

## **Appendix 2A      Life Histories of Aquatic Species**

The following species are considered important species in aquatic ecosystems within the vicinity of the Fermi site. These life histories provide detailed information on any critical life-support requirements such as spawning areas, nursery grounds, food habits, feeding areas, wintering areas, and migration routes. Supplemental life history data was gathered from NatureServe wildlife database ([Reference 2.4-9](#) and [Reference 2.4-80](#)).

### **Alewife-*Alosa pseudoharengus***

The alewife has a native range in North America from Labrador, Canada down the Atlantic coast to North Carolina. It has been introduced into the Great Lakes and streams and rivers west to the Mississippi, as well as in Nebraska. This species was likely introduced in Lake Ogallala as a pelagic forage fish.

The alewife inhabits nearshore areas of the Atlantic Ocean, or open-water areas of lakes. Ocean populations will migrate to quiet portions of rivers or streams (freshwater or brackish) to spawn, while land-locked populations migrate locally to shallow inshore areas. Optimum temperature range for this species is 52 to 66°F for adults and 63 to 66°F for juveniles.

This species generally spawns at night in the spring or summer, depending on locality. The eggs hatch in a week or less, and larvae will school in the vicinity of the spawning area until they are ready to leave the nursery. Juveniles reach sexual maturity in 2-4 years, and marine adults may attain sizes up to 16 inches and live as long as 8 years.

Juvenile alewives feed on diatoms, and zooplankton such as copepods and ostracods. Adult fish will feed on zooplankton, crustaceans, insects, and eggs. Larger individuals will prey on small fishes, as well.

The alewife is a target for larger predatory fish and are commercially harvested for use in animal food.

### **Black crappie-*Pomoxis nigromaculatus***

The native range of the black crappie is difficult to determine, but it is currently distributed from Quebec and Manitoba, south through the St. Lawrence, Great Lakes, and Mississippi River basins to the Gulf of Mexico, as well as the Atlantic Slope from Virginia to Florida and Gulf Slope west to Texas.

The black crappie generally inhabits lakes, ponds, sloughs, and the backwaters of pools and streams. It prefers clear water with some aquatic vegetation, and is often found over mud or sand substrates. Optimum temperature range for the black crappie is 73 to 90°F.

Black crappie spawn in May, June, or July. Males construct a nest by fanning out small depressions on the bottom in and around brush, rocks, or vegetation in water between 1 and 5 feet deep. Females then lay 5,000 to 30,000 eggs in the nest. This species may live up to 15 years and attain a length of 18 inches.

Juveniles feed upon planktonic crustaceans and free-swimming, nocturnal insect larvae. As adults, black crappie will become piscivorous upon smaller species.

Black crappie are a common game fish and are highly regarded by recreational fisherman. It is also one of the largest and most popular of the sport fishes. It can be caught during all seasons and during the day or at night under lights.

### **Bluegill-*Lepomis macrochirus***

Bluegill are distributed from Quebec, south through the St. Lawrence, Great Lakes, and Mississippi River basins to northern Mexico, as well as the Atlantic and Gulf Slope drainages. This species is widely distributed throughout North America and many other parts of the world.

These sunfish are frequently found in shallow lakes, ponds, reservoirs, sloughs, and slow-flowing streams. Often they are associated with rooted aquatic vegetation and silt, sand, or gravel substrates. Bluegill are capable of withstanding a wide range of temperatures (34 to 97°F), although temperatures around 81°F seem to be optimum for northern ranging specimens.

Bluegill lay eggs in a nest made in shallow water by the male on bottoms of gravel, sand, or mud that contain pieces of debris. After their yolk sac is absorbed, larvae move from the littoral to limnetic zone, then return to littoral zone 30 to 40 days later. Adult bluegills can attain sizes between 10 to 16 inches and may live over 10 years.

Young bluegill feed upon planktonic crustaceans, insects, and worms. Adults eat mainly aquatic insects, crayfishes, and small fishes, or, in some bodies of water, mostly zooplankton.

This species has popularity with recreational anglers of all ages because it can be easily caught, are valiant fighters for their size, and are exceptionally fine eating.

### **Bluntnose minnow-*Pimephales notatus***

The bluntnose minnow is one of the most common freshwater fishes in eastern North America, present in the Great Lakes, Hudson Bay, and Mississippi River basins north from Quebec to Manitoba, south to Louisiana and on the Atlantic Slope from the St. Lawrence in Quebec south to North Carolina.

This minnow is found in a variety of habitats including lakes, ponds, rivers, and creeks. It is most common in clear rocky streams, and schools either in mid-water or near the bottom. Bluntnose minnows are capable of withstanding temperatures ranging from approximately 45 to 95°F.

Bluntnose minnows spawn from May to August over sandy, gravelly shoals. The male digs a nest in which several females may lay eggs. The male then guards the nest until the eggs hatch, usually within 6-10 days. Females will grow to sexual maturity in one year, while males generally take two. Maximum life expectancy of this minnow is five years, and it may grow up to 4 inches in length.

Both juvenile and adult minnows are primarily bottom feeders on detritus and algae in the winter. In the summer they have been shown to feed on insects, plant material, and zooplankton.

The bluntnose minnow's small size and abundance allows this species to commonly be used as a bait fish by recreational anglers.

### **Channel catfish-*Ictalurus punctatus***

Channel catfish occur mostly in the central drainages of North America, from southern Canada to northern Mexico, historically. It has been widely distributed throughout the United States as well as other countries.

This species prefers clean, well-oxygenated water of rivers and streams, but will occur in ponds and lakes as well. They occur from clear, rapid flowing waters over firm bottoms, to turbid slow moving water over mud substrates. Optimum temperature range for the channel catfish is 79 to 84°F.

Channel catfish have been known to migrate hundreds of miles throughout their lifetime. They generally spawn between April and July when temperatures are about 27 degrees Celsius. Females lay up to 20,000 eggs in a nest on holes dug in sandy substrates. Males then guard and fan over the nest during the 3-8 day incubation period. Larval development lasts about two weeks, and schools of larvae may persist for weeks after leaving the nest. Sexual maturity is reached anywhere from 2-8 years, and adults may reach over 51 inches and live up to 16 years.

Juvenile channel catfish eat mainly small invertebrates and insects, and prey increasingly on crayfish and fishes as they grow. Adults are mainly piscivorous, but will feed upon insects, small mammals, and vegetation.

The channel catfish size make it a highly sought after sport fish. They also have significant commercial value to fisherman in Lake St. Clair and Lake Erie.

### **Common reed-*Phragmites australis***

The common reed is an aquatic plant found in every U.S. state and is considered an invasive species. The common reed is a clonal grass species with woody hollow stems that typically grows up to six meters in height. Leaves are lanceolate, and flowers develop by mid summer. The common reed is wind-pollinated but self-incompatible. Seed set is highly variable and occurs through fall and winter and may be important in colonization of new areas. Germination occurs in spring on exposed moist soils. Vegetative spread by below-ground rhizomes can result in dense clones with up to 200 stems per square meter.

The common reed is most abundant along the Atlantic Coast and in freshwater and brackish tidal wetlands of the northeastern United States as far south as North Carolina. It occurs in all eastern states and populations are expanding, particularly in the Midwest ([Reference 2.4-41](#)).

### **Common shiner-*Luxilus cornutus***

The common shiner is part of the minnow and carp family. This species is widely distributed across North American from Canada down to the Gulf Coast region. It is small, averaging 2.5 inches, but some specimens can reach approximately 8 inches. Its preferred habitat is creeks and small to

medium rivers, clear cool water, and a moderate to swift current with gravel to rubble bottom. In the north, it can be found abundantly in lakes and reservoirs.

The common shiner spawns in late spring and early summer over gravel beds in running water. Nests are made in the gravel by the male or a nest of another species is utilized. Eggs become lodged in the gravel and are protected by the male until they hatch. Once hatched, the common shiner will reach sexual maturity in 2-3 years. Both adults and juveniles are opportunistic omnivores feeding on aquatic insects, adults and larvae, and other plant material. The common shiner is a hardy species which thrives in temperatures up to 72°F.

Common shiners serve as forage fish for game fish and are often used as a bait minnow for anglers.

### ***Emerald shiner-Notropis atherinoides***

The emerald shiner is a small, slender fish that belongs to the carp and minnow family. This species is widely distributed across North America from Canada to Virginia through Texas. The emerald shiner prefers large, deep rivers and large lakes or reservoirs. They are also found in embayments and backwaters of these systems. Generally, they are found near the surface in open waters. This species is tolerant of turbidity in Great Plains streams, but rarely in other areas. The emerald shiner is capable of withstanding a wide range of temperatures, with an upper lethal limit documented at about 100°F.

Emerald shiners are broadcast spawners with no real substrate preference. They have been known to spawn over sand, gravel, vegetation, and other cover. Adults range in size from 2 to 3.5 inches with a maximum size of 4 inches. Generally, they feed on zooplankton, insects, and flying insects.

The emerald shiner serves as an important forage species for predatory fishes in areas where it is abundant.

### ***Fishhook water flea-Cercopagis pengoi***

The fishhook water flea is an invasive species native to Southwest Asia and is believed to have arrived in the Great Lakes Region via ballast water in the late 1990s. This species is similar to the spiny water flea, as it is also a relatively large plankton species with a high reproductive rate. Its distribution and characteristics are analogous to that of the spiny water flea ([Reference 2.4-43](#)).

### ***Freshwater drum-Aplodinotus grunniens***

This species of drum is widely distributed throughout North and Central America. It ranges from the St. Lawrence, Great Lakes, Hudson Bay, and Mississippi River Basins, Gulf Coast drainages, south through eastern Mexico and down to Guatemala.

Freshwater drum occur in a variety of habitats, but seem to prefer large, silty lakes and large rivers. They generally occur over mud bottoms in open water. Optimum temperature for this species is approximately 86°F.

Spawning usually occurs in the spring or summer when water temperatures reach 19-22 degrees Celsius. They are generally pelagic spawners, utilizing open water far from shore, where their fertilized eggs float on the surface 1-2 days before hatching. Juvenile males generally reach sexual maturity in 2-4 years, while females take 4-6 years. Maximum life expectancy for this drum is ten years, with a growth potential of 37 inches.

Juvenile drum tend to feed upon minute crustaceans and insect larvae. Adults are mostly benthic foragers, and prey items include insect larvae, crustaceans, fishes, and bivalves.

Freshwater drums are harvested commercially in Lake Erie. This species is not a recreationally significant fish as anglers' opinions of the species is mixed on the suitability for consumption.

### **Gizzard shad-*Dorosoma cepedianum***

The gizzard shad is in the Family Clupeidae, the herring family. It is distributed through the mid to eastern region of the United States and the middle and south of Canada around the Great Lakes. As an adult, the gizzard shad will reach 9 to 14 inches in length and be up to two pounds. This fish can thrive in a wide variety of habitats including large rivers, reservoirs, lakes, swamps, bays, sloughs, and similar quiet open waters. Young and juveniles live in the more clear and shallow waters versus adult gizzard shad that stay in deeper waters, near bottom. This species is capable of withstanding temperatures from approximately 43 to 91°F; however, the gizzard shad will begin to experience decreased body functions in a much shorter time period when exposed to lower water temperatures.

These fish spawn at night during the spring and summer in shallow waters over rocky substrate. The eggs are scattered and adhere to objects on the bottom substrate until hatching 2 to 4 days later. The juveniles obtain sexual maturity in 2 to 3 years and have a lifespan of approximately 4 to 6 years.

Juvenile gizzard shad are planktivores, eating protozoans, small crustaceans, Chlorophyta, and Chrysophyta. Adults are primarily bottom filter-feeding detritivores, acquiring food from aufwuch<sup>1</sup> assemblages in littoral areas.

Gizzard shad have been used by anglers as a bait fish. Young gizzard shad are important forage fish for sport and other predator fish. However, their rapid growth makes them too large by the end of their first year of life to be eaten by most fish. The gizzard shad has also been considered a nuisance as it can overpopulate water bodies and is prone to massive die-offs.

### **Lake whitefish-*Coregonus clupeaformis***

During the late 19<sup>th</sup> and early 20<sup>th</sup> centuries, large numbers of lake whitefish entered the Detroit River each year to spawn. Whitefish prefer rock, honeycomb limestone, gravel or sand for optimal spawning conditions. Reports indicate that the lower Detroit River was a prolific spawning area prior to the construction of the Livingstone Shipping Channel. The timing of this construction

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1. Aufwuch – refers to the small animals and plants that encrust hard substrates, such as rocks, in aquatic environments.

coincides with the degradation of whitefish populations in the river and western Lake Erie. The primary sources of food for the lake whitefish in the Western Lake Erie Basin are two small, bottom-dwelling organisms called *Diporeia* and chironomids. Lake whitefish have a narrow temperature tolerance, requiring cold, well oxygenated bottom waters throughout the summer in order to survive. They require relatively silt-free river or lake spawning areas for successful reproduction. Optimum temperature for the lake whitefish ranges from 50 to 57°F for adults and 60 to 67°F for juveniles.

Lake whitefish are recognized as an indicator of ecosystem health and are an integral component of the Great Lakes food web. Recently, populations of lake whitefish were once again discovered in the Detroit River, but further studies are necessary to ascertain their presence in other tributaries of western Lake Erie.

Little information exists regarding whitefish life history, habitat requirements, and ecological niche in Lake Erie and its tributaries including the Detroit River. The Detroit River-Western Lake Erie Basin Indicator Project, sponsored by the EPA has identified a need for the collection of life history data for the lake whitefish and incorporated this need into ongoing monitoring and restoration studies on Lake Erie and the Detroit River.

### **Largemouth bass-*Micropterus salmoides***

The largemouth bass is widely distributed throughout North America, from the St. Lawrence, Great Lakes, Hudson Bay, and Mississippi River basins, as well as the Atlantic drainages from North Carolina to Florida, to northern Mexico. This popular gamefish has been introduced widely throughout the United States and the rest of the world, where it is sometimes considered to have had adverse ecological impacts.

This bass will inhabit clear waters of lakes, ponds, reservoirs, and swamps. Largemouths may also be found in the pools or backwater areas of creeks and rivers. They are usually associated with muddy bottoms and aquatic vegetation as well. The largemouth bass is capable of withstanding temperatures ranging from 50 to 90°F.

Largemouth bass spawn in spring and summer when the water temperature reaches at least 15 degrees Celsius. Males become aggressive and territorial as they dig nests in shallow water. After the female deposits eggs in the nest, the male guards and fans the eggs, which hatch within five days. The hatchlings will reach sexual maturity in 2-5 years, and may attain sizes of nearly 39 inches with a life expectancy up to 23 years.

This species feeds mainly upon zooplankton as fry. As the juvenile grows it begins to prey upon insects, crustaceans, and fish fry. Adults are mainly piscivorous, but will feed upon crawfish and frogs as well. Largemouth bass have also been shown to be cannibalistic and do not feed while spawning.

The largemouth bass is a major sport fish in the Great Lakes. It's excellent fighting ability and good taste makes it a valuable resource for recreational fishing.

### **Pumpkinseed-*Lepomis gibbosus***

The pumpkinseed belongs to the family of sunfishes and freshwater basses. This species is distributed across the United States from coast to coast and up into Canada. This species length ranges from 5 to 6 inches, but some may approach 10 inches. The pumpkinseed can be found in a variety of habitats including lakes, reservoirs, ponds, sloughs, and sluggish streams that have quiet, clear water with aquatic vegetation and some organic debris. Temperature tolerance ranges from 39 to 72°F.

This species spawns in spring and summer with the males digging a pit in the substrate in which the eggs are deposited. The male guards the eggs until they hatch 3 to 5 days later. Sexual maturity occurs in the 2nd or 3rd year. Immature pumpkinseeds feed on zooplankton while adults feed upon snails, aquatic insects, and other invertebrates.

Though there is not a large recreational fishing demand on the pumpkinseeds due to their small size; they are popular with young fisherman because of willingness to bite worms, their large numbers, and location close to shore.

### **Rainbow smelt-*Osmerus mordax***

Though the rainbow smelt was once an exclusively anadromous species; the smelt now successfully inhabits freshwater systems in the northeastern and central United States. More specific to the Great Lakes Region, it was introduced to Michigan's inland waters as food for stocked salmon in the 1900s. The rainbow smelt escaped to Lake Michigan, and by 1930 the rapidly growing population had spread into Lake Superior and beyond. Most adult smelt do not exceed 7 to 9 inches and weigh no more than a few ounces. Rainbow smelt are sensitive to bright lights and warm temperatures so they are usually found in the deeper, cool depths offshore.

They spawn in the spring with females producing 12,000 to 50,000 eggs that sink to the bottom and attached to gravel substrate. The eggs rapidly hatch and sexual maturity is reached at 2 years of age. Adults can live up to 8 years. This carnivorous species feeds primarily upon crustaceans and small fish but also eat terrestrial and aquatic insects.

These fish are a target for recreational anglers and well as being commercially caught for animal feeds.

### **Rock bass-*Ambloplites rupestris***

The rock bass is actually a member of the sunfish family. It is native to the freshwaters of east-central North America, but can be found in some western states and southern Canada. Their average length is 6 to 8 inches with some growing up to 12 inches. Rock bass weight ranges from 4 to 8 ounces. Its preferred habitat is clear, silt free, rocky streams; small, cool, weedy lakes, or shallow, rocky areas of a larger lake. In winter, it remains relatively inactive in deeper waters. Optimum temperature for the rock bass ranges from 50 to 84°F.

Adults live in groups and spawning occurs in late spring in shallow depressions made by the male. The male guards the eggs until they hatch 3 to 4 days later. Sexual maturity is reached at 2 to 3

years of age and adults can live up to 12 years. The rock bass eats a wide variety of foods, including crayfish, small fish, and insects.

These fish are a commercial species in the Great Lakes and are an important sport fish.

### **Round goby-*Neogobius melanostomus***

The round goby is an invasive species abundant throughout the Great Lakes Region with origins in the Black and Caspian Seas. They are currently undergoing a population explosion in Lake Erie, are present in the Detroit River, and are most likely present in Swan Creek and Stony Creek. This species of goby is a small fish that utilizes bivalves, amphipod crustaceans, small fish, and fish eggs as its main food source. Thermal tolerance for this species ranges from 39 to 68°F. It is commonly believed that the round goby was introduced to the Great Lakes through ballast water. Known to compete with other fish for food and consume eggs and juvenile fish, the round goby is seen as a detriment to the Lake Erie ecosystem.

### **Sea lamprey-*Petromyzon marinus***

The sea lamprey is a primitive jawless fish originating in the Atlantic Ocean. The sea lamprey is an invasive species and is larger and far more predacious than the lamprey species' native to Lake Erie, capable of withstanding temperatures ranging from 41 to 68°F. They were first observed in Lake Erie in 1921, and often move into its tributaries to spawn. Many tributaries of Lake Erie are treated with chemicals called lampricides to prevent further expansion of the species. Although Lake Erie and Swan Creek are the only waterways of concern with confirmed occurrence, Stony Creek and the Detroit River could potentially have individuals present during spawning runs.

A single sea lamprey can kill as much as 40 pounds of fish in its lifetime, and it is estimated that only one in seven fish survive an attack by a sea lamprey. They have a strong advantage over the many species of fish native to Lake Erie because they have no natural predators in the lake. The sea lamprey has caused the most damage to native fishes including the lake trout (*Salvelinus namaycush*), lake whitefish and hornyhead chub (*Nocomis biguttatus*). The sea lamprey has no economic value, and during its peak abundance, it is estimated that 85 percent of lake trout encountered that have not been killed by the lamprey will have scarring from their attacks ([Reference 2.4-39](#)).

### **Spiny water flea-*Bythotrephes* spp.**

The spiny water flea is an invasive species native to Europe and Northern Asia and is believed to have arrived in the Great Lakes Region via ballast water in the mid-1980s. The spiny water flea is very abundant in the central basin of Lake Erie, but may be found throughout the lake. There are populations found in inland lakes of the Great Lakes Region, and it is presumed that the spiny water fleas may occur in tributaries of Lake Erie such as Swan Creek, Stony Creek, and the Detroit River as well.

This is a large plankton species, about ½ inch in length, and has a very high reproductive rate. Scientists fear that as the population in Lake Erie starts to increase, they will eradicate many of the native zooplankton species, their main food source. The spiny water flea also competes with



juvenile fish as they share many similar food sources such as zooplankton, fish larvae, and eggs. This species is not an attractive prey to the native inhabitants of Lake Erie because of the sharp spines located on its tail. It is assumed that there will be few deterrents to the success of its rapidly growing population ([Reference 2.4-73](#)).

### **Spottail shiner-*Notropis hudsonius***

The spottail shiner is a member of the carp and minnow family. It is distributed across the northeast portions of the United States and across much of Canada. It is considered a medium sized minnow, growing 3 to 4 inches in length. Its habitat ranges from large lakes and rivers to small streams, but does prefer clear water and is considered the “big water” member of the minnow family. Temperature range for the spottail shiner is 50 to 75°F.

The spottail shiner spawns in late spring or early summer and once hatched, juveniles reach sexual maturity in 1 to 2 years. Both young spottail shiner and adults feed upon insects, crustaceans, and filamentous algae.

This species serves as a popular bait minnow for the recreational angler.

### **Walleye-*Sander vitreus***

Walleye are the largest member of the perch family. They can be found in all the Great Lakes as well as across the central-east United States and up into Canada. It ranges in length from 13 to 25 inches and weighs 1 to 5 pounds. Walleye can be found in a variety of large bodies of freshwater including lakes, pools, backwaters, rivers and flooded marshes. They prefer deep waters and avoid bright light. Optimum temperature for the walleye ranges from 72 to 75°F.

This species spawns in late spring or early summer in turbulent rocky areas in rivers, coarse gravel shoals in lakes or flooded marshes. Eggs are dispersed, then abandoned and will hatch approximately 26 days later. It has been documented that adults may migrate up to 100 miles between spawning habitat and non-spawning habitat. Male juvenile walleye will reach sexual maturity in 2 to 4 years and females 3-8 years. Young walleye up to 6 weeks of age mainly eat copepods, cladocera, and small fishes while adults feed upon fishes and larger invertebrates.

This popular game fish can be caught year round in the Great Lakes and is sought for its excitement to catch and its favorable taste.

### **White bass-*Morone chrysops***

The white bass is a freshwater member of the sea bass family. It is distributed across the United States and eastern Canada, specifically in Lake Michigan, Lake Huron, Lake Ontario, and Lake Erie. This fish prefers open water habitat in lakes and some large rivers. Optimum temperature for the white bass is approximately 89°F.

White bass spawn in spring with each female releasing between 242,000 and 933,000 eggs in shallower water, which sink and adhere to the bottom substrate. Soon after spawning, the parents abandon the eggs and move to deeper waters. The eggs hatch approximately 4.5 days later and

the young fish remain in shallow water for a period of time before migrating to deeper areas. White bass usually do not live past 7 years of age. They are carnivores, eating microscopic crustaceans, insect larvae, and other fish.

It can be easily caught and is an excellent eating fishing causing it to be a highly sought after game fish.

### **White crappie-*Pomoxis annularis***

The white crappie has a wide ecological tolerance and is typically found in impoundments, lakes, ponds, and large streams. This species prefers quiet waters and is attracted to structures, such as submerged logs and brush piles. Young crappie feed primarily on planktonic crustaceans, while adult white crappies eat aquatic insects, some crustaceans, and a large number of small fishes. The white crappie is also popular game and food fish. Optimum temperature for this species is approximately 88°F, although the white crappie is capable of withstanding much lower temperatures.

Spawning takes place from April to early June when average daily water temperatures range from 14 to 23°C, with preferred spawning temperatures between 16 and 20°C. Egg numbers in females can range from 27,000-68,000. Eggs are 0.89 mm in diameter, colorless, demersal, and adhesive. Sexual maturity is attained in the second to fourth year and when fish are approximately 152-203 mm (6-8 in) in length.

White crappie is one of the most popular panfish and can be caught year round, day or night. It is also one of the largest of the sport fishes with a sweet, flaky, white flesh that is excellent eating.

### **White perch-*Morone americana***

These fish belong to the family of temperate basses, a group of food and sport fish. White perch are native to the east coast but can be found in the Great Lakes area and are considered an exotic species. On the Atlantic coast they can be found in brackish waters, but have adapted to inland, freshwater lakes and tributaries. White perch prefer clear water and have no preference for substrate type. Optimum temperature for the white perch ranges from 50 to 86°F.

They spawn in the spring by randomly releasing their eggs in the shallow waters the Great Lakes tributaries. Eggs sink and stick to the bottom until hatching 4 days later. After hatching the young feed on microplankton and as they grow larger feed upon aquatic insects, invertebrates, other fishes, and the eggs of other fish species.

Though generally regarded as undesirable as a game fish in the Great Lakes, in the Eastern United States it is considered an excellent sport fish.

### **Yellow perch-*Perca flavescens***

The yellow perch belongs to the family Percidae or the perch family. It can be found in almost all 50 states as well as most of Canada. More specifically, the yellow perch is one of the most common fishes to Michigan waters, is commonly found in Lake Erie, and is assumed to occur throughout the

Detroit River, Swan Creek, and Stony Creek as well. They travel in schools, generally preferring the clear shallower waters of lakes or weedy backwaters of creeks and rivers. Yellow perch usually grow 6 to 10 inches in length and weigh between 6 and 16 ounces. Thermal tolerances for this species ranges from 32 to 86°F.

This species spawns in the spring in shallower waters over submerged beds of aquatic vegetation or over sand, gravel, or rubble. Eggs hatch in 10 to 20 days with males reaching sexual maturity at 2-3 years and females at 3-4 years. Their maximum lifespan is 10 years. Larvae and young yellow perch primarily feed upon zooplankton and as adults feed among plants, invertebrates, and other fishes.

Primary food sources for the yellow perch include mayfly larvae, caddisfly larvae, amphipods, chironomids, and zooplankton. This species feeds actively year round, leading the yellow perch to be recreationally targeted not only in warmer months, but also by ice fisherman in the winter. These large bodied, large-finned panfish have the distinction of being the most frequently caught game fish in Michigan.

In the late 1980s and early 1990s, after a 40 year absence due to pollution and eutrophication, large benthic invertebrates including mayfly larvae, caddisfly larvae, and amphipods recolonized western Lake Erie. When burrowing mayflies began to recolonize the lake as water quality improved, the yellow perch population began to rebound as well. Of high value economically, the yellow perch is also an indicator of water quality and ecological conditions on Lake Erie. Yellow perch are also beneficial because they feed on the round goby, a nonnative, invasive species.

## **Appendix 2B      Life Histories of Threatened and Endangered Species**

The following species are listed as threatened, endangered, or as a Species of Concern either by the federal government or by the State of Michigan, Ohio, and the Canadian Government. The listed species could potentially occur within the region of the Fermi site. These life histories provide available information on abundance, and any critical life-support requirements such as spawning areas, nursery grounds, food habits, and feeding areas. Supplemental life history data was gathered from NatureServe wildlife database ([Reference 2.4-49](#) and [Reference 2.4-80](#)).

### **B.1      Threatened and Endangered Species**

#### **Aurora trout-*Salvelinus fontinalis timagamiensis***

This species was originally found in two small lakes in northeastern Ontario. The Aurora trout disappeared in the early 1960s when acid rain and other pollution disrupted its ability to reproduce. The species was reintroduced into both lakes in the early 1990s. Today the fish reproduces naturally in only one lake. Low water pH due to acid rain is a continuing threat. The Aurora trout was also introduced into ten other lakes, but has failed to establish reproducing populations in all but one.

Aurora trout prefer colder waters (below 20°C) and seek these out by moving to deeper water or by inhabiting groundwater springs. Thermal tolerances for this species ranges from 32 to 77°F. A water pH of at least five is necessary for the fish to reproduce successfully and thrive. An adult aurora will measure between 25 and 45 centimeters in length and weigh approximately 2 kilograms. The fish reach sexual maturity at between two and four years of age, and then spawn every year in nests built in groundwater springs.

This species feeds on a wide variety of prey including worms, leeches, crustaceans, aquatic and land-based insects, spiders, mollusks, frogs, salamanders and a number of fish species, including young brook trout ([Reference 2.4-36](#)).

#### **Black sandshell-*Ligumia recta***

This species is widespread in eastern and central U.S. and Canada, occurring from the Great Lakes basin south into Mississippi River drainage to Louisiana and in some Gulf Coast drainages. Average threshold temperatures for most freshwater mussel species is approximately 88°F.

The black sandshell is typically found in medium-sized to large rivers in locations with strong current and substrates of coarse sand and gravel with cobbles in water depths from several inches to six feet or more.

The largemouth bass, green sunfish, redbreast sunfish, rockbass, white perch, yellow perch, platy and convict cichlids have been identified as suitable host fish for this species. Gravid females have been found to display marginal papillae to attract fish hosts for their parasitic larvae ([Reference 2.4-45](#), [Reference 2.4-47](#), and [Reference 2.4-51](#)).

### **Blacknose shiner-*Notropis heterolepis***

This species occurs in the Atlantic, Great Lakes, Hudson Bay, and Mississippi River basins from Nova Scotia to Saskatchewan, south to Ohio, Illinois, south-central Missouri, and (formerly) Kansas. It is also common in some parts of range (especially Ontario, Michigan, and Wisconsin).

The blacknose shiner typically favors cool weedy creeks, small rivers, and lakes, usually over sand. As stated above, this species is found in cold-water habitats, usually around 66°F. The species is tolerant of oxygen depletion in winterkill lakes.

This species spawns in spring and summer and usually over sandy substrates. This species becomes sexually mature in 1 year ([Reference 2.4-50](#)).

### **Channel darter-*Percina copelandi***

The channel darter is only listed as endangered by the state of Michigan. Its distribution extends from the upper St. Lawrence drainages, through the Great Lakes basin, and into the Ohio River basin. The darter is found primarily in the Ohio River basin, but isolated populations occur southward to Louisiana. In Michigan, the darter's range includes the nearshore areas of Lake Erie and Lake Huron. Since 1994, it has only been recorded in the Au Sable, Pine and St. Clair Rivers in Michigan.

The channel darter's habitat includes rivers and large creeks with moderate current over sand and gravel substrate. It has also been recorded in wave-swept areas of Lake Huron and Lake Erie with coarse-sand, fine-gravel beach and sandbar substrates. The darter is usually found in deeper water, but will move into shallow water (<1 m) at night.

Flowing water is essential to channel darter spawning, which has been observed in the Cheboygan River, located north-northwest of the Fermi site, in mid-July. Optimum spawning temperatures for this species is approximately 68-72°F. Males maintain a 1-meter nest station around a large rock, where the female buries herself partially to deposit her eggs. After the male fertilizes them, both parents depart the nest of adhesive eggs and provide no parental care.

Channel darters are benthic feeders whose diet is comprised of small invertebrates including mayfly and midge larvae, small crustaceans, and algae and organic debris.

The channel darter has not been recorded in Monroe County in some time, most likely due to unsuitable habitat conditions ([Reference 2.4-23](#)).

### **Creek chubsucker-*Erimyzon oblongus***

The creek chubsucker has only been listed as endangered by the state of Michigan. This species occurs throughout most of the eastern United States, but is becoming increasingly rare toward the edges of its distribution. The creek chubsuckers northern range terminates in Michigan, where it has been found in the Kalamazoo, St. Joseph, and Raisin Rivers and their tributaries. For the last two decades it has only been reported in the Kalamazoo River, located west of Monroe County.

The creek chubsucker inhabits headwaters and clear creeks with moderate currents over sand-gravel substrate, sometimes near aquatic vegetation. This holds true in Michigan, where it has been reported in moderately swift streams up to five feet deep with sand, gravel and mud bottoms.

The creek chubsucker migrates upstream to spawn in early spring. Eggs are generally scattered over substrates, but males have been observed building nests. Adults may produce up to 9,000 eggs per year. Juveniles of this species prefer to form schools in vegetated areas with less current, but migrate to deeper downstream areas as they become adults. Life expectancy of the creek chubsucker is approximately five years. Optimal temperature for spawning is approximately 63°F.

The diet of the creek chubsucker is mostly small invertebrates living on the substrate. However, the terminal mouth of the creek chubsucker suggests that it may feed less on the bottom than other species of suckers.

The habitat near the Fermi site is not an ideal habitat for the creek chubsucker. However, many populations remaining in Michigan have adapted to non-traditional habitats ([Reference 2.4-22](#)).

#### **Eastern pondmussel-*Ligumia nasuta***

The eastern pondmussel is listed as an endangered species within Ohio. Its native range includes eastern North America from the lower Great Lakes to New York, New Hampshire and in coastal rivers to South Carolina. In Canada, only two populations are believed to exist; in the delta area of Lake St. Clair (in the transition zone between wetlands and open water) and in a small tributary of the upper St. Lawrence River, Lyn Creek, near the outlet of Lake Ontario. Average threshold temperatures for most freshwater mussel species is approximately 88°F.

The Eastern pondmussel prefers sheltered areas of lakes or slow streams in substrates of sand and mud. In the late summer, the female eggs are fertilized in a special area of the gill (*marsupium*) where they develop into larvae (*glochidia*). Once released the following spring, glochidia require a suitable host on which they become encysted and feed. They remain on the host until they develop into juveniles, at which time they drop off and bury in the sediment. They remain buried until sexual maturity, estimated to be between 6 and 12 years.

The Eastern Pondmussel is a filter-feeder. Adults consume bacteria, algae and particulate matter from the water. Juveniles feed on similar food; however, because they live entirely buried in the sediment, their food is obtained directly from the sediment and pore water ([Reference 2.4-37](#)).

#### **Eastern sand darter-*Ammocrypta pellucida***

The eastern sand darter may be found from the St. Lawrence River drainage, the Lake Champlain drainage in Vermont, south to West Virginia and Kentucky, and west through Ontario and Michigan. Within Michigan, this darter was found historically in the Huron, Detroit, St. Joseph, Raisin, and Rouge Rivers, as well as Lake St. Clair. However, in the last two decades it has only been recorded in the Lake St. Clair and Huron River drainages.

The preferred habitats of the eastern sand darter are streams and rivers with sandy substrates, and lakes with sandy shoals. They frequently occur in slow moving waters that deposit fine sand, often just downstream of a bend. This species is found in cold-water habitats, usually around 66°F.

Spawning occurs from April through June when water temperatures are around 20-23 degrees Celsius. They deposit their eggs singly, and bury them in the sandy substrate. These darters reach sexual maturity at age one and have a life expectancy of only 2-3 years. The eastern sand darter spends a large amount of its time half-buried in the substrate, presumably to conserve energy and maintain its position on the bottom.

The eastern sand darter feeds mostly on chironomid larvae, but will also prey upon oligochaetes and cladocerans.

The eastern sand darter currently has no known populations in Monroe County ([Reference 2.4-30](#)).

### **Fawnsfoot-*Truncilla donaciformis***

This species occurs in the Mississippian region; Great Lakes: Michigan and Erie; Mobile basin; Gulf Coastal region west to the Rio Grande system of Texas and Mexico (Nuevo Leon and Tamaulipas), and Calcasieu River system of Louisiana. Recently this species has been confirmed to be likely extirpated from the main channel of the Detroit River between Lake St. Clair and Lake Erie, Michigan/Ontario; due to zebra mussel invasion. Average threshold temperatures for most freshwater mussel species is approximately 88°F.

This species occurs in both large and medium-sized rivers at normal depths varying from less than three feet up to 15 to 18 feet in big rivers. A substrate of either sand or mud is suitable and although it is typically found in moderate current, it can adapt to a lake or embayment environment lacking current ([Reference 2.4-52](#)).

### **Greater redhorse-*Moxostoma vaelenciennesi***

In Michigan, this species occurs in the St. Joseph, Kalamazoo, Grand, Muskegan, Shiawassee, Cass, and Black, Mainstee, and AuSable Rivers. In Ohio, this species occurs in Bad Creek, the Sandusky, Ottawa, St. Joseph and Auglaize Rivers, and the Maumee River system. Thermal tolerance temperature for this species has been observed at approximately 88°F.

Spawning occurs in May or June throughout most of the range. Within the Thousand Islands area of the St. Lawrence River, spawning occurred during late June and early July, when water temperatures reached 16.7-18.9 °C. The spawning dates in the St. Lawrence River may run late due to the delayed warming of the river system. In all situations, the spawning runs closely follows that of the white sucker.

Generally, it takes males between five and six years to reach maturity. Maturation is evidenced by the presence of tubercles on breeding individuals.

Typical habitat is moderate to fast-flowing, medium-sized to large rivers. This species prefers clear water with substrates of clean sand, gravel, or boulder. The greater redhorse is sensitive to

siltation, but occurrence in moderately polluted waters suggests some tolerance of siltation as long as sufficient current exists to keep spawning areas free of silt deposition. Spawning habitat is largely the same as non-spawning habitat--shallow runs with sand and gravel substrates.

The greater redhorse is likely to eat various bottom invertebrates and some plant material; aquatic insects and mollusks may be included the main diet ([Reference 2.4-53](#)).

### **Kidney shell-*Ptychobranhus fasciolaris***

The kidney shell was once generally distributed throughout the Ohio, Tennessee, and Cumberland River systems. In the Great Lakes drainage, it was found in Lake Erie and Lake St. Clair and some of their tributaries, the Detroit River, the Niagara River and some of its tributaries, and at least one tributary to lower Lake Huron. It was historically known from Alabama, Illinois, Indiana, Kentucky, Michigan, Mississippi, New York, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and Ontario. In Canada, it is only known from southern Ontario.

Recently this species has been confirmed to be likely extirpated from the main channel of the Detroit River between Lake St. Clair and Lake Erie, Michigan/Ontario; due to zebra mussel invasion.

This species is most commonly found in small (6-16 m wide) to medium-sized (15-20 m wide) rivers, and is rarely found in large rivers (>30-50 m wide). It also occurs in Lake Erie, Lake St. Clair and Lake Chautauqua, where it attains a much smaller size. It has also been found in shallow (<1 m) sections of impoundments that still have some moving water. It is usually absent from headwater creeks less than 3 m wide. It favors riffle areas with substrates of firmly-packed coarse gravel and sand and moderate to swift flows, and has an aversion to ponded or backwater conditions. The species is tolerant of a variety of habitat conditions, although rivers with moderately strong current and a substrate of coarse gravel and sand provide the most suitable one. It may be found at depths of less than three feet up to those as great as 18 to 24 feet. Average threshold temperatures for most freshwater mussel species is approximately 88°F.

The kidney shell, like most freshwater mussels, is considered to be dioecious, although it may be occasionally hermaphroditic. Hermaphroditism affords benefits when population densities are low; under such conditions, females may switch to self-fertilization to ensure that recruitment continues. There are no sexual differences in the shell of *P. fasciolaris*, except that males are slightly more compressed than females - a feature that cannot be used with any certainty to separate the sexes.

The lifespan of *P. fasciolaris* is not known, but members of the Subfamily Lampsilinae generally grow more rapidly and have shorter life spans than members of the Ambleminae, which can live for over 40 years. For comparison, life spans of three other COSEWIC-listed lampsilines are: 10-20 years for *L. fasciola*, more than 15 years for *Epioblasma torulosa rangiana*, and up to 11 years for *V. fabalis*. *Ptychobranhus fasciolaris* is a long-term brooder (bradytictic).

The breeding season begins in August, and glochidia are discharged the following June to perhaps as late as August ([Reference 2.4-54](#)).



Primary food sources are bacteria, algae, particles of organic detritus, and some protozoans. Food availability is not normally a limiting factor, although it could be in the presence of high densities of zebra mussels, which are extremely efficient filter-feeders. During the parasitic larval stage, glochidia feed on the body fluids of the host.

### **Lake chubsucker-*Erimyzon sucetta***

This species range includes the Atlantic Slope from southern Florida to southeastern Virginia; Gulf Slope drainages from southern Florida (Charlotte Harbor) to the Guadalupe River, Texas; Great Lakes and Mississippi River basin lowlands from southern Ontario to Wisconsin and south to the Gulf. Ranges in the north are sporadic and more common through the lower Coastal Plain. The lake chubsucker occurs in all Mobile basin drainages below the Fall Line and in all coastal drainages between the Escatawpa and Chattahoochee drainages in Alabama.

The lake chubsucker favors ponds, lakes, oxbows, sloughs, swamps, impoundments, and similar waters of little or no flow that are clear and have bottoms of sand or silt mixed with organic debris and where aquatic vegetation usually is present. This species rarely occurs in streams. Thermal tolerances for this species ranges from 39 to 68°F. The lake chubsucker eggs are broadcast over beds of vegetation or in gravelly area cleared by male. This species spawns over gravel in streams or in still water over vegetation. The species spawns in spring and early summer; eggs hatch in about a week; and specimens become sexually mature at age 3.

The lake chubsucker typically eats small crustaceans, chironomid larvae, algae, and other small aquatic organisms ([Reference 2.4-55](#)).

### **Lake sturgeon-*Acipenser fulvescens***

The lake sturgeon is listed as a threatened species in Michigan, and is endangered in Ohio. Historically, it has been found in the Hudson Bay watershed, the St. Lawrence estuary, the upper and middle Mississippi River and Great Lakes basins, and scattered throughout the Tennessee, Ohio, and lower Mississippi drainages. It has become rare throughout its historic range, and population estimates are around one percent of their original numbers. Michigan populations are some of the largest, and are scattered throughout most counties bordering the Great Lakes, as well as some inland lakes and rivers.

The lake sturgeon is a benthic organism that occurs in large rivers and the shallow areas of large lakes where food is abundant. They tend to avoid aquatic vegetation and prefer deep run and pool habitats of rivers. Their habitat use varies in lakes, depending on what conditions are available. This species optimal temperature is between 57-63°F.

Lake sturgeon begin spawning migrations in May when the water temperature reaches 10-12 degrees Celsius, but do not actually begin spawning until the water is between 13 and 18 degrees Celsius. Spawning habitat is defined by swift currents, clean rocky substrates, and depths of two to fifteen feet. Large females spawn only once every 3-7 years, but will lay hundreds of thousands of black, adhesive eggs. The eggs are instantly fertilized by a male, who may spawn every one or two years. The eggs hatch in five days, and the juveniles grow relatively quickly for ten years, but

growth slows considerably thereafter. Males reach sexual maturity at about 15 years of age, while females do at about 25 years of age. The lake sturgeon has the greatest life expectancy of any freshwater fish, with some individuals reaching 80 years of age. The most recently documented spawning area along Michigan's Lake Erie shoreline is near Stony Point in Monroe County, however activity has diminished recently and may have ceased.

The lake sturgeon is a bottom feeder that uses its protrusible mouth to extract prey as it forages over gravel, sand, and/or mud substrates. Prey for this sturgeon includes snails, clams, crustaceans, fish, and aquatic insect larvae. The sturgeon will also prey upon eggs of other species of fish during foraging.

Lake Erie was formerly one of the most productive waters for lake sturgeon in North America. The lake sturgeon population in Michigan is estimated to be approximately one percent of its former abundance. In the 1800s, sturgeon were perceived as a pest and a nuisance because they often caused damage to fishing gear in nearshore waters. In the 1860s, the lake sturgeon population was greatly reduced in Lake Erie as a bycatch of the booming gill net fishery. In the following years, over-harvesting, limited reproduction and destruction of spawning habitats nearly eradicated the sturgeon population in the lake.

Lake sturgeon can be utilized as an indicator of ecosystem health because they are very sensitive to human disturbances such as habitat decline and pollution as illustrated by their sharp decline in the late 1800s and early 1900s. As mentioned previously, the most recently documented spawning area on the Lake Erie shoreline was near Stony Point in Monroe County, but activity has diminished and may have ceased altogether. They are not known to occur contemporarily in Swan and Stony Creeks ([Reference 2.4-35](#)).

### **Longnose sucker-*Catostomus catostomus***

The longnose sucker is the most widespread sucker in northern North America. Throughout most of Alaska and Canada, south to New England, West Virginia-Maryland, northern Ohio, northern Indiana, Minnesota, Nebraska, eastern Colorado, Idaho, and Washington. The species is also in northeastern Asia.

This species prefers cold clear waters. Thermal tolerances for this species ranges from 32 to 59°F. It is a bottom dweller in lakes and tributary streams up to a depth of 600 feet in the Great Lakes. It also occurs in brackish water near mouths of Arctic streams. The longnose sucker often spawns in flowing shallow stream water over gravel; otherwise in lakes. Eggs sink and stick to the substrate. Young stay in gravel 1-2 weeks before emerging.

Spawns in occurs in the spring and eggs hatch in about 2 weeks. Specimens become sexually mature in 4-7 years, or as late as 9 years ([Reference 2.4-56](#)).

### **Mudpuppy mussel (salamander mussel)-*Simpsonaisa ambigua***

Historically, this species occurred throughout the upper Mississippi River drainage and as far south as the Cumberland River drainage of Tennessee. It is known from the Lake St. Clair, Lake Huron, and Lake Erie drainages; and from the Ohio River system, the Cumberland River system (Red

River, Kentucky), and the upper Mississippi River system (Illinois, Iowa, Wisconsin, Missouri and Arkansas).

In Minnesota, it is present only in the lower St. Croix River where it is rare and localized. Its distribution in part is apparently related to the distribution of its glochidial host, the mudpuppy. In Canada, it is known from the Sydenham River and a potentially extant occurrence in the Thames River in London, Ontario.

The preferred habitat for this species is in sand or silt under large, flat stones in areas of a swift current. Its presence is presumably linked to the mudpuppy, *Necturus maculosus*. In Canada, the mudpuppy mussel is found in all types of clear, freshwater habitat, including creeks, streams, rivers and lakes; it is found on a variety of substrates (mud, silt, sand, gravel, cobble or boulder) in areas of swift current. Average threshold temperatures for most freshwater mussel species is approximately 88°F.

The host of this species is the mudpuppy. It is suspected "that *necturus* eats the adult mussel and in seeking food visits one rock after another. In satisfying its appetite it becomes infected with the mussel glochidia, nourishing them, and when they have matured serves as a transporting and distributing agent for the young mussels." Glochidia were found deeply imbedded in the external gills of the mudpuppy. There is some evidence that the glochidia are released in the fall ([Reference 2.4-57](#)).

#### **Northern madtom-*Noturus stigmosus***

The northern madtom is found in Lake Erie and Ohio River basins from western Pennsylvania, southern Ontario, and West Virginia, to the Ohio River in southern Illinois. The species is uncommon and is disappearing on the edges of its range. It is protected in Canada as an endangered species.

Inhabits mixed sand and rock riffles and runs with debris in small to large, often swift rivers. This species is found in cold-water habitats, usually around 66°F. This species forages at night, feeding largely on aquatic insect larvae. This species typically spawns from fourth week of June to third week of August ([Reference 2.4-46](#)).

#### **Northern riffelshell-*Epioblasma torulosa rangiana***

The northern riffelshell is federally and state endangered. Currently, the northern riffelshell have only been found in the Black, St. Clair and Detroit Rivers. More specifically, it is found in the Detroit River in Wayne County, Michigan. The northern riffelshell is of moderate size with large adults reaching two inches. The shell is light green-yellow to olive green, with dark, narrow, closely-spaced rays. This mussel requires swiftly moving, well-oxygenated water. Average threshold temperatures for most freshwater mussel species is approximately 88°F. Riffle and run areas with fine to coarse gravel are the preferred habitats. It is believed that this species can reach 15 years of age. The northern riffelshell is graved from late summer to the following spring, at which time the glochidia are released. The Detroit River may still have a viable reproducing population despite human impacts and zebra mussel infestation in the river. In 1992, 110 mussels

were transplanted from the Detroit River to the St. Clair River. The survival of this species depends on the protection and preservation of habitat and host fish. Siltation and run-off must be reduced to facilitate the recovery of this species ([Reference 2.4-49](#)).

#### **Pocketbook-*Lampsilis ovata***

The range includes the Interior Basin: the Mississippi and Ohio drainages, St. Lawrence drainage from Lake Superior to the Ottawa River and Lake Champlain, Hudson Bay drainage; Atlantic slope: and the Potomac River system in Maryland. This extensive range includes various forms, subspecies and possibly valid species, such as *Lampsilis ventricosa* (*Lampsilis cardium*) and *Lampsilis satura*; as the taxonomy of this species complex is convoluted.

This species is generalized in habitat preference, adapting well to both impoundment situations as well as free-flowing, shallow rivers. It may be found in big rivers (reservoirs) at depths of 15 to 20 feet and in small streams in less than two feet of water. Average threshold temperatures for most freshwater mussel species is approximately 88°F. Although usually found in moderate to strong current, it can survive in standing water. The most suitable substrate consists of a mixture of gravel and coarse sand mixed with some silt or mud ([Reference 2.4-58](#)).

#### **Pondhorn-*Unio merus tetralasmus***

This species is found throughout much of the central and lower Mississippian Region; Great Lakes; Southern Atlantic Slope; Peninsular Florida; Gulf Coastal Region, to the lower Rio Grande system into Mexico. The western range extends through Iowa and Missouri to Colorado and western Oklahoma.

This species typically inhabits the quiet or slow-moving, shallow waters of sloughs, borrow pits, ponds, ditches, and meandering streams. Average threshold temperatures for most freshwater mussel species is approximately 88°F. It is tolerant of poor water conditions and can be found well buried in a substrate of fine silt and/or mud. It has been known to survive for extended periods of time when a pond or slough has temporarily dried up by burying itself deep into the substrate.

This species is likely bradytic and the glochidial host is the golden shiner (*Notemigonus crysoleucas*) ([Reference 2.4-59](#)).

#### **Pugnose minnow-*Opsopoeodus emiliae***

The pugnose minnow is listed by both Michigan and Ohio as endangered. The pugnose minnow has been documented from the southern Great Lakes basin, through the Mississippi River valley, to the Gulf of Mexico. Although common in the southeastern portion of its range, it is becoming rare in the northern portion. Historically, the pugnose minnow was documented in Michigan tributaries and nearshore areas of Lake Erie and Lake St. Clair, however the only record in the past twenty years was in the Detroit River near Grosse Isle, located approximately 15 mile northeast of the Fermi site.

The pugnose minnow inhabits the slow, clear waters of rivers and shallow regions of lakes. This species is found in cold-water habitats, usually around 66°F. It is found in greatest abundance in weedy areas over sand or organic substrate. Historically, it has also been found in turbid areas of

the Huron River that lacked submergent vegetation, most likely due to remnant populations changing habitats in submarginal conditions.

The life history of the pugnose minnow is not well documented. The male selects a spawning site where the female lays adhesive eggs, usually under a flat rock. Males then guard the nest, but will make excursions away, unlike bluntnose and fathead minnows. Species growth is rapid, reaching its adult size of two inches in length within two years.

The vertically-oriented mouth of the pugnose minnow suggests adaptation for feeding near the water surface. Diet studies have shown the pugnose minnow feeds on microcrustaceans, fly larvae, and other aquatic invertebrates, as well as algae and plants ([Reference 2.4-19](#)).

The pugnose minnow is listed in Monroe County, MI, but has not been reported in previous impingement studies, or even recorded in the last two decades.

### **Pugnose shiner-*Notropis anogenus***

The original range of this species extended from western New York and eastern Ontario west to southeastern North Dakota, south to northern Iowa, Illinois, Wisconsin, Michigan, northern Indiana, and northern Ohio. However, the historical range was very limited, and occurrences in Illinois, Iowa, North Dakota, Indiana, Ohio, New York, and Ontario are largely peripheral to the main (but spotty) distribution in Minnesota, Wisconsin, and Michigan.

The only records in Ohio were from western Lake Erie, and none have been found in the state since 1931. The species may be extirpated from North Dakota.

Favorable habitat includes clear, heavily vegetated glacial lakes and vegetated pools and runs of low gradient creeks and rivers, over bottoms of sand, mud, marl, or gravel; these fishes are mostly in shallows in warm months, probably in deep water during rest of year. This species is found at temperatures ranging from 59 to 70°F.

The pugnose shiner spawns in June-July in Michigan. This species feeds on filamentous algae and cladocerans and likely other minute organisms ([Reference 2.4-60](#)).

### **Purple lilliput-*Toxolasma lividus***

The purple lilliput is state endangered. Spent shells have been found from sites in the Raisin River in Monroe County. It is a small mussel, growing to a little over an inch in length. The shell is smooth, but with growth lines and is light to dark green or brown. The purple lilliput occurs in small to medium sized streams, less often in large rivers and lakes. Average threshold temperatures for most freshwater mussel species is approximately 88°F.

This species' preferred substrate is well-packed sand or gravel and occurs in water depth less than one meter. It is a long-term breeder, holding the larvae internally for about a year; however, their life span is unknown. The purple lilliput requires clean water for survival, therefore any practice that leads to siltation, pollution, or poor water quality should be avoided ([Reference 2.4-49](#)).

### **Rayed bean-*Villosa fabalis***

The rayed bean was historically known from 106 streams, lakes, and some man-made canals in 10 states and 3 Service regions. The mussel occurred in parts of the upper (i.e., Lake Michigan drainage), lower Great Lakes system, and throughout most of the Ohio and Tennessee River systems. Historically this species was known in Canada from the Thames, Sydenham, and Detroit Rivers and western Lake Erie in southwestern Ontario, but only still extant in the Sydenham and possibly the North Thames in Ontario where a live specimen was found in 2004. A new site was recently discovered in Swan Creek (Lower Maumee drainage) in Ohio.

The rayed bean is reported to be a long-term breeder in that it holds glochidia overwinter for spring release. Gravid females have been collected during mid to late May. The glochidial fish hosts include the Tippecanoe darter.

The rayed bean is generally known from smaller headwater creeks, but records exist in larger rivers. They are usually found in or near shoal or riffle areas, and in the shallow wave-washed areas of glacial lakes, including Lake Erie. In Lake Erie, it is generally associated with islands in the western portion of the lake. Average threshold temperatures for most freshwater mussel species is approximately 88°F. Substrates typically include gravel and sand. It is oftentimes associated with vegetation (e.g., water willow, *Justicia americana*; water milfoil, *Myriophyllum* sp.) in and adjacent to riffles and shoals. Specimens are typically buried among the roots of the vegetation ([Reference 2.4-61](#)).

### **River darter-*Percina shumardi***

The river darter is listed as endangered by the state of Michigan. Its distribution ranges from southern Canada to the Gulf of Mexico. Historically, the river darter was found in rivers and nearshore areas of eastern Michigan, however the last report of the darter was in the Huron River in 1941, and the most recent surveys have found no records of river darters.

The river darter is found in rivers and large streams with deep, fast-flowing riffles and cobble and boulder bottoms. This species is found in cold-water habitats, usually around 66°F. During nocturnal hours or when turbidity is high, the adult darters may move to shallower areas. This turbidity tolerance might explain its continued presence in the Mississippi River and its tributaries. The river darter has also been found in nearshore areas of the Great Lakes with depths approximating five meters.

The river darter tends to move upstream to spawn, toward the northern end of its range. Spawning occurs in late winter to early spring in southern areas, from April through May in the Midwest, and as late as June or July in Canada. The female darters are egg-burying spawners, expelling eggs into the substrate while partially buried. Neither males nor females provide parental care to their young. Species grow to three inches, mostly within the first year of development, and attain sexual maturity at age one. River darters are thought to live two to four years, with males having a greater life expectancy than females.



River darters tend to feed during the day upon a variety of small aquatic invertebrates. As juveniles, they primarily feed upon small zooplankton. Adult darters prey upon midge and caddisfly larvae, as well as some snail species ([Reference 2.4-20](#)).

#### **Round hickorynut-*Obovaria subrotunda***

The round hickorynut is state endangered and can be found in the St. Lawrence and Lake Erie/Lake St. Clair drainage, more specifically, in Lake St. Clair in Macomb County and in the Detroit River in Wayne County. This mussel has a near perfectly circular shell that is moderately thick and inflated. The exterior of the shell is brown, smooth, and lacks rays.

The round hickorynut inhabits medium to large rivers and along the shores of Lake Erie and Lake St. Clair, near the river mouths and prefers sand and gravel substrate in areas with moderate flow. Average threshold temperatures for most freshwater mussel species is approximately 88°F. It is a long-term breeder, holding fertilized eggs over the winter. The life span is unknown. Like most mussels, this species is sensitive to river impoundment, siltation and channel disturbance as well as pollution ([Reference 2.4-49](#)).

#### **Round pigtoe-*Pleurobema sintoxia***

This species was historically distributed from New York and Ontario west to South Dakota, Kansas and Oklahoma, and south to Louisiana and Alabama. The current distribution of the round pigtoe is similar to the historical range. Average threshold temperatures for most freshwater mussel species is approximately 88°F. Although large river populations have for the most part disappeared from the upper Midwest, many populations still survive in tributaries of the Mississippi and Ohio Rivers. In Canada *Pleurobema sintoxia* is only known from southern Ontario including the Thames River. Recently this species has been confirmed to be nearly extirpated (last live specimens probably do not represent a viable population) in the main channel of the Detroit River between Lake St. Clair and Lake Erie, Michigan/Ontario; due to zebra mussel invasion. Long-standing populations exist in the Poteau River and tributaries, Arkansas and Oklahoma.

This round pigtoe is found in medium to large rivers in mixed mud, sand, and gravel. In Canada, the round pigtoe is typically found in medium-sized to large rivers but also occurs in Lake Erie and Lake St. Clair. In Tennessee occurrences include medium-sized and big rivers and in current on a firm substrate of coarse gravel and sand at depths of less than three feet to more than 20 feet.

For this species, age to maturity for this species is not known, but the juvenile stage for most unionids lasts 2-5 years. The round pigtoe is a short-term brooder (tachytictic) with the breeding season lasting from early May to late July in Wisconsin.

Round pigtoes are filter feeders as adults. Their primary food sources are bacteria, algae, particles of organic detritus, and some protozoans. Food availability may be a limiting factor for the Lake St. Clair population due to the presence of high densities of zebra mussels, which are also filter-feeders. During the parasitic larval stage, glochidia feed on the body fluids of the host ([Reference 2.4-62](#)).

### **Sauger-*Sander canadensis***

The sauger is listed as a threatened species by the state of Michigan. Its native range includes the St. Lawrence, Great Lakes, Hudson Bay, and Mississippi River basins, as well as the Tennessee River in Alabama and Louisiana. The sauger has also been introduced into the Atlantic, Gulf, and southern Mississippi River drainages. This species was historically abundant in Lake Erie; however, it has only been recorded in the St. Clair River and Lake St. Clair in the past two decades.

Sauger prefer turbid areas of lakes, reservoirs, and large rivers, where the temperatures throughout the entire water column are within their preferences. This species prefers temperatures at approximately 86°F.

This species spawns over gravel and rubble shoals in May or June, when temperatures range from 3.9 - 6.1 degrees Celsius. Rather than building nests, the sauger broadcasts demersal, adhesive eggs over the shoals during the night. After hatching, young sauger spend up to nine days absorbing yolk while on the bottom. Males reach sexual maturity within three years, while females take four to six years. The life expectancy for the sauger is up to 13 years.

Saugers have a specialized structure in their eyes that makes them very sensitive to light. They prefer to feed at night in clearer waters or during the day in turbid areas. As juveniles, they tend to prey on zooplankton and aquatic insect larvae. Adults feed upon fish and invertebrates such as gizzard shad, emerald shiner, crappie, bass, freshwater drum, leeches, crayfish, and insects ([Reference 2.4-31](#)).

### **Shortnose cisco-*Ammocrypta pellucida***

The historical range of this species includes Lake Michigan, Lake Ontario, and Lake Huron. Apparently extinct; no individuals have been collected since 1985. This species also has limited distribution through the coastal northern Michigan watersheds.

The shortnose cisco generally prefers upper zones of deepwater areas of lakes and prefers temperatures ranging from 36 to 50°F. This species spawns at about 35-145 m, over sand, silt, or clay substrates in some areas. They spawn primarily in spring but may spawn also in fall in some areas. This species feed on crustaceans such as *Mysis* and *Pontoporeia* ([Reference 2.4-63](#)).

### **Silver shiner-*Notropis photogenis***

The silver shiner is only listed as endangered by the state of Michigan. This species ranges from the Great Lakes and their tributaries, through the Ohio River basin and Tennessee drainage, to northern Alabama and Georgia. This shiner is fairly common within most of the Ohio River basin, but occurs more rarely in the Great Lakes' tributaries. Within Michigan it is locally abundant in the St. Joseph and Raisin Rivers. Historically, the silver shiner had been identified in Monroe County and the Huron River.

Preferred habitat for the silver shiner is medium to large streams with moderate to high gradients. They are often found in the deeper water pools or eddies directly below riffles. This species is found in cold-water habitats, usually around 66°F. This species has been documented to prefer a



variety of substrates, including gravel and boulder, pebble and cobble, and sand, mud and clay. Despite the disputes over substrate, it is agreed that silver shiners avoid areas with heavy vegetation and siltation. In Michigan, the shiner has been found to inhabit areas of strong current with wooded banks.

Reproduction of silver shiners is not well documented, due to the fact that spawning behavior has not been observed. Silver shiners are theorized to spawn around June, and may move into different habitats to do so. The juvenile shiners exhibit rapid growth, reaching sexual maturity at age two, and maximum size by age three.

Although the silver shiner primarily feeds at the surface, it will take mid-water prey as well. The majority of the silver shiner's prey are aquatic insects, with adult *Diptera* (true flies) representing the largest portion of gut samples. Silver shiners have even been documented as leaping into the air to capture low-flying insects.

The silver shiner is relatively rare in Michigan and is fairly tolerant to human impact. Populations appear to be stable. Previous impingement studies have not recorded this species, thus impingement is expected to be minimal. However, the silver shiner's population in the River Raisin, located south of the Fermi site, should be monitored in the case of adverse impact ([Reference 2.4-21](#)).

#### **Snuffbox-*Epioblasma triquetra***

The snuffbox mussel is state endangered and can be found in Otter Creek in Monroe County and the Detroit River in Wayne County. The snuffbox is about 2 inches in length and their shells are triangular and thick, yellowish on the outside, and covered with numerous, broken, dark green rays. It inhabits small and medium-sized rivers. They prefer habitats that contain sand, gravel, or cobble substrate with a swift current and individuals are often found buried deep in the sediment. Average threshold temperatures for most freshwater mussel species is approximately 88°F. Reproduction occurs in early to mid-August and the snuffbox lives between 8-10 years. The only host for the snuffbox glochidia is the log perch. This species is sensitive to river impoundment, siltation and disturbance, due to its requirement for clean, swift current and relative immobility as an adult ([Reference 2.4-49](#)).

#### **Southern redbelly dace-*Phoxinus erythrogaster* (Rafinesque)**

The southern redbelly dace is listed as endangered by the state of Michigan. Its total distribution ranges from the Lake Erie and Lake Michigan drainages, through the Mississippi River basin south to Alabama, Arkansas, and Oklahoma. The northern limit of this species' range is in southeastern Michigan, in the Huron and Raisin Rivers.

The southern redbelly dace generally occurs in the clear and cool permanent headwaters of river systems. It prefers clear, wooded streams intermixed with small pools. These streams are usually small, with moderate gradients and overhanging vegetation that provides ample shade. Preferred substrates include mud bottoms of pools and clean gravel of riffles. Average threshold temperatures for most freshwater mussel species is approximately 88°F.

Life history of this species has only been studied extensively in the southern portion of its range, where they spawn from April to June. Southern redbelly dace reach sexual maturity within one year at a length of about one and a half inches. The spawning fish migrate from pools to gravelly riffles where they utilize nests already built by other cyprinids. Two males pressure the sides of the typically larger female who then broadcasts 700 to 1000 eggs that are immediately fertilized.

This species is generally herbivorous, feeding upon filamentous algae, diatoms, and drifting or benthic detritus. Larger fish will also feed on chironomid and mayfly larvae, as well as small invertebrates ([Reference 2.4-69](#)).

### **Spotted gar-*Lepisosteus oculatus***

This species occurs in Lake Erie and southern Lake Michigan including drainages south through Mississippi River basin to Gulf Coast. Also occurs through the Gulf Slope drainages from lower Apalachicola River, Florida, to Nueces River, Texas, as well as some occurrence through Ontario province.

The spotted gar is most abundant in quiet clear pools and backwaters with abundant vegetation. The species also occurs in streams, sloughs, lakes, and swamps. It occasionally enters brackish water in the south. The spotted gar is tolerant of warm water with low dissolved oxygen levels. Thermal tolerances for this species ranges from 54 to 68°F. The species spawns in shallow water among rooted vegetation. It spawns in late spring and early summer. Eggs hatch within a week and the larvae cling to aquatic plants or debris. Males sexually mature in 2-3 years, females in 3rd or 4th year.

While most active in the early morning hours, the spotted gar adults eat mainly fishes (also crabs in southern waters). Very small young may feed on arthropods ([Reference 2.4-64](#)).

### **Threehorn wartyback-*Obliquaria reflexa***

This species occurs throughout most of the Mississippi River drainage from western Pennsylvania, north into Michigan and Minnesota, southwest to eastern Kansas, Oklahoma, and Texas; and in the Coosa-Alabama River and Tombigbee River systems in the southeast. Although once recorded from Lake Erie and its tributaries, recently this species has been confirmed to be likely extirpated from the main channel of the Detroit River between Lake St. Clair and Lake Erie, Michigan/Ontario; due to zebra mussel invasion. In Michigan, the northernmost range is the Grand and Saginaw Rivers. In western Michigan it has been recorded on the Black, Kalamazoo and St. Joseph Rivers. In eastern Michigan records are from Brownstown Creek, Detroit River, lower Raisin River and Lake Erie.

This species is typical of the large rivers where there is moderately strong current and a stable substrate composed of gravel, sand, and mud. Although found at depths of up to 20 feet, it seems to do well at a depth of no more than four to six feet often in shallow, sand- and mud-bottom river embayments with little or no current. It also occurs in many reservoirs. Average threshold temperatures for most freshwater mussel species is approximately 88°F.

Fertilized eggs are brooded in the marsupia (water tubes) up to 11 months, where they develop into larvae, called glochidia. The glochidia are then released into the water where they must attach to the gill filaments and/or general body surface of the host fish. After attachment, epithelial tissue from the host fish grows over and encapsulates a glochidium, usually within a few hours. The glochidia then metamorphoses into a juvenile mussel within a few days or weeks. After metamorphosis, the juvenile is sloughed off as a free-living organism. Juveniles are found in the substrate where they develop into adults. *Obliquaria reflexa* is a long-term brooder, and probably breeds in the summer months in Michigan ([Reference 2.4-47](#) and [Reference 2.4-17](#)).

### **Wavy-rayed lampmussel-Lampsilis fasciola**

The wavy-rayed lampmussel is state threatened and is sporadically distributed in the Great Lake tributaries of Lake Michigan, Lake Erie, Lake Huron, and Lake St. Clair. This mussel has a rounded to ovate, moderately thick shell and is usually under 3.5 inches in length. The shell color ranges from yellow to yellowish green with numerous thin wavy green rays.

It occurs in small to medium sized shallow streams, in and hear riffles, with good currents. Average threshold temperatures for most freshwater mussel species is approximately 88°F. The wavy-rayed lampmussel prefers sand and/or gravel substrate. Males and females are dimorphic.

The release of the larvae (glochidia) coincides with host fish appearing in the shallow riffles. As adults, they remain relatively sessile, probably not moving more than 100 meters in a lifetime. This mussel, like most mussels, is sensitive to river impoundment, siltation and channel disturbance. The wavy-rayed lampmussel is often the first to be affected by disturbances because this species prefers areas with moderate flow and high oxygen content. Pollution is also a great threat to this species well being ([Reference 2.4-49](#)).

### **Western banded killifish-Fundulus diaphanous menoma**

The western killifish is one of two subspecies of the banded killifish. The banded killifish (*Fundulus diaphanous*) occurs in the Atlantic Slope drainages from the Pee Dee River, South Carolina, north to Maritime Provinces and Newfoundland; St. Lawrence-Great Lakes and Mississippi River basins from Quebec to Manitoba, south to southern Pennsylvania, northern Illinois, and northeastern Nebraska. The western banded killifish occurs in the remainder of the range except St. Lawrence and Lake Erie drainages, where the two subspecies intergrade.

The banded killifish prefers quiet waters of lakes, ponds, and sluggish streams usually over sand, gravel, or detritus-covered bottom where there are patches of submerged aquatic plants. Schools tend to stay in shallows in summer. Thermal tolerances for this species ranges from 50 to 77°F. Eggs are released in clusters, attach by filaments to plants in quiet weedy pools. This species spawns in late spring and summer. The eggs hatch in about 11-12 days. Individuals become sexually mature at age II in some localities. On the Atlantic coast of Nova Scotia, hybrids of *F. diaphanus* and *F. heteroclitus* are unisexual diploid gynogens.

This species mostly feeds at all water levels on various invertebrates and some plant material ([Reference 2.4-66](#)).

### **White catpaw-*Epioblasma obliquata perobliqua***

The white catpaw mussel is state endangered and from museum specimens, it has been confirmed that it once inhabited rivers in southeastern Michigan and nearshore areas in Lake Erie. Currently, the only known viable population is in Fish Creek, Indiana. The white catpaw is a medium sized mussel, up to two inches long. The exterior shell color is tan with many fine wavy green rays. Little is known of their required habitat because this species is so rare. Average threshold temperatures for most freshwater mussel species is approximately 88°F.

This mussel prefers coarse, stable substrates, such as gravel and pebble and is typically found buried in the substrate. The exact breeding season is unknown, although other species of this genus typically release glochidia. The lifespan is estimated to exceed 15 years of age. The survival of the white catpaw mussel is currently in severe jeopardy. Changes in river hydrology and morphology can harm this riffle-dwelling species, and dredging, channelization and damming projects should be avoided ([Reference 2.4-49](#)).

### **Species of Concern**

The following species are listed as Species of Concern that have the potential to be present on and in the vicinity of the Fermi site. Species of Concern are species which the USFWS is reviewing for consideration as Candidates for listing under the Endangered Species Act. Additional information is needed in order to propose as threatened or endangered.

### **Brindled madtom-*Noturus miurus***

The brindled madtom is listed as a species of “state special concern” by Michigan. It occurs from the lower Great Lakes drainage, the Ohio River basin, and the Mississippi River basin. They have also been collected in Oklahoma and southeastern Kansas. In the last twenty years, brindled madtom have been recorded in the Huron, Raisin, Belle, and Pine Rivers, as well as Stony Creek in Michigan.

The brindled madtom’s habitat is highly variable with relation to its latitudinal location. In the Midwest, it is generally found in slow-moving rivers with soft substrates and scattered emergent vegetation. Lake habitats are usually characterized by soft bottoms with an abundance of leaves and twigs. This species is found in cold-water habitats, usually around 66°F.

Reproduction of the brindled madtom has not been well documented. However, a Michigan study showed that it spawns from July to early August in water temperatures around 25 degrees Celsius. Spawning occurs in areas comprised of silty substrates and emergent vegetation. Males are nest-guarders, protecting a nest of about 40 large, amber eggs.

The diet of this madtom consists of aquatic insects, other drifting invertebrates, and plants. The brindled madtom is also nocturnal, thus it does the majority of its feeding at night.

Studies suggest that increased siltation is very detrimental to both eggs and adult madtoms because it reduces the amount of dissolved oxygen in the water and hinders feeding ([Reference 2.4-71](#)).

### **Elktoe mussel-*Alasmidonta marginata***

This species is of state special concern. The elktoe is a relatively small, thin-shelled mussel that may reach up to four inches in length. The exterior color of the elktoe shell is yellowish green, with prominent broad dark green rays and dots. It is a hermaphroditic species, containing both male and female sex parts. The elktoe is bradytictic, meaning that it is a long-term breeder. When fertilization occurs, the developing glochidia (larval mussels) are held in the gills for an extended period of time at which time the parasitic glochidia are released and adhere to a fish host. After metamorphosis, the young mussels drop to the substrate, where they spend the remainder of their lives buried in the substrate. The elktoe is a filter feeder, obtaining nutrition from material suspended in the water column.

The elktoe needs clean, fast-flowing water to survive. Therefore, changes to its habitat, such as river impoundment, siltation and channel disturbances, including dredging, negatively affect this species ([Reference 2.4-49](#)). Average threshold temperatures for most freshwater mussel species is approximately 88°F.

### **Purple wartyback-*Cyclonaias tuberculata***

This species is state listed as special concern. The purple wartyback has a roughly circular outline with numerous bumps covering about  $\frac{3}{4}$  of the outside of the shell. The outer covering of the shell is yellow-brown or green-brown in young individuals, becoming dark brown in older individuals. The purple wartyback is found in medium to large rivers with gravel or mixed sand and gravel substrates in areas with relatively fast current. Like most freshwater mussels of the family Unionidae, this species requires a fish host to complete its life cycle. The purple wartyback is a summer breeder and are likely to live over 25 years of age. Average threshold temperatures for most freshwater mussel species is approximately 88°F.

Threats to this species include habitat and water quality degradation from changes in water temperature and flow, the introduction of heavy metals, organic pollution such as excessive nutrients from fertilizers, pesticides and herbicides, dredging and increased sedimentation due to excessive erosion. 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 extirpation of unionid populations ([Reference 2.4-49](#)).

### **Silver chub-*Macrhybopsis storeriana***

The silver chub is listed as a species of “state special concern” in Michigan. Its distribution ranges from southern Canada, through the Lake Erie and Mississippi River drainages, to the Gulf Coast. In the past two decades the silver chub has occurred in Lake St. Clair and the Detroit River in Michigan.

The silver chub generally inhabits deep waters of low-gradient streams and rivers, as well as in lakes at depths less than ten meters. It has been suggested that this chub prefers pools with clean sand and fine gravel substrates, but will avoid silty areas by moving into riffles if necessary. However, this has been disputed by other studies that suggest that they are found in silty regions.

Reproduction of the silver chub is not well understood. Research suggests that the chub spawns in open water in May or June when water temperatures reach about 20 degrees Celsius in Michigan, and that spawning mortality may not be uncommon. Life expectancy is thought to be three to four years.

The silver chub feeds upon cladocerans, copepods, and chironomid larvae as a juvenile. Adults tend to feed upon mayflies, chironomid larvae, and amphipods. More minor items of prey include mollusks, water fleas, and small fish.

Little is known about the life history of the silver chub; therefore, inferring possible population impacts is difficult ([Reference 2.4-29](#)).

### **Slippershell mussel-*Alasmidonta viridis***

This species is of state special concern. The slippershell mussel is a small mussel, usually around one and a half inches long. The exterior of the shell is yellowish-brown, marked with fine green rays. The slippershell is typically found in creeks and headwaters of rivers, but has also been reported in larger rivers and in lakes. The slippershell mussel requires a fish host to complete its life cycle. The slippershell is probably a long-term (bradytictic) breeder, holding the larvae internally for about a year. These larvae (glochidae) then are released into the water and must attach to a suitable fish host in order to survive. After development, it drops from its host and spends the remainder of its life in the substrate. The lifespan is unknown. This mussel is a filter feeder.

The slippershell mussel requires clear, clean water and substrates for survival. Average threshold temperatures for most freshwater mussel species is approximately 88°F. Therefore, any practices that lead to increased siltation and poor water quality will decrease the quality of the habitat of the slippershell. Also, since the slippershell cannot reproduce unless its fish host is present, conservation efforts should aim to maintain the composition of associated fish communities ([Reference 2.4-49](#)).