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Conservation Status of Freshwater Mussels of the United States and Canada

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ABSTRACT

The American Fisheries Society (AFS) herein provides a list of all native freshwater mussels (families Margaritiferidae and Unionidae) in the United States and Canada. This report also provides state and provincial distributions; a comprehensive review of the conservation status of all taxa; and references on biology, conservation, and distribution of freshwater mussels. The list includes 297 native freshwater mussels, of which 213 taxa (71.7%) are considered endangered, threatened, or of special concern. Twenty-one taxa (7.1%) are listed as endangered but possibly extinct, 77 (20.6%) as endangered but extant, 43 (14.5%) as threatened, 72 (24.2%) as of special concern, 14 (4.7%) as undetermined, and only 70 (23.6%) as currently stable. The primary reasons for the decline of freshwater mussels are habitat destruction from dams, channel modification, siltation, and the introduction of nonindigenous mollusks. The high numbers of imperiled freshwater mussels in the United States and Canada, which harbor the most diverse fauna in the world, portend a trajectory toward an extinction crisis that, if unchecked, will severely impoverish one of our richest components of aquatic biodiversity.

Freshwater mussels (also called *naiads*, *unionids*, or *clams*) of the families Margaritiferidae and Unionidae are worldwide in distribution but reach their greatest diversity in North America with about 297 recognized taxa (281 species and 16 subspecies). Adults range in size from 4 cm to more than 30 cm and occupy a wide range of habitats but are most often associated with lotic waters. Mussels are planktivores and serve as food for fishes and other vertebrate predators.

Freshwater mussels were used by Native Americans for food, source material for tools, and ornamental objects. Their importance to Native Americans is revealed by the large shell mounds associated with villages located along streams with abundant mussel populations (Parmalee and Klippel 1974). Until the advent of plastics, mussels represented an important commercial fishery in which shells were used in the manufacture of buttons (Coker 1919). Today, the commercial value of freshwater mussels revolves around the use of shell for

production of seed pearls in the cultured pearl industry.

During the past 30 years, numbers both of individuals and species diversity of native mussels have declined throughout the United States and Canada. Freshwater mussels (as well as other aquatic species) are imperiled disproportionately relative to terrestrial species. For example, The Nature Conservancy recognized 55% of North America's mussels as extinct or imperiled compared to only 7% of the continent's bird and mammal species (Master 1990). This alarming decline, the severity of which was not recognized until recently, is primarily the result of habitat destruction and degradation associated with adverse anthropogenic activities.

On recognizing the decline of native mussels, the AFS Endangered Species Committee initiated a comprehensive review of the current status of mussels to inform the conservation and fisheries communities and to assist managers in forming protection and recovery plans. In this paper, our purpose is to provide (1) state and provincial distributions, (2) a comprehensive review of conservation status for all native freshwater mussels in the United States and Canada, and (3) a list of biology, conservation, and distribution references for freshwater mussels in the United States and Canada.

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Threats

Threats to endangered species generally are categorized under headings such as habitat destruction, overutilization for commercial or other purposes, disease, predation, introduction of nonindigenous species, pollution, hybridization, and restricted range. The decline of freshwater mussels during the past century has involved a variety of threats, the single most important being the destruction of habitat. While habitat destruction continues, expansion of the distribution and populations of nonindigenous mollusks such as the Asian clam, *Corbicula fluminea*, and zebra mussel, *Dreissena polymorpha*, appear poised to decimate many of the remaining native mussel populations.

Mussels are sessile organisms and are considered good indicators of the health of aquatic ecosystems. They are dependent on good water quality and physical habitat conditions and an environment that will support populations of host fish. Destruction of mussel habitat has ranged from the obvious—dams, dredging, and channelization—to the more subtle—siltation and contaminants. Dams change the physical, chemical, and biological environment of

streams, both upstream and downstream of the structure, to the point that approximately 30% to 60% of the mussel fauna is destroyed (Layzer et al. 1993; Williams et al. 1992). The most detrimental effect of dams is likely the disruption of the reproductive cycle by eliminating host species.

Erosion, caused in part by deforestation, poor agricultural practices, and destruction of riparian zones, has led to both increased silt loads and shifting, unstable stream bottoms. Siltation and contaminants, such as heavy metals, pesticides, and acid mine drainage, have long been recognized as threats to mussels (Ortmann 1909; Ellis 1931). An outstanding review of the effects of habitat alteration on mussels can be found in Fuller (1974).

The introduction and spread of nonindigenous mollusks has contributed to the demise of native freshwater mussels. The Asian clam, first introduced to the West Coast in the 1930s, is the most widespread nonindigenous aquatic bivalve mollusk in North America (McMahon 1983). The high densities (up to thousands per square meter) of *Corbicula* in some areas also have been implicated in the decline of native unionids. Harm to native mussels resulting from the invasion of Asian clams may vary



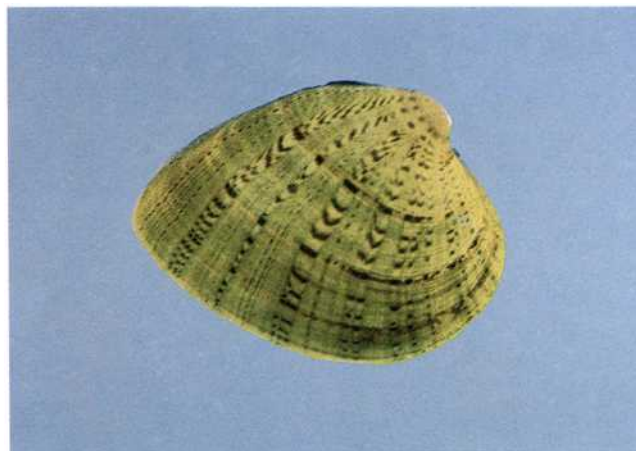
The minnow-like mantle of the pocketbook, *Lampsilis ovata*, lures fish, who act as swimming nurseries for baby mussels.



Ouachita rock-pocketbook, *Arkansia wheeleri*. Endangered. Ouachita River, Arkadelphia [Clark] County, AR. Length: 2.75 in (7.05 cm). A. A. Hinkley collection.



Western fanshell, *Cyprogenia aberti*. Threatened. White River, Norfolk [Baxter] County, AR. Length: 2.25 in (5.77 cm). A. A. Hinkley collection.



Butterfly, *Ellipsaria lineolata*. Special Concern. Mississippi River, Rock Island County, IL. Length: 2.125 in (5.45 cm). K. D. Blodgett et al. collection.

geographically and with time (Belanger et al. 1990; Leff et al. 1990).

The most recent nonindigenous bivalve introduction, the zebra mussel, may prove to be the death knell for many species of freshwater mussels. First discovered in Lake St. Clair in 1988, the zebra mussel quickly spread throughout most of the Great Lakes. In early 1991, it was discovered in the Illinois River, the first record outside of the Great Lakes drainage. By late 1991, the zebra mussel had been reported as far south as the lower portion of the Ohio and Tennessee rivers (Nalepa and Schloesser 1992); recently, it has been found in the lower Mississippi River in southern Louisiana. Ultimately, the range of the zebra mussel may include most of the United States and southern Canada.

Commercial Harvesting

During the past decade a resurgence has occurred in commercial harvest of native mussels for the cultured pearl trade. Most shells harvested are sold to the Japanese pearl industry, where they are cut and ground into beads that form the nucleus of cultured pearls. The increased demand for shell during the past three to five years pushed shell prices in the United States to \$6 per pound on the Japanese market. The preferred source for thick, high quality shells is from wild mussel populations in the United States. The high price for raw shell resulted in as many as 75 to 100 commercial mussel boats simultaneously harvesting single reservoirs. In 1991, the total tonnage exported to Japan was 9,000 short tons, but demand has declined during the past two years and leveled at about 4,500 short tons (Baker 1993). The value of the mussel and cultured pearl business has attracted the interest of the U.S. aquaculture industry (Fassler 1991a, 1991b).

No federal regulations restrict the harvest of native mussels unless species are listed as endangered or threatened under the Endangered Species Act. In response to the increased harvest and shell value, several states have implemented regulations with species, size, location, and season restrictions. The impacts of intensive harvesting are unknown, but some states have initiated monitoring programs to obtain data on the potential threats of this activity.

Although the amount of shell harvested is a potential threat, a more immediate concern is the method used to harvest shell. The two primary harvest methods used are diving and brailing. Dive gear usually involves surface-based air compressors with hookah regulators and to a lesser extent SCUBA. Dive methods allow the sheller to find dense mussel concentrations and selectively harvest legal-size specimens of the approximately 15 commercially valuable species.

Brailing involves dragging a crowfoot dredge or brail across the substrate to "snag" mussels. A brail



Altamaha lance, *Elliptio shepardiana*. Threatened. Altamaha River, GA. Length: 4.5 in (11.54 cm). A. A. Hinkley collection.



Sugarspoon, *Epioblasma arcaeformis*. Endangered, possibly extinct. Cumberland River, TN. Length: 1.125 in (2.88 cm). A. A. Hinkley collection.

is a metal or wooden bar, usually 8 to 16 ft long, with long cotton, nylon, or chain stringers attached at 6- to 12-in intervals along the length of the bar. The stringers have many four-pronged, blunt or beaded tipped hooks called *crowsfeet* attached along their length. Hooks drag across the substrate, and mussels close on the metal prongs when the hooks cross the incumbent aperture. Brailing is nonselective, and undersized or unwanted mussels harvested during brailing are discarded. The survival of discarded mussels after they are removed from the brail is unknown, although one study observed that mortality of undersized mussels may be as high as 50% (Sickel 1989). The impacts of commercial harvesting on native mussel populations, including the effects of collection methods such as brailing, need further investigation.

Methods and Definitions

Our review of the conservation status of mussels includes all species and subspecies of mussels from the United States and Canada as reported in the AFS list of common and scientific names of mollusks (Turgeon et al. 1988). We deviated from Turgeon et al. (1988) in the recognition of the family Margaritiferidae (Smith and Wall 1984; Smith 1986) and the recognition of the genera *Pyganodon* and *Utterbackia*, which were removed from the genus *Anodonta* (Hoeh 1990; W. R. Hoeh, University of Michigan, doctoral dissertation). We also corrected a few errors in spelling of common and scientific names in Turgeon et al. (1988). The status and distribution information was derived from a variety of sources such as state and regional endangered species lists, research publications, and books. We also relied on information and original data from biologists actively working on mussels.

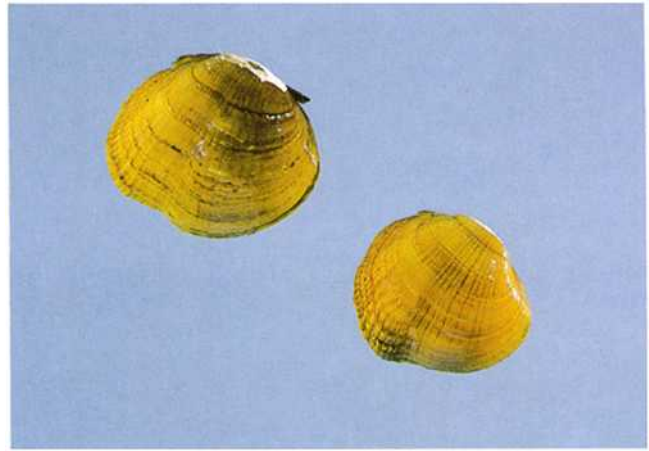
The AFS Endangered Species Committee has reviewed existing distribution and status information and is responsible for the opinions expressed here. The assignment of status categories is based on the status of the taxon throughout its range without regard for political boundaries or considerations. We reviewed species on the federal list of endangered and threatened species and are in agreement with those status classifications. There are several species that currently are under study and consideration for listing by the U.S. Fish and Wildlife Service. The status we have assigned these species may change upon completion of detailed status reviews.

The conservation status categories are defined as follows: Endangered (*E*)—A species or subspecies in danger of extinction throughout all or a significant portion of its range—an asterisk (*) following the letter “*E*” indicates the taxon is possibly extinct; Threatened (*T*)—A species or subspecies that is likely to become endangered throughout all or a significant portion of its range; Special Concern (*SC*)—A species or subspecies that may become endangered or threatened by relatively minor disturbances to its habitat, and deserves careful monitoring of its abundance and distribution; Undetermined (*U*)—A species or subspecies whose historic and current distribution and abundance has not been evaluated in recent years; Currently Stable (*CS*)—A species or subspecies whose distribution and abundance may be stable, or it may have declined in portions of its range but is not in need of immediate conservation management actions.

For each mussel, the list includes common and scientific names, the author who described the species, status in bold letters, and historic distribution by state or province (or an indication of presence in Mexico). We follow the list of standard two-letter abbreviations for states and provinces given in Williams et al. (1989).



Yellow blossom, *Epioblasma florentina florentina*. Endangered, possibly extinct. Duck River, TN. Length: 2.0 in (5.13 cm) for male (top); 2.125 in (5.45 cm) for female (bottom). A. A. Hinkley collection.



Acornshell, *Epioblasma haysiana*. Endangered, possibly extinct. Tennessee River, Florence [Lauderdale] County, AL. Length: 1.25 in (3.20 cm) for male (top); 1.125 in (2.88 cm) for female (bottom). A. A. Hinkley collection.

List of Taxa

The list of mussel species and subspecies is arranged alphabetically by genus and by species and subspecies within the genus. Following the common and scientific name, the conservation status is given using a letter code, *E* = Endangered; *E** = Endangered, Possible Extinct; *T* = Threatened; *SC* = Special Concern; *U* = Undetermined; and *CS* = Currently Stable. The known historical distribution is listed by states of the United States and provinces of Canada. Taxa known to occur southward into Mexico are so indicated.

Freshwater Mussels

Family—Margaritiferidae

Cumberlandia

Spectaclecase, *C. monodonta* (Say). *T.* AL, AR, IA, IL, IN, KY, MN, MO, OH, TN, VA, WI

Margaritifera

Western pearlshell, *M. falcata* (Gould). *U.* AK, CA, ID, MT, NM, NV, OR, UT, WA, WY. Canada, BC
Louisiana pearlshell, *M. hembeli* (Conrad). *T.* LA
Eastern pearlshell, *M. margaritifera* (Linnaeus). *SC.* CT, MA, ME, NH, NY, PA, RI, VT. Canada, NB, NF, NS, PE, PQ
Alabama pearlshell, *M. marrianae* R. I. Johnson. *E.* AL

Family—Unionidae

Actinonaias

Mucket, *A. ligamentina* (Lamarck). *CS.* AL, AR, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, NY, OH, OK, PA, TN, VA, WI, WV. Canada, ON
Pheasantshell, *A. pectorosa* (Conrad). *SC.* AL, KY, TN, VA

Alasmidonta

Altamaha arc-mussel, *A. arcula* (I. Lea). *T.* GA
Cumberland elktoe, *A. atropurpurea* (Rafinesque). *E.* KY, TN
Dwarf wedge mussel, *A. heterodon* (I. Lea). *E.* CT, DE, MA, MD, NC, NH, NJ, NY, PA, VA, VT. Canada, NB
Coosa elktoe, *A. mccordi* Athearn. *E**. AL
Elktoe, *A. marginata* Say. *SC.* AL, AR, IA, IL, IN, KS, KY, MD,

MI, MN, MO, ND, NY, OH, OK, PA, SD, TN, VA, WI, WV. Canada, ON
Appalachian elktoe, *A. raveneliana* (I. Lea). *E.* NC, TN
Carolina elktoe, *A. robusta* Clarke. *E**. NC, SC
Triangle floater, *A. undulata* (Say). *SC.* AL, CT, DE, FL, GA, MA, MD, ME, NC, NH, NJ, NY, PA, RI, SC, VA, VT, WV. Canada, NB, NS, ON, PQ
Brook floater, *A. varicosa* (Lamarck). *T.* CT, DE, GA, MA, MD, ME, NC, NH, NJ, NY, PA, RI, SC, VA, VT, WV. Canada, NB, NS
Slippershell mussel, *A. viridis* (Rafinesque). *SC.* AL, IA, IL, IN, KS, KY, MD, MI, MO, MS, NC, NY, OH, SD, TN, VA, WI. Canada, ON
Ochlockonee arc-mussel, *A. wrightiana* (Walker). *E**. FL

Amblema

Fat threeridge, *A. neislerii* (I. Lea). *E.* FL, GA
Roundlake, *A. plicata perplicata* (Conrad). *CS.* AL, AR, FL, GA, LA, MS, TN, TX
Threeridge, *A. p. plicata* (Say). *CS.* AL, AR, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, ND, NY, OH, OK, PA, SD, TN, TX, VA, WI, WV. Canada, MB, SK, ON

Anodonta

Yukon floater, *A. beringiana* Middendorff. *U.* AK. Canada, YT, BC
California floater, *A. californiensis* I. Lea. *U.* AZ, CA, ID, NV, OR, UT, WA, WY. Mexico
Barrel floater, *A. couperiana* I. Lea. *CS.* FL, GA, NC, SC
Alewife floater, *A. implicata* Say. *CS.* CT, DE, MA, MD, ME, NC, NH, NJ, NY, PA, RI, SC, VA, VT. Canada, NB, NS, PQ
Western floater, *A. kennerlyi* I. Lea. *U.* OR, WA. Canada, AB, BC
Winged floater, *A. nuttalliana* I. Lea. *U.* ID, UT. Canada, BC
Oregon floater, *A. oregonensis* I. Lea. *U.* CA, OR, UT, WA
Flat floater, *A. suborbiculata* Say. *CS.* AL, AR, FL, IA, IL, IN, KS, KY, LA, MO, MS, OH, OK, TN, TX, WI

Anodontoides

Cylindrical papershell, *A. ferussacianus* (I. Lea). *CS.* AR, CO, IA, IL, IN, KS, KY, MI, MN, MO, ND, NE, OH, OK, PA, SD, TN, WI, WY. Canada, MB, ON, PQ, SK
Rayed creekshell, *A. radiatus* (Conrad). *SC.* AL, FL, GA, LA, MS

Arcidens

Rock-pocketbook, *A. confragosus* (Say). *CS.* AL, AR, IA, IL, IN, KS, KY, LA, MN, MO, MS, OH, OK, SC, TN, TX, WI, WV

Arkansia

Ouachita rock-pocketbook, *A. wheeleri* Ortmann and Walker. E. AR, OK

Cyclonaias

Purple wartyback, *C. tuberculata* (Rafinesque). SC. AL, AR, IA, IL, IN, KY, MI, MN, MO, OH, OK, PA, TN, VA, WI, WV. Canada, ON

Cyprogenia

Western fanshell, *C. aberti* (Conrad). T. AR, KS, MO, OK
Fanshell, *C. stegaria* (Rafinesque). E. AL, IL, IN, KY, OH, PA, TN, VA, WV

Cyrtonaias

Tampico pearlymussel, *C. tampicoensis* (I. Lea). CS. TX. Mexico

Disconaias

Salina mucket, *D. salinasensis* (Simpson). T. TX. Mexico

Dromus

Dromedary pearlymussel, *D. dromas* (I. Lea). E. AL, KY, TN, VA

Ellipsaria

Butterfly, *E. lineolata* (Rafinesque). SC. AL, AR, GA, IA, IL, IN, KS, KY, LA, MN, MO, MS, OH, OK, PA, TN, TX, WI, WV

Elliptio

Southern lance, *E. ahenea* (I. Lea). SC. FL
Carolina lance, *E. angustata* (I. Lea). SC. GA, MD, NC, SC, VA
Alabama spike, *E. arca* (Conrad). T. AL, GA, LA, MS, TN
Delicate spike, *E. arctata* (Conrad). SC. AL, FL, GA, MS, TN
Florida shiny spike, *E. buckleyi* (I. Lea). CS. FL
Chipola slabshell, *E. chipolaensis* Walker. T. AL, FL
Box spike, *E. cistelliformis* (I. Lea). U. NC
Eastern elliptio, *E. complanata* (Lightfoot). CS. AL, CT, DE, FL, GA, MA, MD, ME, MI, MN, NC, NH, NJ, NY, PA, RI, SC, VA, VT, WI, WV. Canada, NB, NS, ON, PQ
Carolina slabshell, *E. congaraea* (I. Lea). SC. GA, NC, SC, VA
Elephant-ear, *E. crassidens* (Lamarck). CS. AL, FL, GA, IA, IL, IN, KY, LA, MN, MO, MS, OH, OK, PA, TN, VA, WI, WV
Georgia elephant-ear, *E. dariensis* (I. Lea). SC. GA
Spike, *E. dilatata* (Rafinesque). CS. AL, AR, GA, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, NC, OH, OK, PA, TN, VA, WI, WV. Canada, ON
Satilla elephant-ear, *E. downiei* (I. Lea). SC. FL, GA
Northern lance, *E. fisheriana* (I. Lea). SC. DE, MD, PA, VA
Pod lance, *E. folliculata* (I. Lea). SC. GA, NC, SC
Brother spike, *E. fraterna* (I. Lea). E. AL, GA, SC
Altamaha slabshell, *E. hopetonensis* (I. Lea). SC. GA
Variable spike, *E. icterina* (Conrad). CS. AL, FL, GA, NC, SC, VA
Flat spike, *E. jayensis* (I. Lea). U. FL, GA
Yellow lance, *E. lanceolata* (I. Lea). E. NC, VA
Fluted elephant-ear, *E. mcMichaeli* Clench and Turner. SC. AL, FL
Cape Fear spike, *E. marsupiobesa* Fuller. CS. NC
Winged spike, *E. nigella* (I. Lea). E. AL, GA
Atlantic spike, *E. producta* (Conrad). SC. GA, MD, NC, SC, VA
Carolina spike, *E. raveneli* (Conrad). CS. GA, NC, SC
Roanoke slabshell, *E. roanokensis* (I. Lea). SC. GA, NC, SC, VA
Altamaha lance, *E. shepardiana* (I. Lea). T. GA
Altamaha spiny mussel, *E. spinosa* (I. Lea). E. GA
Tar spiny mussel, *E. steinstansana* R. I. Johnson and Clarke. E. NC
Waccamaw spike, *E. waccamawensis* (I. Lea). SC. NC, SC
Florida lance, *E. waltoni* (Wright). T. FL

Elliptioideus

Purple bankclimber, *E. sloatianus* (I. Lea). T. AL, FL, GA

Epioblasma

Sugarspoon, *E. arcaeformis* (I. Lea). E*. AL, KY, TN
Angled riffleshell, *E. biemarginata* (I. Lea). E*. AL, KY, TN
Cumberlandian combshell, *E. brevidens* (I. Lea). E. AL, KY, TN, VA
Oyster mussel, *E. capsaeformis* (I. Lea). E. AL, KY, TN, VA
Leafshell, *E. flexuosa* (Rafinesque). E*. AL, IL, IN, KY, OH, TN
Curtis pearlymussel, *E. florentina curtisi* (Utterback). E. AR, MO
Yellow blossom, *E. f. florentina* (I. Lea). E*. AL, KY, TN
Tan riffleshell, *E. f. walkeri* (Wilson and H. W. Clark). E. KY, TN, VA
Acornshell, *E. haysiana* (I. Lea). E*. AL, KY, TN, VA
Narrow catspaw, *E. lenior* (I. Lea). E*. AL, TN
Forkshell, *E. lewisii* (Walker). E*. AL, KY, TN
Upland combshell, *E. metastrata* (Conrad). E. AL, GA, TN
Catspaw, *E. obliquata obliquata* (Rafinesque). E. AL, IL, IN, KY, OH, TN
White catspaw, *E. o. perobliqua* (Conrad). E. IL, IN, KY, MI, OH
Southern acornshell, *E. othcaloogensis* (I. Lea). E. AL, GA, TN
Southern combshell, *E. penita* (Conrad). E. AL, GA, MS
Round combshell, *E. personata* (Say). E*. IL, IN, KY, OH
Tennessee riffleshell, *E. propinqua* (I. Lea). E*. AL, IL, IN, KY, OH, TN
Wabash riffleshell, *E. sampsonii* (I. Lea). E*. IL, IN, KY
Cumberland leafshell, *E. stewardsoni* (I. Lea). E*. AL, KY, TN
Green blossom, *E. torulosa gubernaculum* (Reeve). E*. TN, VA
Northern riffleshell, *E. t. rangiana* (I. Lea). E. IL, IN, KY, MI, OH, PA, WV. Canada, ON
Tubercled blossom, *E. t. torulosa* (Rafinesque). E*. AL, IL, IN, KY, OH, TN, WV
Snuffbox, *E. triquetra* (Rafinesque). T. AL, AR, IA, IL, IN, KS, KY, MI, MO, MS, OH, PA, TN, VA, WI, WV. Canada, ON
Turgid blossom, *E. turgidula* (I. Lea). E*. AL, AR, TN

Fusconaia

Texas pigtoe, *F. askewi* (Marsh). SC. LA, OK, TX
Tennessee pigtoe, *F. barnesiana* (I. Lea). SC. AL, MS, NC, TN, VA
Gulf pigtoe, *F. cerina* (Conrad). CS. AL, LA, MS
Shiny pigtoe, *F. cor* (Conrad). E. AL, TN, VA
Fine-rayed pigtoe, *F. cuneolus* (I. Lea). E. AL, TN, VA
Ebonyshell, *F. ebena* (I. Lea). CS. AL, AR, GA, IA, IL, IN, KY, LA, MN, MO, MS, OH, OK, TN, WI
Narrow pigtoe, *F. escambia* Clench and Turner. T. AL, FL
Wabash pigtoe, *F. flava* (Rafinesque). CS. AL, AR, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, ND, NY, OH, OK, PA, SD, TN, TX, WI. Canada, MB, ON
Triangle pigtoe, *F. lananensis* (Frierson). SC. TX
Atlantic pigtoe, *F. masoni* (Conrad). T. GA, NC, SC, VA
Ozark pigtoe, *F. ozarkensis* (Call). SC. AR, KS, MO, OK
Long-solid, *F. subrotunda* (I. Lea). SC. AL, IL, IN, KY, OH, PA, TN, VA, WV
Purple pigtoe, *F. succissa* (I. Lea). SC. AL, FL

Glebula

Round pearlshell, *G. rotundata* (Lamarck). CS. AL, FL, KY, LA, MS, OK, TX

Gonidea

Western ridgemussel, *G. angulata* (I. Lea). U. CA, ID, MT, NV, OR, WA. Canada, BC

Hemistena

Cracking pearlymussel, *H. lata* (Rafinesque). E. AL, IL, IN, KY, OH, PA, TN, VA

Lampsilis

Pink mucket, *L. abrupta* (Say). E. AL, AR, IL, IN, KY, LA, MO,



Western ridgemussel, *Gonidea angulata*. Undetermined. Santa Clara County, CA. Length: 3.5 in (8.97 cm). W. A. Nason collection; ex. L. G. Yates collection.



Forkshell, *Epioblasma lewisii*. Endangered, possibly extinct. Tennessee River, TN. Length: 2.25 in (5.77 cm). A. A. Hinkley collection.

OH, PA, TN, VA, WV
 Fine-lined pocketbook, *L. altilis* (Conrad). T. AL, GA, MS, TN
 Southern sandshell, *L. australis* Simpson. T. AL, FL
 Lined pocketbook, *L. binominata* Simpson. E*. AL, GA
 Texas fatmucket, *L. bracteata* (Gould). SC. TX
 Plain pocketbook, *L. cardium* (Rafinesque). SC. AL, AR, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, OH, OK, TN, TX, WI
 Yellow lampmussel, *L. cariosa* (Say). T. CT, DE, GA, MA, ME, MD, NC, NJ, NY, PA, SC, VA. Canada, NB, NS
 Altamaha pocketbook, *L. dolabraeformis* (I. Lea). T. GA
 Wavy-rayed lampmussel, *L. fasciola* Rafinesque. CS. AL, GA, IL, IN, KY, MI, NC, OH, PA, TN, VA, WV. Canada, ON
 Waccamaw fatmucket, *L. fullerkeri* R. I. Johnson. T. NC
 Haddleton lampmussel, *L. haddletoni* Athearn. E. AL
 Higgins eye, *L. higginsii* (I. Lea). E. IA, IL, MN, MO, WI
 Louisiana fatmucket, *L. hydiana* (I. Lea). CS. AR, LA, MS, OK, TX
 Southern pocketbook, *L. ornata* (Conrad). SC. AL, AR, FL, GA, LA, MS, TN
 Pocketbook, *L. ovata* (Say). SC. AL, IL, IN, KY, MD, MS, NY, OH, PA, TN, VA, VT, WV, WY. Canada, MB, ON, PQ, SK
 Orange-nacre mucket, *L. perovalis* (Conrad). T. AL, MS
 Arkansas fatmucket, *L. powelli* (I. Lea). T. AR
 Carolina fatmucket, *L. radiata conspicua* (I. Lea). CS. NC, SC
 Eastern lampmussel, *L. r. radiata* (Gmelin). CS. CT, DE, MA, MD, ME, MI, NC, NH, NJ, NY, OH, PA, RI, SC, VA, VT, WV. Canada, NB, NS, ON, PQ
 Neosho mucket, *L. rafinesqueana* Frierson. T. AR, KS, OK, MO
 Ozark broken-ray, *L. reeviana brevicula* (Call). SC. MO
 Northern broken-ray, *L. r. brittsi* Simpson. SC. MO
 Arkansas broken-ray, *L. r. reeviana* (I. Lea). T. AR, MO
 Sandbank pocketbook, *L. satur* (I. Lea). SC. AR, LA, MS, OK, TX
 Fatmucket, *L. siliquoides* (Barnes). CS. AR, CO, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, MT, ND, OH, OK, PA, SD, WI. Canada, AB, MB, NT, ON, PQ, SK
 Rayed pink fatmucket, *L. splendida* (I. Lea). SC. GA, SC
 Southern fatmucket, *L. straminea claibornensis* (I. Lea). CS. AL, FL, GA, LA, MS, TN
 Rough fatmucket, *L. s. straminea* (Conrad). SC. AL, MS
 Speckled pocketbook, *L. streckeri* Frierson. E. AR
 Shiny-rayed pocketbook, *L. subangulata* (I. Lea). T. AL, FL, GA
 Yellow sandshell, *L. teres* (Rafinesque). CS. AL, AR, CO, FL, GA, IA, IL, IN, KS, KY, LA, MN, MO, MS, OH, OK, SD, TN, TX, WI
 Alabama lampmussel, *L. virescens* (I. Lea). E. AL, TN



Snuffbox, *Epioblasma triquetra*. Threatened. Embarras River, Douglas County, IL. Length: 2.4 in (6.15 cm) for male (top); 1.9 in (4.87 cm) for female (bottom). K. S. Cummings and C. A. Mayer collection.



Higgins eye, *Lamprolambis higginsii*. Endangered. Mississippi River, Rock Island County, IL. Length: 3.5 in (8.97 cm) for male (top); 3.0 in (7.69 cm) for female (bottom). K. D. Blodgett et al. and R. Lewis and J. Brice collections.

Lasmigona

- Alabama heelsplitter, *L. complanata alabamensis* Clarke. SC. AL, GA, MS
White heelsplitter, *L. c. complanata* (Barnes). CS. AL, AR, GA, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, ND, NE, OH, OK, PA, SD, TN, TX, WI, WV. Canada, AB, MB, ON, SK
Creek heelsplitter, *L. compressa* (I. Lea). CS. IA, IL, IN, KY, MI, MN, ND, NE, NY, OH, PA, SD, VT, WI, WV. Canada, MB, ON, PQ, SK
Fluted-shell, *L. costata* (Rafinesque). CS. AL, AR, GA, IA, IL, IN, KS, KY, MI, MN, MO, MS, ND, NY, OH, OK, PA, SD, TN, VA, VT, WI, WV. Canada, MB, ON, PQ
Carolina heelsplitter, *L. decorata* (I. Lea). E. NC, SC
Tennessee heelsplitter, *L. holstonia* (I. Lea). SC. AL, GA, NC, TN, VA
Green floater, *L. subviridis* (Conrad). T. GA, KY, MD, NJ, NY, NC, PA, SC, TN, VA, WV

Lemiox

- Birdwing pearlymussel, *L. rimosus* (Rafinesque). E. AL, TN, VA

Leptodea

- Fragile papershell, *L. fragilis* (Rafinesque). CS. AL, AR, GA, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, NE, NY, OH, OK, PA, SD, TN, TX, VA, VT, WI, WV. Canada, ON, PQ
Scaleshell, *L. leptodon* (Rafinesque). E. AL, AR, IA, IL, IN, KY, MI, MO, MS, OH, OK, SD, TN, WI
Tidewater mucket, *L. ochracea* (Say). SC. CT, DE, GA, MA, MD, ME, NC, NJ, NY, PA, RI, SC, VA. Canada, NB, NS

Lexingtonia

- Slabside pearlymussel, *L. dolabelloides* (I. Lea). T. AL, KY, TN, VA
Virginia pigtoe, *L. subplana* (Conrad). E. VA

Ligumia

- Eastern pondmussel, *L. nasuta* (Say). SC. CT, DE, MA, MD, ME, MI, NC, NH, NJ, NY, OH, PA, RI, SC, VA. Canada, ON
Black sandshell, *L. recta* (Lamarck). SC. AL, AR, GA, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, ND, NY, OH, OK, PA, SD, TN, VA, VT, WI, WV. Canada, MB, ON, PQ, SK
Pondmussel, *L. subrostrata* (Say). CS. AL, AR, IA, IL, IN, KS, KY, LA, MO, MS, OH, OK, SD, TN, TX

Medionidus

- Alabama moccasinshell, *M. acutissimus* (I. Lea). T. AL, GA, MS, TN
Cumberland moccasinshell, *M. conradicus* (I. Lea). SC. AL, GA, KY, NC, TN, VA
Tombigbee moccasinshell, *M. macglameriae* van der Schalie. E*. AL
Coosa moccasinshell, *M. parvulus* (I. Lea). E. AL, GA, TN
Gulf moccasinshell, *M. penicillatus* (I. Lea). E. AL, FL, GA
Ochlocknee moccasinshell, *M. simpsonianus* Walker. E. FL, GA
Suwannee moccasinshell, *M. walkeri* (Wright). T. FL

Megalonaias

- Round washboard, *M. boykiniana* (I. Lea). SC. AL, FL, GA
Washboard, *M. nervosa* (Rafinesque). CS. AL, AR, IA, IL, IN, KS, KY, LA, MN, MO, MS, OH, OK, SD, TN, TX, WI, WV

Obliquaria

- Threehorn wartyback, *O. reflexa* Rafinesque. CS. AL, AR, GA, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, OH, OK, PA, TN, TX, WI, WV. Canada, ON

Obovaria

- Southern hickorynut, *O. jacksoniana* (Frierson). SC. AL, AR, LA, MO, MS, OK, TX
Hickorynut, *O. olivaria* (Rafinesque). CS. AL, AR, IA, IL, IN, KS,

KY, LA, MI, MN, MO, NY, OH, PA, TN, WI. Canada, ON, PQ
Ring pink, *O. retusa* (Lamarck). E. AL, IL, IN, KY, OH, PA, TN, WV

- Round ebonyshell, *O. rotulata* (Wright). E. AL, FL
Round hickorynut, *O. subrotunda* (Rafinesque). SC. AL, IL, IN, KY, MI, MS, OH, PA, TN, WV. Canada, ON
Alabama hickorynut, *O. unicolor* (I. Lea). SC. AL, LA, MS

Pegias

- Little-wing pearlymussel, *P. fabula* (I. Lea). E. AL, KY, NC, TN, VA

Plectomerus

- Bankclimber, *P. dombeyanus* (Valenciennes). CS. AL, AR, FL, KY, LA, MO, MS, OK, TN, TX

Plethobasus

- White wartyback, *P. cicatricosus* (Say). E. AL, IL, IN, KY, OH, TN
Orange-foot pimpleback, *P. cooperianus* (I. Lea). E. AL, IL, IN, KY, OH, PA, TN
Sheepnose, *P. cyphus* (Rafinesque). T. AL, IA, IL, IN, KS, KY, MN, MO, MS, OH, PA, TN, VA, WI, WV

Pleurobema

- Highnut, *P. altum* (Conrad). E. AL, GA
Hazel pigtoe, *P. avellanum* Simpson. E. AL
Mississippi pigtoe, *P. beadleanum* (I. Lea). SC. LA, MS
Scioto pigtoe, *P. bournianum* (I. Lea). E*. OH
Painted clubshell, *P. chattanoogaense* (I. Lea). E. AL, GA, TN
Clubshell, *P. clava* (Lamarck). E. AL, IL, IN, KY, MI, OH, PA, TN, WV
Round pigtoe, *P. coccineum* (Conrad). CS. AR, IA, IL, IN, KS, KY, MI, MN, MO, OH, OK, PA, SD, TN, WI. Canada, ON
James spiny mussel, *P. collina* (Conrad). E. VA, WV
Ohio pigtoe, *P. cordatum* (Rafinesque). SC. AL, IL, IN, KY, OH, PA, TN, VA, WV
Black clubshell, *P. curtum* (I. Lea). E. AL, MS
Southern clubshell, *P. decisum* (I. Lea). E. AL, GA, MS, TN
Yellow pigtoe, *P. flavidulum* (I. Lea). U. AL, MS
Dark pigtoe, *P. furvum* (Conrad). E. AL
Southern pigtoe, *P. georgianum* (I. Lea). E. AL, GA, TN
Cumberland pigtoe, *P. gibberum* (I. Lea). E. TN
Georgia pigtoe, *P. hanleyanum* (I. Lea). E. AL, GA, TN
Alabama pigtoe, *P. johannis* (I. Lea). U. AL, GA, TN
Flat pigtoe, *P. marshalli* Frierson. E. AL, MS
Coosa pigtoe, *P. murrayense* (I. Lea). E. AL, GA, TN
Longnut, *P. nucleopsis* (Conrad). E. AL, GA
Tennessee clubshell, *P. oviforme* (Conrad). SC. AL, KY, NC, TN, VA
Ovate clubshell, *P. perovatum* (Conrad). E. AL, GA, MS, TN
Rough pigtoe, *P. plenum* (I. Lea). E. AL, IL, IN, KY, OH, PA, TN, VA
Pyramid pigtoe, *P. pyramidatum* (I. Lea). T. AL, AR, IL, IN, KY, LA, MS, OH, PA, TN, VA, WV
Oval pigtoe, *P. pyriforme* (I. Lea). E. AL, FL, GA
Louisiana pigtoe, *P. riddelli* (I. Lea). SC. LA, TX
Warrior pigtoe, *P. rubellum* (Conrad). E. AL, GA, TN
Fuzzy pigtoe, *P. strodeanum* (Wright). SC. AL, FL
Heavy pigtoe, *P. taitianum* (I. Lea). E. AL, MS
Alabama clubshell, *P. troschelianum* (I. Lea). E. AL, GA, TN
True pigtoe, *P. verum* (I. Lea). E. AL

Popenaias

- Texas hornshell, *P. popei* (I. Lea). T. NM, TX. Mexico

Potamilus

- Pink heelsplitter, *P. alatus* (Say). CS. AL, AR, IA, IL, IN, KS, KY, MI, MN, MO, MS, ND, NE, OH, OK, PA, SD, TN, VA, VT, WI, WV. Canada, MB, ON, PQ
Texas heelsplitter, *P. amphichaenus* (Frierson). T. LA, TX

Fat pocketbook, *P. capax* (Green). E. AR, IA, IL, IN, KY, LA, MN, MO, MS, OH, OK, WI
 Inflated heelsplitter, *P. inflatus* (I. Lea). T. AL, LA, MS
 Pink papershell, *P. ohiensis* (Rafinesque). CS. AL, AR, IA, IL, IN, KY, LA, MI, MN, MO, MS, ND, NE, OH, OK, SD, TN, TX, WI
 Bleufer, *P. purpuratus* (Lamarck). CS. AL, AR, GA, IL, KS, KY, LA, MO, MS, OK, TX

Ptychobranchus

Kidneyshell, *P. fasciolaris* (Rafinesque). CS. AL, IL, IN, KY, MI, MS, OH, PA, TN, VA, WV. Canada, ON
 Triangular kidneyshell, *P. greeni* (Conrad). E. AL, GA, TN
 Southern kidneyshell, *P. jonesi* (van der Schalie). T. AL, FL
 Ouachita kidneyshell, *P. occidentalis* (Conrad). T. AR, KS, LA, MO, MS, OK, TX
 Fluted kidneyshell, *P. subtentum* (Say). SC. AL, KY, TN, VA

Pyganodon

Eastern floater, *P. cataracta* (Say). CS. AL, CT, DE, GA, MA, MD, ME, MI, NC, NH, NJ, NY, PA, RI, SC, VA, VT, WI, WV. Canada, NB, NS, ON, PE, PQ
 Newfoundland floater, *P. fragilis* (Lamarck). CS. Canada, NB, NF, NS, PQ
 Gaspé floater, *P. marginata* (Say). CS. ME
 Inflated floater, *P. gibbosa* (Say). SC. GA
 Giant floater, *P. grandis* (Say). CS. AL, AR, CO, FL, GA, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, MT, NC, ND, NE, NY, OH, OK, PA, SD, TN, TX, VA, VT, WI, WV. Canada, AB, MB, NT, ON, PQ, SK, YT. Mexico

Quadrula

Southern mapleleaf, *Q. apiculata* (Say). CS. AL, LA, MS, TX
 Alabama orb, *Q. asperata* (I. Lea). SC. AL, GA, MS
 Golden orb, *Q. aurea* (I. Lea). SC. TX
 Rio Grande monkeyface, *Q. couchiana* (Lea). E. TX
 Rabbitsfoot, *Q. cylindrica cylindrica* (Say). T. AL, AR, IL, IN, KS, KY, LA, MO, MS, OH, OK, PA, TN
 Rough rabbitsfoot, *Q. c. strigillata* (Wright). E. TN, VA
 Winged mapleleaf, *Q. fragosa* (Conrad). E. AL, IA, IL, IN, KY, MN, MO, OH, TN, WI
 Smooth pimpleback, *Q. houstonensis* (I. Lea). T. TX
 Cumberland monkeyface, *Q. intermedia* (Conrad). E. AL, TN, VA
 Monkeyface, *Q. metanevra* (Rafinesque). CS. AL, AR, GA, IA, IL, IN, KS, KY, LA, MN, MO, MS, OH, PA, TN, WI
 Wartyback, *Q. nodulata* (Rafinesque). CS. AL, AR, IA, IL, IN, KS, KY, LA, MN, MO, MS, OH, OK, TN, WI
 Texas pimpleback, *Q. petrina* (Gould). T. TX
 Western pimpleback, *Q. pustulosa mortoni* (Conrad). CS. AR, LA, TX
 Pimpleback, *Q. p. pustulosa* (I. Lea). CS. AL, AR, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, OH, OK, PA, SD, TN, TX, VA, WI, WV. Canada, ON
 Mapleleaf, *Q. quadrula* (Rafinesque). CS. AL, AR, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, ND, NE, OH, OK, PA, SD, TN, TX, WI. Canada, MB, ON
 Purple pimpleback, *Q. refulgens* (I. Lea). SC. LA, MS
 Ridged mapleleaf, *Q. rumphiana* (I. Lea). SC. AL, GA, MS
 Appalachian monkeyface, *Q. sparsa* (I. Lea). E. KY, TN, VA
 Stirrupshell, *Q. stapes* (I. Lea). E. AL, MS
 Rough rockshell, *Q. tuberosa* (I. Lea). E*. KY, TN

Quincuncina

Tapered pigtoe, *Q. burkei* Walker. T. AL, FL
 Sculptured pigtoe, *Q. infucata* (Conrad). SC. AL, FL, GA
 False spike, *Q. mitchelli* (Simpson). T. TX

Simpsonaias

Salamander mussel, *S. ambigua* (Say). SC. AR, IA, IL, IN, KY, MI, MN, MO, NY, OH, PA, TN, WI, WV. Canada, ON

Strophitus

Alabama creekmussel, *S. connasaugaensis* (I. Lea). SC. AL, GA, MS, TN
 Southern creekmussel, *S. subvexus* (Conrad). SC. AL, FL, GA, LA, MS, TX
 Squawfoot, *S. undulatus* (Say). CS. AL, AR, CO, CT, DE, GA, IA, IL, IN, KS, KY, LA, MA, MD, ME, MI, MN, MO, MS, NC, ND, NE, NH, NJ, NY, OH, OK, PA, RI, SC, SD, TN, TX, VA, VT, WI, WV. Canada, MB, NB, NS, ON, PQ, SK

Toxolasma

Southern lilliput, *T. corvunculus* (I. Lea). U. AL
 Pale lilliput, *T. cylindrellus* (I. Lea). E. AL, TN
 Purple lilliput, *T. lividus* (Rafinesque). SC. AL, AR, IL, IN, KY, MI, MO, OH, OK, TN, VA
 Western lilliput, *T. mearnsi* (Simpson). CS. TX
 Lilliput, *T. parvus* (Barnes). CS. AL, AR, FL, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, NY, OH, OK, PA, SD, TN, TX, WI, WV. Canada, ON
 Iridescent lilliput, *T. paulus* (I. Lea). CS. AL, FL, GA
 Savannah lilliput, *T. pullus* (Conrad). T. GA, NC, SC
 Texas lilliput, *T. texasensis* (I. Lea). CS. AR, IL, IN, KY, LA, MS, TN, TX

Tritogonia

Pistolgrip, *T. verrucosa* (Rafinesque). CS. AL, AR, GA, IA, IL, IN, KS, KY, LA, MN, MO, MS, NC, OH, OK, PA, TN, TX, VA, WI, WV

Truncilla

Mexican fawnsfoot, *T. cognata* (I. Lea). E. TX. Mexico
 Fawnsfoot, *T. donaciformis* (I. Lea). CS. AL, AR, GA, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, OH, OK, PA, TN, TX, WI. Canada, ON
 Texas fawnsfoot, *T. macrodon* (I. Lea). E. TX
 Deertoe, *T. truncata* Rafinesque. CS. AL, AR, IA, IL, IN, KS, KY, LA, MI, MN, MO, MS, OH, OK, PA, SD, TN, TX, VA, WI, WV. Canada, ON

Uniomorus

Florida pondhorn, *U. caroliniana* (Bosc). CS. AL, FL, GA, NC, SC
 Tapered pondhorn, *U. declivus* (Say). CS. AL, AR, LA, MS, TX
 Polished pondhorn, *U. excultus* (Conrad). U. LA
 Southern pondhorn, *U. obesus* (I. Lea). CS. GA, NC, SC, VA
 Pondhorn, *U. tetralasmus* (Say). CS. AL, AR, CO, FL, GA, IL, IN, KS, KY, LA, MO, MS, NE, OH, OK, TN, TX, VA, WV

Utterbackia

Paper pondshell, *U. imbecillis* Say. CS. AL, AR, FL, GA, IA, IL, IN, KS, KY, LA, MD, MI, MN, MO, MS, NC, NE, NM, NY, OH, OK, PA, SC, TN, TX, VA, WI, WV. Canada, ON. Mexico
 Florida floater, *U. peggyae* R. I. Johnson. CS. AL, FL, GA

Venustaconcha

Ellipse, *V. ellipsiformis* (Conrad). SC. IA, IL, IN, MI, MN, MO, OH, WI
 Bleedingtooth mussel, *V. pleasi* (Marsh). SC. AR, KS, MO

Villosa

Florida rainbow, *V. amygdala* (I. Lea). CS. FL
 Ouachita creekshell, *V. arkansasensis* (I. Lea). SC. AR, OK
 Choctaw bean, *V. choctawensis* Athearn. T. AL, FL
 Notched rainbow, *V. constricta* (Conrad). SC. NC, VA
 Eastern creekshell, *V. delumbis* (Conrad). CS. GA, NC, SC
 Rayed bean, *V. fabalis* (I. Lea). SC. AL, IL, IN, KY, MI, NY, OH, PA, TN, VA, WV. Canada, ON
 Rainbow, *V. iris* (I. Lea). CS. AL, AR, IL, IN, KY, MI, MO, NC, NY, OH, OK, PA, TN, VA, WI, WV. Canada, ON
 Little spectaclecase, *V. lienosa* (Conrad). CS. AL, AR, FL, GA, IL, IN, KY, LA, MO, MS, OH, OK, TN, TX, WV

Alabama rainbow, *V. nebulosa* (Conrad). T. AL, GA
 Kentucky creekshell, *V. ortmanni* (Walker). SC. KY
 Purple bean, *V. perpurpurea* (I. Lea). E. GA, TN, VA
 Painted creekshell, *V. taeniata* (Conrad). CS. AL, KY, TN
 Cumberland bean, *V. trabalis* (Conrad). E. AL, KY, TN, VA
 Coosa creekshell, *V. vanuxemensis umbrans* (I. Lea). SC. AL, GA, TN
 Mountain creekshell, *V. v. vanuxemensis* (I. Lea). SC. AL, KY, NC, TN, VA
 Carolina creekshell, *V. vaughaniana* (I. Lea). SC. NC
 Southern rainbow, *V. vibex* (Conrad). CS. AL, FL, GA, MS, SC, TN
 Downy rainbow, *V. villosa* (Wright). SC. FL, GA

Additional Reading

We provide this section as a starting point for obtaining additional information on freshwater mussels in North America. Literature on freshwater mussels is extensive but often hard to find without access to a major university or museum library. We list here some of the relatively easy to obtain papers

concerning a variety of topics related to the biology of mussels. The list is organized alphabetically by state and includes both historical and recent publications dealing with large geographic regions (i.e., statewide or large drainages) and endangered species. The list is not comprehensive but includes papers that have relatively large literature cited sections that can be searched to find other papers of interest.

ALABAMA

Harris, S. C. 1990. Preliminary considerations on rare and endangered invertebrates in Alabama. *J. Ala. Acad. Sci.* 61:64-92.
Hurd, J. C. 1974. Systematics and zoogeography of the unionacean mollusks of the Coosa River drainage of Alabama, Georgia and Tennessee. Doctoral dissertation. Auburn University, Auburn, AL.
Isom, B. G. 1969. The mussel resource of the Tennessee River. *Malacologia* 7:397-425.
La Rocque, A. 1962. Key references to the Mollusca of Alabama. *Sterkiana* 7:4, 6.



Cracking pearlymussel, *Hemistena lata*. Endangered. Duck River, Columbia [Maury] County, TN. Length: 2.75 in (7.05 cm). A. A. Hinkley collection.



Slabside pearlymussel, *Lexingtonia dolabelloides*. *Threatened*. Duck River, Columbia [Maury] County, TN. Length: 2.0 in (5.13 cm). W. A. Nason collection.



Rough pigtoe, *Pleurobema plenum*. *Endangered*. Barren River, Warren County, KY. Length: 3.0 in (7.69 cm). K. S. Cummings, C. A. Mayer, and R. R. Cicerello collections.



Louisiana pearlshell, *Margaritifera hembeli*. *Threatened*. Hunters Creek, Conecuh County, AL. Length: 3.5 in (8.97 cm). A. A. Hinkley collection.



Inflated heelsplitter, *Potamilus inflatus*. *Threatened*. Black Warrior River, Tuscaloosa County, AL. Length: 2.375 in (6.09 cm). P. Hartfield, J. Stewart, and R. Bowker collections.



Clubshell, *Pleurobema clava*. *Endangered*. Tippecanoe River, Talma, Fulton County, IN. Length: 1.875 in (4.81 cm). K. S. Cummings et al. collection.



Cumberland monkeyface, *Quadrula intermedia*. *Endangered*. Duck River, Columbia, TN. Length: 1.5 in (3.85 cm). A. A. Hinkley collection.

- Ortmann, A. E.** 1925. The naiad-fauna of the Tennessee River system below Walden George. *Am. Midl. Nat.* 9:321-372.
- Stansbery, D. H.** 1976. Naiad mollusks. Pages 42-52 in H. T. Boschung, ed. *Endangered and threatened plants and animals of Alabama*. Bulletin of the Alabama Museum of Natural History No. 2:1-92.
- Williams, J. D., S. L. H. Fuller, and R. Grace.** 1992. Effects of impoundment of freshwater mussels (Mollusca: Bivalvia: Unionidae) in the main channel of the Black Warrior and Tombigbee rivers in western Alabama. *Bulletin of the Alabama Museum of Natural History* No. 13:1-10.

ALASKA

- Dall, W. H.** 1905. Land and freshwater mollusks of Alaska and adjoining regions. *Harriman Alaska Series, Smithsonian Inst.* 13:xii-171. [Reprinted in 1910.]
- Walker, B.** 1920. The distribution of the Unionidae in Alaska and British America. (Abstract). Pages 115-116 in *Twenty-first Annual Report of the Michigan Academy of Science*.

ARIZONA

- Bequaert, J. C., and W. B. Miller.** 1973. The mollusks of the arid Southwest with an Arizona check list. University of Arizona Press, Tucson.

ARKANSAS

- Call, R. E.** 1895. A study of the Unionidae of Arkansas, with incidental reference to their distribution in the Mississippi Valley. *Transactions of the Academy of Science St. Louis* 7:1-64.
- Gordon, M. E.** 1980. Recent Mollusca of Arkansas with annotations to systematics and zoogeography. *Ark. Acad. Sci. Proc.* 34:58-62.
- Gordon, M. E., L. R. Kraemer, and A. V. Brown.** 1980. Unionacea of Arkansas: historical review, checklist, and observations on distributional patterns. *Bull. Am. Malacol. Union Inc.* 1979:31-37.
- Harris, J. L., and M. E. Gordon.** 1987. Distribution and status of rare and endangered mussels (Mollusca: Margaritiferidae, Unionidae) in Arkansas. *Ark. Acad. Sci. Proc.* 41:49-56.
- Harris, J. L., and M. E. Gordon.** 1990. Arkansas mussels. Arkansas Game and Fish Commission, Little Rock.
- La Rocque, A.** 1962. Key references to the Mollusca of Arkansas. *Sterkiana* 6:39.

CALIFORNIA

- Bonnot, P.** 1951. The fresh-water mussels of California. *Calif. Fish Game* 37:485-488.
- Hannibal, H.** 1912. The aquatic molluscs of southern California and adjacent regions, a transition fauna. *Bull. South. Calif. Acad. Sci.* 11:18-46.
- Taylor, D. W.** 1981. Freshwater mollusks of California: a distributional checklist. *Calif. Fish Game* 67:140-163.

COLORADO

- Baker, F. C.** 1919. Freshwater Mollusca from Colorado and Alberta. *Bull. Am. Mus. Nat. Hist.* 41:527-539.
- Brandauer, N., and S. K. Wu.** 1978. The Bivalvia of Colorado. Part 2. The freshwater mussels (family Unionidae). Pages 41-60 in S. K. Wu and N. Brandauer, eds. *Natural history inventory of Colorado*. 2. The Bivalvia of Colorado. University of Colorado Museum, Boulder.
- Henderson, J.** 1924. Mollusca of Colorado, Utah, Montana, Idaho and Wyoming. *Univ. Colo. Stud.* 13:65-223.
- . 1936. Mollusca of Colorado, Utah, Montana, Idaho, and Wyoming. *Supplement. Univ. Colo. Stud.* 23:81-145.
- Wu, S. K.** 1989. Natural history inventory of Colorado No. 11. Colorado freshwater mollusks. University of Colorado Museum, Boulder.

CONNECTICUT

- Clench, W. J., and H. D. Russell.** 1939. Fresh water shells of New Hampshire. Biological survey of the Connecticut watershed. New Hampshire Fish and Game Department, Survey Report No. 4:222-227.
- Linsley, J. H.** 1845. Catalogue of the shells of Connecticut. *Am. J. Sci. Arts* 48:271-286.

DELAWARE

- Counts, C. L., III, T. S. Handwerker, and R. V. Jesien.** 1991. The naiades (Bivalvia: Unionidae) of the Delmarva Peninsula. *Am. Malacol. Bull.* 9:27-37.
- Rhoads, S. N.** 1904. A glimpse at the shell fauna of Delaware. *Nautilus* 18:63-65.

DISTRICT OF COLUMBIA

- Reardon, L.** 1929. A contribution to our knowledge of the anatomy of the fresh-water mussels of the District of Columbia. *Proc. U.S. Nat. Mus.* 75:1-12.
- Richards, H. G.** 1934. A list of the mollusks of the District of Columbia and vicinity. *Am. Midl. Nat.* 15:85-88.

FLORIDA

- Butler, R. S.** 1989. Distributional records for freshwater mussels (Bivalvia: Unionidae) in Florida and south Alabama, with zoogeographic and taxonomic notes. *Walkerana* 3:239-261.
- Heard, W. H.** 1979. Identification manual of the freshwater clams of Florida. Florida Department of Environmental Regulation Technical Series 4:1-83.
- Johnson, R. I.** 1972. The Unionidae (Mollusca: Bivalvia) of peninsular Florida. *Bull. Fla. State Mus. Biol. Sci.* 16:181-249.
- Thompson, F. G.** 1982. Phylum Mollusca, Class Bivalvia. Pages 23-27 in R. Franz, ed. *Rare and endangered biota of Florida, vol. 6 invertebrates*. University of Florida Press, Gainesville.

GEORGIA

- Fuller, S. L. H.** 1971. A brief guide to the fresh-water mussels (Mollusca: Bivalvia: Unionacea) of the Savannah River system. *Assoc. Southeast Biol. Bull.* 18:139-146.
- Johnson, R. I.** 1970. The systematics and zoogeography of the Unionidae (Mollusca: Bivalvia) of the Southern Atlantic Slope Region. *Bull. Mus. Comp. Zool.* 140:263-449.
- Keferl, E. P.** 1981. A survey of the naiades of the Ohoopsee River, Georgia. *Bull. Am. Malacol. Union Inc.* 1981:11-15.

IDAHO

See Colorado.

ILLINOIS

- Baker, F. C.** 1898. The Mollusca of the Chicago area, part I: the Pelecypoda. *Bull. Chic. Acad. Sci.* 3:1-130.
- . 1906. A catalogue of the Mollusca of Illinois. *Bulletin of the Illinois State Laboratory of Natural History* 7:53-136.
- Cummings, K. S.** 1991. The aquatic Mollusca of Illinois. Pages 429-439 in L. M. Page and M. R. Jeffords, eds. *Our living heritage: the biological resources of Illinois*. Ill. Nat. Hist. Surv. Bull. 34:357-477.
- Herkert, J. R., ed.** 1992. Endangered and threatened species of Illinois: status and distribution. Volume 2—animals. Illinois Endangered Species Protection Board, Springfield.
- Parmalee, P. W.** 1967. The fresh-water mussels of Illinois. *Illinois State Museum of Popular Science Ser.* 8.
- Starrett, W. C.** 1971. A survey of the mussels (Unionacea) of the Illinois River: a polluted stream. *Ill. Nat. Hist. Surv. Bull.* 30:267-403.

INDIANA

- Blatchley, W. S., and L. E. Daniels.** 1903. On some Mollusca known to occur in Indiana—a supplementary paper to Call's

catalogue. Indiana Department of Geology and Natural Resources Annual Report 27:577-628.

- Call, R. E.** 1900. A descriptive illustrated catalogue of the Mollusca of Indiana. Indiana Department of Geology and Natural Resources Annual Report 24:335-535.
- Cummings, K. S., and J. M. K. Berlocher.** 1990. The naiades or freshwater mussels (Bivalvia: Unionidae) of the Tippecanoe River, Indiana. *Malacol. Rev.* 23:83-98.
- Daniels, L. E.** 1903. A check list of Indiana Mollusca, with localities. Indiana Geological Survey Annual Report 26:629-652.
- . 1914. A supplemental check list of Indiana Mollusca, with localities and notes. Indiana Department of Geology and Natural Resources Annual Report 39:318-326.
- Goodrich, C., and H. van der Schalie.** 1944. A revision of the Mollusca of Indiana. *Am. Midl. Nat.* 32:257-326.
- Meyer, E. R.** 1974. Unionid mussels of the Wabash, White, and East Fork White rivers, Indiana. *Va. J. Sci.* 25:20-25.

IOWA

- Keyes, C. R.** 1888. An annotated catalogue of the Mollusca of Iowa. *Bulletin of the Essex Institute* 20:61-83.
- Shimek, B.** 1888. The Mollusca of eastern Iowa. *Iowa University Natural History Bulletin* 1:56-81.
- Witter, F. M.** 1878. List of the shells of Iowa. *Quarterly Journal of Conchology* 1878:385-394.

KANSAS

- Call, R. E.** 1885. Contributions to a knowledge of the freshwater Mollusca of Kansas. III. Fresh-water bivalves. *Bulletin of the Washburn College Laboratory of Natural History* 1:93-97.
- Liechti, P. M., and D. G. Huggins.** 1977. Unionacean mussels of Kansas. *Tech. Publ. State Biol. Surv. Kans.* 4:17-30.
- Murray, H. A., and A. B. Leonard.** 1962. Unionid mussels in Kansas. *Univ. Kans. Mus. Nat. Hist. Misc. Publ. No.* 28.
- Scammon, R. E.** 1906. The Unionidae of Kansas, Part 1. *Univ. Kans. Sci. Bull.* 3:279-373.
- Schuster, G. A., and M. B. Dubois.** 1979. Additional new records of freshwater mussels (Bivalvia: Unionidae) from Kansas. *Tech. Publ. State Biol. Surv. Kans.* 8:1-11.

KENTUCKY

- Bickel, D.** 1967. Preliminary checklist of recent and Pleistocene Mollusca of Kentucky. *Sterkiana* 28:7-20.
- Cicerello, R. R., M. L. Warren, Jr., and G. A. Schuster.** 1991. A distributional checklist of the freshwater unionids (Bivalvia: Unionoidea) of Kentucky. *Am. Malacol. Bull.* 8:113-129.
- Gordon, M. E., and J. B. Layzer.** 1989. Mussels (Bivalvia: Unionoidea) of the Cumberland River. Review of life histories and ecological relationships. *U.S. Fish Wildl. Serv. Biol. Rep.* 89:1-99.
- Neel, J. K., and W. R. Allen.** 1964. The mussel fauna of the upper Cumberland basin before its impoundment. *Malacologia* 1:427-459.
- Ortmann, A. E.** 1926. The naiades of the Green River drainage in Kentucky. *Ann. Carnegie Mus.* 17:167-188.
- Warren, M. L., Jr., and 14 coauthors.** 1986. Endangered, threatened, and rare plants and animals of Kentucky. *Trans. Ky. Acad. Sci.* 47:83-98.

LOUISIANA

- Vidrine, M. F.** 1993. The historical distributions of freshwater mussels in Louisiana. *Gail Q. Vidrine Collectables*, Eunice, LA.

MAINE

- Lermond.** 1909. Shells of Maine, a catalog of the land, freshwater and marine Mollusca of Maine. Report of the Commissioner of Agriculture, Augusta, ME.
- Nylander, O. O.** 1914. Distribution of some freshwater shells of

the St. John's River valley in Maine, New Brunswick, and Quebec. *Nautilus* 27:139-141.

MARYLAND

- Counts, C. L., III, and T. L. Bashore.** 1991. Mollusca of Assateague Island, Maryland and Virginia: a reexamination after seventy-five years. *Veliger* 34:214-221.
- Gerberich, A. G.** 1984. The endangered and threatened freshwater mollusks of Maryland. Maryland Natural Heritage Program Special Publication 84-1:245-266.

MASSACHUSETTS

- Smith, D. G.** 1991. Keys to freshwater macroinvertebrates of Massachusetts no. 1: Mollusca Pelecypoda (clams, mussels). University of Massachusetts, Amherst.

MICHIGAN

- Burch, J. B., and C. M. Paterson.** 1976. Key to the genera of freshwater pelecypods (mussels and clams) of Michigan. *Univ. Mich. Mus. Zool. Circ.* 4.
- De Camp, W. H.** 1881. List of shell-bearing Mollusca of Michigan. Kent Scientific Institute, Grand Rapids, MI.
- Evers, D. C.** 1992. A guide to Michigan's endangered wildlife. University of Michigan Press, Ann Arbor.
- Goodrich, C.** 1932. The Mollusca of Michigan. Michigan handbook ser. no. 5. University of Michigan Press, Ann Arbor.
- Strayer, D. L.** 1979. Some recent collections of mussels from southeastern Michigan. *Malacol. Rev.* 12:93-95.
- Walker, B.** 1892-93. The shell bearing Mollusca of Michigan. *Nautilus* 6:13-19, 6:31-35, 6:42-47, 6:63-67, 6:135-141.
- Winslow, M. L.** 1926. A revised check list of Michigan Mollusca. *Univ. Mich. Mus. Zool. Occasional Papers No.* 181.

MINNESOTA

- Coffin, B., and L. Pfannmuller.** 1988. Minnesota's endangered flora and fauna. University of Minnesota Press, St. Paul.
- Cvancara, A. M.** 1970. Mussels (Unionidae) of the Red River valley in North Dakota and Minnesota. *Malacologia* 10:57-92.
- Dawley, C.** 1947. Distribution of aquatic mollusks in Minnesota. *Am. Midl. Nat.* 38:671-697.
- Grant, U. S.** 1888. Notes on the molluscan fauna of Minnesota. *Minnesota Geology and Natural History Survey* 16:481-484.
- Wilson, C. B., and E. Danglade.** 1914. The mussel fauna of central and northern Minnesota. Report of the U.S. Fish Commission for 1913. Appendix 5:1-6. [Issued separately as U.S. Bureau of Fisheries Document 803.]

MISSISSIPPI

- Hartfield, P. H.** 1987. Status of selected freshwater mussels (Unionidae) in Mississippi. *J. Miss. Acad. Sci.* 23:133-141.
- Stern, E. M.** 1976. The freshwater mussels (Unionidae) of the Lake Maurepas-Ponchartrain-Borgne drainage system, Louisiana and Mississippi. Doctoral dissertation. Louisiana State University, Baton Rouge.

MISSOURI

- Buchanan, A. C.** 1980. Mussels (naiades) of the Meramec River Basin, Missouri. *Aquatic Ser.* 17, Missouri Department of Conservation, Jefferson City.
- Oesch, R. D.** 1984. Missouri naiades. A guide to the mussels of Missouri. Missouri Department of Conservation, Jefferson City.
- Warren, R. E.** 1991. Ozarkian fresh-water mussels (Unionoidea) in the upper Eleven Point River, Missouri. *Am. Malacol. Bull.* 8:131-137.
- Wilson, J. H., ed.** 1984. Rare and endangered species of Missouri. Missouri Department of Conservation, Jefferson City.

MONTANA

See Colorado.

NEBRASKA

- Aughey, S.** 1877. Catalogue of the land and freshwater shells of Nebraska. Pages 697–704 in Report upon the United States Geographical Survey west of the 100th meridian (Hayden Survey), volume 3. U.S. Government Printing Office, Washington, DC.
- Freeman, P. W., and K. Perkins.** 1992. Survey of mollusks of the Platte River. U.S. Fish and Wildlife Service, Final Report, Grand Island, NE.
- Hoke, E.** 1983. Unionid mollusks of the Missouri River on the Nebraska border. *Am. Malacol. Bull.* 1:71–74.

NEVADA

- Walker, B.** 1916. The Mollusca collected in northeastern Nevada by the Walker-Newcomb Expedition of the University of Michigan. *Univ. Mich. Mus. Zool. Occasional Papers* 29:1–8.

NEW HAMPSHIRE

- Baker, F. C.** 1942. Land and fresh water Mollusca of New Hampshire. *Am. Midl. Nat.* 27:74–85.
- Clench, W. J., and H. D. Russell.** 1940. Freshwater shells of New Hampshire. *Nautilus* 54:52–53.

NEW JERSEY

- Freed, S.** 1957. Land and freshwater mollusks of Union County, New Jersey. *Nautilus* 70:135–136.

NEW MEXICO

- New Mexico Department of Game and Fish.** 1985. Handbook of species endangered in New Mexico. Santa Fe, NM.

NEW YORK

- Clarke, A. H., Jr., and C. O. Berg.** 1959. The freshwater mussels of central New York. Cornell University Agricultural Experiment Station Memoir 367.
- Harman, W. N.** 1970. New distribution records and ecological notes on central New York Unionacea. *Am. Midl. Nat.* 84:46–58.
- Letson, E. J.** 1905. Check list of the Mollusca of New York. *NY State Mus. Bull.* 88:1–112.
- Robertson, I. C. S., and C. L. Blakeslee.** 1948. The Mollusca of the Niagara frontier region. *Bull. Buffalo Soc. Nat. Sci.* 19:1–191.
- Strayer, D. L.** 1988. Ecology and zoogeography of the freshwater mollusks of the Hudson River basin. *Malacol. Rev.* 20:1–68.
- Strayer, D. L., K. J. Jirka, and K. J. Scheider.** 1992. Recent collections of freshwater mussels (Bivalvia: Unionidae) from western New York. *Walkerana* 5:63–72.

NORTH CAROLINA

- Adams, W. F., J. M. Alderman, R. G. Biggins, A. G. Gerberich, E. P. Keferl, H. J. Porter, and A. S. Van Devender.** 1990. A report on the conservation status of North Carolina's freshwater and terrestrial molluscan fauna. *NC Wildl. Res. Comm.*, Raleigh.
- Dawley, C.** 1965. Checklist of freshwater mollusks of North Carolina. *Sterkiana* 19:35–39.
- Fuller, S. L. H.** 1977. Freshwater and terrestrial mollusks. Pages 143–194 in J. E. Cooper, S. S. Robinson, and J. B. Funderburg, eds. *Endangered and threatened plants and animals of North*



Rayed bean, *Villosa fabalis*. Special Concern. Salt Fork Vermilion River, Homer Park, Champaign County, IL. Length: 1.125 in (2.88 cm) for male (top); 1.0 in (2.56 cm) for female (bottom). *M. R. Matteson collection.*

Carolina. North Carolina State Museum of Natural History, Raleigh.

Shelley, R. M. 1987. Unionid mollusks from the upper Cape Fear River basin, North Carolina, with a comparison of the faunas of the Neuse, Tar, and Cape Fear drainages (Bivalvia: Unionacea). *Brimleyana* 13:67-89.

Walter, W. M. 1956. Mollusks of the upper Neuse River basin, North Carolina. *J. Elisha Mitchell Sci. Soc.* 72:262-274.

NORTH DAKOTA

Cvancara, A. M. 1970. Illustrated key to the genera and species of North Dakota mussels. University of North Dakota Institute of Ecology Studies Contribution No. 3.

———. 1975. Aquatic malacogeography of North Dakota. *Proc. ND Acad. Sci.* 27:68-82.

———. 1983. Aquatic mollusks of North Dakota. North Dakota Geological Survey Report Investigation No. 78.

Winslow, M. L. 1921. Mollusca of North Dakota. *Univ. Mich. Mus. Zool. Occasional Papers* 98:1-18.

OHIO

Clark, H. W., and **C. B. Wilson.** 1912. The mussel fauna of the Maumee River. Report and Special Papers of the U.S. Fish Commission, 1911. [Issued separately as U.S. Bureau of Fisheries Document 757.]

Dean, G. W. 1890. Distribution of Unionidae in the three rivers, Mahoning, Cuyahoga and Tuscarawas. *Nautilus* 4:20-21.

Stansbery, D. H., and **C. Taft.** 1976. Ohio's endangered naiad mollusks. Pages 21-24 in *American Malacological Union, 42nd annual meeting program.* Columbus.

Sterki, V. 1907. A preliminary catalogue of the land and fresh-water Mollusca of Ohio. *Proceedings of The Ohio State Academy of Science* 4:367-402.

Watters, G. T. 1993. A guide to the freshwater mussels of Ohio. Ohio Department of Natural Resources, Division of Wildlife, Columbus.

OKLAHOMA

Branson, B. A. 1982. The mussels (Unionacea: Bivalvia) of Oklahoma—part 1: Ambleminae. *Proc. Okla. Acad. Sci.* 62:38-45.

———. 1983. The mussels (Unionacea: Bivalvia) of Oklahoma—part 2: The Unioninae, Pleurobemini and Anodontini. *Proc. Okla. Acad. Sci.* 63:49-59.

———. 1984. The mussels (Unionacea: Bivalvia) of Oklahoma—part 3: Lampsilini. *Proc. Okla. Acad. Sci.* 64:20-36.

Isely, F. B. 1924. The fresh-water mussel fauna of eastern Oklahoma. *Bulletin of the Oklahoma Academy of Science* 4:43-118.

Valentine, B. D., and **D. H. Stansbery.** 1971. An introduction of the naiads of the Lake Texoma region, Oklahoma, with notes on the Red River fauna (Mollusca: Unionidae). *Sterkiana* 42:1-40.

OREGON

See Colorado.

PENNSYLVANIA

Ortmann, A. E. 1909. The destruction of freshwater fauna in western Pennsylvania. *Proc. Am. Philos. Soc.* 48:90-110.

———. 1911. A monograph of the naiades of Pennsylvania. Parts I and II. *Memoirs Carnegie Mus.* 4:279-347.

———. 1919. A monograph of the naiades of Pennsylvania. Part III. Systematic account of the genera and species. *Memoirs Carnegie Mus.* 8:1-384.

RHODE ISLAND

Carpenter, H. F. 1890. The shell-bearing Mollusca of Rhode Island. *Nautilus* 3:92-95; 4:46-47; 4:56-57.

SOUTH CAROLINA

Fuller, S. L. H. 1980. Fresh-water mussels (Mollusca: Bivalvia:

Unionidae). Pages 114-125 in *D. M. Forsythe and W. B. Ezell, Jr., eds. Proceedings of the first South Carolina endangered species symposium.* South Carolina Wildlife and Marine Resources Department, Columbia.

Mazyck, W. G. 1913. *Catalog of Mollusca of South Carolina.* Charleston Museum Contributions No. 2:1-39.

SOUTH DAKOTA

Over, W. H. 1942. *Mollusca of South Dakota.* University of South Dakota Natural History Studies 5:1-11.

TENNESSEE

Bickel, D. 1968. Checklist of the Mollusca of Tennessee. *Sterkiana* 31:15-39.

Bogan, A. E., and **P. W. Parmalee.** 1983. Tennessee's rare wildlife volume II: the mollusks. Tennessee Wildlife Resources Agency, Nashville.

Ortmann, A. E. 1918. The nayades (freshwater mussels) of the upper Tennessee drainage. With notes on synonymy and distribution. *Proc. Am. Philos. Soc.* 57:521-626.

Starnes, L. B., and **A. E. Bogan.** 1988. The mussels (Mollusca: Bivalvia: Unionidae) of Tennessee. *Am. Malacol. Union Inc. Bull.* 6:19-37.

TEXAS

Landye, J. J. 1980. Status of rare, endangered and/or threatened molluscan species of Texas and Oklahoma. Bio-Geo Southwest, Inc., Flagstaff, AZ.

Murray, H. D., and **E. C. Roy, Jr.** 1968. Checklist of freshwater and land mollusks of Texas. *Sterkiana* 30:25-42.

Neck, R. W. 1982. A review of interactions between humans and freshwater mussels in Texas. Pages 169-182 in *J. R. Davis, ed. Proceedings of symposium on recent benthological investigations in Texas and adjacent states.* Texas Academy of Science, Austin.

Neck, R. W. 1984. Restricted and declining non-marine molluscs of Texas. Texas Parks and Wildlife Department Tech. Ser. No. 34.

Strecker, J. K. 1931. The distribution of the naiades or pearly fresh-water mussels of Texas. *Baylor University Museum Special Bulletin* 2:1-71.

White, D. S., and **S. J. White.** 1977. Observations on the pelecypod fauna of Lake Texoma, Texas and Oklahoma, after more than 30 years impoundment. *Southwest. Nat.* 22:235-254.

UTAH

Chamberlin, R. V., and **D. T. Jones.** 1929. A descriptive catalog of the Mollusca of Utah. *University of Utah Bulletin* 19:1-203.

VERMONT

Adams, C. B. 1841. *Catalogue of the Mollusca of Middlebury, Vermont, and vicinity, with observations.* *Am. J. Sci. Arts* 40:266-277.

VIRGINIA

Beetle, D. E. 1973. A checklist of the land and freshwater mollusks of Virginia. *Sterkiana* 49:21-35.

Dennis, S. D. 1979. Freshwater and terrestrial molluscs. Pages 123-127 in *D. W. Linzey, ed. Endangered and threatened plants and animals of Virginia.* Virginia Polytechnic Institute and State University, Blacksburg.

Neves, R. J. 1991. Mollusks. Pages 251-320 in *K. Terwilliger, coordinator. Virginia's endangered species.* McDonald and Woodward Publishing Co., Blacksburg, VA.

WASHINGTON

Henderson, J. 1929. Non-marine Mollusca of Oregon and Washington. *Univ. Colo. Stud.* 17:47-190.

WEST VIRGINIA

Knight, K. B. 1986. Threatened and endangered species in West

Virginia. Pages 410–427 in S. K. Majumdar, F. J. Brenner, and A. F. Rhoads, eds. *Endangered and threatened species programs in Pennsylvania and other states: causes, issues and management*. Pa. Acad. Sci. Publ., Easton.

Taylor, R. W., and R. C. Hughart. 1981. The freshwater naiads of Elk River, West Virginia with a comparison of earlier collections. *Nautilus* 95:21–25.

WISCONSIN

Baker, F. C. 1928. The fresh water Mollusca of Wisconsin. Part II. Pelecypoda. Bulletin of the Wisconsin Geological Natural History Survey 70.

Flowers, W. 1975. Notes on the current status of Wisconsin Unionidae. *Sterkiana* 57:40–42.

Mathiak, H. A. 1979. A river survey of the unionid mussels of Wisconsin 1973–1977. Sand Shell Press, Horicon, WI.

Stern, E. M. 1990. An illustrated key to the freshwater mussels (Bivalvia: Unionidae) of Wisconsin. University Wisconsin-Stevens Point Museum of Natural History Reports No. 20.

WYOMING

Beetle, D. E. 1989. Checklist of recent Mollusca of Wyoming, USA. *Great Basin Nat.* 49:627–645.

Henderson, J. 1935. *Margaritifera* and *Fluminicola* in Wyoming. *Nautilus* 48:107.

CANADA

Clarke, A. H. 1973. The freshwater molluscs of the Canadian Interior Basin. *Malacologia* 13:1–509.

———. 1981. The freshwater molluscs of Canada. *Natl. Mus. Nat. Sci. (Ott.) Publ. Nat. Sci. Ottawa, ON.*

Regional and General References

Athearn, H. D. 1968. Changes and reductions in our fresh-water molluscan populations. *Am. Malacol. Union Inc. Annu. Rep.* 1967:44–45.

———. 1970. Discussion of Dr. Heard's paper [see Heard 1970] in A. Clarke, ed. *Papers on the rare and endangered mollusks of North America*. *Malacologia* 10:28–31.

Burch, J. B. 1973. Freshwater unionacean clams (Mollusca: Pelecypoda) of North America. *Biota of Freshwater Ecosystems Identification Manual No. 11*. U.S. Environmental Protection Agency, Washington, DC.

———. 1975. Freshwater unionacean clams (Mollusca: Pelecypoda) of North America, revised edition. *Malacological Publications*, Hamburg, MI.

Clench, W. J., and R. D. Turner. 1956. Freshwater mollusks of Alabama, Georgia, and Florida from the Escambia to the Suwannee River. *Bull. Fla. State Mus.* 1:97–239.

Coker, R. E. 1919. Freshwater mussels and mussel industries of the United States. U.S. Bureau of Fisheries Bulletin No. 36.

Cummings, K. S., and C. A. Mayer. 1992. Field guide to freshwater mussels of the Midwest. *Ill. Nat. Hist. Surv. Manual* 5.

Conrad, T. A. 1835–1838. Monograph of the Family Unionidae, or naiades of Lamarck (fresh-water bivalve shells), of North America, illustrated by figures drawn on stone from nature. J. Dobson, Philadelphia.

Frierson, L. S. 1927. A classified and annotated check list of the North American naiades. Baylor University Press, Waco, TX.

Heard, W. 1970. Eastern freshwater mollusks (II) The south Atlantic and Gulf drainages. *Malacologia* 10:23–27.

Ingram, W. M. 1948. The larger freshwater clams of California, Oregon, and Washington. *Journal of Entomology and Zoology* 40:72–92.

International Union for Conservation of Nature and Natural Resources. 1990. 1990 IUCN red list of threatened animals. IUCN, Gland, Switzerland, and Cambridge, UK.

Johnson, R. I. 1970. The systematics and zoogeography of the Unionidae (Mollusca: Bivalvia) of the southern Atlantic Slope

region. *Bull. Mus. Comp. Zool.* 140:263–449.

———. 1978. Systematics and zoogeography of *Plagiola* (= *Dysnomia* = *Epioblasma*), an almost extinct genus of freshwater mussels (Bivalvia: Unionidae) from middle North America. *Bull. Mus. Comp. Zool.* 148:239–320.

Jorgensen, S. E., and R. W. Sharp, eds. 1971. Proceedings of a symposium on rare and endangered mollusks (naiads) of the United States. U.S. Fish and Wildlife Service, Twin Cities, MN.

Lea, I. 1827–1874. Observations on the genus *Unio*. Privately published, Philadelphia, PA. The 13 volumes that comprise this series contain reprints and expanded species redescrptions of the author's nearly 50 productive years in this field.

Metcalf, A. L. 1974. Fossil and living freshwater mussels from the Pecos River, New Mexico and Texas. *Bull. Am. Malacol. Union Inc.* 1973:47–48.

Ortmann, A. E. 1912. Notes upon the families and genera of the naiades. *Ann. Carnegie Mus.* 8:222–365.

———. 1923. The anatomy and taxonomy of certain Unioninae and Anodontinae from the Gulf drainage. *Nautilus* 36:73–84, 36:129–132.

———. 1923–1924. Notes on the anatomy and certain Lampsiliinae from the Gulf drainage. *Nautilus* 37:56–60, 37:99–105, 37:137–144.

Simpson, C. T. 1900. Synopsis of the naiades, or pearly fresh-water mussels. *Proc. U.S. Nat. Mus.* 22:501–1044.

———. 1914. A descriptive catalogue of the naiades, or pearly fresh-water mussels. Bryant Walker, Detroit, MI.

Stansbery, D. H. 1970. Eastern freshwater mollusks (I) The Mississippi and St. Lawrence River systems. *Malacologia* 10:9–21.

———. 1971. Rare and endangered fresh-water mollusks in eastern United States. Pages 5–18 in S. E. Jorgensen and R. W. Sharp, eds. Proceedings of a symposium of rare and endangered mollusks (naiads) of the United States. U.S. Fish and Wildlife Service, Twin Cities, MN.


Turgeon, D. D., A. E. Bogan, E. V. Coan, W. K. Emerson, W. G. Lyons, W. L. Pratt, C. F. E. Roper, A. Scheltema, F. G. Thompson, and J. D. Williams. 1988. Common and scientific names of aquatic invertebrates from the United States and Canada: mollusks. *American Fisheries Society Special Publication* 16.

Walker, B. 1918. A synopsis of the classification of the fresh-water mollusca of North America. North of Mexico, and a catalogue of the more recently described species, with notes. *Univ. Mich. Mus. Zool. Misc. Publ.* 6:1–213.

Williams, J. C., and G. A. Schuster. 1989. Freshwater mussel investigations of the Ohio River mile 317.0 to mile 981.0. *Ky. Dept. Fish Wildl. Resour. Fish. Bull.*, Frankfort.

Summary

The list includes 297 native freshwater mussels, the entire known fauna, of the United States and Canada. Of these, 213 taxa (71.7%) are considered endangered, threatened, or of special concern; only 70 (23.6%) are listed as currently stable. We emphasize that many taxa in the latter group may be subject to severe future declines as the zebra mussel invades large southern rivers and reservoirs. Twenty-one taxa (7.1%) are listed as possibly extinct, 77 (26.0%) as endangered, 43 (14.5%) as threatened, 72 (24.2%) as of special concern, and 14 (4.7%) as undetermined. Imperilment is extreme in some genera. Within the genera *Epioblasma* and *Pleurobema*, comprising 56 total taxa, 15 taxa are possibly extinct and 31 others

are extant but endangered. Clearly, efforts to protect aquatic resources are inadequate for freshwater mussels as well as other elements of the aquatic biota (Williams et al. 1989; Master 1990). We reiterate here the plea of Williams et al. (1989) that natural resource agencies manage proactively for conservation of entire ecosystems rather than relying on reactive efforts targeted at individual species, but grimly admit that many of the mussels listed herein obviously need emergency attention or they will perish. Freshwater mussels are valuable as a commercial resource, as indicators of aquatic environmental health, and as a major component of worldwide freshwater biodiversity. The numbers of imperiled mussels in the United States and Canada portend a trajectory toward an extinction crisis that, unless dampened by prompt conservation action, may result in the complete loss of some genera and severe impoverishment of the richest freshwater mussel fauna in the world. 

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References

- Belanger, T. V., C. G. Annis, and D. D. VanEpps. 1990. Growth rates of the Asiatic clam, *Corbicula fluminea*, in the upper and middle St. Johns River, Florida. *Nautilus* 104:4-9.
- Coker, R. E. 1919. Fresh-water mussels and mussel industries of the United States. U.S. Bureau of Fisheries Bulletin 36:13-89.
- Coker, R. E., A. F. Shira, H. W. Clark, and A. D. Howard. 1921. Natural history and propagation of fresh-water mussels. U.S. Bureau of Fisheries Bulletin 37:77-181.
- Ellis, M. M. 1931. Some factors affecting the replacement of the commercial fresh-water mussels. U.S. Bureau of Fisheries Circular 7:1-10.
- Fassler, C. R. 1991a. Farming jewels: The aquaculture of pearls. *Aquaculture Magazine* 17:35-52.
- . 1991b. The return of the American pearl. *Aquaculture Magazine* 17:63-78.
- Fuller, S. L. H. 1974. Clams and mussels (Mollusca: Bivalvia). Pages 215-273 in C. W. Hart and S. L. H. Fuller, eds. *Pollution ecology of freshwater invertebrates*. Academic Press, Inc., New York.
- Hoeh, W. R. 1990. Phylogenetic relationships among eastern North American *Anodonta* (Bivalvia: Unionidae). *Malacol. Rev.* 23:63-82.
- Hoggarth, M. A. 1992. An examination of the glochidia-host relationship reported in the literature for North American species of Unionacea (Mollusca: Bivalvia). *Malacology Data Net* 3:1-30.
- Layzer, J. B., M. E. Gordon, and R. M. Anderson. 1993. Mussels: the forgotten fauna of regulated rivers. A case study of the Caney Fork River. *Regul. Rivers Res. & Manage.* 8:63-71.
- Lefevre, G., and W. C. Curtis. 1912. Studies on the reproduction and artificial propagation of fresh-water mussels. U.S. Bureau of Fisheries Bulletin 30:105-201.
- Leff, L. G., J. L. Burch, and J. V. McArthur. 1990. Spatial distribution, seston removal, and potential competitive interactions of the bivalves *Corbicula fluminea* and *Elliptio complanata*, in a coastal plain stream. *Freshwater Biol.* 24:409-416.
- Master, L. 1990. The imperiled status of North American aquatic animals. *Biodiversity Network News* 3:1-2, 7-8.
- McMahon, R. F. 1983. Ecology of an invasive pest bivalve, *Corbicula*. Pages 505-561 in W. D. Russel-Hunter, ed. *The Mollusca*. Vol. 6 Ecology. Academic Press, Inc., New York.
- Nalepa, T. F., and D. W. Schloesser, eds. 1992. *Zebra mussels biology, impacts, and control*. Lewis Publishers, Boca Raton, FL.
- Neves, R. J., and S. N. Moyer. 1988. Evaluation of techniques for age determination of freshwater mussels (Unionidae). *Am. Malacol. Union Inc. Bull.* 6:179-188.
- Neves, R. J., S. N. Moyer, L. R. Weaver, and A. V. Zale. 1985. An evaluation of host fish suitability for glochidia of *Villosa vanuxemi* and *V. nebulosa* (Pelecypoda: Unionidae). *Am. Midl. Nat.* 113:13-19.
- Ortmann, A. E. 1909. The destruction of freshwater fauna in western Pennsylvania. *Proc. Am. Philos. Soc.* 48:90-110.
- Parmalee, P. W., and W. E. Klippel. 1974. Freshwater mussels as a prehistoric food source. *American Antiquity* 39:421-434.
- Sickel, J. B. 1989. Impacts of brailing on mussel communities and habitat in Kentucky Lake. *Ky. Dep. Fish. Wildl. Resour., Frankfort Project No. 2-1J-19-2*.
- Smith, D. 1986. The stomach anatomy of some eastern North American Margaritiferidae (Unionoida: Unionacea). *Am. Malacol. Union Inc. Bull.* 4:13-19.
- Smith, D., and W. P. Wall. 1984. The Margaritiferidae reinstated: a reply to Davis and Fuller (1981), "Genetic relationships among recent Unionacea (Bivalvia) of North America." *Harv. Univ. Mus. Comp. Zool. Spec. Occas. Publ.* 4:321-330.
- Turgeon, D. D., A. E. Bogan, E. V. Coan, W. K. Emerson, W. G. Lyons, W. L. Pratt, C. F. E. Roper, A. Scheltema, F. G. Thompson, and J. D. Williams. 1988. Common and scientific names of aquatic invertebrates from the United States and Canada: mollusks. *American Fisheries Society Special Publication* 16.
- Williams, J. D., S. L. H. Fuller, and R. Grace. 1992. Effects of impoundment on freshwater mussels (Mollusca: Bivalvia: Unionidae) in the main channel of the Black Warrior and Tombigbee rivers in western Alabama. *Bulletin of the Alabama Museum of Natural History* No. 13:1-10.
- Williams J. E., J. E. Johnson, D. A. Hendrickson, W. Contreras-Balderas, J. D. Williams, M. Navarro-Mendoza, D. E. McAllister, and J. E. Deacon. 1989. Fishes of North America endangered, threatened, or of special concern: 1989. *Fisheries (Bethesda)* 14(6):2-20.