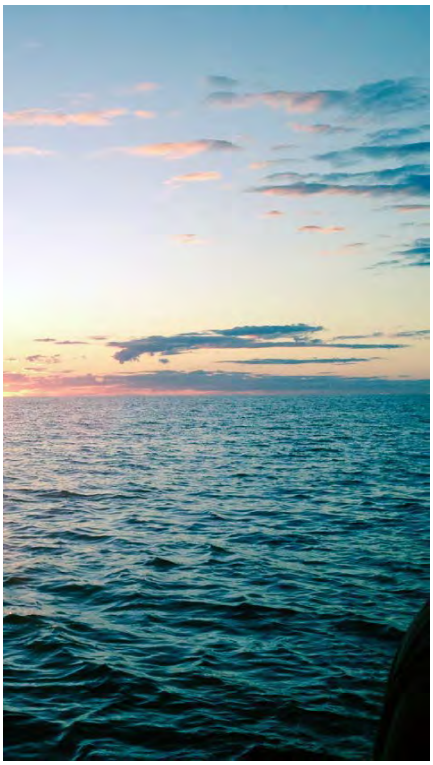
Appendix 5- Aquatic Habitats Michigan's Wildlife Action Plan 2015-2025



Basin Landscape Context

Lake Erie Basin

The Lake Erie basin is situated in the southeastern portion of the Lower Peninsula of Michigan. This area contains all water flows that travel east or southeast into the Lake Erie drainage, including the connecting waterways of the St. Clair and Detroit rivers and Lake St. Clair. The Lake Erie basin is 5,808 square miles and includes the major watersheds of the Black, Pine, Belle, Clinton, Rouge, Huron and Raisin rivers plus several small coastal watersheds. Land use is primarily agricultural and urban parks (58%), forests (19%) and urban areas (15%). Agriculture is dominant in the southern and northern portions of the basin. Urbanization is clustered between these areas and includes the metropolitan Detroit area and its expanding suburbs. Large urban parks are found along the Huron and Clinton rivers, both in urban areas and on the fringe. Only 5% of the area is currently classified as wetlands.

Lake Huron Basin

The Lake Huron basin is situated in the northeastern portion of Michigan. This area contains all waters that travel east or southeast into the Lake Huron drainage, including the connecting waterway of the St. Marys River. This basin spans both the Lower and Upper peninsulas of Michigan.

The Lake Huron basin is 16,148 square land miles and includes the major watersheds of the Munuscong, Carp, Cheboygan, Thunder Bay, Au Sable, Rifle, Saginaw (tributaries : Tittabawassee, Shiawassee, Flint, and Cass rivers), Sebewaing and Pigeon rivers plus several small coastal watersheds. Landcover in this basin is forested (40%) primarily in the northern portions and agricultural (33%) which is mostly in the southern portion. Wetlands still comprise 18% of the basin. Urban areas comprise only 2% of the basin area.

Lake Michigan Basin

The Lake Michigan basin is the largest of the four lake basins in Michigan. It contains all waters that flow into Lake Michigan from the western half of the Lower Peninsula of Michigan and all flows that go south from the Upper Peninsula.

The Lake Michigan basin is 28,509 square land miles and includes the major Upper Pennisula watersheds of the Menominee, Cedar, Ford, Escanaba, Rapid, Whitefish, Sturgeon and Manistique rivers plus several small coastal watersheds. In the Lower Peninsula, the major watersheds are the Pine, Elk, Boardman, Platte, Betsie, Manistee, Pere Marquette, White, Muskegon, Grand, Kalamazoo and St. Joseph rivers plus several small coastal watersheds. This basin is most developed in the southern portion, with agricultural (37%) land most dominant in that area. Forestry (36%) is the primary land use in the northern portion of the basin. Wetlands comprise 19% of the basin and are more common in northern areas.

Lake Superior Basin

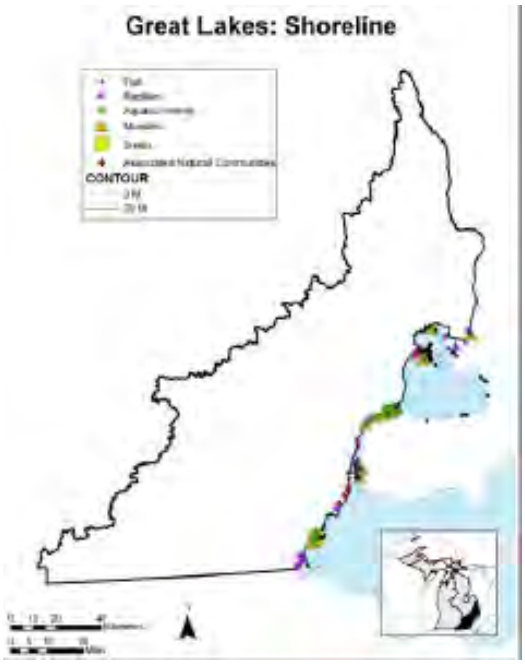
The Lake Superior basin is the most northerly of the four basins in Michigan. It contains all water that flows north from the Upper Peninsula into Lake Superior.

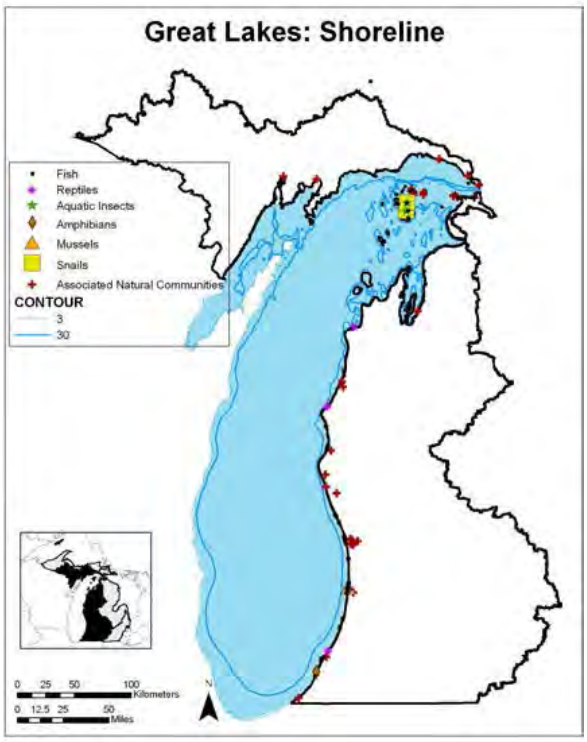
The Lake Superior basin is 7706 square miles and includes the major watersheds of the Montreal, Black, Ontonagon, Portage/Sturgeon, Dead, Chocolay, Au Train, Two Hearted, Tahquamenon and Waiska rivers plus several small coastal watersheds. This basin is the least developed in the State. Seventy percent of the basin is forested and another 20% is wetlands. Agriculture is present, but it is only 4% of the land use.

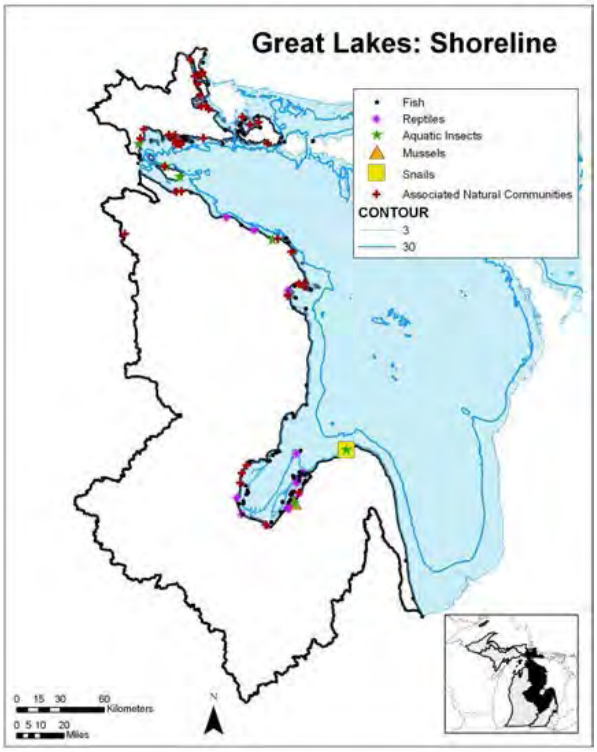
AQUATIC HABITATS

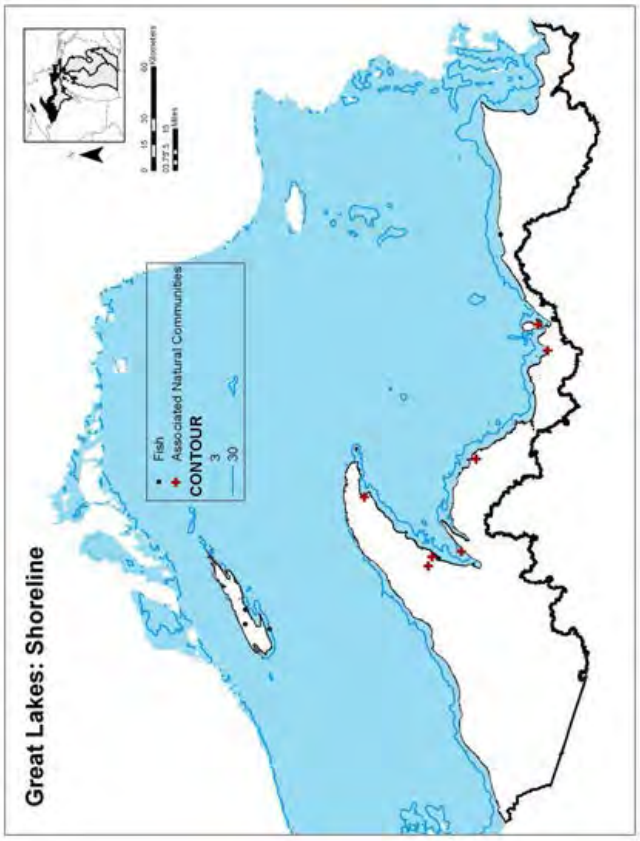
Great Lakes: Shoreline

Description: Shoreline areas of the Great Lakes range from zero to 3 meters in depth. This area includes coastal marshes. For the Lake Erie basin this is the Michigan waters of Lake Erie and the connecting waterways of the St. Clair and Detroit rivers and Lake St. Clair.



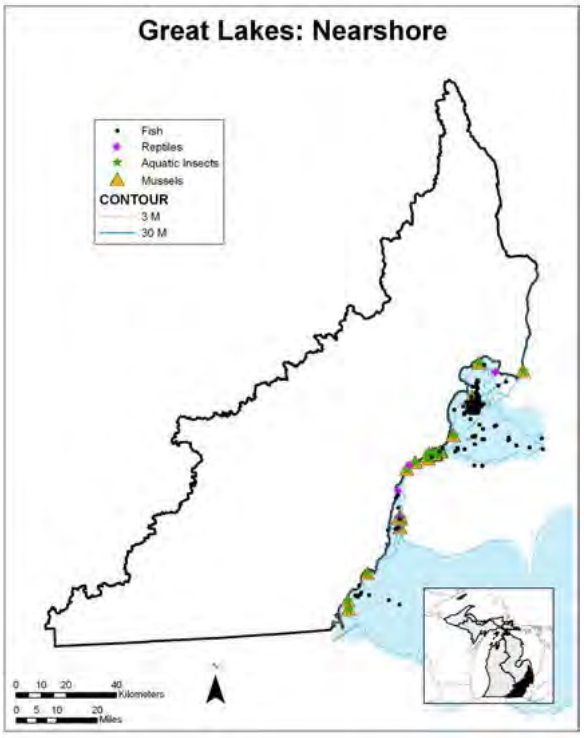

Great Lakes: Shoreline
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
Associated Natural Communities
CONTOUR
3
30
0 25 50 100
Kilometers
0 12.5 25 50
Miles
N

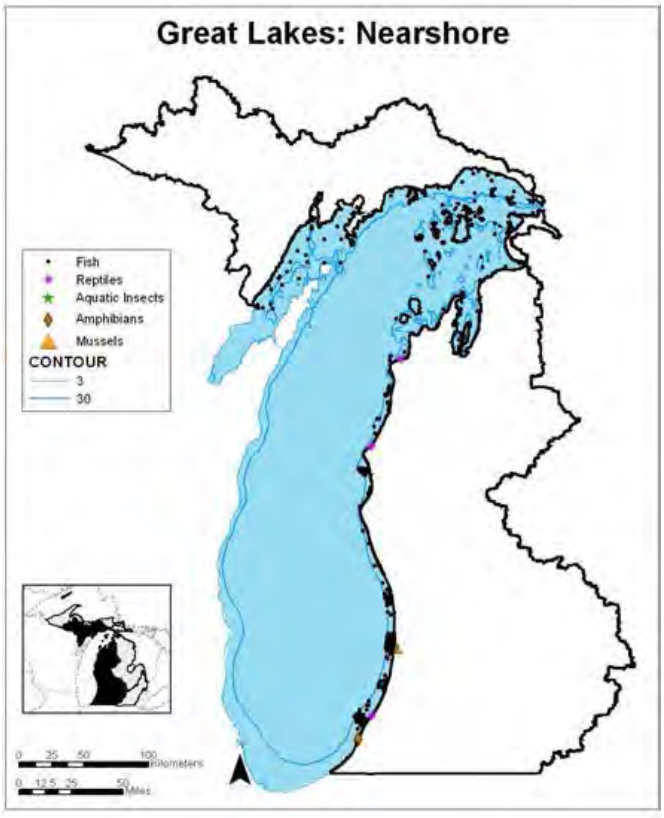

Great Lakes: Shoreline
Fish
Reptiles
Aquatic Insects
Mussels
Snails
Associated Natural Communities
CONTOUR
3
30
0 15 30 60
Kilometers
0 5 10 20
Miles
N

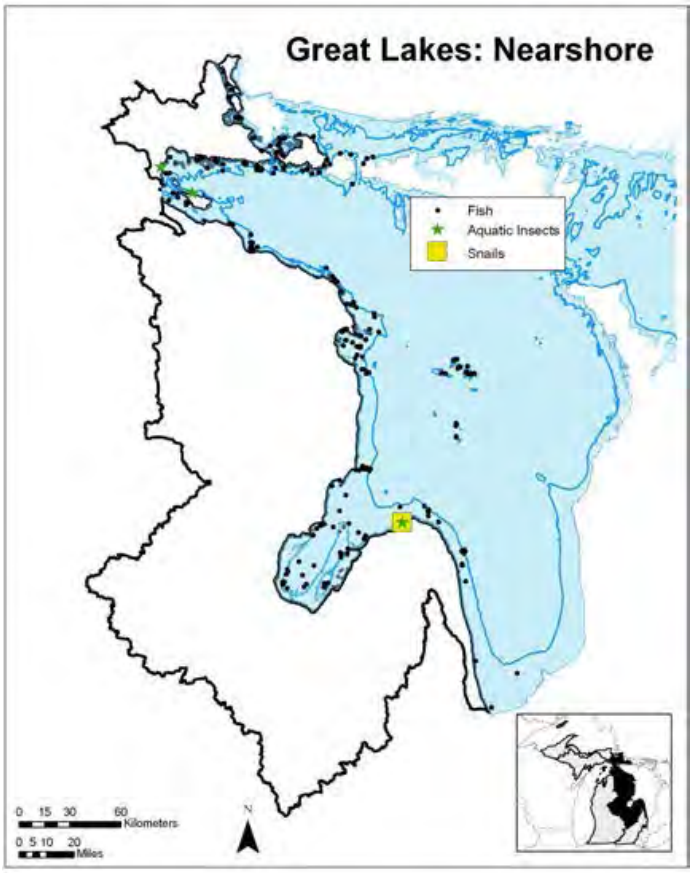


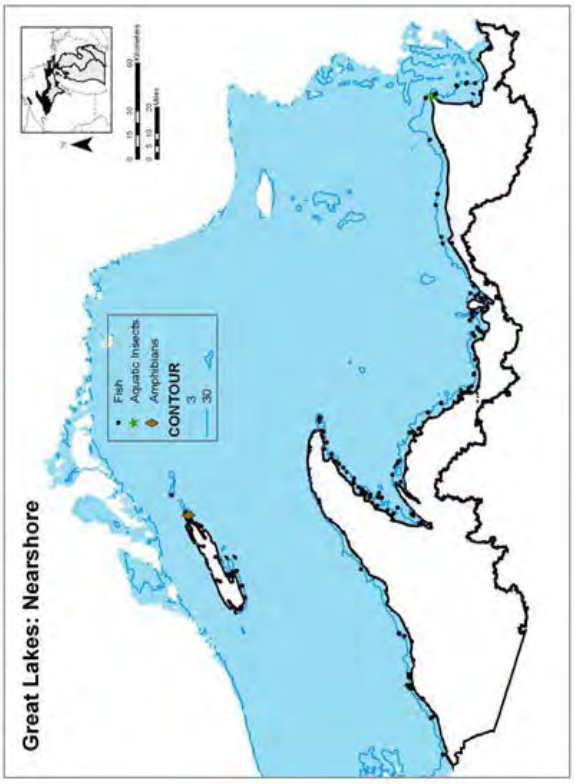
Great Lakes: Nearshore

Description: Nearshore areas of the Great Lakes range from 3 to 30 meters in depth. This area includes both submergent and emergent aquatic vegetation, but not marshes. For the Lake Erie basin this is the Michigan waters of Lake Erie and the connecting waterways of St. Clair and Detroit rivers and Lake St. Clair.


Great Lakes: Nearshore
Fish
Reptiles
Aquatic Insects
Mussels
CONTOUR
3 M
30 M
0 10 20 40
Kilometers
0 5 10 20
Miles

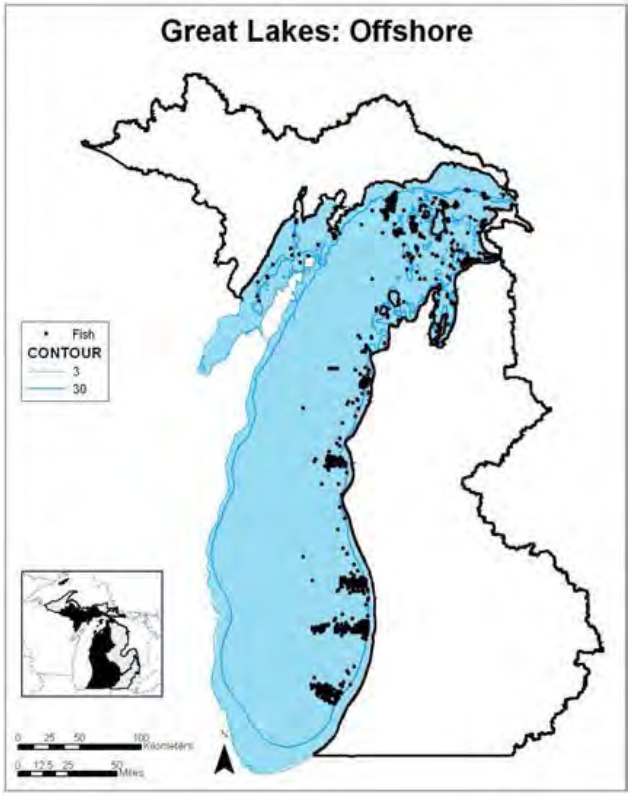

Great Lakes: Nearshore
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
CONTOUR
3
30
0 35 50 100
Kilometers
0 12.5 25 50
Miles

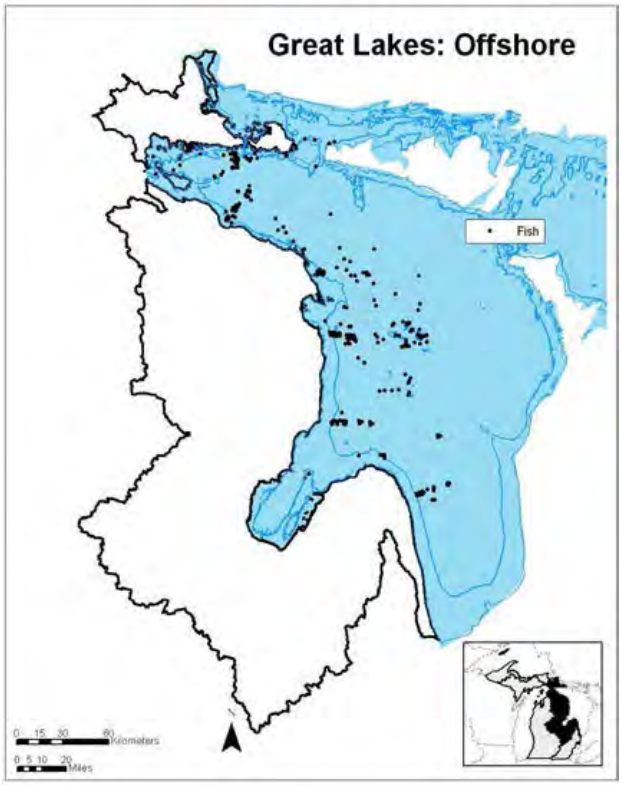

Great Lakes: Nearshore
Fish
Aquatic Insects
Snails
0 15 30 60
Kilometers
0 5 10 20
Miles
N

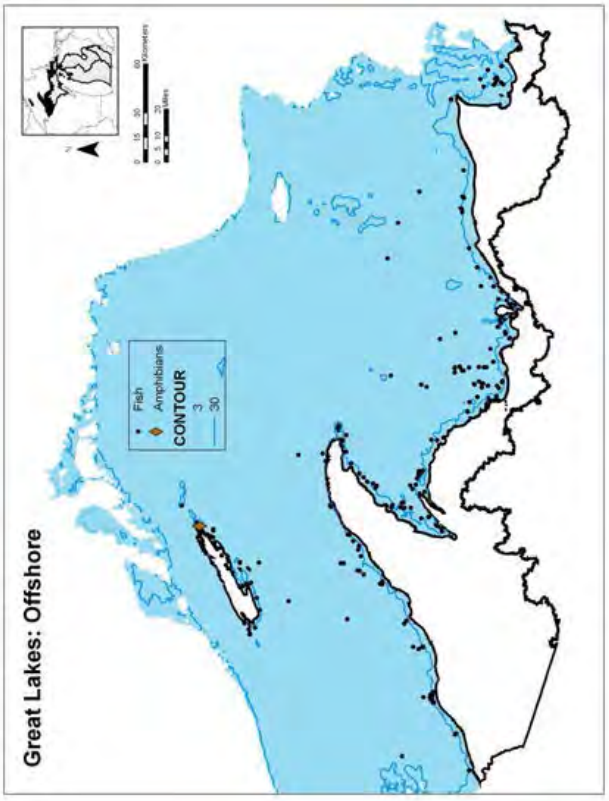


Great Lakes: Offshore

Description: Offshore areas of the Great Lakes are 30 meters and greater in depth.

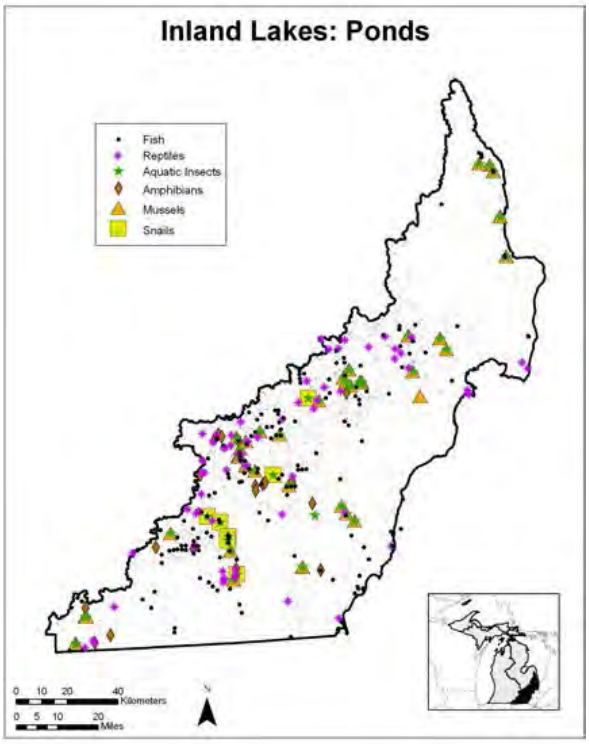

Great Lakes: Offshore
Fish
CONTOUR
3
30
0 25 50 100 Kilometers
0 12.5 25 50 Miles

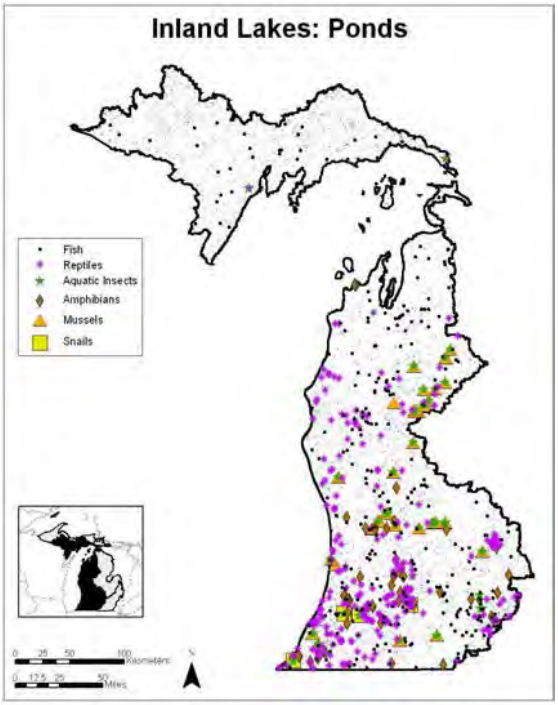

Great Lakes: Offshore
Fish
0 15 30 60 Kilometers
0 5 10 20 Miles

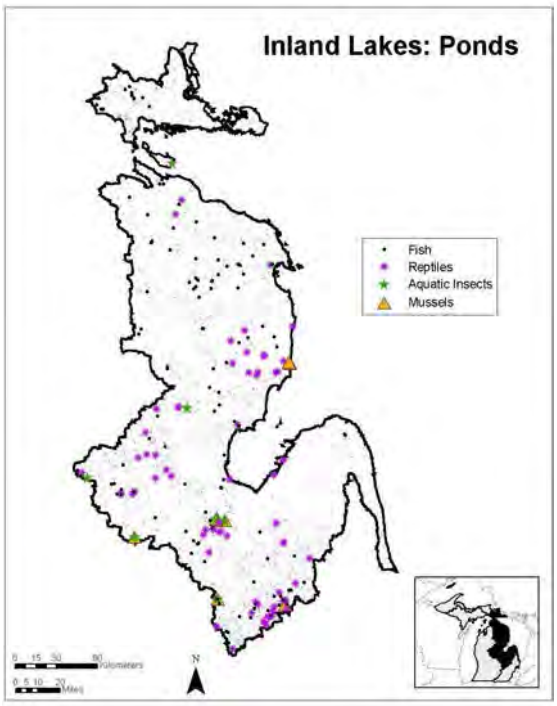


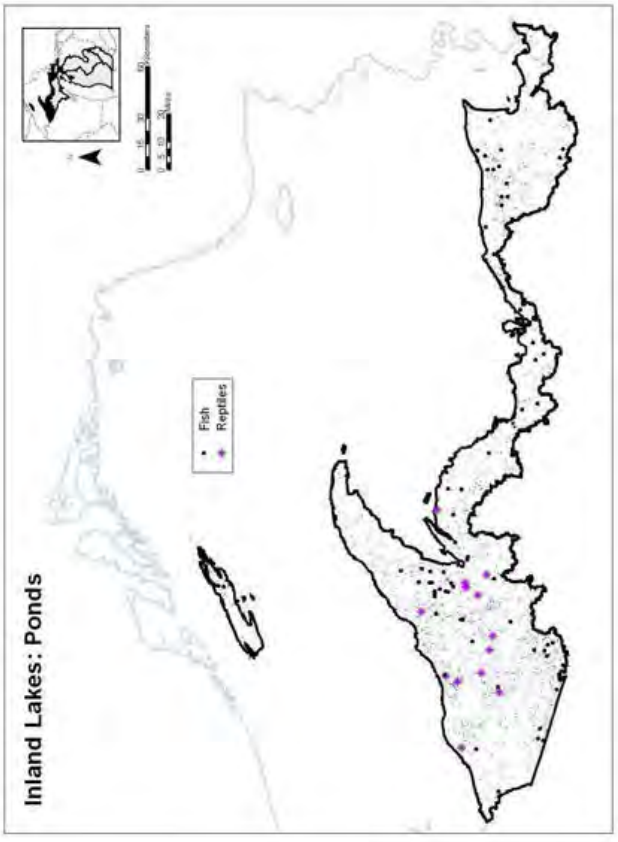
Inland Lakes: Ponds

Description: Ponds are permanent standing water bodies <5 acres in area. This group is highly diverse in terms of chemical and biological variables. Most are shallow, unstratified, generally warmer, and higher in nutrient concentration than larger water bodies, and somewhat likely to have low winter oxygen levels. There are two states that ponds are generally found in. The first is characterized by high nutrients, high wind resuspension, no rooted plants, and turbid water. The second is characterized by low to medium nutrients, low wind resuspension, rooted plants dominant, and clear water. Because of their size, most ponds are privately owned and have no public access points.


Inland Lakes: Ponds
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 10 20 40 Kilometers
0 5 10 20 Miles
N

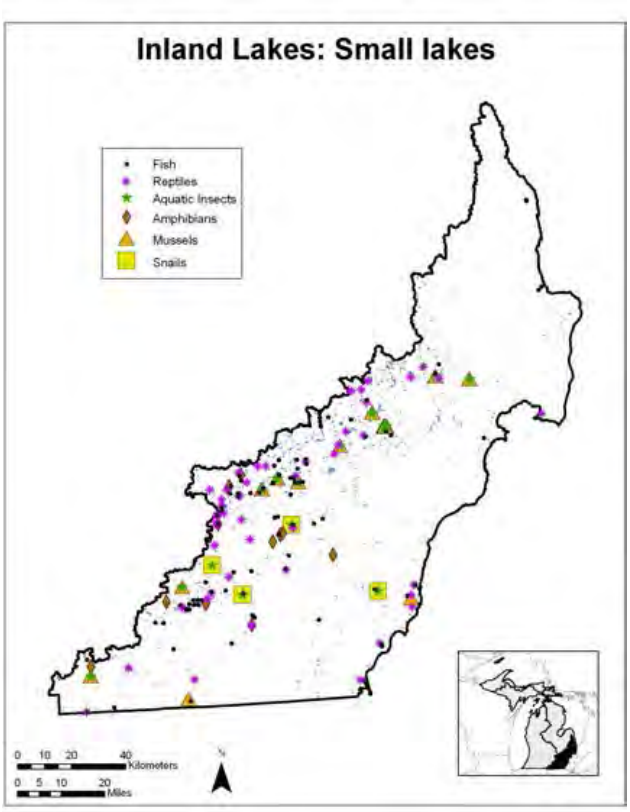

Inland Lakes: Ponds
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
N

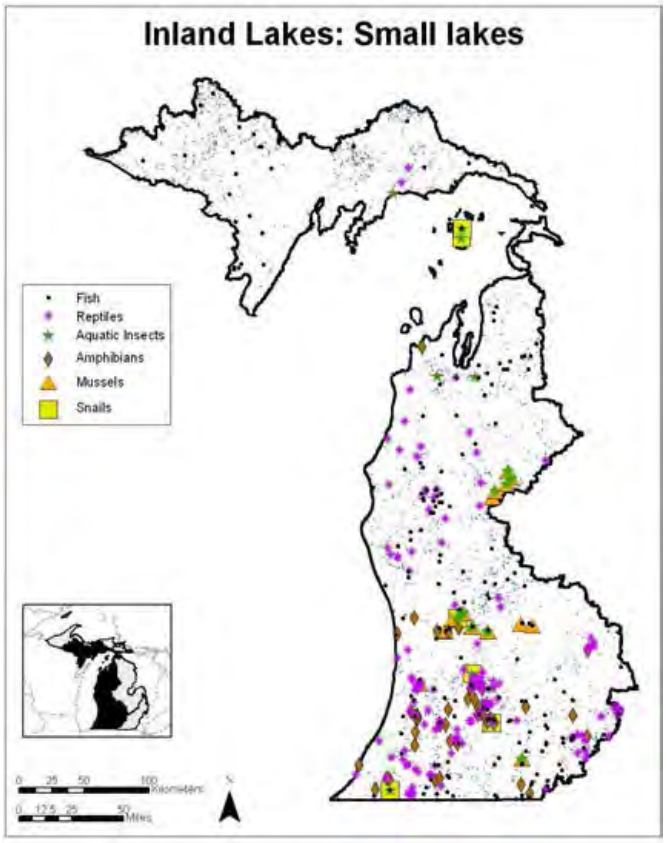

Inland Lakes: Ponds
Fish
Reptiles
Aquatic Insects
Mussels
N

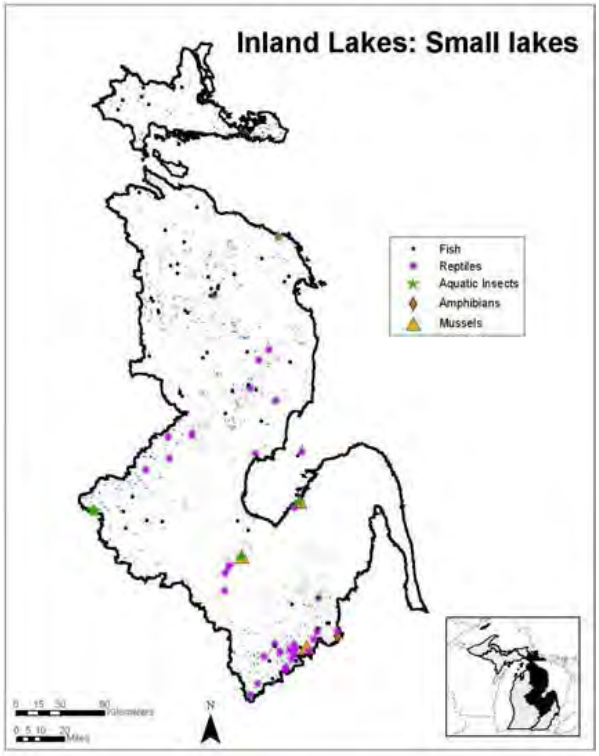

Inland Lakes: Ponds
Fish
Reptiles

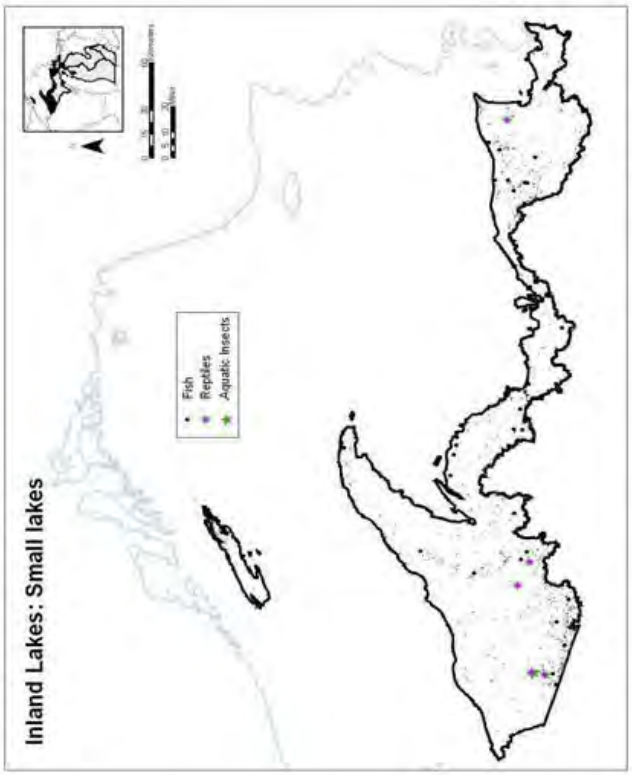
Inland Lakes: Small Lakes

Description: Small lakes are permanent standing water bodies that are greater than 5 acres and less than 99 acres in area. Water bodies in this group are highly diverse in terms of chemical and biological variables. Stratification status can range from fully stratified throughout the summer season, to no stratification. In lakes with stratification, there is development of true open-water (pelagic) zones that are distinct from shallow nearshore zones. Small lakes can range from cold to warm water depending on amounts of groundwater inflows, lake depth, and climate. Winter oxygen levels are also variable and depend on lake depth. If lakes are shallow (< 2 m average depth), there are two states in which they are generally found. The first is characterized by high nutrients, high wind resuspension, no rooted plants, and turbid water, and the second is characterized by low to medium nutrients, low wind resuspension, rooted plants dominant, and clear water.



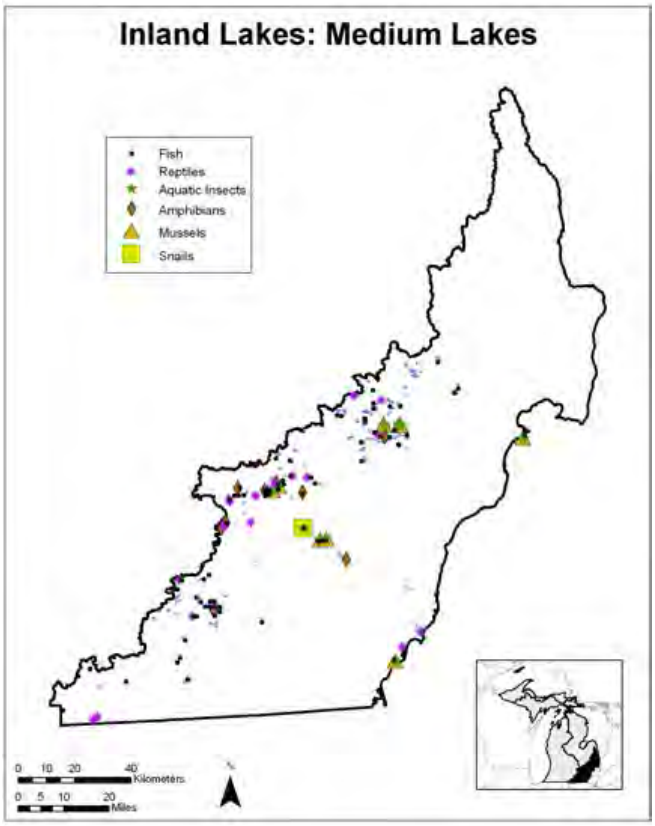

Inland Lakes: Small lakes
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 25 50 100 Kilometers
0 12.5 25 50 Miles
N

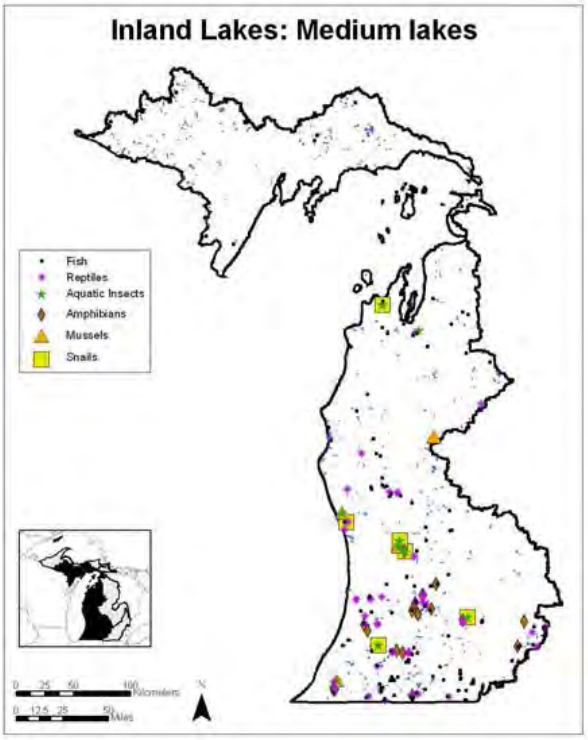

Inland Lakes: Small lakes
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
0 15 30 60 Kilometers
0 5 10 20 Miles
N

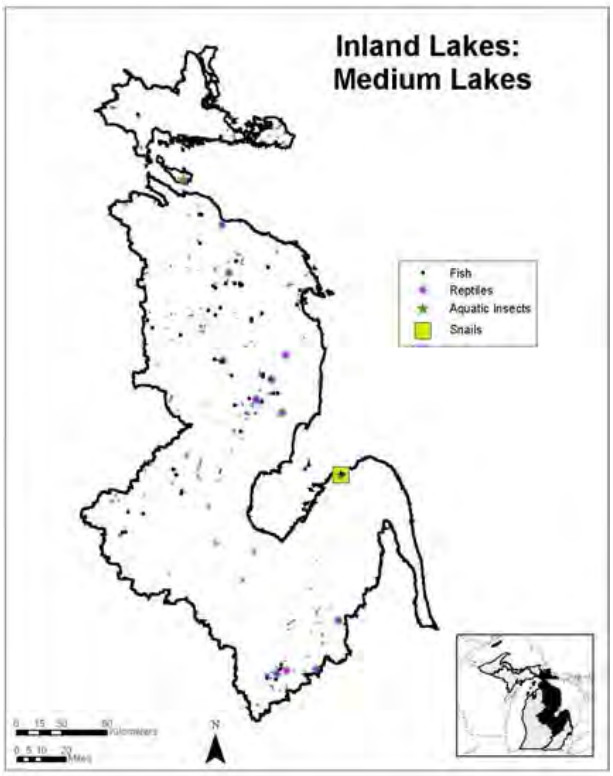


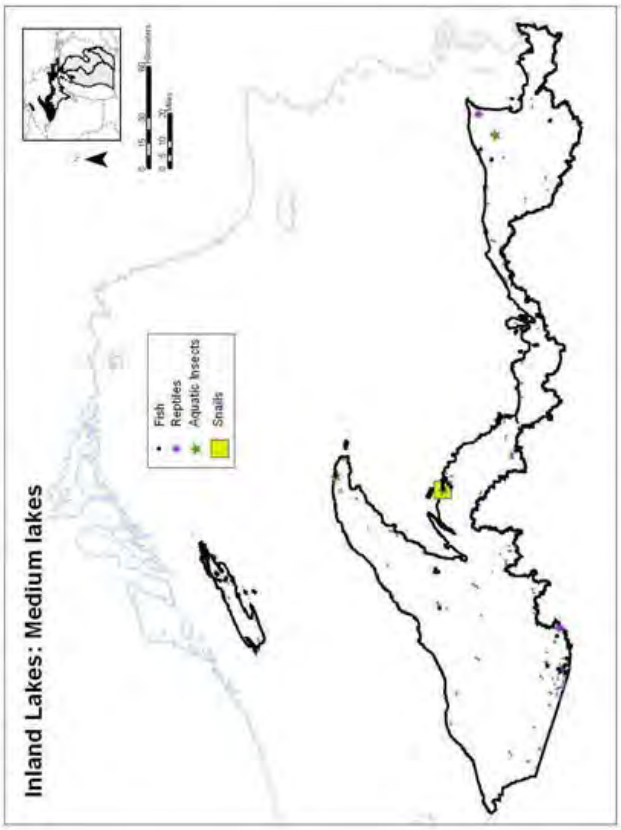
Inland Lakes: Medium Lakes

Description: Medium lakes are permanent standing water bodies 100 to 999 acres in area. This group has moderately diverse features for chemical and biological variables. In general, these lakes will tend to have increasing shoreline complexity (lakes with many bays) and increasing basin complexity (lakes with more than one deep hole) compared to small lakes and ponds. Stratification status can range from fully stratified throughout the summer season, to no stratification. In lakes with stratification, there is development of true open-water (pelagic) zones that are distinct from shallow nearshore zones. These lakes can span a broader temperature range (from relatively cold water to relatively warm water) compared to larger lakes, with temperature depending on amount of groundwater inflows, lake depth, and climate. Winter oxygen levels are also variable and depend on lake depth, but are generally higher than in small lakes and ponds.


Inland Lakes: Medium Lakes
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 10 20 40
Kilometers
0 5 10 20
Miles
N

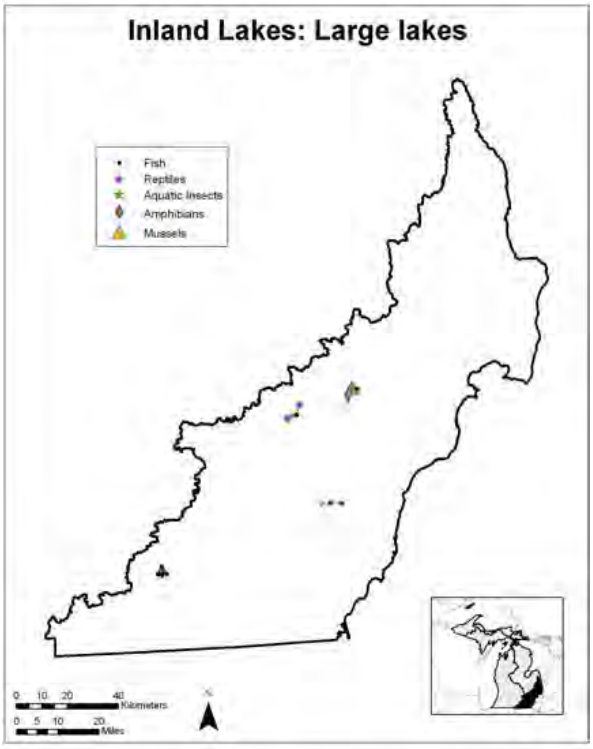

Inland Lakes: Medium lakes
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 25 50 100
Kilometers
0 12.5 25 50
Miles
N

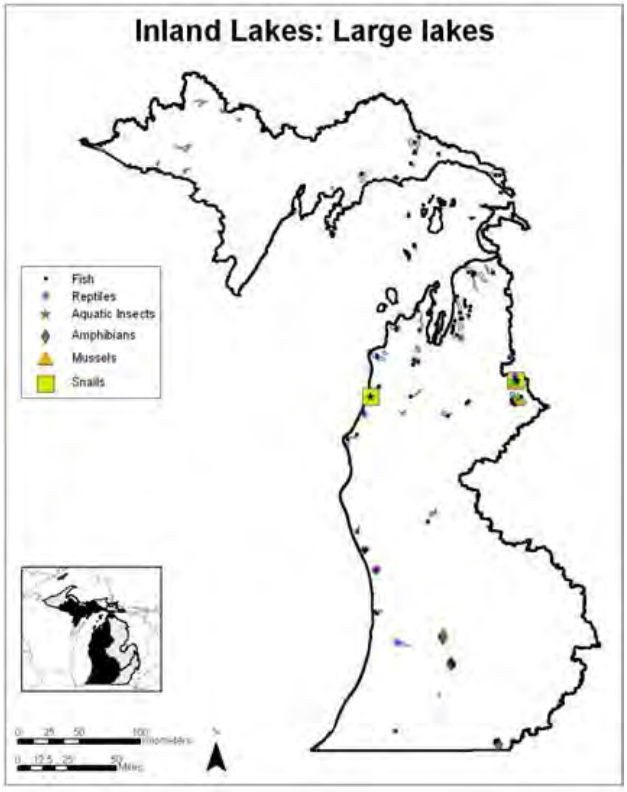

Inland Lakes:
Medium Lakes
Fish
Reptiles
Aquatic Insects
Snails
N

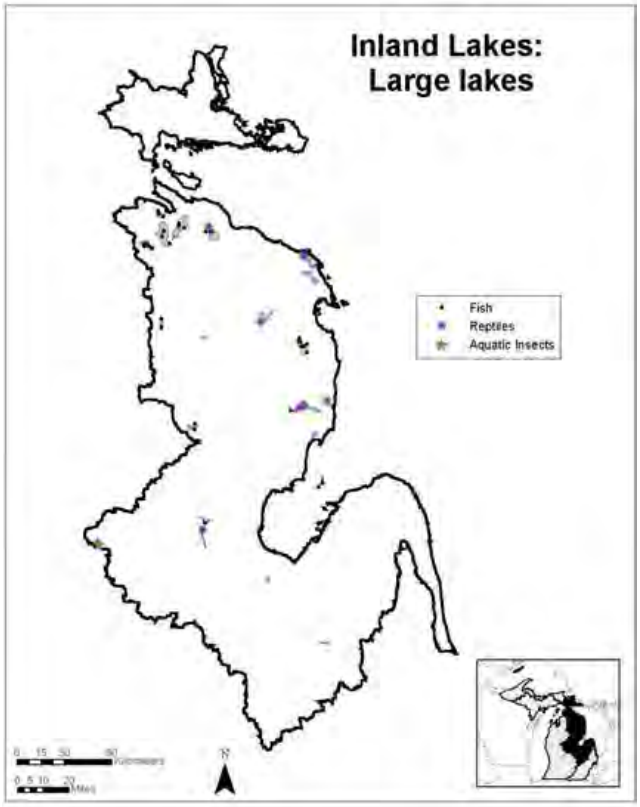

Inland Lakes: Medium lakes
Fish
Reptiles
Aquatic Insects
Snails

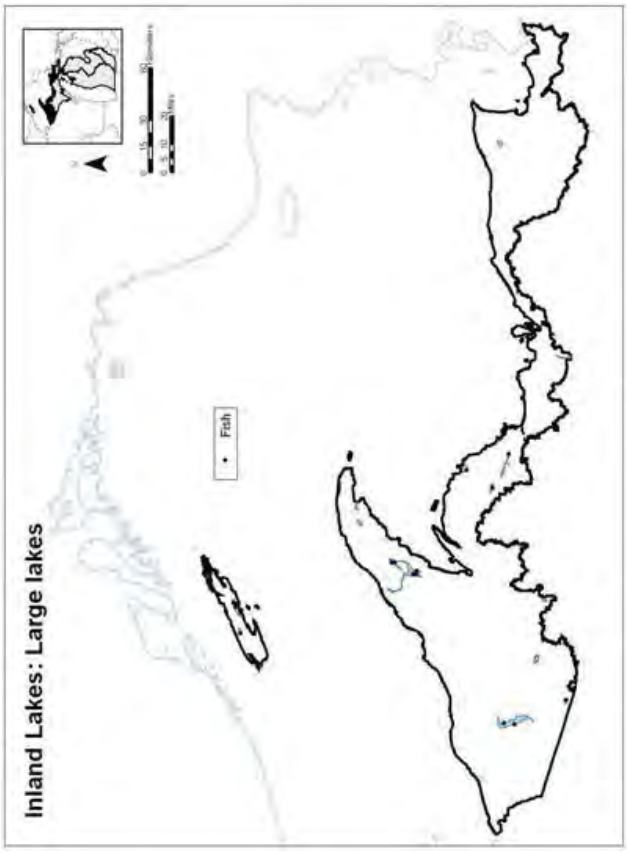
Inland Lakes: Large Lakes

Description: Large lakes are permanent standing water bodies greater than 1000 acres in area. These lakes are more homogeneous in terms of chemical and biological variables than smaller lakes, although there is still some diversity. They are typically oligotrophic to mesotrophic and most are dominated by open-water zones (pelagic) and are stratified. Large lakes are more likely to have wave-washed shores compared to smaller lakes and are unlikely to have low winter oxygen levels. There is more diversity of within-lake habitats in these lakes than smaller lakes. These lakes are the most likely to have public access points.



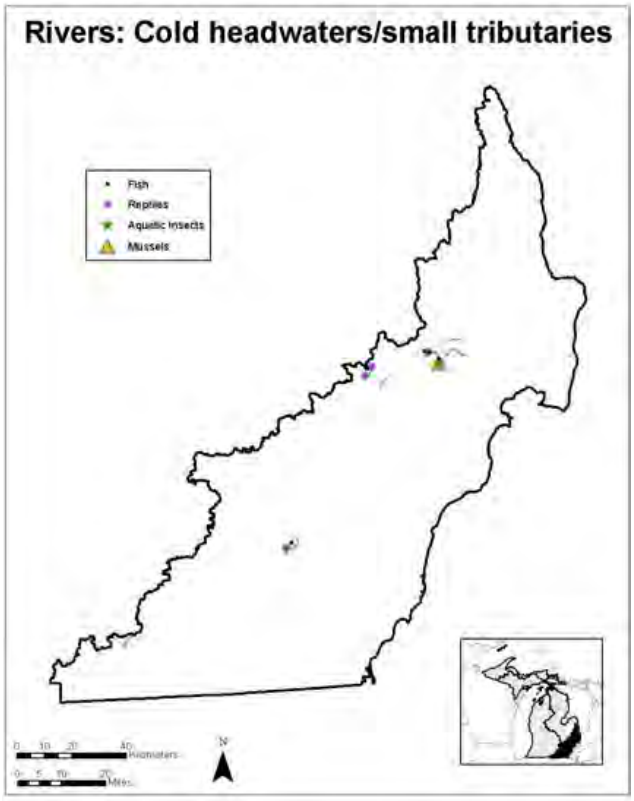

Inland Lakes: Large lakes
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails

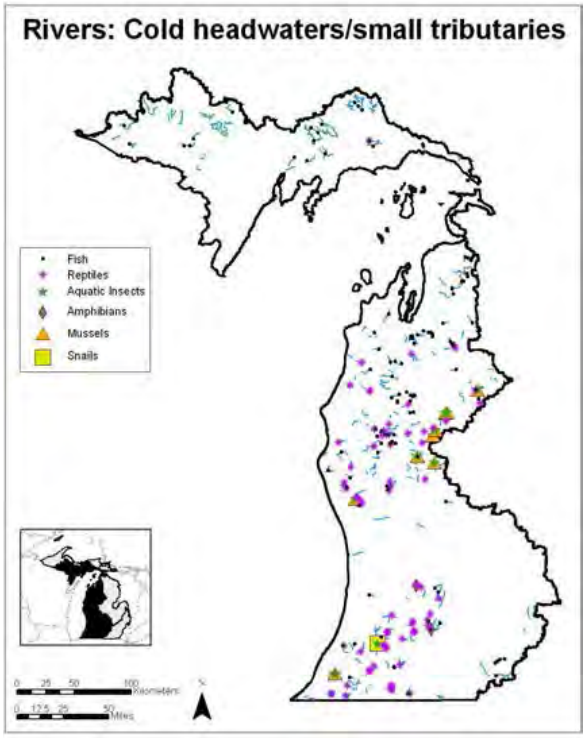

Inland Lakes:
Large lakes
Fish
Reptiles
Aquatic Insects

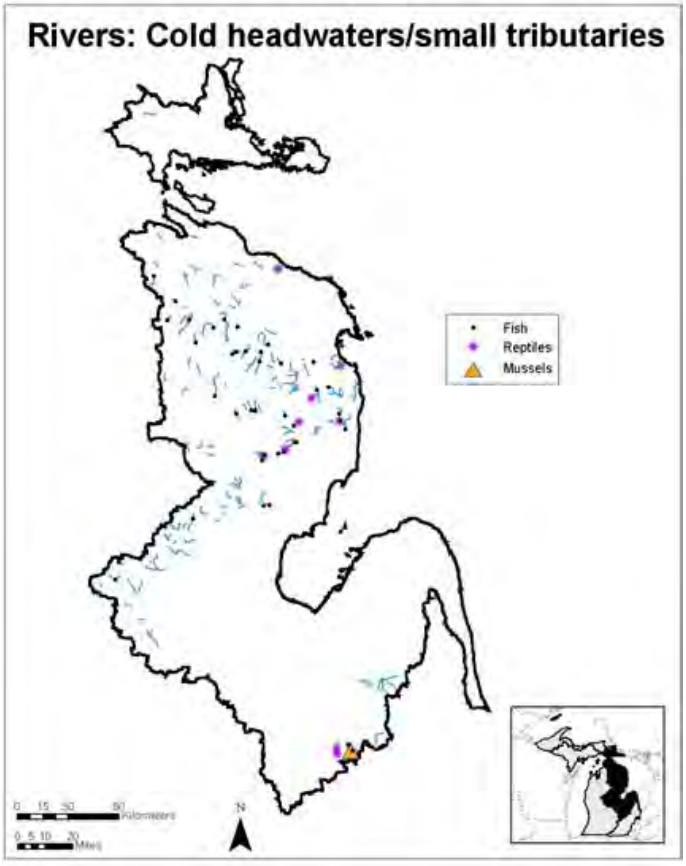


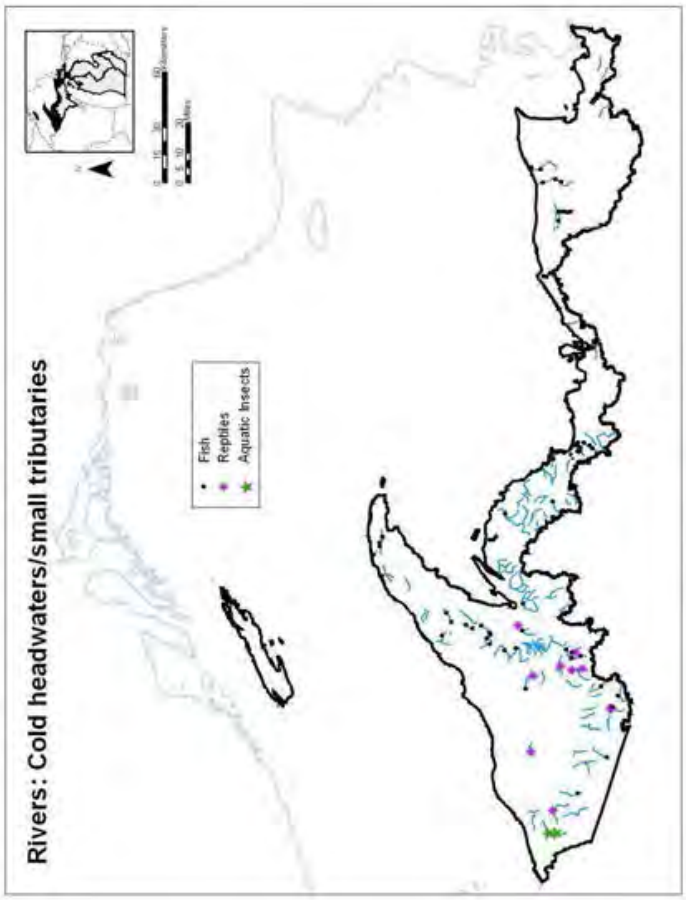
Rivers: Cold Headwaters and Small Tributaries

Description: Headwater streams and small tributaries are wadeable systems that have a midpoint catchment area (the land area above the midpoint of the stream from which water drains towards the stream) less than 40 square miles. These low stream order systems join together to form larger streams and rivers, or run directly into other streams, rivers, and lakes. They have great influence on the collective health and functioning of the primary stream network to which they belong. Headwater streams and small tributaries tend to be strongly affected by riparian vegetation Cold headwater streams and small tributaries in Michigan are typically groundwater-dominated systems that pass through unconfined alluvial valleys of varying gradient, although some runoff-driven systems occur. Baseflows are relatively high and stable. July weekly mean temperature in these streams is less than 19oC (66oF). In the Lake Erie basin these systems are rare due to flat topography and clay soils present in the region.


Rivers: Cold headwaters/small tributaries
Fish
Reptiles
Aquatic Insects
Mussels
Kilometers
Miles
N

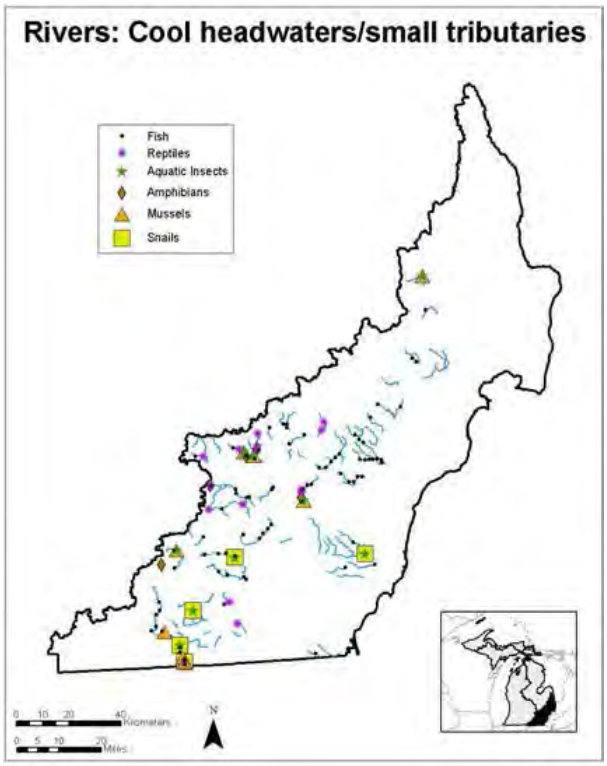

Rivers: Cold headwaters/small tributaries
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
Kilometers
Miles
N

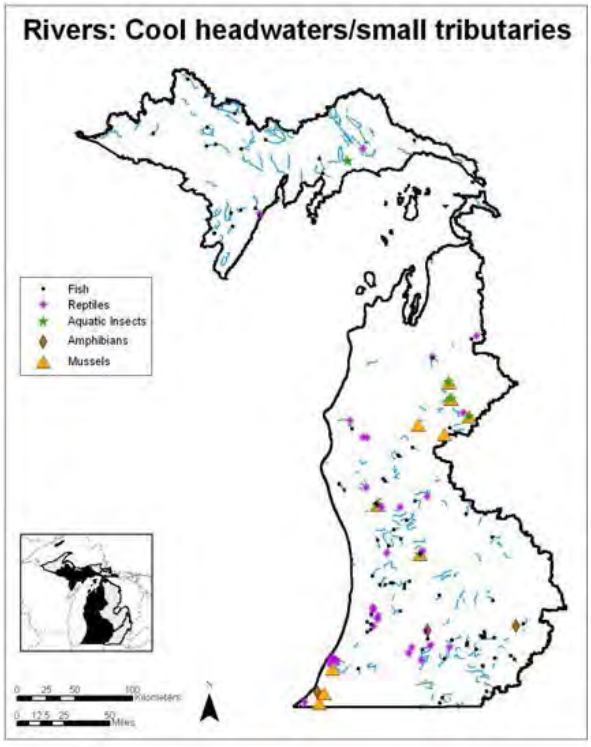

Rivers: Cold headwaters/small tributaries
Fish
Reptiles
Mussels
0 15 30 60
Kilometers
0 5 10 20
Miles
N

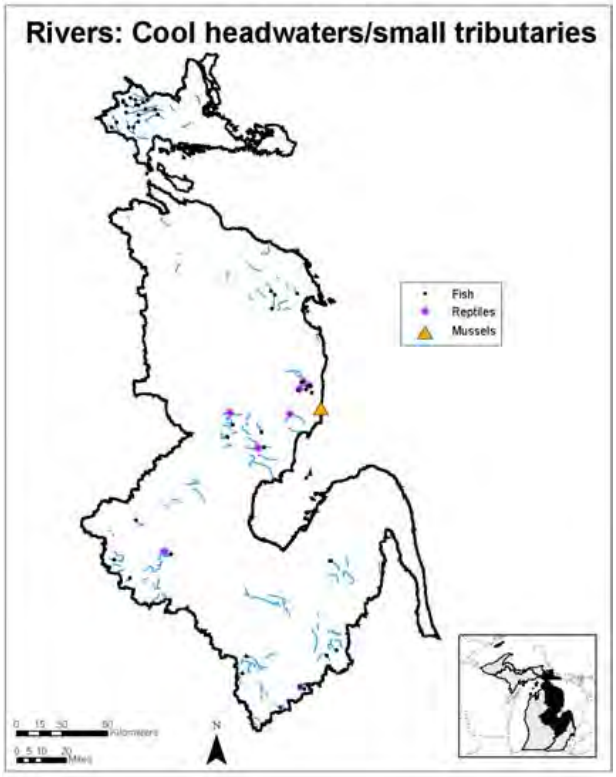


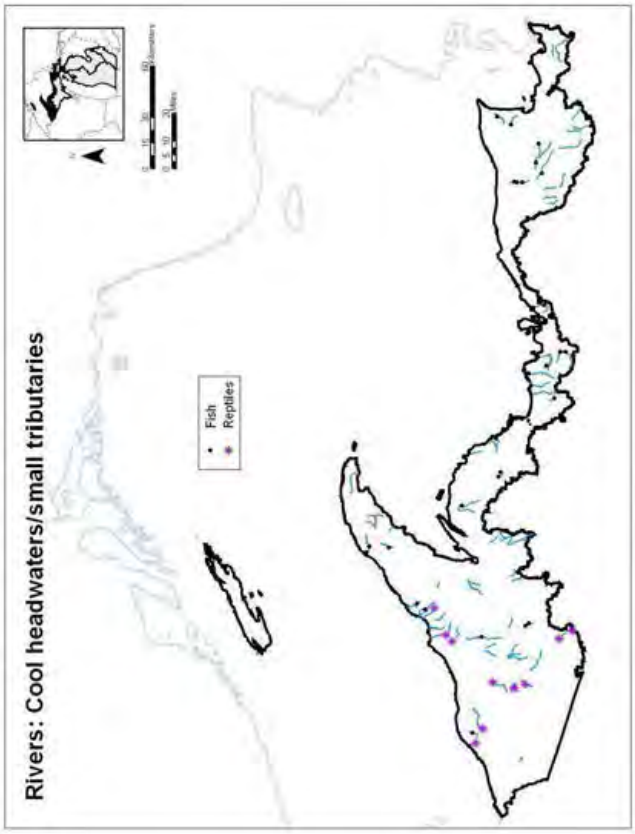
Rivers: Cool Headwaters and Small Tributaries

Description: Headwater streams and small tributaries are wadeable systems that have a midpoint catchment area (the land area above the midpoint of the stream from which water drains towards the stream) less than 40 square miles. These low stream order systems join together to form larger streams and rivers, or run directly into other streams, rivers, and lakes. They have great influence on the collective health and functioning of the primary stream network to which they belong. Headwater streams and small tributaries tend to be strongly affected by riparian vegetation. Cool headwater streams and small tributaries are usually low-gradient, runoff-driven systems with fair to moderate baseflows and moderate to high peak flows. Many of these systems pass through unconfined alluvial valleys. July weekly mean temperature in cool headwater streams range from 19-22oC. These systems are common in the till plains of the Lake Erie basin.


Rivers: Cool headwaters/small tributaries
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 10 20 40 Kilometers
0 5 10 20 Miles
N

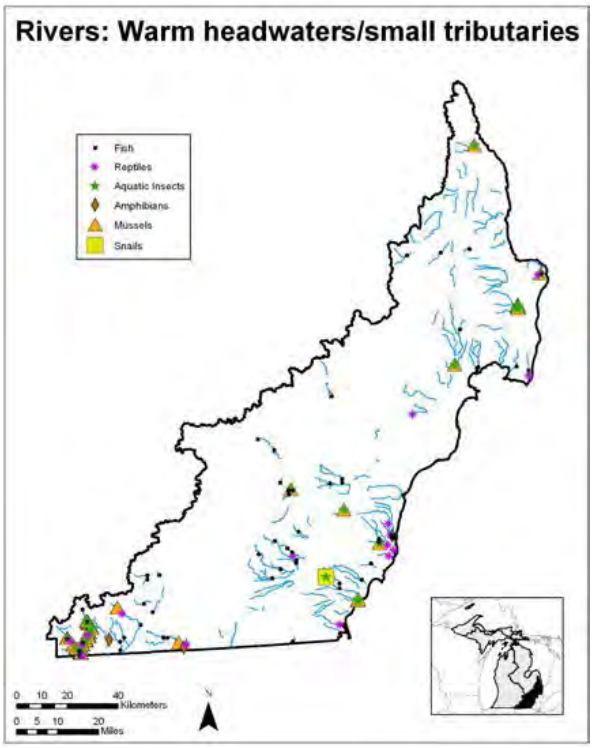

Rivers: Cool headwaters/small tributaries
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
0 25 50 100 Kilometers
0 12.5 25 50 Miles
N

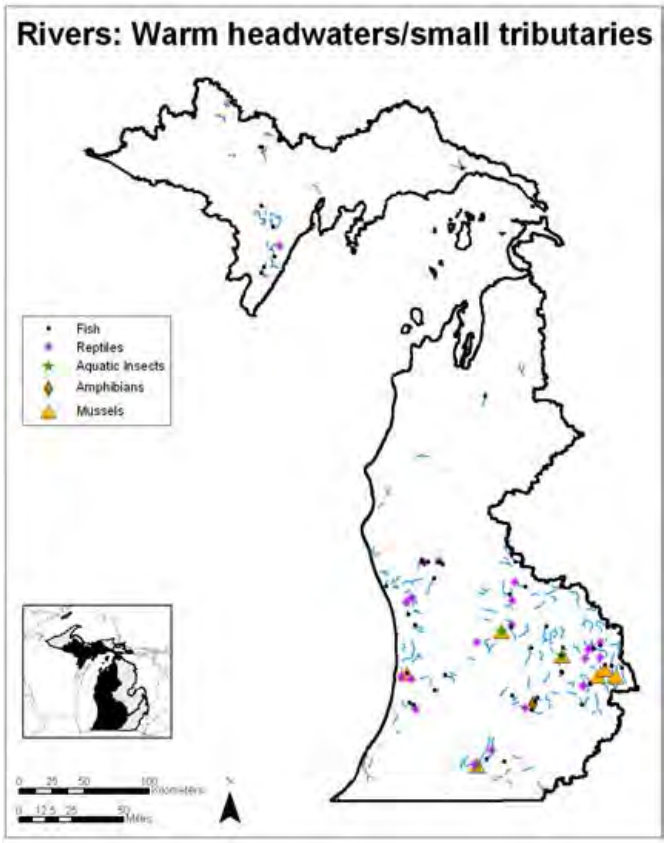

Rivers: Cool headwaters/small tributaries
Fish
Reptiles
Mussels
0 15 30 60 Kilometers
0 5 10 20 Miles
N

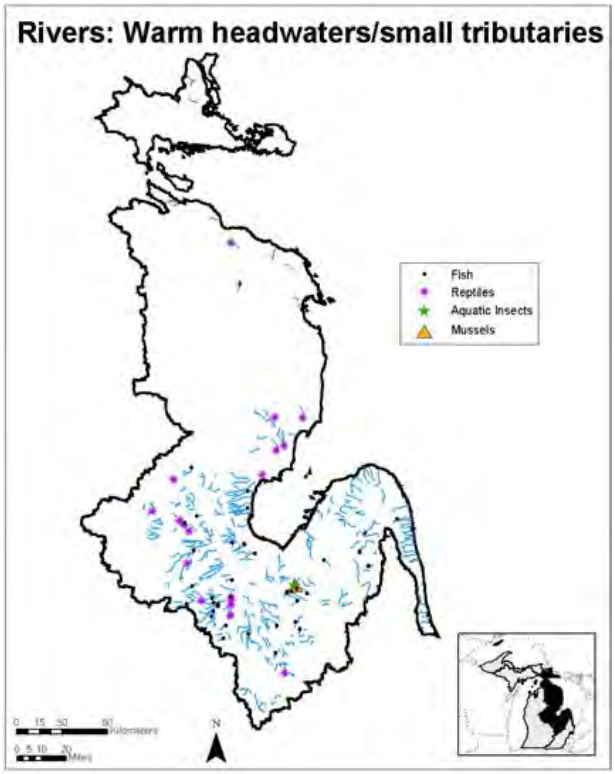

Rivers: Cool headwaters/small tributaries
Fish
Reptiles

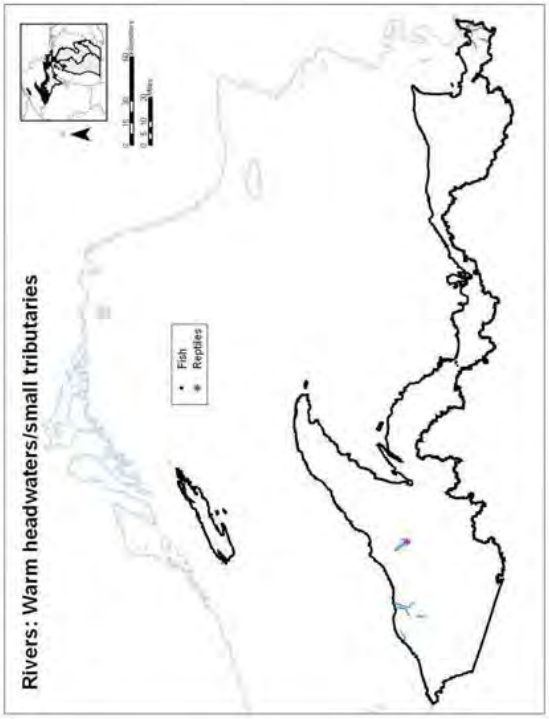
Rivers: Warm Headwaters and Small Tributaries

Description: Headwater streams and small tributaries are wadeable systems that have a midpoint catchment area (the land area above the midpoint of the stream from which water drains towards the stream) less than 40 square miles. These low stream order systems join together to form larger streams and rivers, or run directly into other streams, rivers, and lakes. They have great influence on the collective health and functioning of the primary stream network to which they belong. Headwater streams and small tributaries tend to be strongly affected by riparian vegetation. Warm headwater streams and small tributaries are generally low-gradient, runoff-driven systems that pass through unconfined alluvial valleys, but tend to have lower baseflows and higher peak flows than cool headwater systems. July weekly mean temperatures in these systems are greater than 22oC (72oF). These systems are very common in the flat lacustrine clay and silt plains of the Lake Erie basin.



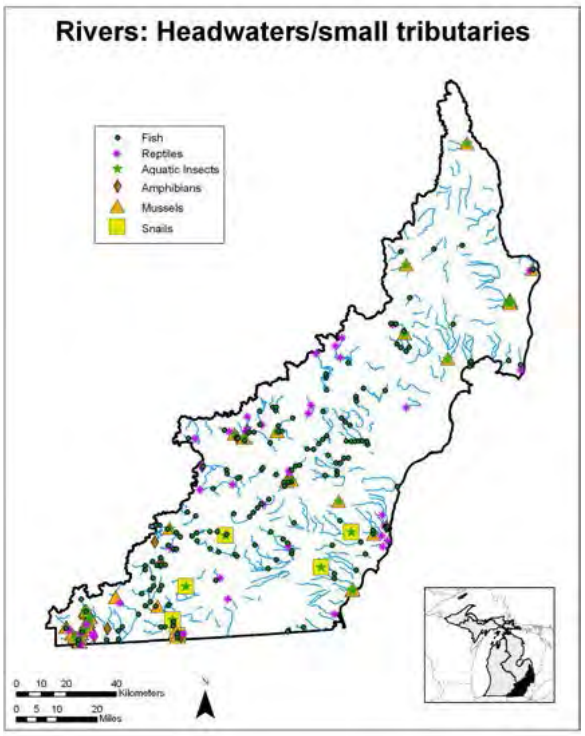

Rivers: Warm headwaters/small tributaries
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
0 25 50 100 Kilometers
0 12.5 25 50 Miles
N

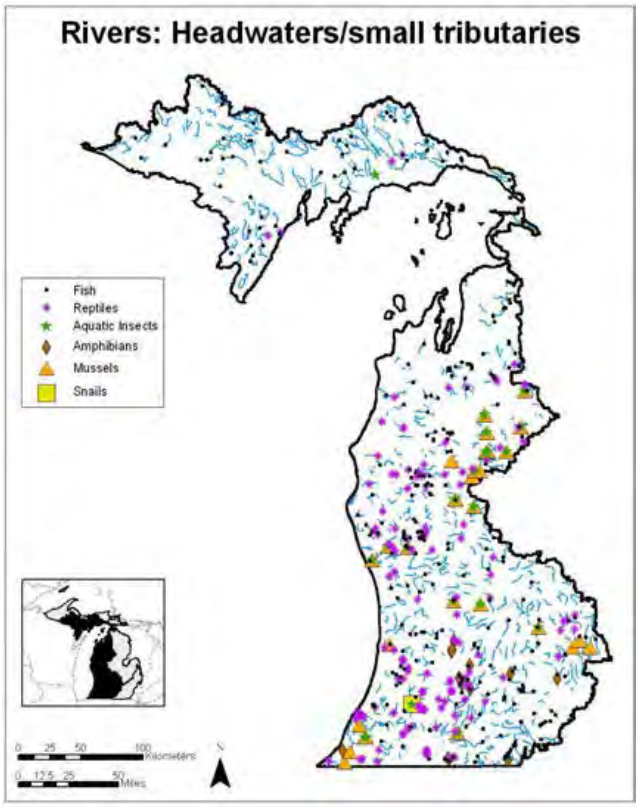

Rivers: Warm headwaters/small tributaries
Fish
Reptiles
Aquatic Insects
Mussels
0 15 30 60 Kilometers
0 5 10 20 Miles
N

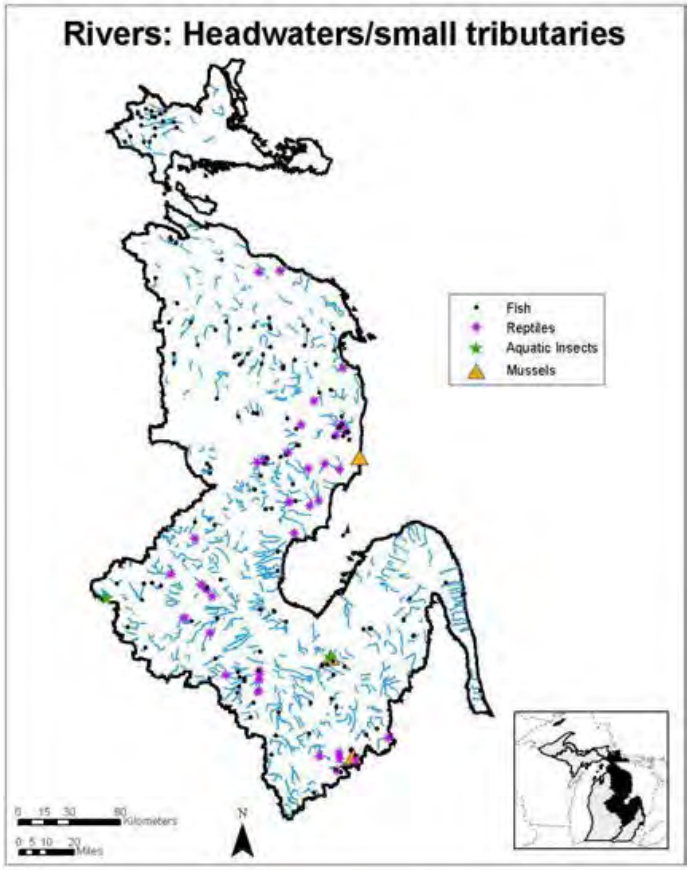


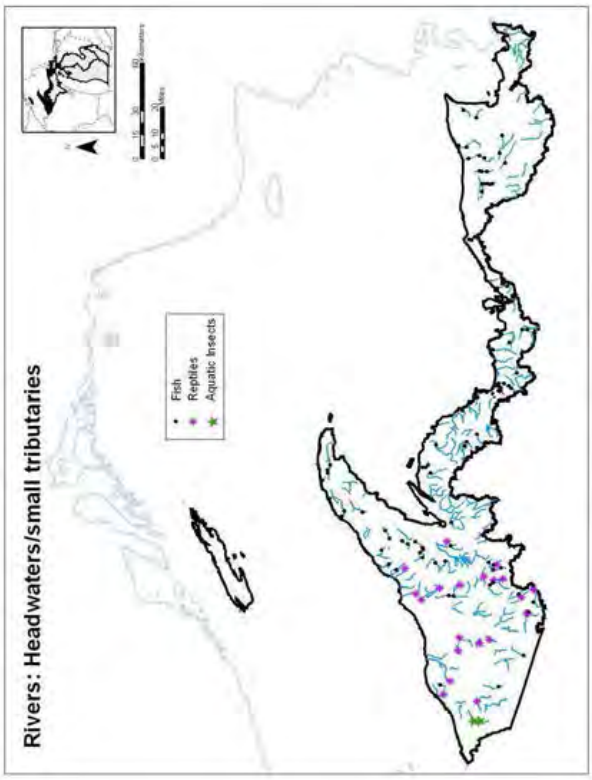
Rivers: Headwaters and Small Tributaries

Description: Headwater streams and small tributaries are wadeable systems that have a midpoint catchment area (the land area above the midpoint of the stream from which water drains towards the stream) less than 40 square miles. These low stream order systems join together to form larger streams and rivers, or run directly into other streams, rivers, and lakes. They have great influence on the collective health and functioning of the primary stream network to which they belong. Headwater streams and small tributaries tend to be strongly affected by riparian vegetation. This landscape feature is a catch-all for species with no recorded water temperature preferences as reported in primary literature.


Rivers: Headwaters/small tributaries
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 10 20 40
Kilometers
0 5 10 20
Miles
N


Rivers: Headwaters/small tributaries
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 25 50 100
Kilometers
0 12.5 25 50
Miles
N

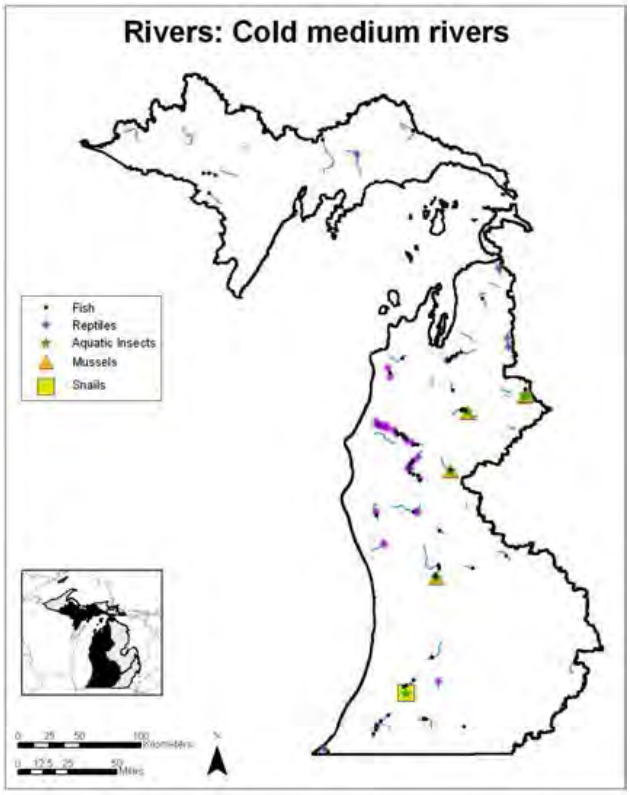

Rivers: Headwaters/small tributaries
Fish
Reptiles
Aquatic Insects
Mussels
0 15 30 60 Kilometers
0 5 10 20 Miles
N

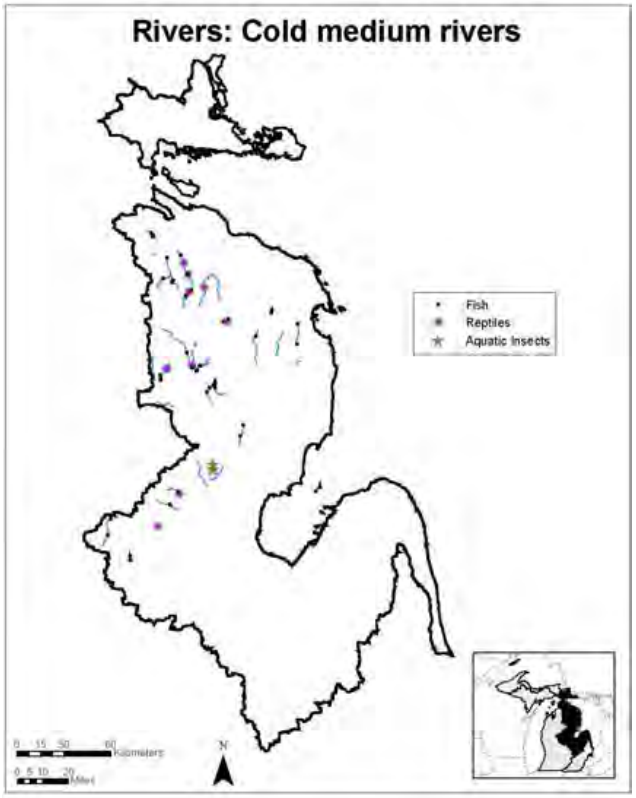


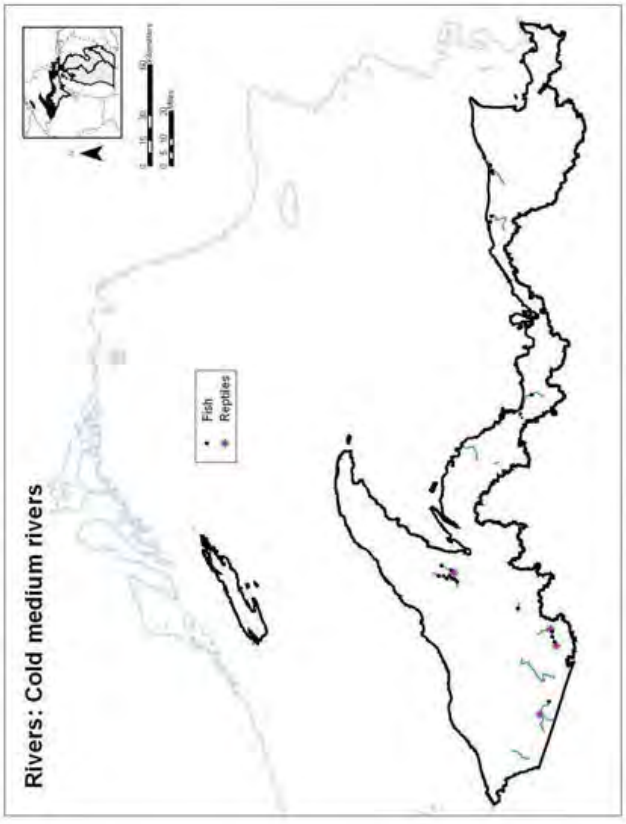
Rivers: Cold Medium Rivers

Description: Medium rivers are wadeable systems that have a midpoint catchment area from 40 to 179 square miles. They are intermediate stream order. Substrate and habitat are variable and more diverse than headwater systems. Cold medium rivers in Michigan are typically groundwater-driven with high baseflow and peak flow, although a few systems are runoff-driven with fair to moderate baseflow and peak flow. Most are low to moderate gradient and flow through unconfined alluvial valleys, while a smaller number of cold medium rivers flow through confined, sporadically confined, or unconfined glacial valleys. July weekly mean temperature in these rivers is less than 19oC (66oF). These systems are uncommon in the Lake Erie basin.


Rivers: Cold medium rivers
Reptiles
0 10 20 40 Kilometers
0 5 10 20 Miles
N

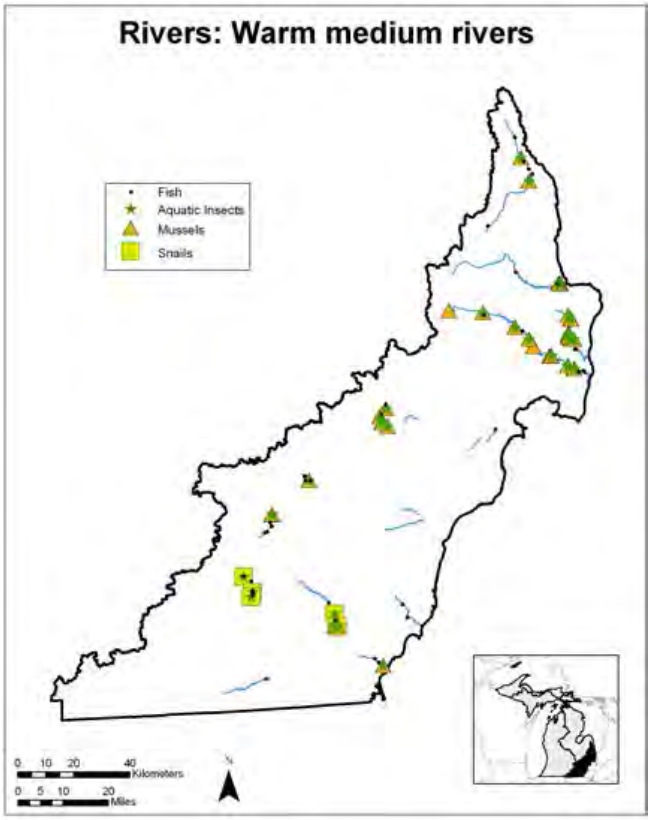

Rivers: Cold medium rivers
Fish
Reptiles
Aquatic Insects
Mussels
Snails
0 25 50 100 Kilometers
0 12.5 25 50 Miles
N

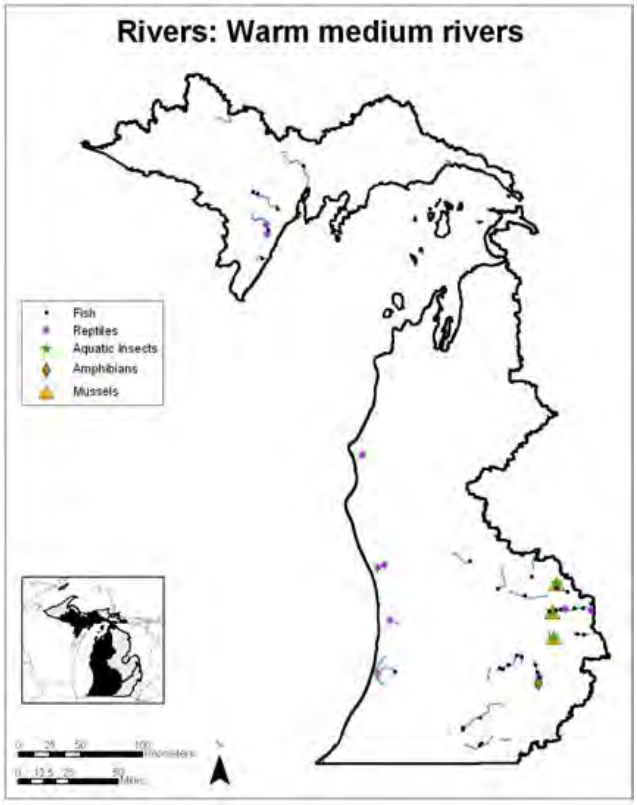

Rivers: Cold medium rivers
Fish
Reptiles
Aquatic Insects
N

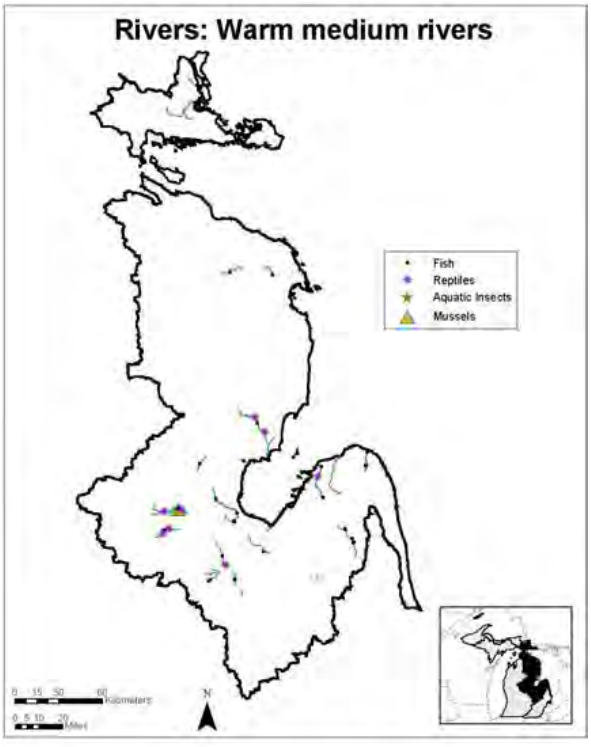

Rivers: Cold medium rivers
Fish
Reptiles

Rivers: Warm Medium Rivers

Description: Medium rivers are wadeable systems that have a midpoint catchment area from 40 to 179 square miles. They are intermediate stream order. Substrate and habitat are variable and more diverse than headwater systems. Warm medium rivers In Michigan are generally runoff-driven systems with low baseflow and high peak flow. Most are low gradient and flow through unconfined alluvial valleys. July weekly mean temperatures in these systems are greater than 22oC (72oF). These systems are common in the lacustrine clay and silt areas of the Lake Erie basin.

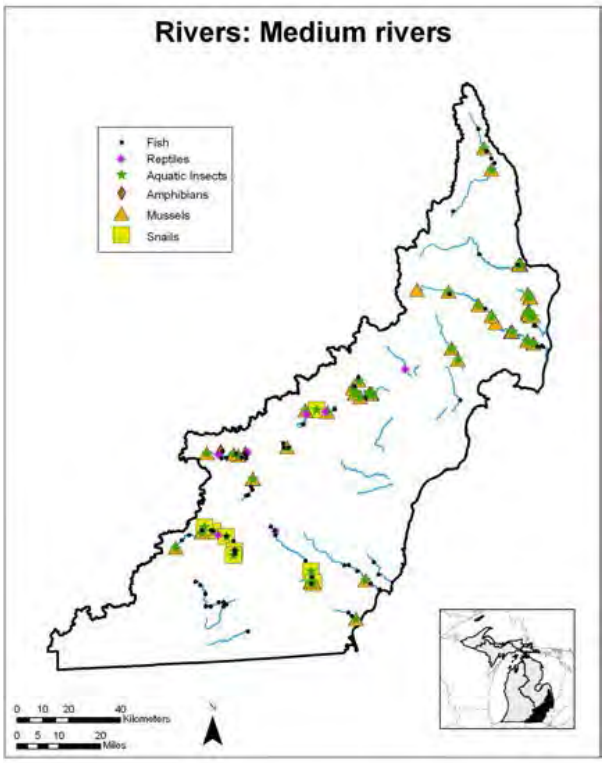


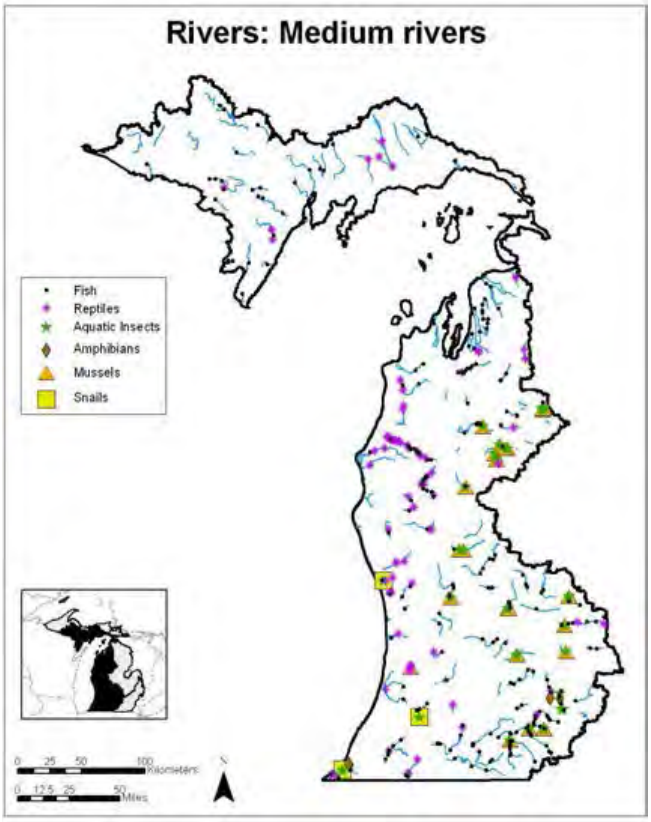

Rivers: Warm medium rivers
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
N

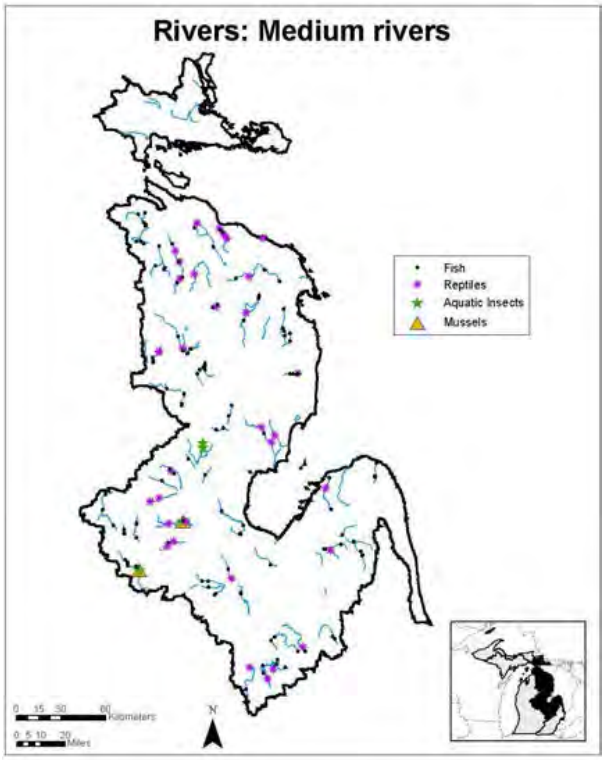

Rivers: Warm medium rivers
Fish
Reptiles
Aquatic Insects
Mussels
N

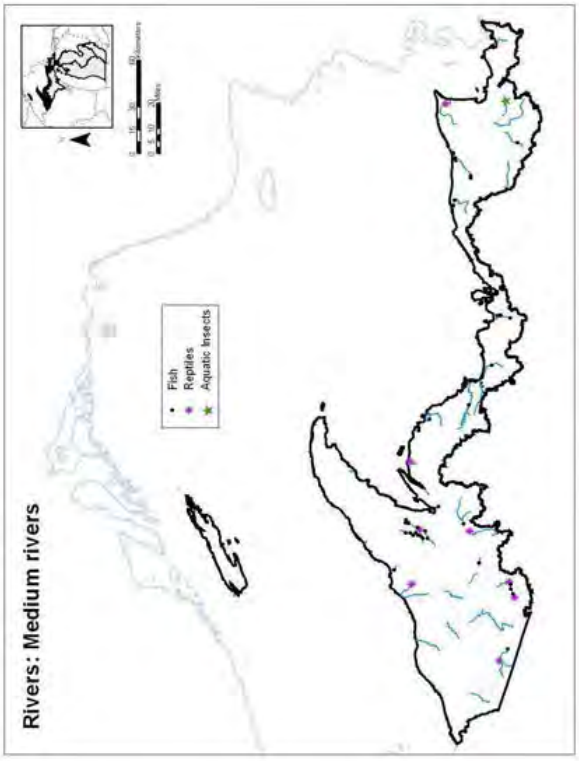
Rivers: Medium Rivers

Description: Medium rivers are wadeable systems that have a midpoint catchment area from 40 to 179 square miles. They are intermediate order. Substrate and habitat are variable and more diverse than headwater systems and can range in water temperature from cold to warm. This landscape feature is a catch-all for species with no recorded water temperature preferences as reported in primary literature.



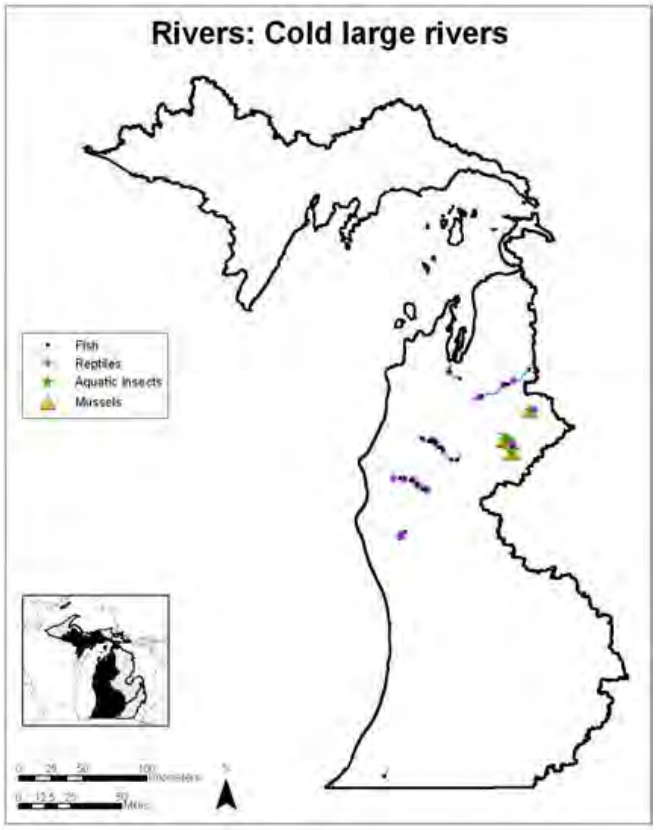

Rivers: Medium rivers
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 25 50 100 Kilometers
0 12.5 25 50 Miles
N

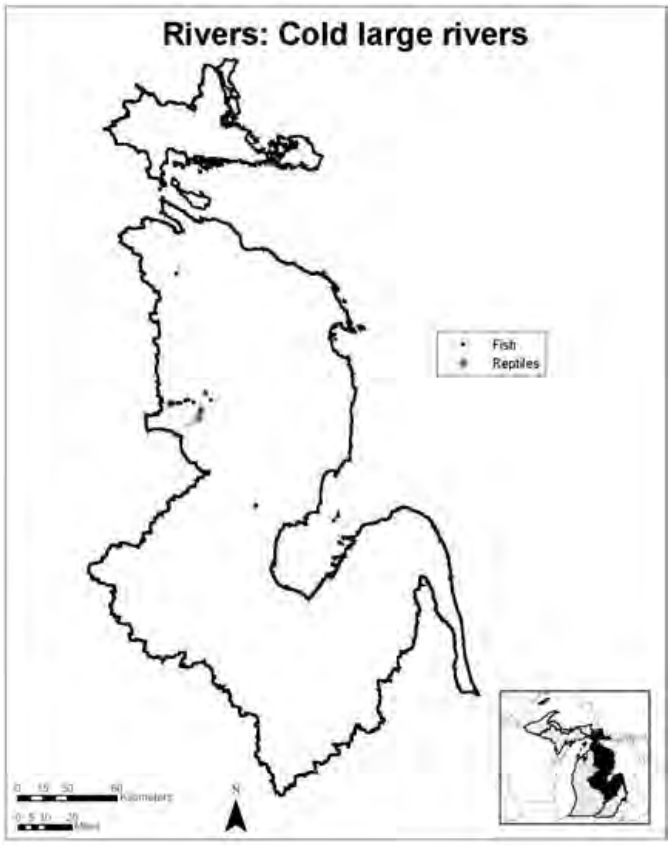

Rivers: Medium rivers
Fish
Reptiles
Aquatic Insects
Mussels
0 15 30 60 Kilometers
0 5 10 20 Miles
N

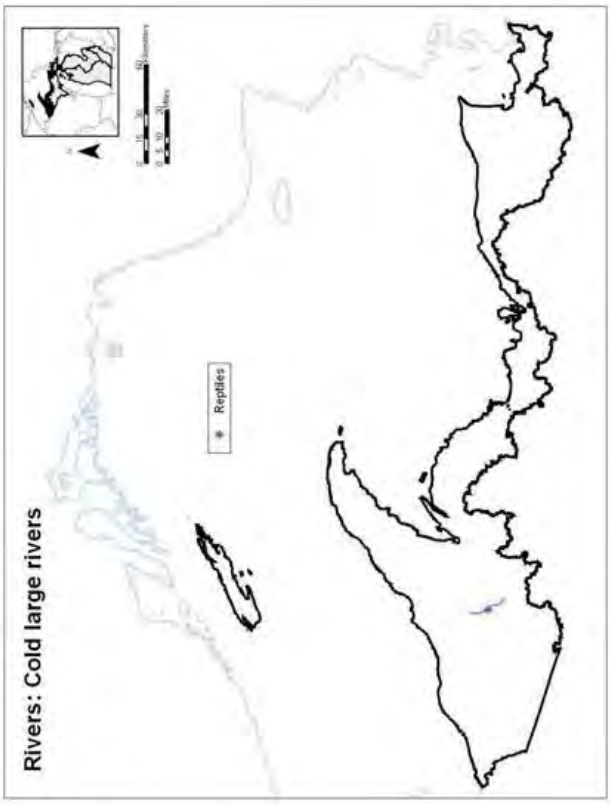


Rivers: Cold Large Rivers

Description Large rivers are wadeable and non-wadeable systems that have a midpoint catchment area from 180 to 620 square miles. Large rivers are intermediate stream order systems with diverse substrate and habitat. Cold large rivers in Michigan are typically groundwater-driven with high to very high baseflow and low to moderate peak flow, and pass through several different valley types including unconfined glacial and alluvial valleys, as well as confined and sporadically confined glacial valleys. July weekly mean temperature in these rivers is less than 19oC (66oF). In the Lake Erie basin these systems are rare.

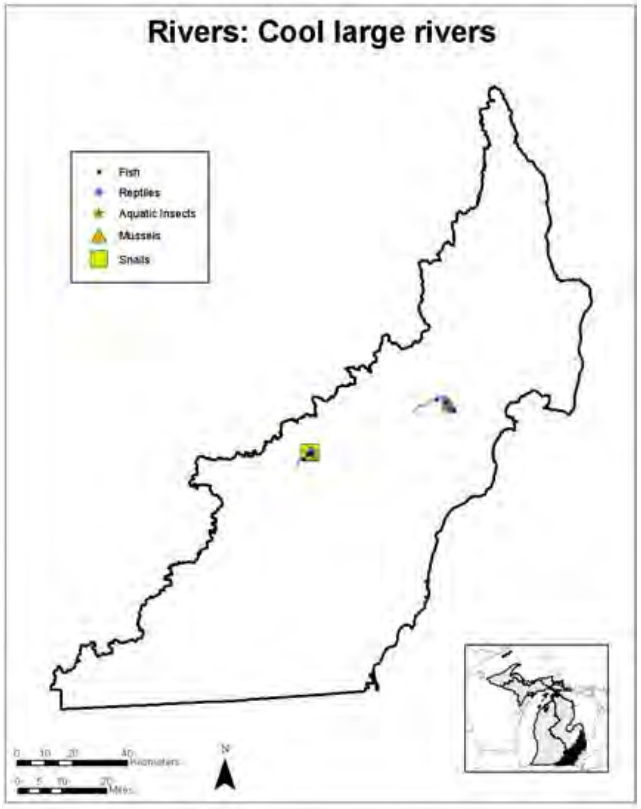

Rivers: Cold large rivers
Fish
Reptiles
Aquatic Insects
Mussels

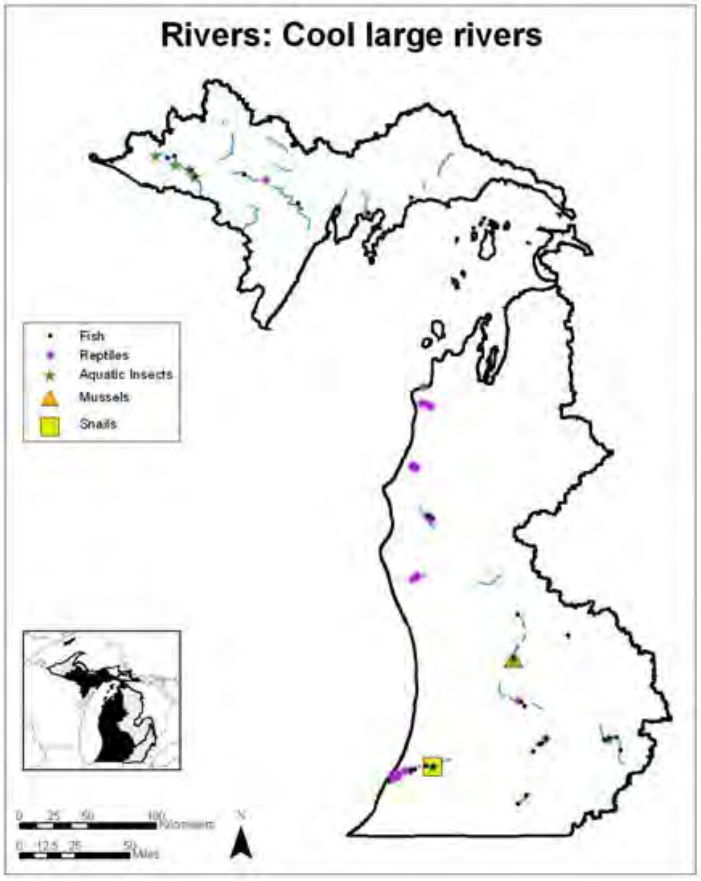

Rivers: Cold large rivers
Fish
Reptiles
N

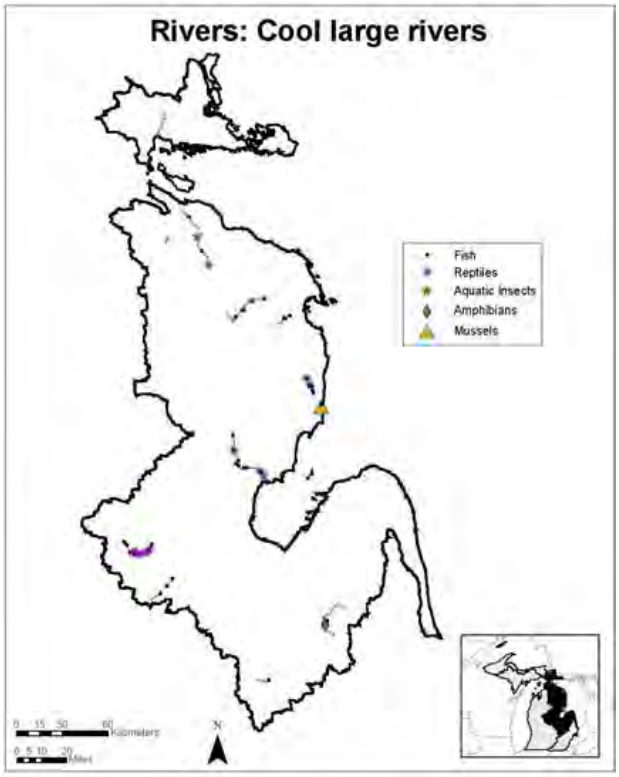


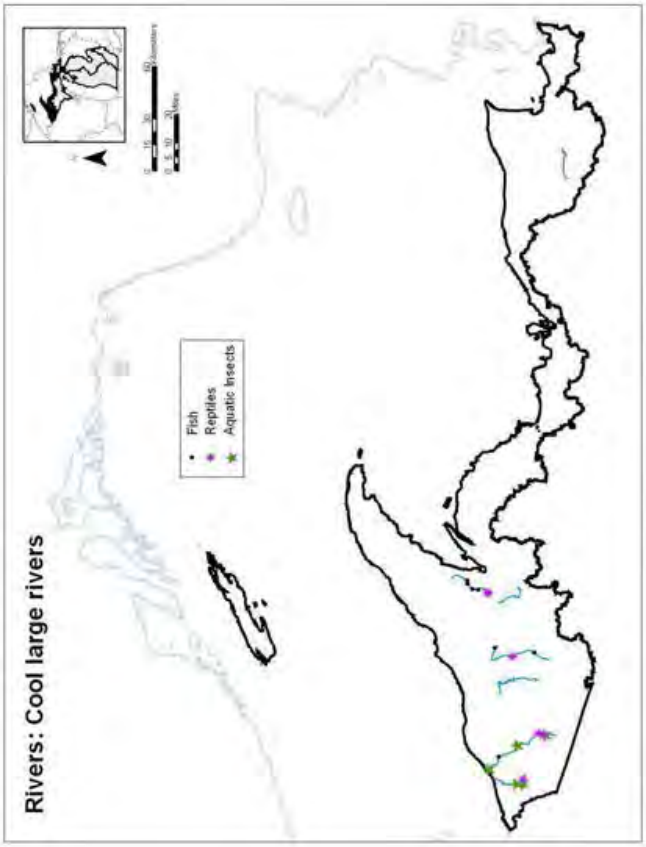
Rivers: Cool Large Rivers

Description Large rivers are wadeable and non-wadeable systems that have a midpoint catchment area from 180 to 620 square miles. Large rivers are intermediate stream order systems with diverse substrate and habitat. Cool large rivers in Michigan are usually runoff-driven systems with fair to moderate baseflow and peak flow. The gradient varies from low to high and most flow through confined or unconfined glacial or alluvial valleys. July weekly mean temperatures in these systems range from 19-22oC (66-72oF).


Rivers: Cool large rivers
Fish
Reptiles
Aquatic Insects
Mussels
Snails
0 10 20 40
Kilometers
0 5 10 20
Miles
N

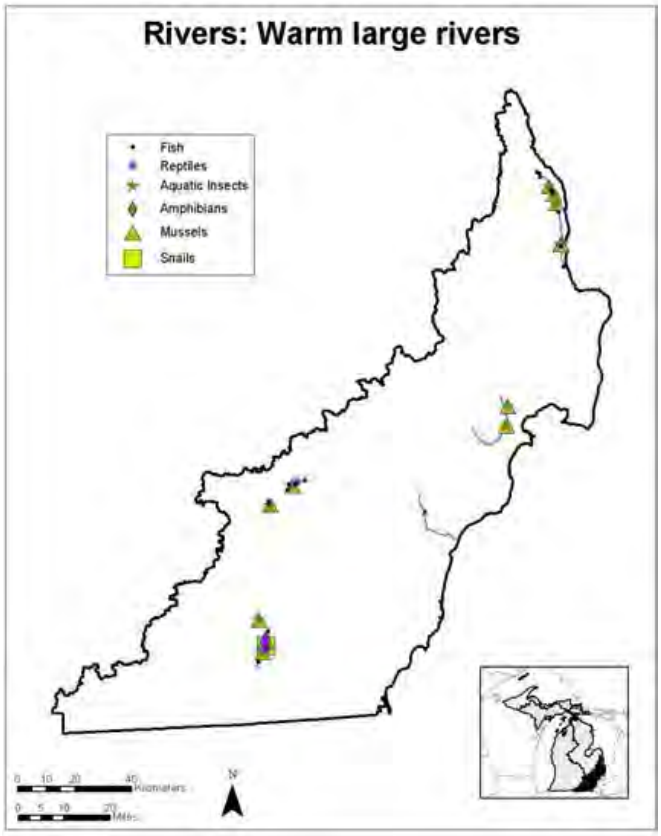

Rivers: Cool large rivers
Fish
Reptiles
Aquatic Insects
Mussels
Snails
0 25 50 100 Kilometers
0 12.5 25 50 Miles
N

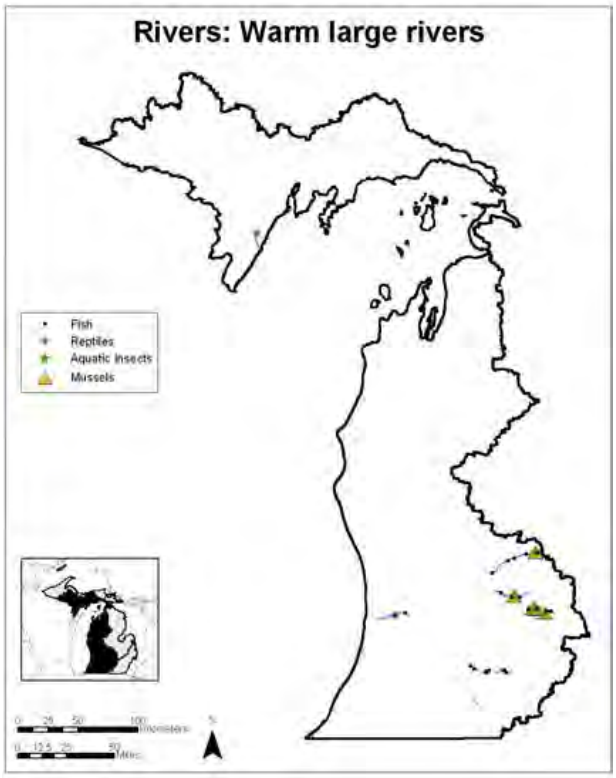

Rivers: Cool large rivers
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
0 15 30 60
Kilometers
0 5 10 20
Miles
N

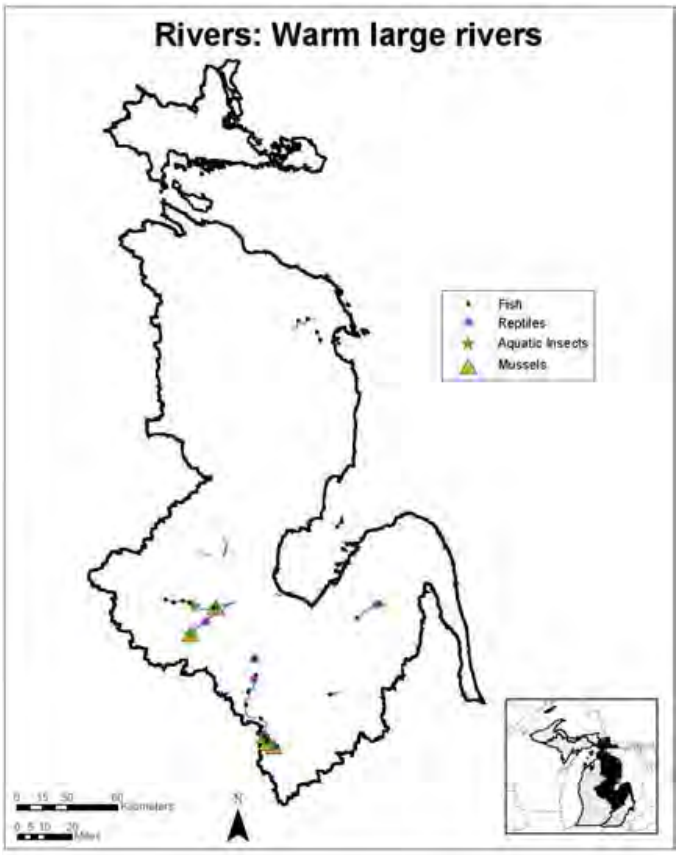


Rivers: Warm Large Rivers

Description Large rivers are wadeable and non-wadeable systems that have a midpoint catchment area from 180 to 620 square miles. Large rivers are intermediate stream order systems with diverse substrate and habitat. Warm large rivers in Michigan are generally runoff-driven systems with low to moderate baseflow, high peak flows, and low gradient. The majority flow through unconfined glacial or alluvial valleys. July weekly mean temperatures in these systems are greater than 22oC (72oF). These systems are common in the Lake Erie basin.

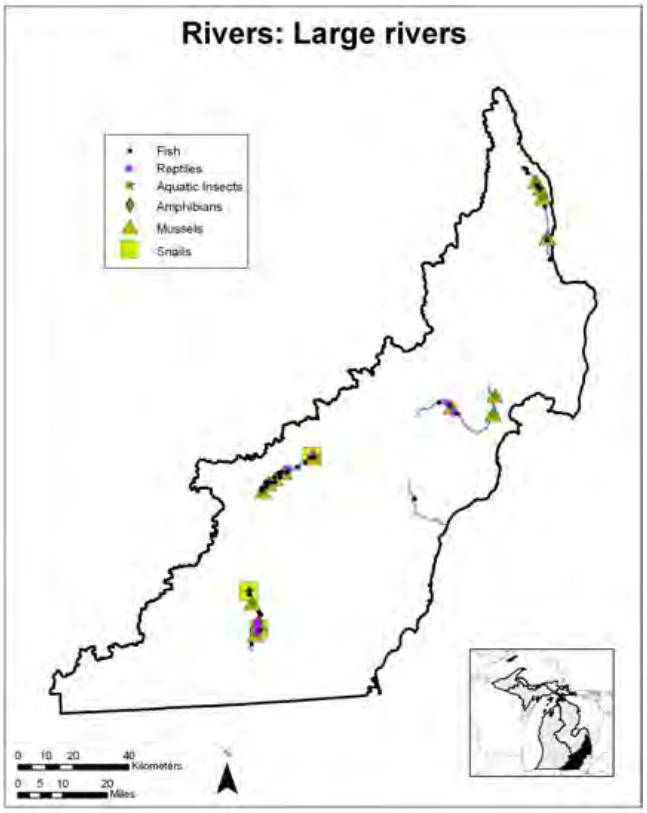

Rivers: Warm large rivers
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 10 20 40 Kilometers
0 5 10 20 Miles
N

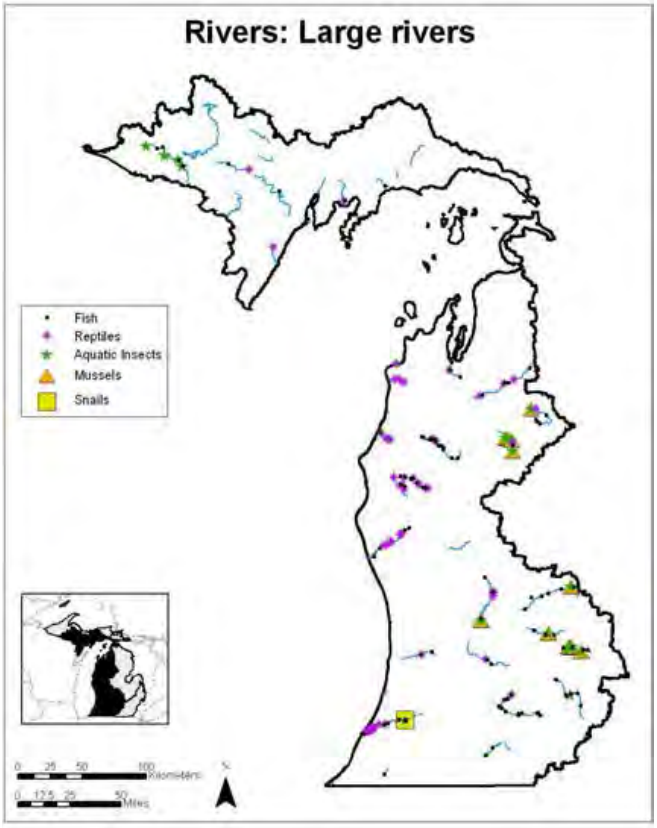

Rivers: Warm large rivers
Fish
Reptiles
Aquatic Insects
Mussels
0 25 50 100 Kilometers
0 12.5 25 50 Miles
N

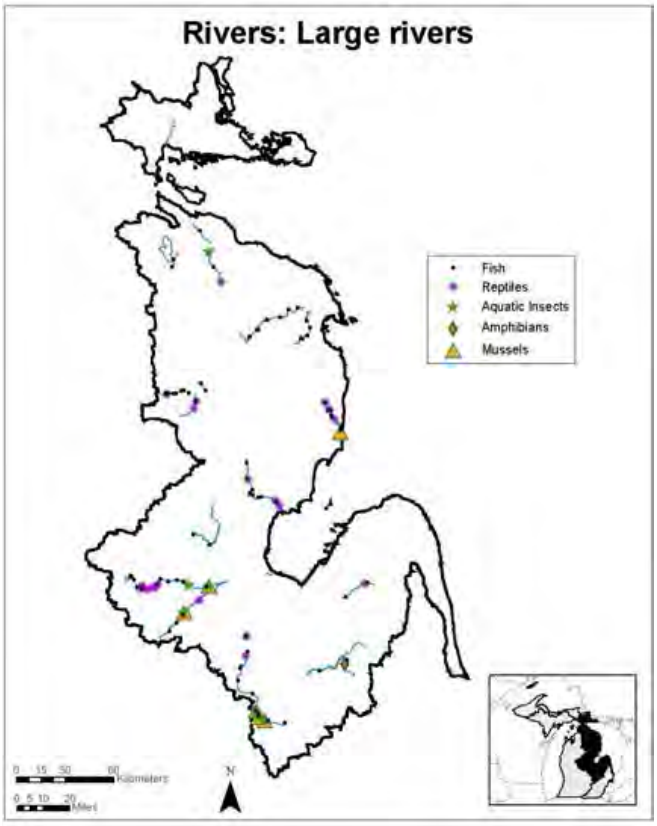


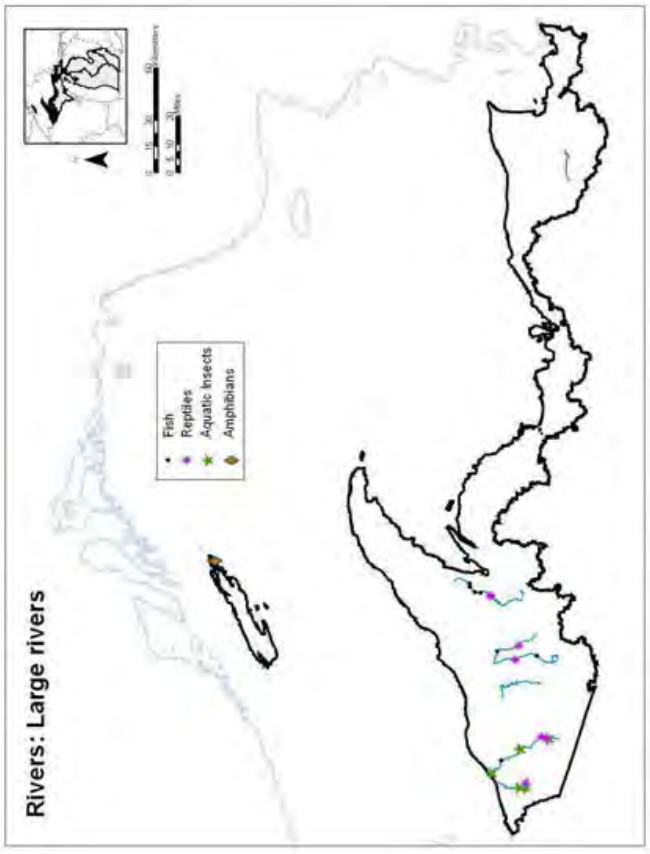
Rivers: Large Rivers

Description Large rivers are wadeable and non-wadeable systems that have a midpoint catchment area from 180 to 620 square miles. Large rivers are intermediate stream order systems with diverse substrate and habitat. Temperatures range from cold to warm. This landscape feature is a catch-all for species with no recorded water temperature preferences as reported in primary literature.


Rivers: Large rivers
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 10 20 40
Kilometers
0 5 10 20
Miles
N

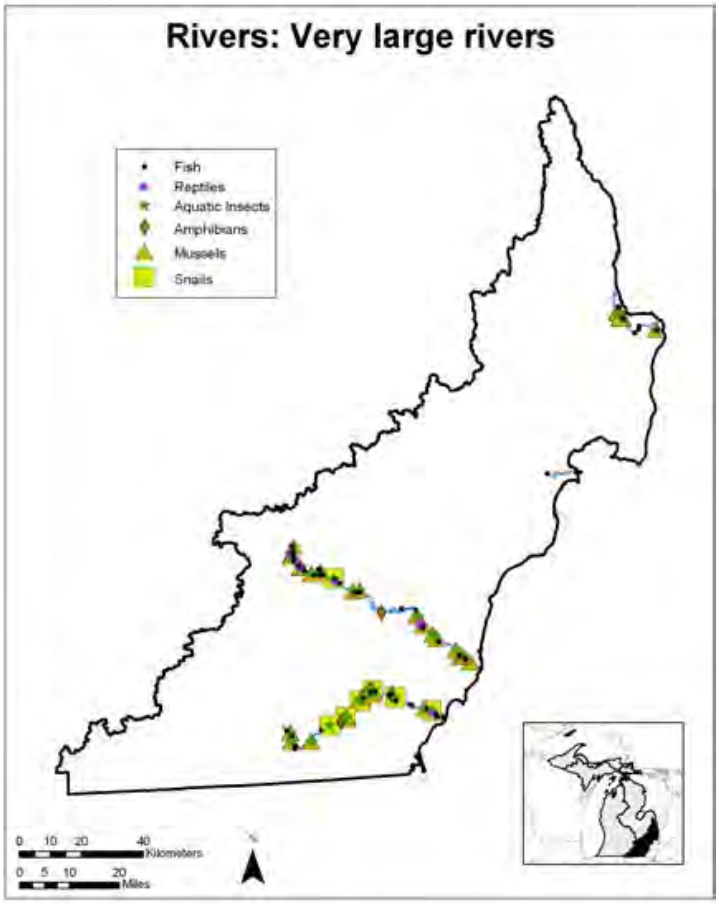

Rivers: Large rivers
Fish
Reptiles
Aquatic Insects
Mussels
Snails
0 25 50 100 Kilometers
0 12.5 25 50 Miles
N

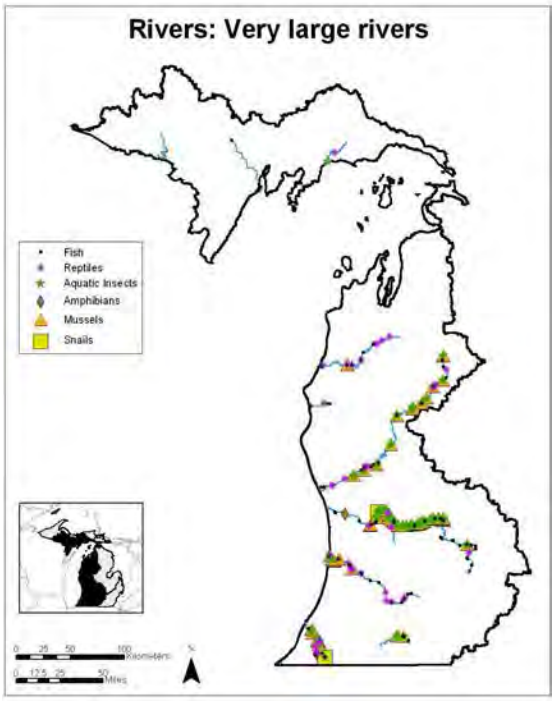

Rivers: Large rivers
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
0 15 30 60
Kilometers
0 5 10 20
Miles
N

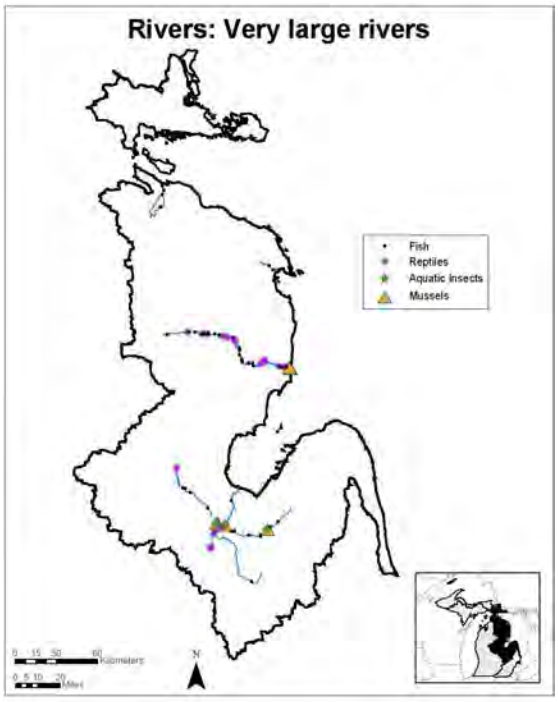


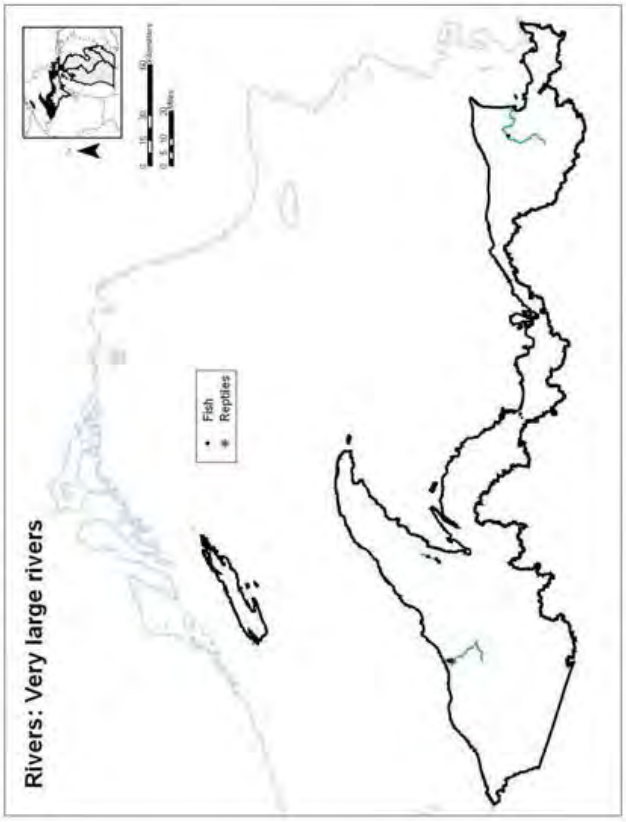
Rivers: Very Large Rivers

Description Very large rivers are those systems that have a midpoint catchment area greater than 620 square miles. Very large rivers are high stream order systems that are typically unwadeable. They include runoff and groundwater-driven systems that encompass a variety of thermal regimes from cool to warm. Most are low or moderate gradient, a few are high gradient. Very large rivers flow through a variety of valley types including confined, sporadically confined, and unconfined glacial valleys and unconfined alluvial valleys. Temperatures range from cold to warm.


Rivers: Very large rivers
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 10 20 40
Kilometers
0 5 10 20
Miles


Rivers: Very large rivers
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails


Rivers: Very large rivers
Fish
Reptiles
Aquatic Insects
Mussels
N


Rivers: Very large rivers
Fish
Reptiles