Illinois, was one of America's earliest naturalists. Say traveled to the Midwest as early as 1817 and in 1826 moved from Philadelphia to the utopian community of New Harmony, Indiana (Van Cleave 1951). While there, he collected and described many of the mollusks found in the Wabash River and its tributaries, some of which are still recognized today.

Few attempts have been made to compile a list of the mollusk species found in Illinois. In 1906, Frank C. Baker published an annotated checklist of the Mollusca of Illinois in which he summarized the available data on the distribution of the species within the state. A prolific writer, Baker published over 400 papers, including many important works on the molluscan fauna of Illinois (Baker 1897, 1898, 1899, 1900, 1901, 1902, 1906, 1922, 1926). Baker's papers remain the best source of published information on the biology and

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distribution of aquatic mollusks in the state. Other early workers on the freshwater mollusks of Illinois included Kennicott (1855); Ulfers (1855); Calkins (1874a, 1874b, 1874c); Strode (1891, 1892); Wilson and Clark (1912); Danglade (1912, 1914); Zetek (1918); and Hinkley (1919).

Few papers were published on the aquatic Mollusca of Illinois in the 1930s and 1940s. During the late 1940s and 1950s, Dr. Max R. Matteson of the University of Illinois collected mussels at over 200 sites in Illinois and amassed one of the largest and best documented collections that exists for any state in the nation. Matteson's surveys provided both distribution and abundance data on mussels from Illinois streams, many of which had not been previously sampled. His collections, now at the Illinois Natural History Survey, provide an invaluable data set and serve as the benchmark for mussel surveys conducted today.

In 1967, Paul W. Parmalee of the Illinois State Museum published *The Fresh-water Mussels of Illinois*, which included many original observations on the distribution and habitat of unionids. This monograph, one of the most frequently cited regional works on freshwater mussels, is still the best guide available on the mussels of the state. Other papers on aquatic mollusks of Illinois in the 1950s and 60s include van der Schalie and van der Schalie (1950); Dexter (1953, 1956); Parmalee (1955, 1956); Matteson (1961); Matteson and Dexter (1966); and Fechtner (1963).

In the 1970s and 1980s, stream surveys were conducted on the Illinois (Starrett 1971), Kankakee (Lewis and Brice 1980; Suloway 1981), Kaskaskia (Suloway et al. 1981), and Wabash rivers (Meyer 1974; Clark 1976). These and current studies document the rapid decline of the freshwater mussels of Illinois and provide data on the status of rare species.

BIVALVIA: MUSSELS AND CLAMS

Freshwater mussels in the families Margaritiferidae and Unionidae are found throughout the holarctic region but reach their greatest diversity in eastern North America, where they number about 285 species (Turgeon et al. 1988). A total of 78 species in two families and four subfamilies has been recorded from Illinois and boundary waters (pages 435-436).

Biology. Mussels filter-feed on plankton, which they remove from the water as it circulates through the animal via incurrent and excurrent apertures. In most freshwater mussel species, the sexes are separate. Sperm are released into the water and taken into the female via the incurrent aperture. The eggs are fertilized and develop into an intermediate stage, the glochidium. Glochidia are stored in the female's gills, which function as brood chambers. Nearly all unionids must pass through a parasitic phase in order to complete their life cycle. In the spring or summer, glochidia are expelled into the water and must come in contact with the appropriate host, usually a fish, to which they attach and metamorphose into a juvenile mussel. Glochidia are either internal parasites on the gills or external parasites on the fins. Some species are host specific, but others are generalists and use a wide variety of fishes as hosts. Mussels are long lived. Many species live as long as 25 years, and some are reported to live more than 50 years.

Commercial Use. In 1891 a German immigrant, J.F. Boepple of Petersburg, Illinois, realized that the mussels of the United States could be used, as they had been in Europe, to manufacture buttons. In the early part of the twentieth century, enormous quantities of mussels were harvested for the button industry, with some beds in Illinois producing over 700 tons in a single year (Coker 1919). Mussel shells were collected, cooked out, and shipped to factories where they were cut into blanks, sorted, polished, and finished into buttons. Today freshwater mussel shells are exported to Japan where they are converted into beads and inserted into oysters where they serve as nuclei for cultured pearls. The oysters are maintained in cages under water, and over a period of about a year, a layer of mother-of-pearl is secreted around the bead to form the pearl.

From 1912 to 1914, roughly 15,000 tons of shells were taken in Illinois and boundary waters and sold at a price that varied from \$4 to \$10 a ton. The increase in price over the last 75 years has been astronomical. In the 1940s, the price of shells was about \$25 a ton and remained at that level until the button industry collapsed in the late 1950s due to the advent of plastics. As the demand for shells to manufacture cultured pearls increased, so did the price, from \$45 a ton in the 60s, \$800 in the 70s, and

\$1,800 in the 80s, to \$2,400 a ton this year (N. Cohen, pers. comm.). At current prices, the estimated harvest of 1912 to 1914 would be worth about \$36 million.

Status. Surveys across North America have documented significant declines in freshwater mussel populations. Recent surveys for mussels in Illinois using the same methods as those of previous studies have documented a reduction in the fauna for all streams sampled (Table 1). In 1966, William C. Starrett of the Illinois Natural History Survey conducted an in-depth study of the Illinois River. He collected only 23 of the 47 species previously reported from the Illinois (Starrett 1971). Two of the 24 extirpated species were the butterfly, *Ellipsaria lineolata* (Rafinesque 1820), a species that has declined statewide in recent years; and the Higgins eye, *Lampsilis higginsii* (Lea 1857), now on the federally endangered species list. Similar results were obtained in the Kankakee River where Suloway (1981) reported only 24 of the 32 species historically known to inhabit the river. The Kankakee River drainage continues to support some of the richest mussel populations of the state, including the state threatened bullhead, *Plethobasus cyphus* (Rafinesque 1820), and the ellipse, *Venustaconcha ellipsiformis* (Conrad 1836). In the Kaskaskia River, the decline in diversity has been pronounced. Only 32 of the 39 species recorded from the drainage were found in 1956, and that number was reduced to 24 by 1978 (Suloway et al. 1981). In addition, the number of individuals dropped from 2,595 to 498, an 80% reduction in just over 20 years. A survey of the Sangamon River in 1988–1989 recov-

ered all of the species found in 1956–1960; however, overall numbers collected per unit of effort were much lower, and some, for example, *Elliptio dilatata* (Rafinesque 1820) and *Megaloniais nervosa* (Rafinesque 1820) have been nearly extirpated (Schanzle and Cummings 1991).

In the Wabash River drainage, even the relatively undisturbed Vermilion River has suffered a serious decline, with almost 40% of the mussel species extirpated by the 1970s. Although its species richness has declined, this river supports the only known populations of at least two state endangered species: the wavy-rayed lampmussel, *Lampsilis fasciola* Rafinesque 1820, and the rabbitsfoot, *Quadrula cylindrica* (Say 1817). The pattern is the same in the Embarras River, where the number of species has dropped from 44 to 27. A comparison of surveys done in 1956 and 1986 revealed that the Embarras River continues to support a fairly diverse fauna; however, the number of individuals has declined over 80% in the last 30 years. Two state endangered species are found in Illinois only in the Embarras: the kidneyshell, *Ptychobranhus fasciolaris* (Rafinesque 1820), and the snuffbox, *Epioblasma triquetra* (Rafinesque 1820). The Little Wabash River has suffered a similar decline, and a 1988 survey revealed that only 31 of the 41 species known to have occurred in the drainage are extant.

A variety of factors are responsible for the decline of mussel populations. Foremost is siltation from agricultural run-off due to poor land management. Mussels are sedentary and particularly susceptible to the smothering effects of siltation. Channelization is detrimental because it eliminates habitat for mussels as well as potential host fishes. Impoundments often create good habitat directly below the dam, but they also inundate large areas of the stream and impede the migration of host species. Herbicides, pesticides, and petroleum-related pollution also have negative effects, and competition from exotics has been implicated in the decline of native mussels, although the mechanisms involved are not entirely understood.

One result of the status surveys conducted in Illinois and other states in recent years has been the addition of many mussel species to state and federally endangered species lists. Thirteen species are now consid-

Table 1. Selected streams in Illinois where recent surveys have documented declines in the freshwater mussel fauna. Data from Starrett 1971; Suloway et al. 1981; Suloway 1981; and Cummings et al. unpublished.

	Number of mussel species	
	Pre-1960	Post-1960
Mississippi River drainage		
Illinois River	47	23
Kaskaskia River	39	24
Kankakee River	32	24
Wabash River drainage		
Embarras River	44	27
Vermilion River	41	25
Little Wabash River	41	31

ered to be globally extinct, including four once found in Illinois (Turgeon et al. 1988; see listing on pages 435–436, this publication). On the federal level, 37 mussels are listed as endangered and another 56 are proposed or candidates for listing (U.S. Department of the Interior, Fish and Wildlife Service 1989a, 1989b). The Illinois Threatened and Endangered Species List now contains 33 mussels (29 endangered and 4 threatened), slightly over 40% of the species ever recorded from Illinois (Illinois Endangered Species Protection Board 1990). Another 11 species are candidates or species of special concern that may be listed in the future. These bring the total number of rare, endangered, or extirpated species in Illinois to 44 species—56% of the state's known mussel fauna. Other states have similar problems. North Carolina, for example, recently reported that half of its mussel species are disappearing and in need of protection (Venters 1990). This national decline has received some much needed attention and funding has been provided in recent years to begin to document and address the problem.

The fingernail clams and peaclams of the family Sphaeriidae are holarctic in distribution and occupy a wide variety of habitats. Thirty-eight species in four genera are found in North America, and 26 species in three genera are reported from Illinois (pages 436–437). Although little has been published on the distribution and status of these animals in Illinois since Baker's list of 1906, unpublished reports make clear that many species have disappeared from the streams in which they formerly occurred and are declining throughout their range. Sphaeriids are hermaphroditic and, unlike freshwater mussels, have direct development, with about 2 to 20 young produced per female. Although sphaeriids have no direct economic value, they are an important food source for many animals, including fishes and diving ducks.

The family Corbiculidae is represented in Illinois by the exotic Asian Clam, *Corbicula fluminea* (Müller 1774). Introduced in North America in the 1920s (Counts 1981), this species was first reported in Illinois from the Ohio River in southern Illinois in the early 1960s (Fechtner 1962). Since then it has spread at least as far north as Rock Island and is present in most if not all drainages in the state.

As is the case with most established exotics, *Corbicula* has had serious negative effects on the environment. This extremely prolific clam has caused major problems associated with the fouling of cooling water intakes of power plants (Isom 1986) and may outcompete native species (Clarke 1988).

The family Dreissenidae is represented in North American freshwaters by the zebra mussel *Dreissena polymorpha* (Pallas 1771). Although the zebra mussel is not currently established in Illinois waters, it was recently discovered in the Indiana portion of Lake Michigan and its arrival here is imminent. This exotic is causing tremendous economic problems in Lake Erie and Lake St. Clair and will negatively affect our native mussels by smothering and suffocating them as it has in the Great Lakes.

GASTROPODA: FRESHWATER SNAILS

Freshwater snails are basically herbivores and detritivores and use their radulae to scrape algae and diatoms from plants and rocks. About 500 species of freshwater snails are found in North America, 350 Prosobranchs and 150 Pulmonates (Burch 1989). Of those, 85 or about one-fifth of the species are candidates for federal protection (U.S. Department of Interior, Fish and Wildlife Service 1989b). A review of the literature suggests that there are or were about 74 species of freshwater snails in Illinois, two of which were introduced and three that are under consideration for federal listing (pages 437–438).

The subclass Prosobranchia is represented in Illinois by 37 species in six families: Valvatidae, Viviparidae, Bithyniidae, Hydrobiidae, Pomatiopsidae, and Pleuroceridae.

The shells of North American Valvatidae are relatively small (up to 5 mm) and flattened in shape. Valvatids are egg layers and, unlike most Prosobranchs, hermaphroditic. Five species, all in the genus *Valvata*, have been reported from Illinois.

The family Viviparidae is found on all continents except Antarctica and South America and occurs throughout eastern North America. The sexes are separate, and as their name implies, they are "live bearers" as opposed to egg layers. Six species in three genera are found in Illinois.

The family Bithyniidae is represented in Illinois by the Mud Bithynia, *Bithynia tentaculata* (Linnaeus 1758). This species also occurs in Europe, and populations have been introduced into North America where the species has spread widely (Burch 1989). *Bithynia tentaculata* has been reported from Pleistocene deposits in Chicago, and it may, therefore, have been present in North America before Europeans arrived.

The family Hydrobiidae is one of the most common and widely distributed snail families in the world. These small- to medium-sized snails are a major component of the North American fauna and number about 35 genera and 170 species (Hershler and Thompson 1987; Turgeon et al. 1988). Most live in fresh water, although a few have been found in brackish water. Twelve species in seven genera have been reported from Illinois.

The family Pomatiopsidae is represented in North America by six species, two of which are found in Illinois. These snails are usually regarded as amphibious, inhabiting river banks or moist areas near streams.

The Pleuroceridae are widely distributed, occurring in North, Central, and South America and in Africa and Asia. They reach their greatest diversity, however, in the southeastern United States. Pleurocerids are extremely sensitive to the effects of pollution and siltation. At least 23 species are presumed extinct, and many others are candidates for threatened or endangered status (Turgeon et al. 1988; U.S. Department of the Interior, Fish and Wildlife Service 1989b). Eleven species in four genera have been found in Illinois, three of which are candidates for federal listing (page 437). Their current status in Illinois is unknown and needs investigation.

The subclass Pulmonata is represented in Illinois by four families. Like the pleurocerids, members of the family Lymnaeidae are found worldwide but reach their greatest diversity in North America. Fourteen species (1 introduced) in six genera have been reported from Illinois.

The family Physidae is mainly a New World family with a few species found in Eurasia and Africa. Physids are found in a wide variety of habitats and are the most widespread and abundant snails in North America. They appear to be the most pollution tolerant of all freshwater mollusks and may be the only species found in highly degraded waters.

The family Planorbidae is restricted to fresh water and is worldwide in distribution. Planorbids vary widely in size from about 1 to 30 mm. A few species are known to serve as intermediate hosts for human parasites and have been studied extensively; most others are relatively unknown ecologically. Twelve species (1 introduced) in six genera have been found in Illinois.

The Ancyliidae, or freshwater limpets, are worldwide in distribution and are found in many freshwater habitats. The family, revised in 1963, is currently thought to contain about 13 species in four genera (Basch 1963; Turgeon et al. 1988). Ancyliids can usually be found attached to aquatic vegetation or living on stones or other debris. Little is known about the biology of freshwater limpets, but they are reported to be fairly intolerant of chemical pollution (Basch 1963). Six species in three genera have been found in Illinois.

The current distribution and status of gastropods in Illinois are poorly understood, and as a result we are unable to compile a list of threatened or endangered freshwater snail species for the state. Given the documented decline in freshwater mussels and other aquatic organisms, however, there can be little doubt that Illinois has lost and is likely in danger of losing many species of snails as well.

Conservation efforts in Illinois and other states have thus far concentrated on preserving or protecting terrestrial ecosystems and their inhabitants. While the protection of prairies, bogs, fens, glades, and forests is an extremely important and worthwhile endeavor, we need to protect aquatic habitats as well or we will most certainly lose many of the fascinating and unique species that are found in the fresh waters of North America.

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The Aquatic Mollusca of Illinois. Species are arranged alphabetically within each family or in the case of Unionidae within each subfamily. Abbreviations for status are as follows: (†) = extinct, X = extirpated from Illinois, FE = federally endangered, FC = federal candidate, SE = state endangered, ST = state threatened, SC = state candidate (watch list), I = introduced.

Scientific Name	Common Name	Status ¹
CLASS BIVALVIA		
ORDER UNIONOIDA		
Family Margaritiferidae (1 species)		
Subfamily Cumberlandinae		
<i>Cumberlandia monodonta</i> (Say 1829)	Spectaclecase	FC, SE
Family Unionidae (77 species)		
Subfamily Ambleminae		
<i>Amblyma plicata</i> (Say 1817)	Threeridge	
<i>Cyclonaias tuberculata</i> (Rafinesque 1820)	Purple wartyback	
<i>Elliptio crassidens</i> (Lamarck 1819)	Elephant-ear	ST
<i>Elliptio dilatata</i> (Rafinesque 1820)	Spike	SC
<i>Fusconaia ebena</i> (Lea 1831)	Ebonysell	SC
<i>Fusconaia flava</i> (Rafinesque 1820)	Wabash pigtoe	
<i>Fusconaia subrotunda</i> (Lea 1831)	Long-solid	FC, SC, X
<i>Hemistena lata</i> (Rafinesque 1820)	Cracking pearl mussel	FE, SE, X
<i>Megaloniaias nervosa</i> (Rafinesque 1820)	Washboard	
<i>Plethobasus cicatricosus</i> (Say 1829)	White wartyback	FE, SE, X
<i>Plethobasus cooperianus</i> (Lea 1834)	Orange-foot pimpleback	FE, SE
<i>Plethobasus cyphus</i> (Rafinesque 1820)	Sheepnose	ST
<i>Pleurobema clava</i> (Lamarck 1819)	Clubshell	FC, SE
<i>Pleurobema cordatum</i> (Rafinesque 1820)	Ohio pigtoe	SC
<i>Pleurobema plenum</i> (Lea 1840)	Rough pigtoe	FE, SE, X
<i>Pleurobema rubrum</i> (Rafinesque 1820)	Pyramid pigtoe	SC
<i>Pleurobema sintoxia</i> (Rafinesque 1820)	Round pigtoe	
<i>Quadrula cylindrica</i> (Say 1817)	Rabbitsfoot	SE
<i>Quadrula fragosa</i> (Conrad 1835)	Winged mapleleaf	FC, SC, X
<i>Quadrula metanevra</i> (Rafinesque 1820)	Monkeyface	
<i>Quadrula nodulata</i> (Rafinesque 1820)	Wartyback	
<i>Quadrula pustulosa</i> (Lea 1831)	Pimpleback	
<i>Quadrula quadrula</i> (Rafinesque 1820)	Mapleleaf	
<i>Tritogonia verrucosa</i> (Rafinesque 1820)	Pistolgrip	
<i>Unio merus tetralasmus</i> (Say 1831)	Pondhorn	ST
Subfamily Anodontinae		
<i>Alasmidonta marginata</i> Say 1818	Elktoe	
<i>Alasmidonta viridis</i> (Rafinesque 1820)	Slippershell	SE
<i>Anodonta grandis</i> Say 1829	Giant floater	
<i>Anodonta imbecillis</i> Say 1829	Paper pondshell	
<i>Anodonta suborbiculata</i> Say 1831	Flat floater	
<i>Anodontoides ferussacianus</i> (Lea 1834)	Cylindrical papershell	
<i>Arcidens confragosus</i> (Say 1829)	Rock-pocketbook	
<i>Lasmigona complanata</i> (Barnes 1823)	White heelsplitter	
<i>Lasmigona compressa</i> (Lea 1829)	Creek heelsplitter	ST
<i>Lasmigona costata</i> (Rafinesque 1820)	Fluted-shell	
<i>Simpsoniaias ambigua</i> (Say 1825)	Salamander mussel	FC, SE
<i>Strophitus undulatus</i> (Say 1817)	Squawfoot	
Subfamily Lampsilinae		
<i>Actinonaias ligamentina</i> (Lamarck 1819)	Mucket	
<i>Cyprogenia stegaria</i> (Rafinesque 1820)	Fanshell	FE, SE
<i>Ellipsaria lineolata</i> (Rafinesque 1820)	Butterfly	SC
<i>Epioblasma flexuosa</i> (Rafinesque 1820)	Leafshell	(†), SE, X
<i>Epioblasma obliquata</i> (Rafinesque 1820)	Catspaw	FE, SE, X
<i>Epioblasma personata</i> (Say 1829)	Round combshell	(†), SE, X

Scientific Name	Common Name	Status ¹
<i>Epioblasma propinqua</i> (Lea 1857)	Tennessee riffleshell	(†), SE, X
<i>Epioblasma rangiana</i> (Lea 1839)	Northern riffleshell	FC, SC, X
<i>Epioblasma sampsonii</i> (Lea 1861)	Wabash riffleshell	(†), SE, X
<i>Epioblasma torulosa</i> (Rafinesque 1820)	Tubercled blossom	FE, SE, X
<i>Epioblasma triquetra</i> (Rafinesque 1820)	Snuffbox	SE
<i>Lampsilis abrupta</i> (Say 1831)	Pink mucket	FE, SE, X
<i>Lampsilis cardium</i> Rafinesque 1820	Plain pocketbook	
<i>Lampsilis fasciola</i> Rafinesque 1820	Wavy-rayed lampmussel	SE
<i>Lampsilis higginsii</i> (Lea 1857)	Higgins eye	FE, SE
<i>Lampsilis ovata</i> (Say 1817)	Pocketbook	SC
<i>Lampsilis siliquoidea</i> (Barnes 1823)	Fatmucket	
<i>Lampsilis teres</i> (Rafinesque 1820)	Yellow sandshell	
<i>Leptodea fragilis</i> (Rafinesque 1820)	Fragile papershell	
<i>Leptodea leptodon</i> (Rafinesque 1820)	Scaleshell	FC, SE, X
<i>Ligumia recta</i> (Lamarck 1819)	Black sandshell	
<i>Ligumia subrostrata</i> (Say 1831)	Pondmussel	
<i>Obliquaria reflexa</i> Rafinesque 1820	Threehorn wartyback	
<i>Obovaria olivaria</i> (Rafinesque 1820)	Hickorynut	
<i>Obovaria retusa</i> (Lamarck 1819)	Ring Pink	FE, SE, X
<i>Obovaria subrotunda</i> (Rafinesque 1820)	Round hickorynut	SE
<i>Potamilus alatus</i> (Say 1817)	Pink heelsplitter	
<i>Potamilus capax</i> (Green 1832)	Fat pocketbook	FE, SE
<i>Potamilus ohioensis</i> (Rafinesque 1820)	Pink papershell	
<i>Potamilus purpuratus</i> (Lamarck 1819)	Bleufer	SC
<i>Ptychobranhus fasciolaris</i> (Rafinesque 1820)	Kidneyshell	SE
<i>Toxolasma lividus</i> (Rafinesque 1831)	Purple lilliput	FC, SE
<i>Toxolasma parvus</i> (Barnes 1823)	Lilliput	
<i>Toxolasma texasensis</i> (Lea 1857)	Texas lilliput	
<i>Truncilla donaciformis</i> (Lea 1828)	Fawnsfoot	
<i>Truncilla truncata</i> Rafinesque 1820	Deertoe	
<i>Venustaconcha ellipsiformis</i> (Conrad 1836)	Ellipse	SC
<i>Villosa fabalis</i> (Lea 1831)	Rayed bean	FC, SE, X
<i>Villosa iris</i> (Lea 1829)	Rainbow	SE
<i>Villosa lienosa</i> (Conrad 1834)	Little spectaclecase	SE

ORDER VENEROIDA

Family Sphaeriidae (26 species)

<i>Musculium lacustre</i> (Müller 1774)	Lake fingernailclam
<i>Musculium partumeium</i> (Say 1822)	Swamp fingernailclam
<i>Musculium securis</i> (Prime 1852)	Pond fingernailclam
<i>Musculium transversum</i> (Say 1829)	Long fingernailclam
<i>Pisidium adamsi</i> Prime 1851	Adam peaclam
<i>Pisidium casertanum</i> (Poli 1791)	Ubiquitous peaclam
<i>Pisidium compressum</i> Prime 1852	Ridged-beak peaclam
<i>Pisidium conventus</i> Clessin 1877	Alpine peaclam
<i>Pisidium cruciatum</i> Sterki 1895	Ornamented peaclam
<i>Pisidium dubium</i> (Say 1817)	Greater eastern peaclam
<i>Pisidium equilaterale</i> Prime 1852	Round peaclam
<i>Pisidium fallax</i> Sterki 1896	River peaclam
<i>Pisidium ferrugineum</i> Prime 1852	Rusty peaclam
<i>Pisidium idahoense</i> Roper 1890	Giant northern peaclam
<i>Pisidium lilljeborgi</i> (Clessin 1886)	Lilljeborg peaclam
<i>Pisidium nitidum</i> Jenyns 1832	Shiny peaclam
<i>Pisidium punctatum</i> Sterki 1895	Perforated peaclam
<i>Pisidium punctiferum</i> (Guppy 1867)	Striate peaclam
<i>Pisidium rotundatum</i> Prime 1852	Fat peaclam
<i>Pisidium variabile</i> Prime 1852	Triangular peaclam
<i>Pisidium walkeri</i> Sterki 1895	Walker peaclam
<i>Sphaerium fabale</i> (Prime 1852)	River fingernailclam

Scientific Name	Common Name	Status ¹
<i>Sphaerium occidentale</i> (Lewis 1856)	Herrington fingernailclam	
<i>Sphaerium rhomboideum</i> (Say 1822)	Rhomboid fingernailclam	
<i>Sphaerium simile</i> (Say 1817)	Grooved fingernailclam	
<i>Sphaerium striatinum</i> (Lamarck 1818)	Striated fingernailclam	
Family Corbiculidae (1 species)		
<i>Corbicula fluminea</i> (Müller 1774)	Asian clam	I
Family Dreissenidae (1 species)		
<i>Dreissena polymorpha</i> (Pallas 1771)	Zebra mussel	I
CLASS GASTROPODA (74 species)		
SUBCLASS PROSOBRANCHIA		
ORDER MESOGASTROPODA		
Family Valvatidae (5 species)		
<i>Valvata bicarinata</i> Lea 1841	Two-ridge valvata	
<i>Valvata lewisi</i> Currier 1868	Fringed valvata	
<i>Valvata perdepressa</i> Walker 1906	Purplecap valvata	
<i>Valvata sincera</i> Say 1824	Mossy valvata	
<i>Valvata tricarinata</i> (Say 1817)	Threeridge valvata	
Family Viviparidae (6 species)		
<i>Campeloma crassulum</i> Rafinesque 1819	Ponderous campeloma	
<i>Campeloma decisum</i> (Say 1817)	Pointed campeloma	
<i>Lioplax sulciosa</i> (Menke 1827)	Furrowed lioplax	
<i>Viviparus georgianus</i> (Lea 1834)	Banded mysterysnail	
<i>Viviparus intertextus</i> (Say 1829)	Rotund mysterysnail	
<i>Viviparus subpurpureus</i> (Say 1829)	Olive mysterysnail	
Family Bithyniidae (1 species)		
<i>Bithynia tentaculata</i> (Linnaeus 1758)	Mud bithynia	
Family Hydrobiidae (12 species)		
<i>Amnicola limosa</i> (Say 1817)	Mud amnicola	
<i>Amnicola pilsbryi</i> Walker 1906	Lake duskysnail	
<i>Amnicola walkeri</i> Pilsbry 1898	Canadian duskysnail	
<i>Birgella subglobosus</i> (Say 1825)	Globe siltsnail	
<i>Fontigens aldrichi</i> (Call & Beecher 1886)	Hoosier amnicola	
<i>Fontigens antroecetes</i> (Hubricht 1940)		
<i>Fontigens nickliniana</i> (Lea 1838)	Watercress snail	
<i>Hoya sheldoni</i> (Pilsbry 1890)	Storm hydrobe	
<i>Probythinella lacustris</i> (Baker 1928)	Delta hydrobe	
<i>Pyrgulopsis lustrica</i> (Pilsbry 1890)	Boreal marstonia	
<i>Pyrgulopsis scalariformis</i> (Wolf 1870)	Moss pyrg	
<i>Somatogyrus depressus</i> (Tryon 1862)	Sandbar pebblesnail	
Family Pomatiopsidae (2 species)		
<i>Pomatiopsis cincinnatiensis</i> (Lea 1840)	Brown walker	
<i>Pomatiopsis lapidaria</i> (Say 1817)	Slender walker	
Family Pleuroceridae (11 species)		
<i>Elimia costifera</i> (Reeve 1861)	Corded elimia	
<i>Elimia livescens</i> (Menke 1830)	Liver elimia	
<i>Elimia semicarinata</i> (Say 1829)	Fine-ridged elimia	
<i>Leptoxis praerosa</i> (Say 1821)	Onyx rocksnail	FC, SC
<i>Leptoxis trilineata</i> (Say 1829)	Broad mudalia	
<i>Lithasia armigera</i> (Say 1821)	Armored rocksnail	FC, SC
<i>Lithasia obovata</i> (Say 1829)	Shawnee rocksnail	
<i>Lithasia verrucosa</i> (Rafinesque 1820)	Verrucose rocksnail	FC, SC
<i>Pleurocera acuta</i> Rafinesque 1831	Sharp hornsail	
<i>Pleurocera alveare</i> (Conrad 1834)	Rugged hornsail	
<i>Pleurocera canaliculata</i> (Say 1821)	Silty hornsail	

Scientific Name	Common Name	Status ¹
SUBCLASS PULMONATA		
ORDER BASOMMATOPHORA		
Family Lymnaeidae (14 species)		
<i>Acella haldemani</i> (Binney 1867)	Spindle lymnaea	
<i>Fossaria dalli</i> (Baker 1907)	Dusky fossaria	
<i>Fossaria humilis</i> (Say 1822)	Marsh fossaria	
<i>Fossaria obrussa</i> (Say 1825)	Golden fossaria	
<i>Fossaria parva</i> (Lea 1841)	Pygmy fossaria	
<i>Fossaria tazewelliana</i> (Wolf 1870)	Tazewell fossaria	
<i>Lymnaea stagnalis</i> Linnaeus 1758	Swamp lymnaea	
<i>Pseudosuccinea columella</i> (Say 1817)	Mimic lymnaea	
<i>Radix auricularia</i> (Linnaeus 1758)	Big-ear radix	I
<i>Stagnicola caperatus</i> (Say 1829)	Wrinkled marshsnail	
<i>Stagnicola catascopium</i> (Say 1817)	Woodland pondsnail	
<i>Stagnicola elodes</i> (Say 1821)	Marsh pondsnail	
<i>Stagnicola exilis</i> (Lea 1834)	Flat-whorled pondsnail	
<i>Stagnicola woodruffi</i> (Baker 1901)	Coldwater pondsnail	
Family Physidae (5 species)		
<i>Aplexa elongata</i> (Say 1821)	Lance aplexa	
<i>Physella gyrina</i> (Say 1821)	Tadpole physa	
<i>Physella heterostropha</i> (Say 1817)	Pewter physa	
<i>Physella integra</i> (Haldeman 1841)	Ashy physa	
<i>Physella virgata</i> (Gould 1855)	Protean physa	
Family Planorbidae (12 species)		
<i>Biomphalaria glabrata</i> (Say 1818)	Bloodfluke planorb	I
<i>Gyraulus deflectus</i> (Say 1824)	Flexed gyro	
<i>Gyraulus parvus</i> (Say 1817)	Ash gyro	
<i>Helisoma anceps</i> (Menke 1830)	Two-ridge rams-horn	
<i>Micromenetus dilatatus</i> (Gould 1841)	Bugle sprite	
<i>Micromenetus sampsoni</i> (Ancey 1885)		
<i>Planorbella armigera</i> (Say 1821)	Thicklip rams-horn	
<i>Planorbella campanulata</i> (Say 1821)	Bellmouth rams-horn	
<i>Planorbella pseudotrivolvis</i> (Baker 1920)		
<i>Planorbella trivolvis</i> (Say 1817)	Marsh rams-horn	
<i>Planorbella truncata</i> (Miles 1861)	Druid rams-horn	
<i>Promenetus exacuouus</i> (Say 1821)	Sharp sprite	
Family Ancylidae (6 species)		
<i>Ferrissia fragilis</i> (Tryon 1863)	Fragile ancylid	
<i>Ferrissia parallela</i> (Haldeman 1841)	Oblong ancylid	
<i>Ferrissia rivularis</i> (Say 1817)	Creeping ancylid	
<i>Laevapex diaphanus</i> (Haldeman 1841)	Cymbal ancylid	
<i>Laevapex fuscus</i> (Adams 1840)	Dusky ancylid	
<i>Rhodacmea hinkleyi</i> (Walker 1908)	Knobby ancylid	

¹ Readers may be puzzled by such dual designations for a species as endangered and extirpated or endangered and extinct. The current Illinois list of threatened and endangered mussels was compiled in 1987. Since that time, surveys have determined that some of the species on that list are probably no longer extant. Future lists will reflect such changes and species thought to be extirpated or extinct will be removed. At the present time, however, a species may continue to be listed as endangered but considered by researchers to be extirpated or extinct.

Appendix One: Native Illinois Species and Related Bibliography

Susan L. Post, Illinois Natural History Survey

ILLINOIS STATE NATURAL HISTORY SURVEY
Reprint Series No. R1174

The assemblage of living forms native to Illinois . . . are held together as a definitely organized, living whole. —Stephen A. Forbes, 1889

The Illinois State Agricultural Society was formed in 1853 and brought zoologists and botanists together in an organized natural history society. In the first transactions of the Agricultural Society, three Illinois species lists were published: *The Birds of Southern Illinois* by H. Pratten (1855), *The Mollusca of Southern Illinois* by H.A. Ulfers (1855), and *The Animals of Cook County* by R. Kennicott (1855). These were the first attempts to list the species of Illinois.

By the turn of the century, biologists from the State Laboratory of Natural History, later to become the Illinois Natural History Survey, were systematically sampling the state. These early field investigations formed the basis for understanding our ecosystems and the natural histories of the organisms found in them. Because of these early records, comparisons can be made between conditions that exist today and those that existed a century ago. From its first publication in 1876, Stephen A. Forbes' *List of Illinois Crustacea*, to its most recent, the Survey has concerned itself not only with cataloging organisms and their distributions in the state but also with the relationships of these organisms to their environments. The Survey's long existence has allowed continuity. Field studies have been and continue to be repeated at intervals, and long-term changes in populations and natural habitats have thereby been documented.

E.O. Wilson (1988) notes in his recent discussion of biological diversity that we do not know the true number of species on Earth, possibly even to the nearest order of magnitude. The same is true for Illinois. We are fairly certain of the numbers of our more visible fauna in the Phylum Cordata—the reptiles, amphibians, fishes, birds, and mammals. In other phyla, however, we are less certain. Research on many of these groups is at an early stage, and new

species are frequently found. Even though we list approximately 17,000 insects, this number is only an approximation. The nematodes, which may outnumber even the insects, are an even more difficult group to estimate. The vast majority of the species in Illinois remain unmonitored. Like the dead in Gray's *Elegy Written in a Country Churchyard*, they may pass from the Earth unnoticed and unknown.

The list of species native to Illinois that follows was not generated by a single biological survey but is the result of a search of the literature and a query of systematists familiar with the organisms of Illinois. Sources are listed in the bibliography and in the acknowledgments. The list is divided into five kingdoms: Monera, Protista, Fungi, Plantae, and Animalia (Whittaker 1959). Classification of the invertebrates follows Brusca and Brusca (1990), and plant nomenclature follows Mohlenbrock (1986).

The numbers of certain groups were impossible to estimate and are listed as unknown—the bacteria, nematodes, and protozoa. According to the Bacteriological Code (1958), bacteria cannot be described as simply as other organisms. Every individual is treated as belonging to a number of categories of consecutive rank. Only the individual is considered "real." Until the taxonomic problems have been solved, no list of species for Illinois can be constructed. Although the protozoa are divided into seven phyla (Levine et al. 1980), we have left them as the generic "protozoa." Much of protozoan systematics is still in the alpha stage, with thousands of species yet to be discovered and classified (Lee et al. 1985). Few invertebrate groups illustrate the diversity in form, habitat, and behavior found in the nematodes. An examination of virtually any organic substrate commonly yields nematode specimens representing undescribed species. The systematics of this group is in an embryonic stage.

Although the class Insecta is very large and new species are continually being described, an estimate was made by consulting specialists for each group. The species number for Coleoptera (J. Bouseman, pers. comm.), Hymenoptera (W. LaBerge, pers. comm.), and Diptera (D. Webb, pers. comm.) are only estimates. The number of Diptera was determined by randomly choosing 1,000 species from *A Catalog of the Diptera of America North of Mexico* (Stone et al. 1965) and determining how many of those occur in Illinois. This process was replicated three times and a homogeneity chi square was used to determine if the three samples could be lumped. A nonsignificant χ^2 indicated that the three samples could be combined and the mean determined. The percent of species found to occur in Illinois was multiplied by 17,000 (number of species of Diptera in North America) to estimate the number in Illinois.

Only a small fraction of the Illinois fungi are known, but estimates suggested that Illinois has at least 20,000 species (L. Crane, pers. comm.). The number of species of mites in the order Acari was estimated based on the number of mite species in Canada and the assumption that the total number of mites in Illinois would equal half the number of insect species in the state (J. Kethley, pers. comm.). In the class Aves, the number of species includes native breeding species and migrants.

Determining the numbers of species that are extirpated from the state or extinct is difficult. With the exception of the showiest birds, mammals, and flowering plants, biologists are reluctant to say with finality that a species has come to its end. The possibility always exists that a few individuals or a population will be discovered in some remote habitat. As with species numbers, we know with near certainty that some of the more conspicuous fauna have been extirpated; we are less certain about other species.

Species thought to no longer exist in Illinois are listed in Table 1A along with the source from which the determination was made. The plant list was compiled using Sheviak (1978), Paulson and Schwegman (1976), Paulson et al. (1976), and Bowles et al. (1991), and was reviewed by M.L. Bowles, J.E. Ebinger, D.M. Ketzner, G. Kruse, S. Lauzon, L.R. Phillippe, K.R. Robertson, J. Schwegman, M.K. Solecki, and J.B. Taft. The final list was reviewed by K.R. Robertson.

Included in Table 1A are species listed in the 1990 Illinois Endangered Species Protection Board's *Checklist of Endangered and Threatened Animals and Plants of Illinois* but now considered extirpated. Not included are three species of birds, two species of mammals, and one plant species that disappeared from the state and were successfully reintroduced—peregrine falcon, ruffed grouse, wild turkey, white-tailed deer, beaver, and lakeside daisy. Species that no longer occur in the United States are indicated.

The bibliography that concludes this appendix lists all publications that were used to create the list of native Illinois species and the table of extirpated species.

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LIST OF NATIVE ILLINOIS TAXA (AND NUMBERS OF SPECIES)

Kingdom Monera (112* species)

- Division Schizophyta: bacteria (number of species unknown)
- Division Cyanophyta: blue-green algae (112 species)

Kingdom Protista (1,406* species)

- Division Protozoa: (number of species unknown)
- Division Euglenophyta: euglenoids (30 species)
- Division Chrysophyta: diatoms and golden brown algae (440 species)
- Division Pyrrophyta: fire algae (20 species)
- Division Chlorophyta: green algae (507 species)
- Division Phaeophyta: brown algae (0 species)
- Division Rhodophyta: red algae (5 species)
- Division Myxomycota: plasmodial slime molds (400 species)
- Division Acrasiomycota: cellular slime molds (2 or 3 species)
- Division Plasmodiophoromycota: (1 species)

Kingdom Fungi (~ 20,000 species)

- Division Chytridiomycota: chytrids (~ 300 species)
- Division Oomycota: water molds (~ 300 species)
- Division Zygomycota: bread molds (~ 400 species)
- Division Ascomycota: sac fungi (~ 9,000 species including 500 species of lichens)
- Division Basidiomycota: club fungi (~ 5,000 species)
- Division Deuteromycota: fungi imperfecti (~ 5,000 species)

Kingdom Plantae (2,574 species)

- Division Bryophyta
 - Class Anthocerotata: hornworts (3 species)
 - Class Hepaticae: liverworts (118 species)
 - Class Musci: mosses (385 species including 2 extirpated species)
- Division Lycodiophyta: club mosses, quillworts, and spike mosses (12 species including 3 endangered species of clubmosses and 1 extirpated species of quillwort)
- Division Equisetophyta: horsetails (12 species including 3 endangered and 1 extirpated species)
- Division Filicophyta: ferns (75 species including 11 endangered, 3 threatened, and 2 extirpated species)
- Division Coniferophyta: conifers (14 species, including 4 endangered and 3 threatened species)
- Division Anthophyta: monocots and dicots (1,955 species including 275 endangered, 54 threatened, 53 extirpated, 1 extinct, and 1 extirpated but reintroduced species)

Kingdom Animalia (29,662* species)

- Phylum Porifera: sponges (14 species)
- Phylum Cnidaria: polyps and jellyfish
 - Class Hydrozoa: hydra and freshwater jellyfish (<10 species of hydra and 1 species of freshwater jellyfish)
- Phylum Platyhelminthes: flatworms (400 species)
- Phylum Nemertea: ribbon worms (1 species)
- Phylum Nematoda: nematodes (number of species unknown)
- Phylum Nematomorpha: horsehair worms (2 species)
- Phylum Acanthocephala: spiny-headed worms (27 species including 1 species found in the endangered greater prairie-chicken)
- Phylum Gastrotricha (60 species)
- Phylum Rotifera: rotifers (150–175 species)
- Phylum Entoprocta (1 species)
- Phylum Annelida: segmented worms
 - Class Oligochaeta: "earthworms" (20 terrestrial and 83 aquatic species)
 - Class Hirudinea: leeches (32 species)
 - Class Aphanoneura (3 species)
 - Class Branchiobdellida: crayfish worms (9 species)

Phylum Arthropoda

Class Chelicerata (10,598+ species)

Subclass Arachnida

- Order Scorpiones: scorpions (1 species)
- Order Araneae: spiders (530 species)
- Order Pseudoscorpionida: pseudoscorpions (28 species)
- Order Opiliones: daddy long-legs (19 species)
- Order Acari: mites and ticks (20 species of ticks and ~10,000 species of mites)

Class Myriapoda (74 species)

- Subclass Diplopoda: millipedes (29 species)
- Subclass Pauropoda: pauropods (5 species)
- Subclass Chilopoda: centipedes (37 species)
- Subclass Symphyla: symphylans (3 species)

Class Insecta (~17,000 species)

Subclass Myrientomata

- Order Proturans: proturans (6 species)

Subclass Oligoentomata

- Order Collembola: springtails (73 species)

Subclass Diplurata

- Order Diplura: diplurans (6–10 species)

Subclass Zygoentomata

- Order Thysanura: silverfish (6+ species)

Subclass Pterygota

- Order Ephemeroptera: mayflies (126 species)
- Order Odonata: dragonflies (98 species) and damselflies (44 species)
- Order Blattodea: cockroaches (9 species)
- Order Mantodea: mantids (1 species)
- Order Isoptera: termites (5 species)
- Order Plecoptera: stoneflies (57 species)
- Order Orthoptera: grasshoppers, crickets, and katydids (157 species)
- Order Dermaptera: earwigs (3 species)
- Order Phasmida: walking sticks (5 species)
- Order Zoraptera: zorapterans (1 species)
- Order Psocoptera: book and bark lice (91 species)
- Order Hemiptera: true bugs (910 species)
- Order Thysanoptera: thrips (200 species)
- Order Anoplura: sucking lice (18 native and 19 nonnative [from domestic animals and man] species)
- Order Mallophaga: biting lice (280 species including 1 extinct species that occurred on the passenger pigeon)
- Order Homoptera: plant bugs (1,485 species)
- Order Strepsiptera: twisted-wing insects (15–20 species)
- Order Coleoptera: beetles (5,000 species)
- Order Neuroptera: lacewings, antlions, alderflies (45 species including 1 extirpated species)
- Order Hymenoptera: bees, ants, wasps (2,000+ species)
- Order Mecoptera: scorpionflies (18 species)
- Order Siphonaptera: fleas (33 species including 1 species that occurs on the endangered Eastern wood rat)
- Order Diptera: true flies, mosquitoes, and gnats (4,100 species)
- Order Trichoptera: caddisflies (184 species)
- Order Lepidoptera: butterflies and moths (2,000 species including 1 endangered, 2 threatened, and 5 extirpated species)

Subphylum Crustacea

Class Branchiopoda (52 species)

- Order Anostraca: fairy shrimp (4 species)
- Order Cladocera: water fleas (~43 species)
- Order Conchostraca: clam shrimp (5 species)

Class Maxillopoda (84 species)

- Subclass Ostracoda: seed shrimp (53 species)
- Subclass Copepoda (21 species)
- Subclass Branchiura: fish lice (10 species)

- Class Malacostraca (71 species)
 Order Decapoda: crayfish (23 species including 4 endangered and 2 extirpated species)
 Order Isopoda: pillbugs (28 species including 1 endangered species)
 Order Amphipoda: scuds (19 species including 5 endangered and 1 threatened species)
 Order Musida: opossum shrimp (1 species)
- Phylum Pentastomida: tongue worms (no species found in native fauna)
- Phylum Tardigrada: water bears (13 species)
- Phylum Mollusca
 Class Gastropoda: snails (170 species including 1 endangered species)
 Class Bivalvia: mussels and clams (104 species including 29 endangered, 4 threatened, 16 extirpated, and 4 extinct species)
- Phylum Ectoprocta (9 species)
- Phylum Chordata
 Subphylum Vertebrata
 Class Agnatha: lampreys and jawless fish (6 species including 1 endangered and 1 threatened species)
 Class Osteichthyes: boney fishes (181 species including 12 endangered, 14 threatened, and 12 extirpated species)
 Class Amphibia: amphibians (39 species including 2 endangered, 1 threatened, and 1 presumed extirpated species)
 Class Reptilia: reptiles (59 species including 5 endangered, 4 threatened, and 1 presumed extirpated species)
 Class Aves: birds (297 native breeding and migrant species including 37 endangered, 6 threatened, 8 extirpated, 4 extinct, and 3 extirpated but reintroduced species)
 Class Mammalia: mammals (67 species including 7 endangered, 3 threatened, 9 extirpated, and 2 extirpated but reintroduced species)
- Total number of species: 53,754+
 Total number of extirpated species: 115
 Total number of threatened and endangered species: 497

Table 1A. Native Illinois species presumed extirpated.

Scientific name	Common name	Source
KINGDOM PLANTAE		
Division Bryophyta		
<i>Brachylema subulatum</i> (P. Beauvois)		
Schimper ex Cardot	Moss	McKnight pers. comm.
<i>Neckera pennata</i> Hedwig	Moss	McKnight pers. comm.
Division Lycodiophyta		
<i>Isoetes engelmannii</i> A. Braun	Englemann's quillwort	Mohlenbrock 1967
Division Equisetophyta		
<i>Equisetum palustre</i> L.	Marsh horsetail	Bowles et al. 1991
Division Filicophyta		
<i>Asplenium ruta-muraria</i> L.	Wall-rue spleenwort	Mohlenbrock 1967
<i>Woodwardia virginica</i> (L.) J.E. Smith	Chain fern	Bowles et al. 1991
Division Anthophyta		
<i>Apios priceana</i> Robinson	Price's groundnut	Schwegman pers. comm.
<i>Arabis drummondii</i> Gray	Rock cress	Swink & Wilhelm 1979
<i>Arethusa bulbosa</i> L.	Dragon's mouth	Sheviak 1974
<i>Bacopa acuminata</i> (Walter) B.L. Robinson	Purple hedge-hyssop	Bowles et al. 1991
<i>Baptisia tinctoria</i> (L.) R. Brown	Yellow wild indigo	Bowles et al. 1991
<i>Carex cumulata</i> (Bailey) Fernald	Sedge	Bowles et al. 1991
<i>Carex plantaginea</i> Lamarck	Sedge	Bowles et al. 1991
<i>Cinna latifolia</i> (Trevisanus) Grisebach	Drooping wood reed	Bowles et al. 1991
<i>Cirsium picheri</i> (Torrey & Eaton) Torrey & Gray	Dune thistle	Bowles pers. comm.
<i>Clintonia borealis</i> (Aiton) Rafinesque	Bluebead lily	Swink 1988
<i>Corallorhiza trifida</i> Chatelain	Pale coral root orchid	Sheviak 1974
<i>Daucus pusillus</i> Michaux	Small wild carrot	Bowles et al. 1991

Scientific name	Common name	Source
<i>Delphinium carolinianum</i> Walter var. <i>penardii</i> (Huth) Warnock	Prairie larkspur	Mohlenbrock 1981
<i>Elatine brachysperma</i> Gray	Waterwort	Mohlenbrock 1978
<i>Eleocharis caribaea</i> (Rottboell) Blake	Spike rush	Mohlenbrock 1976
<i>Eleocharis equisetoides</i> (Elliott) Torrey	Horsetail spike rush	Bowles et al. 1991
<i>Epigaea repens</i> L. var. <i>glabrifolia</i> Fernald	Trailing arbutus	Swink & Wilhelm 1979
<i>Erianthus brevibarbis</i> Michaux	Brown plume grass	Mohlenbrock 1973
<i>Fuirena scirpoides</i> Michaux	Umbrella grass	Bowles et al. 1991
<i>Gaillardia aestivalis</i> (Walter) Rock	Blanket flower	Mohlenbrock 1986
<i>Geum rivale</i> L.	Purple avens	Bowles et al. 1991
<i>Glyceria canadensis</i> (Michaux) Trinius	Rattlesnake manna grass	Bowles et al. 1991
<i>Gnaphalium macounii</i> Greene	Western cudweed	Bowles et al. 1991
<i>Gratiola aurea</i> Muhlenberg	Goldenpert	Swink & Wilhelm 1979
<i>Hippuris vulgaris</i> L.	Mare's tail	Swink & Wilhelm 1979
<i>Hypericum ellipticum</i> Hooker	St. John's wort	Mohlenbrock 1978
<i>Linnaea borealis</i> L. ssp. <i>americana</i> (Forbes) Hulten	Twinflower	Swink & Wilhelm 1979
<i>Malaxis monophylla</i> (L.) Swartz	Adder's mouth orchid	Sheviak 1978
<i>Malaxis unifolia</i> Michaux	Adder's mouth orchid	Sheviak 1978
<i>Nemopanthus mucronata</i> (L.) Trelease	Mountain holly	Mohlenbrock 1978
<i>Oryzopsis asperifolia</i> Michaux	Rice grass	Mohlenbrock 1972
<i>Oryzopsis pungens</i> (Torrey) Hitchcock	Rice grass	Mohlenbrock 1972
<i>Paspalum lentiferum</i> Lamarck	Bead grass	Bowles et al. 1991
<i>Plantago heterophylla</i> Nuttall	Small plantain	Bowles et al. 1991
<i>Platanthera (Habenaria) dilatata</i> (Pursh) Hooker	White orchid	Sheviak 1974
<i>Platanthera (Habenaria) hookeri</i> Torrey	Hooker's orchid	Bowles et al. 1991
<i>Platanthera (Habenaria) orbiculata</i> (Pursh) Torrey	Round-leaved orchid	Sheviak 1974
<i>Polygala paucifolia</i> Willdenow	Flowering wintergreen	Swink & Wilhelm 1979
<i>Potamogeton epihydrus</i> Rafinesque	Pondweed	Mohlenbrock 1970a
<i>Potamogeton vaseyi</i> J.W. Robbins	Pondweed	Bowles et al. 1991
<i>Ranunculus ambigens</i> S. Watson	Spearwort	Bowles et al. 1991
<i>Ranunculus gmelinii</i> DC. var. <i>hookeri</i> (D. Don) L. Benson	Small yellow crowfoot	Swink & Wilhelm 1979
<i>Schedonnardus paniculatus</i> (Nuttall) Trelease	Tumble grass	Mohlenbrock 1972
<i>Scheuchzeria palustris</i> L. var. <i>americana</i> Fernald	Arrow grass	Bowles et al. 1991
<i>Scirpus microcarpus</i> Presl	Bulrush	Bowles et al. 1991
<i>Scirpus pedicellatus</i> Fernald	Bulrush	Bowles et al. 1991
<i>Scirpus subterminalis</i> Torrey	Bulrush	Swink & Wilhelm 1979
<i>Sparganium minimum</i> (Hartman) Fries	Least bur-reed	Mohlenbrock 1970a
<i>Thismia americana</i> N.E. Pfeiffer ¹	Thismia	Mohlenbrock 1983
<i>Trautvetteria caroliniensis</i> (Walter) Vail	False bugbane	Mohlenbrock 1981
<i>Trifolium stoloniferum</i> Eaton	Running buffalo grass	Schwegman 1989
<i>Trillium cernuum</i> L.	Nodding trillium	Bowles et al. 1991
<i>Valerianella patellaria</i> (Sullivant) Wood	Corn salad	Sheviak 1978

KINGDOM ANIMALIA

Phylum Arthropoda

Class Insecta

<i>Columbicola extinctus</i> Malcomson	Chewing louse on passenger pigeon	Malcomson 1937
<i>Hesperia dacotae</i> (Skinner)	Dakota skipper	Sternburg pers. comm.
<i>Notodonta simplaria</i> Graef	Simple promenant	Godfrey pers. comm.
<i>Pieris napi oleracea</i> (Harris)	Mustard white	Irwin & Downy 1973
<i>Schinia indiana</i> (J.B. Smith)	Indiana schinia	Godfrey pers. comm.
<i>Speyeria diana</i> (Cramer)	Diana fritillary	Irwin & Downy 1973
<i>Symphobius occidentalis</i> Fitch	Brown lacewing	Macleod pers. comm.

Class Malacostraca

<i>Cambarus robustus</i> Girard	Lusty crayfish	Page 1985
<i>Macrobrachium ohione</i> (Smith)	Ohio shrimp	Page 1985

Scientific name	Common name	Source
Phylum Mollusca		
Class Bivalvia		
<i>Epioblasma flexuosa</i> (Rafinesque) ¹	Leafshell	Cummings 1991
<i>Epioblasma obliquata</i> (Rafinesque)	Catspaw	Cummings 1991
<i>Epioblasma personata</i> (Say) ¹	Round combshell	Cummings 1991
<i>Epioblasma propinqua</i> (Lea) ¹	Tennessee riffleshell	Cummings 1991
<i>Epioblasma rangiana</i> (Lea)	Northern riffleshell	Cummings 1991
<i>Epioblasma sampsonii</i> (Lea) ¹	Wabash riffleshell	Cummings 1991
<i>Epioblasma torulosa</i> (Rafinesque)	Tubercled blossom	Cummings 1991
<i>Fusconaia subrotunda</i> (Lea)	Long-solid	Cummings 1991
<i>Hemistena lata</i> (Rafinesque)	Cracking pearlymussel	Cummings 1991
<i>Lampsilis abrupta</i> (Say)	Pink mucket	Cummings 1991
<i>Leptodea leptodon</i> (Rafinesque)	Scaleshell	Cummings 1991
<i>Obovaria retusa</i> (Lamarck)	Ring pink	Cummings 1991
<i>Plethobasus cicatricosus</i> (Say)	White wartyback	Cummings 1991
<i>Pleurobema plenum</i> (Lea)	Rough pigtoe	Cummings 1991
<i>Quadrula fragosa</i> (Conrad)	Winged mapleleaf	Cummings 1991
<i>Villosa fabalis</i> (Lea)	Rayed bean	Cummings 1991
Phylum Cordata		
Class Osteichthyes		
<i>Atractosteus spatula</i> (Lacépède)	Alligator gar	Burr 1991
<i>Coregonus nigripinnis</i> (Gill)	Blackfin cisco	Smith 1979
<i>Crystallaria asprella</i> (Jordan)	Crystal darter	Smith 1979
<i>Esox masquinongy</i> Mitchill	Muskellunge	Smith 1979
<i>Etheostoma histrio</i> Jordan & Gilbert	Harlequin darter	Burr 1991
<i>Hypopsis amblops</i> (Rafinesque)	Bigeye chub	Burr 1991
<i>Ichthyomyzon bdellium</i> (Jordan)	Ohio lamprey	Smith 1979
<i>Lythrurus ardens</i> (Cope)	Rosefin shiner	Smith 1979
<i>Noturus stigmosus</i> Taylor	Northern madtom	Burr 1991
<i>Percina evides</i> (Jordan & Copeland)	Gilt darter	Smith 1979
<i>Percina uranidea</i> (Jordan & Gilbert)	Stargazing darter	Smith 1979
<i>Pteronotropis hubbsi</i> (Bailey & Robison)	Bluehead shiner	Burr 1991
Class Amphibia		
<i>Cryptobranchus alleganiensis</i> (Daudin)	Hellbender	Morris pers. comm.
Class Reptilia		
<i>Nerodia fasciata</i> (Linnaeus)	Broad-banded watersnake	Morris pers. comm.
Class Aves		
<i>Ajaia ajaja</i> (Linnaeus)	Roseate spoonbill	Bohlen 1989
<i>Campephilus principalis</i> (Linnaeus) ¹	Ivory-billed woodpecker	Bohlen 1989
<i>Conuropsis carolinensis</i> (Linnaeus) ¹	Carolina parakeet	Bohlen 1989
<i>Corvus corax</i> Linnaeus	Common raven	Bohlen 1989
<i>Cygnus buccinator</i> Richardson	Trumpeter swan	Bohlen 1989
<i>Ectopistes migratorius</i> (Linnaeus) ¹	Passenger pigeon	Bohlen 1989
<i>Numenius borealis</i> (Forster) ¹	Eskimo curlew	Bohlen 1989
<i>Tympanuchus phasianellus</i> (Linnaeus)	Sharp-tailed grouse	Bohlen 1989
Class Mammalia		
<i>Bison bison</i> (Linnaeus)	Bison	Hoffmeister 1989
<i>Canis lupus</i> Linnaeus	Gray wolf	Hoffmeister 1989
<i>Cervus elaphus</i> Linnaeus	Elk	Hoffmeister 1989
<i>Erethizon dorsatum</i> (Linnaeus)	Porcupine	Hoffmeister 1989
<i>Felis concolor</i> Linnaeus	Mountain lion	Hoffmeister 1989
<i>Martes americana</i> (Turton)	Marten	Hoffmeister 1989
<i>Martes pennanti</i> (Erxleben)	Fisher	Hoffmeister 1989
<i>Peromyscus gossypinus</i> (Le Conte)	Cotton mouse	Hoffmeister 1989
<i>Ursus americanus</i> Pallas	Black bear	Hoffmeister 1989

¹This species no longer occurs in the United States.

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Appendix Two



County reference map. Readers who wish to identify counties on maps shown in the text will find this map a convenient reference.