



**Status:** State and Federally listed as Endangered

**Global and state ranks:** G2/S1

**Family:** Unionidae (Pearly mussels)

**Total range:** Historically, the clubshell was present in the Wabash, Ohio, Kanawha, Kentucky, Green, Monogahela, and Alleghany Rivers and their tributaries. Its range covered an area from Michigan south to Alabama, and Illinois east to Pennsylvania. The clubshell currently occurs in 12 streams within the Tennessee, Cumberland, Lake Erie, and Ohio drainages. These include the St. Joseph River in Michigan (Badra and Goforth 2001) and Ohio (Watters 1988), Pymatuning Creek (Ohio)(Huehner and Corr 1994), Little Darby Creek (Ohio), Fish Creek (Ohio and Indiana), Tippecanoe River (Indiana), French Creek (Pennsylvania), and the Elk River (West Virginia). This species has been extirpated from Illinois (Cummings et al. 1998), Alabama, Tennessee, and possibly New York (Naturserve 2001).

**State distribution:** The clubshell’s range in Michigan is restricted to the St. Joseph River (Maumee drainage) in Hillsdale County.

**Recognition:** The clubshell has a triangular outline with

umbos located close to the anterior end of the shell. Viewed from the top, the clubshell is wedge-shaped tapering towards the posterior end. Maximum length is approximately 3 ½ inches (90mm). The shell is tan/ yellow, with broad, dark green rays that are almost always present and are interrupted at the growth rings. There is often a crease or groove near the center of the shell running perpendicular to the annular growth rings. Beak sculpture consists of a few small bumps or loops, or is absent. The clubshell has well-developed lateral and pseudo-cardinal teeth and a white nacre. Shells of males and females are morphologically similar. Similar species found in Michigan include the kidneyshell (*Ptychobranthus fasciolaris*) which is much more compressed laterally than the clubshell and has a kidney shaped outline; the round pigtoe (*Pleurobema sintoxia*) which has a more circular outline and does not have rays; and the wabash pigtoe (*Fusconaia flava*) which has a more rectangular outline, umbos closer to the center of the shell, and faint rays present only on young individuals.

**Best survey time:** Surveys for the clubshell are best performed in the summer when water levels are lowest and water clarity is high. Low water levels expose muskrat middens that often contain empty freshwater mussel shells. In rivers that are less than two feet deep,



a glass-bottomed bucket is an efficient tool for finding live freshwater mussels. The clubshell is often buried up to four inches in the substrate making it more difficult to find than most other mussel species.

**Habitat:** The clubshell is found in small to medium streams with gravel/sand substrate and relatively little silt. It occurs most often in runs with laminar flow (0.06-0.25 m/sec). Mean summer chemical measures from clubshell habitat in the St. Joseph River, Michigan were as follows: pH (8.1), conductivity (478 mS), and dissolved oxygen (8.6 mg/liter). The three-ridge (*Amblema plicata*) and kidneyshell (*Ptychobranthus fasciolaris*) may act as indicators for suitable clubshell habitat, given that their abundance was positively correlated with clubshell abundance in the St. Joseph River, Michigan (Badra and Goforth 2001). Suitable habitat for fish host species must be present in order for clubshell reproduction to be successful.

**Biology:** Relatively little is known specifically about clubshell biology. Like most freshwater mussels of the family Unionidae, the clubshell requires a fish host to complete its life cycle. After fertilization, eggs develop into larvae within the female. These larvae, called glochidea, are released into the water and must attach to a suitable fish host in order to survive. The females of some unionids have structures resembling small fish, crayfish, or other prey that are displayed when the larvae are ready to be released. Other unionids display conglutinates, packets of glochidea that are trailed out in the stream current, attached to the mussel by a clear strand. These “lures” may entice fish into coming into contact with glochidea, increasing the chances that glochidea will attach to a suitable host. Clubshells are not known to have a lure. Glochidea remain on the fish host for a couple weeks to several months depending on mussel species and other factors. During this time the mussel transforms into the adult form and then drops off its host. The benefits of having fish hosts are not fully understood. One benefit is that larvae are dispersed geographically by host fish. Similar to animal facilitated seed dispersal in plants, fish hosts allow mussels that are relatively sessile as adults to be transported to new habitat, allowing gene flow to occur among populations. Some unionids are able to utilize many different fish species as hosts while others have only one or two known hosts (Kat 1983). Four fish species have been identified in laboratory studies as suitable hosts for the

clubshell, these are the blackside darter (*Percina maculata*), central stoneroller (*Campostoma anomalum*), logperch (*Percina caprodes*), and striped shiner (*Luxilus chrysocephalus*) (O’Dee 1998). Maximum life-span for the clubshell is at least 50 years of age (Badra and Goforth 2001).

**Conservation/Management:** Within the past century the clubshell has been extirpated from most of its range and is now restricted mainly to headwater stretches of its former habitat. In 1993 the U.S. Fish and Wildlife Service estimated that the clubshell’s range had been reduced by at least 95% and it was federally listed as endangered. Its decline has been mainly attributed to pollution from agricultural runoff and alteration of waterways, including drain clean-outs and impoundment construction. This species is especially sensitive to siltation. Conservation of the clubshell, as with other unionids, requires an approach that recognizes the interdependence of the different communities and habitats within its ecosystem. The clubshell cannot reproduce without the presence of its fish hosts. Conservation efforts should aim to maintain the composition of associated fish communities, including fish habitat and food resources such as aquatic insects. Surrounding land use can have a dramatic effect on aquatic habitats and freshwater mussels. Clubshell in Michigan occur in an area with a long history of agriculture. Conservation tillage, reforestation, and grass filter strips are some of the incentive programs now being promoted in the St. Joseph River watershed by The Nature Conservancy and the USDA. Other creative solutions that minimize impact of land use on the clubshell’s ecosystem while maintaining (or increasing) economic value of the land are needed. The zebra mussel (*Dreissena polymorpha*) and the Asian clam (*Corbicula fluminea*) are exotics from Eurasia that have spread quickly throughout the eastern U.S. While the Asian clam has few documented harmful effects on native mussels, zebra mussels are known to have negative impacts on native mussels. Zebra mussels require stable, hard substrates for attachment and often use native mussels as substrate. Native mussels are sometimes covered with enough zebra mussels that they cannot reproduce or feed normally, eventually killing the native mussel. This exotic has had a dramatic effect on native mussel communities in habitats where it has been introduced. The continued range expansion of the zebra mussel into clubshell



habitat remains a serious threat.

**Research needs:** Additional studies are needed in order to determine all of the suitable fish hosts for the clubshell. Periodic monitoring of clubshell populations and associated communities is needed to identify any negative trends and attempt to remedy the cause. A better understanding of the relationship between surrounding land use, sediment, and freshwater mussel habitat quality is needed in order to ensure that clubshell habitat is maintained or improved (Box 1999). Methods of preventing or minimizing the spread of zebra mussels into clubshell habitat are needed.

**Related abstracts:** White catspaw (*Epioblasma obliquata perobliqua*), northern riffleshell (*Epioblasma torulosa rangiana*), snuffbox (*Epioblasma triquetra*), and rayed bean (*Villosa fabalis*)

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