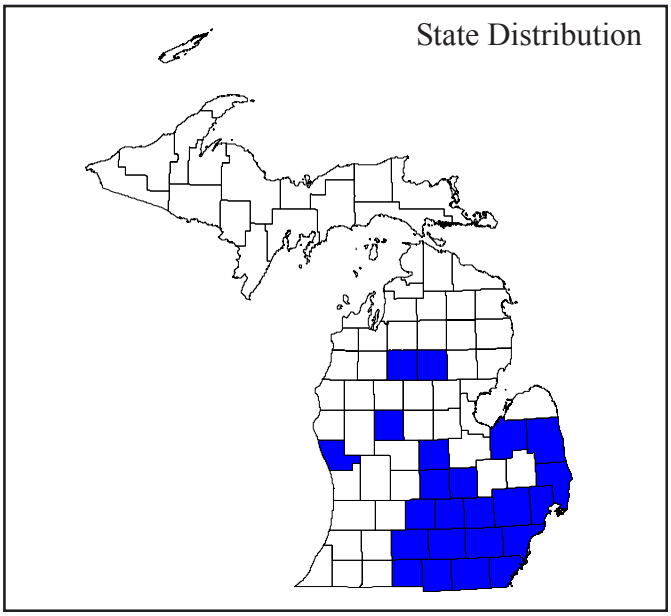
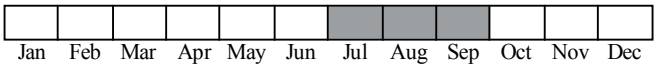
Villosa iris Lea — Rainbow

Photo by Kurt Stepnitz, MSU University Relations



Best Survey Period



Status: State listed as Special Concern

Global and state ranks: G5/S2S3

Family: Unionidae (Pearly mussels)

Synonyms: *Micromya iris* (Lea). Another common name is rainbow shell.

Total range: The global range of the rainbow is restricted to eastern North America, from Ontario, Canada south to Alabama, west to Oklahoma, and east to New York. It is present in the St. Lawrence River system in the Lake Michigan, Lake Huron, Lake Erie, and Lake Ontario drainages, and in the Ohio, Tennessee, and upper Mississippi River systems. (Burch 1975, Clarke 1981, NatureServe 2006)

State distribution: In Michigan the rainbow has been documented in the St. Joseph (Lake Michigan drainage), St. Joseph (Maumee drainage, Hillsdale Co.), Kalamazoo, Grand, Muskegon, Saginaw, St. Clair, Clinton, Detroit, Huron, and Raisin watersheds. Though this species is fairly wide ranging in Michigan, it was found infrequently and in relatively low abundance in recent surveys. (Badra and Goforth 2003, Carman and Goforth 2003, Badra 2004, Badra 2005)

Recognition: The rainbow has an oval outline that can be slightly pinched at the posterior end of the shell. It is moderately compressed, as opposed to highly inflated or highly compressed. The outside of the shell is smooth, without bumps or ridges, and is yellow to dark tan in color. The posterior ridge often has a slight convex shape. Green rays are almost always present, becoming wider and more pronounced toward the posterior end of the shell. Maximum length of the rainbow is approximately 3 inches (75mm). The beaks (also known as umbos) are low, only slightly raised above the hinge line. Beak sculpture consists of irregular double looped ridges. The shells are of moderate thickness relative to most species in Michigan. Pseudocardinal and lateral teeth are somewhat fine but well developed. The lateral teeth and hinge line are relatively long. The beak cavity is shallow. The nacre is white or bluish-white, and iridescent posteriorly. Shells of males and females are morphologically similar.

Similar species in Michigan are the ellipse (*Venustaconcha ellipsiformis*), slippershell (*Alasmidonta viridis*), and spike (*Elliptio dilatata*). Rainbow can be difficult to separate from the ellipse, which has a shorter hinge line and is usually more pinched at the posterior end than the rainbow. The ellipse's rays tend to be more wavy and more uniformly

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distributed from the anterior to posterior end of the shell. The ellipse often has wrinkles near the posterior end of the shell running from the edge of the shell toward the beak. The slippershell is more inflated than the rainbow and is smaller, although large old slippershells can be equal in size to small young rainbows. The slippershell also has a roughly rectangular outline. The spike is a larger species than the rainbow, brown to black in color, and lacks rays. (Clark 1981, Oesch 1984, Cummings and Mayer 1992, Watters 1995, pers. observation of Michigan shells)

Best survey time: Surveys for the rainbow, as with most freshwater mussels, are best performed in the summer when water levels are low and water clarity is high. Low water levels make it easier to spot mussels and can expose muskrat middens containing empty freshwater mussel shells. During the winter months unionid mussels tend to burrow deeper into the stream bottom making them difficult to detect. In water that is less than two to three feet deep, a glass-bottomed bucket is an efficient tool for finding live mussels. In deeper habitats, SCUBA is often needed to perform surveys.

Habitat: The rainbow is found in small to medium sized streams with sand and gravel substrates. Suitable habitat for fish host species must be present for rainbow reproduction to be successful (see Biology).

Biology: Like most freshwater mussels of the family Unionidae, the rainbow requires a fish host to complete its life cycle. Eggs are fertilized and develop into larvae within the female. These larvae, called glochidia, are released into the water and must attach to a suitable fish host to survive. The females of some unionids have structures resembling small fish or other prey that are displayed when the larvae are ready to be released. Other unionids display conglutinates, packets of glochidia that are trailed out in the stream current, attached to the unionid by a clear strand. These lures entice fish into coming into contact with glochidia, increasing the chances that glochidia will attach to a suitable host. The rainbow attracts potential host fish with an elaborate lure and behavior. The rainbow's lure is a specialized structure extending from the mantle flap (edge of the mussels body near the siphons) that resembles a crayfish, complete with eyespots, antennae, legs, and tail. What makes the lure even more convincing is that the mussel flaps the "tail" and moves the "legs", mimicking the swimming motion of a crayfish. Some unionids are winter breeders that carry eggs, embryos, or glochidia through the winter and into the spring (bradytictic), while others are summer breeders whose eggs are fertilized and glochidia released during one summer (tachytictic). The rainbow is reported to be a summer breeder (Oesch 1984).

Glochidia remain on the fish host for a couple weeks to several months depending on the unionid species and other factors. During this time the glochidia transforms into the adult form then drops off its host (Kat 1984). Although the advantages of having fish hosts are not fully understood, two factors are known to provide benefits. Similar to animal facilitated seed dispersal in plants, fish hosts allow mussels that are relatively sessile as adults to be transported to new habitat and allow gene flow to occur among populations. The fish host also provides a suitable environment for glochidia to transform in. Some unionid species are able to utilize many different fish species as hosts while others have only one or two known hosts. In laboratory experiments (O'Dee and Watters 2000), the rainbow has been found to utilize striped shiner (*Luxilus chrysocephalus*), streamline chub (*Hybopsis dissimilis*), smallmouth bass (*Micropterus dolomieui*), largemouth bass (*Micropterus salmoides*), green sunfish (*Lepomis cyanellus*), bluebreast darter (*Etheostoma camurum*), greenside darter (*Etheostoma blennioides*), rainbow darter (*Percina shumardi*), and yellow perch (*Perca flavescens*) as hosts. Other fish species may act as hosts in Michigan. Maximum life-span for some unionids is over 50 years. Rainbow likely live to over 15 years of age.

Conservation/Management: Eastern North America is the global center of diversity for freshwater mussels with over 290 species. In a review of the status of U.S. and Canadian unionids by the American Fisheries Society, one third (97) of these were considered endangered (Williams et al. 1993). Thirty-five unionids are thought to have gone extinct in recent times (Turgeon et al. 1998). There are 45 species native to Michigan and nineteen of these are state-listed as endangered, threatened, or special concern.

The decline of this group over the last couple hundred years has been attributed mainly to direct and indirect

impacts to aquatic ecosystems. Threats include habitat and water quality degradation from changes in water temperature and flow regime; the introduction of heavy metals; organic pollution such as excessive nutrients from fertilizers, pesticides and herbicides; dredging; and increased sedimentation due to excessive erosion (Fuller 1974, Bogan 1993, Box and Mossa 1999). High proportions of fine particles (sand and silt) were found to be a limiting factor for unionid density and species richness across several watersheds in lower Michigan (Badra and Goforth 2003). Using certain agricultural practices such as conservation tillage, grass filter strips between fields and streams, and reforestation in the floodplain can help reduce the input of silt and other pollutants. Forested riparian zones help maintain a balanced energy input to the aquatic system, provide habitat for fish hosts in the form of large woody debris, reduce the input of fine particles by stabilizing the stream banks with roots, and provide shade which regulates water temperature. Due to the unique life cycle of unionids, fish hosts must be present in order for reproduction to occur. The loss of habitat for these hosts can cause the extirpation of unionid populations. Barriers to the movement of fish hosts such as dams and impoundments also prevent unionid migration and exchange of genetic material among populations, which helps maintain genetic diversity within populations.

The zebra mussel (*Dreissena polymorpha*) and the Asian clam (*Corbicula fluminea*) are exotics from Eurasia that have spread quickly throughout the Great Lakes region. Zebra mussels are known to have severe negative impacts on native unionids. Zebra mussels require stable, hard substrates for attachment and often use unionid mussels as substrate. Unionids can get covered with enough zebra mussels that they cannot reproduce or feed, eventually killing the unionid. This exotic has had a dramatic effect on native unionid communities in habitats where it has been introduced. The continued range expansion of the zebra mussel into streams and lakes remains a serious threat. Boaters can reduce the spread of zebra mussels by making sure they do not transport water (which can contain zebra mussel larvae) from one water body to another. Washing boat and trailer or letting both dry overnight reduces the potential for spreading zebra mussels. Zebra mussels are present throughout the rainbow's range in Michigan. Laboratory experiments have demonstrated that, at high densities, Asian clams can affect the survival and growth of juvenile rainbow (Yeager et al. 2000)

Because unionid conservation involves a wide range of issues they are useful umbrella taxa for the conservation of aquatic ecosystems as a whole. By working towards solutions to threats to freshwater mussels we ameliorate threats to the stream and lake ecosystems they inhabit.

Research needs: Unionid mussels are found in rivers that are subject to cumulative impacts from upstream. Creative solutions are needed to promote the reduction of impacts that occur throughout entire watersheds while allowing for agricultural, development, and other landuses. Cultural, economic, and ecological perspectives need to be integrated into management plans for each watershed. Rainbow populations that are threatened by zebra mussels should be monitored. Methods for minimizing the spread of zebra mussels and preventing future invasive species from being introduced need to be developed and applied. Additional studies are needed to determine which fish species act as hosts for the rainbow in Michigan.

Related abstracts: Ellipse (*Venustaconcha* ellipsiformis), Slippershell (*Alasmidonta viridis*), Wavy-rayed lampmussel (*Lampsilis fasciola*)

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Abstract Citation: Badra, P.J. 2007. Special Animal Abstract for *Villosa iris* (Rainbow). Michigan Natural Features Inventory. Lansing, MI. 5pp.

Funding for abstract provided by Michigan Department of Transportation