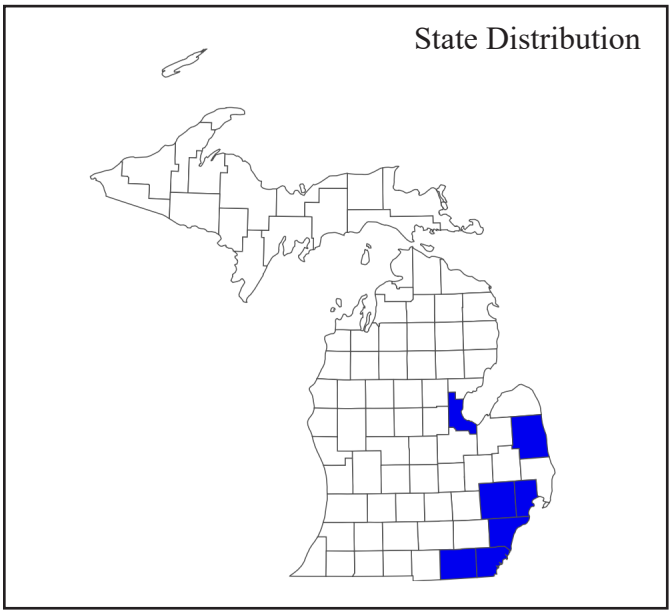
Epioblasma rangiana Lea — Northern riffleshell

Photo by Kurt Stepnitz



Best Survey Period

Status: Federal and State Endangered

Global and State Rank: G1 (Critically Imperiled) / S1 (Critically Imperiled)

Family: Unionidae (Pearly mussels)

Synonyms: *Unio rangianus* Lea, *Dysnomia* (*Torulosa*) *rangiana* Lea, *Dysnomia* (*Torulosa*) *torulosa rangiana* Lea, *Dysnomia perplexa rangiana* Lea, *Dysnomia* (*Pilea*) *perplexa rangiana* Lea, *Dysnomia* (*Pilea*) *torulosa rangiana* Lea, *Dysnomia rangiana* Lea, *Dysnomia torulosa rangiana* Lea, *Epioblasma torulosa biloba* Rafinesque, *Epioblasma torulosa rangiana* Lea, *Plagiola* (*Torulosa*) *torulosa* Rafinesque, *Margarita* (*Unio*) *rangianus* Lea, *Margaron* (*Unio*) *rangianus* Lea, *Truncilla* (*Pilea*) *perplexa rangiana* Lea, *Truncilla rangiana* Lea, *Truncilla* (*Scalenaria*) *sulcata delicata* Simpson, *Unio rangianus* Lea (Watters et al. 2009, MolluscaBase 2026).

Total Range: Historically the northern riffleshell was widespread in the Ohio and Maumee River basins and in tributaries of western Lake Erie located in Illinois, Indiana, Kentucky, Michigan, New York, Ohio, Pennsylvania, West Virginia, and western Ontario. The current range of northern riffleshell has been drastically reduced to eight to ten populations. The species is now considered critically imperiled (S1) in seven states and one province, and imperiled (S2) in Pennsylvania. Only four populations in the world are thought to have successful recruitment, two in Canada (Ontario) and two in the U.S. (Pennsylvania; NatureServe 2026).

State Range: Historically, northern riffleshell was found in southeastern Michigan from Lenawee and Monroe Counties north to Oakland and Macomb Counties. Additionally, it has been documented in Sanilac and Bay Counties further north. The Detroit River and the Black River watersheds (St. Clair and Sanilac Counties) of the eastern Lower Peninsula were once a stronghold of northern riffleshell across its range. Although old worn shells have been found at multiple locations in the Detroit River in the last 20 years, the species is likely extirpated from this waterway (van der Schalie 1986, Kovalak and Brusate 1990, Schloesser et al. 1997, Schloesser et al. 1998, Sweet 1998, Badra 2004, Badra 2006a-c, Schloesser et al. 2006, Morris and Burridge 2006, Badra 2009, Keretz et al. 2021, MNFI 2026). Surveys at four sites in the Detroit River, seven sites in Lake St. Clair, and five sites along the western shore of Lake Erie in Michigan during 2011 and 2012 did not reveal any northern riffleshell (Zanatta et al. 2015).

A viable population may still occur in the Black River watershed in the thumb region of Michigan. Live individuals, including gravid females, were documented there in the early, mid, and late 1980s (Hoeh and Trdan

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1985, Trdan et al. 1987). A fresh dead individual with some soft tissue still attached was found in 1998 (Badra et al. 1998) and two live northern riffleshell were found in the Black River in 2025 (J. Samu-Pittard, USFWS, personal communication 2025). Shells have also been found within the last 20 years in the Black River (Sweet 2005, MNFI 2026). The available habitat has not been extensively searched, and surveys targeting northern riffleshell are ongoing. The species was found at one location in the North Branch of the Clinton River in 1965 but has not been found since despite relatively thorough survey efforts in the watershed (Strayer 1980, Morowski et al. 2009). There are also historical records for northern riffleshell in the River Raisin and Huron River, but it has not been documented in these rivers for nearly 100 years (MNFI 2026). On October 10,1992, a "Rescue the Riffleshell" event translocated 110 northern riffleshell from the Detroit River to the St. Clair River in an attempt to mitigate impacts from zebra mussels. The current status of this translocated population is unknown (USFWS 1993, MDEQ 1996).

Recognition: Northern riffleshell is a medium sized unionid mussel with a maximum length of around 7 cm (2.75 inches). The shells are sexually dimorphic, though both are roughly oval in outline. Females have a prominent expanded posterior margin. Males are more pointed posteriorly, usually with a distinct sulcus (concave surface) running from nearly the umbo (beak) to the posterior/ventral margin of the shell. Both sexes are moderately inflated in their cross section. The umbo is broad and inflated. The shells are moderately thick but become thinner posteriorly, especially in the expanded posterior area in females. The outside of the shell is usually yellow to tan. Fine wavy green rays are often present and can be sparse or numerous, sometimes covering greater than half of the shell surface giving the shell a yellow-green color. Beak sculpture has been reported as 4-6 microscopic widely "V" shaped ridges or fine double-looped ridges. The lateral and cardinal teeth are moderately developed and lateral teeth are short. The nacre (inside of the shell) is white and iridescent (Watters et al. 2009, Mulcrone and Rathbun 2020).

Male shells of the white cat's paw (*Epioblasma perobliqua*, State and Federal Endangered) can be difficult to distinguish from male northern riffleshell. Male white cat's paw tend to be more evenly rounded in outline than northern riffleshell and have a less deep concave to their sulcus. The ridges running along each side of the sulcus are less prominent than in northern riffleshell. Female white cat's paw have an expanded posterior area with two lobes making the shell resemble the paw of a cat, in contract to female northern riffleshell, which have a single expanded area (Watters et al. 2009). In addition, wavy-rayed lampmussel (*Lampsilis fasciola*, State Threatened) can superficially resemble northern riffleshell; it also has numerous fine wavy green rays and can be the same size. However, wavy-rayed lampmussel does not have an expanded posterior area, as in female northern riffleshell, nor the sulcus of male northern riffleshell.

Best Survey Time: The best time of year to survey for unionid mussels is typically the first week of June through the last week of September. Northern riffleshell and other unionid mussel species burrow deeper into the stream bottom as temperatures get colder in the fall and deciduous leaves that fall into rivers at that time of year make them more difficult to detect during surveys. Periods of high water levels and high turbidity should be avoided. Northern riffleshell are often completely buried in the river substrate; however, females move to the surface of the substrate during the winter and spring to brood. Due to this brooding behavior, surveying in spring may allow for improved detection rates depending on other factors such as water level and turbidity.

Habitat: Northern riffleshell generally inhabits stable sand and cobble within riffles and runs of streams and large rivers. It has also been found in Lake St. Clair near the mouth of the Detroit River and the near shore of Lake Erie near the outflow of the Detroit River (USFWS 1994, Watters et al. 2009).

Biology: Northern riffleshell, like all Unionidae, are filter feeders that eat phytoplankton, zooplankton, bacteria, fine organic detritus, and other microscopic particles (Vaughn et al. 2008). Northern riffleshell have separate sexes. Eggs are fertilized within the female in the summer months then develop into larvae, called glochidia. These glochidia are brooded within marsupial gills of female mussels until they are ready to be released. In some mussel species, the glochidia overwinter within the female mussel (bradytictic), while in other species they are released in the fall (tachytictic). Northern riffleshell are bradytictic (Ortman 1912) and females are gravid from September to the following June (Ortman 1919). Glochidia must attach to the gills or fins of a fish host after they are released to survive

and develop into the adult mussel form. Without the proper species of fish co-occurring with the unionid mussel population, glochidia do not survive and reproduction cannot occur. Some species of mussel are specialists and have only a few species of fish known to act as hosts; others are generalists and are known to utilize a dozen or more different host species. Glochidia do not harm their hosts. There are two main benefits to having fish as hosts: the fish host provides a stable environment for the glochidia to grow, and glochidia are transported with their host fish until they transform into the adult form and drop from the fish. This allows unionid mussels, which are otherwise mostly sedentary, to migrate to new habitats and exchange genes among populations. Fish hosts provide unionid mussels the capacity to disperse, with the exception of salamander mussel (*Simpsonaias ambigua*), which uses mudpuppy (*Necturus maculosus*) as its host, and rare chance events where a mussel may hitch a ride on a bird, insect, frog, or newt (Darwin 1882). There is evidence for northern riffleshell using nine different host fish species, eight of which occur in Michigan—mottled sculpin (*Cottus bairdi*), rainbow darter (*Etheostoma caeruleum*), Iowa darter (*Etheostoma exile*), Johnny darter (*Etheostoma nigrum*), banded darter (*Etheostoma zonale*), logperch (*Percina caprodes*), blackside darter (*Percina maculata*), and brown trout (*Salmo trutta*) —and one which does not, bluebreast darter (*Etheostoma camurum*) (Freshwater Mussel Host Database 2026).

Some species of unionid mussels use structures resembling minnows or other fish prey to lure potential host fish when glochidia are ready to be released. For example, the minnow-like lures of species in the *Lampsilis* genus have an eye spot and fringes that look like fins. The female mussel extends and moves the lure in an undulating motion. When the fish bites the lure, glochidia are released and have improved chances of attaching to a fish host. Female northern riffleshell display their posterior mantle margin when glochidia are ready to be released. This part of the mantle is bright white and can be seen from several meters away in clear water. When a potential host fish investigates the mantle, the female traps the head of the fish between its shells and pumps glochidia onto the fish for 5-10 minutes before releasing it (Watters 2008). The maximum lifespan of northern riffleshell is around 15 years (Watters et al. 2009).

Conservation/Management: Unionid mussels are considered one of the most endangered animal groups in the world (Lydeard et al. 2004). North America has more unionid mussel species than any other zoogeographic region (Bogan 2008) but over 70% of the approximately 300 species in the region are considered imperiled (Bogan 1993, Williams et al. 1993, Strayer et al. 2004). Globally, 17 of the 28 species in the genus *Epioblasma* are thought to be extinct, 10 are critically imperiled (G1), and one is imperiled (G2) (NatureServe 2026).

Northern riffleshell populations in Michigan have declined due to invasive dreissenid mussels, habitat alteration (e.g. dredging and channelization), point and non-point source inputs, and altered stream flows/hydrologic regimes (i.e., dams/impoundments and increased flashiness). The most severe impact on populations in the Detroit River and Lake St. Clair has been the spread of zebra mussels (*Dreissena polymorpha*) (Schloesser 1998, Schloesser 2006, Morris and Burridge 2006, Schloesser and Walsh 2015). These non-native dreissenid mussels were introduced to Michigan in the late 1980s and have spread throughout the Great Lakes (except Lake Superior), and their connecting waterways, tributary rivers, and many inland lakes in the Lower Peninsula. Unlike unionid mussels, larvae of dreissenid mussels (veligers) are free swimming and therefore not dependent on fish hosts, allowing them to spread more rapidly. Dreissenid mussels must use byssal threads to attach to a solid substrate to survive. They often attach to the shells of native mussels in large numbers preventing them from feeding, moving, and reproducing, eventually causing mortality (Mackie 1991, Haag et al. 1993). Zebra mussels are present throughout the range of northern riffleshell in Michigan, except for the Black River (St. Clair and Sanilac Counties), and remain an ongoing stressor that would likely prevent any reestablishment of the species in the Detroit River and would continue to be at least a moderate threat in the Huron, River Raisin, and Clinton River watersheds where zebra mussels occur in much lower densities.

The greatest impact to northern riffleshell populations in its other former stronghold in Michigan, the Black River (St. Clair and Sanilac Counties), has been dredging and channelization. Sections of the river were dredged and channelized in 1948 and again in 1989. In 1988, when dredging was imminent, 118 live northern riffleshell were removed from a three mile stretch of the Black River to try to mitigate impacts from dredging and channelization (Trdan and Hoeh 1993). These were relocated to the Detroit River, which at the time supported a rela-

tively large population of northern riffleshell and had not yet been noticeably impacted by zebra mussel invasion. In 1992, 110 northern riffleshell were translocated from the Detroit River to the St. Clair River to mitigate the impacts of zebra mussels. This was a collective effort among local businesses, citizens, the City of Detroit, MDNR, and USFWS. The rescue group included 50 scuba divers from several police departments, 20 Boy Scouts, 6 biologists, and 50 community volunteers. The current status of the translocated population is unknown (USFWS 1993, MDEQ 1996). The discovery of a fresh dead northern riffleshell (shells with soft tissue still intact) in the Black River (Sanilac and St. Clair Counties) in 1998 indicates at least some individuals survived dredging that took place in 1989. Though a survey of 12 sites in the Black River in 2003 did not reveal any live northern riffleshell or empty shells (Badra 2004), the two live individuals found in 2025 (J. Samu-Pittard personal communication 2025) have renewed hope that a viable population still exists in Michigan.

The number of surveys for unionid mussels in Michigan has increased greatly over the past 25+ years (MNFI 2026). Improvements in the collection, storage, and dissemination of unionid mussel survey data (i.e., distribution and abundance) may allow these data to be more easily accessible and integrated into natural resource management decision making and policy, helping to address a shortfall impairing knowledge and conservation of freshwater mollusks described by Lopes-Lima et al. (2021).

A new management tool that has begun to be utilized and further developed is the use of eDNA to locate mussel populations. eDNA samples can be collected from rivers and lakes relatively quickly, allowing most intensive in-stream visual and tactile survey efforts to narrow in on particular river reaches and habitat with positive eDNA results (Marshall et al. 2026 *in review*). This approach may be well suited to investigating northern riffleshell because of their rarity and difficulty to detect. Foundational work on northern riffleshell genetics has been done to help inform any future propagation and reintroduction efforts in Michigan (Zanatta and Murphy 2006, 2007)

The lower reaches of rivers and Great Lakes coastline that northern riffleshell tends to inhabit are subjected to the cumulative effect of upstream point and non-point impacts including agricultural and urban run-off, industrial waste, and herbicides and pesticides used to treat aquatic habitats. Certain components of some herbicides and pesticides, like copper and surfactants, are harmful to unionid mussels. Unionid mussels are particularly sensitive to heavy metals such as copper and cadmium (Newton 1995, Keller and Zam 1991), chlorides (e.g. road salt, Gibson et al. 2018), and ammonia (Newton et al. 2003).

More severe fluctuations in precipitation due to climate change have led to altered stream flows and hydrologic regimes, bringing higher peak flows during heavier rain events and lower minimum flows during more severe dry periods. This increase in stream flashiness has led to more erosion and scouring of stream bottoms, which negatively impacts unionid mussels. Michigan is expected to experience larger rain events with climate change (Manzano and Barkdoll 2022), resulting in increased runoff into rivers and streams, likely leading to poor water quality. Ongoing conversion of land from natural cover types (e.g. forest and wetlands) to impervious or otherwise highly modified cover types (e.g. residential, commercial, and paved) has led to faster inflow of precipitation into streams and rivers, as well as increased surface runoff of nitrogen, ammonia, chlorides, heavy metals, sediment, and other substances harmful to native mussels and other stream life. Maintaining and restoring naturally vegetated riparian corridors along rivers and streams can help mediate impacts of increased stream flashiness and surface runoff on native mussels and their habitats.

Removing barriers and improving fish passage in Michigan, such as removing obsolete dams, can improve connectivity of mussel populations, allowing for migration to new habitats and transportation of mussels between populations via host fish movement. Gene flow (interbreeding) among populations prevents negative impacts from inbreeding and genetic isolation of populations (Watters 1996, Haag 2012). Alteration of stream flows with dams or other in-stream structures can lead to scouring of substrates used by mussels. Poor stream crossings, such as culverts that are too small or that are perched above stream water level, can also interfere with fish passage, as well as increase erosion and create flooding hazards. The construction of dams and impoundments on large rivers in the southern U.S. has caused or contributed to the extinction of at least twelve native mussel species over the past century (Haag 2012) and is one of the major impacts to Michigan's native

mussel fauna. Host species for northern riffleshell are often smaller fish, such as darters and sculpin, which have short dispersal ranges (less than 100 m [330 feet]), thereby limiting northern riffleshell dispersal (Schwalb et al. 2011). Conservation and management of local fish host populations is therefore especially important for maintaining northern riffleshell populations.

Research Needs: Locating any remaining populations of northern riffleshell in Michigan and identifying and addressing ongoing impacts to these populations is critical for conserving the species in the state. Targeted surveys throughout the Black River watershed and at historical locations in the River Raisin, Huron River, Clinton River, and Lake St. Clair are needed. In particular, the status of the St. Clair River translocation needs to be assessed. Using eDNA to detect northern riffleshell may be an effective and cost-efficient way to focus in-stream survey efforts and discover remaining populations. Determining the best seasonal timing to detect eDNA in this very rare species could help ensure eDNA efforts with northern riffleshell are successful.

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