LAKE ERIE BASIN
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Lake Erie Basin

Landscape Context

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.

Priority Threats

Eleven threats to wildlife and landscape features in this basin were identified as significant by participants at a workshop for this region (see Methods chapter in the Introductory Text & Statewide Assessments section for more information). Invasive species (both established species that require control or eradication, and the potential for more species to colonize) was identified as the most severe threat in the basin. This was followed by altered hydrologic regimes and fragmentation. Wetland modifications, riparian modifications and urban, municipal and industrial pollution were also considered highly significant threats. The highly urbanized nature of this region contributes to the altered hydrologic flow regimes common to the basin. The remaining threats considered significant are also primarily a result of rapid urban sprawl in the region. In descending order of importance they are: dredging and channelization, macrophyte removal, thermal changes and altered nutrient inflows.

Solutions to these threats lie in planning and cooperation between local units of government. Understanding natural processes and how they function as opposed to working only within geo-political boundaries is the key to successfully addressing these needs.

Priority Conservation Actions

The following are conservation actions that were repeated most frequently within each landscape feature category and, therefore, should be considered priorities for the basin, because they will have the most widespread benefits for wildlife conservation in this region (no order implied):

Great Lakes

- Continue vigilance and cooperation toward preventing more aquatic invasive species establishments
- Expand the education programs for the general public regarding natural processes, invasive species, hydrologic cycles and stewardship issues
- Limit dredging activities and avoid open water disposal of uncontaminated materials

Inland Lakes

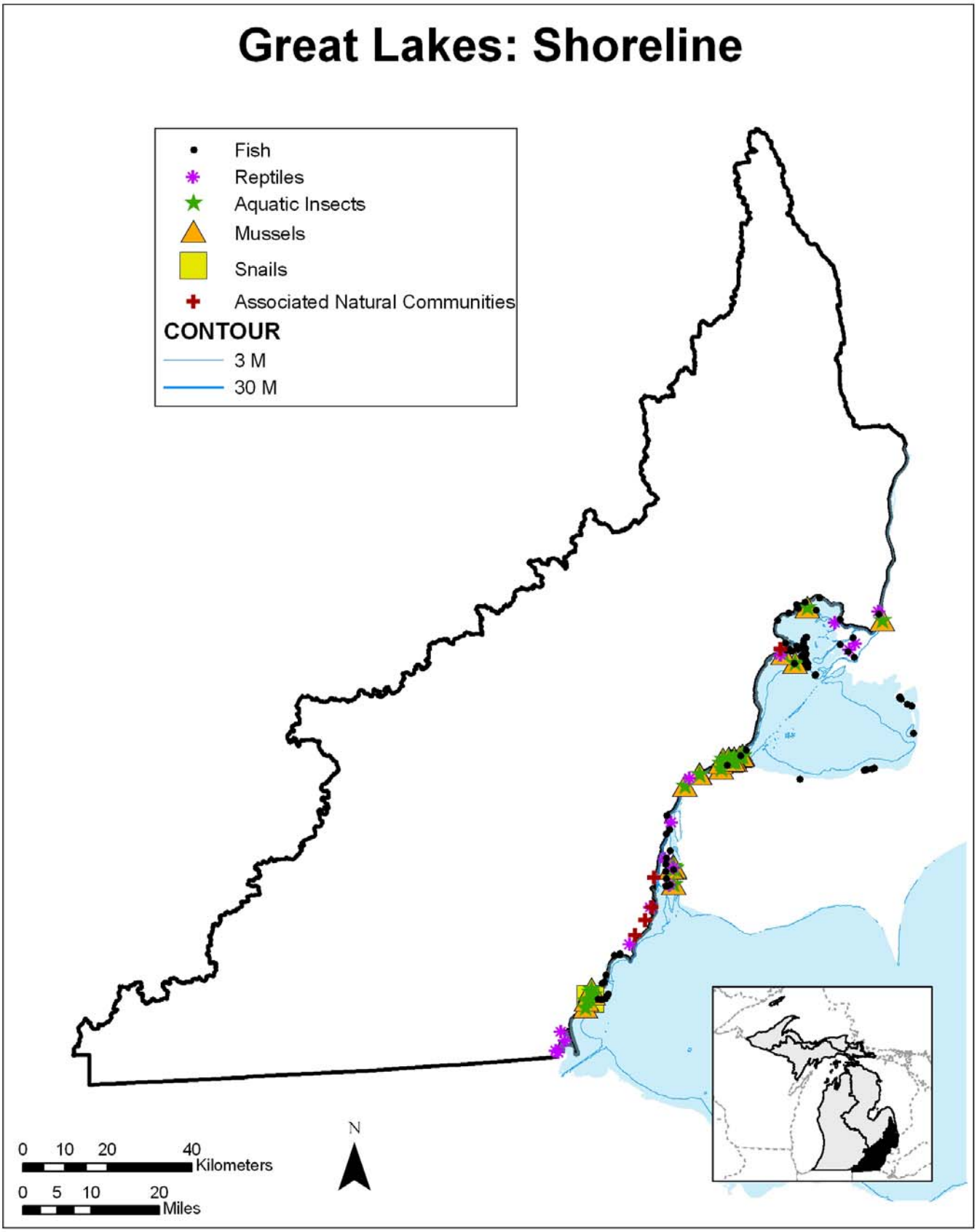
- Control and prevent aquatic invasive species introductions and establishments
- Educate the public on the prevention and control of aquatic invasive species
- Encourage clustered developments rather than evenly spaced home lots
- Expand education programs for the general public regarding natural processes, invasive plants and animals, hydrologic cycles and stewardship issues
- Maintain or establish riparian buffers at least 50 feet wide

Rivers

- Allow seasonal flooding
- Protect the public trust by requiring dam owners to make appropriate financial provisions for future dam removal
- Rehabilitate rivers and streams to original flow paths
- Remove dams to rehabilitate natural hydrology and habitat connectivity
- Work with road commissions to rehabilitate eroding stream crossings and on siting and maintaining new streams crossings

Wetlands

- Allow seasonal flooding
- Continue working with and educating Drain Commissioners
- Maintain or establish riparian buffers at least 50 feet wide
- Prevent and control introduction and establishment of aquatic invasive species
- Protect and rehabilitate wetlands
- Support land conservancy purchase of undeveloped land
- Work with road commissions to site and maintain road crossings


Great Lakes: Shoreline
Fish
Reptiles
Aquatic Insects
Mussels
Snails
Associated Natural Communities
CONTOUR
3 M
30 M
0 10 20 40
Kilometers
0 5 10 20
Miles
N

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.

General Condition of Feature

This habitat is considered 20% in good to excellent condition, 30% in fair condition, and 50% in degraded to very degraded condition.

Associated Natural Communities

Great Lakes Marsh

Associated Species of Greatest Conservation Need

MUSSELS
- northern riffleshell (*Epioblasma torulosa rangiana*)
- eastern pondmussel (*Ligumia nasuta*)
- black sandshell (*Ligumia recta*)

FISH
- lake sturgeon (*Acipenser fulvescens*)
- mooneye (*Hiodon tergisus*)
- brassy minnow (*Hybognathus hankinsoni*)
- silver chub (*Macrhybopsis storeriana*)
- black buffalo (*Ictiobus niger*)
- spotted sucker (*Minytrema melanops*)
- stonecat (*Noturus flavus*)
- tadpole madtom (*Noturus gyrinus*)
- brindled madtom (*Noturus miurus*)

FISH cont.
- grass pickerel (*Esox americanus*)
- cisco or lake herring (*Coregonus artedi*)
- slimy sculpin (*Cottus cognatus*)
- eastern sand darter (*Ammocrypta pellucida*)
- channel darter (*Percina copelandi*)
- river darter (*Percina shumardi*)
- sauger (*Sander canadensis*)

AMPHIBIANS
- mudpuppy (*Necturus maculosus maculosus*)

REPTILES
- eastern fox snake (*Elaphe gloydi*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Decreased variation in water levels; lower water levels
- Climate change: Global warming
- Fragmentation: Dredging- alters habitat, increases boat traffic, fragments habitat

POLLUTION
- Altered nutrient inflows: Water quality – Dissolved oxygen issues (low threat)
- Altered sediment loads: Water quality – turbidity, sediment starvation- diminished natural sedimentation because of upstream dams (low threat)

HABITAT CONVERSION
- Dredging and channelization: Dredging - alters habitat, increases boat traffic, fragments habitat; navigational dredging - new channel; Aquatic navigation expansion - bigger ships, system of locks, etc
- Riparian modification: Alteration of shoreline - seawall construction, fill, shoreline development; hardening of shoreline; and recreational boating wakes

BIOLOGICAL INTERACTIONS
- Invasive plants and animals: Especially *Phragmites*, zebra mussels, round gobies – these species present a tremendous threat to native mussels and native fish; Sea lamprey

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Macrophyte removal: Mowing emergent vegetation, weed control (low threat)
- Recreational vehicles: ATV, jet ski (low threat on Lake Erie, high threat on Lake St. Clair)

EDUCATION
- Lack of scientific knowledge: Lack of information on habitat types and extent, and aquatic organism communities
- Social attitudes: Lack of education to understand importance of natural shoreline

Conservation Actions Needed (Threats addressed)

LAND & WATER PROTECTION
- Expanding conservation easement programs (altered hydrologic regimes, dredging and channelization, riparian modification)

LAND, WATER & SPECIES MANAGEMENT

- Continued vigilance and cooperation on preventing invasive species establishments (invasive plants and animals, social attitudes)
- Improve access to spawning and nursery habitats in rivers and coastal wetlands (fragmentation, species in general)
- Rehabilitate natural hydrological processes along the Lake Erie shoreline including softening shorelines(altered hydrologic regimes, dredging and channelization, macrophyte removal, social attitudes)
- Rehabilitate submerged macrophyte communities in estuaries and embayments (macrophyte removal)

LAW & POLICY

- Removal of exotic vegetation needs to preserve 60-80% of native vegetation (invasive plants and animals)
- Work with local officials to develop planning and zoning guidelines that consider natural processes and softened shorelines (altered natural flow, altered sediment loads, macrophyte removal, riparian modification)

EDUCATION & AWARENESS

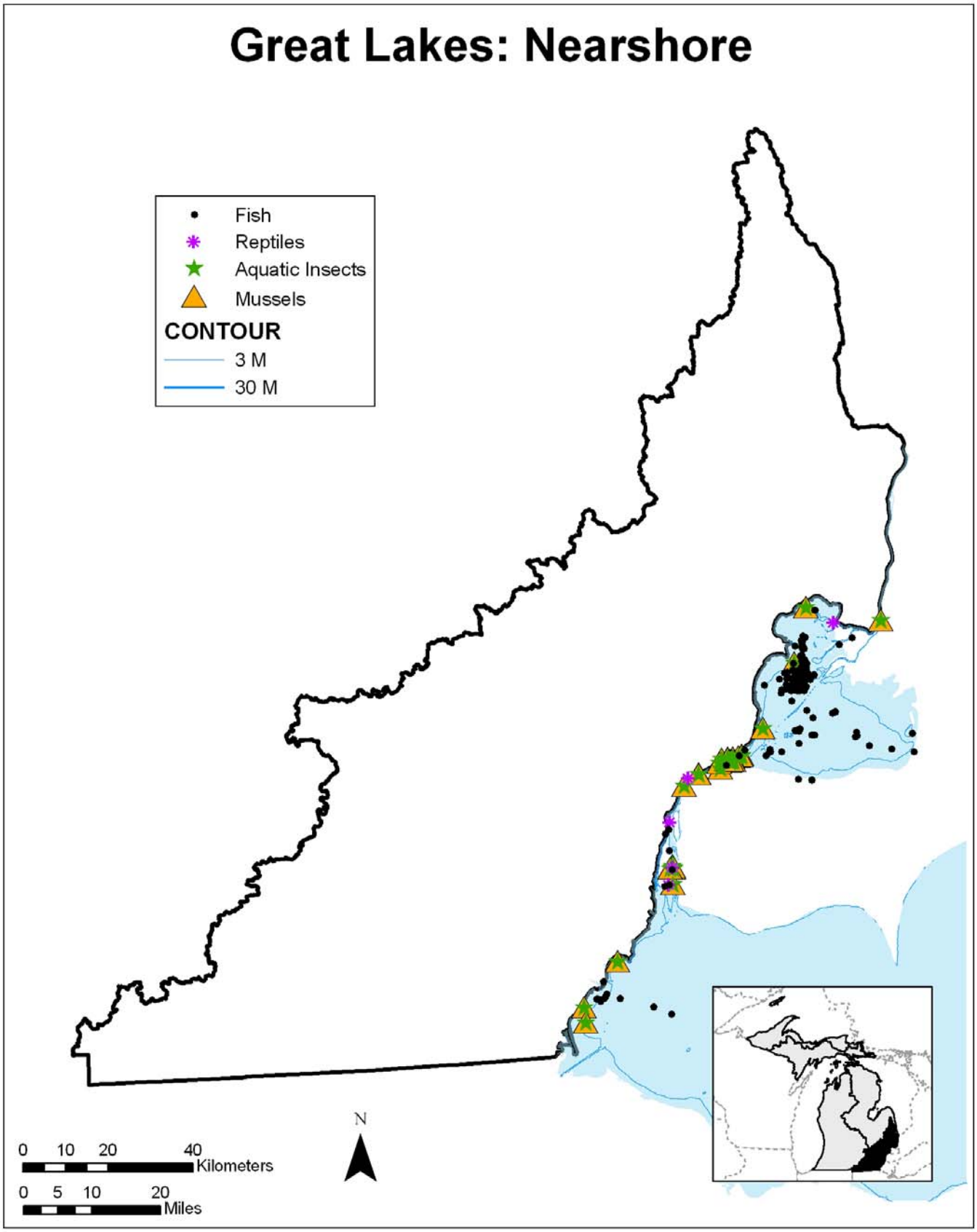
- Expand the education programs for the general public regarding natural processes, invasive species, hydrologic cycles, and stewardship issues (altered hydrologic regimes, altered nutrient inflows, invasive plants and animals, fragmentation, macrophyte removal, riparian modification, social attitudes)

Research and Survey Needs

- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Classify all Lake Erie, Lake St. Clair, and Detroit and St. Clair rivers shoreline
- Continue interactive governmental decision making from local to international levels
- Determine aquatic community interactions (i.e., food webs, changing species community, genetic affects of non-indigenous species on locally adapted species, etc.)
- Model hydrology of Lake Erie and Lake St. Clair tributaries
- Survey shoreline and inventory aquatic species and physical features of this landscape feature
- Survey shoreline areas to determine relationship between cumulative shoreline armoring at a landscape scale
- Survey social attitudes and determine effective communication approaches
- Determine unknown species life history and habitat requirements
- Continue interagency cooperation on invasive species prevention, control, and rapid response

Monitoring

- Effluent discharges to Lake Erie and its tributaries: wastewater treatment plants, septic systems, industrial
- Lake Erie and Lake St. Clair tributary water flows and levels
- Riparian modification


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

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.

General Condition of Feature

Lake Erie near shore areas are considered 40 % in good to excellent condition, 25% in fair condition, and 35% degraded to very degraded.

Associated Species of Greatest Conservation Need

MUSSELS

Specific associations with this landscape feature were not found in the literature

FISH

lake sturgeon (*Acipenser fulvescens*)
mooneye (*Hiodon tergisus*)
brassy minnow (*Hybognathus hankinsoni*)
silver chub (*Macrhybopsis storeriana*)
black buffalo (*Ictiobus niger*)
spotted sucker (*Minytrema melanops*)
stonecat (*Noturus flavus*)

FISH cont.

tadpole madtom (*Noturus gyrinus*)
brindled madtom (*Noturus miurus*)
cisco or lake herring (*Coregonus artedi*)
eastern sand darter (*Ammocrypta pellucida*)
channel darter (*Percina copelandi*)
river darter (*Percina shumardi*)
sauger (*Sander canadensis*)

AMPHIBIANS

mudpuppy (*Necturus maculosus maculosus*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES

- Climate change: (low threat)

POLLUTION

- Altered nutrient inflows: Water quality – Dissolved oxygen issues (low threat)
- Altered sediment loads: Water quality - turbidity (low threat)
- Pesticides and herbicides: Contaminated sediments (low threat)
- Urban, municipal, and industrial pollution: (low threat)

HABITAT CONVERSION

- Dredging and channelization: Dumping dredge spoil; Open water disposal; Combined disposal facility (CDF) placement; Expanded commercial navigation

BIOLOGICAL INTERACTIONS

- Invasive plants and animals: Zebra mussels, Quagga mussels; Round gobies; Sea lamprey

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE

- Non-consumptive recreation: Extra wave energy from recreational boating

EDUCATION

- Social attitudes: Lack of understanding by riparian owners; Level of societal education of aquatic issues- how much do people understand and how will they vote for environmental issues

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT

- Avoid open water disposal of uncontaminated materials (dredging and channelization)
- Continued vigilance and cooperation on preventing more aquatic invasive species establishments (invasive plants and animals)
- Facilitate the shift from a transient food web dominated by exotic species to one dominated by native species (invasive plants and animals)

LAW & POLICY

- Continue and expand enforcement of permits regulating effluent discharge (altered nutrient inflows, Urban, municipal, and industrial pollution)
- Continue working with ACOE to limit dredging to agreed upon windows to protect spawning aquatic species (dredging and channelization)

EDUCATION & AWARENESS

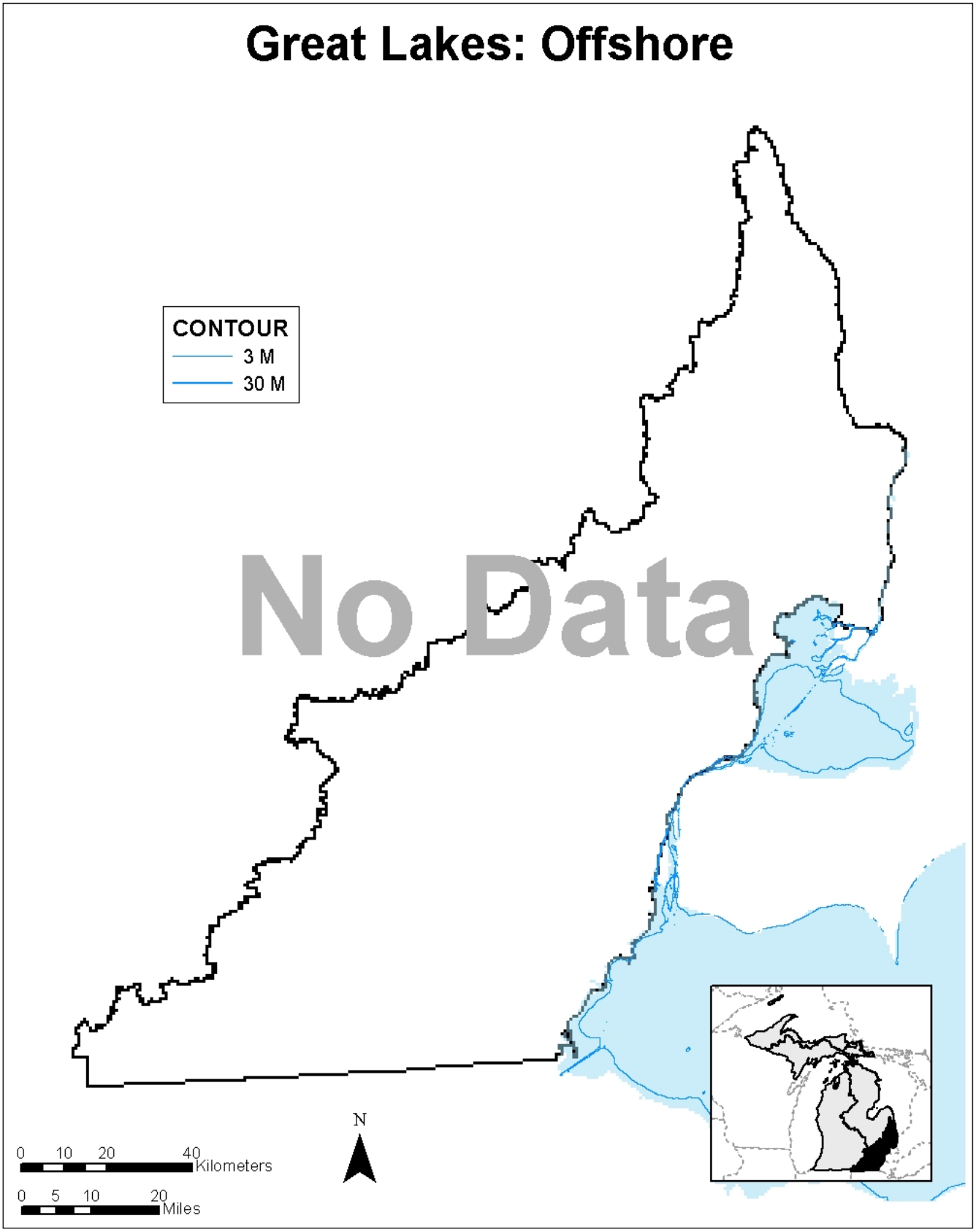
- Expand the education programs for the general public regarding natural processes, invasive species, hydrologic cycles, and stewardship issues (altered hydrologic regimes, altered nutrient inflows, invasive plants and animals, social attitudes)

Research and Survey Needs

- Investigate affects of invasive species on the native and naturalized aquatic community
- Determine ballast control practices that reduce or eliminate invasive species (from virus up through fish)
- Continue to work with GLFC Lake Erie Technical Advisory Group implementing fish-community objectives
- Continue interagency cooperation on invasive species prevention and control
- Establish baseline estimates of *Dreissena* abundance
- Investigate methods to monitor and control current established aquatic invasive species
- Model habitat dynamics and species relationships and linkages to better understand community dynamics

Monitoring

- Continue monitoring lake sturgeon and lake herring populations to prevent extinction
- Continue monitoring summer water transparencies to ensure they remain in the 3-5 m range
- Expand monitoring of the lower trophic levels to track changes in the food web and contaminant uptake
- Monitor phosphorus levels to attain 10-20 ug L-1


Great Lakes: Offshore
CONTOUR
3 M
30 M
No Data
N
0 10 20 40 Kilometers
0 5 10 20 Miles

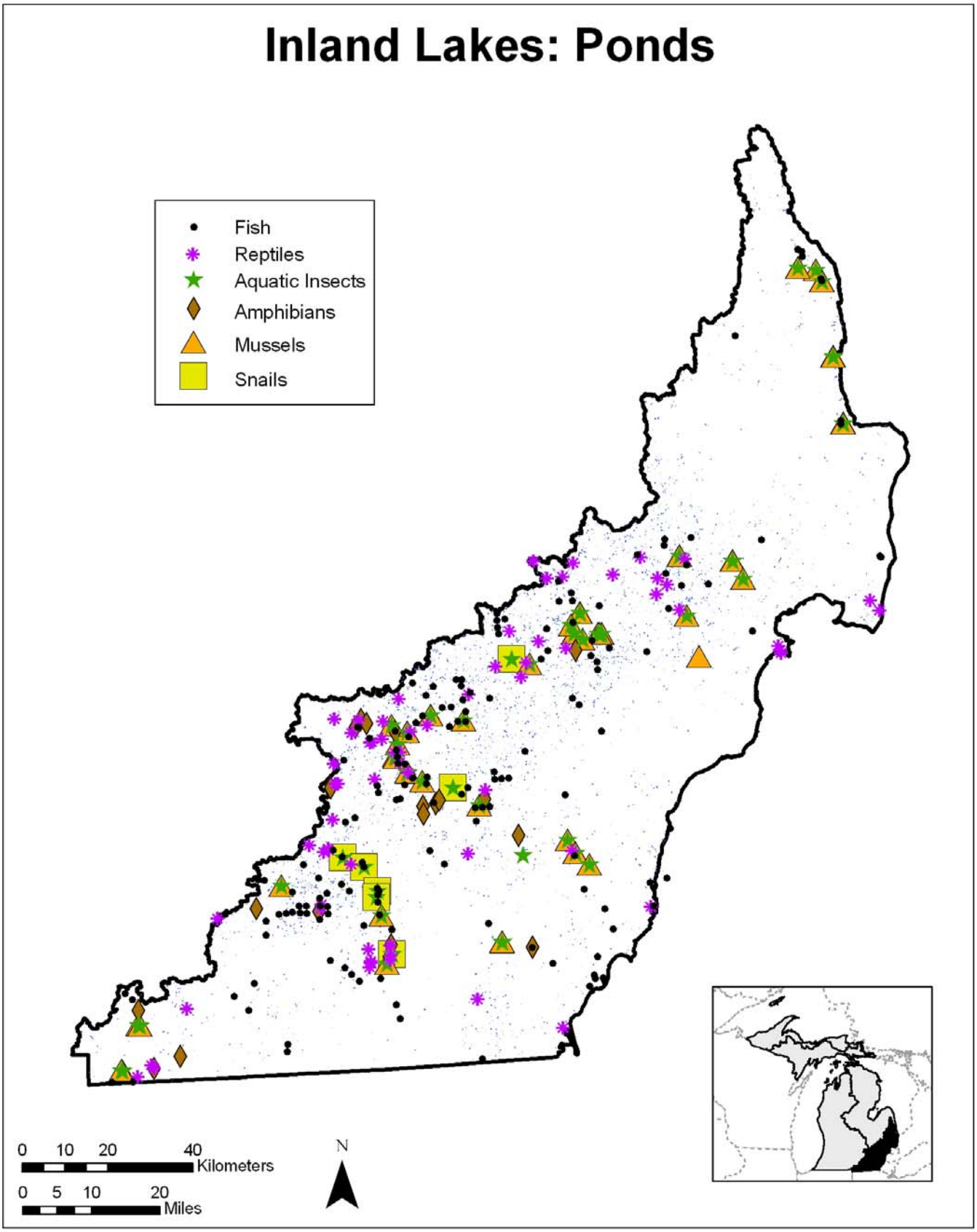
Great Lakes: Offshore

Description

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

General Condition of Feature

No offshore habitat in the Michigan waters of Lake Erie.


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

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.

General Condition of Feature

This habitat is considered 30% in good to excellent condition, 30 % in fair condition, and 40% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
- cylindrical papershell (*Anodontoides ferussacianus*)
- eastern pondmussel (*Ligumia nasuta*)
- lilliput (*Toxolasma parvus*)

SNAILS
- spindle lymnaea (*Acella haldemani*)

CRAYFISH
- devil crawfish (*Cambarus diogenes*)
- digger crayfish (*Fallicambarus fodiens*)

INSECTS
- spatterdock darner (*Aeshna mutata*)
- Cantrall's bog beetle (*Liodessus cantralli*)

FISH
- finescale dace (*Phoxinus neogaeus*)
- brown bullhead (*Ameiurus nebulosus*)
- tadpole madtom (*Noturus gyrinus*)
- grass pickerel (*Esox americanus*)
- pirate perch (*Aphredoderus sayanus*)
- least darter (*Etheostoma microperca*)

AMPHIBIANS
- spotted salamander (*Ambystoma maculatum*)
- smallmouth salamander (*Ambystoma texanum*)
- eastern tiger salamander (*Ambystoma tigrinum tigrinum*)
- four-toed salamander (*Hemidactylium scutatum*)
- Fowler's toad (*Bufo fowleri*)
- Blanchard's cricket frog (*Acris crepitans blanchardi*)
- western chorus frog (*Pseudacris triseriata triseriata*)
- pickerel frog (*Rana palustris*)
- northern leopard frog (*Rana pipiens*)

REPTILES
- copperbelly water snake (*Nerodia erythrogaster neglecta*)
- queen snake (*Regina septemvittata*)
- spotted turtle (*Clemmys guttata*)
- Blanding's turtle (*Emydoidea blandingii*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Water fluctuations - groundwater levels (especially fens, vernal ponds, and especially in spring + early summer); changing the surrounding land surge (water levels, runoff); Conversion to retention and detention
- Fragmentation

POLLUTION
- Altered nutrient inflows: Changing the surrounding land surge (runoff, nutrients); Eutrophication - chemical conditions
- Altered sediment loads
- Pesticides and herbicides: (low threat)
- Urban, municipal, and industrial pollution: Dumping toxics, oils, etc.

HABITAT CONVERSION
- Dams
- Dredging and channelization
- Riparian modification: Alteration of shoreline; Clearing
- Wetland modification: Draining and filling - loss of habitat; The main threat to this feature would be filling for sub-urban development

BIOLOGICAL INTERACTIONS
- Invasive plants and animals: Especially loosestrife; Fish introductions into fishless systems; Predator introductions into predatorless systems

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Macrophyte removal: Vegetation control through mowing or chemical treatments

EDUCATION

- Lack of scientific knowledge: Lack of data on small ponds
- Social attitudes: Lack of education for public to understand value of small ponds

Conservation Actions Needed (Threats addressed)

LAND & WATER PROTECTION

- Create and expand conservation easements (variety of threats)
- Support land conservancy purchase of undeveloped land (variety of threats)

LAND, WATER & SPECIES MANAGEMENT

- Allow seasonal flooding (altered hydrologic regimes)
- Control and prevent aquatic invasive species (invasive plants and animals)
- Encourage use of natural materials or soft engineering techniques for any shoreline modification (riparian modification)
- Maintain or rehabilitate natural corridors between significant pond habitats and upland areas (fragmentation)
- Maintain or establish riparian buffers to at least 50 ft. (altered hydrologic regimes, altered sediment loads, riparian modification)
- Remove dams to rehabilitate natural connections between ponds and streams (altered hydrologic regimes, dams, fragmentation)

LAW & POLICY

- Protect the public trust by requiring dam owners to make appropriate financial provision for future dam removal (dams)
- Work with planners and developers to make sound landscape decisions when development is to occur (altered hydrologic regimes, altered sediment loads, riparian modification, wetland modification)
- Encourage clustered development rather than evenly spaced home lots (riparian modification)
- No dredging during spawning or migration seasons (dredging and channelization)
- When dams cannot be removed incorporate mechanisms to provide for release of water to mimic natural flows (altered hydrologic regimes)
- Encourage sound water withdrawal practices that take into account biotic species needs (altered hydrologic regimes)
- Work with law enforcement and local officials to prevent unauthorized land use changes (riparian modification)
- Encourage green-space planning (riparian modification)

EDUCATION & AWARENESS

- Educate private landowners on the value of riparian areas (altered hydrologic regimes, altered sediment loads, riparian modification)
- Educate legislators, local planning boards, and other policy makers on the importance of natural processes (all threats)
- Educate the public on prevention and control of aquatic invasive species and the affects of disturbance on the spread of aquatic invasive species (invasive plants and animals)

CAPACITY BUILDING

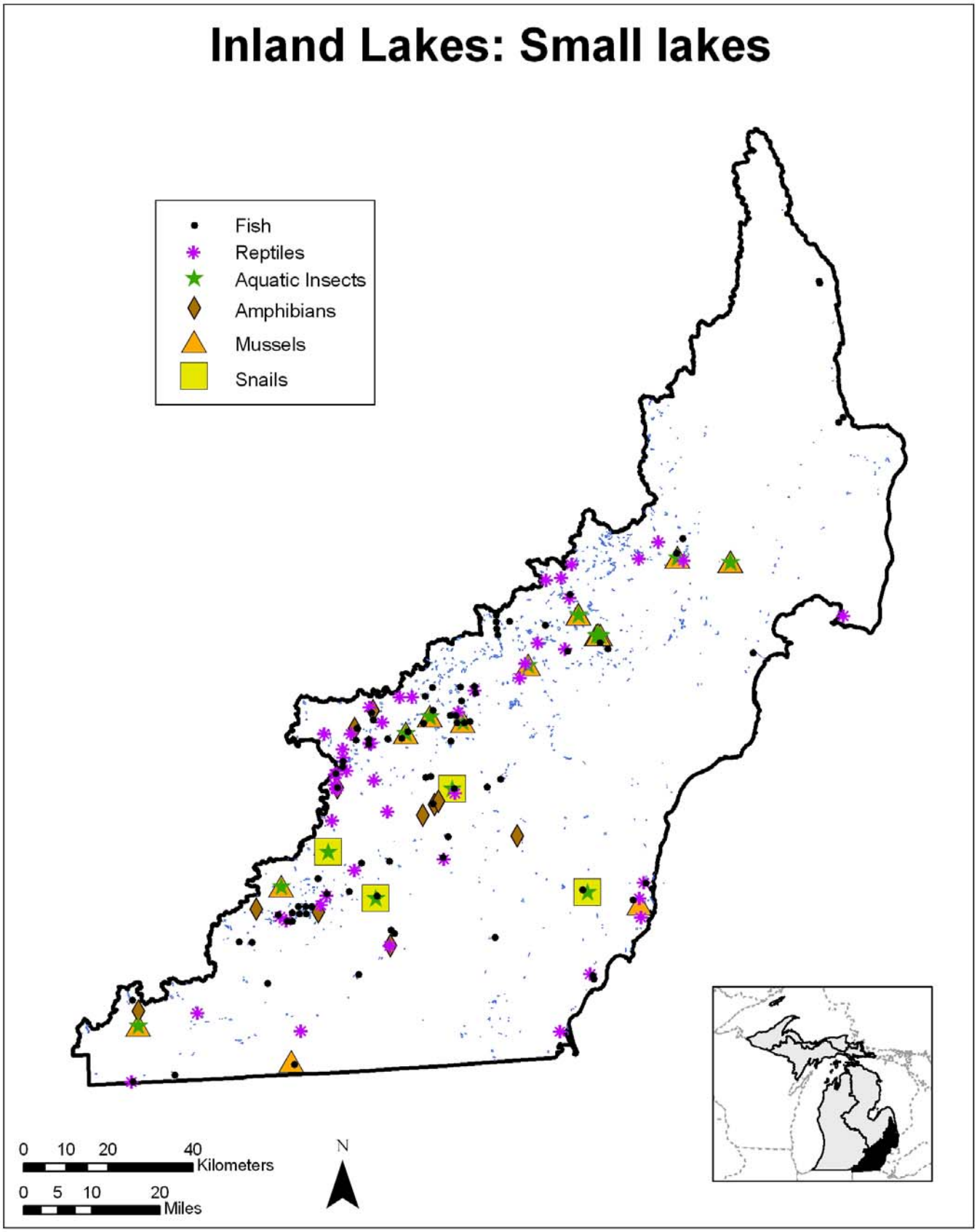
- Support watershed councils, regional conservation groups, and other local conservation groups (social attitudes)

Research and Survey Needs

- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Determine life history requirements for SGCN associated with this landscape feature
- Determine effective methods of communicating with the public the role they play in stewardship
- Research the affects of landscape alterations on pond processes
- Quantify the number of dams that are present on ponds

Monitoring

- Assess education efforts to inform citizens of good stewardship practices
- Indicator species
- Hydrologic outflows from dams
- Land use changes
- Riparian modification


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

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.

General Condition of Feature

This habitat is considered 30% in good to excellent condition, 30% in fair condition, and 40% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
- slippershell mussel (*Alasmidonta viridis*)
- rainbow (*Villosa iris*)
- cylindrical papershell (*Anodontoides ferussacianus*)
- eastern pondmussel (*Ligumia nasuta*)
- lilliput (*Toxolasma parvus*)
- rayed bean (*Villosa fabalis*)

SNAILS
- spindle lymnaea (*Acella haldemani*)

INSECTS
- spatterdock darner (*Aeshna mutata*)

FISH
- pugnose shiner (*Notropis anogenus*)
- pugnose minnow (*Opsopoeodus emiliae*)
- finescale dace (*Phoxinus neogaeus*)
- lake chubsucker (*Erimyzon sucetta*)
- brown bullhead (*Ameiurus nebulosus*)

FISH cont.
- tadpole madtom (*Noturus gyrinus*)
- brindled madtom (*Noturus miurus*)
- grass pickerel (*Esox americanus*)
- eastern sand darter (*Ammocrypta pellucida*)
- least darter (*Etheostoma microperca*)

AMPHIBIANS
- mudpuppy (*Necturus maculosus maculosus*)
- Fowler's toad (*Bufo fowleri*)
- Blanchard's cricket frog (*Acris crepitans blanchardi*)
- pickerel frog (*Rana palustris*)
- northern leopard frog (*Rana pipiens*)

REPTILES
- copperbelly water snake (*Nerodia erythrogaster neglecta*)
- queen snake (*Regina septemvittata*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Lake level control structures, dams
- Climate change

POLLUTION
- Altered nutrient inflows: Surface water runoff – nutrients; run-off from fertilizers
- Altered sediment loads
- Pesticides herbicides: Runoff, fertilizer, etc (low threat)
- Thermal changes
- Urban, municipal, and industrial pollution: Surface water runoff - contaminants

HABITAT CONVERSION
- Dams: Lake level manipulations
- Dredging and channelization: Dredging
- Riparian modification: Lack of woody debris; Alteration of shoreline; Clearing of shoreline for beach areas

BIOLOGICAL INTERACTIONS
- Disease, pathogens, and parasites: (low threat)
- Invasive plants and animals: Zebra mussels, round gobies, water milfoil

CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Removal of wildlife: Over harvesting of species such as turtles

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Macrophyte removal: Vegetation control through mowing or chemical treatments
- Non-consumptive recreation: Recreational boating - wave energy and ramp damage

EDUCATION

- Other: Lack of knowledge about these ecosystems
- Social attitudes: Lack of aquatic resource education on the importance of this habitat

Conservation Actions Needed (Threats addressed)

LAND & WATER PROTECTION

- Create and expand conservation easements (variety of threats)
- Support land conservancy purchase of undeveloped land (variety of threats)

LAND, WATER & SPECIES MANAGEMENT

- Allow seasonal flooding (altered hydrologic regimes)
- Control aquatic invasive species (invasive plants and animals)
- Maintain or establish riparian buffers to at least 50 ft. (riparian modification)
- Modify remaining lake-level control structures to mimic the natural hydrologic regime (altered hydrologic regimes)
- Removal of exotic vegetation needs to preserve 60-80% of native vegetation (invasive plants and animals, macrophyte removal)
- Remove lake-level control structures where possible (altered hydrologic regimes)
- Rehabilitate native flora (invasive plants and animals, macrophyte removal, riparian modification)
- Use soft engineering instead of hard structures for shoreline modification (riparian modification)
- Vegetation management should be preformed in conjunction with a lake management plan (macrophyte removal)
- Work with Drain Commissioners to allow or closely mimic natural hydrologic processes (altered hydrologic regimes)

LAW & POLICY

- Restrict beach grooming (macrophyte removal)
- Enact and enforce shoreline protection (riparian modification)
- Encourage clustered developments rather than evenly spaced home lots (riparian modification)
- Strengthen water quality laws and continue enforcing permits that control effluent discharge (Urban, municipal, and industrial pollution)
- Upgrade and maintain septic systems (altered nutrient inflows, Urban, municipal, and industrial pollution)
- Work with local officials on setback and buffer ordinances (riparian modification)
- Work with local officials to develop planning and zoning guidelines that consider natural processes (altered hydrologic regimes, altered sediment loads, riparian modification)

EDUCATION & AWARENESS

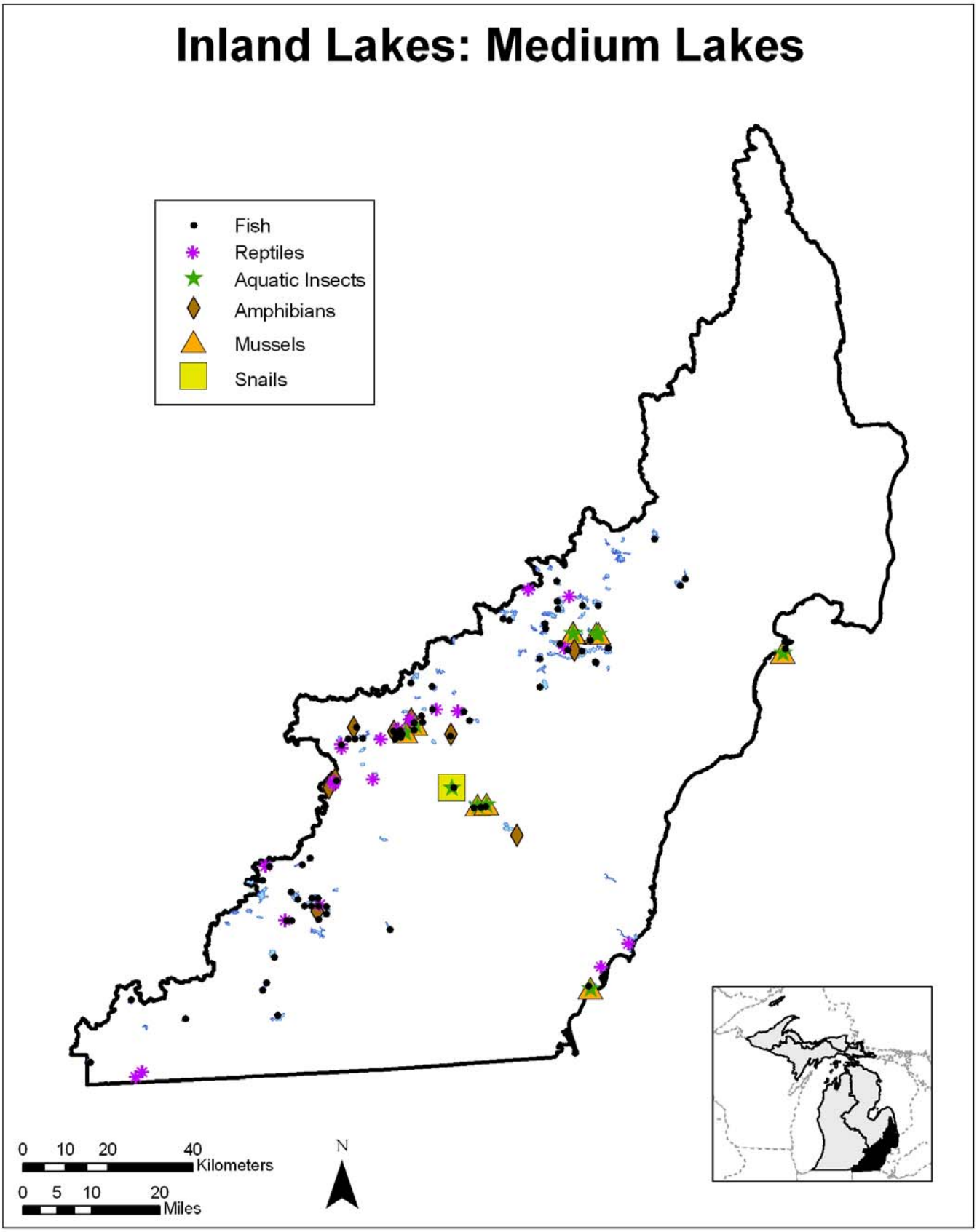
- Educate legislators, local planning boards, and other policy makers on the importance of natural processes (social attitudes)
- Educate the public on the prevention and control of aquatic invasive species (invasive plants and animals, social attitudes)
- Expand education programs for the general public regarding natural processes, invasive species, hydrologic cycles, riparian buffers, and stewardship issues (social attitudes)

Research and Survey Needs

- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Determine life history requirements for SGCN associated with small lakes
- Determine the number and method of operation of lake-level control structures
- Determine effects of over zealous macrophyte removal on native vegetation and species communities
- Determine effects of various pollutants on small lakes and their processes
- Determine socially acceptable ways of maintaining natural lake inflows and outlets

Monitoring

- Aquatic invasive species
- Indicator species
- Effluent discharges: waste water treatment plants, septic systems, industrial
- Macrophyte removals
- Riparian modification
- Water levels downstream of water-level controlled lakes to ensure that streams continue to have sufficient water
- Water levels in water-level controlled lakes to ensure they mimic natural hydrologic regimes within lake


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

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.

General Condition of Feature

This habitat is considered 40% in good to excellent condition, 25% in fair condition, and 35% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
- slippershell mussel (*Alasmidonta viridis*)
- rainbow (*Villosa iris*)
- eastern pondmussel (*Ligumia nasuta*)
- threehorn wartyback (*Obliquaria reflexa*)
- kidneyshell (*Ptychobranchus fasciolaris*)
- fawnsfoot (*Truncilla donaciformis*)
- rayed bean (*Villosa fabalis*)

SNAILS
- spindle lymnaea (*Acella haldemani*)

AQUATIC INSECTS
- Specific associations with this landscape feature were not found in the literature

FISH
- pugnose shiner (*Notropis anogenus*)
- pugnose minnow (*Opsopoeodus emiliae*)

FISH cont.
- lake chubsucker (*Erimyzon sucetta*)
- river redhorse (*Moxostoma carinatum*)
- brown bullhead (*Ameiurus nebulosus*)
- tadpole madtom (*Noturus gyrinus*)
- brindled madtom (*Noturus miurus*)
- cisco or lake herring (*Coregonus artedi*)
- eastern sand darter (*Ammocrypta pellucida*)
- least darter (*Etheostoma microperca*)

AMPHIBIANS
- mudpuppy (*Necturus maculosus maculosus*)
- Fowler's toad (*Bufo fowleri*)
- Blanchard's cricket frog (*Acris crepitans blanchardi*)
- pickerel frog (*Rana palustris*)

REPTILES
- Blanding's turtle (*Emydoidea blandingii*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Lake level manipulations; Surface water runoff changes due to riparian modification
- Climate change: (low threat)

POLLUTION
- Altered nutrient inflows: Surface water runoff – nutrients
- Altered sediment loads: (low threat)
- Pesticides and herbicides: Fertilizers; herbicides
- Thermal changes: (low threat)
- Urban, municipal, and industrial pollution: Surface water runoffs - contaminants

HABITAT CONVERSION
- Dredging and channelization: Dredging (low threat)
- Riparian modification: Lack of woody debris; Alteration of shoreline; Shoreline development; Shoreline hardening

BIOLOGICAL INTERACTIONS
- Disease, pathogens, and parasites
- Invasive plants and animals: Zebra mussels; Others

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Macrophyte removal: Vegetation control through mowing and chemical treatments
- Non-consumptive recreation: Recreational boating- wave energy - prop damage

EDUCATION
- Social attitudes: Lack of public education to understand value of lakes and conditions needed for a healthy system.

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT

- Allow seasonal flooding (altered hydrologic regimes)
- Control and prevent aquatic invasive species (invasive plants and animals)
- Maintain or establish riparian buffers to at least 50 ft. (riparian modification)
- Modify remaining lake-level control structures to mimic the natural hydrologic regime (altered hydrologic regimes, dams)
- Removal of exotic vegetation needs to preserve 60-80% of native vegetation (invasive plants and animals, macrophyte removal)
- Remove lake-level control structures and dams where possible (altered hydrologic regimes, altered sediment loads, dams)
- Rehabilitate native flora (invasive plants and animals, macrophyte removal, riparian modification)
- Use soft engineering instead of hard structures for shoreline modification (riparian modification)
- Vegetation management should only be preformed in conjunction with a lake management plan (macrophyte removal)

LAW & POLICY

- Restrict beach grooming (macrophyte removal)
- Enact and enforce shoreline protection (riparian modification)
- Encourage clustered developments rather than evenly spaced home lots (riparian modification)
- Protect the public trust by requiring dam owners to make appropriate financial provision for future dam removal (dams)
- Work with Drain Commissioners to allow or closely mimic natural hydrologic processes on legally controlled lake-level control structures (altered hydrologic regimes)
- Work with local officials on setback and buffer ordnances (riparian modification)
- Work with local officials to develop planning and zoning guidelines that consider natural processes (riparian modification)

EDUCATION & AWARENESS

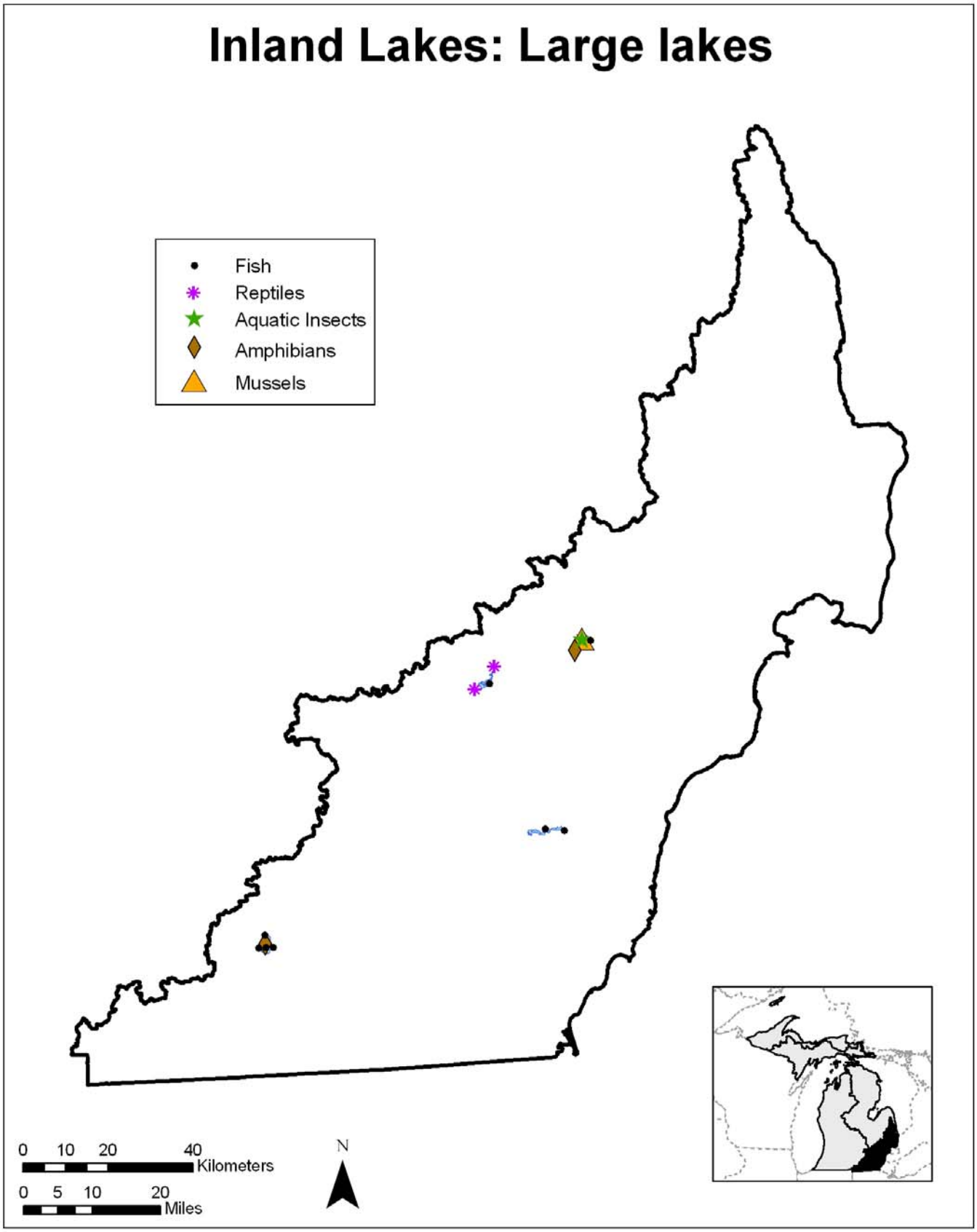
- Educate legislators, local planning boards, and other policy makers on the importance of natural processes (social attitudes)
- Educate private landowners on the value of riparian areas (riparian modification, social attitudes)
- Educate the public on the prevention and control of aquatic invasive species (invasive plants and animals, social attitudes)
- Expand education programs for the general public regarding natural processes, invasive plants and animals, hydrologic cycles, and stewardship issues (social attitudes)

Research and Survey Needs

- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Determine SGCN aquatic insect use of medium lakes
- Determine life history requirements for SGCN associated with medium lakes
- Determine the number and method of operation of lake-level control structures
- Determine effects of over zealous macrophyte removal on native vegetation and species communities
- Determine socially acceptable ways of maintaining natural lake inflows and outlets
- Work with watershed councils and other local groups on identification skills and habitat restoration techniques

Monitoring

- Aquatic invasive species
- Indicator species
- Effluent discharges: waste water treatment plants, septic systems, industrial
- Macrophyte removals
- Riparian modification
- Water levels downstream of water-level controlled lakes to ensure that streams continue to have sufficient water
- Water levels in water-level controlled lakes to ensure they mimic natural hydrologic regimes within lake


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

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.

General Condition of Feature

This habitat is considered 40% in good to excellent condition, 20% in fair condition, and 40% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
- rainbow (*Villosa iris*)
- pimpleback (*Quadrula pustulosa*)
- eastern pondmussel (*Ligumia nasuta*)
- black sandshell (*Ligumia recta*)
- threehorn wartyback (*Obliquaria reflexa*)
- round hickorynut (*Obovaria subrotunda*)
- kidneyshell (*Ptychobranchus fasciolaris*)
- fawnsfoot (*Truncilla donaciformis*)

INSECTS
- elusive snaketail (*Stylurus notatus*)

FISH
- pugnose minnow (*Opsopoeodus emiliae*)
- black buffalo (*Ictiobus niger*)
- river redhorse (*Moxostoma carinatum*)

FISH cont.
- brown bullhead (*Ameiurus nebulosus*)
- stonecat (*Noturus flavus*)
- tadpole madtom (*Noturus gyrinus*)
- brindled madtom (*Noturus miurus*)
- cisco or lake herring (*Coregonus artedi*)
- eastern sand darter (*Ammocrypta pellucida*)
- sauger (*Sander canadensis*)

AMPHIBIANS
- mudpuppy (*Necturus maculosus maculosus*)
- Fowler's toad (*Bufo fowleri*)

REPTILES
- Specific associations with this landscape feature were not found in the literature

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Lake level modification
- Fragmentation

POLLUTION
- Altered nutrient inflows: Surface water runoff - nutrients
- Altered sediment loads: Sedimentation
- Thermal changes
- Urban, municipal, and industrial pollution: Surface water runoff – contaminants

HABITAT CONVERSION
- Dredging and channelization: Dredging
- Riparian modification: Alteration of shoreline; Lack of woody debris

BIOLOGICAL INTERACTIONS
- Disease, pathogens, and parasites: (low threat)
- Invasive plants and animals: Zebra mussels; Gobies; Loosestrife; Milfoil

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Macrophyte removal: Vegetation control through mowing or chemicals
- Non-consumptive recreation: Recreational boating - wave energy (low threat)

EDUCATION
- Social attitudes: Lack of public education to understand value of lakes and conditions needed for a healthy system.

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Control and prevent aquatic invasive species (invasive plants and animals)
- Work with road commissions on placement and maintenance of stream crossings (altered sediment loads)
- Maintain or establish riparian buffers to at least 50 ft. (altered hydrologic regimes, altered sediment loads, riparian modification)
- Removal of exotic vegetation needs to preserve 60-80% of native vegetation (macrophyte removal, invasive plants and animals)

- Rehabilitate native flora (macrophyte removal, riparian modification)
- Use soft engineering instead of hard structures for shoreline modification (riparian modification)
- Vegetation management should only be preformed in conjunction with a lake management plan (macrophyte removal)

LAW & POLICY

- Restrict beach grooming (macrophyte removal)
- Enact and enforce shoreline protection (riparian modification)
- Encourage clustered developments rather than evenly spaced home lots (riparian modification)
- Work with local officials on setback and buffer ordnances (riparian modification)
- Work with local officials to develop planning and zoning guidelines that consider natural processes (riparian modification)

EDUCATION & AWARENESS

- Educate legislators, local planning boards, and other policy makers on the importance of natural processes (social attitudes)
- Educate private landowners on the value of riparian areas (riparian modification, social attitudes)
- Educate the public on the prevention, control, and effect of aquatic invasive species (invasive plants and animals, social attitudes)
- Expand education programs for the general public regarding natural processes, invasive species, hydrologic cycles, and stewardship issues (social attitudes)

Research and Survey Needs

- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Determine SGCN reptile use of large lakes
- Determine unknown life history requirements for SGCN associated with large lakes
- Determine the number and method of operation of lake-level control structures
- Determine effects of over zealous macrophyte removal on native vegetation and species communities
- Determine socially acceptable ways of maintaining natural lake inflows and outlets
- Work with watershed council and other local groups on identification skills and habitat restoration techniques

Monitoring

- Effluent discharges: waste water treatment plants, septic systems, industrial
- Indicator species
- Macrophyte removals
- Movement and introduction of aquatic invasive species
- Public attitudes and perceptions
- Riparian modification
- Water levels downstream of water-level controlled lakes to ensure that streams continue to have sufficient water
- Water levels in water-level controlled lakes to ensure they mimic natural hydrologic regimes with lakes

Lake Characteristic:
Wave-Washed Shore
No Data
0 10 20 40 Kilometers
0 5 10 20 Miles
N

Lake Characteristic: Wave-Washed Shore

Description

Wave-washed shores are areas of lakes with constant wind-generated wave energy in relatively shallow water with natural substrates and with the absence of human altered shorelines. These areas are found primarily in the Great Lakes and large inland lakes.

General Condition of Feature

This habitat is considered 30% in good to excellent condition, 30% in fair condition, and 40% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

FISH

lake sturgeon (*Acipenser fulvescens*)
eastern sand darter (*Ammocrypta pellucida*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES

- Altered hydrologic regimes: Impervious surface - more than anywhere else in the State; Factors affecting water levels and hydrodynamics - wave action, shears, etc. (low threat)

POLLUTION

- Altered nutrient inflows: Surface water runoff – nutrients
- Altered sediment loads: Sedimentation of fines (low threat)
- Urban, municipal, and industrial pollution: Surface water runoff - contaminants

HABITAT CONVERSION

- Dams: (low threat)
- Dredging and channelization: Very prevalent in basin more than anywhere else
- Riparian modification: Filling; Hard shore engineering; Altered shoreline – break walls, etc.

BIOLOGICAL INTERACTIONS

- Invasive plants and animals: Phragmites has been replacing cattails; Other exotics

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE

- Non-consumptive recreation: Recreational boating - wave energy

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT

- Control and prevent aquatic invasive species (invasive plants and animals)
- Preserve woody riparian vegetation (riparian modification)
- Soften or remove hard shoreline structures (riparian modification)
- Use alternatives to dredging to achieve the same results (dredging and channelization)
- Use natural materials or soft engineering techniques for shoreline modification (riparian modification)

LAW & POLICY

- Encourage clustered housing developments rather than evenly spaced home lots (riparian modification)
- Manage boating use to reduce wave and wave effects (non-consumptive recreation)
- No open water disposal of uncontaminated dredge spoils (dredging and channelization)
- Require use of Best management practices (altered hydrologic regimes, altered sediment loads, riparian modification)
- Restrict beach grooming (riparian modification)
- Restrict dredging, especially during spawning and migration seasons (dredging and channelization)
- Work with local governments to develop planning and zoning regulations and ordinances (riparian modification)
- Work with local officials on setback and buffer ordinances (riparian modification)

EDUCATION & AWARENESS

- Educate the public on natural hydrologic cycles (social attitudes)

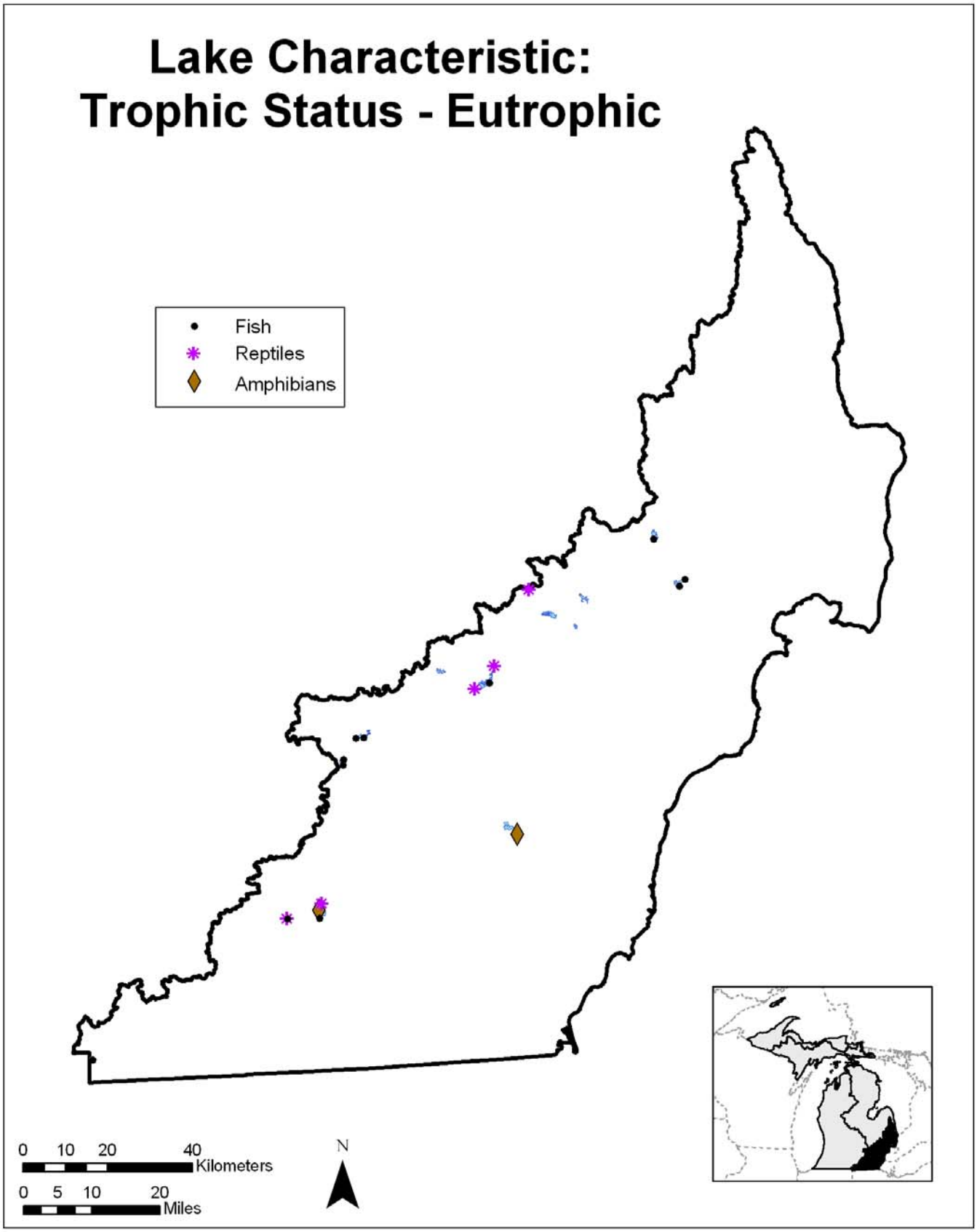
Research and Survey Needs

- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Determine the extent of hard shoreline modification
- Document effective methods of communication with the public and their stewardship role
- Assess effects of jet skis on spawning and migrating aquatic species

Monitoring

- Aquatic invasive species

- Effectiveness of local ordnances
- Jet ski use
- Shoreline modification (dredging, shoreline structures, etc.)
- Use of Best management practices


Lake Characteristic:
Trophic Status - Eutrophic
Fish
Reptiles
Amphibians
0 10 20 40
Kilometers
0 5 10 20
Miles
N

Lake Characteristic: Trophic Status – Eutrophic

Description

Eutrophic lakes have high concentrations of nutrients (total phosphorus >25 µg/L) resulting in generally high biomass of algae. They also generally have lower water clarity and potentially low oxygen concentrations in the hypolimnion. They are more likely to have low winter oxygen concentrations under the ice depending on lake depth and basin shape.

General Condition of Feature

This habitat is considered 30% in good to excellent condition, 30% in fair condition, and 40% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
Specific associations with this landscape feature were not found in the literature

SNAILS
spindle lymnaea (*Acella haldemani*)

INSECTS
Specific associations with this landscape feature were not found in the literature

FISH
Specific associations with this landscape feature were not found in the literature

AMPHIBIANS
Specific associations with this landscape feature were not found in the literature

REPTILES
Blanding's turtle (*Emydoidea blandingii*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Runoff rates increase due to development
- Climate change

POLLUTION
- Altered nutrient inflows: Fertilizer- increase eutrophication rate and influence status; Runoff from impervious surfaces; Surface runoff - extra nutrients; Eutrophic systems may be increasing due to nutrient loading
- Urban, municipal, and industrial pollution: Surface runoff - contaminants

HABITAT CONVERSION
- Riparian modification: If considerable surrounding forest, its removal or modification may accelerate lake ontology (low threat)
- Wetland modification

BIOLOGICAL INTERACTIONS
- Invasive plants and animals

CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Removal of wildlife: May be some removal of Blanding's turtles for pet trade and uninformed public (low threat)

EDUCATION
- Lack of scientific knowledge: (low threat)
- Social attitudes: (low threat)

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- When removing exotic macrophytes, at least 60-80% of native vegetation should be preserved (macrophyte removal, invasive plants and animals)
- Control and prevent the introduction of aquatic invasive species (invasive plants and animals)
- Encourage agricultural conservation practices (tilling, decreased use of pesticides and herbicides) (altered hydrologic regimes, altered nutrient inputs, altered sediment loads, pesticides and herbicides)
- For inland lakes have lake management plans (general)
- Maintain or establish riparian buffers to at least 50 ft. (altered hydrologic regimes, altered sediment loads, riparian modification)
- Rehabilitate native flora (macrophyte removal, riparian modification)
- Use Best management practices (altered hydrologic regimes, altered sediment loads, riparian modification)

LAW & POLICY
- Enact and enforce shoreline protection (i.e. restrict beach grooming) (riparian modification)
- Strengthen water quality laws and continue to enforce permits controlling effluent discharge (Urban, municipal, and industrial pollution)
- Work with local officials on setback and buffer ordinances (riparian modification)

EDUCATION & AWARENESS

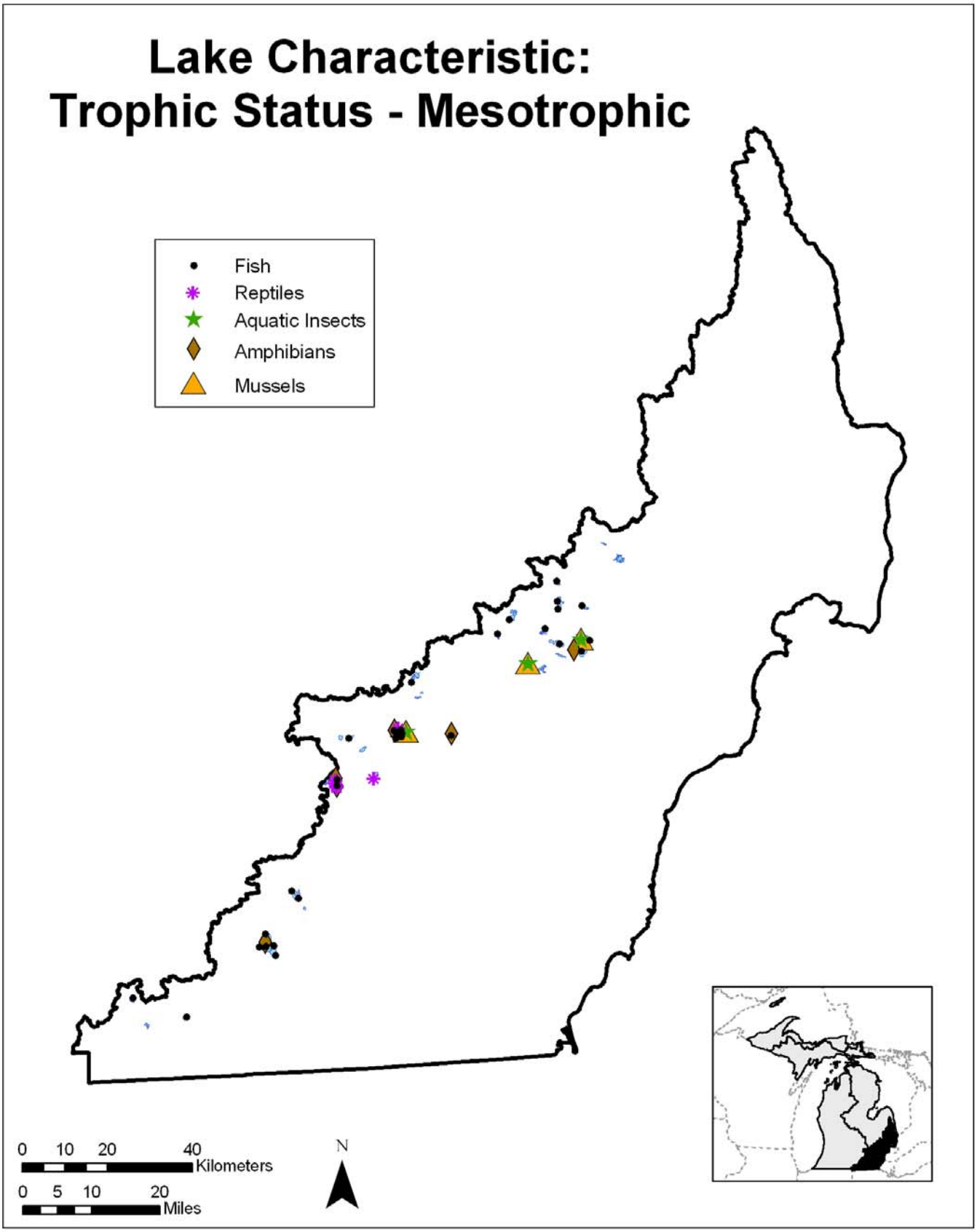
- Educate the public on the use of and reasons for maintaining septic systems (altered nutrient loads, social attitudes)
- Educate the public on the value of riparian areas (riparian modification, social attitudes)

Research and Survey Needs

- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Determine effects on native communities by aquatic invasive species
- Determine use of eutrophic lakes by SGCN
- Document effective methods of communicating with the public and their stewardship role
- Assess the amount of wetlands under 5 acres that are being converted to other use
- Develop quick and effective lake management plans

Monitoring

- Agricultural practices
- Aquatic invasive species
- Beach grooming
- Nutrient inflows: local septic systems and municipal waste water treatment plants
- Riparian development


Lake Characteristic:
Trophic Status - Mesotrophic
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
0 10 20 40
Kilometers
0 5 10 20
Miles
N

Lake Characteristic: Trophic Status – Mesotrophic

Description

Mesotrophic lakes have moderate concentrations of nutrients (total phosphorus = 15-25 µg/L) resulting in generally moderate biomass of algae. They generally have lower water clarity and potentially lower oxygen concentrations in the hypolimnion than oligotrophic lakes. They are not likely to have low winter oxygen concentrations under the ice unless the lakes are particularly shallow.

General Condition of Feature

No data available.

Associated Species of Greatest Conservation Need

MUSSELS
Specific associations with this landscape feature were not found in the literature

INSECTS
Specific associations with this landscape feature were not found in the literature

FISH
lake sturgeon (*Acipenser fulvescens*)
mooneye (*Hiodon tergisus*)

FISH cont.
silver chub (*Macrhybopsis storeriana*)
cisco or lake herring (*Coregonus artedi*)

AMPHIBIANS
Specific associations with this landscape feature were not found in the literature

REPTILES
Specific associations with this landscape feature were not found in the literature

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Runoff rates increase due to development
- Climate change

POLLUTION
- Altered nutrient inflows: Fertilizer- increased eutrophication rate and influence status; Runoff from impervious surfaces; Surface runoff - extra nutrients
- Urban, municipal, and industrial pollution: Surface runoff - contaminants

HABITAT CONVERSION
- Riparian modification
- Wetland modification

BIOLOGICAL INTERACTIONS
- Invasive plants and animals

EDUCATION
- Social attitudes

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Control and prevent the introduction of aquatic invasive species (invasive plants and animals)
- Maintain or establish riparian buffers to at least 50 ft. (altered hydrologic regimes, altered sediment loads, riparian modification)
- Rehabilitate native flora (macrophyte removal, riparian modification)
- Use Best management practices (altered hydrologic regimes, altered sediment loads, riparian modification)

LAW & POLICY
- Restrict beach grooming (macrophyte removal)
- Enact and enforce shoreline protection (riparian modification)
- Strengthen water quality laws and continue enforcing permits controlling effluent discharge (Urban, municipal, and industrial pollution)
- Work with local officials on setback and buffer ordnances (riparian modification)

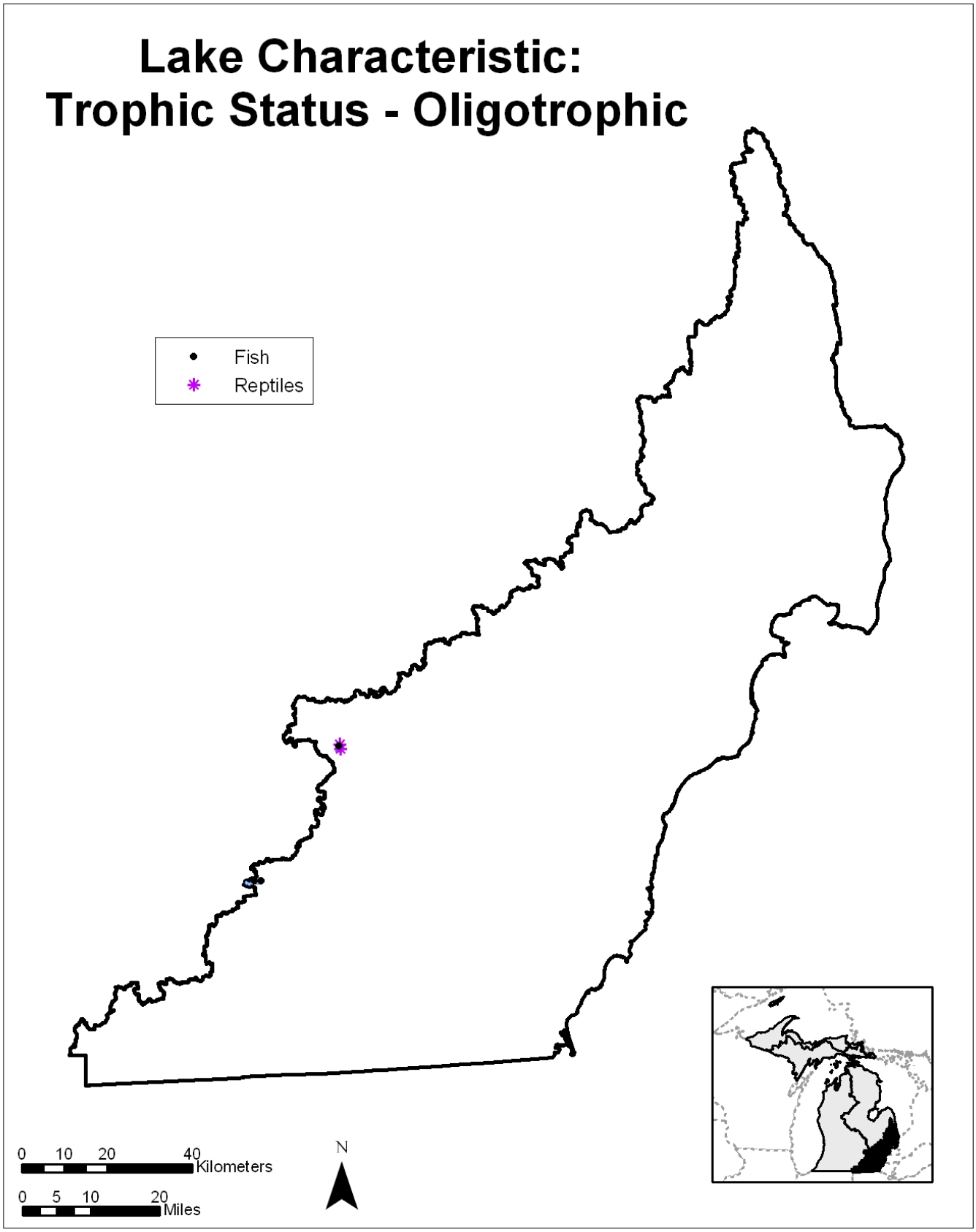
EDUCATION & AWARENESS
- Educate the public on the use of and reasons for maintaining septic systems (altered nutrient inflows, social attitudes)
- Educate the public on the value of riparian areas (riparian modification, social attitudes)

Research and Survey Needs
- Assess the amount of wetlands under 5 acres that are being converted to other use
- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Assess the affect of aquatic invasive species on native communities
- Determine use of mesotrophic lakes by SGCN

- Determine effective methods of communicating with the public and their stewardship role

Monitoring

- Aquatic invasive species
- Beach grooming
- Effluent discharges: waste water treatment plants, septic systems, industrial
- Nutrients
- Riparian development


Lake Characteristic:
Trophic Status - Oligotrophic
Fish
Reptiles
0 10 20 40
Kilometers
0 5 10 20
Miles
N

Lake Characteristic: Trophic Status – Oligotrophic

Description

Oligotrophic lakes with low concentrations of nutrients (total phosphorus < 15 µg/L) resulting in generally low biomass of algae. They generally have the highest water clarity and high oxygen concentrations in the hypolimnion and are not likely to have low winter oxygen concentrations under the ice.

General Condition of Feature

No data available.

Associated Species of Greatest Conservation Need

In the literature examined for species habitat information, oligotrophic lakes were not mentioned.

Associated Threats

POLLUTION

- Altered nutrient inflows

Conservation Actions Needed (Threats addressed)

LAW & POLICY

- Encourage townships to separate combined sewer systems (altered nutrient inflows)
- Upgrade septic systems (altered nutrient inflows)

EDUCATION & AWARENESS

- Educate the public on lawn fertilizers and its affects on lakes (altered nutrient inflows)
- Educate the public on the use of and reasons for maintaining septic systems (altered nutrient inflows)

Research and Survey Needs

- Determine the condition of this feature in the basin
- Determine use of oligotrophic lakes by species of greatest conservation need
- Determine what conservation actions need to be taken
- Determine research and survey needs
- Determine monitoring that should be done

Monitoring

- Lake water temperatures
- Nutrients

Lake Characteristic: Stratified

Lake Characteristic: Stratified

Description

The development of discrete vertical layers of water with different water temperature resulting in two thermal habitats in the lake: (1) warm surface water that is always well oxygenated and (2) cold bottom waters that can have low to high oxygen concentrations. Lakes that are not stratified (unstratified) are generally shallow (< 2 m average depth), characterized by frequent complete mixing from top to bottom, and high oxygen levels throughout. Unstratified lakes generally can occur in one of two states. 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.

General Condition of Feature

This habitat is considered 30% in good to excellent condition, 35% in fair condition, and 35% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

FISH

cisco or lake herring (*Coregonus artedi*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES

- Altered hydrologic regimes: Modification of lake levels (low threat)

POLLUTION

- Altered nutrient inflows: Surface runoff - nutrients
- Urban, municipal, and industrial pollution: Surface runoff – contaminants

HABITAT CONVERSION

- Dams: (low threat)

BIOLOGICAL INTERACTIONS

- Invasive plants and animals: Zebra mussels filtering phytoplankton/zooplankton used by associated species

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT

- Maintain or establish riparian buffers to at least 50 ft. (altered hydrologic regimes, altered nutrient inflows)

LAW & POLICY

- Reduce effluent inflows (Urban, municipal, and industrial pollution)
- Enforce permits controlling effluent discharges (Urban, municipal, and industrial pollution)

CAPACITY BUILDING

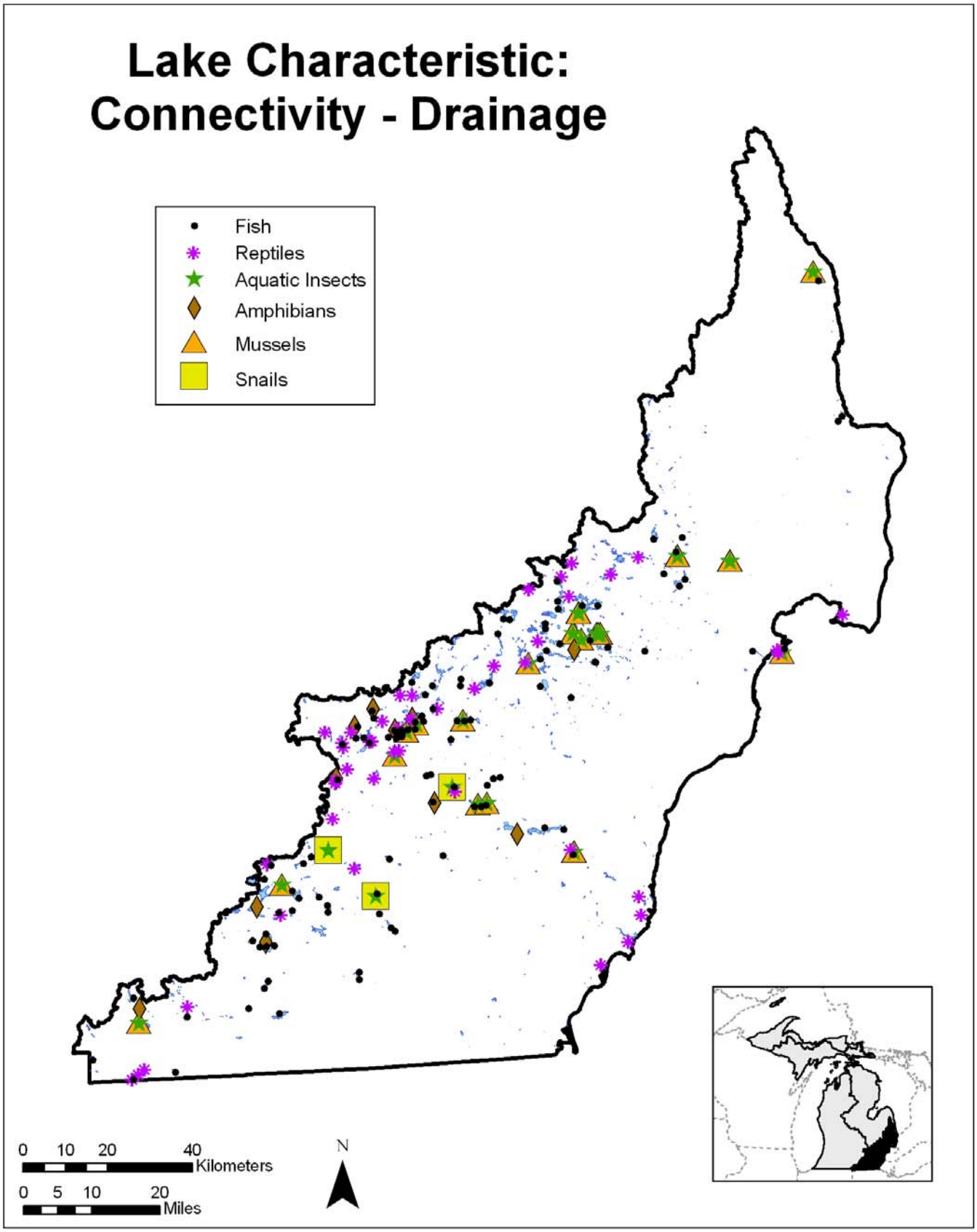
- Support watershed councils and regional conservation groups (general)

Research and Survey Needs

- Research alternative methods for dealing with urban runoff
- Determine ways of decreasing imperviousness in a watershed
- Determine and document effective methods of communicating with the public and their stewardship role (reduce pesticide use, proper oil disposal, etc)

Monitoring

- Effluent discharges: waste water treatment plants, septic systems, industrial
- Riparian buffer modification
- Watershed and regional councils and their needs


Lake Characteristic:
Connectivity - Drainage
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 10 20 40
Kilometers
0 5 10 20
Miles
N

Lake Characteristic: Connectivity – Drainage

Description

Drainage lakes have permanent or temporary stream connections, which allow for the movement of aquatic species. These lakes are more likely to have high buffering capacity (and so higher alkalinity) relative to seepage lakes.

General Condition of Feature

No data available.

Associated Species of Greatest Conservation Need

In the literature examined for species habitat information, drainage lakes were not mentioned.

Associated Threats

MODIFICATION OF NATURAL PROCESSES

- Fragmentation: lake-level control structures and dams

HABITAT CONVERSION

- Wetland modification: destroy wetlands through dredge and fills
- Dredging: lake outlets, outflow and inflow wetlands

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT

- Allow seasonal flooding (altered hydrologic regimes)
- Operate remaining dams and lake-level control structures as run-of-the-river (altered hydrologic regimes, dams)
- Remove unnecessary dams and lake-level control structures (altered hydrologic regimes, dams)

LAW & POLICY

- Protect the public trust by requiring dam owners to make appropriate financial provision for future dam removal (dams)
- Work with Drain Commissioners to allow or closely mimic natural hydrologic processes on legally controlled lake-level control structures (altered hydrologic regimes)
- Work with Drain Commissioners to use natural channel processes to allow a river to manage sediment and water flow and decrease the amount of channelization needed (altered hydrologic regimes, altered sediment loads)

EDUCATION & AWARENESS

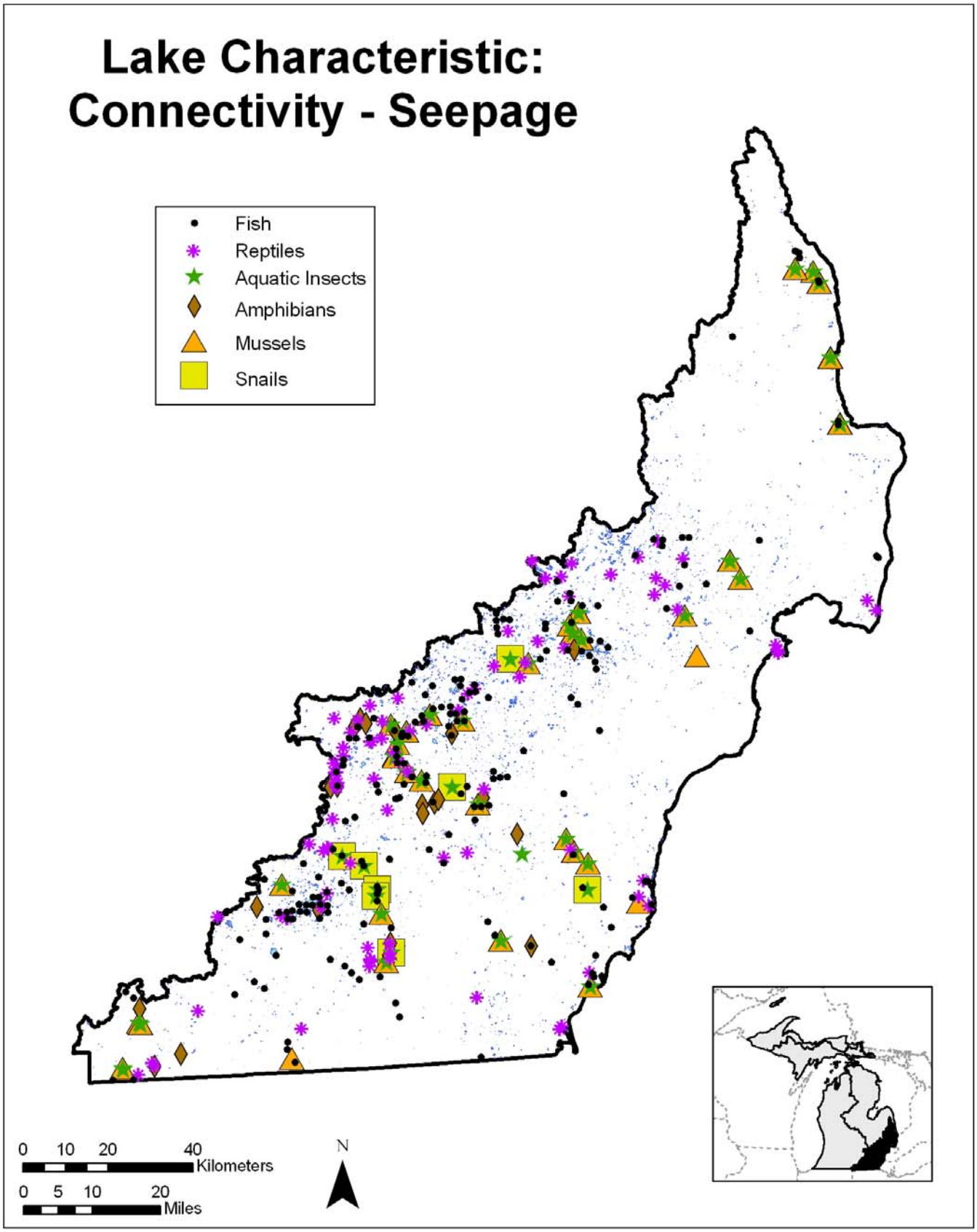
- Educate riparian land owners on the value of the natural habitat and the ecological services it provides (riparian modification, social attitudes)

Research and Survey Needs

- Determine the condition of drainage
- Determine the number of lakes in Michigan that have drainage
- Determine the species that use drainage lakes and the relative importance of the habitat to species

Monitoring

- Hydrologic affects on drainages that are controlled by lake-level control structures or dams
- Loss of natural inflow and outflows


Lake Characteristic:
Connectivity - Seepage
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 10 20 40
Kilometers
0 5 10 20
Miles
N

Lake Characteristic: Connectivity – Seepage

Description

Seepage lakes have no permanent or temporary stream connections. These lakes are more likely to have poor buffering capacity (and so lower alkalinity) relative to drainage lakes.

General Condition of Feature

No data available.

Associated Species of Greatest Conservation Need

In the literature examined for species habitat information, seepage lakes were not mentioned.

Associated Threats

MODIFICATION OF NATURAL PROCESSES

- Altered hydrologic regimes: water withdrawals; any activity which affects the water table

HABITAT CONVERSION

- Wetland modification: tiling for agriculture, drainage

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT

- Allow seasonal flooding (altered hydrologic regimes)
- Rehabilitate natural hydrologic functions (altered hydrologic regimes)
- Maintain and establish riparian buffers to at least 50 ft. (riparian modification)
- Rehabilitate destroyed and degraded wetlands (exp. remove tiling) (wetland modification)

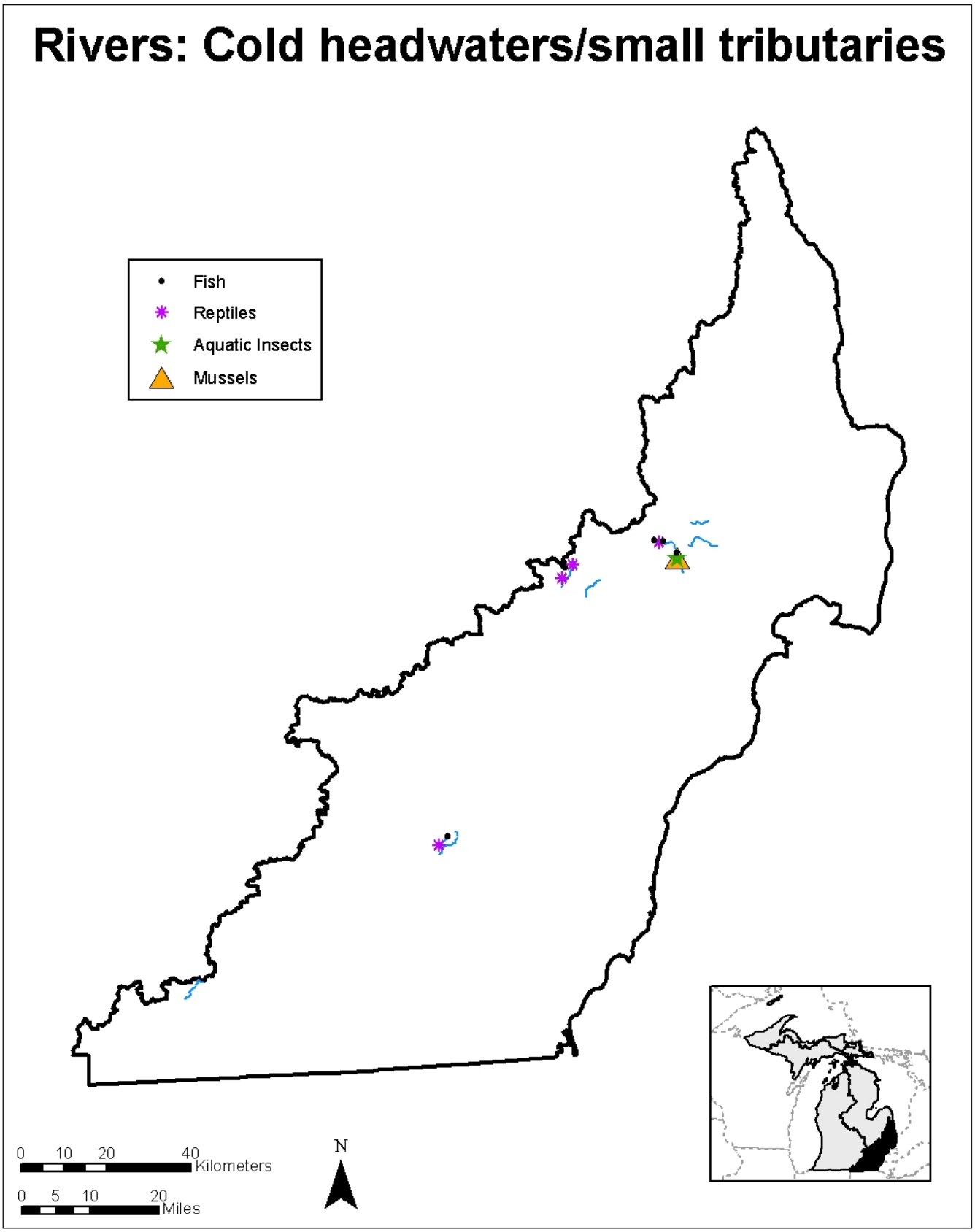
Research and Survey Needs

- Determine hydrologic significance of seepage lakes and ponds
- Determine the number and condition of seepage lakes and ponds in Michigan
- Determine the species that use seepage lakes and the relative importance of the habitat to species
- For those species documented, determine life history strategies
- Model Hydrology of seepage systems

Monitoring

- Riparian buffers
- Surrounding wetlands
- Water withdrawals in the watershed

Rivers: Cold headwaters/small tributaries



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 19°C (66°F). In the Lake Erie basin these systems are rare due to flat topography and clay soils present in the region.

General Condition of Feature

This habitat is considered 40% in good to excellent condition, 30% in fair condition, and 30% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
Specific associations with this landscape feature were not found in the literature

INSECTS
Specific associations with this landscape feature were not found in the literature

FISH
redside dace (*Clinostomus elongatus*)

REPTILES
Specific associations with this landscape feature were not found in the literature

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Increased runoff due to urbanization; Altered runoff patterns and recharge areas are affected by development

POLLUTION
- Altered sediment loads: Erosion and sediment runoff from uplands
- Thermal changes: Temperature affects from detention, runoff, etc

HABITAT CONVERSION
- Dams
- Dredging and channelization: Channelization (low threat)
- Riparian modification

Conservation Actions Needed (Threats addressed)

LAND & WATER PROTECTION
- Create and expand conservation easements (variety of threats)
- Support land conservancy purchase of undeveloped land (variety of threats)

LAND, WATER & SPECIES MANAGEMENT
- Decrease amount of impervious service in a watershed (altered hydrologic regimes)
- Maintain or establish riparian buffers to at least 50 ft., however 500 ft provides for better conservation value (altered sediment loads, riparian modification, thermal changes)
- Remove dams to rehabilitate connectivity, habitat, and natural hydrology (altered hydrologic regimes, dams)
- Rehabilitate original hydrologic functions (altered hydrologic regimes)
- Use sediment barriers and Best management practices during road and stream crossing construction (altered sediment loads)
- Work with road commissions and forest management agencies on rehabilitating eroding stream crossings (altered sediment flows)
- Work with road commissions to site new stream crossings (altered sediment flows)

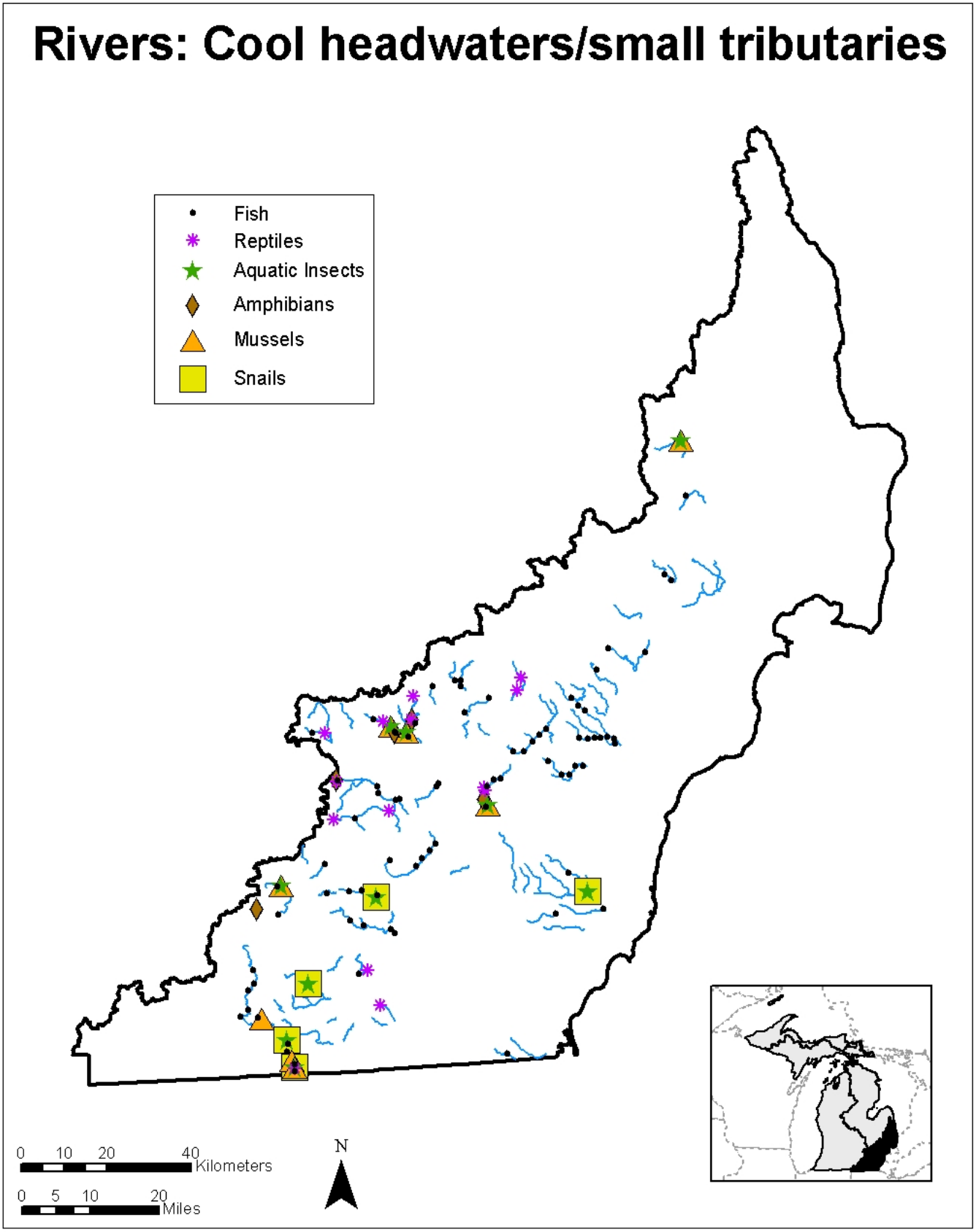
LAW & POLICY
- Operate remaining dams as run-of-the river (altered hydrologic regimes, dams)
- Protect groundwater recharge by requiring all development run off be captured by infiltration basins (altered hydrologic regimes)
- Protect the public trust by requiring dam owners to make appropriate financial provision for future dam removal (dams)

Research and Survey Needs

- Create hydrologic models of cold headwaters and small tributaries and the watershed
- Determine effects of thermals changes on the aquatic invertebrate communities
- Determine location and condition of cold water tributaries
- Determine use of cold headwaters and small tributaries by mussels, aquatic insects, and reptiles SGCN
- Determine ways of decreasing imperviousness in a watershed
- Determine ways to decrease temperature swings from retention and detention basins
- Explore other options to dams
- Model hydrologic flows in each watershed

Monitoring

- Channelization
- Dam operations
- Indicator species
- Riparian development
- Stream water temperature and flows


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 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 19-22°C. These systems are common in the till plains of the Lake Erie basin.

General Condition of Feature

This habitat is considered 40% in good to excellent condition, 30% in fair condition, and 30% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
rainbow (*Villosa iris*)

INSECTS
a stonefly (*Isogenoides doratus*)

FISH
redside dace (*Clinostomus elongatus*)
striped shiner (*Luxilus chrysocephalus*)
southern redbelly dace (*Phoxinus erythrogaster*)
finescale dace (*Phoxinus neogaeus*)
black redhorse (*Moxostoma duquesnei*)

FISH cont.
golden redhorse (*Moxostoma erythrurum*)
eastern sand darter (*Ammocrypta pellucida*)
fantail darter (*Etheostoma flabellare*)
least darter (*Etheostoma microperca*)

AMPHIBIANS
pickerel frog (*Rana palustris*)

REPTILES
Specific associations with this landscape feature were not found in the literature

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Due to increased runoff from urbanization; Runoff patterns disrupted due to development; Flow alteration due to development and impervious surfaces and runoff; Groundwater levels (agriculture, water supply to wells- extraction); changes to riparian vegetation; water inputs to channels (exceeding natural variability); Enclosed streams
- Climate change
- Fragmentation: Dam and connectivity

POLLUTION
- Altered nutrient inflows: Surface water runoff - nutrients
- Altered sediment loads: Erosion; Siltation; Sedimentation and erosion due to construction, etc
- Pesticides and herbicides
- Thermal changes: Altered temperature regime; Temperature impacts due to retention, detention basins, and storm water runoff
- Urban, municipal, and industrial pollution

HABITAT CONVERSION
- Dams: Altered hydrologic regimes due to dams and control structures; loss of connectivity
- Dredging and channelization: Channelization
- Riparian modification: Unprotected riparian area; Development within riparian zones; Removal of natural vegetation at rivers edge
- Wetland modification: Loss of wetlands (low threat)

EDUCATION
- Lack of scientific knowledge: In almost all cases, we know relatively little about ecological and other life histories of aquatic insects in this basin - taxonomic accuracy, sampling effort, etc. (low threat)
- Social attitudes: Lack of education on how to protect these systems and the impacts of human actions; Lack of understanding by riparian owners

Conservation Actions Needed (Threats addressed)

LAND & WATER PROTECTION

- Create and expand conservation easements (variety of threats)
- Support land conservancy purchase of undeveloped land (variety of threats)

LAND, WATER & SPECIES MANAGEMENT

- Allow seasonal flooding (altered hydrologic regimes)
- Decrease the amount of impervious surfaces (altered hydrologic regimes)
- Maintain natural corridors between wetlands and upland areas (fragmentation)
- Maintain or establish riparian buffers to at least 50 ft., however 500 ft provides for better conservation value (altered hydrologic regimes, altered sediment loads, riparian modification)
- Maintain stream crossings (altered hydrologic regimes, altered sediment loads)
- Preserve woody riparian vegetation to reduce sedimentation (altered sediment loads, riparian modification)
- Remove unnecessary or abandoned stream crossings and enclosures (altered hydrologic regimes, altered sediment loads)
- Rehabilitate damaged wetlands and protect existing natural wetlands (wetland modification)
- Rehabilitate streams to original flow paths (altered hydrologic regimes)
- Soften or remove hard stream riparian structures (riparian modification)
- Use natural materials or soft engineering techniques for riparian modification (riparian modification)
- Use sediment barriers and Best management practices during road and stream crossing constructions (altered sediment loads)
- Work with road commission on rehabilitating eroding stream crossings (altered sediment flows)
- Work with road commissions to site new stream crossings (altered hydrologic regimes, altered sediment loads)

LAW & POLICY

- Avoid stream relocations (altered hydrologic regimes, dredging and channelization, riparian modification)
- Continue working with and educating Drain Commissioners (altered hydrologic regimes, altered sediment loads, riparian modification, wetland modification)
- Encourage clustered home development rather than evenly spaced housing (riparian modification)
- Encourage use of bridges over culverts for new crossings (altered hydrologic regimes, fragmentation)
- If culverts are used, use single culverts that are sized for bankfull flows (altered hydrologic regimes, fragmentation)
- Operate remaining dams at run-of-the-river (altered hydrologic regimes, dams)
- Reduce effluent flow (thermal pollution, Urban, municipal, and industrial pollution)
- Remove unnecessary dams to rehabilitate flow and habitat (altered hydrologic regimes, dams, fragmentation)
- Restrict dredging during spawning and migration seasons (dredging and channelization)
- Strengthen existing environmental laws (sedimentation, municipal waste, etc.) (altered sediment loads, thermal changes, Urban, municipal, and industrial pollution)
- Work with local governments to develop and refine planning and zoning regulations (altered hydrologic regimes, altered sediment loads, riparian modification, wetland modification)

EDUCATION & AWARENESS

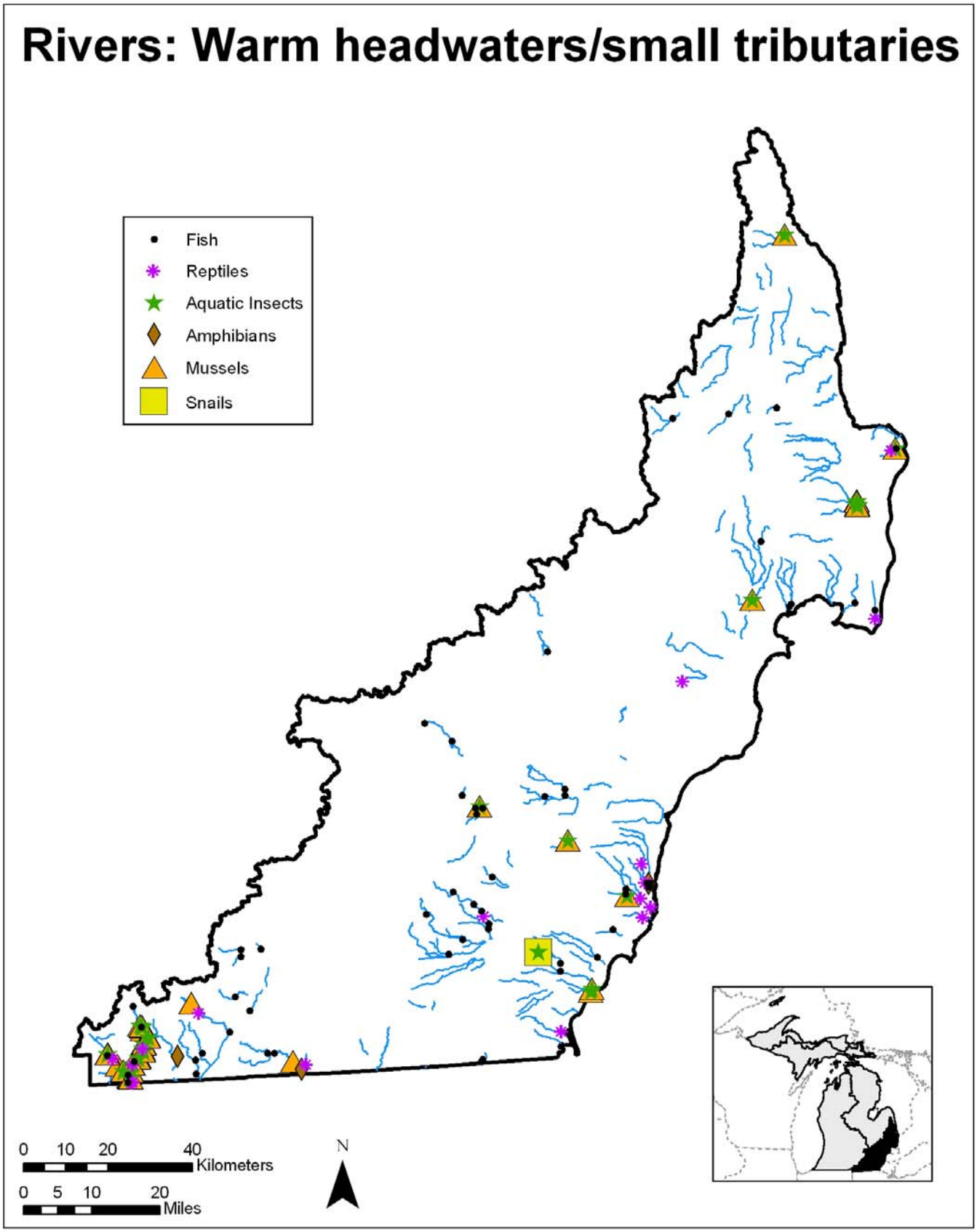
- Educate legislators, local planning boards, and other policy makers on the importance of natural processes (social attitudes)
- Educate private land owners on the value of riparian areas (riparian modification, social attitudes)
- Expand education programs for the public on natural processes, hydrologic cycles, and stewardship issues (social attitudes)
- Work with watershed councils and regional conservation groups on identifications skills and habitat restorations (social attitudes)

Research and Survey Needs

- Determine use of cool headwaters and small tributaries by snail and reptile SGCN
- Model hydrologic flows in each watershed
- Need more information about aquatic insect life histories
- Need more information about sampling effort needed to collect aquatic insects
- Need effective methods of communicating with the public their stewardship role

Monitoring

- Effluent discharges: waste water treatment plants, septic systems, industrial
- Dams
- Indicator species
- Riparian modification
- Enforcement of environmental laws


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

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 22°C (72°F). These systems are very common in the flat lacustrine clay and silt plains of the Lake Erie basin.

General Condition of Feature

This habitat is considered 25% in good to excellent condition, 40% in fair condition, and 35% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
Specific associations with this landscape feature were not found in the literature

SNAILS
Specific associations with this landscape feature were not found in the literature

INSECTS
Specific associations with this landscape feature were not found in the literature

FISH
striped shiner (*Luxilus chrysocephalus*)
pugnose shiner (*Notropis anogenus*)
southern redbelly dace (*Phoxinus erythrogaster*)

FISH cont.
western creek chubsucker (*Erimyzon claviformis*)
grass pickerel (*Esox americanus*)
eastern sand darter (*Ammocrypta pellucida*)
fantail darter (*Etheostoma flabellare*)
least darter (*Etheostoma microperca*)

AMPHIBIANS
Specific associations with this landscape feature were not found in the literature

REPTILES
Specific associations with this landscape feature were not found in the literature

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Dewatering; Draining wetlands; Increased runoff due to urbanization; Storm water management; Instream retention; Enclosed streams
- Fragmentation

POLLUTION
- Altered nutrient inflows: Surface runoff - nutrients
- Altered sediment loads: Bank erosion; Siltation
- Pesticides and herbicides: (low threat)
- Thermal changes: Altered temperature regime
- Urban, municipal, and industrial pollution: (low threat)

HABITAT CONVERSION
- Dams
- Dredging and channelization: Headwater tributary channel filling by urban development
- Riparian modification: Urban development alters riparian zones
- Wetland modification: Loss of wetlands (low threat)

EDUCATION
- Social attitudes: Lack of understanding by riparian owners

Conservation Actions Needed (Threats addressed)

LAND & WATER PROTECTION
- Create and expand conservation easements (variety of threats)
- Support land conservancy purchase of undeveloped land (variety of threats)

LAND, WATER & SPECIES MANAEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Decrease amount of impervious surfaces (altered hydrologic regimes)

- Maintain or establish riparian buffers to at least 50 ft., however 500 ft provides for better conservation value (riparian modification)
- Maintain wetlands and small feeder creeks (altered hydrologic regimes, wetland modification)
- Protect or rehabilitate hydrologic stream and wetland functions (altered hydrologic regimes, wetland modification)
- Rehabilitate streams to original flow paths (altered hydrologic regimes)
- Use sediment barriers and Best management practices during road and stream crossing constructions (altered sediment loads)
- Work with road commission to site new stream crossings and rehabilitate eroding ones (altered hydrologic regimes, altered sediment loads)

LAW & POLICY

- Discourage water withdrawals in flow limited situations (altered hydrologic regimes)
- Continue working with and educating Drain Commissioners (social attitudes)
- Require maintained septic systems (altered nutrient inflows)
- Remove unnecessary dams (dams, fragmentation)
- Operate remaining dams to provide for run-of-the river flows (altered hydrologic regimes, dams)
- Protect the public trust by requiring dam owners to make appropriate financial provision for future dam removal (dams)
- Work with local governments to develop planning and zoning regulations that consider natural streams (altered hydrologic regimes, altered sediment loads, riparian modification)
- Work with local officials on setback and buffer ordnances (riparian modification)

EDUCATION & AWARENESS

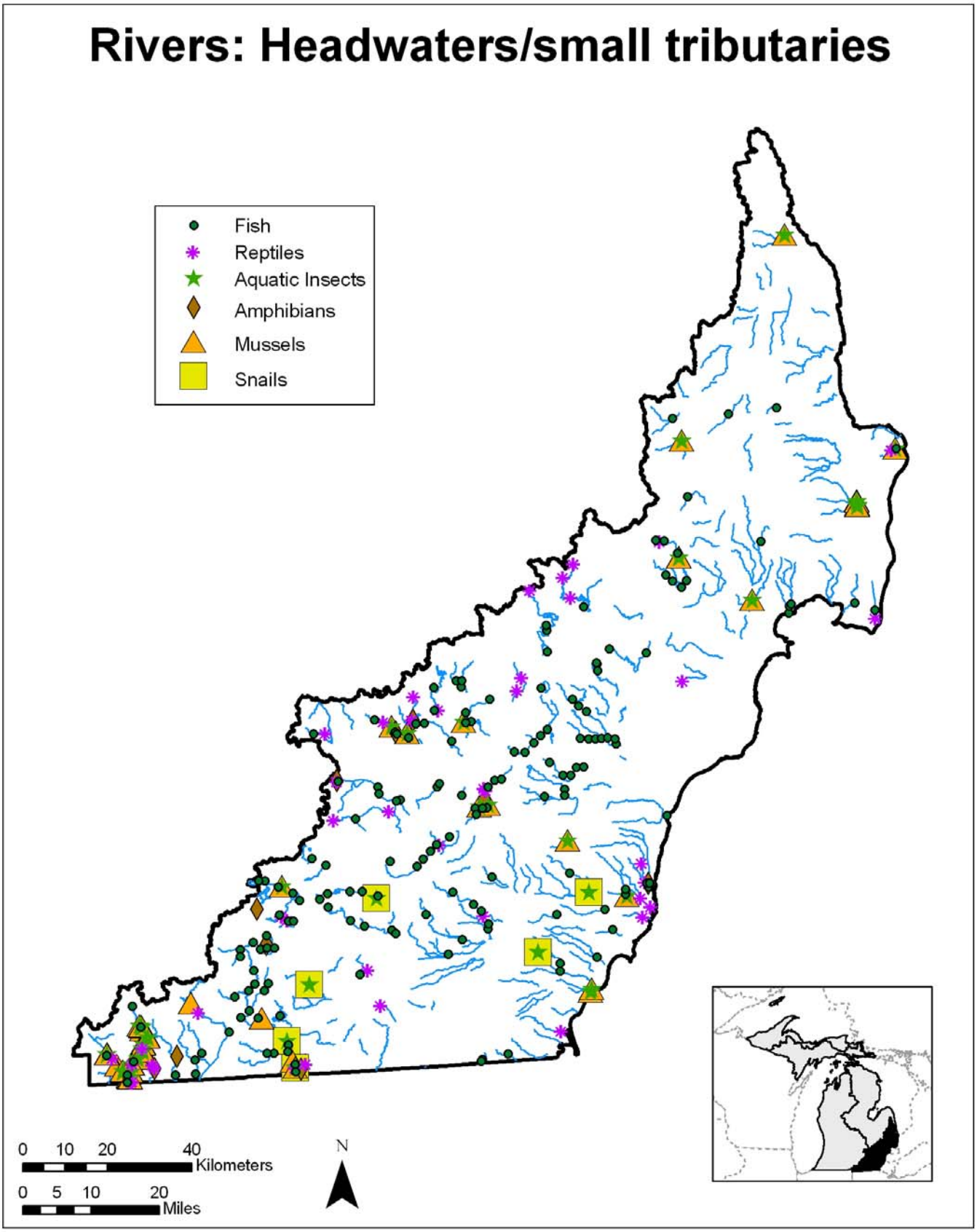
- Educate legislators, local planning boards, and other policy makers on the importance of natural processes (social attitudes)
- Educate private land owners on the value of riparian areas (riparian modification, social attitudes)
- Expand education programs for the general public regarding natural processes, hydrologic cycles, and stewardship issues (social attitudes)

Research and Survey Needs

- Create hydrologic models of warm headwaters and small tributaries and their watersheds
- Determine SGCN use of warm headwaters, especially mussels, snails, aquatic insects, amphibians, and reptiles
- Determine extent of riparian corridors
- Determine ways of decreasing imperviousness in a watershed
- Explore other options to dams

Monitoring

- Effluent discharges: waste water treatment plants, septic systems, industrial
- Filling of streams and wetlands
- Indicator species
- Riparian buffers
- Stream enclosures


Rivers: Headwaters/small tributaries
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
0 10 20 40 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.

General Condition of Feature

This habitat is considered 30% in good to excellent condition, 40% in fair condition, and 30% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
- slippershell mussel (*Alasmidonta viridis*)
- ellipse (*Venustaconcha ellipsiformis*)
- clubshell (*Pleurobema clava*)
- cylindrical papershell (*Anodontoides ferussacianus*)
- creek heelsplitter (*Lasmigona compressa*)
- eastern pondmussel (*Ligumia nasuta*)
- purple lilliput (*Toxolasma lividus*)
- lilliput (*Toxolasma parvus*)
- rayed bean (*Villosa fabalis*)

SNAILS
- brown walker (*Pomatiopsis cincinnatiensis*)

CRAYFISH
- devil crawfish (*Cambarus diogenes*)
- digger crayfish (*Fallicambarus fodiens*)

INSECTS
- splendid clubtail (*Gomphus lineatifrons*)
- rapids clubtail (*Gomphus quadricolor*)

INSECTS cont.
- Laura's snaketail (*Stylurus laurae*)
- a dobsonfly (*Nigronia fasciatus*)

FISH
- brindled madtom (*Noturus miurus*)
- orangethroat darter (*Etheostoma spectabile*)

AMPHIBIANS
- smallmouth salamander (*Ambystoma texanum*)
- four-toed salamander (*Hemidactylium scutatum*)
- mudpuppy (*Necturus maculosus maculosus*)
- Fowler's toad (*Bufo fowleri*)
- Blanchard's cricket frog (*Acris crepitans blanchardi*)

REPTILES
- copperbelly water snake (*Nerodia erythrogaster neglecta*)
- queen snake (*Regina septemvittata*)
- Blanding's turtle (*Emydoidea blandingii*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Increased runoff due to urbanization; Storm water management; Enclosed streams
- Climate change
- Fragmentation

POLLUTION
- Altered nutrient inflows: Surface runoff - nutrients
- Altered sediment loads: Erosion; Siltation; Sedimentation; Construction runoff
- Pesticides and herbicides
- Urban, municipal, and industrial pollution

HABITAT CONVERSION
- Dams
- Dredging and channelization: Channelization
- Riparian modification: Development of riparian zone; Loss of flood plain

EDUCATION
- Social attitudes: Lack of education for public; Lack of understanding by riparian owners

Conservation Actions Needed (Threats addressed)

LAND & WATER PROTECTION
- Create and expand conservation easements (variety of threats)
- Support land conservancy purchase of undeveloped land (variety of threats)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Encourage use of natural materials or soft engineering techniques for modification (riparian modification)
- Maintain or rehabilitate natural corridors between wetlands and uplands (fragmentation, riparian modification)

- Maintain or establish riparian buffers to at least 50 ft., however 500 ft provides for better conservation value (altered hydrologic regimes, altered sediment loads, riparian modification)
- Preserve woody riparian vegetation (riparian modification)
- Rehabilitate damaged wetland and stream hydrology (altered hydrologic regimes, wetland modification)
- Rehabilitate original hydrologic functions (altered hydrologic regimes)
- Rehabilitate streams to original flow paths (altered hydrologic regimes)
- Soften or remove hard stream riparian structures (riparian modification)
- Work with road commissions on placement and maintenance of stream crossings (altered hydrologic regimes, altered sediment loads, fragmentation)

LAW & POLICY

- Avoid stream relocations (dredging and channelization)
- Continue working with and educating Drain Commissioners (social attitudes)
- Enforce the use sediment barriers and Best management practices during road and stream crossing constructions (altered sediment loads)
- Protect the public trust by requiring dam owners to make appropriate financial provision for future dam removal (dams)
- Remove dams to rehabilitate habitat (dams, fragmentation)
- Remove unnecessary or abandoned stream crossings and enclosures (altered hydrologic regimes)
- Require remaining dams to operate at run-of-the-river (altered hydrologic regimes)
- Restrict dredging during spawning or migration seasons (dredging and channelization)
- Strengthen existing environmental laws (variety of threats)
- Use single large capacity culverts that match bankfull width if culverts are necessary (altered hydrologic regimes, altered sediment loads)
- Work with local planning and zoning to develop and refine regulations and ordinances that include natural processes (altered hydrologic regimes, altered sediment loads, riparian modification, wetland modification)

EDUCATION & AWARENESS

- Educate legislators, local planning boards, and other policy makers on the importance of natural processes (social attitudes)
- Educate private landowners on the value of riparian areas (riparian modification, social attitudes)
- Expand education programs for the general public regarding natural processes, hydrologic cycles, and stewardship issues (social attitudes)

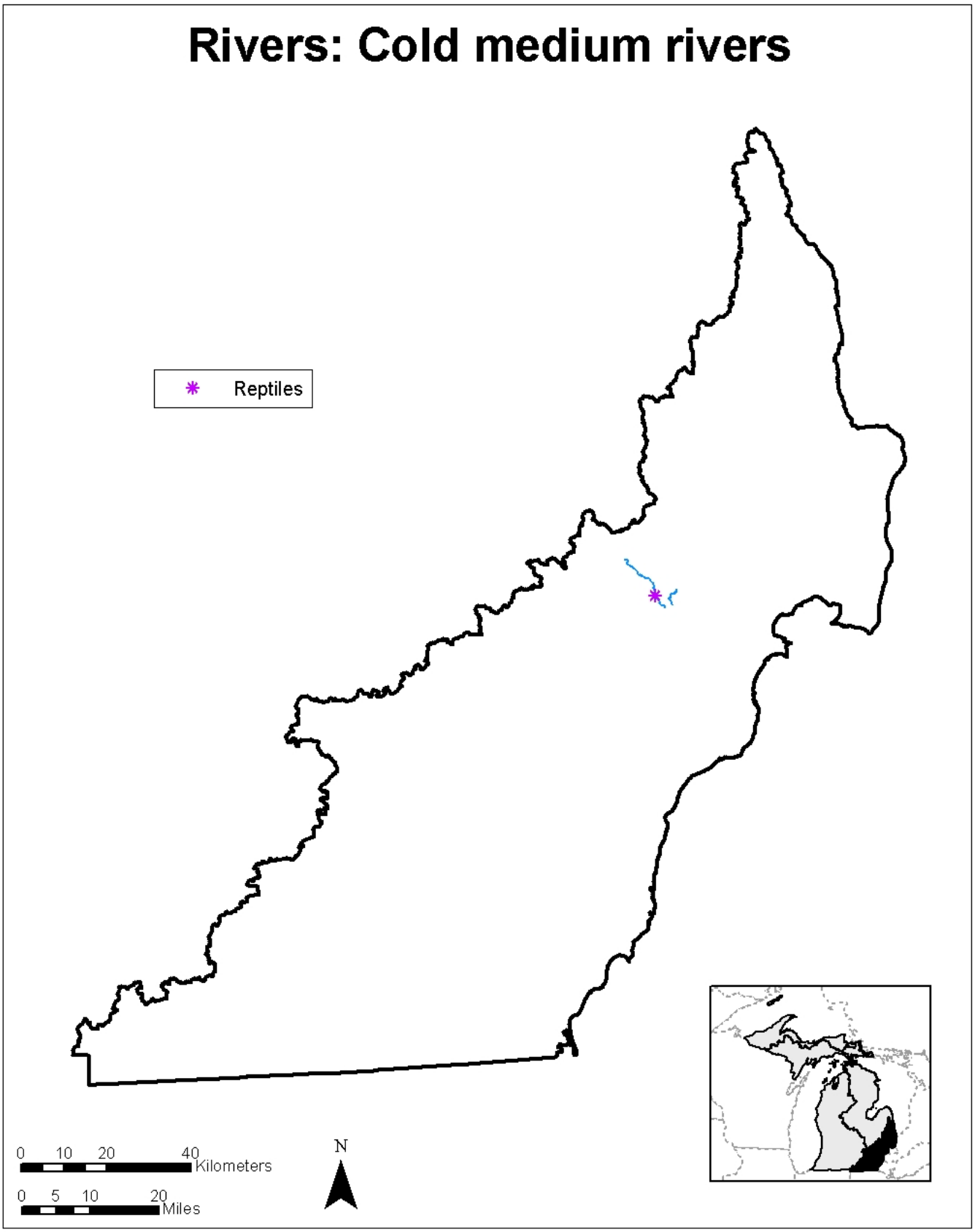
Research and Survey Needs

- Determine extent and condition of riparian buffers
- Determine the best way of communicating natural resource concerns with the public
- Determine the best way of getting local planning groups to work together
- Investigate complete life history strategies for SCGN that use headwaters and small tributaries
- Determine reptile and amphibian corridors
- Determine temperature preferences for SGCN species

Monitoring

- Amphibian and reptile corridors
- Industrial effluent
- Mussels populations
- Riparian modification
- Road crossings
- Septic systems and wastewater treatment plants
- Stream modification

Rivers: Cold medium rivers



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 19°C (66°F). These systems are uncommon in the Lake Erie basin.

General Condition of Feature

No data available.

Associated Species of Greatest Conservation Need

In the literature examined for species habitat information, cold medium rivers were not mentioned.

Associated Threats

- No data available

Conservation Actions Needed (Threats addressed)

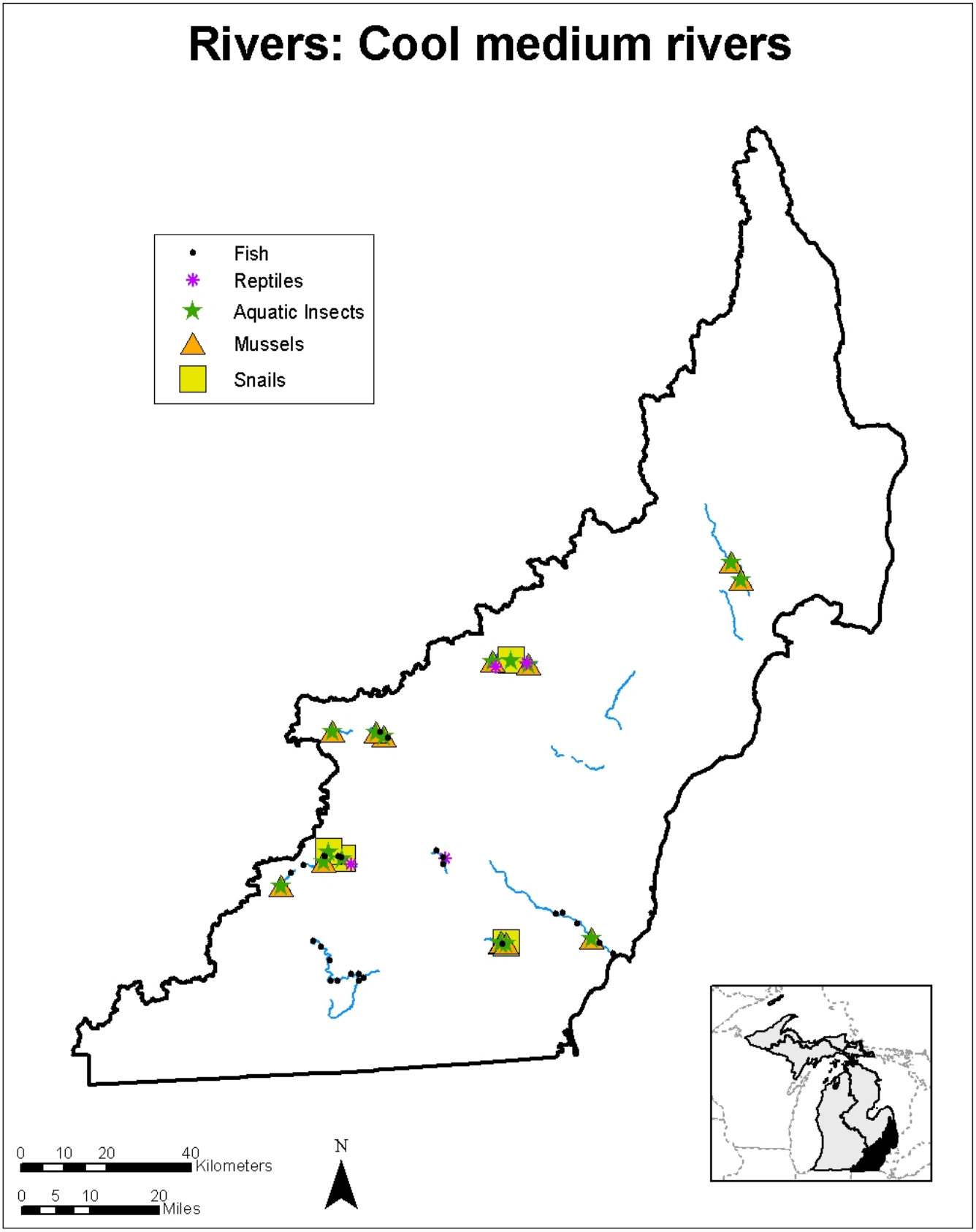
- No data available

Research and Survey Needs

- Determine SGCN that use cold medium rivers in the basin
- Determine the extent and condition of cold medium rivers in the basin
- Determine the threats to cold medium rivers in this basin
- Determine the conservation actions needed
- Determine research and survey needs
- Determine monitoring needs

Monitoring

- Indicator species
- Stream temperatures


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

Rivers: Cool 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. Cool medium rivers in Michigan are usually runoff-driven with low to moderate baseflow and fair to moderate peak flow, with the exception of a few systems that are groundwater-driven. The majority of these rivers are low gradient and flow through unconfined glacial or alluvial valleys. July weekly mean temperature in cool medium rivers ranges from 19-22°C (66-72°F). These systems are found throughout the Lake Erie basin.

General Condition of Feature

No data available.

Associated Species of Greatest Conservation Need

MUSSELS
rainbow (*Villosa iris*)

SNAILS
Specific associations with this landscape feature were not found in the literature

INSECTS
ocellated darner (*Boyeria grafiana*)
a stonefly (*Isogenoides doratus*)

FISH
mooneye (*Hiodon tergisus*)
striped shiner (*Luxilus chrysocephalus*)
silver shiner (*Notropis photogenis*)

FISH cont.
spotted sucker (*Minytrema melanops*)
black redhorse (*Moxostoma duquesnei*)
golden redhorse (*Moxostoma erythrurum*)
brown bullhead (*Ameiurus nebulosus*)
stonecat (*Noturus flavus*)
eastern sand darter (*Ammocrypta pellucida*)
fantail darter (*Etheostoma flabellare*)

REPTILES
Specific associations with this landscape feature were not found in the literature

Associated threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: dams; development and impervious surfaces; Altered runoff patterns due to development; Increased runoff due to urbanization; Enclosed streams
- Fragmentation

POLLUTION
- Altered nutrient inflows: Surface runoff - nutrients
- Altered sediment loads: Erosion; Siltation; Sedimentation
- Pesticides and herbicides
- Thermal changes: Altered temperature regime; Impacts due to development
- Urban, municipal, and industrial pollution: road runoff pollutants; Surface runoff - contaminants

HABITAT CONVERSION
- Dams: Altered flows
- Dredging and channelization: Channelization
- Riparian modification: Lack of woody; Loss of floodplain; Development in riparian zones
- Wetland modification: Loss of wetlands (low threat)

BIOLOGICAL INTERACTIONS
- Invasive plants and animals: (low threat)

EDUCATION
- Social attitudes: Lack of understanding by riparian owners

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Work with road commissions on maintenance and placement of new bridges (altered hydrologic regimes, altered sediment loads)
- Encourage use of natural materials or soft engineering techniques for any shoreline modification (riparian modification)
- Maintain and rehabilitate natural corridors between significant habitats such as wetlands and other water bodies (fragmentation, riparian modification)
- Maintain or establish riparian buffers to at least 50 ft., but 500 ft. or wider maximizes conservation benefits (altered hydrologic regimes, altered sediment loads, riparian modification)
- Maintain or rehabilitate woody structure (riparian modification)

- Protect and rehabilitate wetland and floodplain functions (wetland modification)
- Reduce pesticide use (pesticides and herbicides)
- Rehabilitate native flora (riparian modification)

LAW & POLICY

- Continue working with and educating Drain Commissioners (altered hydrologic regimes, altered sediment loads, riparian modification, social attitudes)
- Develop and refine planning and zoning regulations and ordinances (altered hydrologic regimes, altered nutrient inflows, altered sediment loads, riparian modification, wetland modification)
- Encourage Best management practices (altered hydrologic regimes, altered sediment loads, riparian modification)
- Encourage green-space planning (riparian modification)
- Protect existing wetlands and floodplains (altered hydrologic regimes, riparian modification, wetland modification)
- Protect the public trust by requiring dam owners to make appropriate financial provision for future dam removal (dams)
- Remove dams to rehabilitate habitat connectivity (altered hydrologic regimes, dams, fragmentation)
- Remove unnecessary or abandoned stream enclosures and bridges (altered hydrologic regimes)
- Strengthen existing environmental laws (variety of threats)
- Upgrade septic systems (altered nutrient inflows)
- Use sediment barriers and Best management practices during road and stream crossing constructions (altered sediment loads)
- Work with watershed councils (social attitudes)

EDUCATION

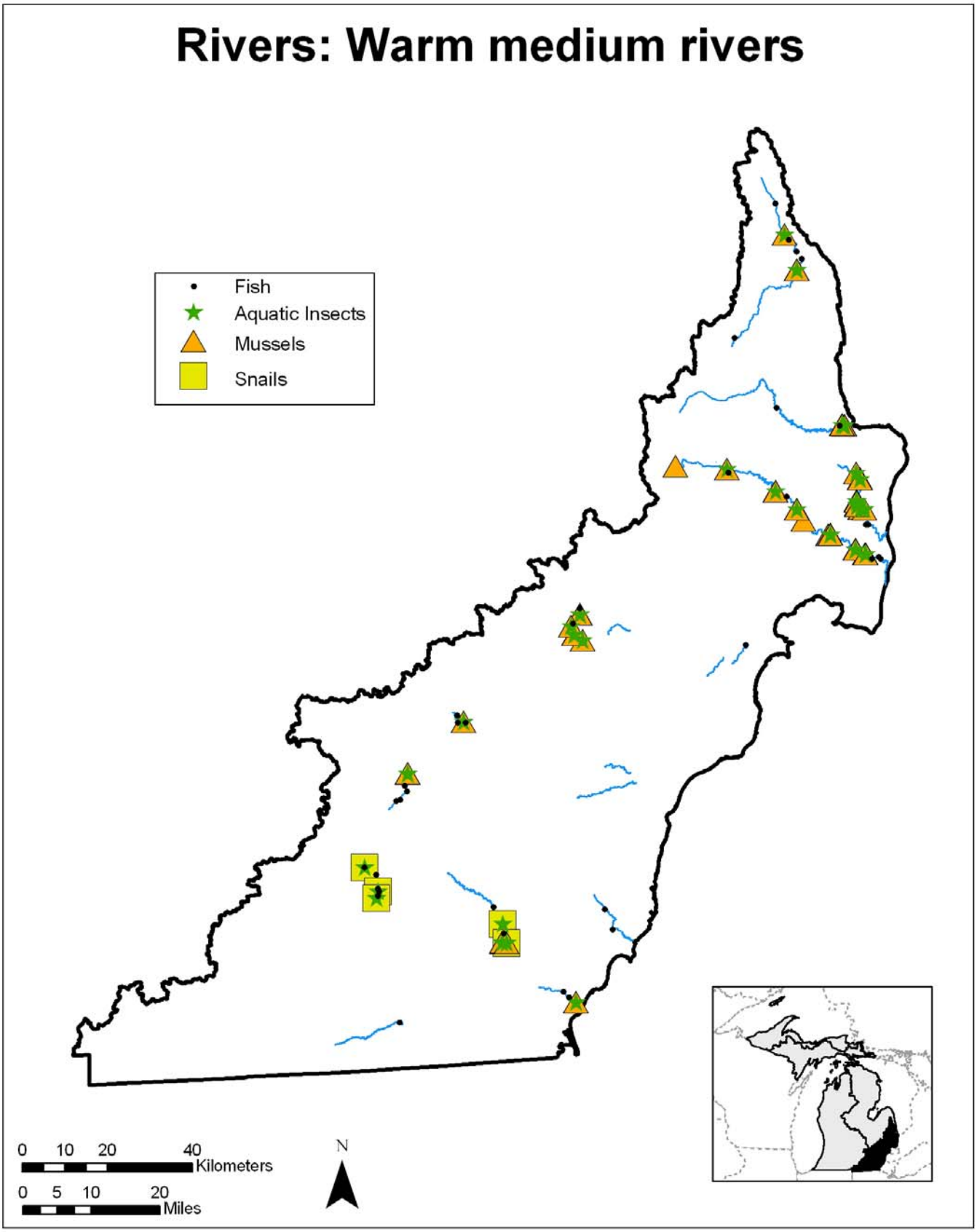
- Create awareness of environmental issues (social attitudes)
- Educate legislators, local planning boards, and other policy makers on the importance of natural processes (social attitudes)
- Educate private landowners on the value of riparian areas (riparian modification, social attitudes)
- Educate riparian land owners about the importance of riparian vegetated buffers and the ecological services they provide (altered nutrient inflows, riparian modification)

Research and Survey Needs

- Determine the extent and condition of cool medium rivers in the basin
- Determine effective ways to educate the public on stewardship issues
- Inventory dams and determine those which are no longer needed
- Inventory septic systems and their condition
- Determine life history strategies of SGCN where this information is lacking
- Model hydrologic flows

Monitoring

- Indicator species
- Industrial effluent
- Municipal wastewater treatment plans
- Riparian development
- Road crossings
- Storm water flows
- Stream modification


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

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 22°C (72°F). These systems are common in the lacustrine clay and silt areas of the Lake Erie basin.

General Condition of Feature

This habitat is considered 25% in good to excellent condition, 35% in fair condition, and 40% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

SNAILS
Specific associations with this landscape feature were not found in the literature

INSECTS
Specific associations with this landscape feature were not found in the literature

FISH
striped shiner (*Luxilus chrysocephalus*)
river chub (*Nocomis micropogon*)
pugnose shiner (*Notropis anogenus*)
pugnose minnow (*Opsopoeodus emiliae*)
western creek chubsucker (*Erimyzon claviformis*)
lake chubsucker (*Erimyzon sucetta*)

FISH cont.
spotted sucker (*Minytrema melanops*)
brown bullhead (*Ameiurus nebulosus*)
stonecat (*Noturus flavus*)
tadpole madtom (*Noturus gyrinus*)
grass pickerel (*Esox americanus*)
pirate perch (*Aphredoderus sayanus*)
eastern sand darter (*Ammocrypta pellucida*)
fantail darter (*Etheostoma flabellare*)

REPTILES
Specific associations with this landscape feature were not found in the literature

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Channel modification and flow alteration; Altered flows due to development, dams, impervious surfaces, urbanization, etc.; Enclosed streams
- Climate change
- Fragmentation: Habitat loss and fragmentation

POLLUTION
- Altered nutrient inflows: Surface runoff – nutrients
- Altered sediment loads: Erosion; Siltation; Sedimentation
- Thermal changes: Altered temperature regime
- Urban, municipal, and industrial pollution: Surface runoff - contaminants

HABITAT CONVERSION
- Dams
- Dredging and channelization: Channelization
- Riparian modification: Lack of woody structure; Loss of floodplain
- Wetland modification: Loss of wetlands; Wetland modification (low threat)

BIOLOGICAL INTERACTIONS
- Invasive plants and animals

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Macrophyte removal

EDUCATION
- Social attitudes: Lack of understanding by riparian owners

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Removal of exotic vegetation should preserve 60-80% of native vegetation and be in conjunction with a watershed management plan (invasive plants and animals, macrophyte removal)
- Encourage use of natural materials or soft engineering techniques for modification (riparian modification)
- Maintain or rehabilitate natural corridors between wetlands and uplands (fragmentation, riparian modification)
- Maintain or establish riparian buffers to at least 50 ft., but 500 ft. or wider maximizes conservation benefits (altered hydrologic regimes, altered sediment loads, riparian modification)

- Preserve woody riparian vegetation (riparian modification)
- Rehabilitate damaged wetland and stream hydrology (altered hydrologic regimes, wetland modification)
- Rehabilitate original hydrologic functions (altered hydrologic regimes)
- Rehabilitate streams to original flow paths (altered hydrologic regimes)
- Soften or remove hard stream riparian structures (riparian modification)
- Work with road commissions on maintenance and placement of new bridges (altered hydrologic regimes, altered sediment loads)

LAW & POLICY

- Avoid stream relocations (dredging and channelization)
- If culverts are necessary, use single large capacity culverts that match bankfull width (altered hydrologic regimes, fragmentation)
- Protect the public trust by requiring dam owners to make appropriate financial provisions for future dam removal (dams)
- Reduce effluent inflow (thermal changes, Urban, municipal, and industrial pollution)
- Remove dams to rehabilitate habitat (altered hydrologic regimes, altered sediment loads, dams, fragmentation)
- Remove unnecessary or abandoned stream crossings or enclosures and dams (altered hydrologic regimes, altered sediment loads, dams, fragmentation)
- Require remaining dams to operate at run-of-the-river (altered hydrologic regimes, dams)
- Restrict dredging during spawning or migration seasons of fish and around mussel beds (dredging and channelization)
- Strengthen existing environmental laws and continue enforcement of permits controlling effluent discharge (thermal changes, Urban, municipal, and industrial pollution)
- Use sediment barriers and Best management practices during road and stream crossing constructions (altered sediment loads)
- Work with Drain Commissioners to limit amount of woody structure removed from a system (altered hydrologic regimes, altered sediment loads)
- Work with local planning and zoning to develop ordinances that include natural processes (general threats, social attitudes)

EDUCATION & AWARENESS

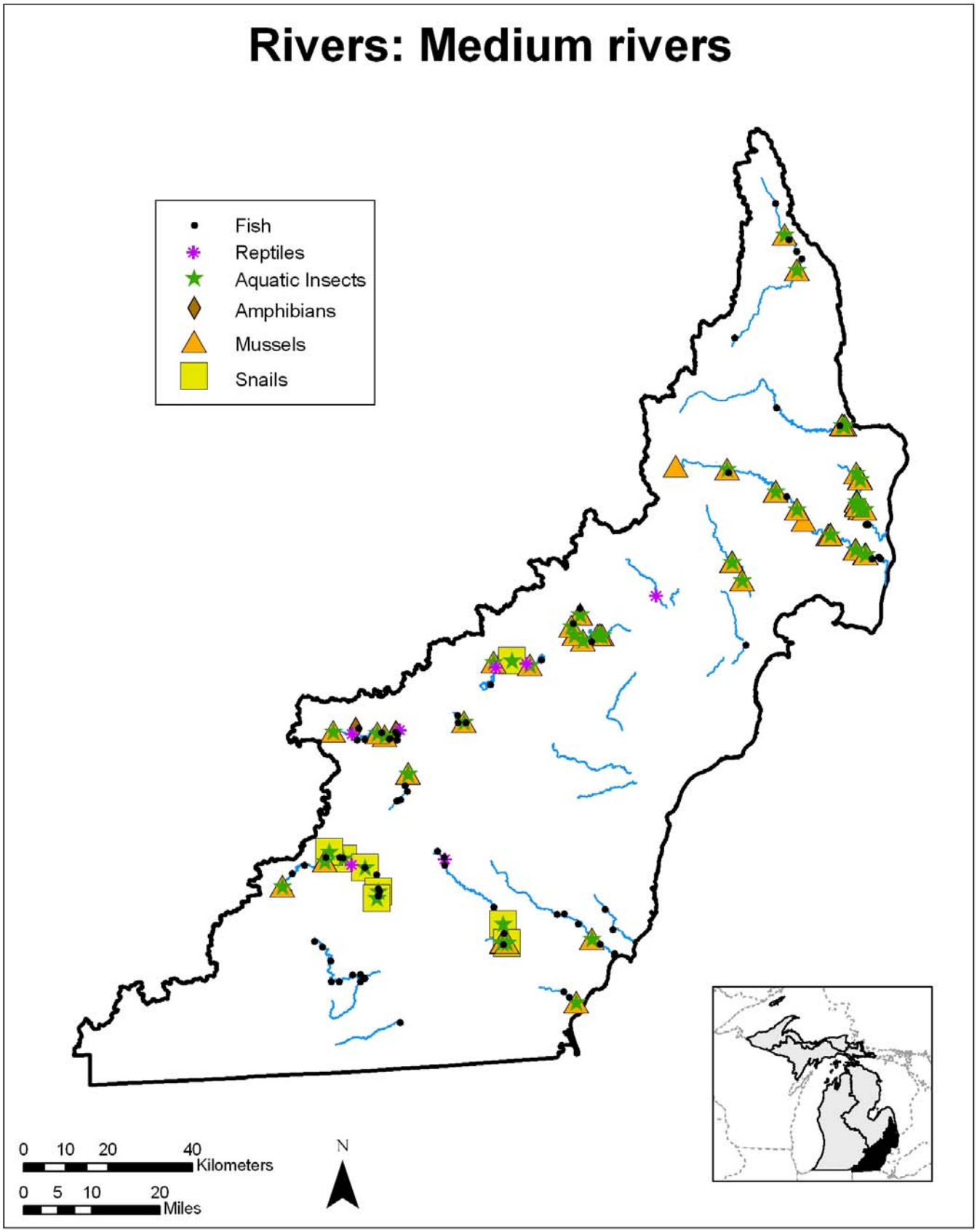
- Create awareness of environmental issues (social attitudes)
- Educate legislators, local planning boards, and other policy makers on the importance of natural processes (social attitudes)
- Educate private landowners on the value of riparian areas (riparian modification, social attitudes)
- Educate the public on prevention and control of aquatic invasive species and the affects of invasives (invasive plants and animals, social attitudes)
- Work with conservation groups to emphasize the value of riparian areas and woody structure in streams (social attitudes)

Research and Survey Needs

- Determine effective prevention, control, and survey techniques for aquatic invasive species (biological, mechanical, chemical, etc.)
- Determine affects of aquatic invasive species on native communities
- Establish effective methods of communication with the public about stewardship
- Investigate life history strategies of SGCN where this information is lacking
- Survey loadings of nutrients and sediments to streams and develop strategies to reduce problems
- Update dam inventory and determine those dams which are no longer used or useful

Monitoring

- Aquatic invasive species
- Dam operations
- Effluent discharges: waste water treatment plants, septic systems, industrial
- Indicator species
- Riparian modification
- Stream modification


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

General Condition of Feature

This habitat is considered 20% in good to excellent condition, 40% in fair condition, and 40% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
- elktoe (*Alasmidonta marginata*)
- slippershell mussel (*Alasmidonta viridis*)
- round pigtoe (*Pleurobema coccineum*)
- ellipse (*Venustaconcha ellipsiformis*)
- purple wartyback (*Cyclonaias tuberculata*)
- clubshell (*Pleurobema clava*)
- pimpleback (*Quadrula pustulosa*)
- creek heelsplitter (*Lasmigona compressa*)
- salamander mussel (*Simpsonaias ambigua*)
- white catspaw (*Epioblasma obliquata perobliqua*)
- northern riffleshell (*Epioblasma torulosa rangiana*)
- snuffbox (*Epioblasma triquetra*)
- wavy-rayed lampmussel (*Lampsilis fasciola*)
- black sandshell (*Ligumia recta*)
- threehorn wartyback (*Obliquaria reflexa*)
- round hickorynut (*Obovaria subrotunda*)
- kidneyshell (*Ptychobranchus fasciolaris*)
- purple lilliput (*Toxolasma lividus*)
- lilliput (*Toxolasma parvus*)
- fawnsfoot (*Truncilla donaciformis*)
- rayed bean (*Villosa fabalis*)

SNAILS
- Specific associations with this landscape feature were not found in the literature

CRAYFISH
- devil crawfish (*Cambarus diogenes*)

INSECTS
- a sand minnow mayfly (*Siphloplecton basale*)
- splendid clubtail (*Gomphus lineatifrons*)
- rapids clubtail (*Gomphus quadricolor*)
- Laura's snaketail (*Stylurus laurae*)
- a stonefly (*Helopicus nalatus*)

FISH
- brindled madtom (*Noturus miurus*)
- northern madtom (*Noturus stigmosus*)

AMPHIBIANS
- mudpuppy (*Necturus maculosus maculosus*)
- Fowler's toad (*Bufo fowleri*)
- Blanchard's cricket frog (*Acris crepitans blanchardi*)
- northern leopard frog (*Rana pipiens*)

REPTILES
- copperbelly water snake (*Nerodia erythrogaster neglecta*)
- Blanding's turtle (*Emydoidea blandingii*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Dams and altered flows; Increased runoff ; Due to development and storm water management; Increased runoff due to urbanization; Especially water input from surface sources, affecting fluvial hydraulics and channel conditions, storm flow (hydrographs); Enclosed streams
- Fragmentation

POLLUTION
- Altered nutrient inflows: Water quality; nutrient and organic enrichments; Surface runoff - nutrients
- Altered sediment loads: Erosion; Siltation; Sedimentation
- Pesticides and herbicides
- Thermal changes: Altered temperature regime
- Urban, municipal, and industrial pollution: Surface runoff - contaminants

HABITAT CONVERSION
- Dams: Dams and altered flows; Impoundments
- Dredging and channelization: Channelization
- Riparian modification: Loss of floodplain; Lack of woody debris; Development in riparian zones; Riparian vegetation removal
- Wetland modification: Loss of wetlands (low threat)

BIOLOGICAL INTERACTIONS
- Invasive plants and animals: (low threat)

EDUCATION
- Social attitudes: Lack of understanding by riparian owners

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT

- Allow seasonal flooding (altered hydrologic regimes)
- Encourage use of natural materials or soft engineering techniques for modification (riparian modification)
- Maintain or rehabilitate natural corridors between wetlands and uplands (fragmentation, riparian modification)
- Maintain or establish riparian buffers to at least 50 ft., but 500 ft. or wider maximizes conservation benefits (altered hydrologic regimes, altered sediment loads, riparian modification)
- Preserve or rehabilitate woody riparian vegetation (riparian modification)
- Rehabilitate damaged wetland and stream hydrology (altered hydrologic regimes)
- Rehabilitate original hydrologic functions (altered hydrologic regimes)
- Rehabilitate streams to original flow paths (altered hydrologic regimes)
- Soften or remove hard stream riparian structures (riparian modification)
- Use sediment barriers and Best management practices during road and stream crossing constructions (altered sediment loads)
- Work with road commissions on maintenance and placement of new bridges (altered hydrologic regimes, fragmentation)

LAW & POLICY

- Avoid stream relocations (altered hydrologic regimes, dredging and channelization)
- Encourage townships to separate combined sewer systems (altered nutrient inflows)
- If culverts are necessary, use single large capacity culverts that match bankfull width (altered hydrologic regimes, fragmentation)
- Protect existing natural wetlands (wetland modification)
- Protect the public trust by requiring dam owners to make appropriate financial provisions for future dam removal (dams)
- Reduce effluent inflow (Urban, municipal, and industrial pollution)
- Remove dams to rehabilitate habitat (altered hydrologic regimes, dams, fragmentation)
- Remove unnecessary or abandoned dams, streams crossings, or enclosures (altered hydrologic regimes, fragmentation)
- Require remaining dams to operate flows to provide for run-of-the-river (altered hydrologic regimes, dams)
- Restrict dredging during spawning or migration seasons of fish and around mussel beds (dredging and channelization)
- Strengthen existing environmental laws and enforcement of permits controlling effluent discharge (thermal changes, Urban, municipal, and industrial pollution)
- Work with Drain Commissioners to limit amount of woody structure removed from a system (altered sediment loads)
- Work with local planning and zoning to develop ordinances that include natural processes (altered hydrologic regimes, altered sediment loads, riparian modification, wetland modification)

EDUCATION & AWARENESS

- Create awareness of environmental issues (social attitudes)
- Educate legislators, local planning boards, and other policy makers on the importance of natural processes (social attitudes)
- Educate private landowners and work with conservation groups to emphasize the value of riparian areas and woody structure in streams (riparian modification, social attitudes)
- Educate the public on prevention and control of aquatic invasive species (invasive plants and animals, social attitudes)

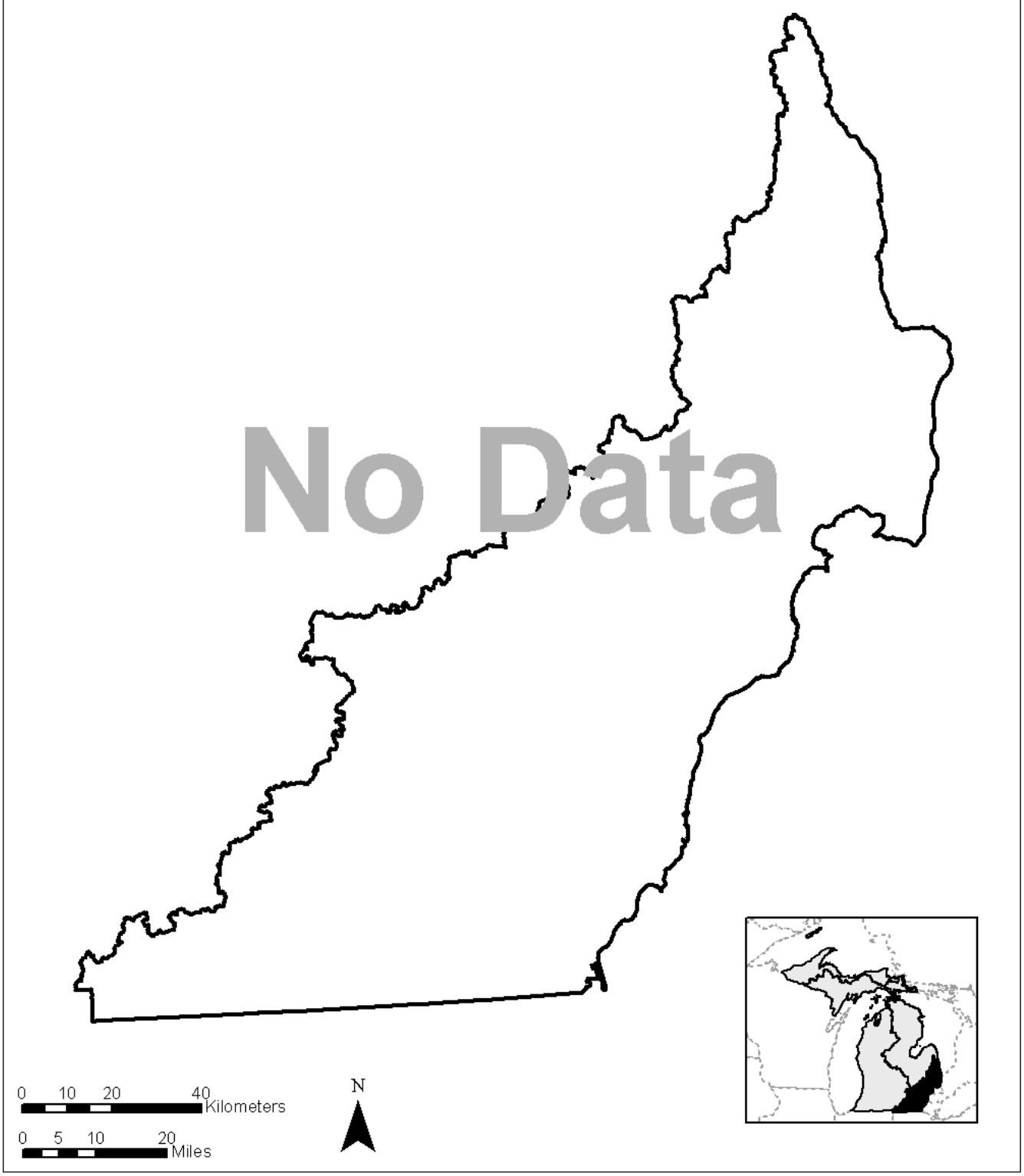
Research and Survey Needs

- Determine amount of riparian buffer needed to preserve different conservation values
- Determine life history requirements for SGCN associated with medium rivers, especially water temperature preferences
- Establish effective methods of communication with the public about stewardship
- Survey loadings of nutrients to streams and develop strategies to reduce problems
- Update the dam inventory and determine those dams which no longer serve a useful purpose

Monitoring

- Effluent discharges: waste water treatment plants, septic systems, industrial
- Invasive species
- Riparian modification (extent, condition, etc.)
- Stream temperatures

Rivers: Cold large rivers



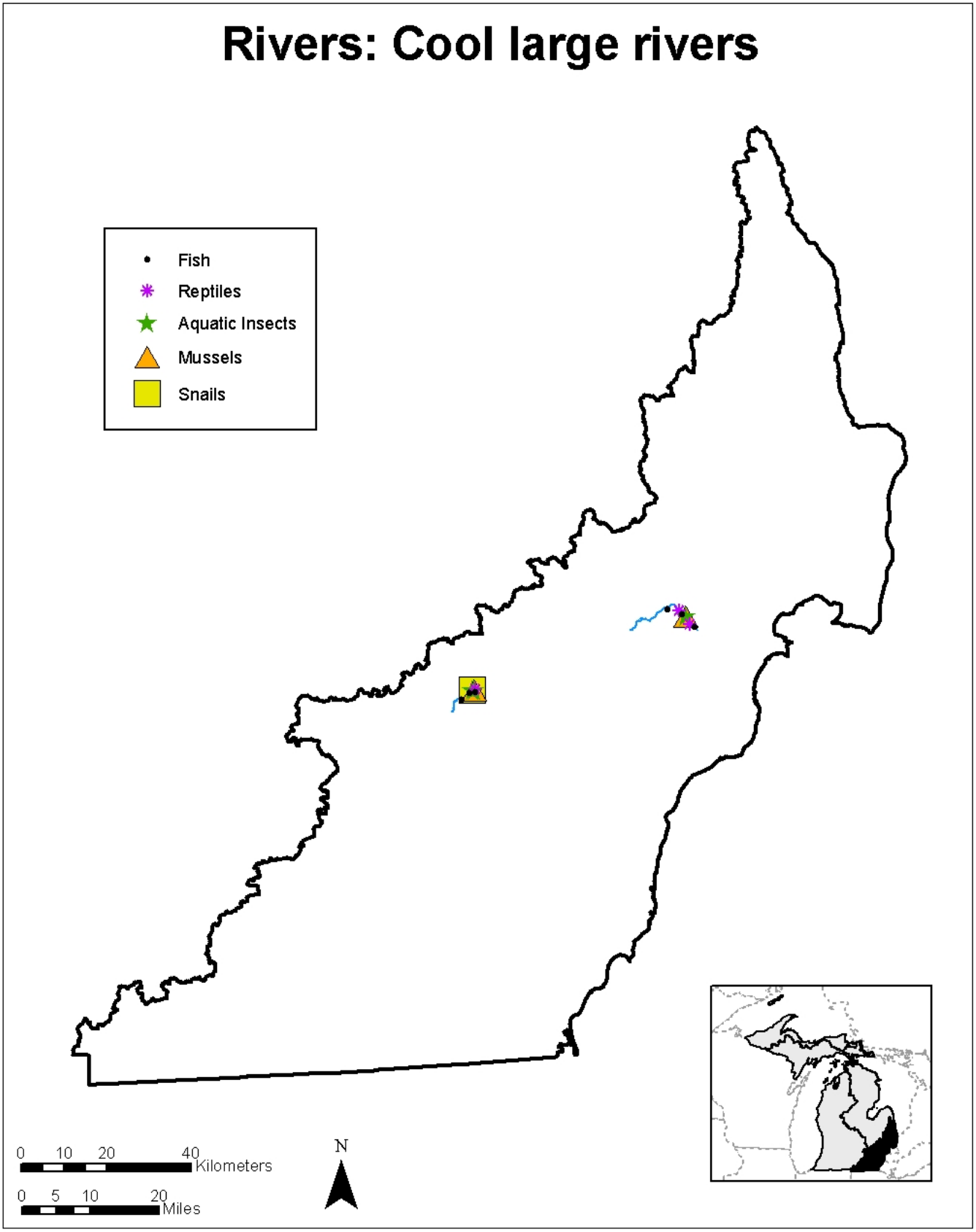
Rivers: Cold Large Rivers

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 19°C (66°F). In the Lake Erie basin these systems are rare.

General Condition of Feature

Cold large rivers do not occur in the Lake Erie basin.


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

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 19-22°C (66-72°F).

General Condition of Feature

This habitat is considered 25% in good to excellent condition, 40% in fair condition, and 35% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
rainbow (*Villosa iris*)

SNAILS
Specific associations with this landscape feature were not found in the literature

INSECTS
Specific associations with this landscape feature were not found in the literature

FISH
lake sturgeon (*Acipenser fulvescens*)
mooneye (*Hiodon tergisus*)

FISH cont.
silver shiner (*Notropis photogenis*)
spotted sucker (*Minytrema melanops*)
golden redhorse (*Moxostoma erythrurum*)
cisco or lake herring (*Coregonus artedi*)
channel darter (*Percina copelandi*)
river darter (*Percina shumardi*)
sauger (*Sander canadensis*)

REPTILES
Specific associations with this landscape feature were not found in the literature

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Increased surface runoff due to urbanization; Dam operations; Storm water management; Road crossings
- Fragmentation: Road crossings

POLLUTION
- Altered nutrient inflows: Eutrophication; Surface water runoff - nutrients
- Altered sediment loads: Construction and development runoff; Sedimentation
- Thermal changes
- Urban, municipal, and industrial pollution: Surface water runoff – contaminate

HABITAT CONVERSION
- Dams
- Dredging and channelization: Channelization; Dredging; Channel alteration
- Riparian modification: Armoring of banks; Loss of floodplain; Removal of large woody structure
- Wetland modification: Loss of wetlands (low threat)

BIOLOGICAL INTERACTIONS
- Invasive plants and animals

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Implement storm water and non-point source Best management practices (altered hydrologic regimes, thermal changes, Urban, municipal, and industrial pollution)
- Maintain, rehabilitate, and protect riparian areas (thermal pollution, riparian modification)
- Preserve woody riparian vegetation and in-stream woody structure (riparian modification)
- Protect and rehabilitate wetland and floodplains (riparian modification, wetland modification)
- Protect the natural hydrologic regime of streams by protecting existing wetlands and floodplains (altered hydrologic regimes, riparian modification, wetland modification)
- Use sediment barriers and Best management practices during road and stream crossing constructions (altered sediment loads)
- Work with road commissions on maintenance and placement of new bridges (altered hydrologic regimes, altered sediment loads, fragmentation)

LAW & POLICY

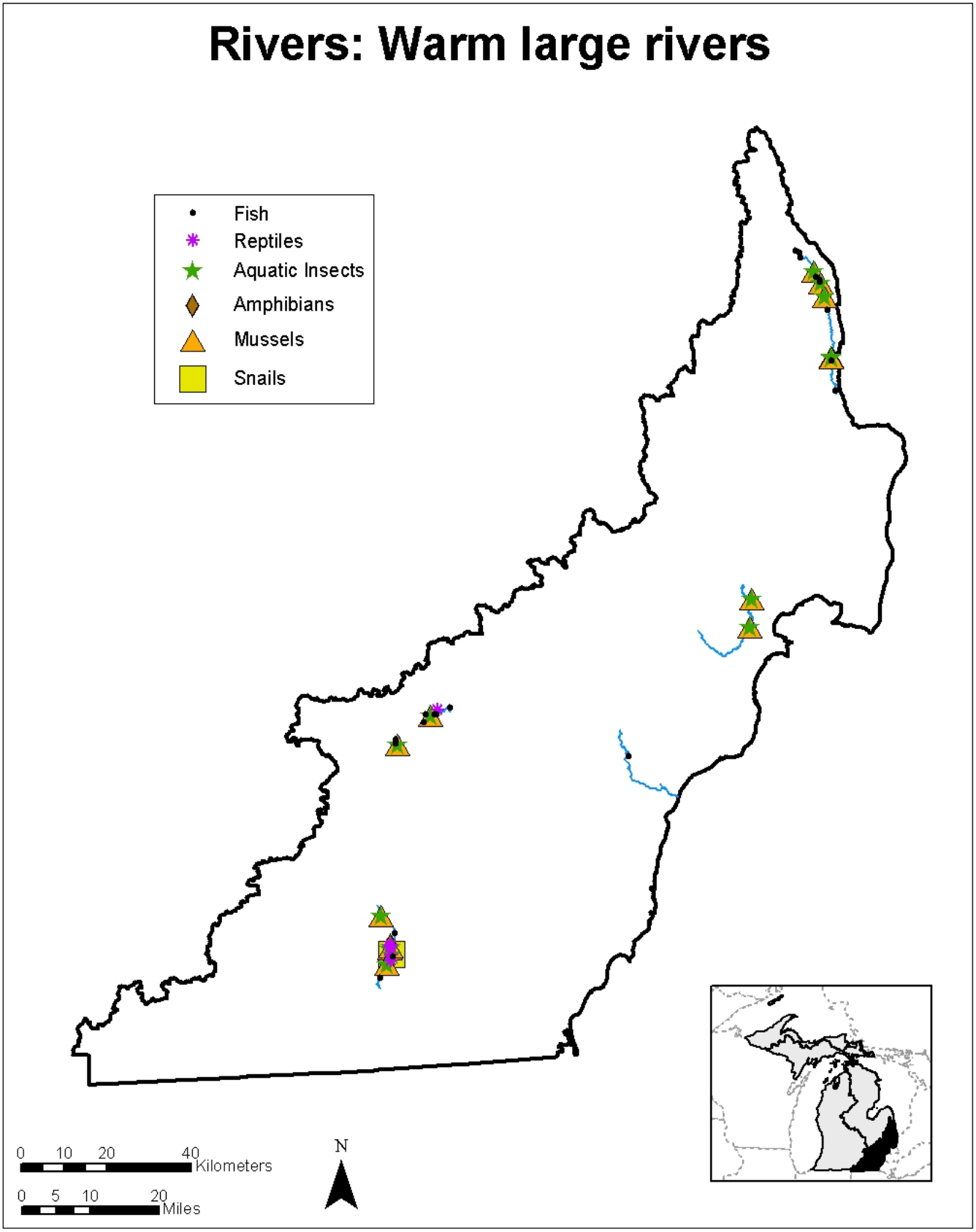
- Develop planning and zoning regulations and ordinances (altered hydrologic regimes, altered nutrient inflows, altered sediment loads, riparian modification, wetland modification)
- Operate dams in run-of-the-river mode (altered hydrologic regimes, dams)
- Protect the public trust by requiring dam owners to make appropriate financial provision for future dam removal (dams)
- Remove unnecessary dams to rehabilitate natural hydrology (altered hydrologic regimes, dams)
- Work with Drain Commissioners to find alternatives to maintenance dredging (altered hydrologic regimes, altered sediment loads, dredging and channelization, riparian modification)

Research and Survey Needs

- Determine amount and condition of riparian areas
- Determine number and condition of road crossings
- Investigate life history strategies of SGCN where this information is lacking
- Investigate alternatives to dams
- Model hydrologic flow of entire watersheds

Monitoring

- Dam operations
- Effluent discharges: waste water; septic systems, industrial
- Indicator species
- Riparian modification
- Stream water temperatures


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

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 22°C (72°F). These systems are common in the Lake Erie basin.

General Condition of Feature

This habitat is considered 35% in good to excellent condition, 30% in fair condition, and 35% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
Specific associations with this landscape feature were not found in the literature

SNAILS
Specific associations with this landscape feature were not found in the literature

INSECTS
Specific associations with this landscape feature were not found in the literature

FISH
river chub (*Nocomis micropogon*)
pugnose minnow (*Opsopoeodus emiliae*)

FISH cont.
lake chubsucker (*Erimyzon sucetta*)
spotted sucker (*Minytrema melanops*)
river redhorse (*Moxostoma carinatum*)
tadpole madtom (*Noturus gyrinus*)
pirate perch (*Aphredoderus sayanus*)

AMPHIBIANS
Specific associations with this landscape feature were not found in the literature

REPTILES
Specific associations with this landscape feature were not found in the literature

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Increased flashiness due to faster runoff due to urbanization; Road crossings
- Fragmentation: Road crossings

POLLUTION
- Altered sediment loads: Sediment inputs from erosion and development

HABITAT CONVERSION
- Dams
- Dredging and channelization: Channelization
- Riparian modification: Changes in riparian land use
- Wetland modification: Loss of wetlands (low threat)

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Encourage use of natural materials or soft engineering techniques for any shoreline modification (riparian modification)
- Maintain, rehabilitate, and protect riparian areas (altered hydrologic regimes, altered sediment loads, riparian modification)
- Preserve woody riparian vegetation and in-stream woody structure (riparian modification)
- Protect and rehabilitate wetlands and floodplains (altered hydrologic regimes, riparian modification, wetland modification)
- Protect the natural hydrologic regime of streams by protecting existing wetlands and floodplains (altered hydrologic regimes, riparian modification, wetland modification)
- Work with road commissions on maintenance and placement of new bridges (altered hydrologic regimes, altered sediment loads, fragmentation)

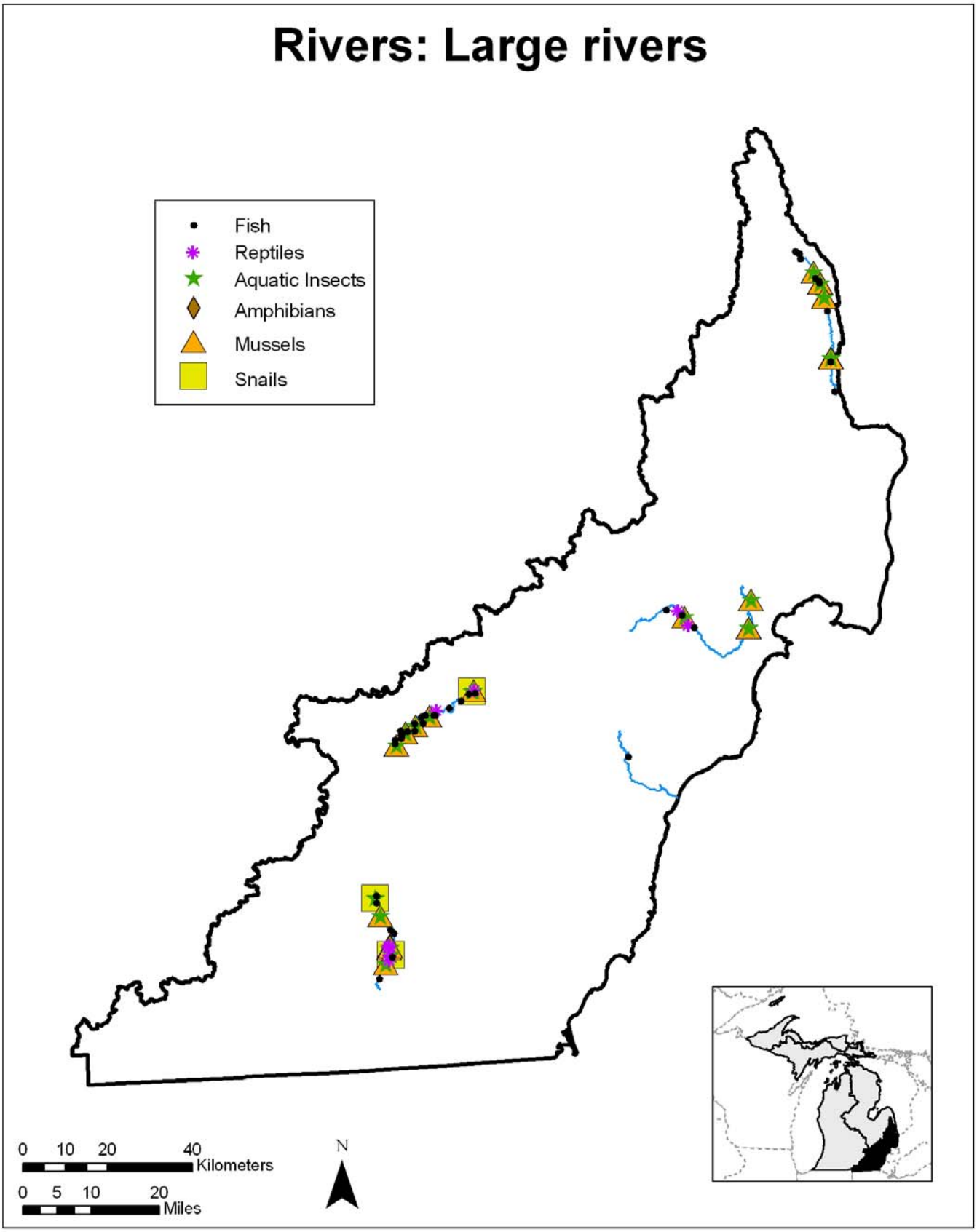
LAW & POLICY
- Operate dams in run-of-the-river mode (altered hydrologic regimes, dams)
- Protect the public trust by requiring dam owners to make appropriate financial provisions for future dam removal (dams)
- Remove unnecessary dams to rehabilitate natural hydrology and stream habitat (altered hydrologic regimes, dams, fragmentation)

Research and Survey Needs

- Determine amount and condition of riparian areas and investigate how much riparian buffer is needed to preserve different conservation values
- Determine number and condition of road crossings
- Establish effective methods of communicating with the public and enhancing their stewardship role
- Investigate life history strategies of SGCN where this information is lacking
- Explore alternatives to dams
- Model hydrologic flow of entire watersheds

Monitoring

- Dam operations
- Indicator species
- Riparian modification (extent, condition)
- Road crossings
- Stream water temperatures


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

General Condition of Feature

This habitat is considered 35% in good to excellent condition, 30% in fair condition, and 35% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
- slippershell mussel (*Alasmidonta viridis*)
- scaleshell (*Leptodea leptodon*)
- round pigtoe (*Pleurobema coccineum*)
- purple wartyback (*Cyclonaias tuber*culata)
- clubshell (*Pleurobema clava*)
- pimpleback (*Quadrula pustulosa*)
- salamander mussel (*Simpsonaias ambigua*)
- white catspaw (*Epioblasma obliquata perobliqua*)
- northern riffleshell (*Epioblasma torulosa rangiana*)
- snuffbox (*Epioblasma triquetra*)
- black sandshell (*Ligumia recta*)
- threehorn wartyback (*Obliquaria reflexa*)
- round hickorynut (*Obovaria subrotunda*)
- kidneyshell (*Ptychobranchus fasciolaris*)
- fawnsfoot (*Truncilla donaciformis*)

SNAILS
- Specific associations with this landscape feature were not found in the literature

INSECTS
- elusive snaketail (*Stylurus notatus*)
- a stonefly (*Taeniopteryx burksi*)
- a stonefly (*Taeniopteryx maura*)

FISH
- black buffalo (*Ictiobus niger*)
- northern madtom (*Noturus stigmosus*)

AMPHIBIANS
- Specific associations with this landscape feature were not found in the literature

REPTILES
- Specific associations with this landscape feature were not found in the literature

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Habitat loss and conversion due to flow changes; Increased flashiness due to runoff from development in watershed; Increased runoff due to urbanization; Road Crossings
- Fragmentation: Dam fragmentation; Road crossings

POLLUTION
- Altered sediment loads: Habitat loss and conversion due to sedimentation impacts; Upstream erosion and landscape sediment inputs affecting channel stability and hydraulics

HABITAT CONVERSION
- Dams
- Dredging and channelization: Channelization
- Riparian modification: Agricultural and urban land development in watershed; Riparian and in-stream wetland and macrophyte removal.
- Wetland modification: Loss of wetlands (low threat)

BIOLOGICAL INTERACTIONS
- Invasive plants and animals: (low threat)

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Macrophyte removal: Riparian and in-stream wetland and macrophyte removal (low threat)

EDUCATION
- Social attitudes: Need for public education

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Maintain, rehabilitate, and protect riparian buffers (altered hydrologic regimes, altered sediment loads, riparian modification)
- Protect existing natural hydrologic regimes by protection of wetlands and floodplains (altered hydrologic regimes, wetland modification)
- Rehabilitate original hydrologic functions (i.e., connect meanders, throughflow, wetlands) (altered hydrologic regimes)
- Rehabilitate rivers to original flow paths (altered hydrologic regimes)

- Work with road commissions to site and maintain road crossings (altered hydrologic regimes, altered sediment loads, fragmentation)

LAW & POLICY

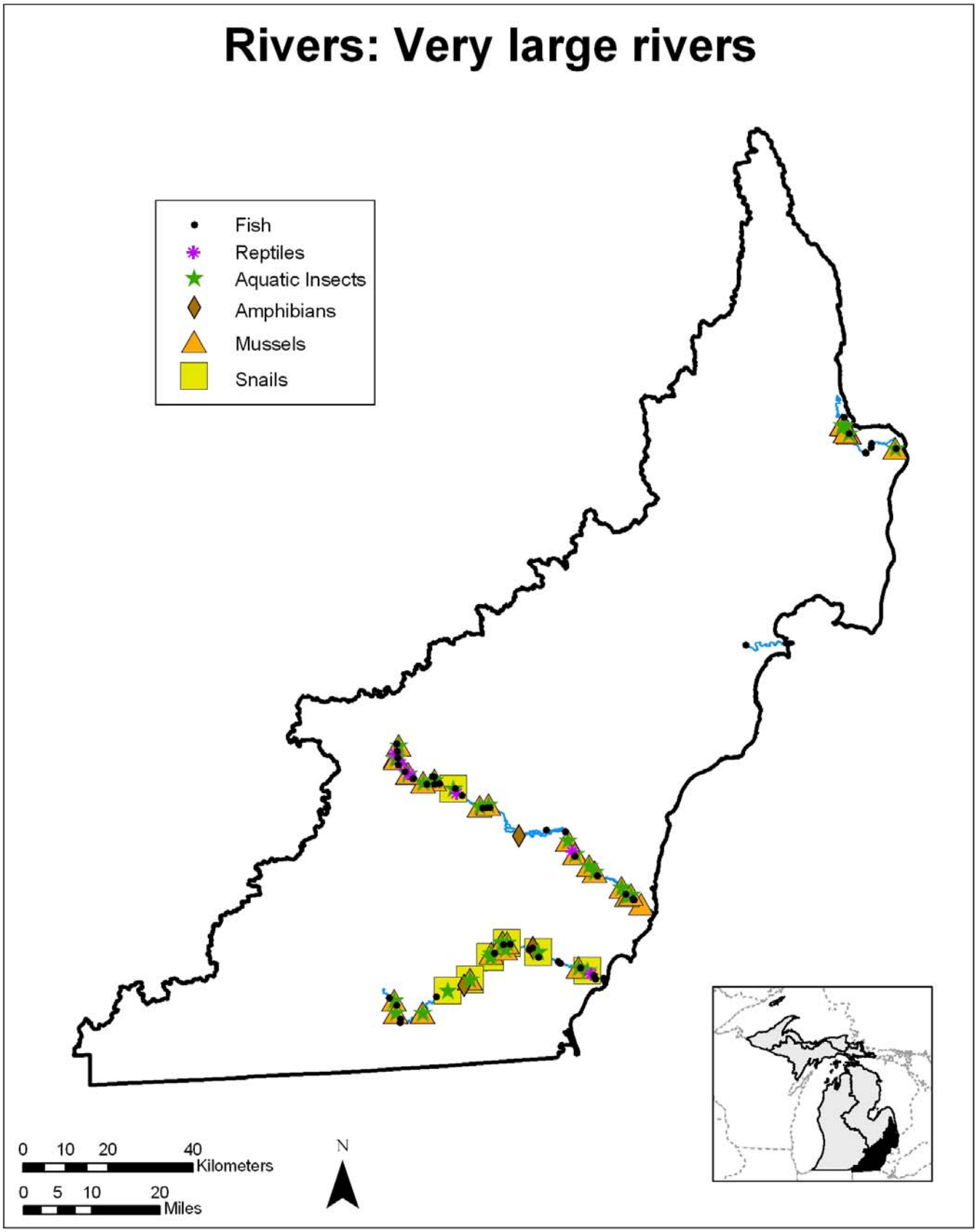
- Operate dams to provide for run-of-the-river flows (altered hydrologic regimes, dams)
- Protect the public trust by requiring dam owners to make appropriate financial provisions for future dam removal (dams)
- Remove dams to rehabilitate natural hydrology (altered hydrologic regimes, dams)

Research and Survey Needs

- Create a hydrologic model of the watershed
- Determine life history requirements for SGCN associated with large rivers, especially water temperature preferences
- Determine the dams that are no longer necessary
- Determine the number and condition of areas that are disconnected from rivers and how to rehabilitate them
- Determine the number of eroding road crossings and conduct rehabilitation actions
- Explore alternatives to dams
- Explore ways to decrease imperviousness in watersheds

Monitoring

- Dam operations
- Riparian modification
- Road crossings
- Stream water temperatures
- Wetland modification


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

General Condition of Feature

This habitat is considered 70% in fair condition and 30% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
Specific associations with this landscape feature were not found in the literature

SNAILS
Specific associations with this landscape feature were not found in the literature

INSECTS
Specific associations with this landscape feature were not found in the literature

FISH
lake sturgeon (*Acipenser fulvescens*)
silver chub (*Macrhybopsis storeriana*)
river chub (*Nocomis micropogon*)

FISH cont.
pugnose minnow (*Opsopoeodus emiliae*)
black buffalo (*Ictiobus niger*)
spotted sucker (*Minytrema melanops*)
river redhorse (*Moxostoma carinatum*)
cisco or lake herring (*Coregonus artedi*)
sauger (*Sander canadensis*)

AMPHIBIANS
Specific associations with this landscape feature were not found in the literature

REPTILES
Specific associations with this landscape feature were not found in the literature

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Power plant intakes and discharges; Altered flow regime
- Climate change
- Fragmentation: Habitat fragmentation due to dams

POLLUTION
- Altered nutrient inflows: (low threat)
- Altered sediment loads
- Pesticides and herbicides: Contaminated sediments
- Thermal changes: Power plant discharges; Altered thermal regime
- Urban, municipal, and industrial pollution: Contaminated sediments; Chemical mills on the Canadian side of St. Clair River; Degraded water quality

HABITAT CONVERSION
- Dams: Habitat fragmentation
- Dredging and channelization: Shipping and navigation maintenance; Dredging
- Riparian modification: Shoreline hardening; Shoreline modification and loss of connected wetlands
- Wetland modification: Loss of wetlands

BIOLOGICAL INTERACTIONS
- Invasive plants and animals

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Macrophyte removal: Aquatic vegetation removal

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Encourage the use of best management practices (altered hydrologic regimes, altered nutrient inflows, altered sediment loads, riparian modification)
- Engineered drainage channels should mimic natural stream channel stability (channel dimension, pattern, and profile) (altered hydrologic regimes, altered sediment loads)
- Maintain, rehabilitate, and protect riparian buffers (altered hydrologic regimes, altered sediment loads, riparian modification)
- Preserve woody riparian vegetation to reduce sedimentation (altered sediment loads)

- Prevent establishment of more aquatic invasive species (invasive plants and animals)
- Protect existing natural wetlands and floodplains and rehabilitate damaged and degraded wetlands and floodplains (wetland modification)
- Reduce pesticide and herbicide use (pesticides and herbicides)
- When removing exotic vegetation, at least 60-80% of native vegetation should be preserved (invasive – animals and plants, macrophyte removal)
- Require all vegetation management to occur in conjunction with a watershed management plan (macrophyte removal)
- Rehabilitate natural flora (macrophyte removal, riparian modification)
- Soften or remove hard steam structures (riparian modification)
- Use natural materials or soft engineering techniques for riparian modification (riparian modification)
- Use sediment barriers and Best management practices during road and stream crossing construction (altered sediment loads)

LAW & POLICY

- Implement ballast control regulations (invasive plants and animals)
- No open water disposal of dredging spoils (dredging and channelization)
- Reduce effluent flows (thermal changes, Urban, municipal, and industrial pollution)
- Restrict dredging activities during spawning and migration seasons (dredging and channelization)
- Strengthen water quality laws (altered hydrologic regimes and all pollution threats)

EDUCATION & AWARENESS

- Educate landowners on the value and ecological services of macrophytes (macrophyte removal, social attitudes)
- Educate the public on prevention and control of aquatic invasive species (invasive plants and animals, social attitudes)
- Increase awareness of effects of aquatic invasive species on the ecosystem (invasive plants and animals, social attitudes)
- Work with Extension and Natural Resource Conservation services to educate farmers and landowners on natural processes and ecological services (social attitudes)

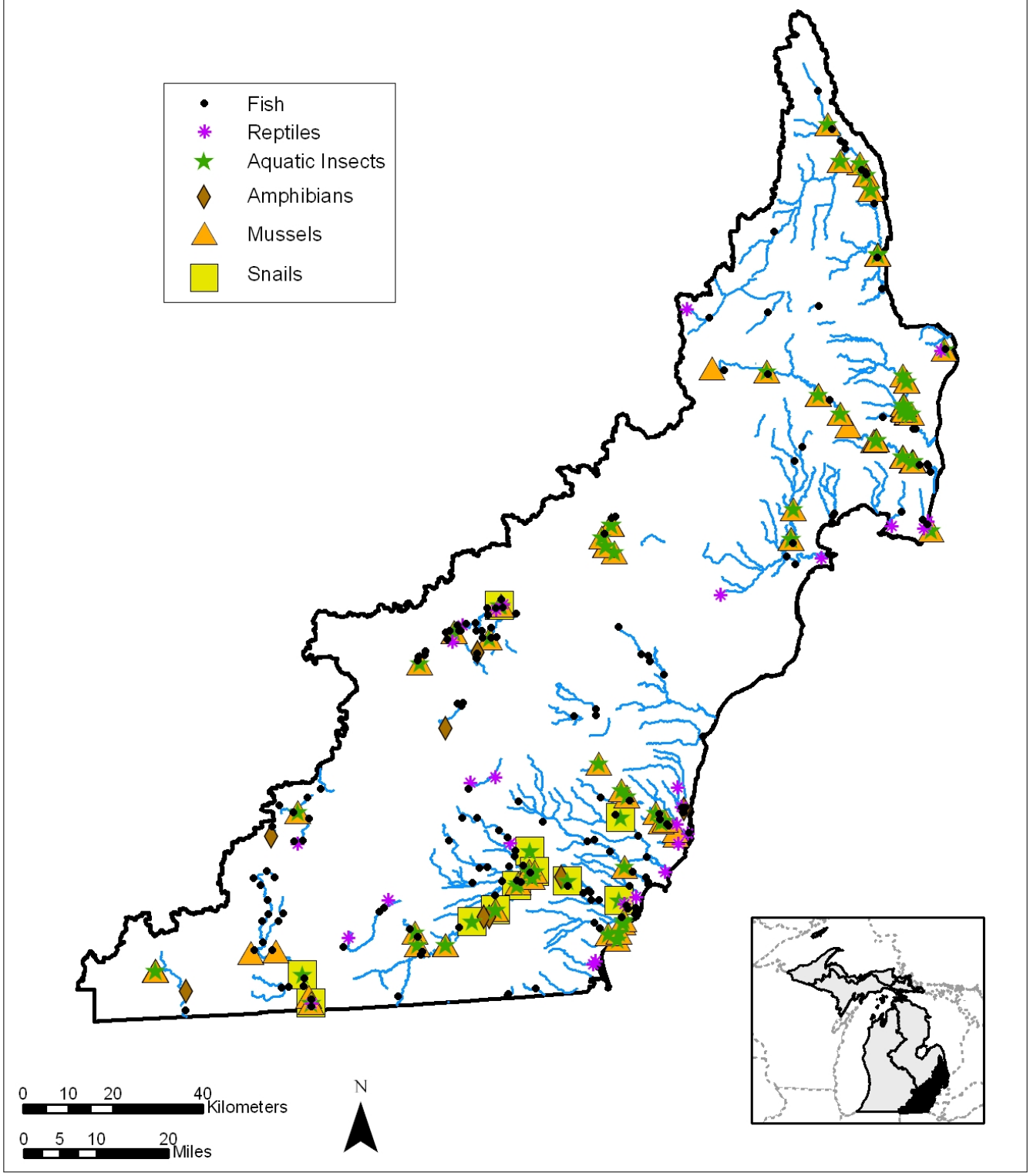
Research and Survey Needs

- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Conduct inventories to determine problem erosion sites
- Develop biological controls of aquatic invasive species
- Develop early detection, rapid response protocols for aquatic invasive species
- Establish effective methods of communicating with the public and enhancing their stewardship role
- Inventory the number and condition of wetlands less than 5 acres
- Investigate life history strategies of SGCN where this information is lacking

Monitoring

- Aquatic invasive species
- Industrial effluent
- Municipal wastewater treatment plants
- Riparian modification
- Storm water flows
- Wetland and floodplain modification

River Characteristic: Gradient - Slow



River Characteristic: Gradient – Slow

Description

Gradient is the general slope, or the change in vertical elevation per unit of horizontal distance, of the water surface in a flowing stream. Slow gradient is defined as having a change in the vertical elevation of the water surface of a flowing stream ranging from 0.0-3.9 feet per mile.

General Condition of Feature

This habitat is considered 20% in good to excellent condition, 30% in fair condition, and 50% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
- cylindrical papershell (*Anodontoides ferussacianus*)
- eastern pondmussel (*Ligumia nasuta*)
- round hickorynut (*Obovaria subrotunda*)
- fawnsfoot (*Truncilla donaciformis*)

SNAILS
- Specific associations with this landscape feature were not found in the literature

CRAYFISH
- digger crayfish (*Fallicambarus fodiens*)

INSECTS
- a sand minnow mayfly (*Siphloplecton basale*)
- splendid clubtail (*Gomphus lineatifrons*)
- Laura's snaketail (*Stylurus laurae*)
- a stonefly (*Taeniopteryx burksi*)
- a stonefly (*Taeniopteryx maura*)
- a stonefly (*Paracapnia opis*)

FISH
- lake sturgeon (*Acipenser fulvescens*)
- mooneye (*Hiodon tergisus*)
- redside dace (*Clinostomus elongatus*)
- striped shiner (*Luxilus chrysocephalus*)
- silver chub (*Macrhybopsis storeriana*)
- pugnose shiner (*Notropis anogenus*)
- pugnose minnow (*Opsopoeodus emiliae*)
- finescale dace (*Phoxinus neogaeus*)

FISH cont.
- western creek chubsucker (*Erimyzon claviformis*)
- lake chubsucker (*Erimyzon sucetta*)
- spotted sucker (*Minytrema melanops*)
- golden redhorse (*Moxostoma erythrurum*)
- brown bullhead (*Ameiurus nebulosus*)
- tadpole madtom (*Noturus gyrinus*)
- brindled madtom (*Noturus miurus*)
- grass pickerel (*Esox americanus*)
- pirate perch (*Aphredoderus sayanus*)
- fantail darter (*Etheostoma flabellare*)
- least darter (*Etheostoma microperca*)
- orangethroat darter (*Etheostoma spectabile*)
- channel darter (*Percina copelandi*)
- river darter (*Percina shumardi*)
- sauger (*Sander canadensis*)

AMPHIBIANS
- smallmouth salamander (*Ambystoma texanum*)
- four-toed salamander (*Hemidactylium scutatum*)
- mudpuppy (*Necturus maculosus maculosus*)
- Blanchard's cricket frog (*Acris crepitans blanchardi*)

REPTILES
- copperbelly water snake (*Nerodia erythrogaster neglecta*)
- queen snake (*Regina septemvittata*)
- Blanding's turtle (*Emydoidea blandingii*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Flow flashiness due to faster runoff from storm water management
- Fragmentation

POLLUTION
- Altered nutrient inflows: Altered macrophytes; Altered water quality related to dissolved oxygen; Nutrient enrichment
- Altered sediment loads: Sedimentation due to increased inputs from construction; Sedimentation; Siltation
- Urban, municipal, and industrial pollution: Contaminated sediments

HABITAT CONVERSION
- Dredging and channelization: Channelization; Dredging
- Riparian modification: Altered banks and riparian areas; Lack of woody debris; Loss of riparian habitat; bank armoring and manipulation and macrophyte removal
- Wetland modification: Loss of wetlands (low threat)

BIOLOGICAL INTERACTIONS
- Invasive plants and animals

EDUCATION
- Social attitudes: Need for public education

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Encourage use of natural materials or soft engineering techniques for riparian modification (riparian modification)

- Implement Best management practices (variety of threats)
- Maintain and rehabilitate natural corridors between significant habitats such as wetlands and other water bodies (fragmentation, riparian modification)
- Maintain stream crossings (altered hydrologic regimes, altered sediment loads)
- Maintain, rehabilitate, and protect riparian buffers (altered hydrologic regimes, altered sediment loads, riparian modification)
- Prevent and control aquatic invasive species introductions and establishments (invasive plants and animals)
- Protect and rehabilitate groundwater recharge (altered hydrologic regimes)
- Protect, maintain, and rehabilitate wetlands and floodplains (altered hydrologic regimes, altered sediment loads, wetland modification)
- Use sediment barriers and best management practices during road and stream crossing construction (altered sediment loads)
- Vegetation management should be preformed in conjunction with a watershed management plan (invasive plants and animals, riparian modification)
- Work with road commissions on siting and maintaining road crossings (altered hydrologic regimes, altered sediment loads)

LAW & POLICY

- Avoid stream relocations (dredging and channelization)
- Engineered drainage channels should mimic natural stream channel stability (altered hydrologic regimes, altered sediment loads, dredging and channelization)
- Pipeline and utility crossings should use existing crossings and bore and jack or directional drill installation (altered hydrologic regimes, altered sediment loads)
- Work with Drain Commissioners to use natural channel processes to allow a river to manage sediment and flow (altered hydrologic regimes, altered sediment loads, dredging and channelization, riparian modification)
- Work with local officials on setback and buffer ordinances (riparian modification)

EDUCATION & AWARENESS

- Educate landowners on the value of riparian areas (riparian modification, social attitudes)

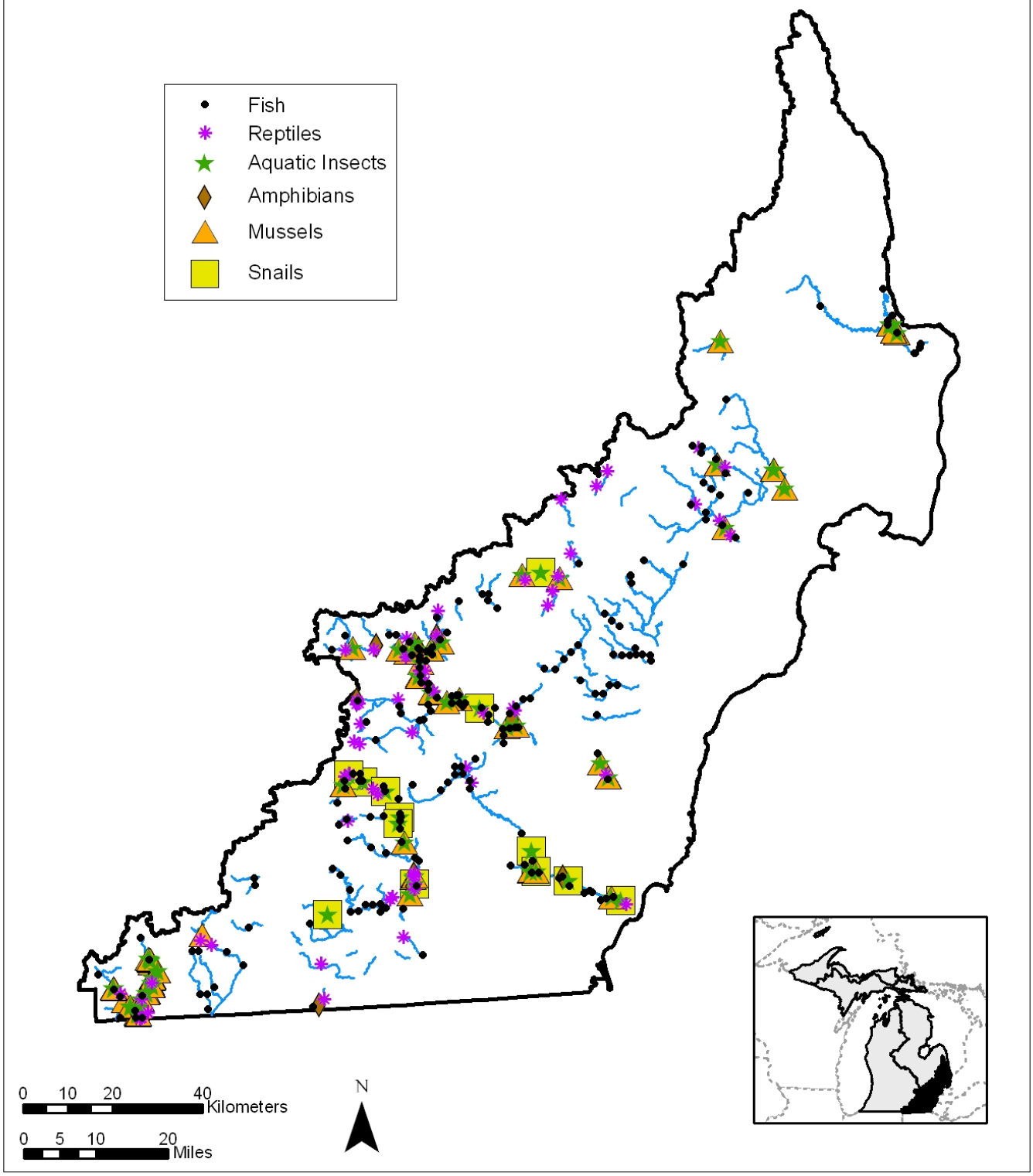
Research and Survey Needs

- Determine effective control and prevention techniques for aquatic invasive species
- Determine life history requirements for SGCN associated with slow gradients
- Determine ways to decrease imperviousness in the watershed
- Survey sediment loadings to stream and develop strategies to reduce problems

Monitoring

- Aquatic invasive species
- Riparian modification
- Stream crossings
- Wetland and floodplain modification

River Characteristic: Gradient - Moderate



River Characteristic: Gradient – Moderate

Description

Gradient is the general slope, or the change in vertical elevation per unit of horizontal distance, of the water surface in a flowing stream. Moderate gradient is defined as having a change in the vertical elevation of the water surface of a flowing stream ranging from 4.0-9.9 feet per mile.

General Condition of Feature

This habitat is considered 25% in good to excellent condition, 35% in fair condition, and 40% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
- scaleshell (*Leptodea leptodon*)
- round pigtoe (*Pleurobema coccineum*)
- ellipse (*Venustaconcha ellipsiformis*)
- rainbow (*Villosa iris*)
- purple wartyback (*Cyclonaias tuberculata*)
- creek heelsplitter (*Lasmigona compressa*)
- snuffbox (*Epioblasma triquetra*)
- black sandshell (*Ligumia recta*)
- threehorn wartyback (*Obliquaria reflexa*)
- round hickorynut (*Obovaria subrotunda*)
- kidneyshell (*Ptychobranchus fasciolaris*)
- purple lilliput (*Toxolasma lividus*)

SNAILS
- Specific associations with this landscape feature were not found in the literature

INSECTS
- rapids clubtail (*Gomphus quadricolor*)
- elusive snaketail (*Stylurus notatus*)
- smoky rubyspot (*Hetaerina titia*)

FISH
- lake sturgeon (*Acipenser fulvescens*)
- mooneye (*Hiodon tergisus*)
- redside dace (*Clinostomus elongatus*)
- striped shiner (*Luxilus chrysocephalus*)
- silver chub (*Macrhybopsis storeriana*)
- silver shiner (*Notropis photogenis*)
- black buffalo (*Ictiobus niger*)
- spotted sucker (*Minytrema melanops*)
- river redhorse (*Moxostoma carinatum*)
- black redhorse (*Moxostoma duquesnei*)
- golden redhorse (*Moxostoma erythrurum*)
- stonecat (*Noturus flavus*)
- eastern sand darter (*Ammocrypta pellucida*)
- fantail darter (*Etheostoma flabellare*)

AMPHIBIANS
- Specific associations with this landscape feature were not found in the literature

REPTILES
- queen snake (*Regina septemvittata*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Increased runoff due to urbanization; Hydraulic regime changes - storm flow periodicity and channel adjustment; Due to dams
- Fragmentation

POLLUTION
- Altered sediment loads: Erosion; Sedimentation; Bank stability; Woody debris dams
- Pesticides and herbicides
- Urban, municipal, and industrial pollution

HABITAT CONVERSION
- Dams: Dam operations - lake level management impacts on river flows; Loss of riffle habitat due to dams
- Dredging and channelization: Channelization; Loss of riffle habitat due to channelization
- Riparian modification: Altered riparian land cover; Altered banks; Flood plain alteration; Some stream armoring; Loss of riparian vegetation; Loss of floodplains
- Wetland modification: Loss of wetlands (low threat)

BIOLOGICAL INTERACTIONS
- Invasive plants and animals

EDUCATION
- Social attitudes: Lack of education on how lake level management affects rivers

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Control aquatic invasive species (invasive plants and animals)
- Prevent establishment of new aquatic invasive species (invasive plants and animals)
- Protect and rehabilitate groundwater recharge (altered hydrologic regimes)

- Rehabilitate original hydrologic functions (i.e., connect meanders, throughflow, wetlands) (altered hydrologic regimes)
- Rehabilitate, maintain, and protect wetlands and riparian buffers (riparian modification, wetland modification)
- Use sediment barriers and Best management practices during road and stream crossing constructions (altered sediment loads)
- Work with road commissions to site and maintain stream crossings (altered hydrologic regimes, altered sediment loads)

LAW & POLICY

- Avoid stream relocations (dredging and channelization)
- Encourage clustered development and green-space planning (riparian modification)
- Remove unnecessary dams and stream enclosures to rehabilitate natural hydrologic flow (altered hydrologic regimes)
- Restrict dredging and channelization during fish spawning and migration periods and around mussel beds (dredging and channelization)
- Work with Drain Commissioners to use natural channel processes to allow a river to manage sediment and flow and decrease the amount of channelization needed (altered hydrologic regimes, altered sediment loads, dredging and channelization, riparian modification, wetland modification)
- Work with planning and zoning boards to establish zoning and setback regulations (altered hydrologic regimes, altered sediment loads, riparian modification, wetland modification)

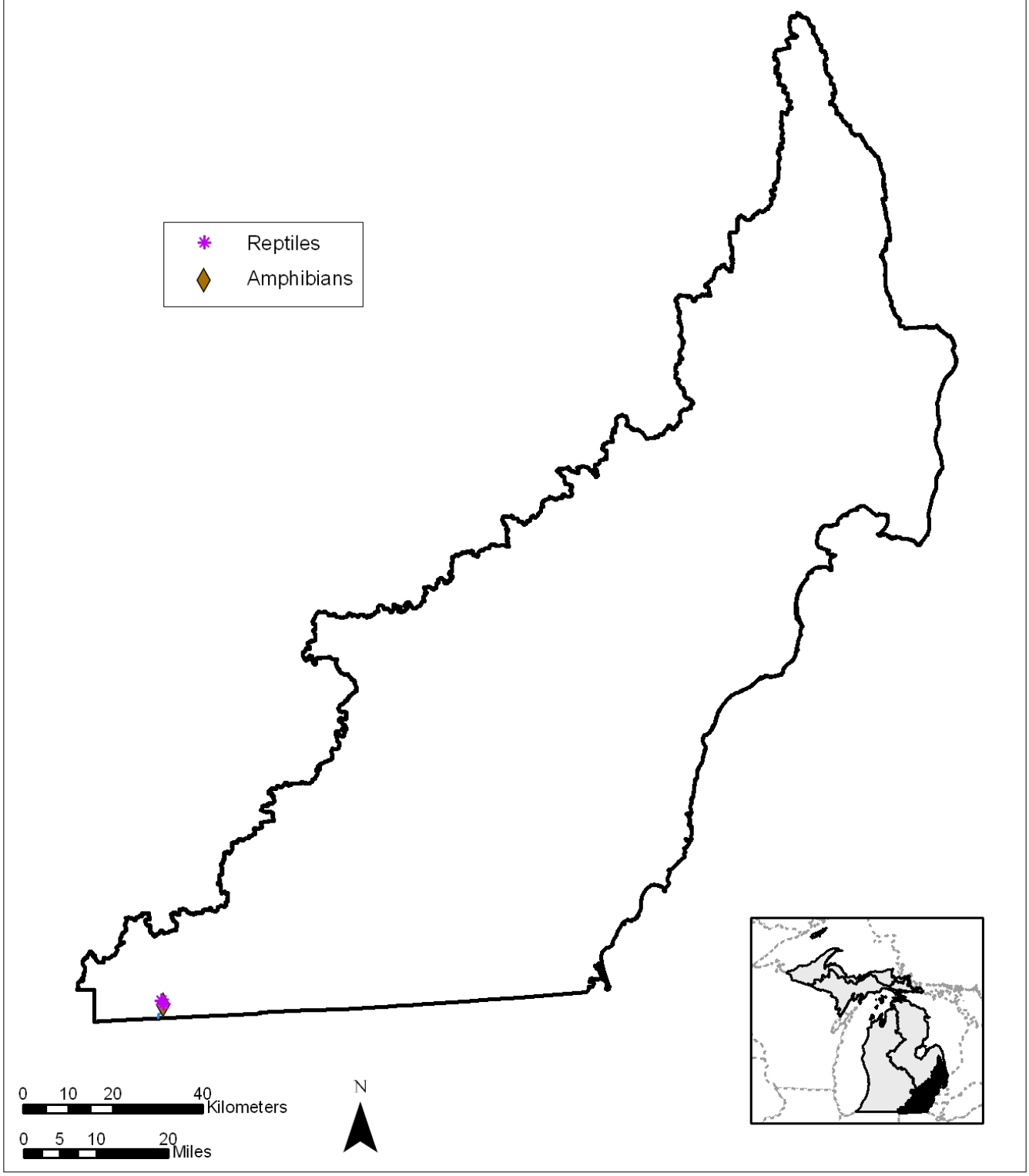
Research and Survey Needs

- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Determine life history requirements for SGCN associated with moderate gradient rivers
- Develop alternatives to current drainage practices
- Inventory eroding stream sites
- Model hydrologic flow of the entire watershed
- Survey sediment loading to the watershed

Monitoring

- Aquatic invasive species
- Dredging activities
- Erosion sites
- Riparian modification
- Road crossings
- Sediment loading

River Characteristic: Gradient - Fast



River Characteristic: Gradient – Fast

Description

Gradient is the general slope, or the change in vertical elevation per unit of horizontal distance, of the water surface in a flowing stream. The fast gradient category is defined as having a change in the vertical elevation of the water surface of a flowing stream ranging from 10.0-69.9 feet per mile.

General Condition of Feature

This habitat is considered 20% in good to excellent condition, 30% in fair condition, and 40% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
snuffbox (*Epioblasma triquetra*)

INSECTS
a sand minnow mayfly (*Siphloplecton basale*)
rapids clubtail (*Gomphus quadricolor*)

FISH
lake sturgeon (*Acipenser fulvescens*)
silver chub (*Macrhybopsis storeriana*)
river chub (*Nocomis micropogon*)
silver shiner (*Notropis photogenis*)
river redhorse (*Moxostoma carinatum*)
black redhorse (*Moxostoma duquesnei*)

FISH cont.
golden redhorse (*Moxostoma erythrurum*)
stonecat (*Noturus flavus*)
northern madtom (*Noturus stigmosus*)
eastern sand darter (*Ammocrypta pellucida*)
fantail darter (*Etheostoma flabellare*)

AMPHIBIANS
Specific associations with this landscape feature were not found in the literature

REPTILES
Specific associations with this landscape feature were not found in the literature

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Development causing runoff changes (usually faster) and loss of recharge areas; Altered flow regime due to urbanization
- Fragmentation

POLLUTION
- Altered sediment loads: Bank erosion and riparian sediment erosion into stream; Sedimentation
- Thermal changes: Altered temp regime

HABITAT CONVERSION
- Dams
- Dredging and channelization: Channelization
- Riparian modification: Loss of natural floodplain; Altered banks; Riparian corridor vegetation removal and changes; Loss of woody debris

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Protect and rehabilitate groundwater recharge (altered hydrologic regimes)
- Rehabilitate original hydrologic functions (i.e., connect meanders, throughflow, wetlands) (altered hydrologic regimes)
- Rehabilitate, maintain, and protect wetlands and riparian buffers (altered hydrologic regimes, altered sediment loads, thermal changes, riparian modification)
- Use sediment barriers and Best management practices during road and stream crossing construction (altered sediment loads)
- Work with road commissions to site and maintain stream crossings (altered hydrologic regimes, altered sediment loads)

LAW & POLICY
- Avoid stream relocations (dredging and channelization)
- Protect the public trust by requiring dam owners to make appropriate financial provisions for future dam removal or perpetual maintenance (dams)
- Remove unnecessary dams and stream enclosures to rehabilitate natural hydrologic flow and functions (altered hydrologic regimes, dams)
- Restrict dredging and channelization during fish spawning and migration periods and around mussel beds (dredging and channelization)

- Work with Drain Commissioners to use natural channel processes to allow a river to manage sediment and flow and decrease the amount of channelization needed (altered hydrologic regimes, altered sediment loads, dredging and channelization, riparian modification)
- Work with local officials on setback and buffer ordnances (riparian modification)
- Work with planning and zoning boards to establish zoning and setback regulations (variety of threats)

Research and Survey Needs

- Determine life history requirements for SGCN associated with fast gradient
- Determine the number and condition of road crossings
- Determine the number of unnecessary dams and stream enclosures
- Explore other options to dams
- Model hydrologic flow

Monitoring

- Dam operations
- Riparian buffers
- Stream crossings (types of bridges and culverts being used, erosion sites, etc.)

River Characteristic: Gradient - Very Fast

River Characteristic: Gradient – Very Fast

Description

Gradient is the general slope, or the change in vertical elevation per unit of horizontal distance, of the water surface in a flowing stream. The very fast gradient is defined as having a change in the vertical elevation of the water surface of a flowing stream greater than 70.0 feet per mile.

General Condition of Feature

Very fast gradient streams do not occur in the Lake Erie basin.

River Characteristic: Sand Banks

River Characteristic: Sand Banks

Description

Banks are the ground bordering a channel above the streambed and below the level of rooted vegetation that often has a gradient steeper than 45° and exhibits a distinct break in slope from the stream bottom; the portion of the channel cross section that restricts lateral movement of water during normal streamflow. Sand banks are predominantly composed of particles between 0.062 and 2 mm (0.00003-0.01 in) in diameter.

General Condition of Feature

No data available.

Associated Species of Greatest Conservation Need

In the literature examined for species habitat information, sand banks were not mentioned.

Associated Threats

CONSUMPTIVE BIOLOGICAL RESOURCE USE

- Mining practices: sand and gravel mining

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT

- Rehabilitate and protect riparian buffers (riparian modifications)

LAW & POLICY

- Require mitigation and remediation for mining affects (riparian modifications)
- Restrict sand removal during spawning and migration times (riparian modifications)

Research and Survey Needs

- Determine life history requirements for SGCN associated with sand banks
- Determine the location and conditions of sand banks in this basin
- Determine the needs of redside dace for this habitat
- Determine what other species require sand banks for all or part of their life history

Monitoring

- Riparian modification
- Sand and gravel mining
- Species that require sand bank habitat

River Characteristic: Clay Banks

River Characteristic: Clay Banks

Description

Banks are the ground bordering a channel above the streambed and below the level of rooted vegetation that often has a gradient steeper than 45° and exhibits a distinct break in slope from the stream bottom; the portion of the channel cross section that restricts lateral movement of water during normal streamflow. Clay banks are predominantly composed of natural earthy material which is plastic when wet, and consist essentially of hydrated silicates of aluminum, less than 4µm.

General Condition of Feature

This habitat is considered 10% in good to excellent condition, 30% in fair condition, and 60% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

SNAILS
brown walker (*Pomatiopsis cincinnatiensis*)

INSECTS
Cantrall's bog beetle (*Liodessus cantralli*)

Associated Threats

HABITAT CONVERSION
- Riparian modification: Development in riparian zones

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Rehabilitate and protect riparian buffers (riparian modification)

LAW & POLICY
- Restrict clay removal during spawning and migration times (riparian modification)

Research and Survey Needs
- Determine life history requirements of land snails and aquatic insects that are SGCN
- Determine the location and conditions of clay banks in this basin
- Determine the needs of redside dace for this habitat
- Determine what other species require clay banks for all or part of their life history

Monitoring
- Clay removal operations, including individuals
- Riparian modification
- Species that require clay bank habitat

River Characteristic: Rock Banks

River Characteristic: Rock Banks

Description

Banks are the ground bordering a channel above the streambed and below the level of rooted vegetation that often has a gradient steeper than 45° and exhibits a distinct break in slope from the stream bottom; the portion of the channel cross section that restricts lateral movement of water during normal streamflow. Rock banks are predominantly composed of a mass of stone of any size, consolidated or unconsolidated, of various mineral compositions.

General Condition of Feature

No data available.

Associated Species of Greatest Conservation Need

FISH

lake sturgeon (*Acipenser fulvescens*)

Associated Threats

HABITAT CONVERSION

- Riparian modifications

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT

- Rehabilitate and protect riparian buffers (riparian modification)

LAW & POLICY

- Require mitigation and remediation for rock removal (riparian modification)
- Restrict rock removal during spawning and migration times (riparian modification)

Research and Survey Needs

- Determine the amount and condition of rock banks in this basin
- Determine the amount of use by SGCN of rock banks
- Determine what other species require rock banks for all or part of their life history

Monitoring

- Species that require rock bank habitat
- Rock removal operations
- Riparian modification

River Characteristic: Intermittent

River Characteristic: Intermittent

Description

Intermittent flows are waters that flow or exist sporadically or periodically often due to surface water runoff. Intermittent flows often occur at certain times of the year when groundwater levels are adequate and may cease entirely in low water years or be reduced to a series of separated pools.

General Condition of Feature

No data available.

Associated Species of Greatest Conservation Need

In the literature examined for species habitat information, intermittent was not mentioned.

Associated Threats

MODIFICATION OF NATURAL PROCESSES

- Altered hydrologic regimes

HABITAT CONVERSION

- Riparian modification: enclosures, filling, drainage tiles

EDUCATION

- Social attitudes: The importance of these systems are often not understood

Conservation Actions Needed (Threats addressed)

LAW & POLICY

- Continue working with and educating Drain Commissioners (altered hydrologic regimes, riparian modification, social attitudes)
- Develop planning and zoning regulations that address intermittent streams (altered hydrologic regimes, riparian modification)
- Protect areas that become intermittent streams

EDUCATION & AWARENESS

- Educate the public on the value of intermittent streams (social attitudes)

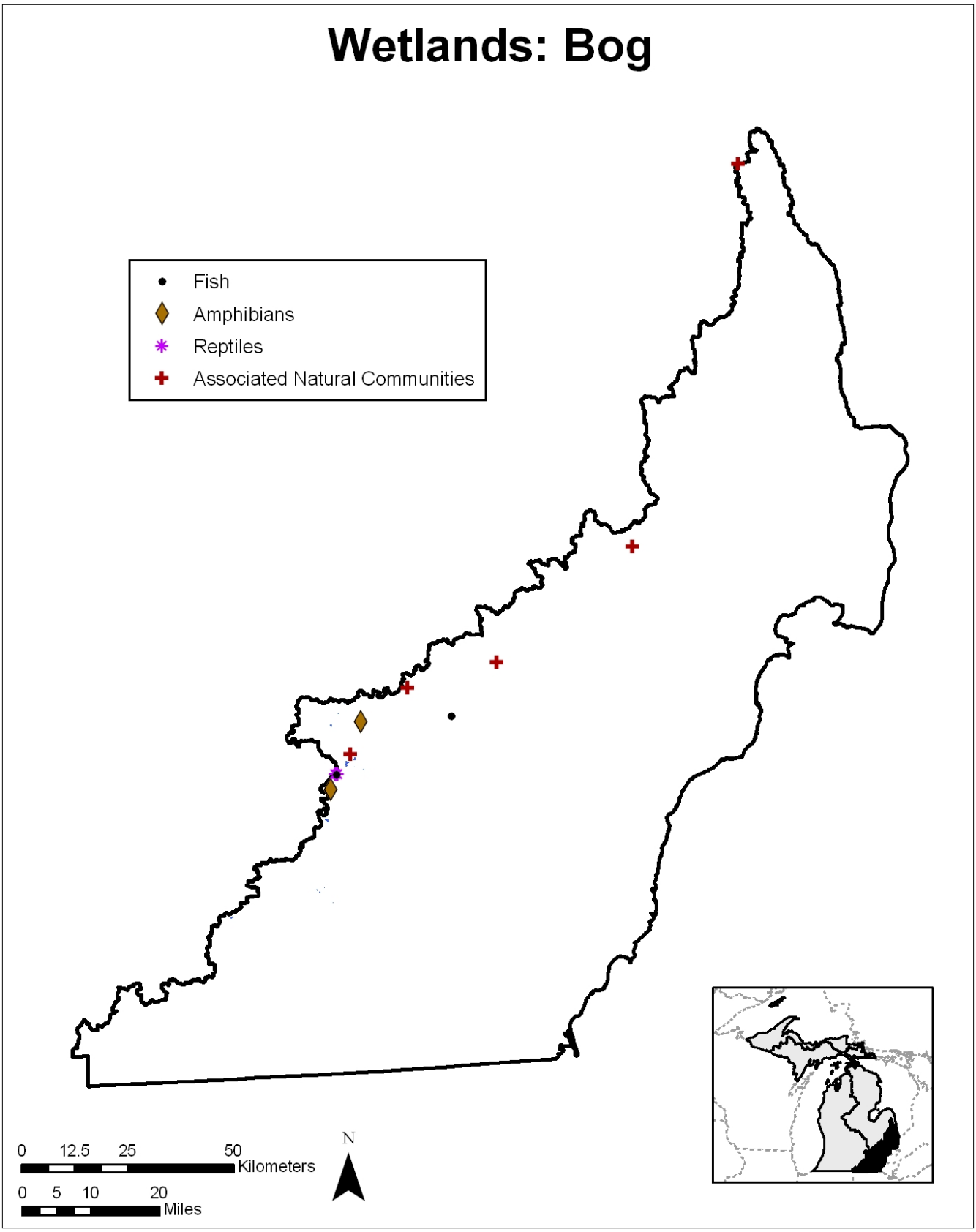
Research and Survey Needs

- Determine amount and condition of intermittent streams
- Determine the importance of intermittent streams in individual watersheds
- Determine species that require intermittent streams (e.g., amphibians and reptiles)

Monitoring

- Channel modification
- Riparian modification
- Stream enclosures

Wetlands: Bog



Wetlands: Bog

Description

Bogs are peat-accumulating, acidic, low nutrient wetlands that receive all or most of their water and nutrients from precipitation. Sphagnum moss (*Sphagnum andersonianum*) mats are characteristic of bogs. Other characteristic vegetation includes carnivorous plants such as sundew (*Drosera sp.*) and pitcher plants (*Sarracenia purpurea*), shrubs from the Heath family, and sedges (*Carex sp.*).

General Condition of Feature

This habitat is considered 50% in good to excellent condition, 25% in fair condition, and 25% in degraded to very degraded condition.

Associated Natural Communities

Bog

Associated Species of Greatest Conservation Need

INSECTS
spatterdock darner (*Aeshna mutata*)
Cantrall's bog beetle (*Liodessus cantralli*)

FISH
finescale dace (*Phoxinus neogaeus*)

AMPHIBIANS
blue-spotted salamander (*Ambystoma laterale*)
four-toed salamander (*Hemidactylium scutatum*)

AMPHIBIANS cont.
Blanchard's cricket frog (*Acris crepitans blanchardi*)
pickerel frog (*Rana palustris*)
northern leopard frog (*Rana pipiens*)

REPTILES
copperbelly water snake (*Nerodia erythrogaster neglecta*)
spotted turtle (*Clemmys guttata*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Loss of groundwater; Loss of water supply due to development and drainage changes; Changes to flow regime
- Altered fire regime: Drought; Fire (low threat)
- Fragmentation

POLLUTION
- Altered nutrient inflows: (low threat)

HABITAT CONVERSION
- Dredging and channelization: Dredging (low threat)
- Riparian modification: Land development and draining
- Wetland modification: Land development and draining

BIOLOGICAL INTERACTIONS
- Disease, pathogens, and parasites
- Invasive plants and animals

CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Mining practices: Removal of peat (low threat)

Conservation Actions Needed (Threats addressed)

LAND & WATER PROTECTION
- Create and expand conservation easements (variety of threats)
- Support land conservancy purchase of undeveloped land (variety of threats)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Maintain and rehabilitate natural corridors between significant habitats such as bogs, wetlands, and floodplains (fragmentation, riparian modification)
- Protect and rehabilitate wetlands (altered hydrologic regimes, wetland modification)
- Repair damaged wetland hydrology through the removal of tiles in abandoned farm fields (wetland modification)
- Rehabilitate and maintain riparian buffers of at least 50 ft., however 500 ft provides for better conservation value (riparian modification)
- Use Best management practices to protect hydrology (variety of threats)

LAW & POLICY
- Continue working with and educating Drain Commissioners (altered hydrologic regimes, dredging and channelization, riparian modification, wetland modification)

- Discourage water withdrawals and water diversions (altered hydrologic regimes)
- Encourage cluster development rather than evenly spaced home lots (riparian modification)
- Include wetland protections in zoning and planning ordnances (variety of threats)
- Protect and rehabilitate groundwater recharge by capturing development related runoff in infiltration basins (altered hydrologic regimes)

EDUCATION & AWARENESS

- Continue to educate the public about the benefits of wetlands and stewardship (social attitudes)

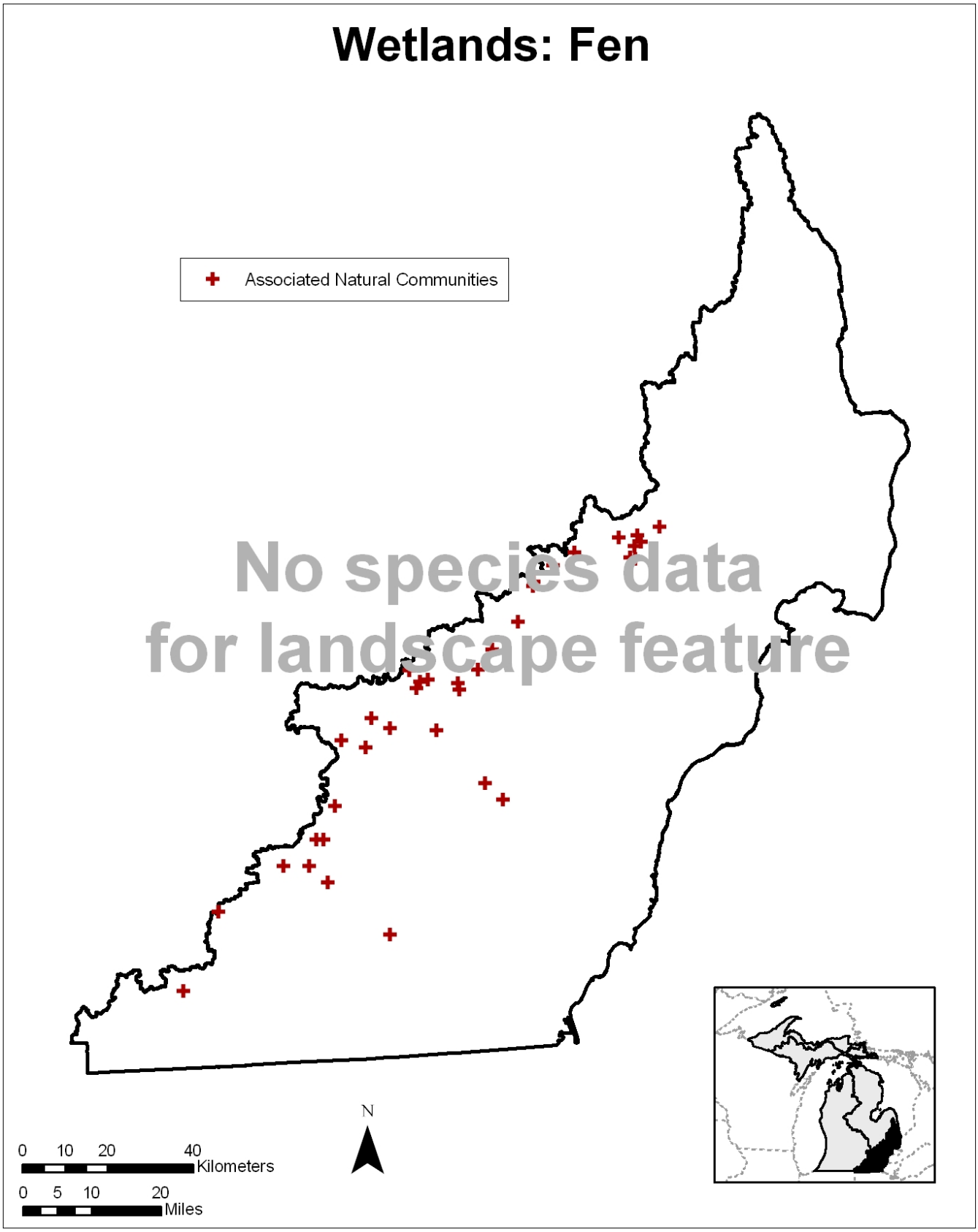
Research and Survey Needs

- Conduct statewide wetlands inventory
- Determine life history requirements for SGCN associated with bog
- Determine the amount of abandoned tiled farmland and ways to return it to the original condition
- Determine the amount of impervious in the watershed
- Investigate alternatives to water withdrawals and diversions
- Model hydrologic flow of each watershed

Monitoring

- Amount of impervious surface in watershed
- Draining and channelization activities
- Storm water
- Water withdrawals
- Wetland modification

Wetlands: Fen



Wetlands: Fen

Description

Fens are peat-accumulating wetlands that receive much of their water and nutrients from groundwater rich in calcium and magnesium carbonates. Fens tend to have relatively high pH and nutrient levels, hence supporting a great diversity of grasses, sedges (*Carex sp.*), rushes (*Juncus sp.)*, and wildflowers. Open conditions are maintained by seasonal water fluctuations, fire, and beaver-flooding.

General Condition of Feature

Condition is unknown for this feature; however fens are very threatened systems in the Lake Erie basin.

Associated Natural Communities

Prairie Fen

Associated Species of Greatest Conservation Need

INSECTS
spatterdock darner (*Aeshna mutata*)
Cantrall's bog beetle (*Liodessus cantralli*)

AMPHIBIANS
pickerel frog (*Rana palustris*)

REPTILES
copperbelly water snake (*Nerodia erythrogaster neglecta*)
spotted turtle (*Clemmys guttata*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Changes to flow regime (phreatic flows); Groundwater level changes

POLLUTION
- Altered nutrient inflows

HABITAT CONVERSION
- Dredging and channelization
- Riparian modification
- Wetland modification

BIOLOGICAL INTERACTIONS
- Invasive plants and animals:

Conservation Actions Needed (Threats addressed)

LAND & WATER PROTECTION
- Create and expand conservation easements (variety of threats)
- Support land conservancy purchase of undeveloped land (variety of threats)

LAND, WATER & SPECIES MANAGEMENT
- Maintain or establish riparian buffers of at least 50 ft., but 500 ft. or wider maximizes conservation benefits (altered hydrologic regimes, riparian modifications)
- Maintain and rehabilitate natural corridors between significant habitats such as fens, wetlands, and floodplains (fragmentation, species issues)
- Protect and rehabilitate groundwater recharge by capturing development related runoff in infiltration basins (altered hydrologic regimes)
- Protect and rehabilitate wetlands (altered hydrologic regimes, wetland modification)

LAW & POLICY
- Continue working and educating Drain Commissioners (altered hydrologic regimes, dredging and channelization, riparian modification, wetland modification)
- Discourage water withdrawals and water diversions (altered hydrologic regimes)

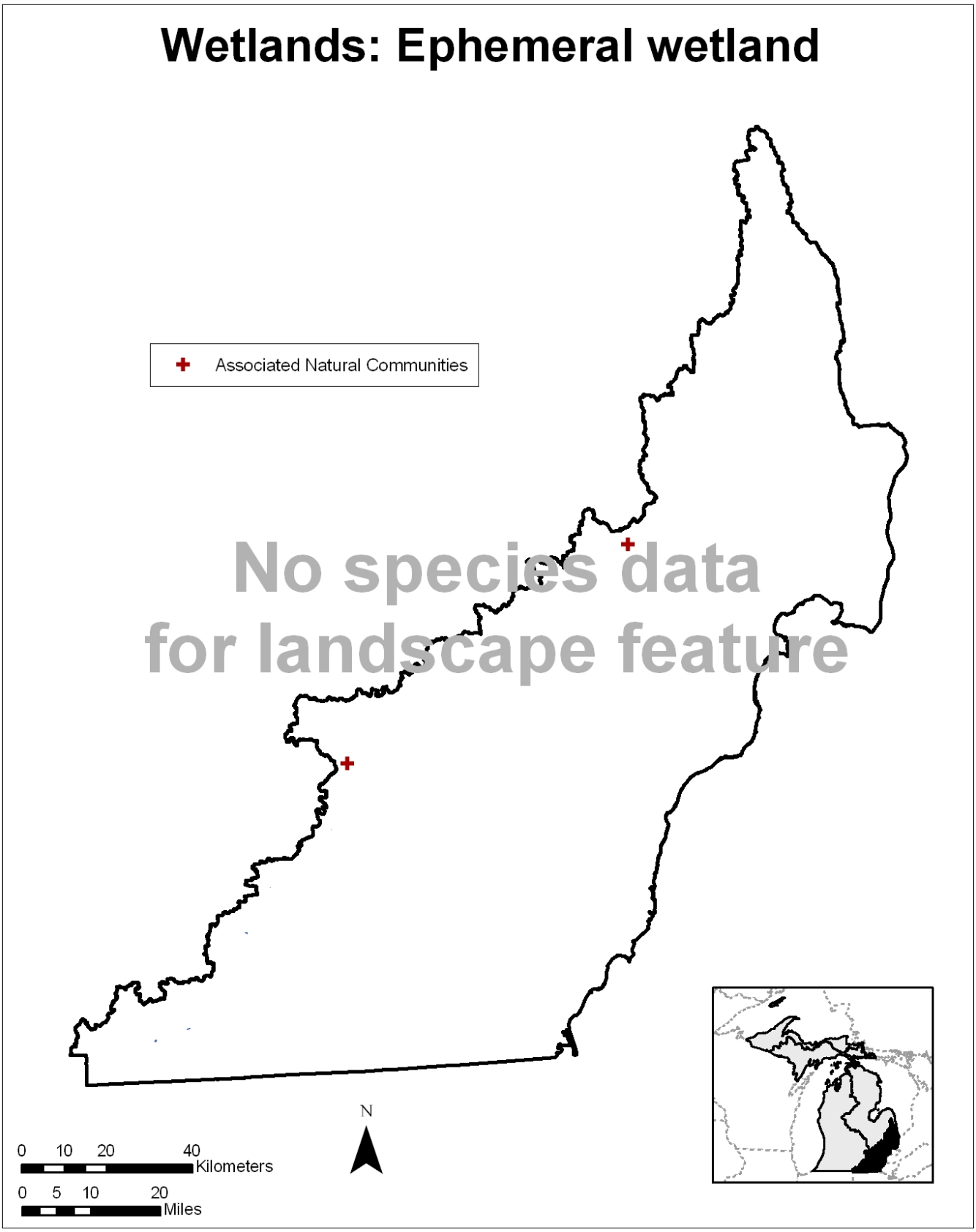
Research and Survey Needs
- Conduct statewide wetlands inventory
- Determine effective restoration techniques
- Determine life histories of those SGCN that use fen
- Determine the locations and conditions of fens in the basin and update information in the National Wetlands Database to reflect this
- Determine the amount of abandoned tiled farmland and ways to return it to the original condition
- Determine the amount of impervious in the watershed
- Determine the number and condition of fens in all watersheds
- Investigate alternatives to water withdrawals and diversions

- Model hydrologic flow of the entire watershed

Monitoring

- Amount of impervious surface in watershed
- Draining and channelization activities
- Storm water
- Water withdrawals
- Wetland modification

Wetlands: Ephemeral wetland



Wetlands: Ephemeral wetland

Description

Ephemeral wetlands are semi-permanent, seasonally flooded areas. These areas may be small and only a couple of feet in diameter (e.g., vernal pools) or very large. Ephemeral wetlands can have standing water for a few weeks in the spring or short periods after heavy rains during the rest of the year. When not flooded, soils in ephemeral wetlands may feel dry but typically show evidence of hydric conditions. In addition to seasonal fluctuations, water level can vary dramatically from year to year in ephemeral wetlands such as coastal plain marsh, interdunal wetland, and intermittent wetland.

General Condition of Feature

This habitat is considered 15% in good to excellent condition, 30% in fair condition, and 55% in degraded to very degraded condition.

Associated Natural Communities

Coastal Plain Marsh
Intermittent Wetland

Associated Species of Greatest Conservation Need

CRAYFISH
digger crayfish (*Fallicambarus fodiens*)

FISH
tadpole madtom (*Noturus gyrinus*)

AMPHIBIANS
blue-spotted salamander (*Ambystoma laterale*)
spotted salamander (*Ambystoma maculatum*)
smallmouth salamander (*Ambystoma texanum*)
eastern tiger salamander (*Ambystoma tigrinum tigrinum*)

AMPHIBIANS cont.
four-toed salamander (*Hemidactylium scutatum*)
western chorus frog (*Pseudacris triseriata triseriata*)

REPTILES
eastern fox snake (*Elaphe gloydi*)
copperbelly water snake (*Nerodia erythrogaster neglecta*)
queen snake (*Regina septemvittata*)
spotted turtle (*Clemmys guttata*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Drainage pattern changes due to development
- Climate change
- Fragmentation: Habitat fragmentation; Isolation of breeding areas from living areas

POLLUTION
- Altered sediment loads
- Pesticides and Herbicides
- Urban, municipal, and industrial pollution

HABITAT CONVERSION
- Dredging and channelization: (low threat)
- Riparian modification: Development; Development and filling of small low areas; Ephemeral wetlands are highly endangered because of their ease of conversion to urban type space; Habitat manipulation for farming: Tiling
- Wetland modification: Filling; Development and filling of small low areas; Loss of wetlands; Ditching; Draining

BIOLOGICAL INTERACTIONS
- Invasive plants and animals

EDUCATION
- Social attitudes: Need public education so that society will see the value of these habitats; Lack of understanding of the importance of this habitat by riparian owners

Conservation Actions Needed (Threats addressed)

LAND & WATER PROTECTION
- Create and expand conservation easements (variety of threats)
- Support land conservancy purchase of undeveloped land (variety of threats)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Close roads or install tunnels to allow amphibians and reptiles safe passage to breeding grounds (fragmentation, species issue)
- Control aquatic invasive species (invasive animals and plants)
- Maintain and rehabilitate buffers around wetlands (riparian modification, wetland modification)

- Maintain or rehabilitate natural corridors between ephemeral wetlands and other significant habitats, both upland and wetlands (fragmentation, species issue)
- Maintain or establish riparian buffers to at least 50 ft. (altered hydrologic regimes, altered sediment loads, riparian modification)
- Prevent establishment of new aquatic invasive species (invasive animals and plants)
- Protect and rehabilitate groundwater recharge (altered hydrologic regimes)
- Protect and rehabilitate the natural hydrologic regime (altered hydrologic regimes)
- When removing exotic vegetation at least 60-80% of native species should be preserved (invasive animals and plants)
- Rehabilitate and maintain wetland functions (wetland modification)
- Use integrated pest management practices (invasive –animals and plants)

LAW & POLICY

- Discourage water withdrawals (altered hydrologic regimes)
- Discourage draining practices (altered hydrologic regimes)
- Remove unnecessary or abandoned field tiles (altered hydrologic regimes, wetland modification)
- Continue working with and educating Drain Commissioners (altered hydrologic regimes, altered sediment loads, dredging and channelization, riparian modification, wetland modification)
- Encourage green-space planning and clustered development (riparian modification)
- Work with local officials on setback and buffer ordinances (riparian modification)
- Work with road commissions to site and maintain road crossings (altered hydrologic regimes, altered sediment loads)

EDUCATION & AWARENESS

- Expand education programs regarding natural processes, invasive species, hydrologic cycles, and stewardship (social attitudes)
- Increase awareness of affects of disturbance on the spread of aquatic invasive species (invasive plants and animals, social attitudes)
- Educate landowners on the value of wetlands (social attitudes)
- Continue to educate the public regarding the benefit of wetlands (social attitudes)

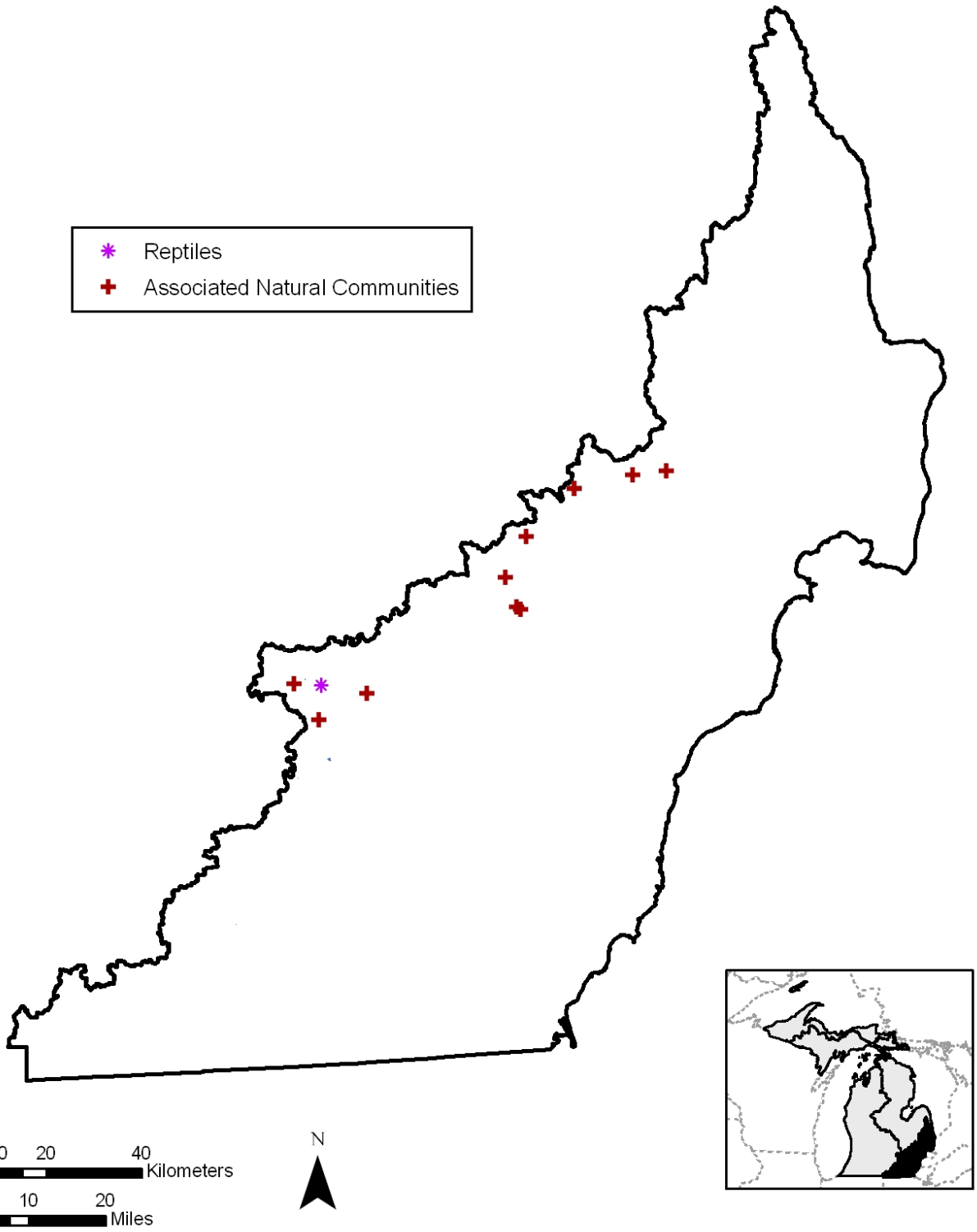
Research and Survey Needs

- Conduct statewide wetlands inventory
- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Determine critical pathways between habitats for amphibians and reptiles to prevent vehicular fatalities and fragmentation of habitats
- Determine life history requirements for SGCN associated with ephemeral wetlands
- Establish effective methods of communicating with the public and their stewardship role
- Investigate ephemeral wetlands and their role in a watershed
- Model hydrologic flows
- Explore safe and cost effective methods to remove exotic vegetation without harming native species

Monitoring

- Aquatic invasive species
- Draining and channelization
- Fragmentation
- Indicator species
- Riparian modification
- Water withdrawals

Wetlands: Inland emergent wetland



Wetlands: Inland Emergent Wetland

Description

Inland emergent wetlands, also called marshes, are frequently or continually inundated with water and are characterized by emergent herbaceous vegetation adapted to saturated soil conditions. These wetlands tend to have abundant nutrients and are highly organic. Inland emergent wetlands are quite varied and can be found in poorly drained depressions and along lakes, ponds, and rivers.

General Condition of Feature

This habitat is considered 20% in good to excellent condition, 20% in fair condition, and 60% in degraded to very degraded condition.

Associated Natural Communities

Coastal Plain Marsh
Emergent Marsh
Intermittent Wetland
Southern Wet Meadow

Associated Species of Greatest Conservation Need

CRAYFISH
devil crawfish (*Cambarus diogenes*)
digger crayfish (*Fallicambarus fodiens*)

INSECTS
Cantrall's bog beetle (*Liodessus cantralli*)

FISH
grass pickerel (*Esox americanus*)
pirate perch (*Aphredoderus sayanus*)

AMPHIBIANS
Fowler's toad (*Bufo fowleri*)
western chorus frog (*Pseudacris triseriata triseriata*)
pickerel frog (*Rana palustris*)
northern leopard frog (*Rana pipiens*)

REPTILES
spotted turtle (*Clemmys guttata*)
Blanding's turtle (*Emydoidea blandingii*)
eastern box turtle (*Terrapene carolina carolina*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Altered drainage patterns due to development; Lake level control
- Climate change
- Fragmentation

POLLUTION
- Altered sediment loads: Sediment impacting vegetation
- Urban, municipal, and industrial pollution: Surface runoff, contamination; Chemicals impacting vegetation

HABITAT CONVERSION
- Dredging and channelization: Dredging
- Riparian modification: Shoreline alteration
- Wetland modification: Filling; Dredging; Development pressure to fill wetlands for economical purposes

BIOLOGICAL INTERACTIONS
- Invasive plants and animals: Purple loosestrife; Phragmites replacing mature plants

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Macrophyte removal

EDUCATION
- Social attitudes: Lack of public education on the importance of these habitats, especially by riparian owners

Conservation Action Needs (Threats addressed)

LAND & WATER PROTECTION
- Create and expand conservation easements (variety of threats)
- Support land conservancy purchase of undeveloped land (variety of threats)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Control aquatic invasive species (invasive plants and animals)
- Maintain or establish buffer zones of at least 50 ft., but 500 ft. or wider maximizes conservation benefits (riparian modification, wetland modification)
- Maintain natural water levels and fluctuations (altered hydrologic regimes)
- Maintain or rehabilitate both woody structure and native macrophytes (invasive plants and animals, macrophyte removal)
- Maintain or rehabilitate natural corridors between other significant wetlands and significant upland areas (fragmentation, species issue)

- Prevent establishment of new aquatic invasive species (invasive plants and animals)
- Protect and rehabilitate wetlands (altered hydrologic regimes, wetland modification)
- When removing exotic vegetation, at least 60-80% of native species should be preserved (invasive plants and animals, macrophyte removal)
- Rehabilitate and maintain wetland functions (wetland modification)
- Rehabilitate original hydrologic functions (altered hydrologic regimes)
- Use integrated pest management practices (invasive plants and animals)
- Use natural materials or soft engineering techniques for any shoreline modification (riparian modification, wetland modification)

LAW & POLICY

- Avoid use of herbicides in inland emergent wetlands (macrophyte removal)
- Enact shoreline protection regulations (riparian modification, wetland modification)
- Manage lake-level control structures as fixed-crest weirs (altered hydrologic regimes)
- Protect existing hydrologic conditions by prohibiting construction of new lake-level control structures (altered hydrologic regimes)
- Remove lake-level control structures where possible (altered hydrologic regimes)
- Restrict beach grooming (macrophyte removal, riparian modification)
- Strengthen wetland regulations and enforcement (wetland modification)
- Work with and educate Drain Commissioners (variety of threats)
- Work with local officials on setback and buffer ordinances (variety of threats)
- Work with regulatory agencies to restrict dredging and channelization (dredging and channelization)
- Work with road commissions to site and maintain road crossings (altered hydrologic regimes, altered sediment loads)

EDUCATION & AWARENESS

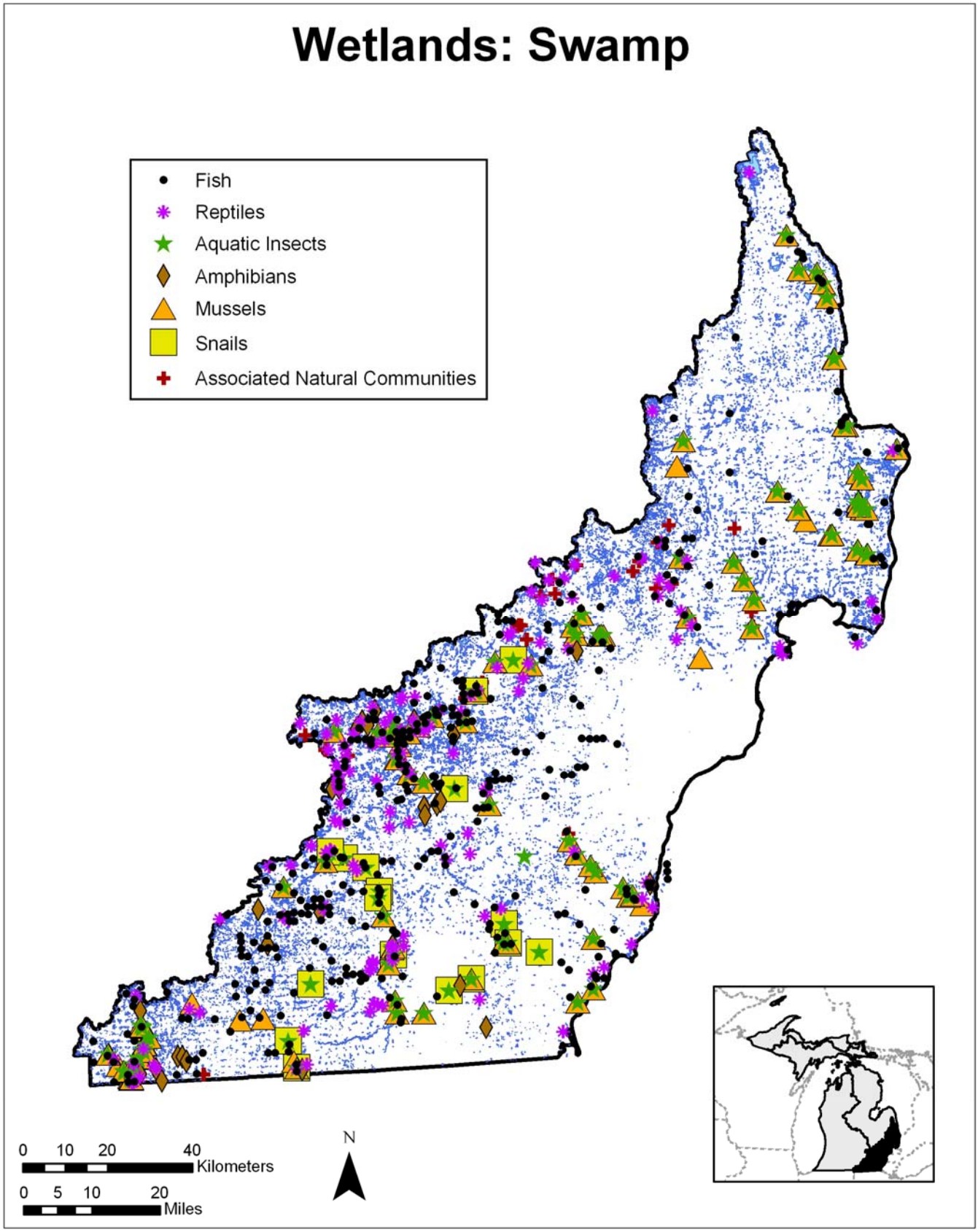
- Educate legislators, local planning boards, and other policy makers on the importance of natural processes (social attitudes)
- Educate private landowners on the value of riparian areas (riparian modification, social attitudes)
- Educate riparian and shoreline owners of the importance of woody structure and macrophytes for a healthy ecosystem (riparian modification, social attitudes)
- Expand education programs for the public on natural processes, invasive species, hydrologic cycles, and stewardship (social attitudes)

Research and Survey Needs

- Conduct statewide wetlands inventory
- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Determine all species and life stages that require inland emergent wetlands
- Determine number and condition of inland emergent wetlands in the Erie basin
- Develop new socially-acceptable ways of managing lake levels
- Document effects on beach grooming
- Explore natural alternatives to pesticides and herbicides
- Explore safe and cost effective methods to remove exotic vegetation without harming native species

Monitoring

- Aquatic invasive species
- Beach grooming
- Dredging and channelization
- Hydrologic regimes
- Indicator species
- Operation of lake-level control structures
- Riparian modification
- Wetland modification


Wetlands: Swamp
Fish
Reptiles
Aquatic Insects
Amphibians
Mussels
Snails
Associated Natural Communities
0 10 20 40
Kilometers
0 5 10 20
Miles
N

Wetlands: Swamp

Description

Swamps are wetlands dominated by trees or shrubs with saturated soils during the growing season and standing or slowly moving water during certain times of the year. Swamps can be dominated by trees such as red maple (*Acer rubrum*), black ash (*Fraxinus nigra*), yellow birch (*Betula alleghaniensis*), northern white cedar (*Thuja occidentalis*) and tamarack (*Larix laricina*), or shrubs such as buttonbush (*Cephalanthus occidentalis*), willow (*Salix sp*.), and dogwood (*Cornus sp*.). Composition and structure are influenced by disturbance factors such as flooding regime, windthrow, insect outbreak, and beaver (*Castor canadensis*).

General Condition of Feature

This habitat is considered 30% in good to excellent condition, 25% in fair condition, and 45% in degraded to very degraded condition.

Associated Natural Communities

Hardwood-Conifer Swamp
Inundated Shrub Swamp
Poor Conifer Swamp
Relict Conifer Swamp
Rich Conifer Swamp
Southern Floodplain Forest
Southern Shrub-Carr
Southern Swamp

Associated Species of Greatest Conservation Need

MUSSELS
Specific associations with this landscape feature were not found in the literature

SNAILS
spindle lymnaea (*Acella haldemani*)

CRAYFISH
devil crawfish (*Cambarus diogenes*)
digger crayfish (*Fallicambarus fodiens*)

INSECTS
spatterdock darner (*Aeshna mutata*)

FISH
pirate perch (*Aphredoderus sayanus*)

AMPHIBIANS
smallmouth salamander (*Ambystoma texanum*)
four-toed salamander (*Hemidactylium scutatum*)
western chorus frog (*Pseudacris triseriata triseriata*)

REPTILES
copperbelly water snake (*Nerodia erythrogaster neglecta*)
spotted turtle (*Clemmys guttata*)
Blanding's turtle (*Emydoidea blandingii*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Development; Draining; Altered hydrology due to runoff and development
- Fragmentation

POLLUTION
- Altered nutrient inflows: Surface runoff, nutrients
- Urban, municipal, and industrial pollution: Surface runoff, contamination

HABITAT CONVERSION
- Riparian modification: Development
- Wetland modification

BIOLOGICAL INTERACTIONS
- Invasive plants and animals: Especially plants

EDUCATION
- Social attitudes: Lack of aquatic resource education, so that society sees the importance of this habitat (low threat)

Conservation Actions Needed (Threats addressed)

LAND & WATER PROTECTION
- Create and expand conservation easements (variety of threats)
- Support land conservancy purchase of undeveloped land (variety of threats)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Control aquatic invasive species (invasive plants and animals)
- Maintain natural water levels and fluctuations (altered hydrologic regimes)
- Maintain or establish riparian buffer zones of at least 50 ft., but 500 ft. or wider maximizes conservation benefits (riparian modification, wetland modification)

- Maintain or rehabilitate both woody structure and native macrophytes (wetland modification)
- Maintain or rehabilitate natural corridors between other significant wetlands and significant upland areas (fragmentation, riparian modification, species issue)
- Prevent establishment of new aquatic invasive species (invasive plants and animals)
- Protect and rehabilitate wetland and floodplain functions (altered hydrologic regimes, wetland modification)
- Protect and rehabilitate groundwater recharge (altered hydrologic regimes)
- Protect and rehabilitate wetlands (altered hydrologic regimes, wetland modification)
- When removing exotic vegetation, at least 60-80% of native species should be preserved (invasive plants and animals)
- Rehabilitate hydrologic functions (altered hydrologic regimes)

LAW & POLICY

- Protect the natural hydrologic regime by protecting wetlands and floodplains (altered hydrologic regimes, riparian modification, wetland modification)
- Reduce effluent flow (Urban, municipal, and industrial pollution)
- Remove unnecessary drainage tiles (altered hydrologic regimes, wetland modification)
- Upgrade septic systems (altered hydrologic regimes, altered nutrient inflows)
- Use Best management practices (variety of threats)
- Use integrated pest management practices (invasive plants and animals)
- Work with and educate Drain Commissioners (variety of threats)
- Work with local officials to decrease the amount of impervious surface in a watershed (altered hydrologic regimes, altered nutrient inflows, Urban, municipal, and industrial pollution)
- Work with road commissions to site and maintain road crossings (altered hydrologic regimes, altered sediment loads, fragmentation)
- Work with road commissions to site and maintain road crossings (altered hydrologic regimes, altered sediment loads)

EDUCATION & AWARENESS

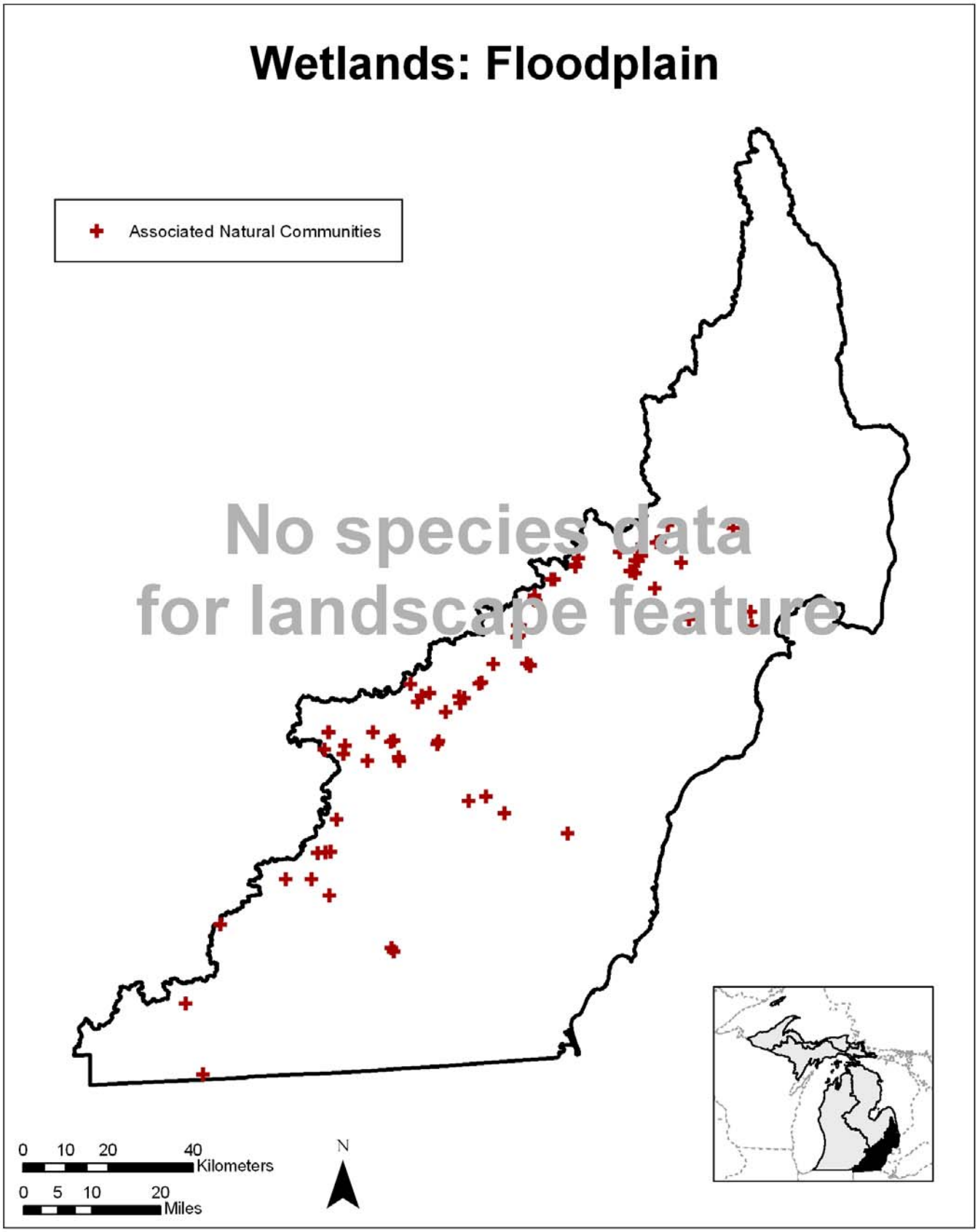
- Educate legislators, local planning boards, and other policy makers on the importance of swamps and natural processes (social attitudes)

Research and Survey Needs

- Conduct statewide wetlands inventory
- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Conduct inventories of wetlands
- Determine critical pathways between habitats for amphibians and reptiles to prevent vehicular fatalities and fragmentation of habitats
- Determine life history requirements for SGCN associated with swamps or where information is lacking
- Determine most effective bridge and culvert designs to limit fragmentation of individual swamps
- Establish effective methods of communicating with the public and their stewardship role
- Model hydrologic flows
- Explore using prescribe burns as a management tool

Monitoring

- Aquatic invasive species
- Dredging and channelization
- Effluent discharges: wastewater treatment plants, septic systems, industrial
- Hydrologic flow
- Indicator species
- Riparian modification
- Storm water
- Water withdrawals


Wetlands: Floodplain
Associated Natural Communities
No species data
for landscape feature
0 10 20 40
Kilometers
0 5 10 20
Miles
N

Wetlands: Floodplain

Description

Floodplains are low-lying areas adjacent to streams and rivers that are subject to periodic over-the-bank flooding and cycles of erosion and deposition, which allow for exchanges of energy and nutrients between terrestrial and aquatic systems. The soils tend to be high in nutrients. Species composition and community structure vary regionally along with varying flooding frequency and duration.

General Condition of Feature

This habitat is considered 20% in good to excellent condition, 20% in fair condition, and 60% in degraded to very degraded condition. Extreme loss of natural habitat in floodplains in SE Michigan

Associated Natural Communities

Emergent Marsh
Hardwood Conifer Swamp
Prairie Fen
Relict Conifer Swamp
Rich Conifer Swamp
Southern Floodplain Forest
Southern Shrub-Carr
Southern Wet Meadow
Submergent Marsh
Wet Prairie
Wet-mesic Prairie

Associated Species of Greatest Conservation Need

FISH
pirate perch (*Aphredoderus sayanus*)

AMPHIBIANS
western chorus frog (*Pseudacris triseriata triseriata*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Flow alterations; Increased flooding

HABITAT CONVERSION
- Dams
- Riparian modification: Inadequate buffers to protect natural processes; Development; Loss of riparian vegetation; Altered land cover; Loss of floodplain through development
- Wetland modification: Fill

EDUCATION
- Social attitudes: Need for public education to understand importance of natural floodplains

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES/MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Rehabilitate and maintain floodplains (riparian modification, wetland modification)
- Rehabilitate and maintain natural hydrologic functions (altered hydrologic regimes)
- Rehabilitate and maintain wetlands (wetland modification)

LAW & POLICY
- Continue educating and working with Drain Commissioners (variety of threats)
- Protect the public trust by requiring dam owners to make appropriate financial provisions for future dam removal or perpetual maintenance (dams)
- Remove unnecessary dams (altered hydrologic regimes, dams)
- Require existing dams to operate to provide at run-of-the-river flows (altered hydrologic regimes, dams)
- Work with local officials on setback and buffer ordinances (riparian modification)
- Work with road commissions to site and maintain road crossings (altered hydrologic regimes)

EDUCATION & AWARENESS
- Educate landowners on the value of floodplains (social attitudes)

Research and Survey Needs

- Determine the best way for local planning groups to work together
- Determine the floodplains that are disconnected from the hydrologic system and how to rehabilitate the original conditions
- Develop socially acceptable alternatives to dams
- Effective methods of communicating with the public and their stewardship role
- Inventory dams and determine those which are no longer necessary
- Map, in GIS, this landscape feature
- Model hydrologic flows

Monitoring

- Dam operations
- Dredging and channelization
- Floodplain development
- Hydrologic flow
- Riparian modification

Aquatic Characteristic: Rock Substrates

Aquatic Characteristic: Rock Substrates

Description

Rock substrates are predominately composed of a mass of stone of any size, consolidated or unconsolidated, of various mineral compositions often described as bedrock, rock, cobble, and gravel.

General Condition of Feature

This habitat is considered 25% in good to excellent condition, 30% in fair condition, and 45% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
- elktoe (*Alasmidonta marginata*)
- slippershell mussel (*Alasmidonta viridis*)
- round pigtoe (*Pleurobema coccineum*)
- ellipse (*Venustaconcha ellipsiformis*)
- rainbow (*Villosa iris*)
- purple wartyback (*Cyclonaias tuberculata*)
- clubshell (*Pleurobema clava*)
- pimpleback (*Quadrula pustulosa*)
- cylindrical papershell (*Anodontoides ferussacianus*)
- creek heelsplitter (*Lasmigona compressa*)
- salamander mussel (*Simpsonaias ambigua*)
- white catspaw (*Epioblasma obliquata perobliqua*)
- northern riffleshell (*Epioblasma torulosa rangiana*)
- snuffbox (*Epioblasma triquetra*)
- wavy-rayed lampmussel (*Lampsilis fasciola*)
- black sandshell (*Ligumia recta*)
- threehorn wartyback (*Obliquaria reflexa*)
- round hickorynut (*Obovaria subrotunda*)
- kidneyshell (*Ptychobranchus fasciolaris*)
- purple lilliput (*Toxolasma lividus*)
- fawnsfoot (*Truncilla donaciformis*)
- rayed bean (*Villosa fabalis*)

INSECTS
- ocellated darner (*Boyeria grafiana*)
- rapids clubtail (*Gomphus quadricolor*)
- a stonefly (*Helopicus nalatus*)
- a caddisfly (*Rhyacophila sp*.)
- a dobsonfly (*Nigronia fasciatus*)

FISH
- lake sturgeon (*Acipenser fulvescens*)
- redside dace (*Clinostomus elongatus*)
- brassy minnow (*Hybognathus hankinsoni*)
- striped shiner (*Luxilus chrysocephalus*)

FISH cont.
- silver chub (*Macrhybopsis storeriana*)
- river chub (*Nocomis micropogon*)
- pugnose shiner (*Notropis anogenus*)
- silver shiner (*Notropis photogenis*)
- southern redbelly dace (*Phoxinus erythrogaster*)
- western creek chubsucker (*Erimyzon claviformis*)
- lake chubsucker (*Erimyzon sucetta*)
- black buffalo (*Ictiobus niger*)
- spotted sucker (*Minytrema melanops*)
- river redhorse (*Moxostoma carinatum*)
- black redhorse (*Moxostoma duquesnei*)
- golden redhorse (*Moxostoma erythrurum*)
- stonecat (*Noturus flavus*)
- tadpole madtom (*Noturus gyrinus*)
- brindled madtom (*Noturus miurus*)
- northern madtom (*Noturus stigmosus*)
- grass pickerel (*Esox americanus*)
- cisco or lake herring (*Coregonus a*rtedi)
- slimy sculpin (*Cottus cognatus*)
- eastern sand darter (*Ammocrypta pellucida*)
- fantail darter (*Etheostoma flabellare*)
- least darter (*Etheostoma microperca*)
- orangethroat darter (*Etheostoma spectabile*)
- channel darter (*Percina copelandi*)
- river darter (*Percina shumardi*)
- sauger (*Sander canadensis*)

AMPHIBIANS
- smallmouth salamander (*Ambystoma texanum*)
- mudpuppy (*Necturus maculosus maculosus*)

REPTILES
- queen snake (*Regina septemvittata*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Construction runoff due to inadequate runoff control; Changes in flow due to urbanization

POLLUTION
- Altered nutrient inflows: (low threat)
- Altered sediment loads: Construction runoff due to inadequate runoff control; Sedimentation due to stream bank erosion and riparian erosion; Increased embeddedness
- Pesticides and herbicides: (low threat)
- Thermal changes: (low threat)
- Urban, municipal, and industrial pollution: (low threat)

HABITAT CONVERSION
- Dams: Channel modification due to dams; Impoundments can cover good rocky substrates
- Dredging and channelization
- Riparian modification: Shoreline hardening; Rock and gravel substrates seen very critical for many mussel species. Perhaps important for recruitment. Sedimentation from riparian disturbance destroying many gravel reaches

- Wetland modification

BIOLOGICAL INTERACTIONS

- Invasive plants and animals

EDUCATION

- Social attitudes: Aquatic resource education - need for public to understand the uniqueness of rocky substrates and species which use this niche (low threat)

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT

- Control aquatic invasive species (invasive plants and animals)
- Monitor sand and gravel operations (dredging and channelization)
- Prevent establishment of new aquatic invasive species (invasive plants and animals)
- Protect, maintain, and establish riparian buffers to at least 50 ft., but 500 ft. or wider maximizes conservation benefits (altered hydrologic regimes, altered sediment loads, riparian modification)
- Protect, maintain, and establish important movement corridors for amphibians and reptiles (riparian modifications, species issue)
- Rehabilitate rivers to their original flow paths (altered hydrologic regimes)
- Shoreline and riparian modification should be completed with natural materials and soft engineering (riparian modification)

LAW & POLICY

- Remove dams to rehabilitate riparian and stream habitats and natural hydrologic conditions (altered hydrologic regimes, dams)
- Use Best management practices (variety of threats)
- Use sediment barriers and Best management practices near any water body (altered sediment loads)
- Work with and educate Drain Commissioners (variety of threats)
- Work with road commissions to site and maintain road crossings (altered hydrologic regimes, altered sediment loads)

EDUCATION & AWARENESS

- Educate riparian owners on the values of riparian buffers to decrease sediment into a water body (riparian modification, social attitudes)

Research and Survey Needs

- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Determine amount of sediment loading to the watershed
- Determine life history requirements for SGCN associated with rock substrates
- Determine the number and condition of erosion sites

Monitoring

- Aquatic invasive species
- Dam operations
- Erosion sites
- Riparian modification
- Road crossings
- Sand and gravel mining

Aquatic Characteristic: Soft Substrates

Aquatic Characteristic: Soft Substrates

Description

Soft substrates are predominately composed of particles less than 2 mm often described as sand, silt, mud, or organic matter.

General Condition of Feature

This habitat is considered 35% in good to excellent condition, 25% in fair condition, and 40% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

MUSSELS
- slippershell mussel (*Alasmidonta viridis*)
- scaleshell (*Leptodea leptodon*)
- round pigtoe (*Pleurobema coccineum*)
- rainbow (*Villosa iris*)
- purple wartyback (*Cyclonaias tuberculata*)
- pimpleback (*Quadrula pustulosa*)
- cylindrical papershell (*Anodontoides ferussacianus*)
- creek heelsplitter (*Lasmigona compressa*)
- salamander mussel (*Simpsonaias ambigua*)
- wavy-rayed lampmussel (*Lampsilis fasciola*)
- eastern pondmussel (*Ligumia nasuta*)
- black sandshell (*Ligumia recta*)
- threehorn wartyback (*Obliquaria reflexa*)
- round hickorynut (*Obovaria subrotunda*)
- kidneyshell (*Ptychobranchus fasciolaris*)
- lilliput (*Toxolasma parvus*)
- fawnsfoot (*Truncilla donaciformis*)
- rayed bean (*Villosa fabalis*)

SNAILS
- spindle lymnaea (*Acella haldemani*)

INSECTS
- Laura's snaketail (*Stylurus laurae*)
- elusive snaketail (*Stylurus notatus*)

FISH
- lake sturgeon (*Acipenser fulvescens*)
- brassy minnow (*Hybognathus hankinsoni*)

FISH cont.
- silver chub (*Macrhybopsis storeriana*)
- pugnose shiner (*Notropis anogenus*)
- pugnose minnow (*Opsopoeodus emiliae*)
- finescale dace (*Phoxinus neogaeus*)
- western creek chubsucker (*Erimyzon claviformis*)
- lake chubsucker (*Erimyzon sucetta*)
- black buffalo (*Ictiobus niger*)
- spotted sucker (*Minytrema melanops*)
- golden redhorse (*Moxostoma erythrurum*)
- brown bullhead (*Ameiurus nebulosus*)
- tadpole madtom (*Noturus gyrinus*)
- brindled madtom (*Noturus miurus*)
- grass pickerel (*Esox americanus*)
- cisco or lake herring (*Coregonus artedi*)
- pirate perch (*Aphredoderus sayanus*)
- eastern sand darter (*Ammocrypta pellucida*)
- least darter (*Etheostoma microperca*)
- channel darter (*Percina copelandi*)
- river darter (*Percina shumardi*)

AMPHIBIANS
- Blanchard's cricket frog (*Acris crepitans blanchardi*)
- pickerel frog (*Rana palustris*)

REPTILES
- spotted turtle (*Clemmys guttata*)
- Blanding's turtle (*Emydoidea blandingii*)
- eastern box turtle (*Terrapene carolina carolina*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: "Flashy" flow regimes due to farming and development in floodplains have blown out many of the good soft sediments; Changes in flow due to urbanization
- Climate change
- Fragmentation

POLLUTION
- Altered nutrient inflows: Low dissolved oxygen; Overgrowth of macrophyte due to eutrophication
- Altered sediment loads: Sedimentation
- Urban, municipal, and industrial pollution: Accumulation of pollutants; Contaminants

HABITAT CONVERSION
- Dams
- Riparian modification: Natural floodplains and soft substrates - development, armored, filling

BIOLOGICAL INTERACTIONS
- Invasive plants and animals: Especially plants

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Decrease imperviousness in watersheds (altered hydrologic regimes, altered sediment loads, Urban, municipal, and industrial pollution)
- Maintain or rehabilitate natural hydrologic functions such as wetlands, meanders, throughflow (altered hydrologic regimes)

- Protect natural seasonal flow patterns and allow flooding (altered hydrologic regimes)
- Rehabilitate and protect riparian buffers of at least 50 ft., but 500 ft. or wider maximizes conservation benefits (altered hydrologic regimes, altered sediment loads, riparian modification)
- Rehabilitate rivers to original flow paths (altered hydrologic regimes)

LAW & POLICY

- Encourage green-space planning and clustered development (riparian modification)
- Ensure that sand mining operations are done in an ecologically sound way (altered sediment loads)
- Remove dams to allow natural sediment pathways to occur (altered hydrologic regimes, altered sediment loads)
- Use sediment barriers and Best management practices during construction (altered sediment loads)
- Work with and educate Drain Commissioners (variety of threats)
- Work with local officials on setback and buffer ordinances (riparian modification)

Research and Survey Needs

- Determine and implement methods to handle runoff
- Determine life history requirements for SGCN associated with soft substrates
- Determine the number and location of sand mining operations in the basin
- Determine ways of decreasing imperviousness in the watershed
- Model hydrologic flows

Monitoring

- Dredging and channelization
- Riparian modification
- Sand mining operations
- Sedimentation
- Storm water

Aquatic Characteristic: Clay Substrates

Aquatic Characteristic: Clay Substrates

Description

Clay substrates are predominately composed of natural earthy material which is plastic when wet, and consist essentially of hydrated silicates of aluminum, less than 4µm.

General Condition of Feature

No data available.

Associated Species of Greatest Conservation Need

CRAYFISH
devil crawfish (*Cambarus diogenes*)

FISH
lake sturgeon (*Acipenser fulvescens*)
grass pickerel (*Esox americanus*)

Associated Threats

HABITAT CONVERSION
- Dredging and channelization

CONSUMPTIVE BIOLOGICAL USES
- Mining practices: clay removal by potters

EDUCATION
- Social attitudes

Conservation Actions Needed (Threats addressed)

LAW & POLICY
- Control the amount of dredging and channelization (dredging and channelization)

EDUCATION & AWARENESS
- Educate the public on the value of clay substrates and the wise use of natural resources (social attitudes)

Research and Survey Needs
- Determine life history requirements for SGCN associated with clay substrates
- Determine severity of threats to clay substrates
- Determine the distribution of clay substrates and its condition in the basin

Monitoring
- Clay mining
- Hydrologic flow

Aquatic Characteristic: Vegetation

Aquatic Characteristic: Vegetation

Description

Vegetation are plants that grow in and around water bodies and provide in-water cover and physical structuring.

General Condition of Feature

This habitat is considered 25% in good to excellent condition, 25% in fair condition, and 50% in degraded to very degraded condition. Vegetation has been increasing in Lake Erie and St. Clair due to zebra mussel induced water clarity. This feature is not consider as a threatened habitat type.

Associated Species of Greatest Conservation Need

MUSSELS
rayed bean (*Villosa fabalis*)

SNAILS
spindle lymnaea (*Acella haldemani*)
brown walker (*Pomatiopsis cincinnatiensis*)

CRAYFISH
digger crayfish (*Fallicambarus fodiens*)

INSECTS
a sand minnow mayfly (*Siphloplecton basale*)
spatterdock darner (*Aeshna mutata*)
rapids clubtail (*Gomphus quadricolor*)
smoky rubyspot (*Hetaerina titia*)

FISH
lake sturgeon (*Acipenser fulvescens*)
mooneye (*Hiodon tergisus*)
brassy minnow (*Hybognathus hankinsoni*)
silver chub (*Macrhybopsis storeriana*)
pugnose shiner (*Notropis anogenus*)
pugnose minnow (*Opsopoeodus emiliae*)
finescale dace (*Phoxinus neogaeus*)
western creek chubsucker (*Erimyzon claviformis*)
lake chubsucker (*Erimyzon sucetta*)
spotted sucker (*Minytrema melanops*)

FISH cont.
brown bullhead (*Ameiurus nebulosus*)
tadpole madtom (*Noturus gyrinus*)
brindled madtom (*Noturus miurus*)
grass pickerel (*Esox americanus*)
cisco or lake herring (*Coregonus artedi*)
pirate perch (*Aphredoderus sayanus*)
slimy sculpin (*Cottus cognatus*)
least darter (*Etheostoma microperca*)

AMPHIBIANS
blue-spotted salamander (*Ambystoma laterale*)
smallmouth salamander (*Ambystoma texanum*)
eastern tiger salamander (*Ambystoma tigrinum tigrinum*)
four-toed salamander (*Hemidactylium scutatum*)
mudpuppy (*Necturus maculosus maculosus*)
Blanchard's cricket frog (*Acris crepitans blanchardi*)
pickerel frog (*Rana palustris*)
northern leopard frog (*Rana pipiens*)

REPTILES
spotted turtle (*Clemmys guttata*)
Blanding's turtle (*Emydoidea blandingii*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Changes in flow due to urbanization
- Climate change
- Fragmentation

POLLUTION
- Altered nutrient inflows: Overgrowth resulted from eutrophication
- Altered sediment loads: Increased sedimentation due to runoff
- Urban, municipal, and industrial pollution: Contaminants

HABITAT CONVERSION
- Riparian modification: Filling; Shoreline alterations

BIOLOGICAL INTERACTIONS
- Invasive plants and animals: Especially exotic plants such as erosion milfoil

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Macrophyte removal: Physical removal; Herbicide and mechanical harvesting; Chemical treatment to reduce macrophytes for recreation

EDUCATION
- Social attitudes: Lack of aquatic resource education, society needs to understand the importance of aquatic vegetation (low threat)

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- When removing aquatic invasive vegetation, at least 60-80% of native vegetation should be preserved (invasive plants and animals, macrophyte removal)

- Control aquatic invasive plant species (invasive plants and animals)
- Maintain and rehabilitate woody structure (altered sediment loads)
- Prevent establishment of new aquatic invasive species (invasive plants and animals)
- Protect wetlands and floodplains (altered hydrologic regimes, riparian modification)
- Rehabilitate and maintain riparian buffers (riparian modification)
- Rehabilitate native flora (invasive plants and animals, macrophyte removal, riparian modification)
- Rehabilitate original hydrologic functions i.e., reconnect meanders and floodplains (altered hydrologic regimes)
- Use natural materials or soft engineering techniques for any shoreline or riparian modification (riparian modification)
- Vegetation management needs to be done in conjunction with a vegetation management plan (invasive plants and animals, macrophyte removal)

LAW & POLICY

- Restrict beach grooming (riparian modification)
- Use sediment barriers and Best management practices during construction (altered sediment loads)

EDUCATION & AWARENESS

- Educate riparian land owners on the importance of vegetated buffers along water bodies, macrophytes, and woody structure (riparian modification, social attitudes)

Research and Survey Needs

- Determine effective prevention, control, and survey techniques for aquatic invasive species
- Determine life history requirements for SGCN associated with vegetation
- Educate the public on the role and value of vegetation
- Model hydrologic flows
- Work with watershed councils and conservation groups to help stop the spread of aquatic invasive plants

Monitoring

- Aquatic invasive species
- Hydrologic flows
- Native flora
- Riparian modification
- Vegetation manipulation

Aquatic Characteristic: Woody Structure

Aquatic Characteristic: Woody Structure

Description

Woody structure is the physical structuring under water by woody material of various sizes both live and dead. This can include coarse (logs) and fine (twigs) woody debris, as well as tree or shrub roots within the water.

General Condition of Feature

This habitat is considered 10% in good to excellent condition, 20% in fair condition, and 70% in degraded to very degraded condition.

Associated Species of Greatest Conservation Need

INSECTS
- splendid clubtail (*Gomphus lineatifrons*)
- smoky rubyspot (*Hetaerina titia*)
- a stonefly (*Taeniopteryx burksi*)
- a stonefly (*Taeniopteryx maura*)
- a stonefly (*Paracapnia opis*)

FISH
- southern redbelly dace (*Phoxinus erythrogaster*)
- finescale dace (*Phoxinus neogaeus*)
- golden redhorse (*Moxostoma erythrurum*)
- pirate perch (*Aphredoderus sayanus*)

AMPHIBIANS
- blue-spotted salamander (*Ambystoma laterale*)
- smallmouth salamander (*Ambystoma texanum*)

AMPHIBIANS cont.
- eastern tiger salamander (*Ambystoma tigrinum tigrinum*)
- four-toed salamander (*Hemidactylium scutatum*)
- mudpuppy (*Necturus maculosus maculosus*)
- Blanchard's cricket frog (*Acris crepitans blanchardi*)
- western chorus frog (*Pseudacris triseriata triseriata*)
- pickerel frog (*Rana palustris*)
- northern leopard frog (*Rana pipiens*)

REPTILES
- copperbelly water snake (*Nerodia erythrogaster neglecta*)
- queen snake (*Regina septemvittata*)
- Blanding's turtle (*Emydoidea blandingii*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Changes in flow due to urbanization; Lower base flows; Flow regimes with more "flashy" events; Hydraulic instability (flow regime, channel adjustment)

POLLUTION
- Altered sediment loads: Sedimentation and surface runoff

HABITAT CONVERSION
- Dredging and channelization
- Riparian modification: Riparian land use alterations; Shoreline modification; Clearing of riparian zone

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Other structure removal: River and stream "cleanup" efforts without proper understanding; Physical removal; Removal of logs from rivers and lakes for navigation, increased flow, etc

EDUCATION
- Social attitudes: Lack of understanding by society of the importance of woody structure

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGMENT
- Allow seasonal flooding (altered hydrologic regimes)
- Maintain and rehabilitate woody structure (other structure removal)
- Protect wetlands and floodplains (riparian modification, wetland modification)
- Rehabilitate and maintain riparian buffers of at least 50 ft., but 500 ft. or wider maximizes conservation benefits (riparian modification)
- Rehabilitate native flora (riparian modification)
- Rehabilitate original hydrologic functions i.e., reconnect meanders and floodplains (altered hydrologic regimes)
- Use natural materials or soft engineering techniques for any shoreline or riparian modification (riparian modification)

LAW & POLICY
- Restrict beach grooming (riparian modification, other structure removal)
- Use sediment barriers and Best management practices during construction (altered sediment loads)

EDUCATION & AWARENESS
- Educate landowners of the value of riparian areas, macrophytes, and woody structure (social attitudes)
- Educate legislators, local planning boards, and other policy makers on the value of woody structure (social attitudes)

Research and Survey Needs
- Determine life history requirements for SGCN associated with woody structure

- Work with watershed councils and conservation groups to rehabilitate wood habitats and teach its value

Monitoring

- Dredging and channelization
- Macrophyte, woody, and other structure removals
- Riparian modification

Aquatic Characteristic: Turbid Water

Aquatic Characteristic: Turbid Water

Description

Turbid water is water where the amount of particulate matter suspended in the water column is high, thereby decreasing the amount of light available to aquatic plants and animals.

General Condition of Feature

No data available.

Associated Species of Greatest Conservation Need

FISH
- striped shiner (*Luxilus chrysocephalus*)
- silver chub (*Macrhybopsis storeriana*)
- black buffalo (*Ictiobus niger*)
- brown bullhead (*Ameiurus nebulosus*)

FISH cont.
- stonecat (*Noturus flavus*)
- eastern sand darter (*Ammocrypta pellucida*)
- river darter (*Percina shumardi*)
- sauger (*Sander canadensis*)

Associated Threats

BIOLOGICAL INTERACTIONS
- Invasive plants and animals: Zebra mussels

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Control zebra mussels infestations (invasive plants and animals)
- Control the spread of zebra mussels (invasive plants and animals)

Research and Survey Needs
- Determine amount and condition of turbid habitat in Erie basin
- Determine the conservation actions needed to address threats
- Determine the threats associated with turbid water
- Map, in GIS, this landscape feature
- Methods of controlling zebra mussels

Monitoring
- Aquatic invasive species

Aquatic Characteristic: Clear Water

Aquatic Characteristic: Clear Water

Description

Clear water is water that has little particulate matter suspended in the water column and allows large quantities of light to aquatic plants and animals.

General Condition of Feature

No data available.

Associated Species of Greatest Conservation Need

MUSSELS
- elktoe (*Alasmidonta marginata*)
- slippershell mussel (*Alasmidonta viridis*)
- scaleshell (*Leptodea leptodon*)
- rainbow (*Villosa iris*)
- cylindrical papershell (*Anodontoides ferussacianus*)
- snuffbox (*Epioblasma triquetra*)

INSECTS
- rapids clubtail (*Gomphus quadricolor*)
- smoky rubyspot (*Hetaerina titia*)

FISH
- lake sturgeon (*Acipenser fulvescens*)
- mooneye (*Hiodon tergisus*)
- redside dace (*Clinostomus elongatus*)
- striped shiner (*Luxilus chrysocephalus*)
- silver chub (*Macrhybopsis storeriana*)

FISH cont.
- river chub (*Nocomis micropogon*)
- pugnose shiner (*Notropis anogenus*)
- silver shiner (*Notropis photogenis*)
- southern redbelly dace (*Phoxinus erythrogaster*)
- western creek chubsucker (*Erimyzon claviformis*)
- lake chubsucker (*Erimyzon sucetta*)
- black redhorse (*Moxostoma duquesnei*)
- brown bullhead (*Ameiurus nebulosus*)
- stonecat (*Noturus flavus*)
- cisco or lake herring (*Coregonus artedi*)
- eastern sand darter (*Ammocrypta pellucida*)
- least darter (*Etheostoma microperca*)

AMPHIBIANS
- pickerel frog (*Rana palustris*)

Associated Threats

MODIFICATION OF NATURAL PROCESSES
- Altered hydrologic regimes: Increased flashiness increases erosion and thus turbidity due to development and runoff changes; Altered flow regime due to development and farming

POLLUTION
- Altered nutrient inflows: Surface runoff, nutrients; Eutrophication
- Altered sediment loads: Inadequate runoff controls on construction sites; Erosion; Increased flashiness increases erosion and thus turbidity due to development and runoff changes; Sedimentation; Sediment resulted from urban, agriculture, road construction, and bank erosion
- Pesticides and herbicides: Plant harvesting; Herbicide use
- Urban, municipal, and industrial pollution

HABITAT CONVERSION
- Dams
- Dredging and channelization: Dredging
- Riparian modification: Hardened shoreline; Wave reverberation
- Wetland modification

BIOLOGICAL INTERACTIONS
- Disease, pathogens, and parasites
- Invasive plants and animals

NON-CONSUMPTIVE BIOLOGICAL RESOURCE USE
- Macrophyte removal: Removal of macrophytes through chemical treatments and mechanical removal can lead to increased turbidity in lakes
- Non-consumptive recreation: Recreational boating - wave energy

EDUCATION
- Lack of scientific knowledge
- Social Attitudes: Poor understanding by society for the need for clean water for aquatic organisms

Conservation Actions Needed (Threats addressed)

LAND, WATER & SPECIES MANAGEMENT
- Allow seasonal flooding (altered hydrologic regimes)
- When removing aquatic invasive vegetation, at least 60-80% of native vegetation should be preserved (invasive plants and animals, macrophyte removal)
- Control aquatic invasive plant species (invasive plants and animals)

- Maintain and rehabilitate riparian corridors (riparian modification)
- Prevent establishment of new aquatic invasive species (invasive plants and animals)
- Protect and rehabilitate degraded wetlands, floodplains, and riparian areas (riparian modification, wetland modification)
- Rehabilitate original hydrologic functions i.e., reconnect meanders and floodplains (altered hydrologic regimes)
- Vegetation management needs to be done in conjunction with a vegetation management plan (invasive plants and animals, macrophyte removal)

LAW & POLICY

- Encourage green-space planning and clustered development (riparian modification)
- Remaining dams should be operated as run-of-the-river (altered hydrologic regimes, dams)
- Remove dams to rehabilitate riparian and stream habitats and natural hydrologic conditions (altered hydrologic regimes, dams)
- Restrict beach grooming (riparian modification)
- Shoreline and riparian modification should be completed with natural materials and soft engineering (riparian modification)
- Use Best management practices (variety of threats)
- Use sediment barriers and Best management practices during construction (altered sediment loads)
- Work with and educate Drain Commissioners to use natural stream processes(variety of threats)
- Work with farmers and the Natural Resources Conservation Service to decrease pesticide and herbicide use (pesticides and herbicides)
- Work with local officials on planning and zoning regulations and ordinances (variety of threats)
- Work with local officials on setback and buffer ordinances (riparian modification)
- Work with road commissions to site and maintain road crossings (altered hydrologic regimes, altered sediment loads)

EDUCATION & AWARENES

- Educate legislators, local planning boards, other policy makers, and the public on the importance of natural processes, invasive species, hydrologic cycles and stewardship (social attitudes)
- Educate landowners on the value of riparian areas (riparian modification, social attitudes)
- Work with watershed councils and conservation groups on habitat restoration (riparian modification)

Research and Survey Needs

- Explore alternatives to pesticides and herbicides
- Develop early detection and rapid response protocols for aquatic invasive species
- Determine erosion sites and condition
- Determine life history requirements for SGCN associated with clear water habitats
- Determine the condition of clear water habitats in the basin
- Map, in GIS, this landscape feature

Monitoring

- Aquatic invasive specie
- Beach grooming
- Effluent flows: municipal waste water treatment plants, septic systems, industrial
- Erosion site
- Pesticide and herbicide use
- Riparian modification
- Road crossings