

## Appendix C

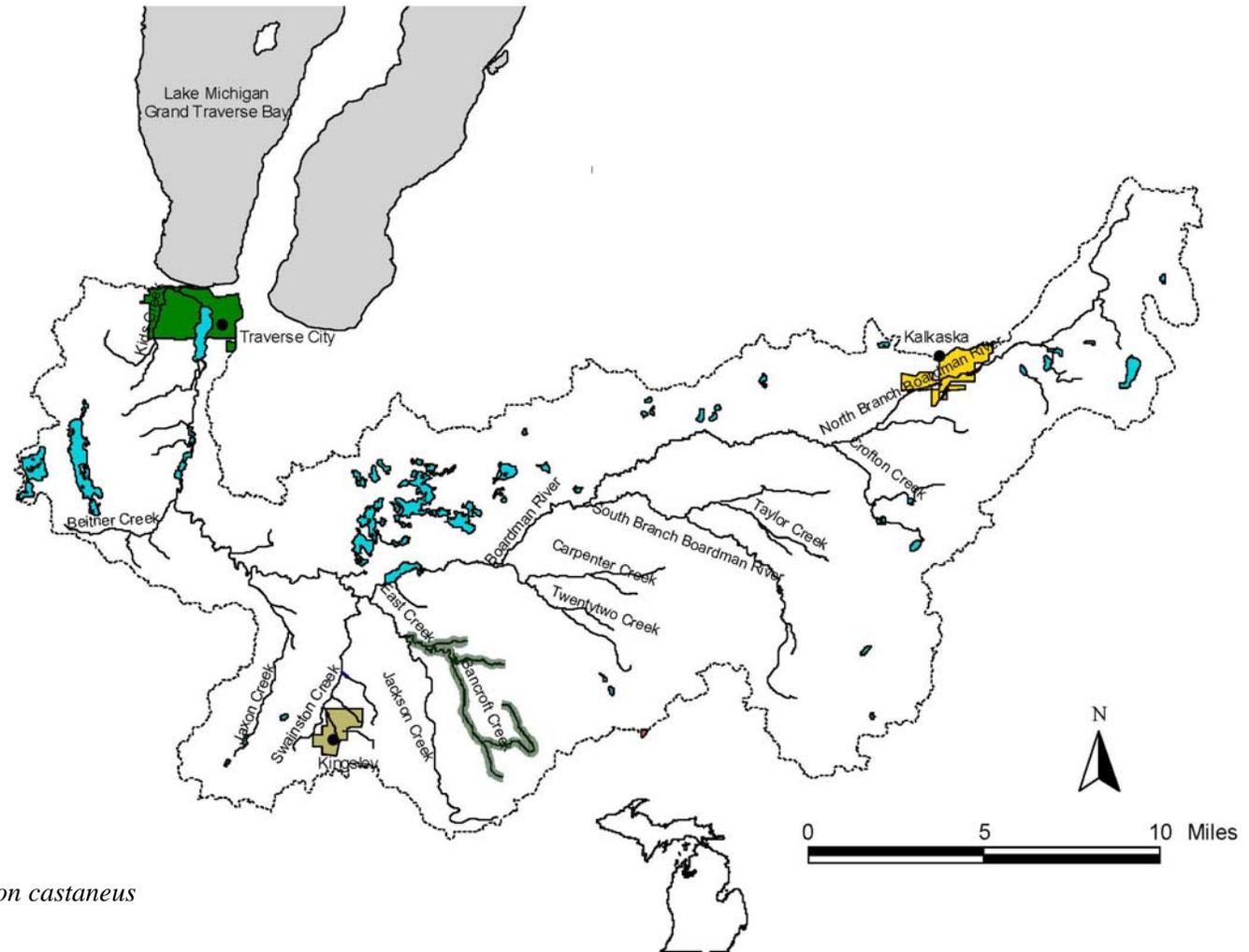
### Distribution maps of fish species within the Boardman River watershed

This appendix contains maps of known past and present fish distributions within the Boardman River watershed. The distributions of fish species were compiled from records located at the University of Michigan, Museums Fisheries Library; Michigan Department of Natural Resources, Institute for Fisheries Research; and Central Lake Michigan Management Unit offices in Traverse City and Cadillac.

Habitat descriptions were compiled from Fishes of Ohio (Trautman 1981), Freshwater Fishes of Canada (Scott and Crossman 1973), Fishes of Wisconsin (Becker 1983), Fishes of Missouri (Pflieger 1975), and Fishes of the Great Lakes Region (Hubbs and Lagler 1947).

## APPENDIX B INDEX

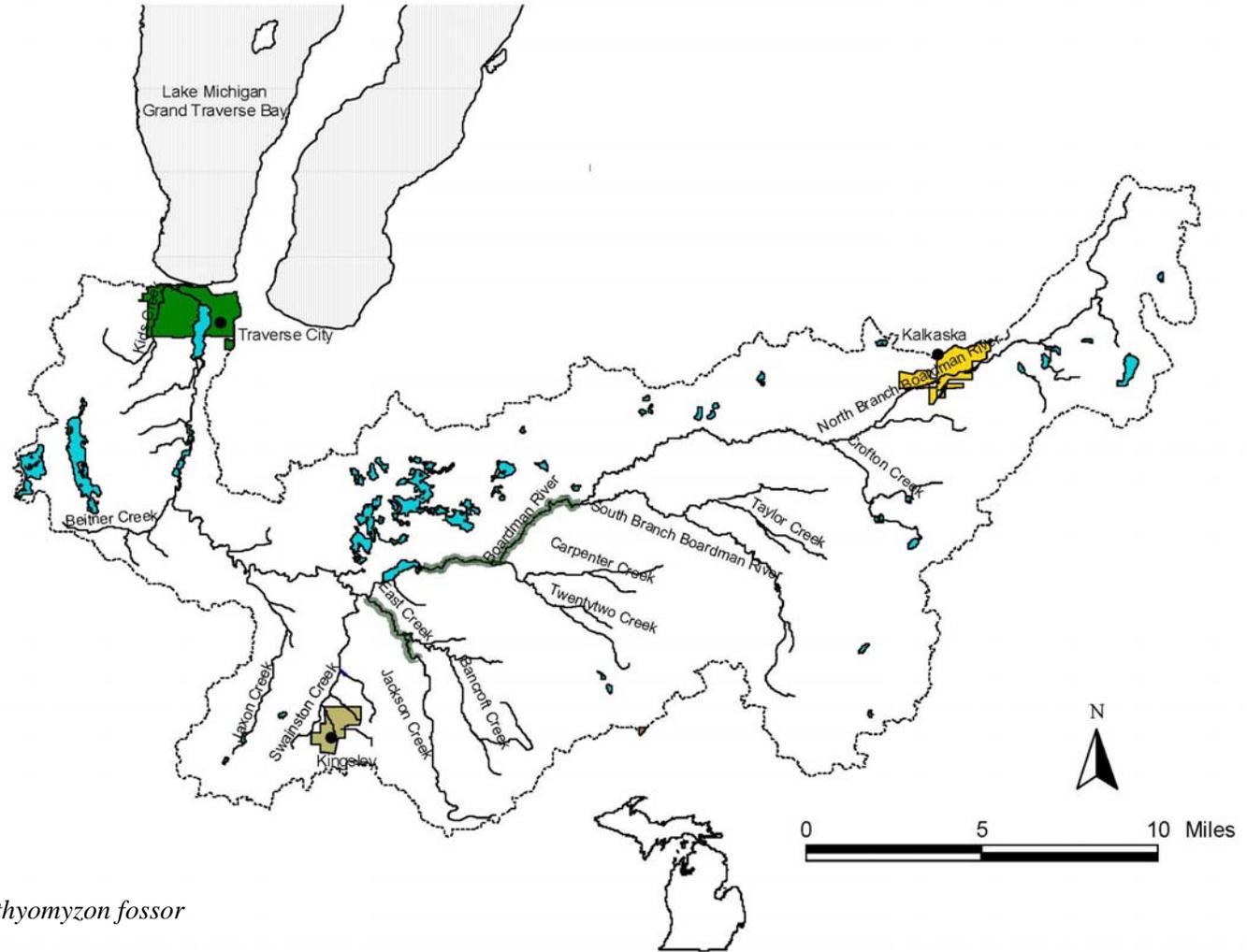
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**Chestnut lamprey** *Ichthyomyzon castaneus*

Habitat:

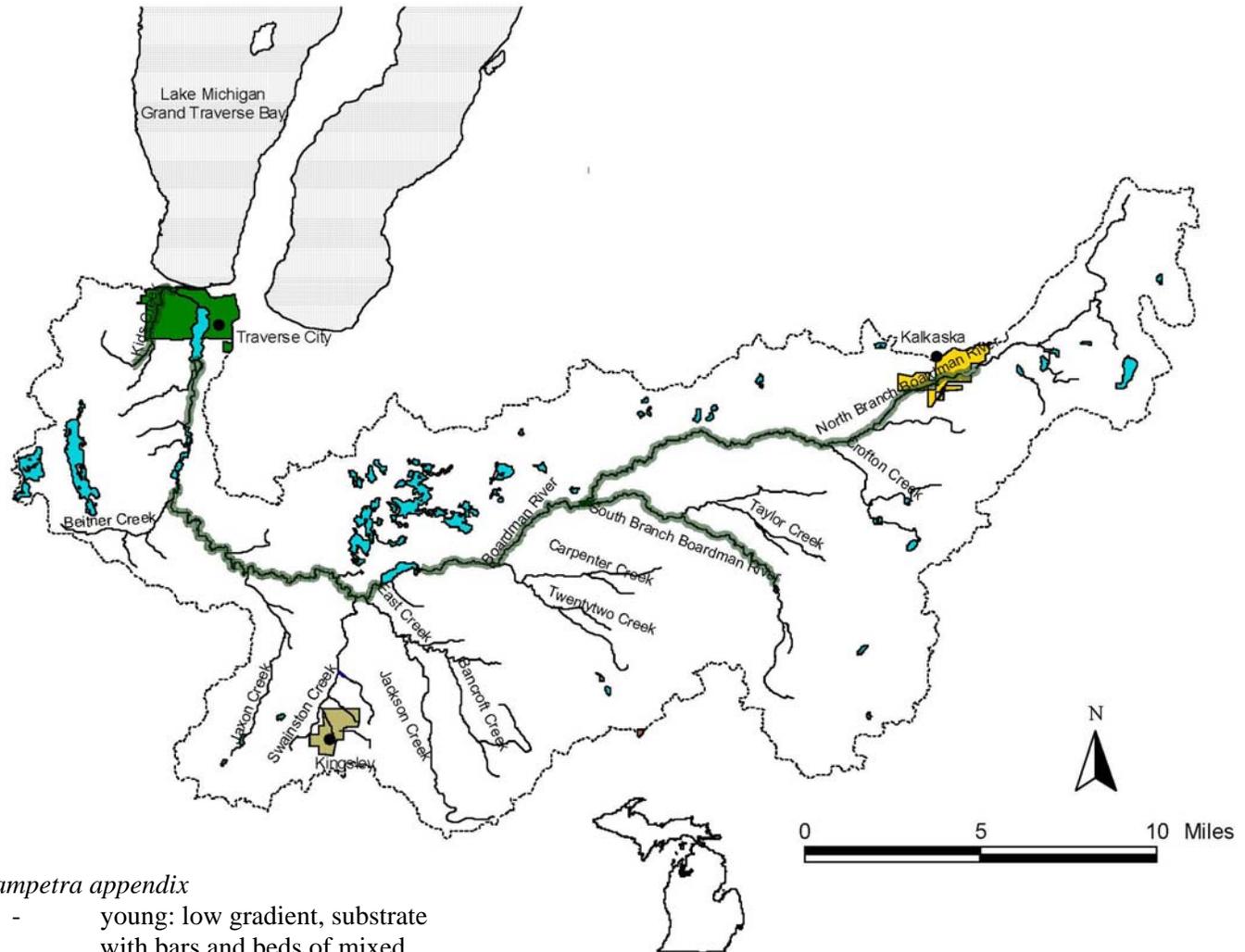
- feeding - stable substrate of sand and silt with light growth of *chara* or quiet backwaters of muck and silt with dense rooted vegetation
- moderate current
- clear moderate-size water
- spawning - moderate-size stream



**Northern Brook Lamprey** *Ichthyomyzon fossor*

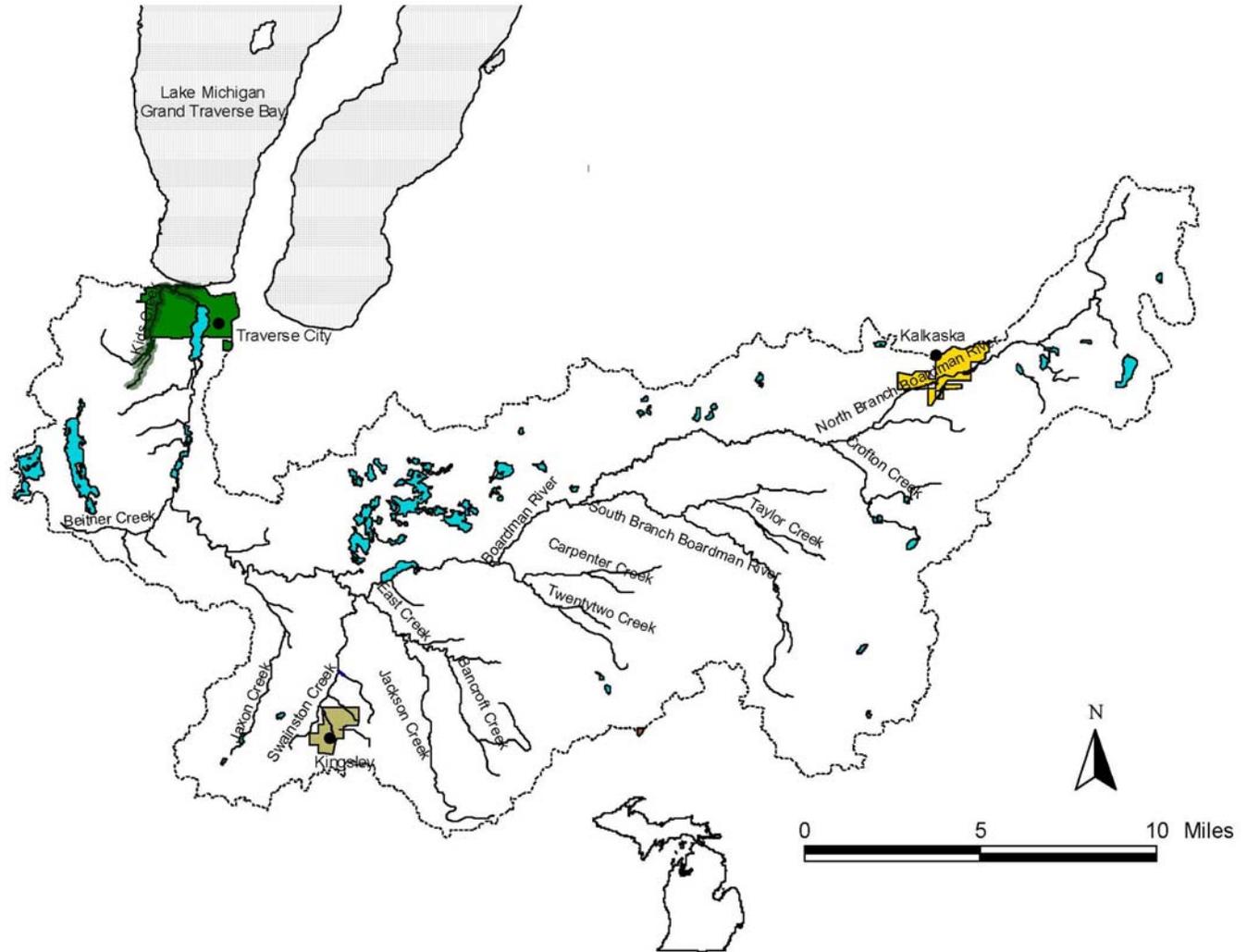
**Habitat:**

- feeding - young: low gradient, substrate with bars and beds of mixed sand and organic debris
- moderately warm water
- spawning - clear, high gradient streams (<15 feet wide)
- riffles with sand or gravel substrate



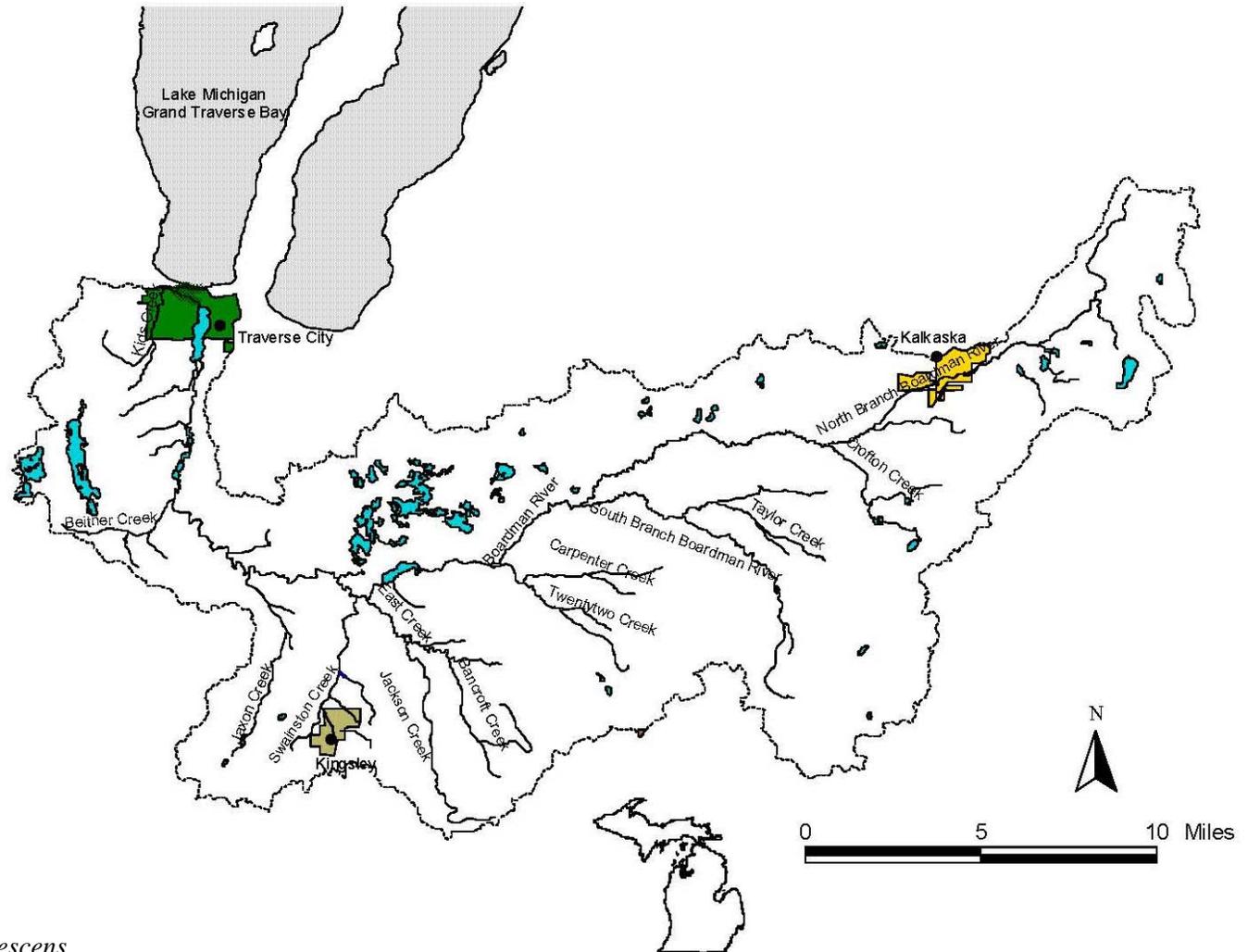
**American Brook Lamprey** *Lampetra appendix*

- Habitat: feeding - young: low gradient, substrate with bars and beds of mixed sand and organic debris
- clear cool stream water, sensitive to turbidity
- spawning - clear, high gradient streams (>15 feet wide)
- cold water
  - gravel substrate
- winter refuge - sand or silt substrate for ammocetes



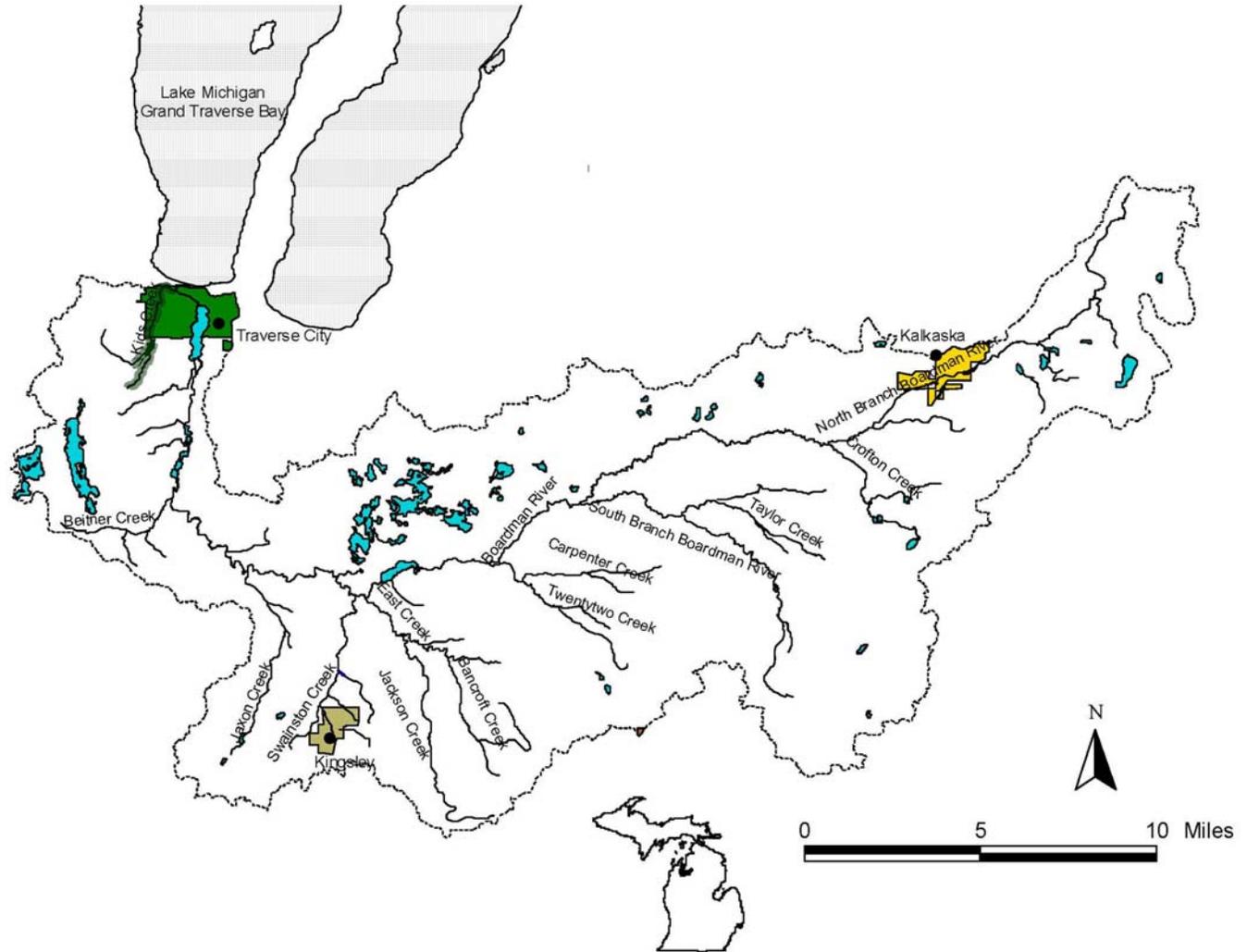
**Sea Lamprey *Petromyzon marinus***

- Habitat: feeding - young: substrate with beds of sand mixed with organic debris  
 - cannot tolerate silt  
 - adults: clear cool water of Lake Michigan  
 spawning - no dams  
 - riffles with sand and gravel substrates



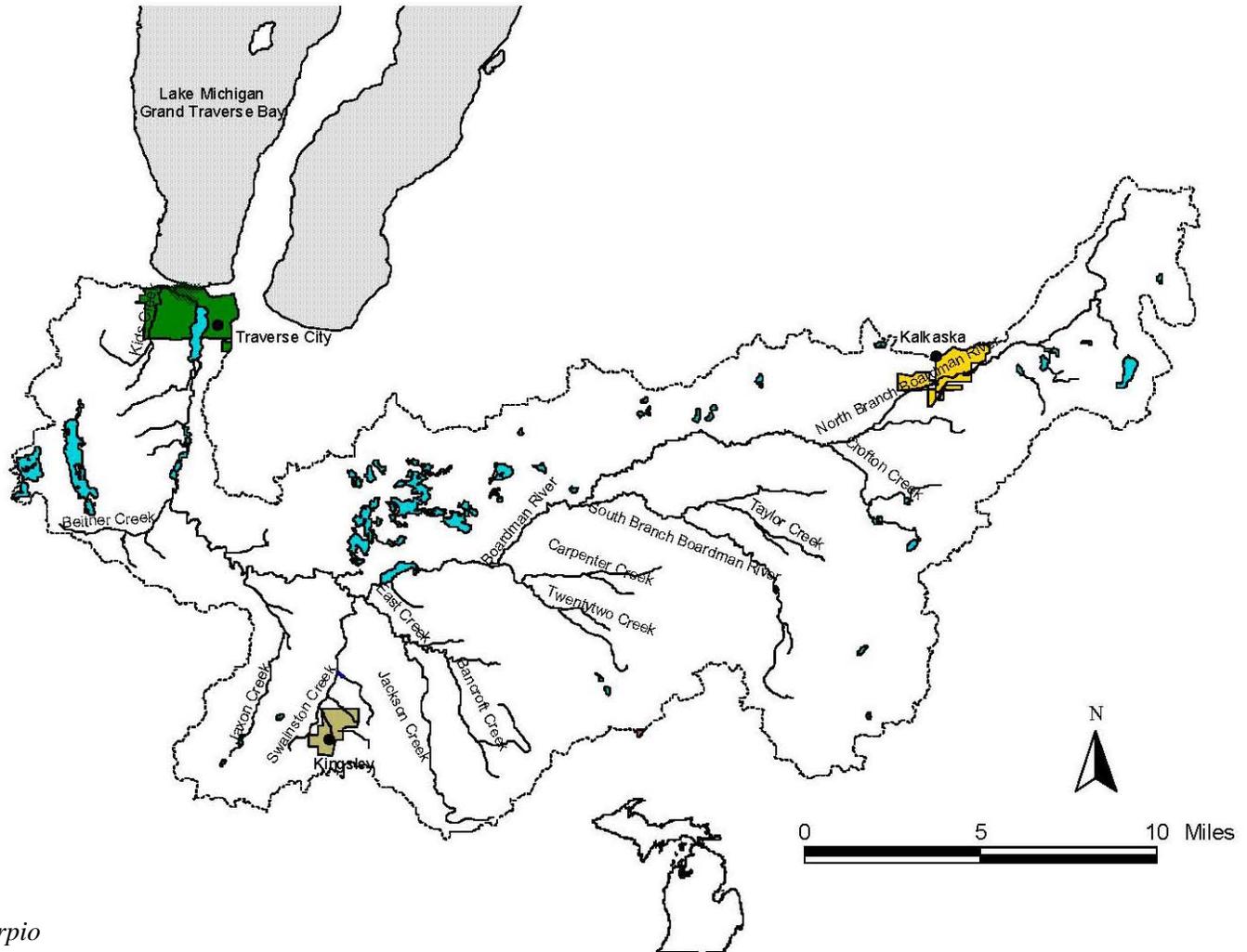
**Lake sturgeon** *Acipenser fulvescens*

- Habitat:
- feeding - shoal areas of large rivers, lakes, and impoundments
    - gravel, sand, rock substrates
  - spawning - in or before rapids, at the base of dams in rivers
    - in 2-15 feet of water
    - swift current
    - rocky ledges or around rocky islands in Great Lakes



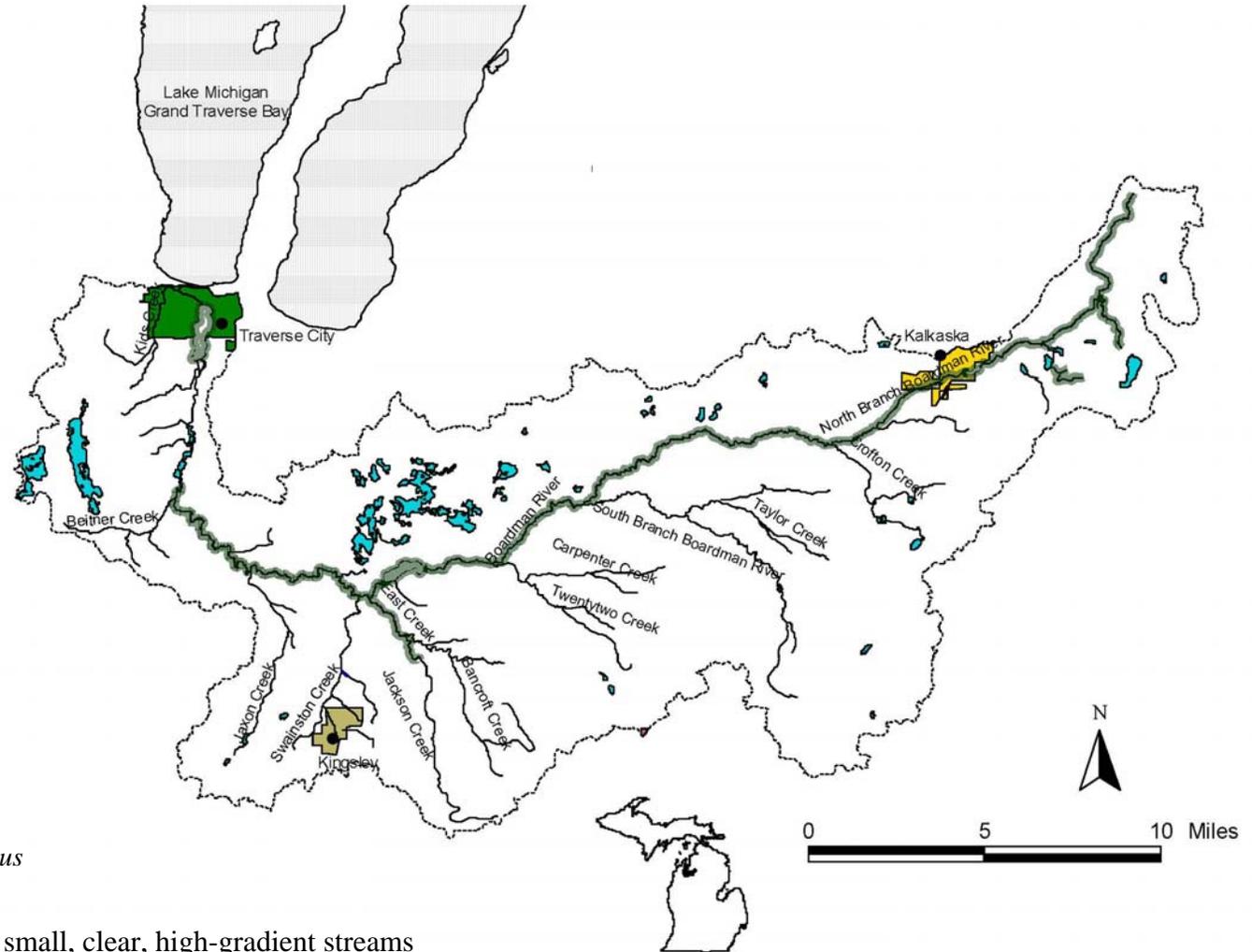
**Goldfish** *Carassius auratus*  
Habitat:

- feeding - vegetation
- low gradient, shallow, warm water streams, rivers, lakes, and impoundments
- tolerates some turbidity and siltation
- spawning - warm, weedy shallows



**Common carp** *Cyprinus carpio*  
**Habitat:**

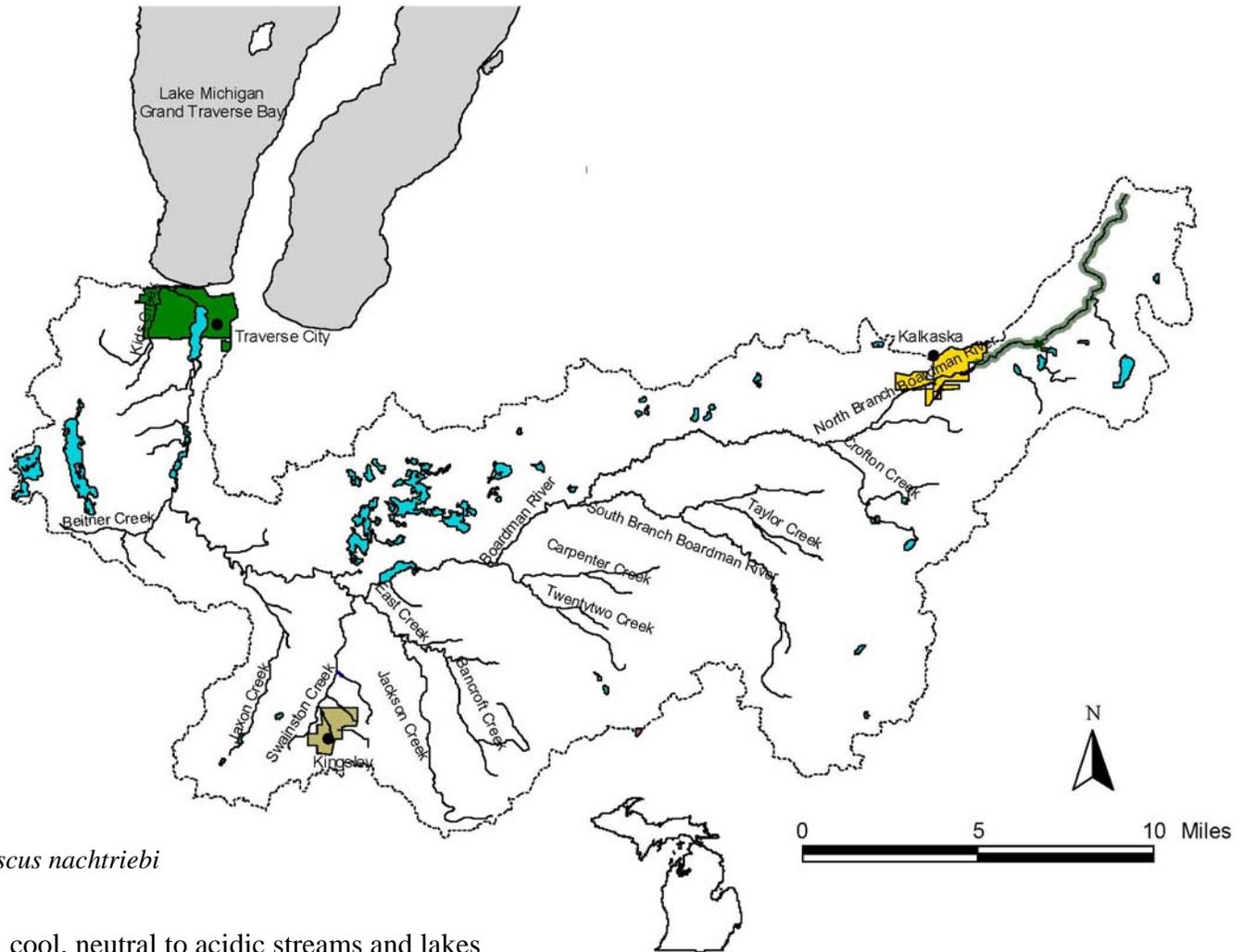
- feeding - low gradient fertile streams, rivers, lakes, and impoundments
- abundance of aquatic vegetation or organic matter
- tolerant of all substrates and clear to turbid water
- spawning - weedy or grassy shallows



**Common shiner *Luxilus cornutus***

**Habitat:**

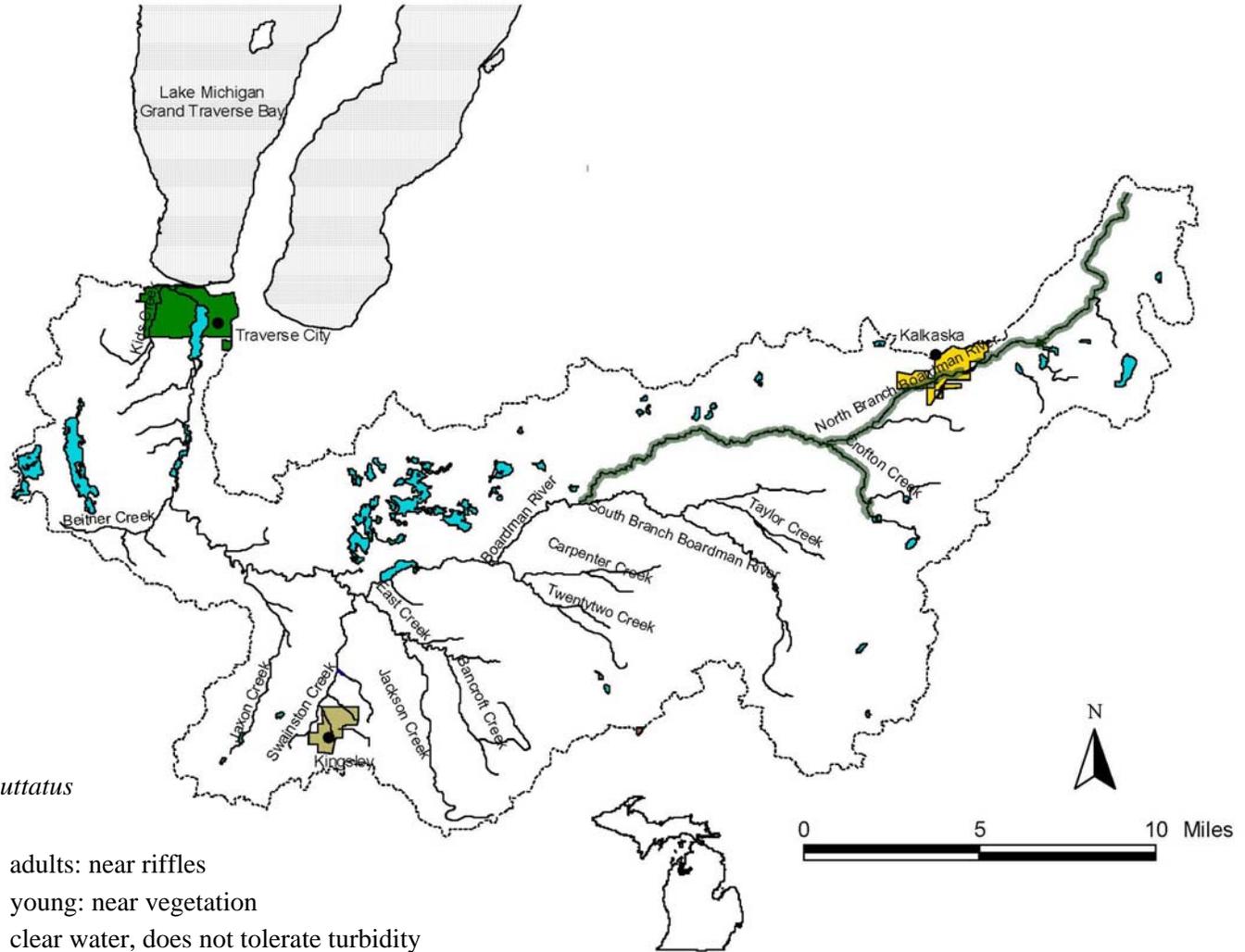
- feeding - small, clear, high-gradient streams and rivers, or shores of clear water lakes and impoundments
- gravel substrate
- can tolerate some submerged aquatic vegetation
- not very tolerant of turbidity or silted waters



**Northern pearl dace** *Margariscus nachtriebi*

Habitat:

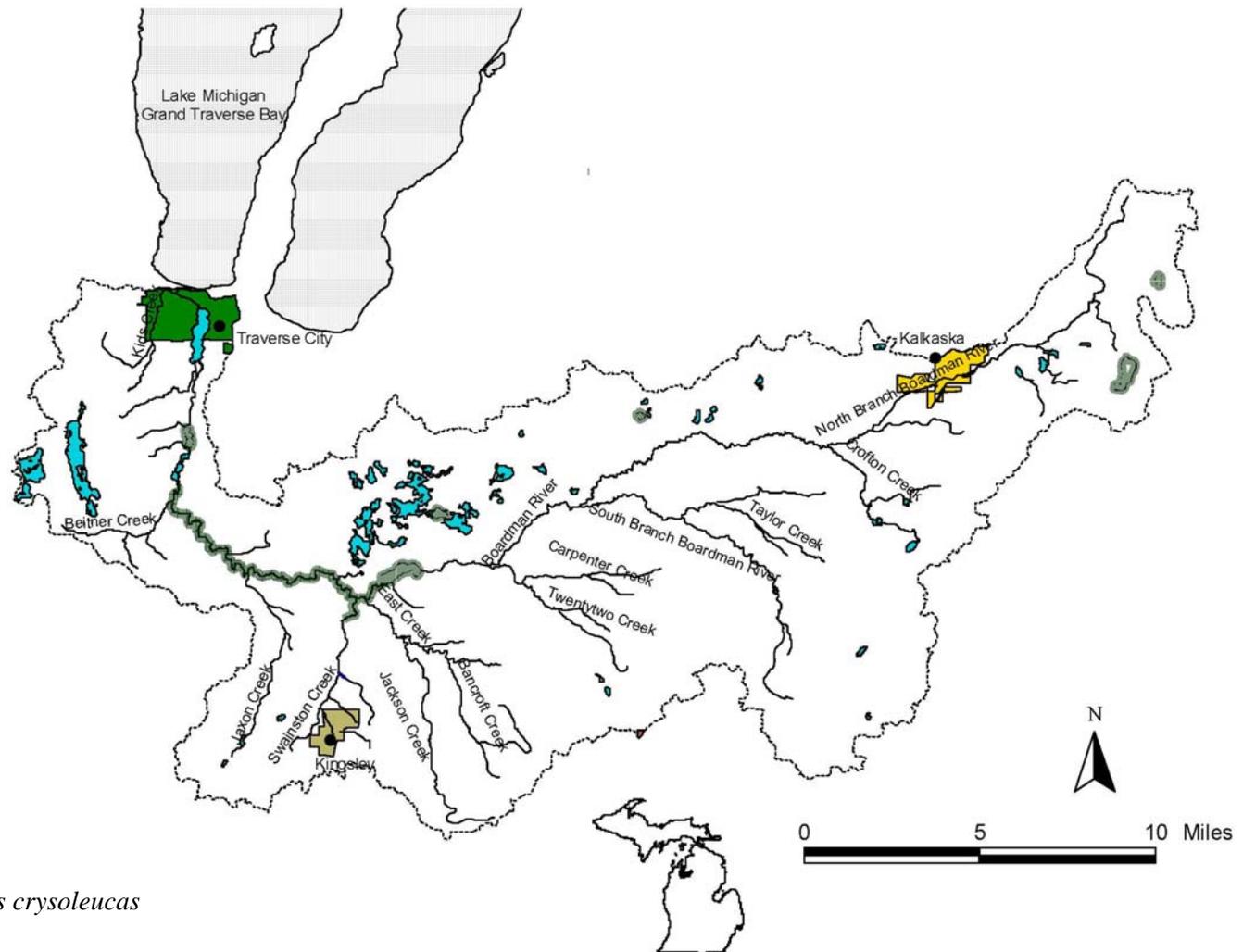
- feeding - cool, neutral to acidic streams and lakes
- clear to slightly turbid water
- spawning - males are territorial
- clear water, 18-24 inches deep
- sand or gravel substrate
- weak to moderate current



**Hornyhead chub** *Nocomis biguttatus*

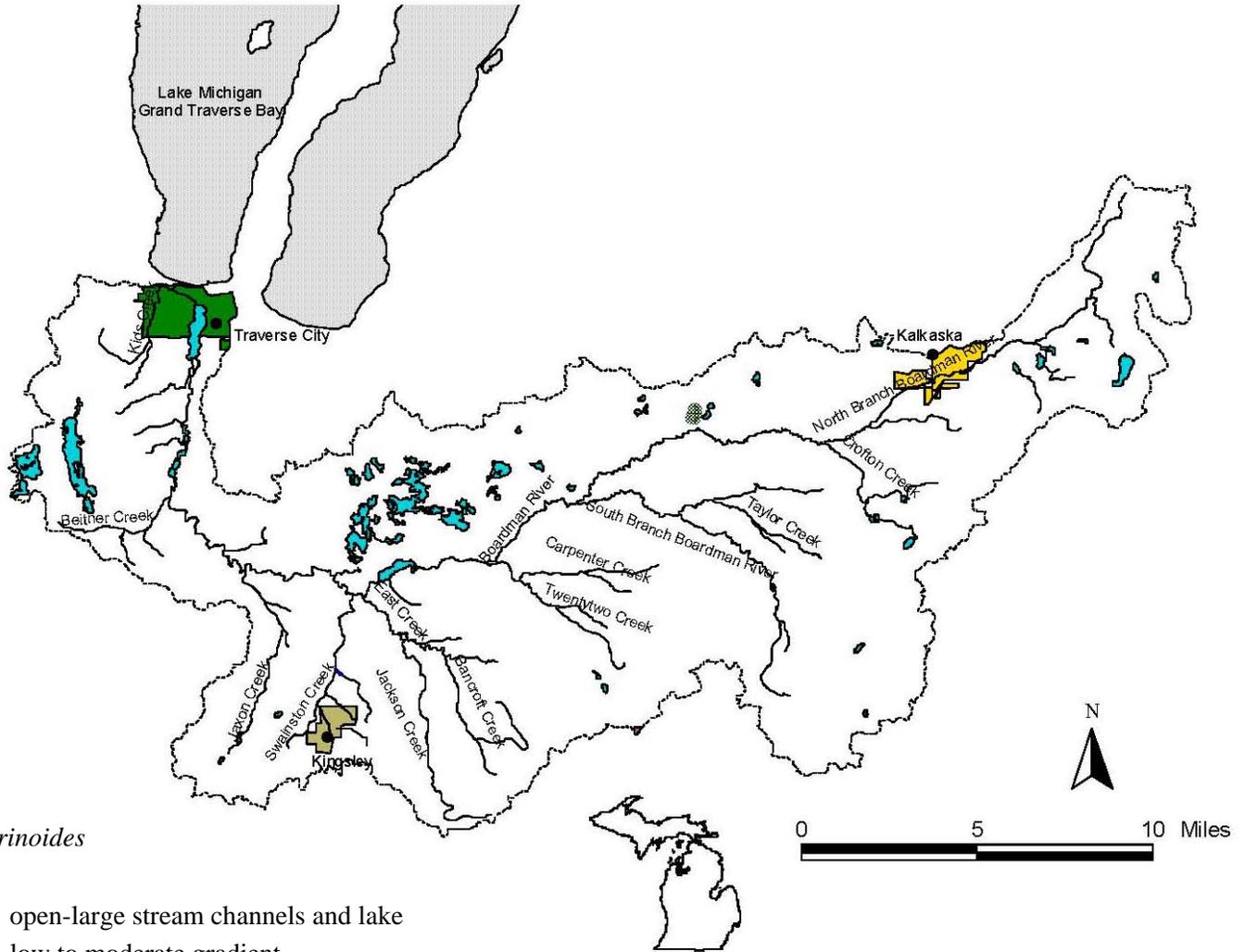
Habitat:

- feeding - adults: near riffles
- young: near vegetation
- clear water, does not tolerate turbidity
- gravel substrate
- low gradient streams that are tributaries to large streams
- spawning - large stones and pebbles present
- often below a riffle in shallow water
- gravel substrate



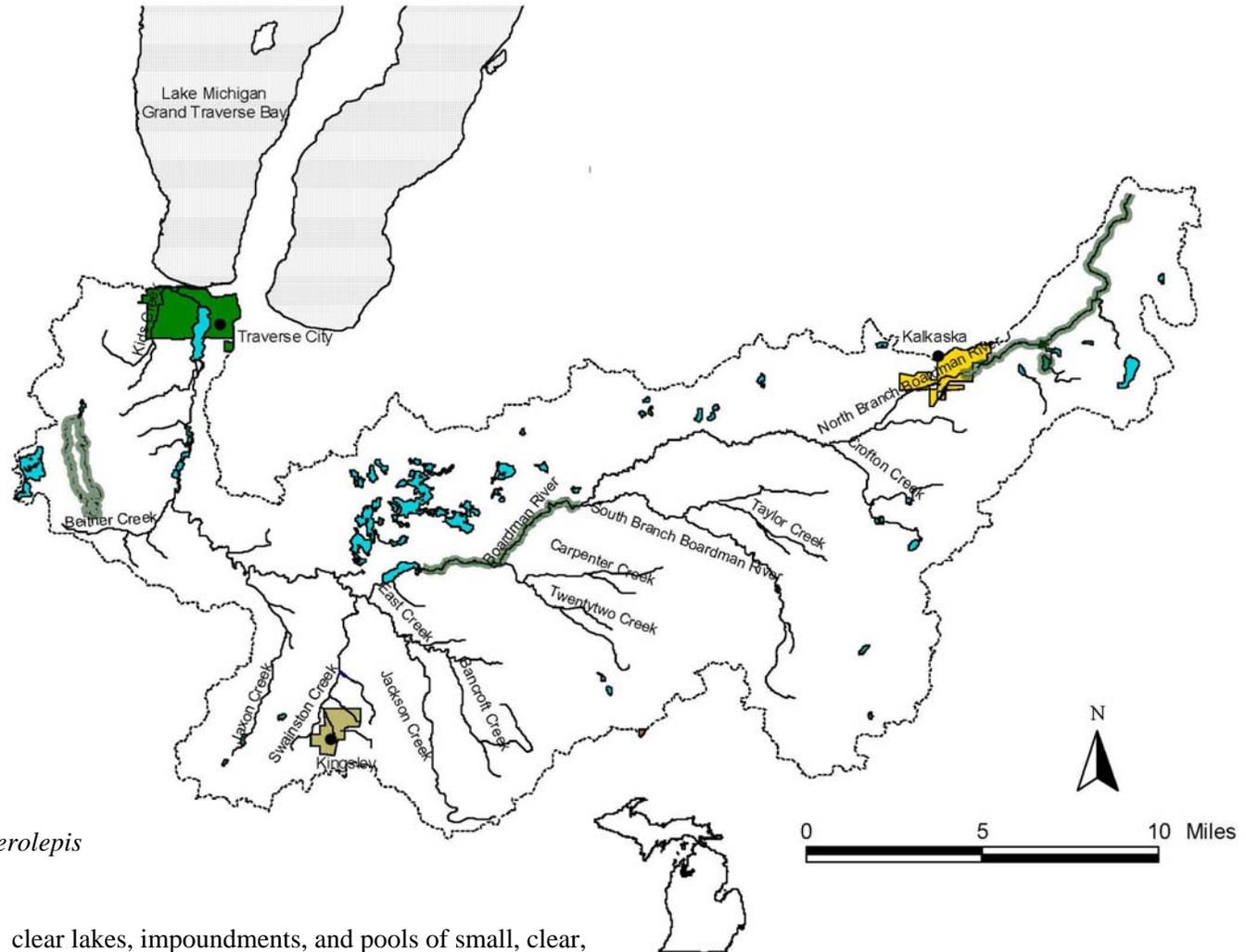
**Golden shiner** *Notemigonus crysoleucas*  
Habitat:

- feeding - lakes and impoundments and quiet pools of low gradient streams
- clear shallow water
- heavy vegetation
- spawning - vegetation



**Emerald shiner** *Notropis atherinoides*  
Habitat:

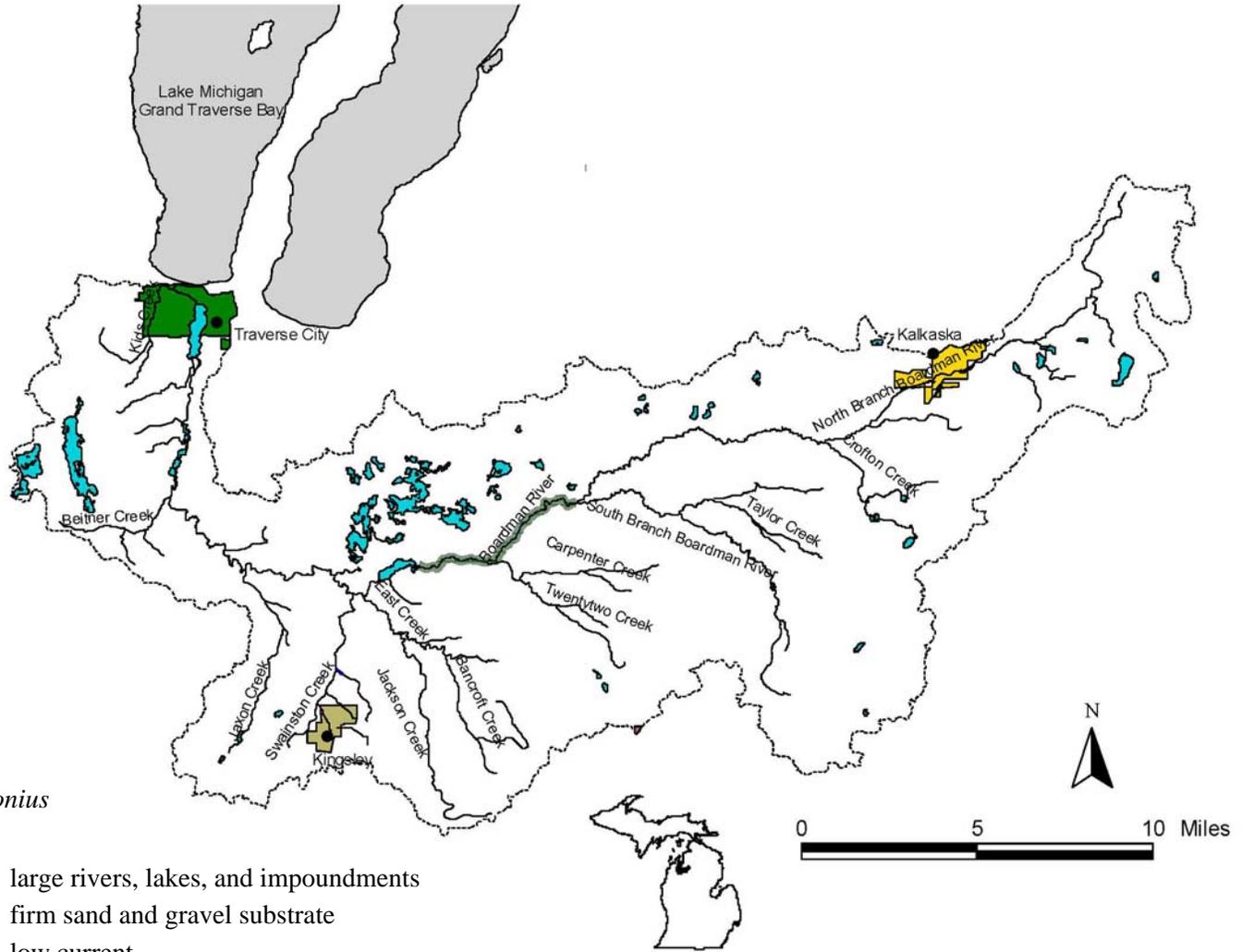
- feeding
  - open-large stream channels and lake
  - low to moderate gradient
  - range of turbidities and bottom types
  - midwater or surface preferred, substrate of little importance
  - avoids rooted vegetation
- spawning
  - sand or firm mud substrate or gravel shoals



**Blacknose shiner** *Notropis heterolepis*

Habitat:

- feeding - clear lakes, impoundments, and pools of small, clear, low-gradient streams
- aquatic vegetation
- clean sand, gravel, marl, muck, peat, or organic debris substrate
- cannot tolerate much turbidity, much siltation, or loss of aquatic vegetation
- spawning - sandy substrate



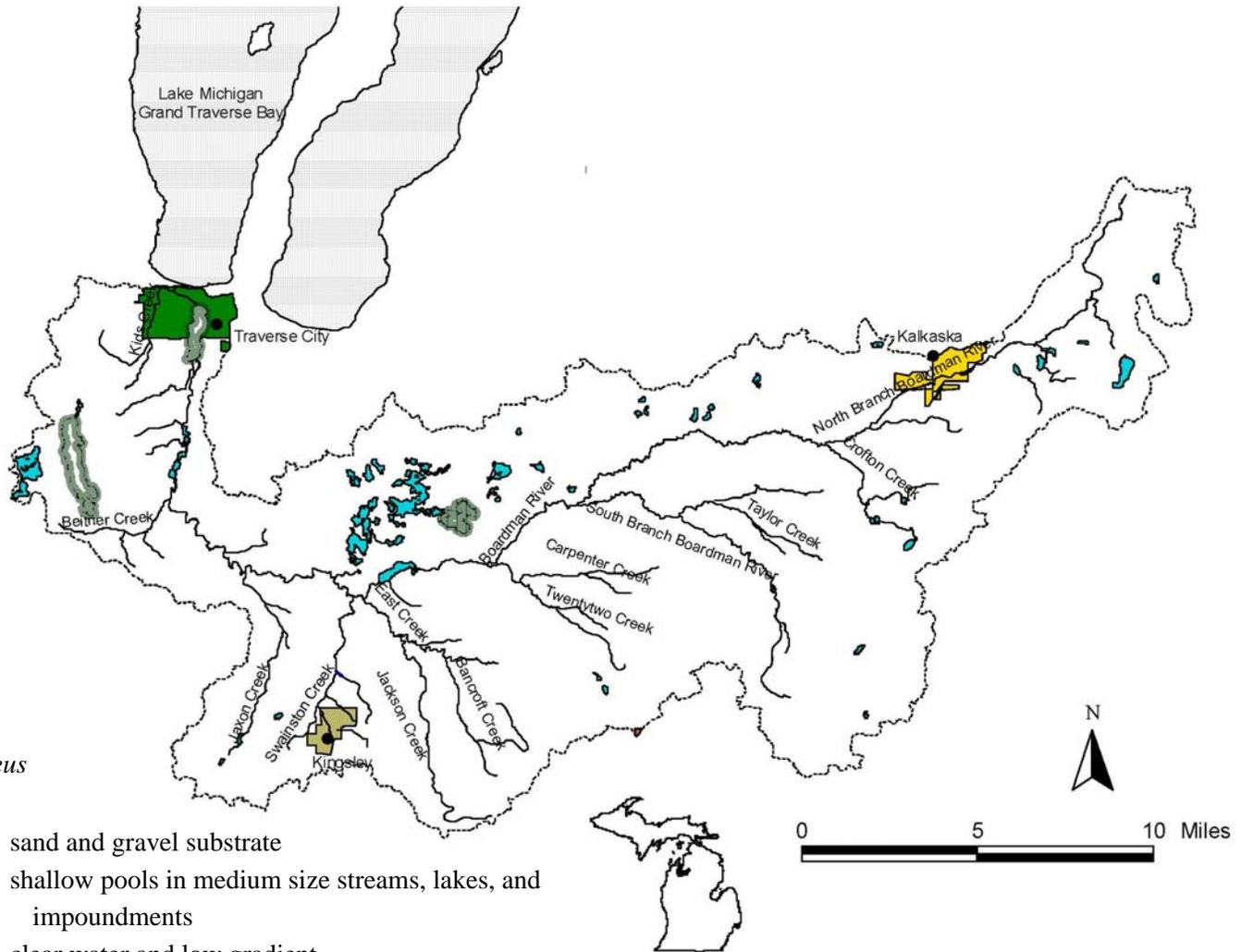
**Spottail shiner** *Notropis hudsonius*

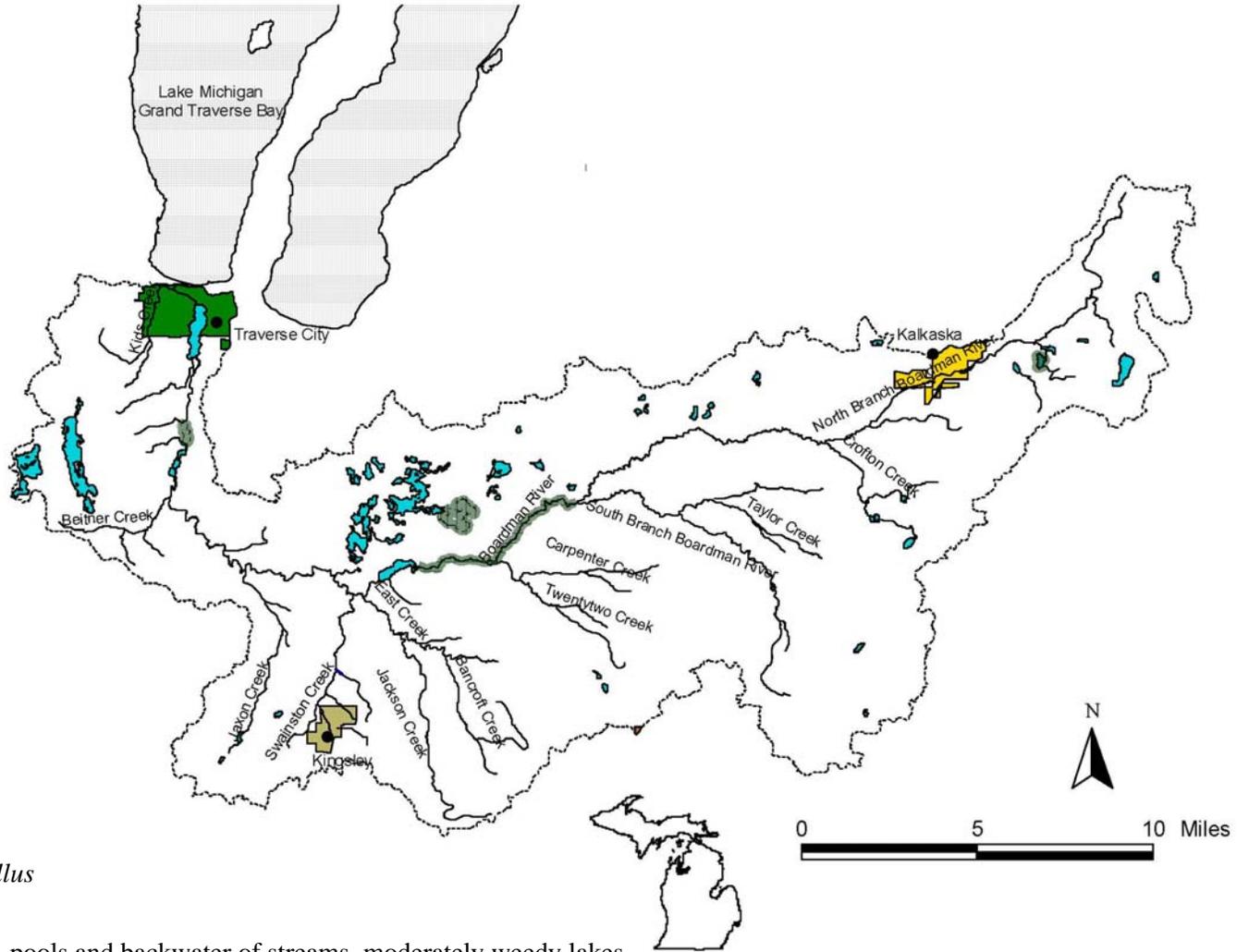
Habitat:

- feeding - large rivers, lakes, and impoundments
- firm sand and gravel substrate
- low current
- sparse to moderate vegetation
- avoids turbidity
- spawning - over sandy shoals or gravelly riffles
- near the mouths of small streams

**Sand shiner** *Notropis stramineus*  
Habitat:

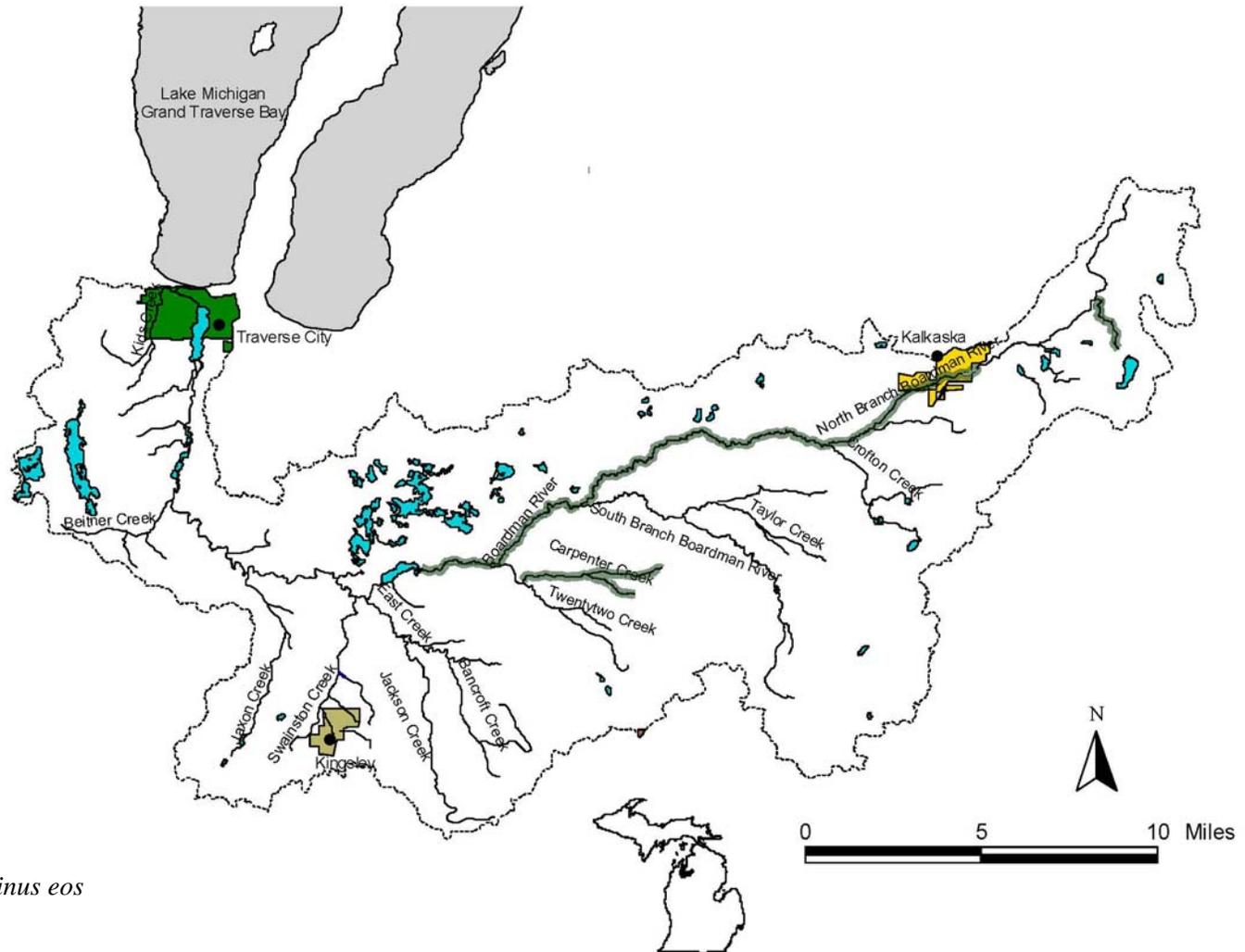
- feeding - sand and gravel substrate
- shallow pools in medium size streams, lakes, and impoundments
- clear water and low gradient
- rooted aquatic vegetation preferred
- tolerant of some inorganic pollutants provided substrate is not covered
- spawning - clean gravel or sand substrate





**Mimic shiner** *Notropis volucellus*  
Habitat:

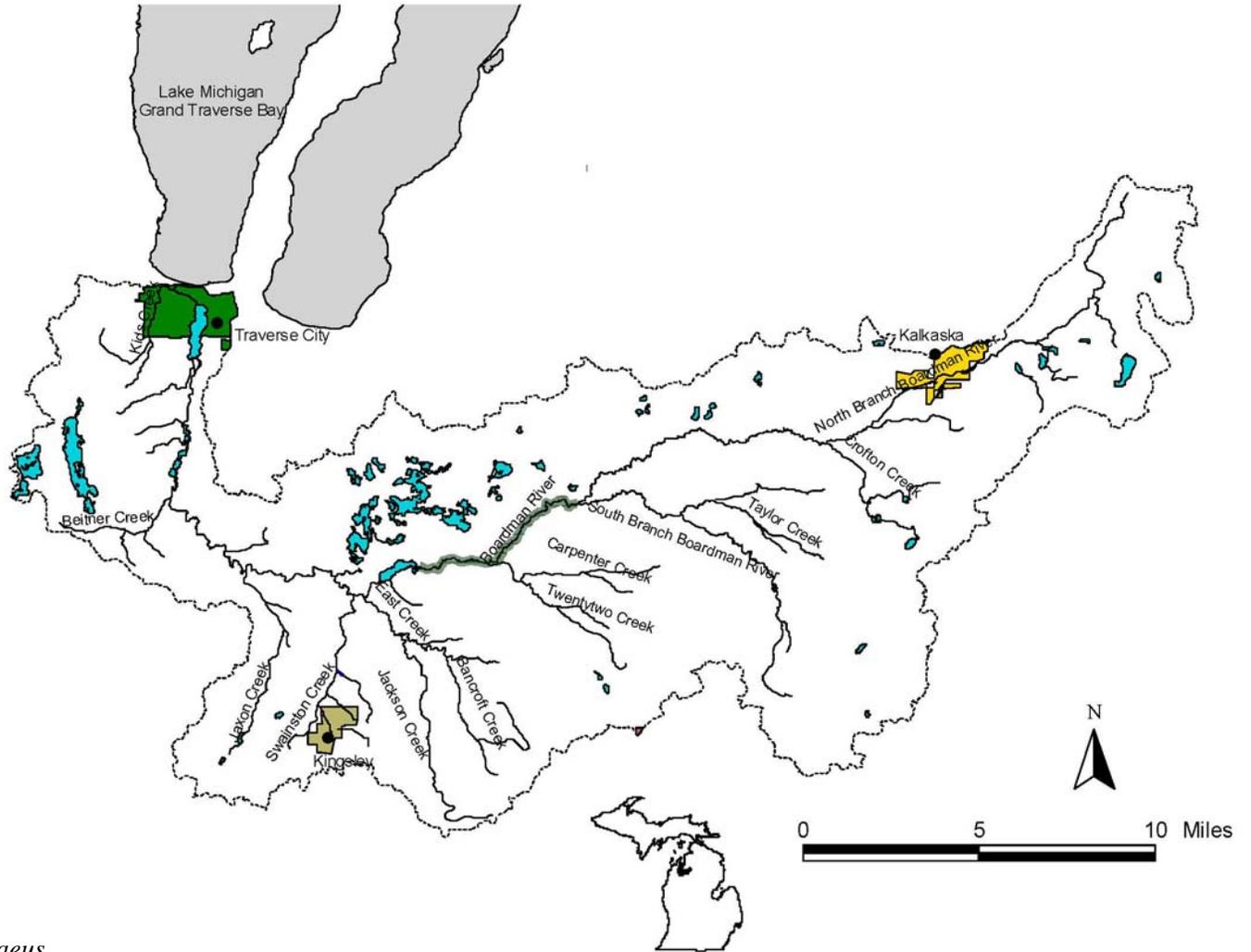
- feeding - pools and backwater of streams, moderately weedy lakes and impoundments
- quiet or still water
- clear shallow water
- spawning - aquatic vegetation necessary



**Northern redbelly dace** *Phoxinus eos*

**Habitat:**

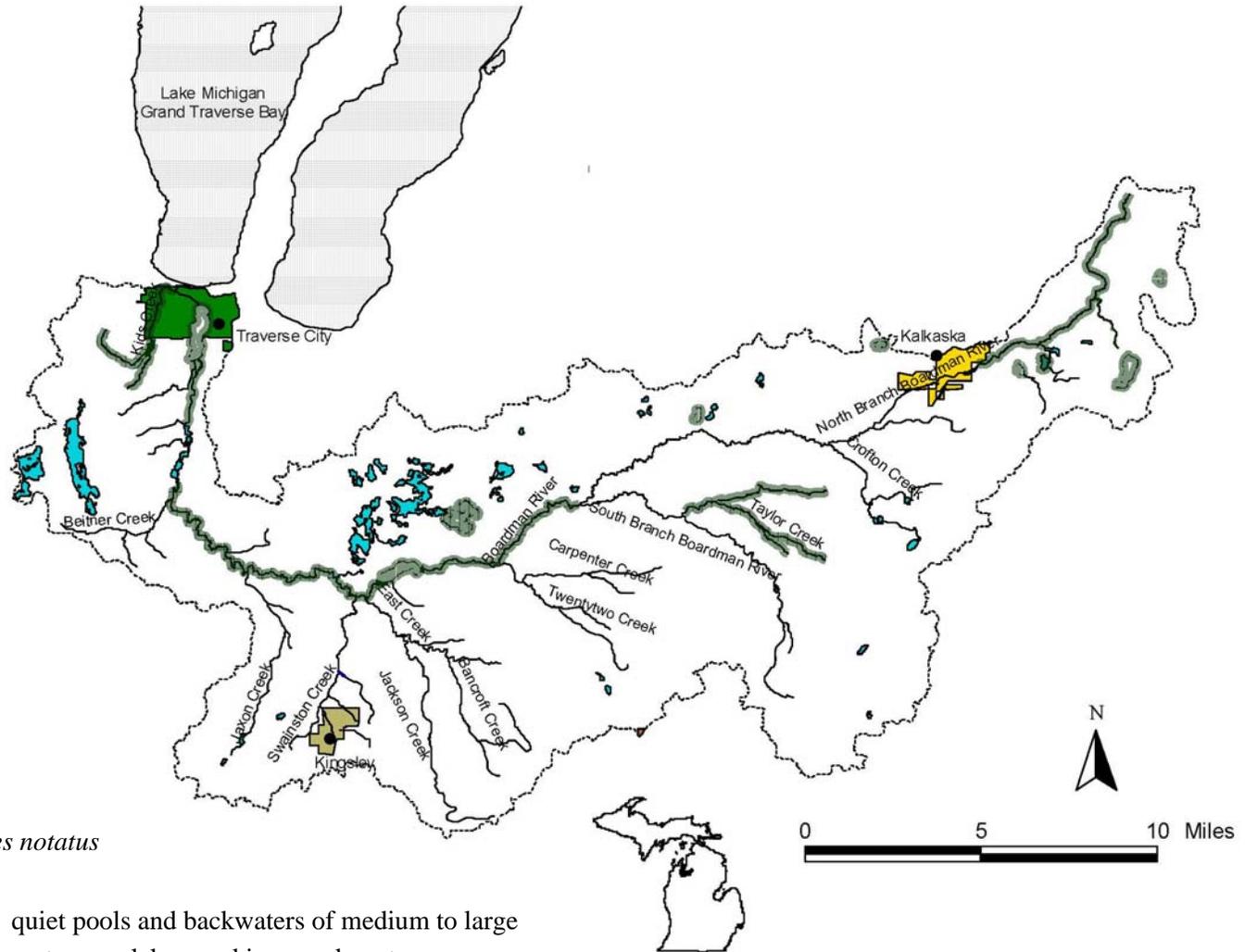
- feeding - slow current
- in boggy lakes and streams
- detritus or silt substrate
- clear to slightly turbid water
- spawning - filamentous algae needed for egg deposition



**Finescale dace** *Phoxinus neogaeus*

Habitat:

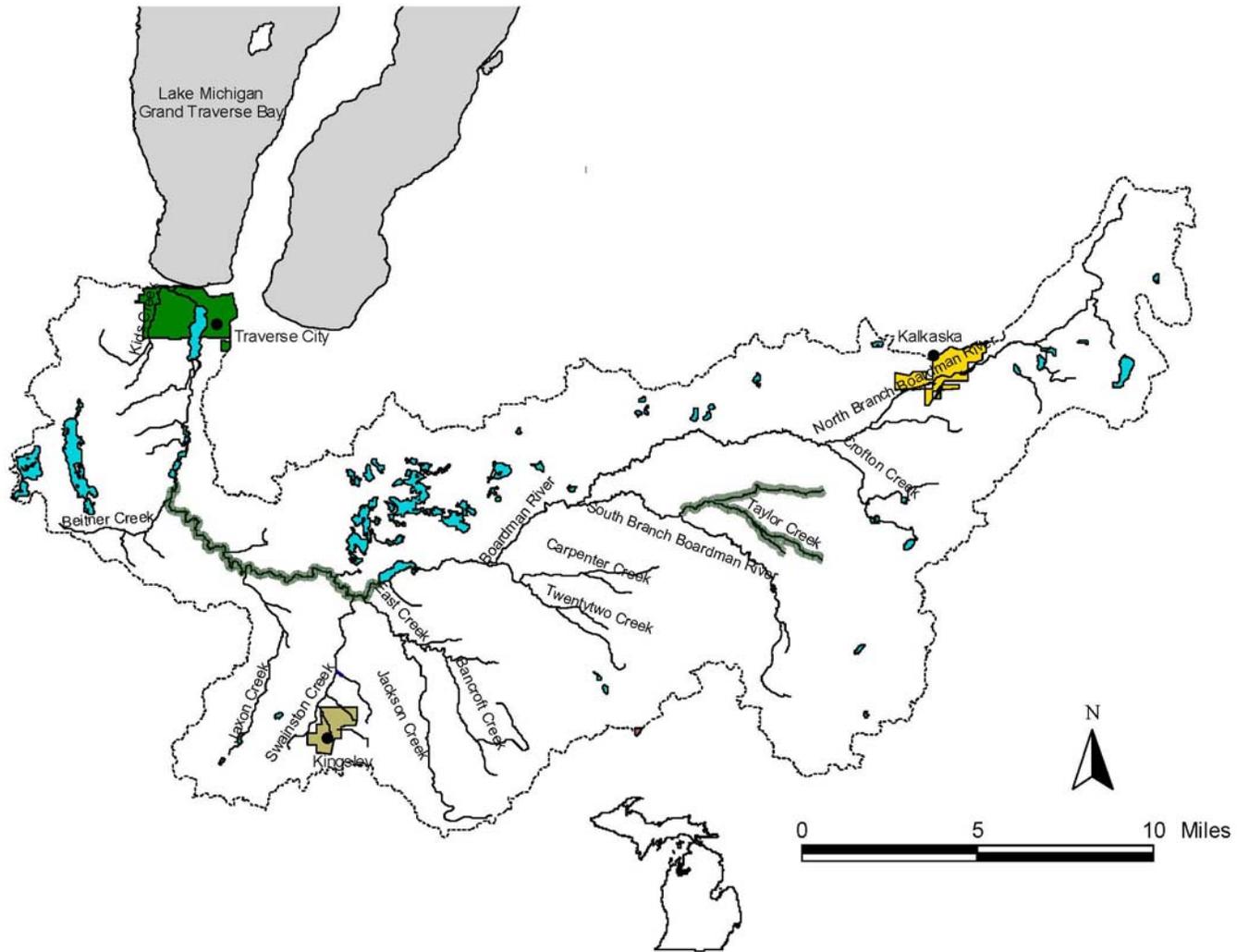
- feeding - cool bog lakes and streams
- neutral to slightly acidic waters
- various substrates



**Bluntnose minnow** *Pimephales notatus*

Habitat:

- feeding - quiet pools and backwaters of medium to large streams, lakes, and impoundments
- clear warm water
- some aquatic vegetation
- firm substrates
- tolerates all gradients, turbidity, organic and inorganic pollutants
- spawning - eggs deposited on the underside of flat stones or objects
- nests in sand or gravel substrate

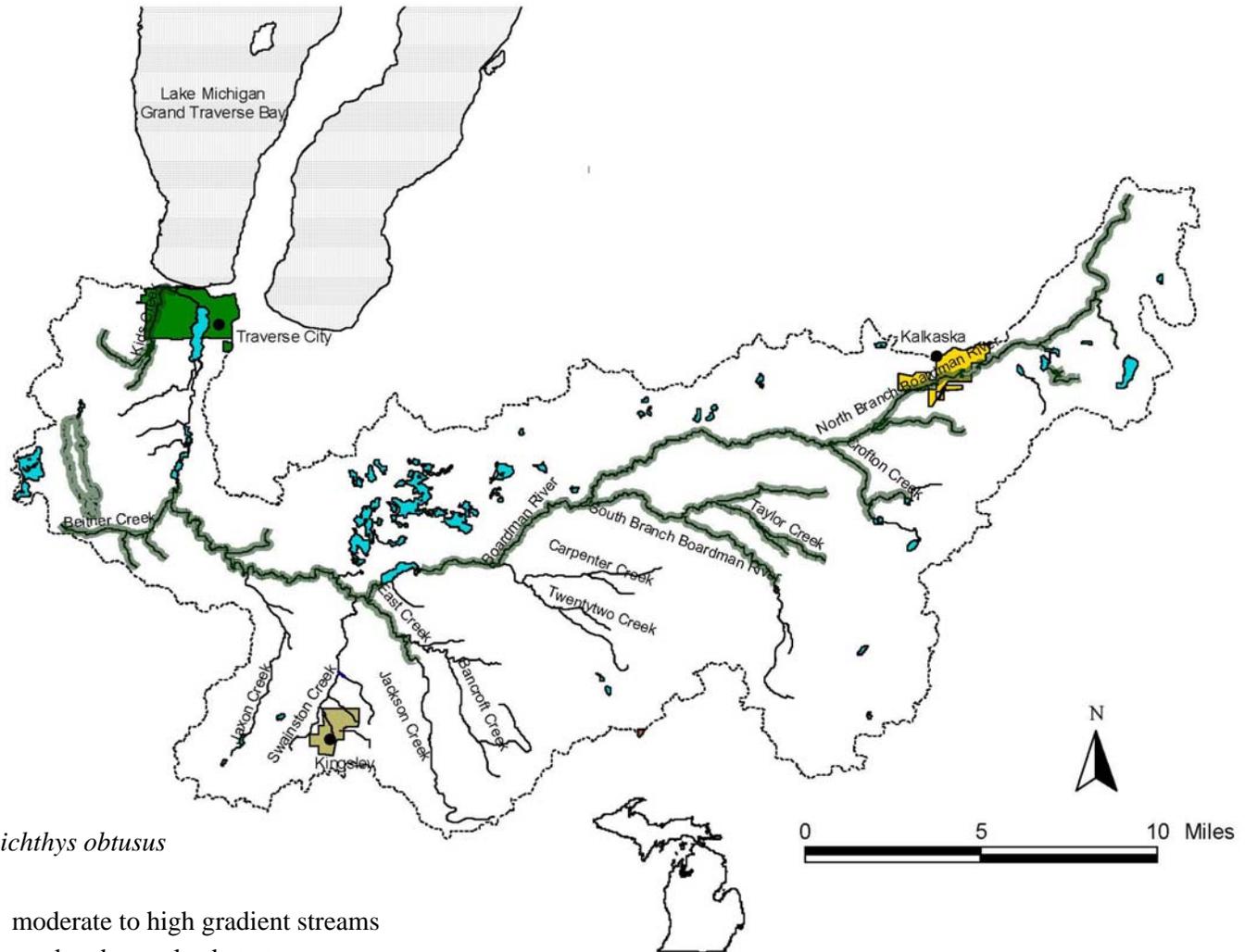


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**Longnose dace** *Rhinichthys cataractae*

Habitat:

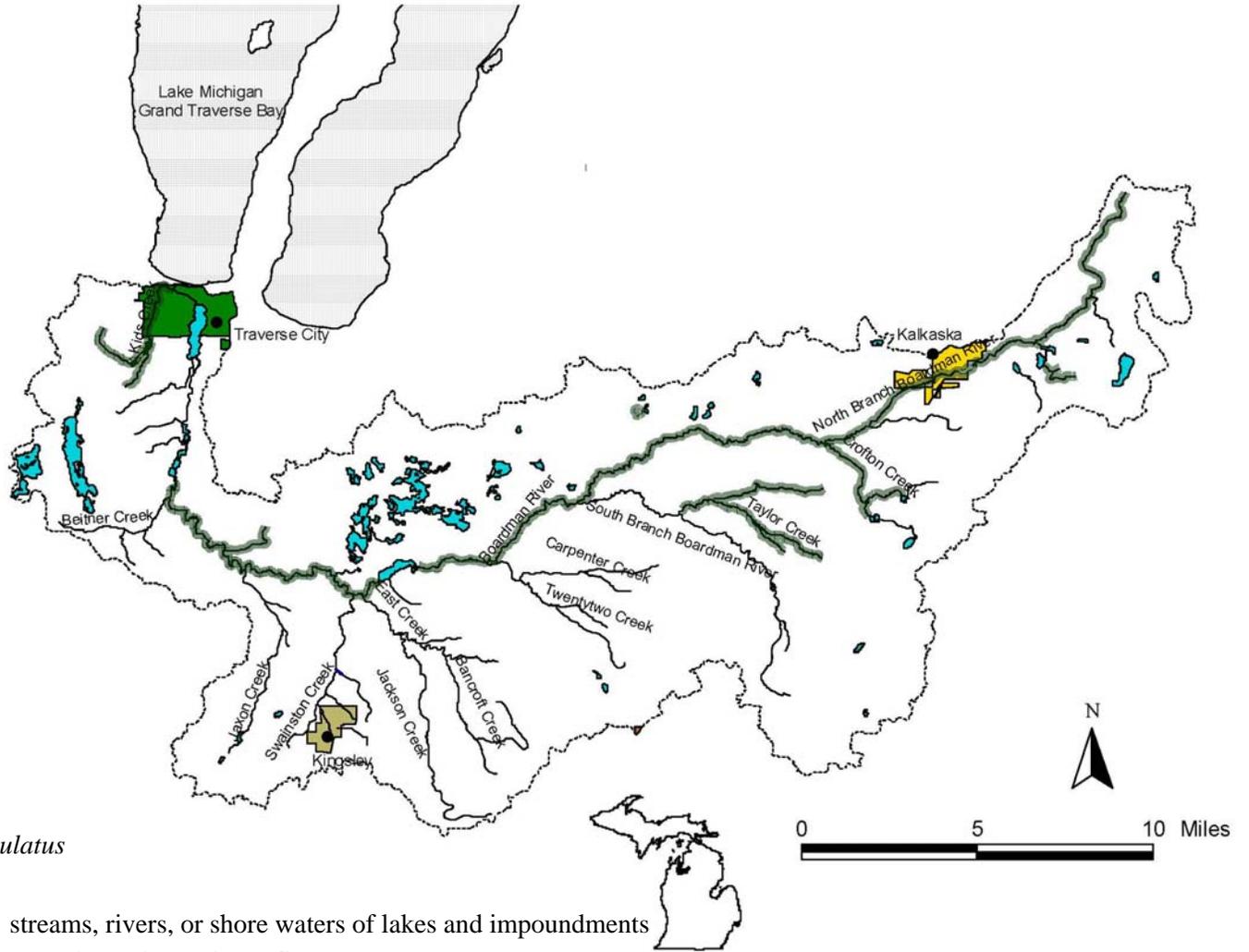
- feeding - lakes and streams
- high gradient
- gravel or boulder substrate



**Western blacknose dace** *Rhinichthys obtusus*

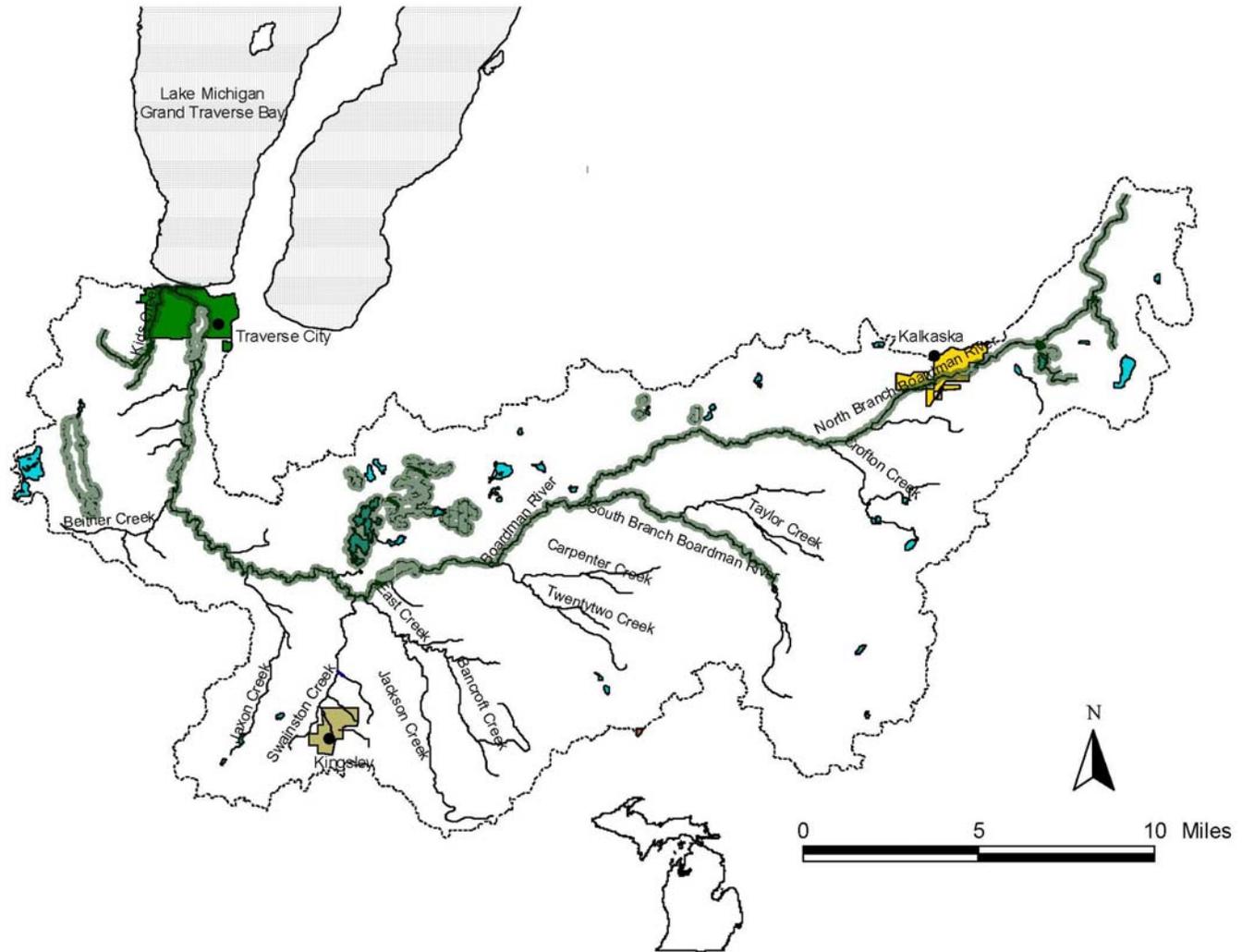
Habitat:

- feeding - moderate to high gradient streams
- sand and gravel substrate
- clear cool water in pools with deep holes and undercut banks
- does not tolerate turbidity and silt well
- spawning - riffles with gravel substrate and fast current
- winter refuge - larger waters



**Creek chub** *Semotilus atromaculatus*  
Habitat:

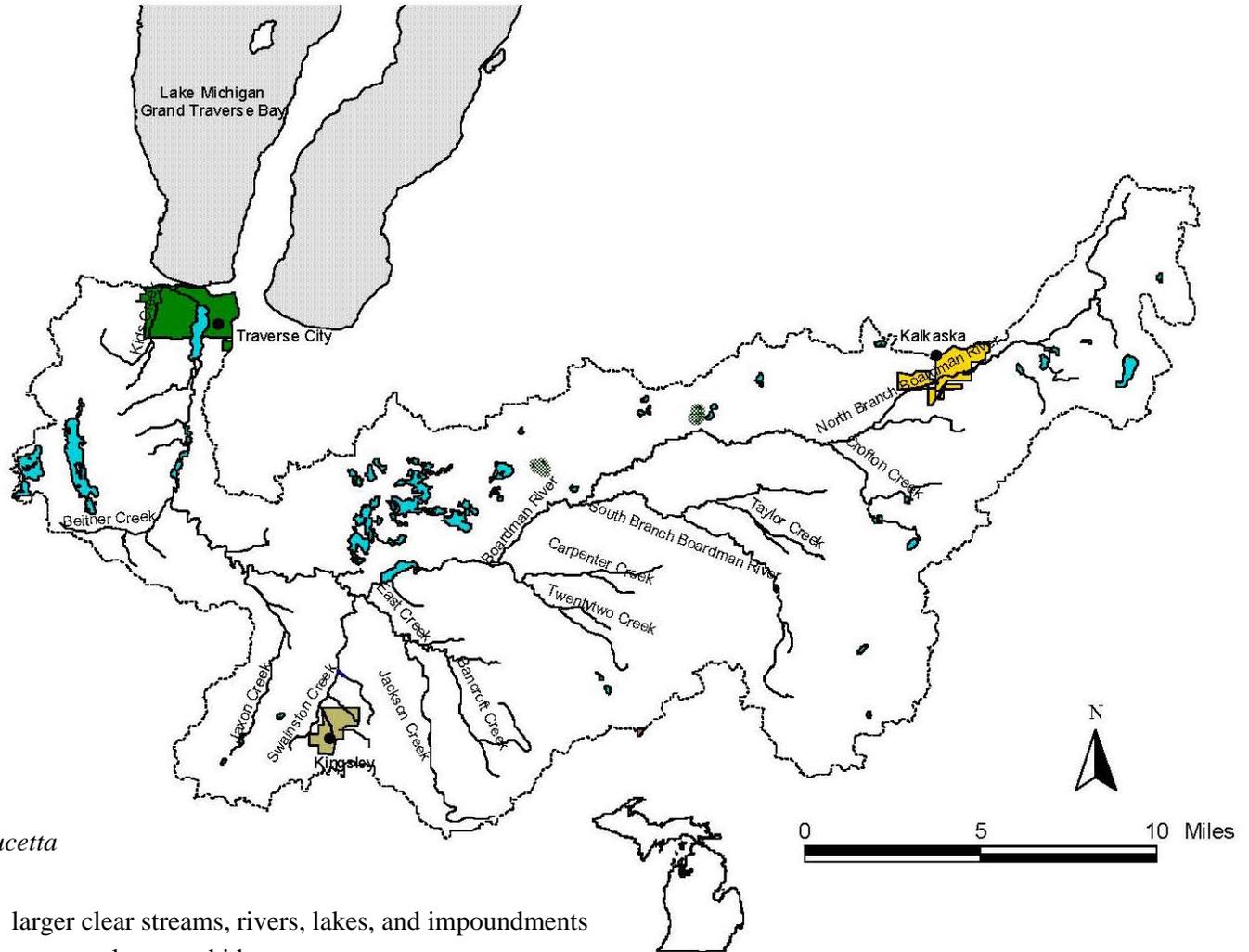
- feeding - streams, rivers, or shore waters of lakes and impoundments
- can tolerate intermittent flows
- tolerates moderate turbidity
- spawning - gravel nests
- low current
- winter refuge - deeper pools and runs



**White sucker** *Catostomus commersonii*

Habitat:

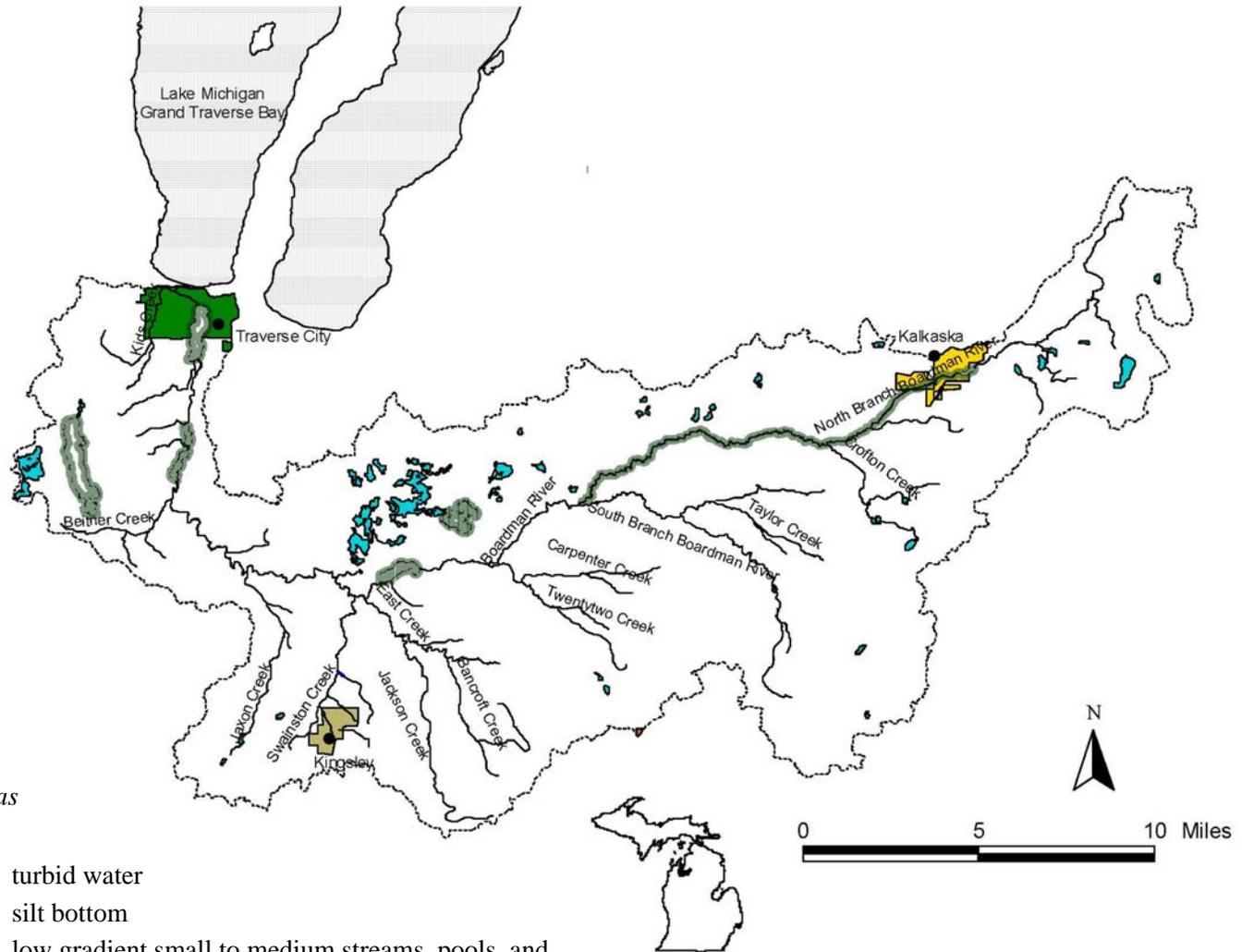
- feeding - streams, rivers, lakes, and impoundments
- can inhabit highly turbid and polluted waters
- spawning - quiet gravelly shallow areas of streams



**Lake chubsucker** *Erimyzon sucetta*

Habitat:

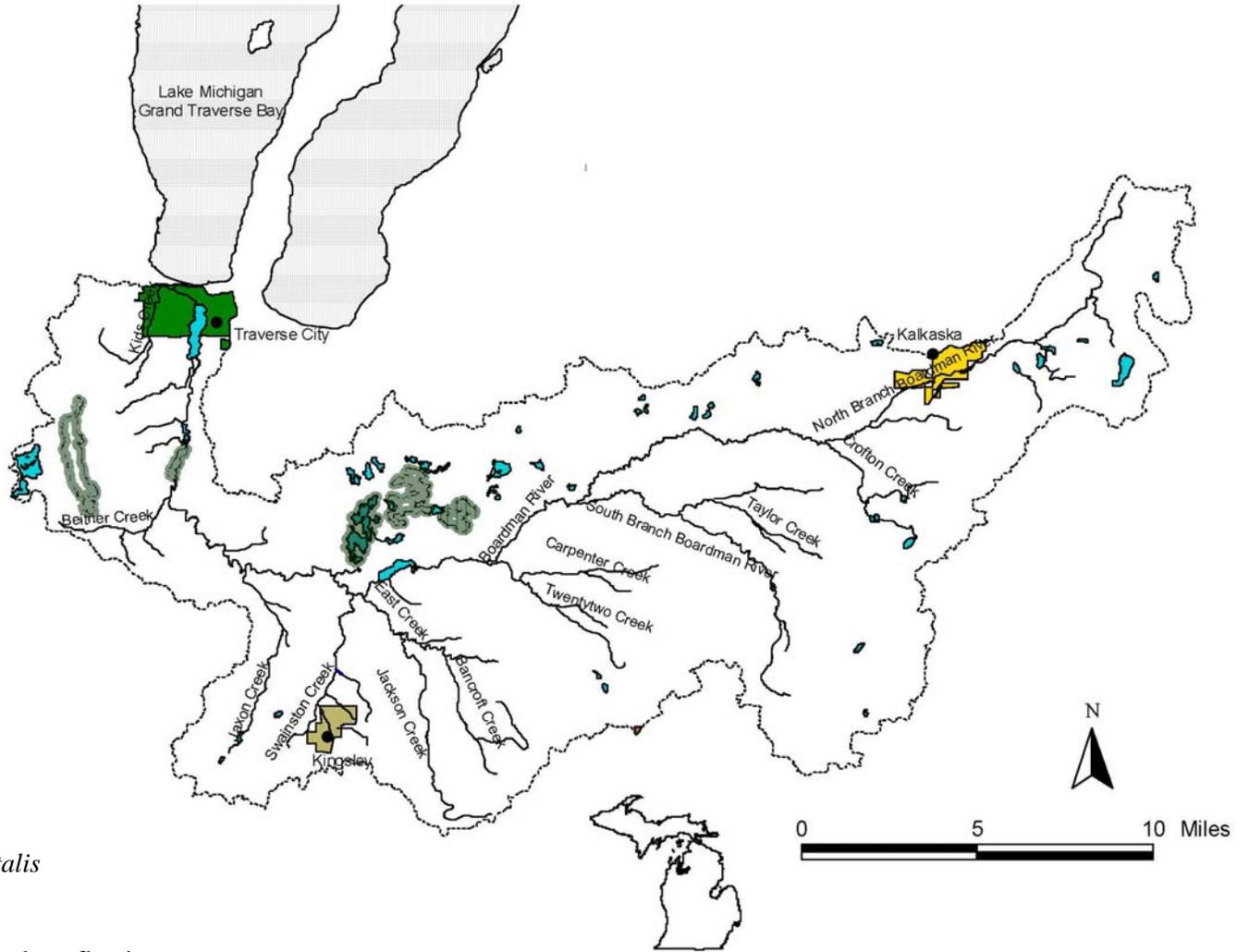
- feeding
  - larger clear streams, rivers, lakes, and impoundments
  - cannot tolerate turbid water
  - low gradient
  - prefers dense vegetation over substrate of sand or silt mixed with organic debris
- spawning
  - small clear streams with moderate to high gradient
  - sand or gravel substrate; no clayey silt



**Black bullhead** *Ameiurus melas*

Habitat:

- feeding - turbid water
- silt bottom
- low gradient small to medium streams, pools, and headwaters of large rivers; also in lakes and impoundments
- can tolerate very warm water and very low dissolved oxygen
- spawning - nest in moderate to heavy vegetation or woody debris and under overhanging banks



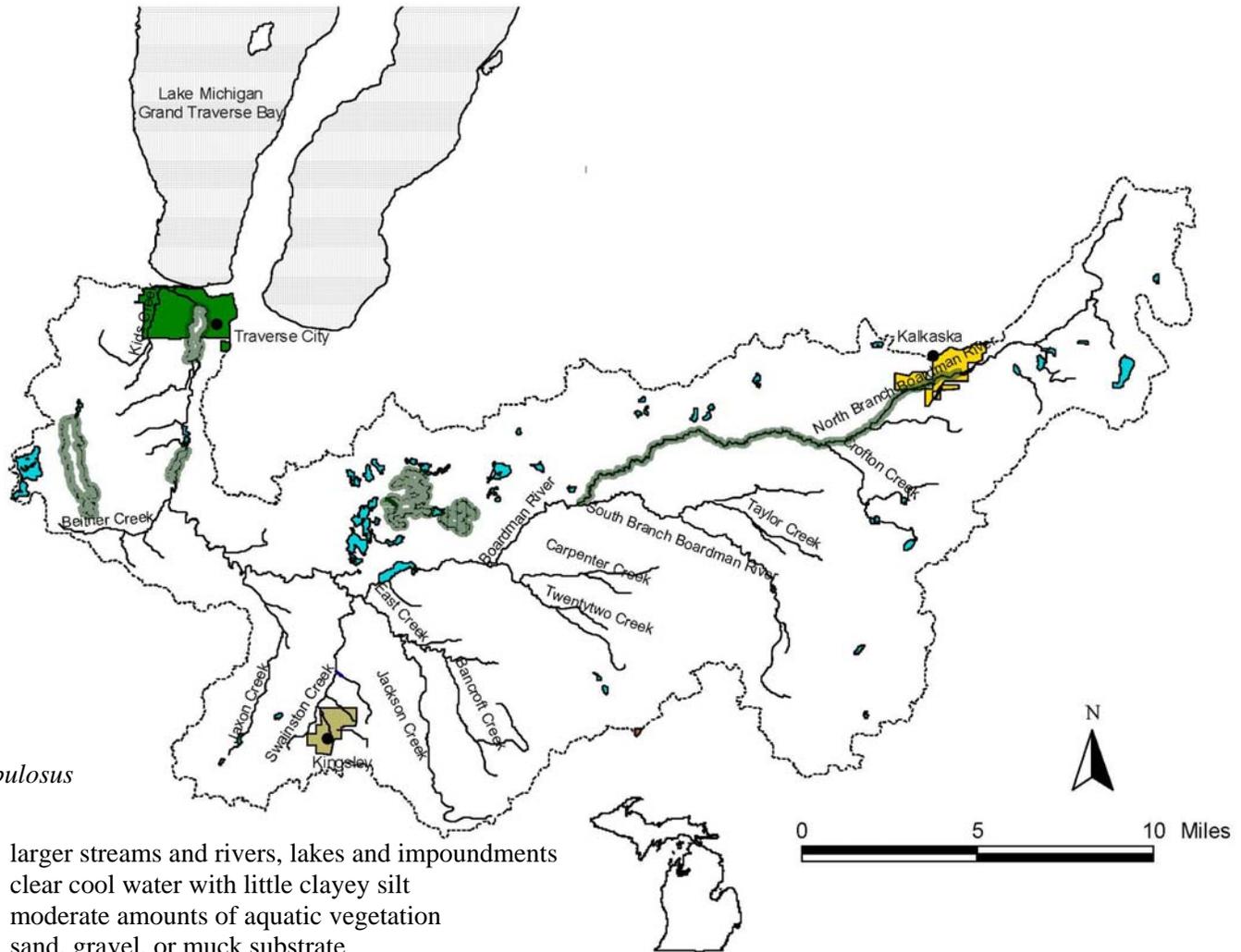
**Yellow bullhead** *Ameiurus natalis*

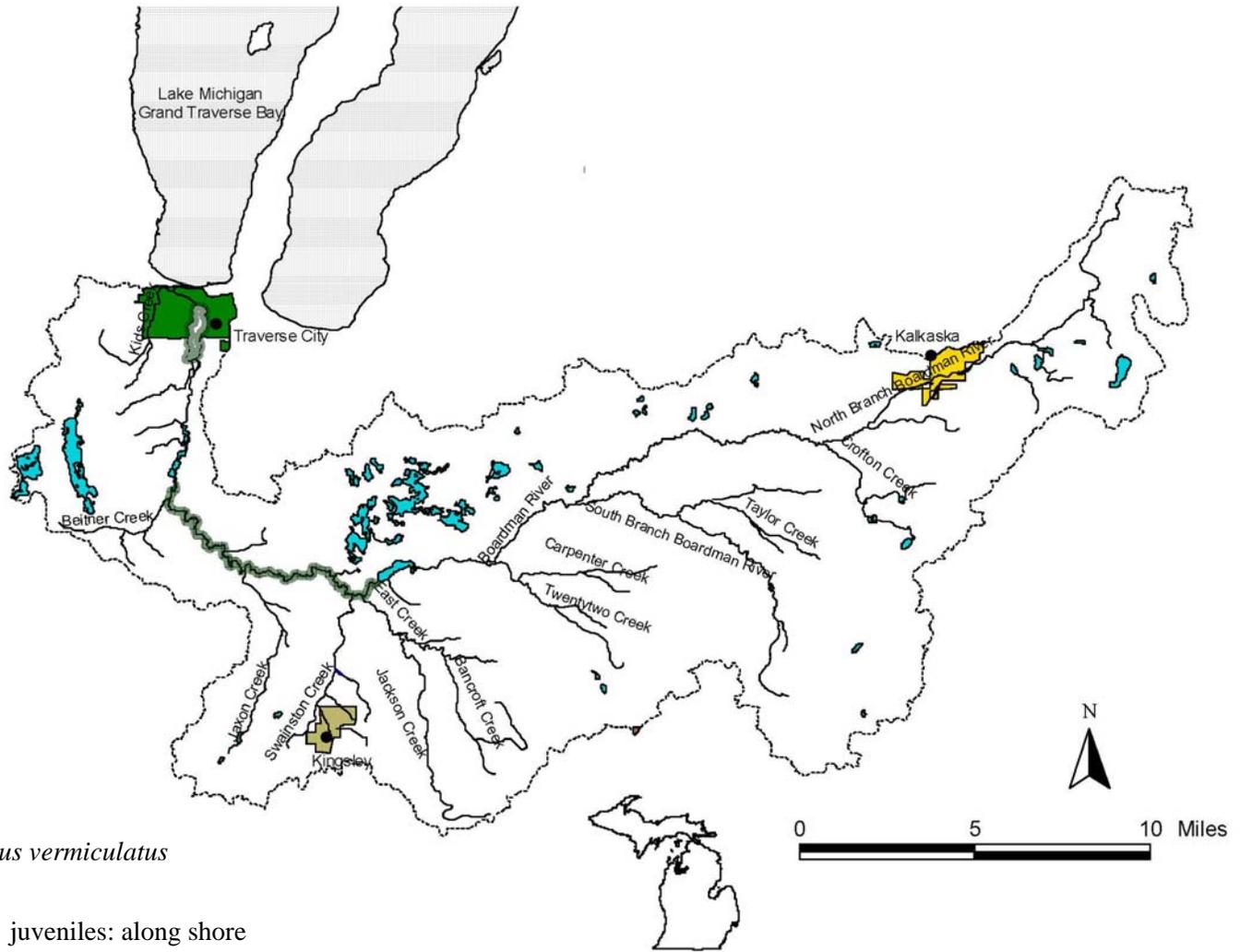
**Habitat:**

- feeding - clear, flowing water
- heavy vegetation
- low gradient streams, lakes, and impoundments
- tolerant of low oxygen
- spawning - nest under a stream bank or near stones or stumps

**Brown bullhead** *Ameiurus nebulosus*  
Habitat:

- feeding - larger streams and rivers, lakes and impoundments
- clear cool water with little clayey silt
- moderate amounts of aquatic vegetation
- sand, gravel, or muck substrate
- not tolerant of turbid water
- tolerant of warm water and low oxygen
- spawning - nest in mud or sand substrate among rooted aquatic vegetation  
usually near a stump, tree, or rock
- winter refuge - in muddy bottoms

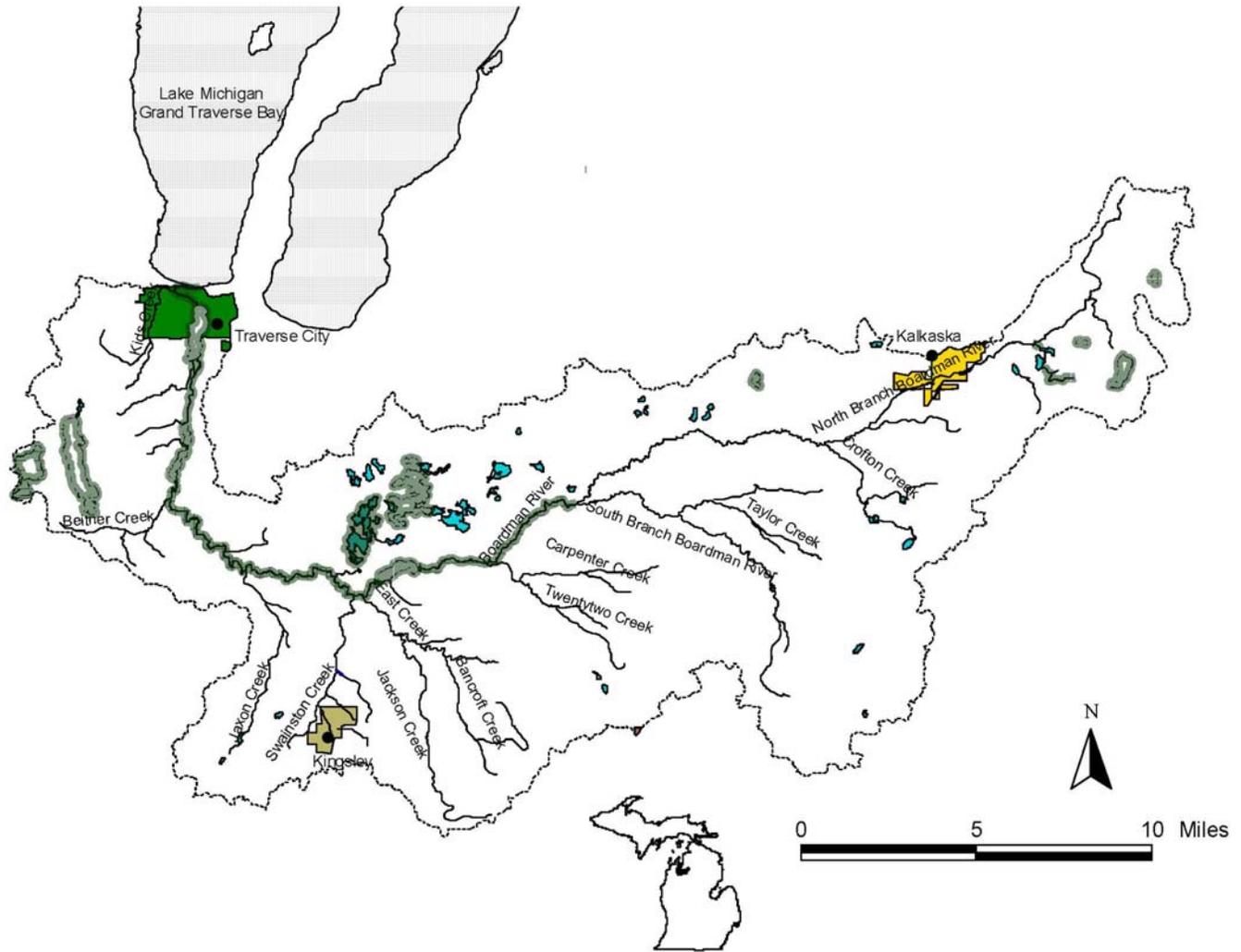




**Grass pickerel** *Esox americanus vermiculatus*

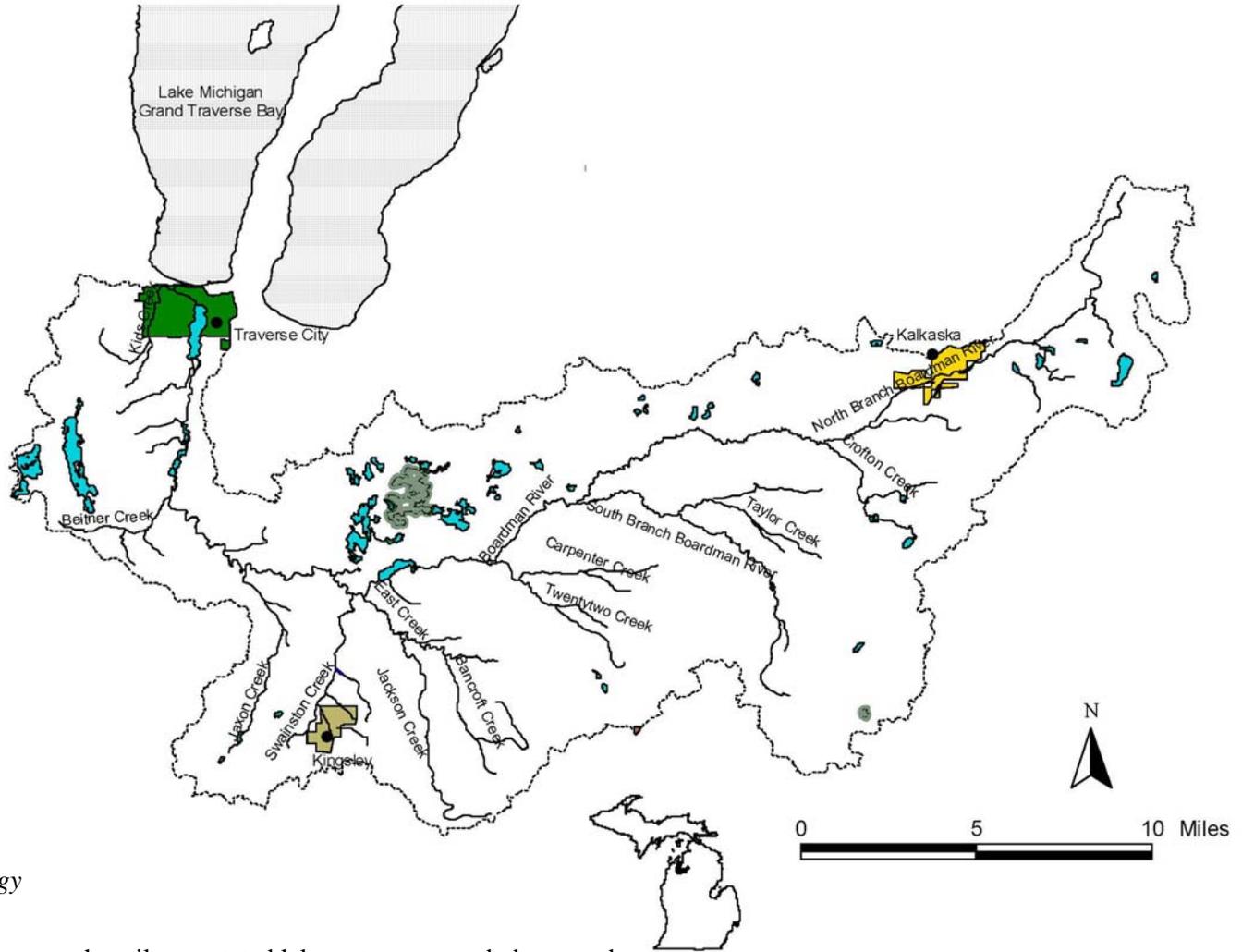
**Habitat:**

- feeding - juveniles: along shore
- adults: in deeper portions of streams, rivers, lakes, and impoundments
- clear water, little current, dense vegetation
- tolerates low oxygen concentrations
- spawning - broadcast spawner over submerged vegetation



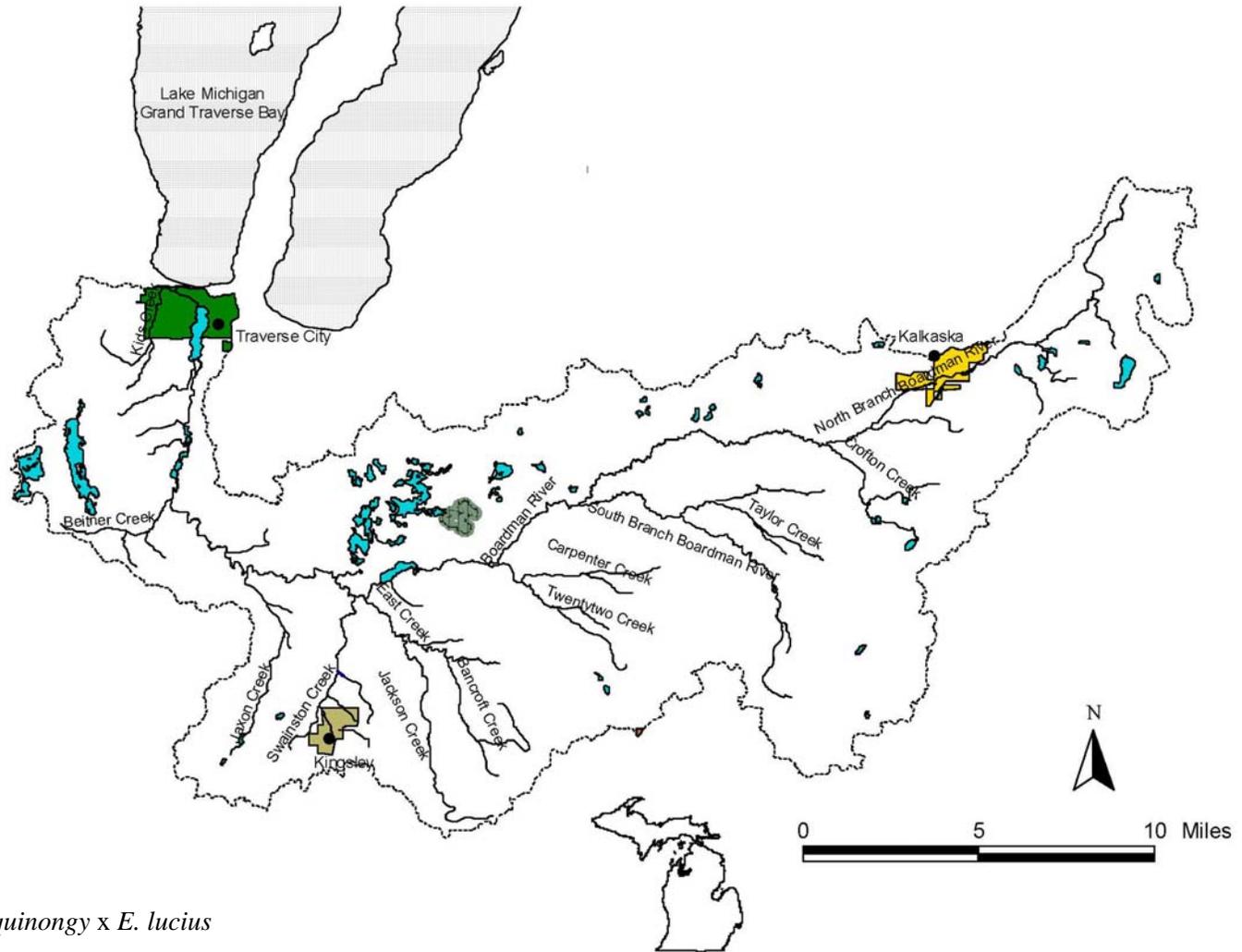
**Northern pike** *Esox lucius*  
 Habitat:

- feeding - cool to moderately warm streams, rivers, lakes, and impoundments
- vegetation in slow to moderate current
- spawning - submerged vegetation with slow current in shallow water



**Muskellunge** *Esox masquinongy*  
Habitat:

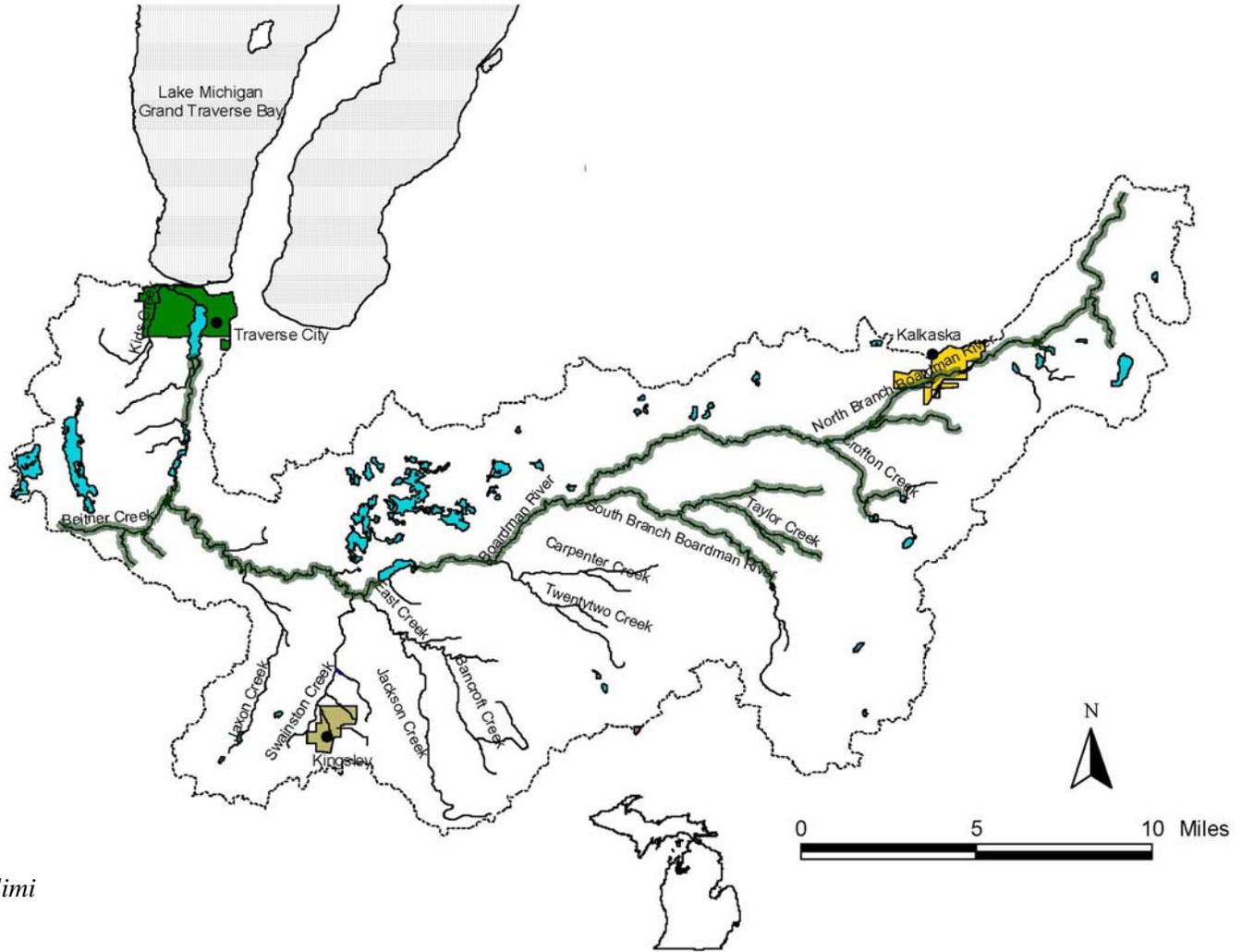
- feeding - warm, heavily vegetated lakes, stumpy weedy bays, and slow heavily vegetated medium to large rivers
- shallow cool water
- tolerant of low oxygen
- spawning - clear shallow waters (15-20") in heavily vegetated areas



**Tiger muskellunge** *Esox masquinongy* x *E. lucius*

Habitat:

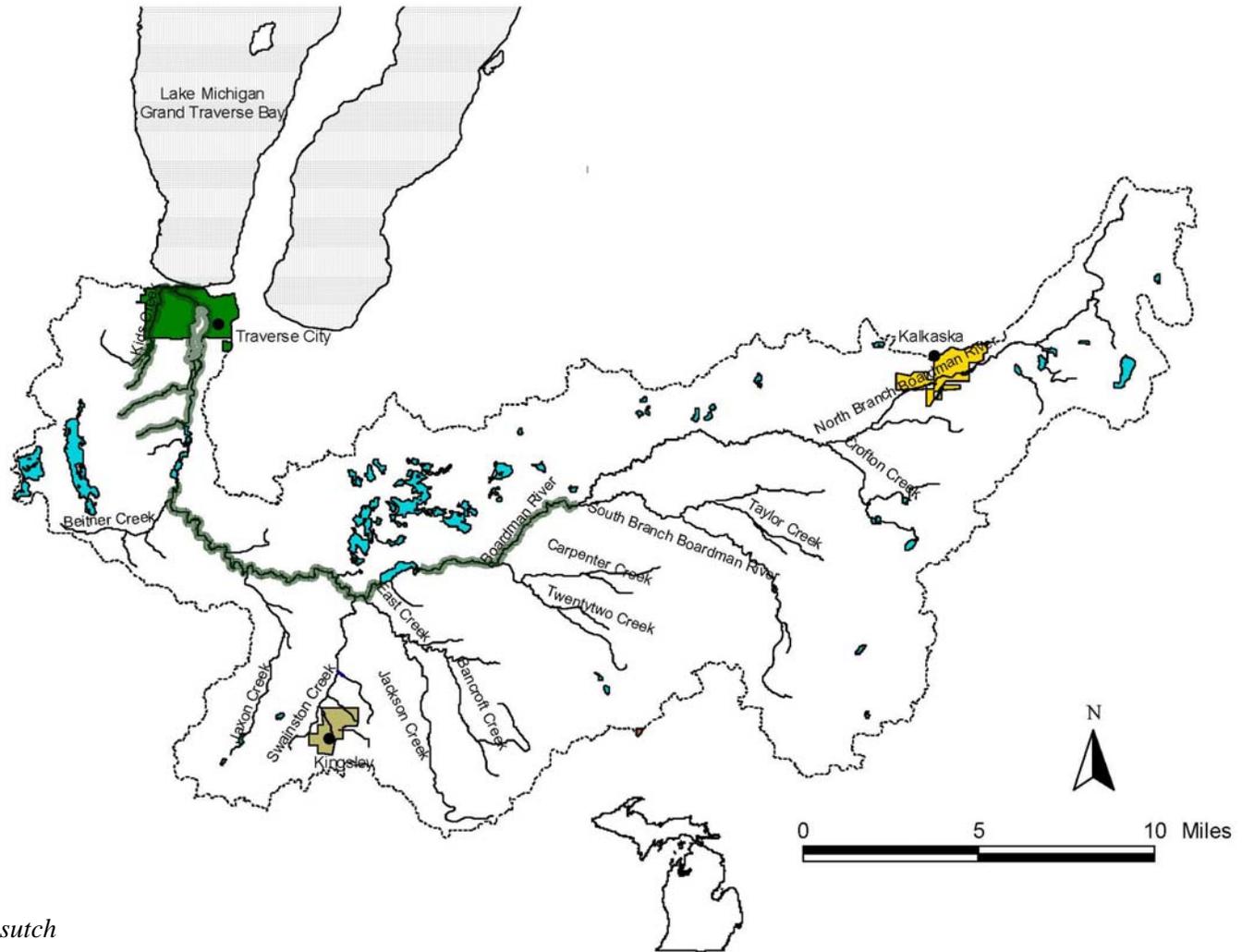
- feeding - intermediate between muskellunge and northern pike
- spawning - hybrid species; muskellunge x northern pike
  - occasionally produced in wild, but most often from hatcheries
  - males are sterile, females may be fertile



**Central mudminnow *Umbra limi***

**Habitat:**

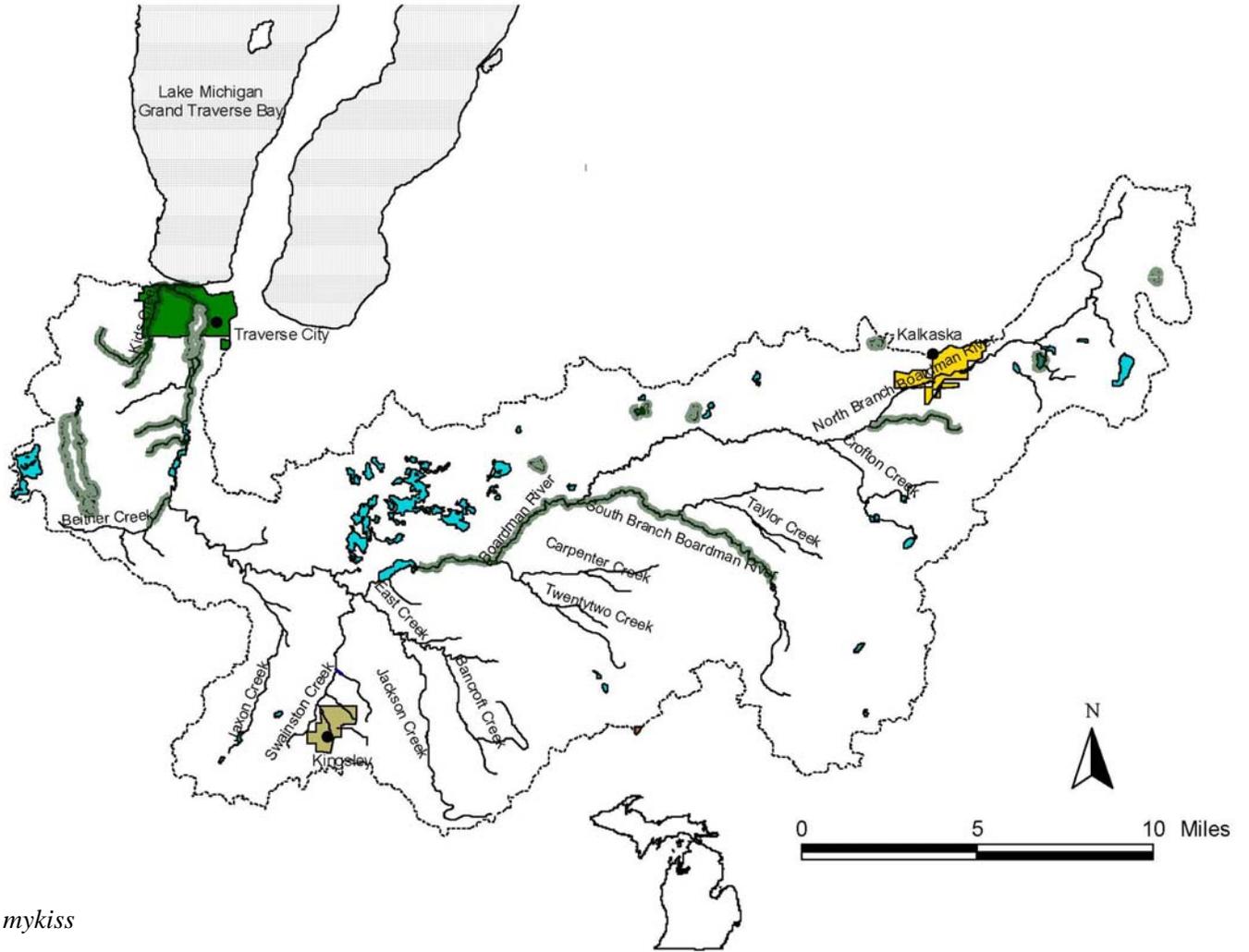
- feeding - undisturbed clear, low-gradient streams or rivers and lakes and impoundments
- organic debris, muck, or peat substrates
- aquatic vegetation
- spawning - floodplain areas, on vegetation



**Coho salmon *Oncorhynchus kisutch***

**Habitat:**

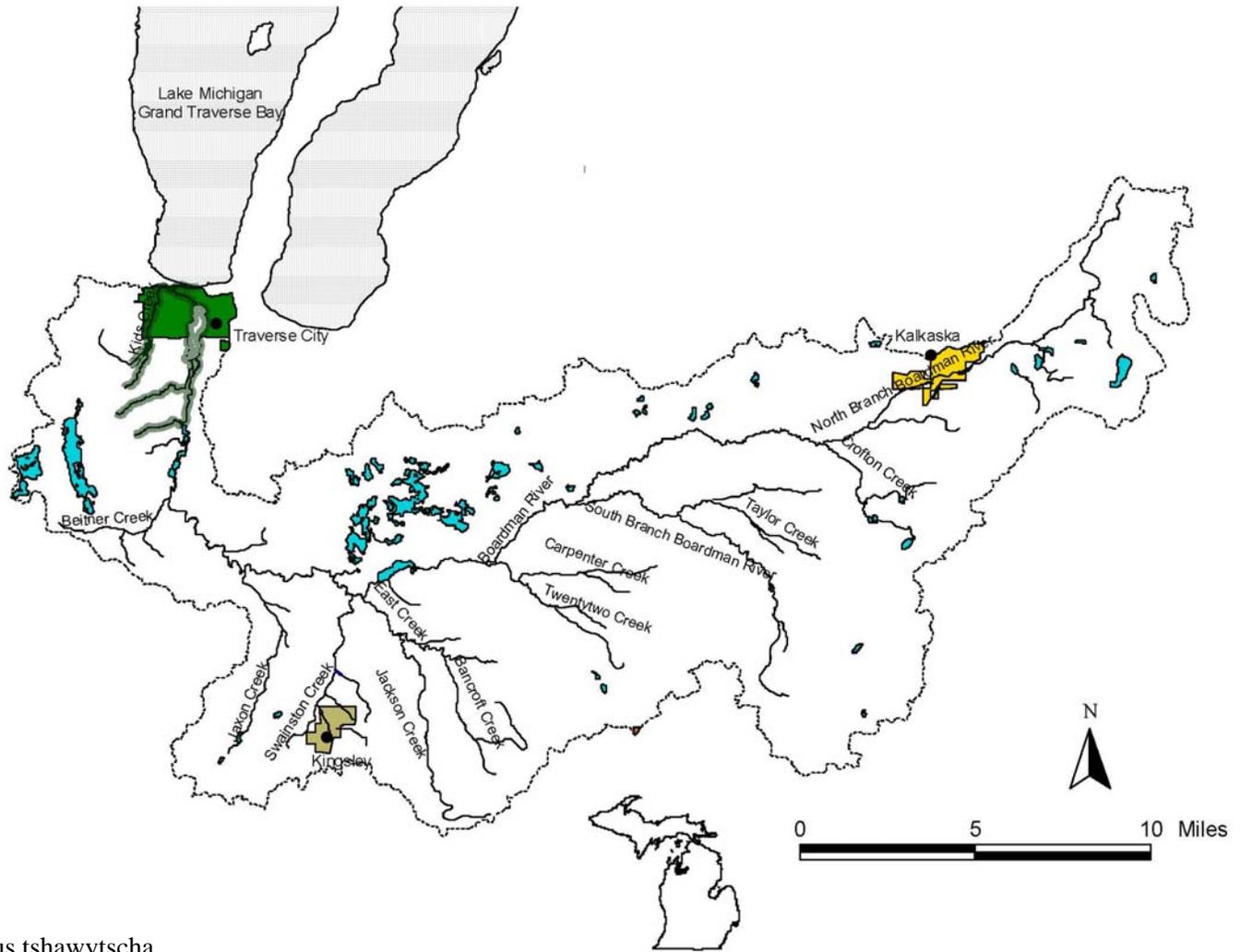
- feeding - adults: Lake Michigan
- young: shallow gravel substrate in cold streams, later into pools
- spawning - cold streams and rivers
- swifter water of shallow gravelly substrate



**Rainbow trout** *Oncorhynchus mykiss*

Habitat:

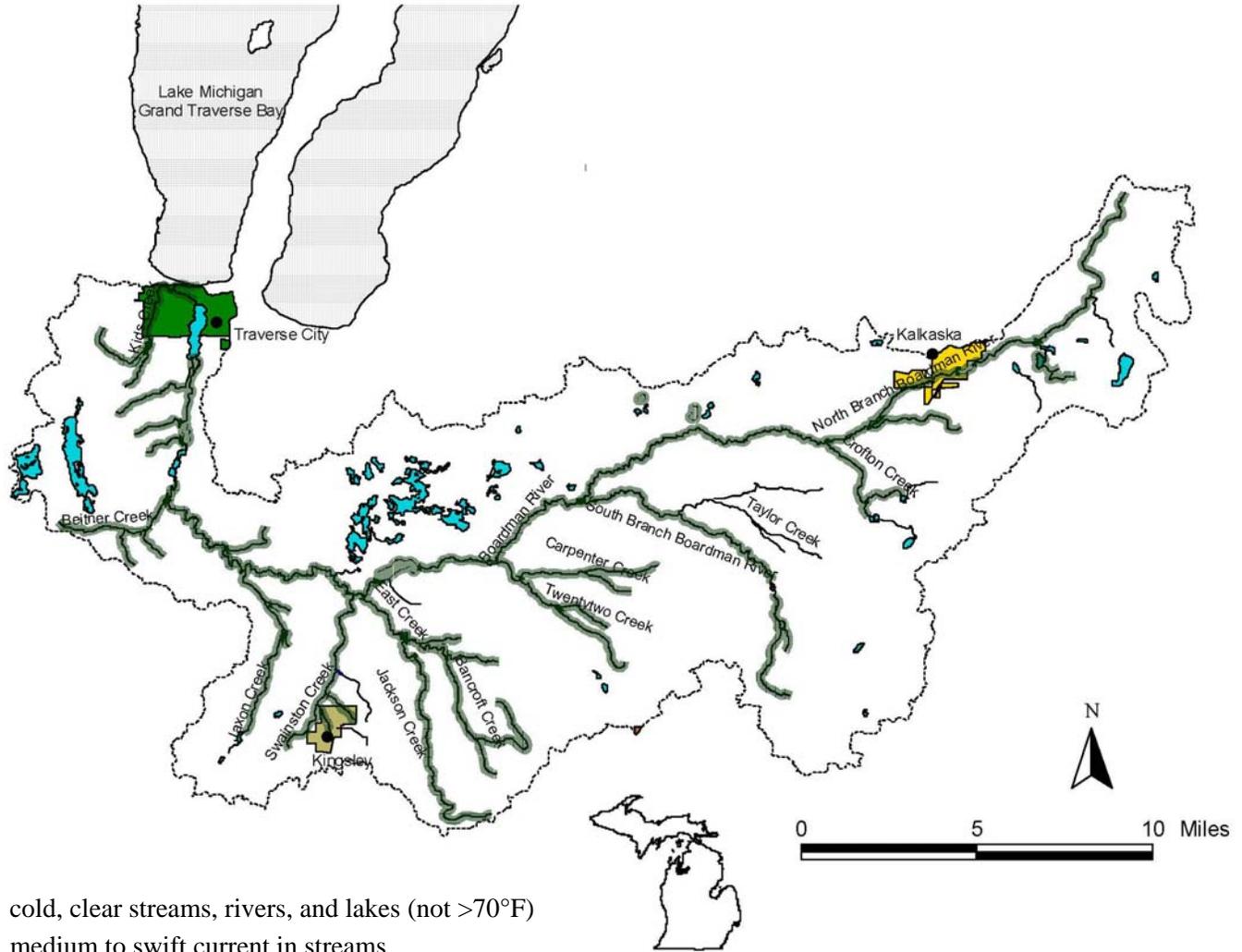
- feeding - cold clear water of rivers and Lake Michigan
- moderate current
- spawning - gravelly riffles above a pool
- smaller tributaries



**Chinook salmon** *Oncorhynchus tshawytscha*

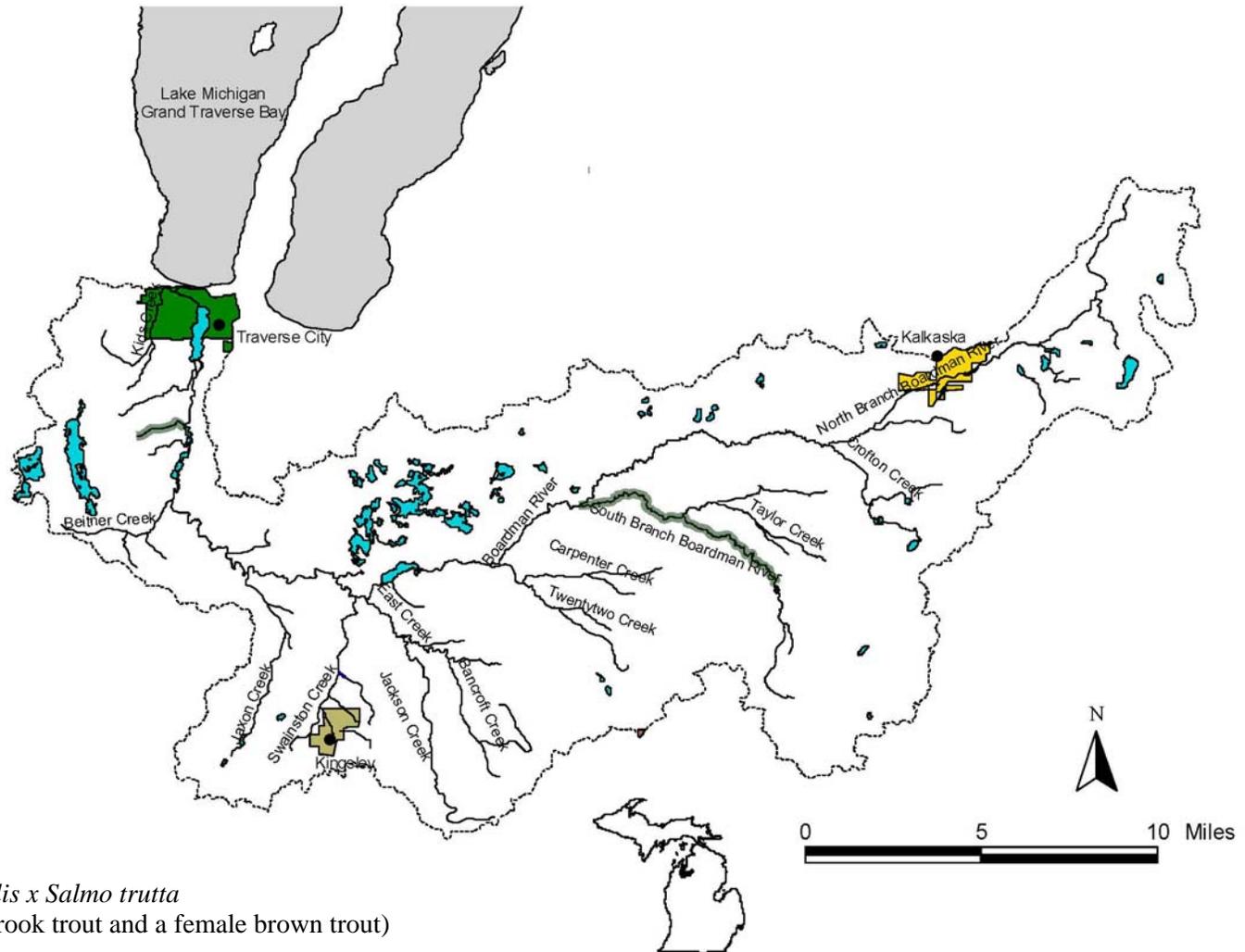
**Habitat:**

- feeding - adults: Lake Michigan
- young: shallow gravel substrate in cool streams, later into pools
- spawning - gravelly substrate in cool streams



**Brown trout *Salmo trutta***  
Habitat:

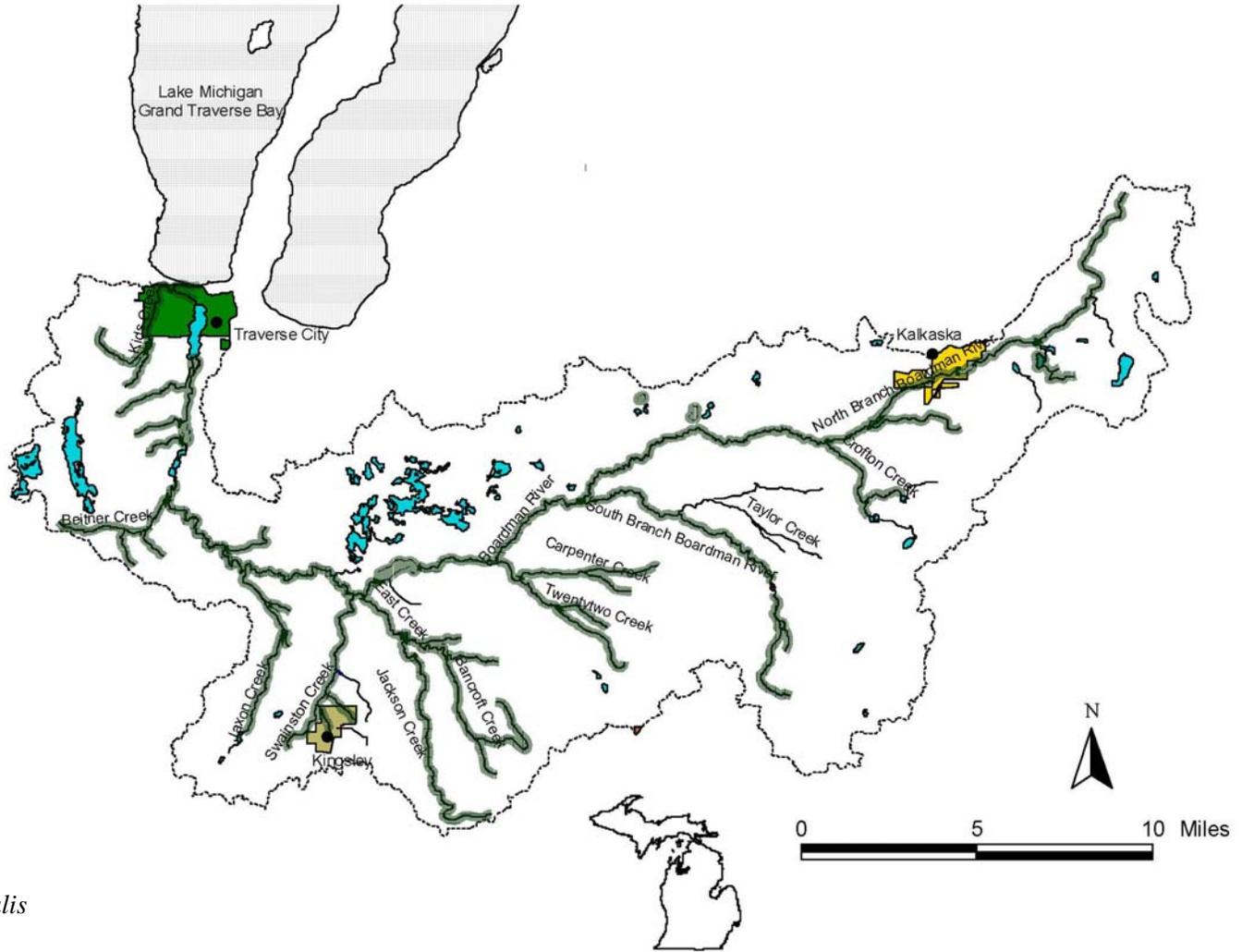
- feeding - cold, clear streams, rivers, and lakes (not >70°F)
- medium to swift current in streams
- does not tolerate silt well
- prefers few individuals and species around
- abundance of aquatic and land insects
- spawning - gravelly riffles; shallow headwater areas



**Tiger trout** *Salvelinus fontinalis x Salmo trutta*  
 (hybrid cross between a male brook trout and a female brown trout)

**Habitat:**

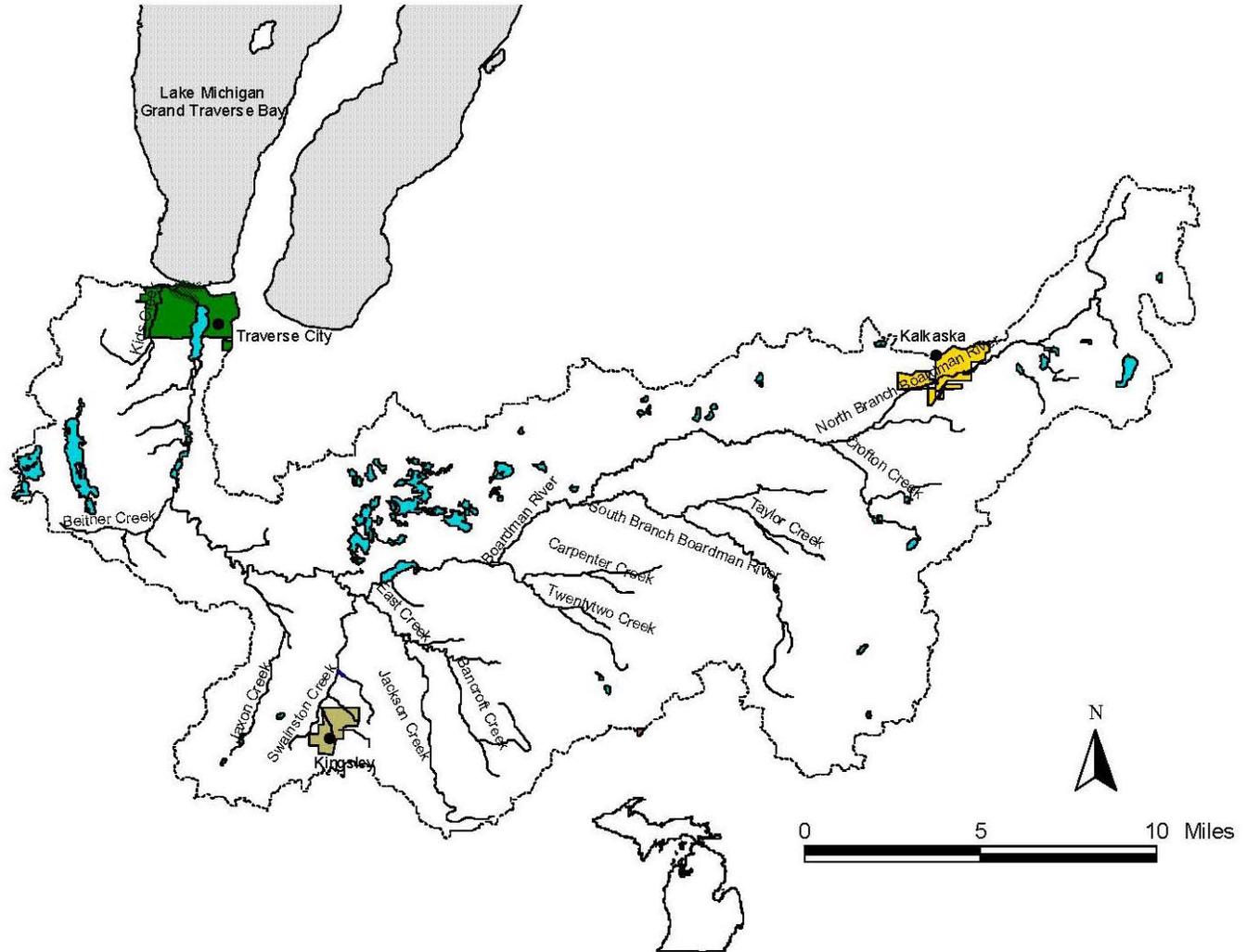
- feeding - cold, clear streams, rivers, and lakes
- low to medium current
- well oxygenated
- spawning - not reproductively viable



**Brook trout** *Salvelinus fontinalis*

Habitat:

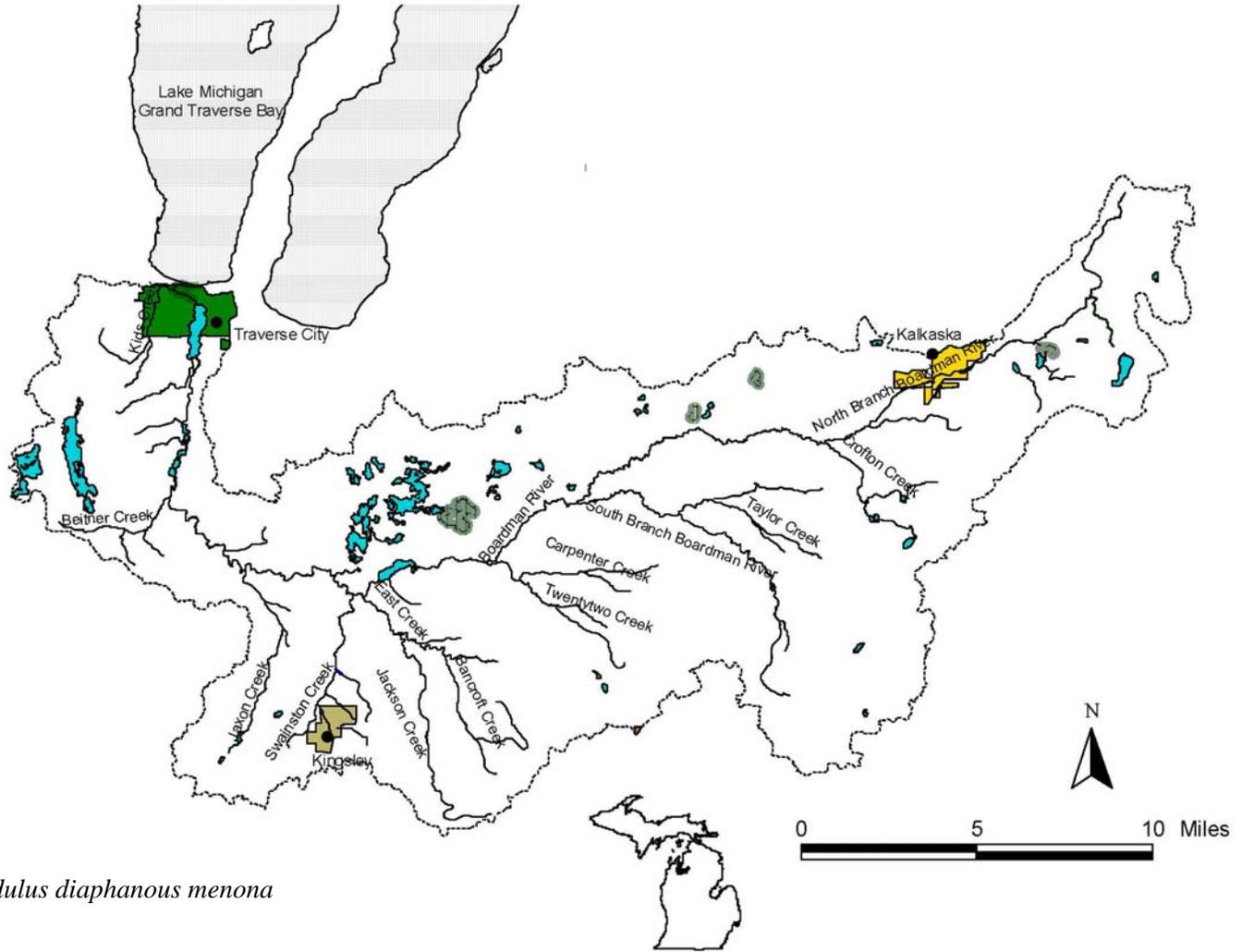
- feeding - cold, clear streams, rivers, and lakes (not >65°F)
- low current
- well oxygenated water
- spawning - gravelly riffles; shallow or headwater streams



**Lake trout** *Salvelinus namaycush*

Habitat:

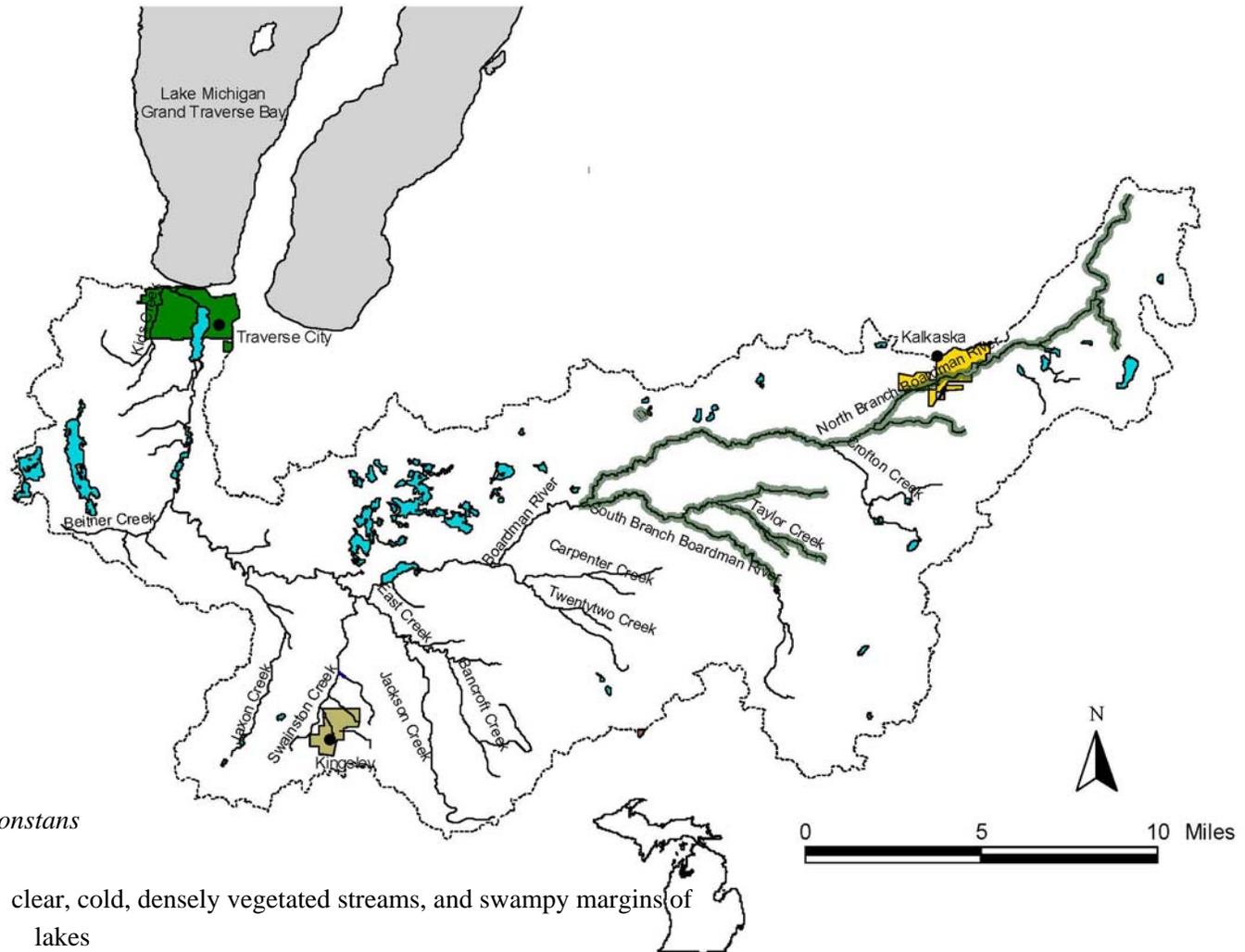
- feeding - cold lakes and rivers
- spawning - large boulder or rubble substrate
- shallow water of lakes and rivers



**Western banded killifish *Fundulus diaphanous menona***

**Habitat:**

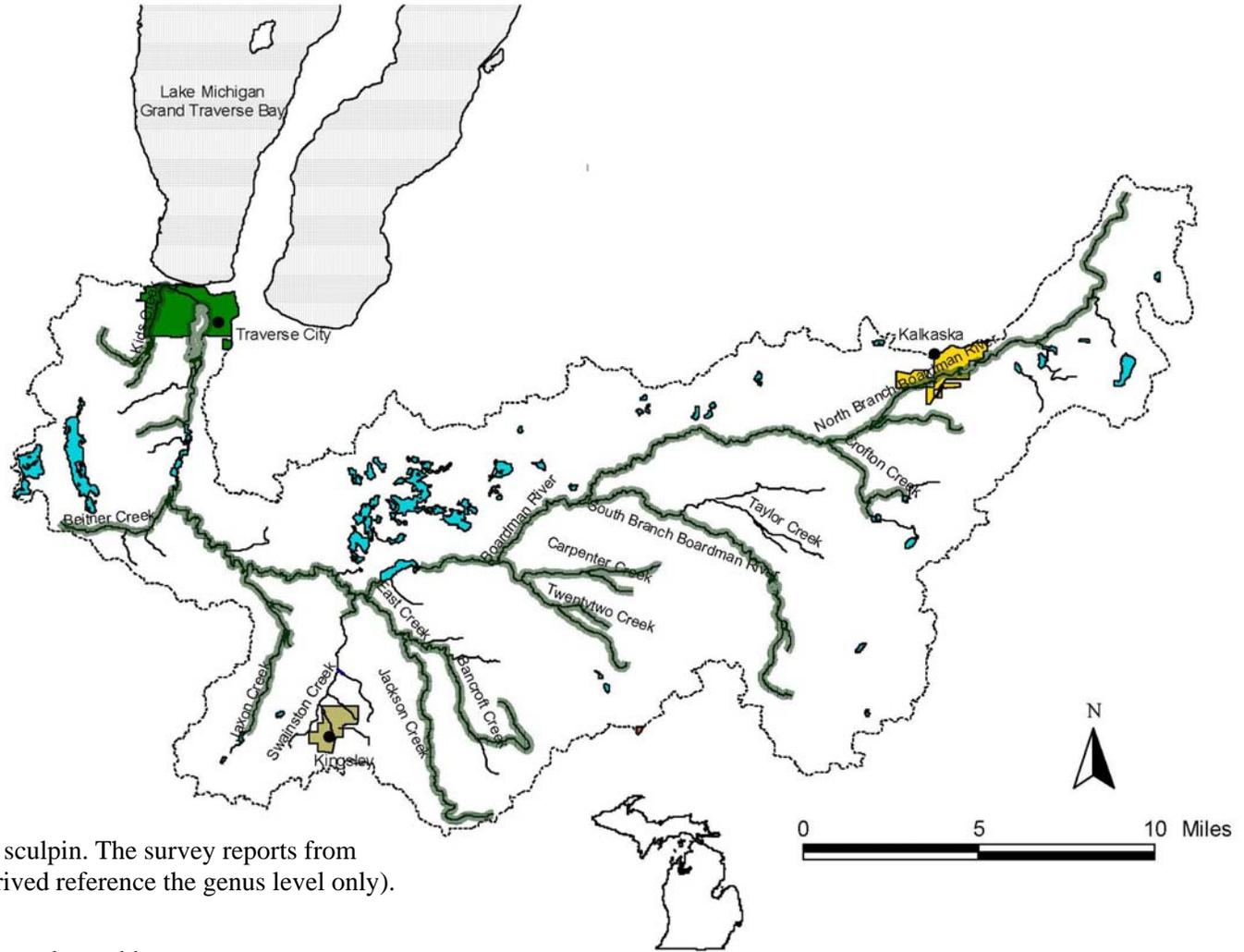
- feeding - quiet backwaters at the mouths of streams and lakes
- substrate of sand, gravel, and a few boulders
- also found over detritus substrate where patches of submerged aquatic vegetation are present
- spawning - quiet areas of weedy pools



**Brook stickleback** *Culaea inconstans*

Habitat:

- feeding - clear, cold, densely vegetated streams, and swampy margins of lakes
- low gradient
- muck, peat, or marl substrate
- not tolerant of turbidity
- spawning - shallow cool (<66°F) water
- aquatic reeds or grasses necessary

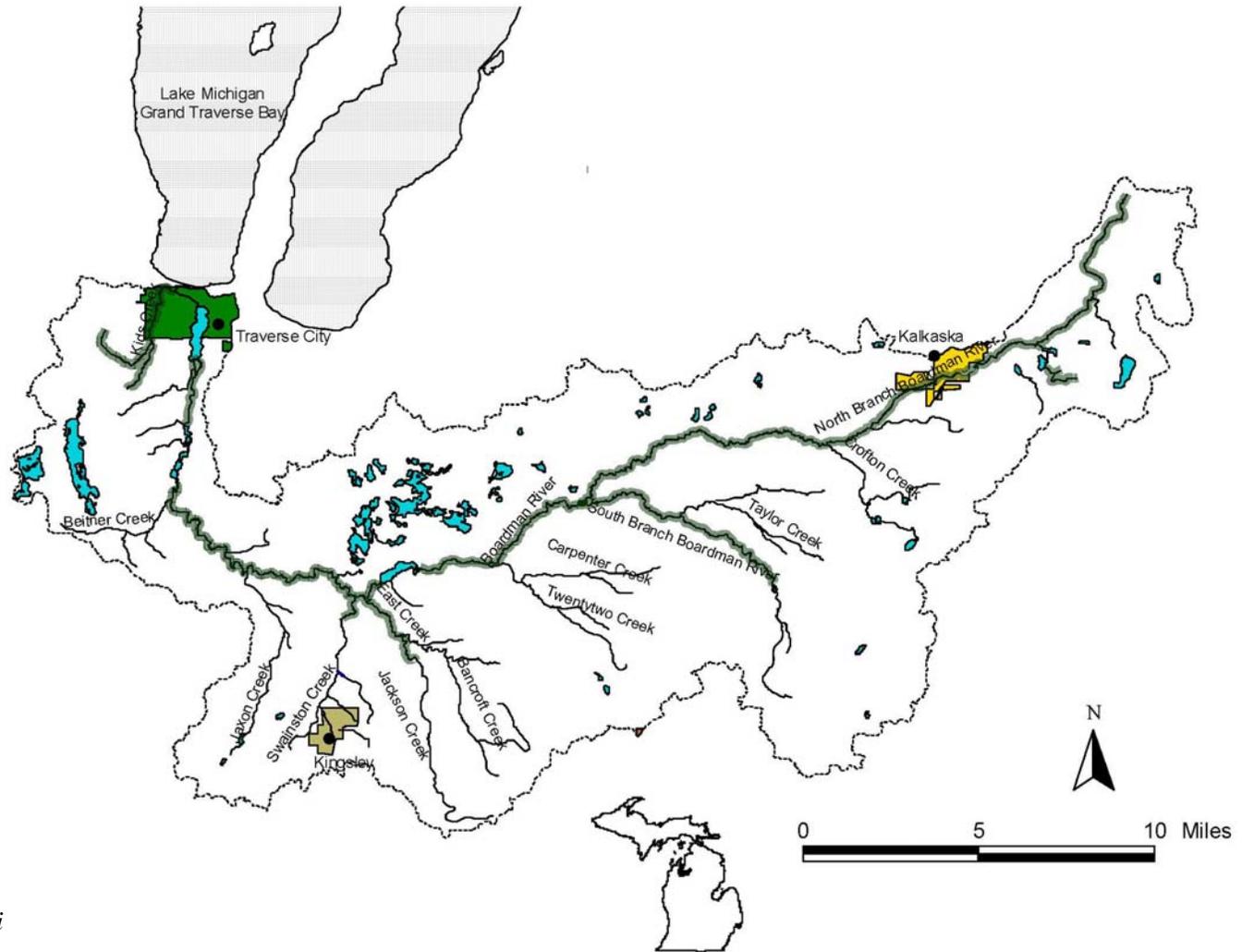


**Sculpins spp. (*Cottus*)**

(This includes mottled or slimy sculpin. The survey reports from which the map data were derived reference the genus level only).

**Habitat:**

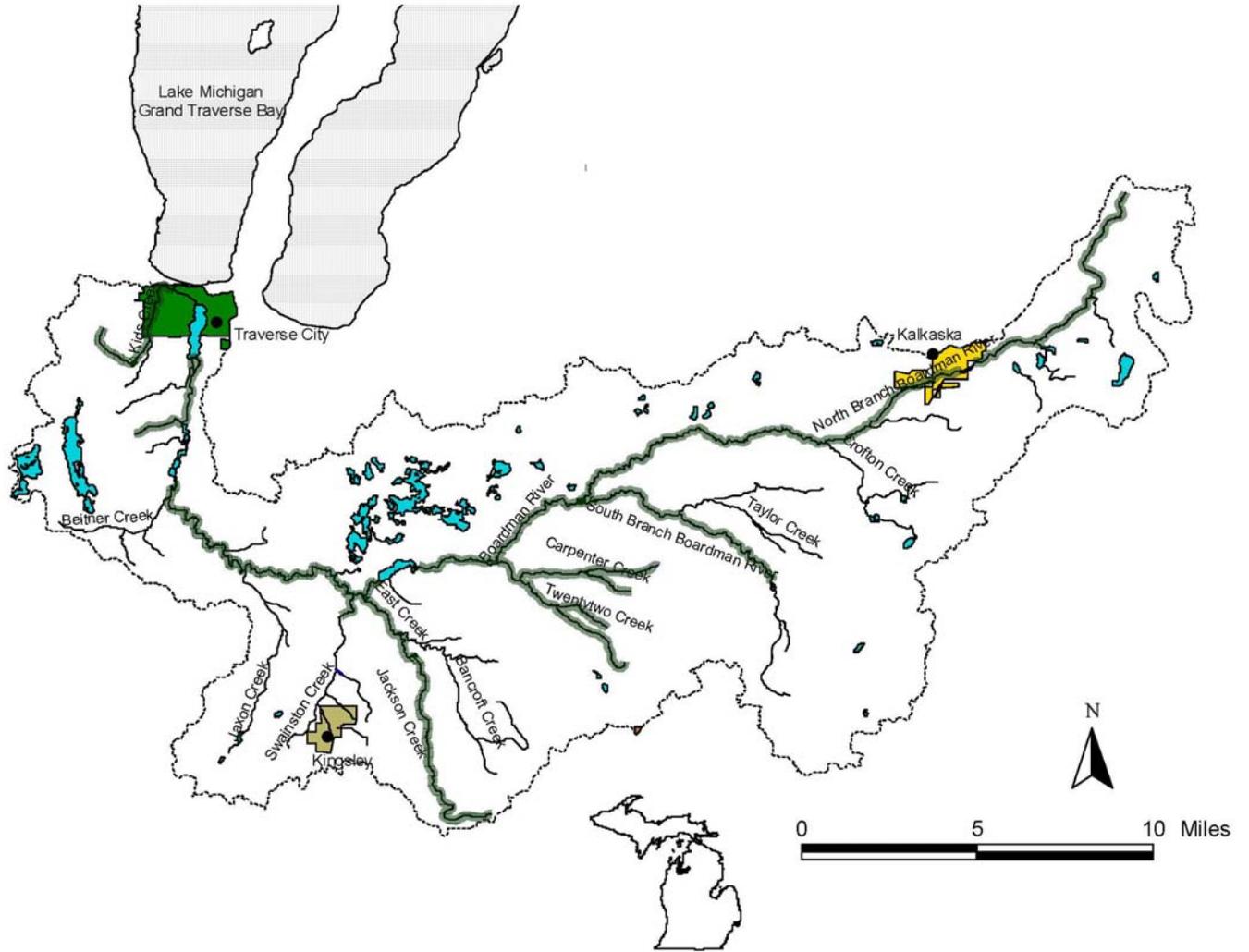
- feeding - cool to cold streams
- cool lakes, impoundments and rivers (Slimy sculpin)
- riffle and rock substrates
- spawning - nests under logs or rock
- shallow area of lakes (Slimy sculpin)



**Mottled sculpin** *Cottus bairdii*

Habitat:

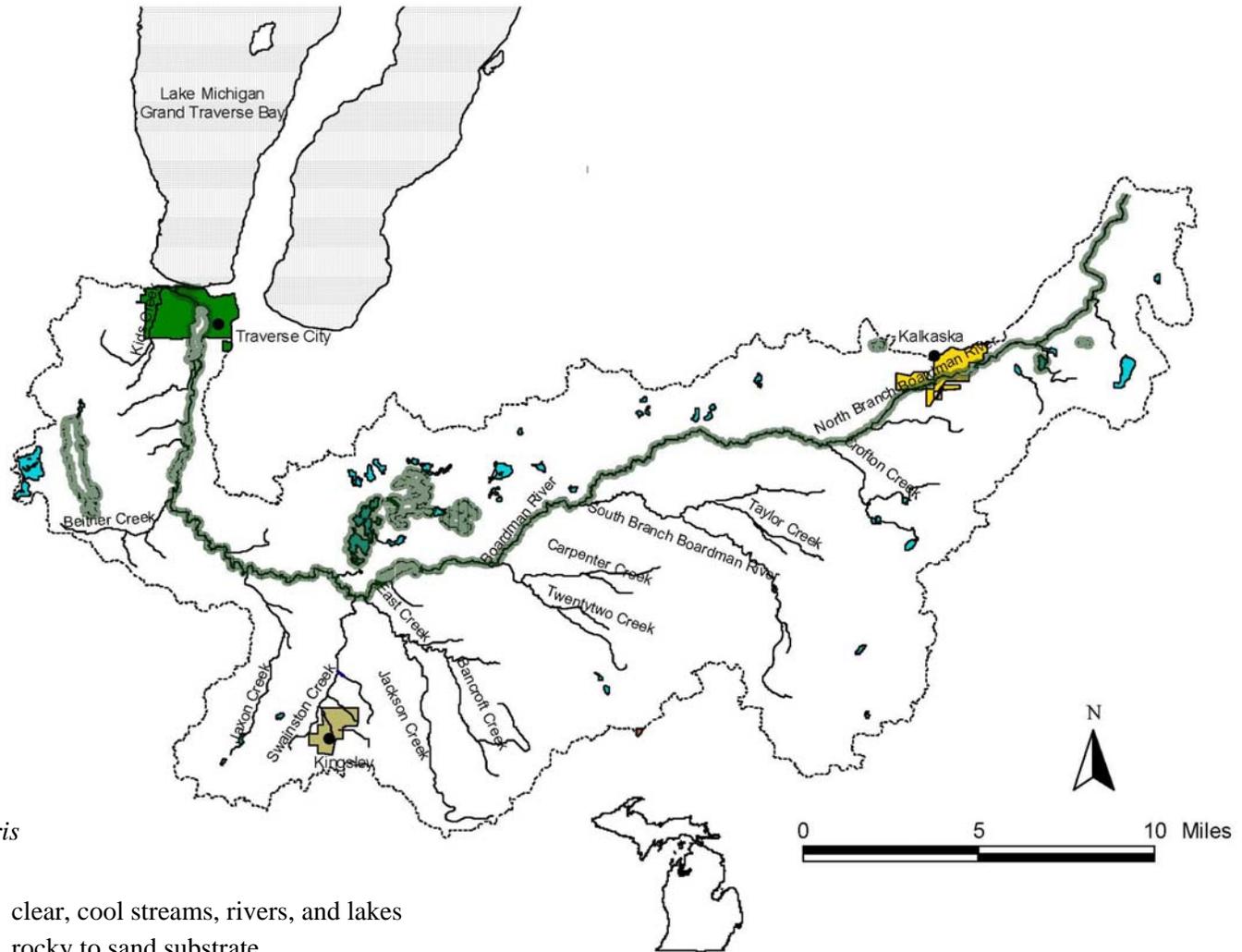
- feeding - cool to cold streams
- riffle and rock substrates preferred
- clear to slightly turbid shallow water
- spawning - nests under logs or rock



**Slimy sculpin** *Cottus cognatus*

Habitat:

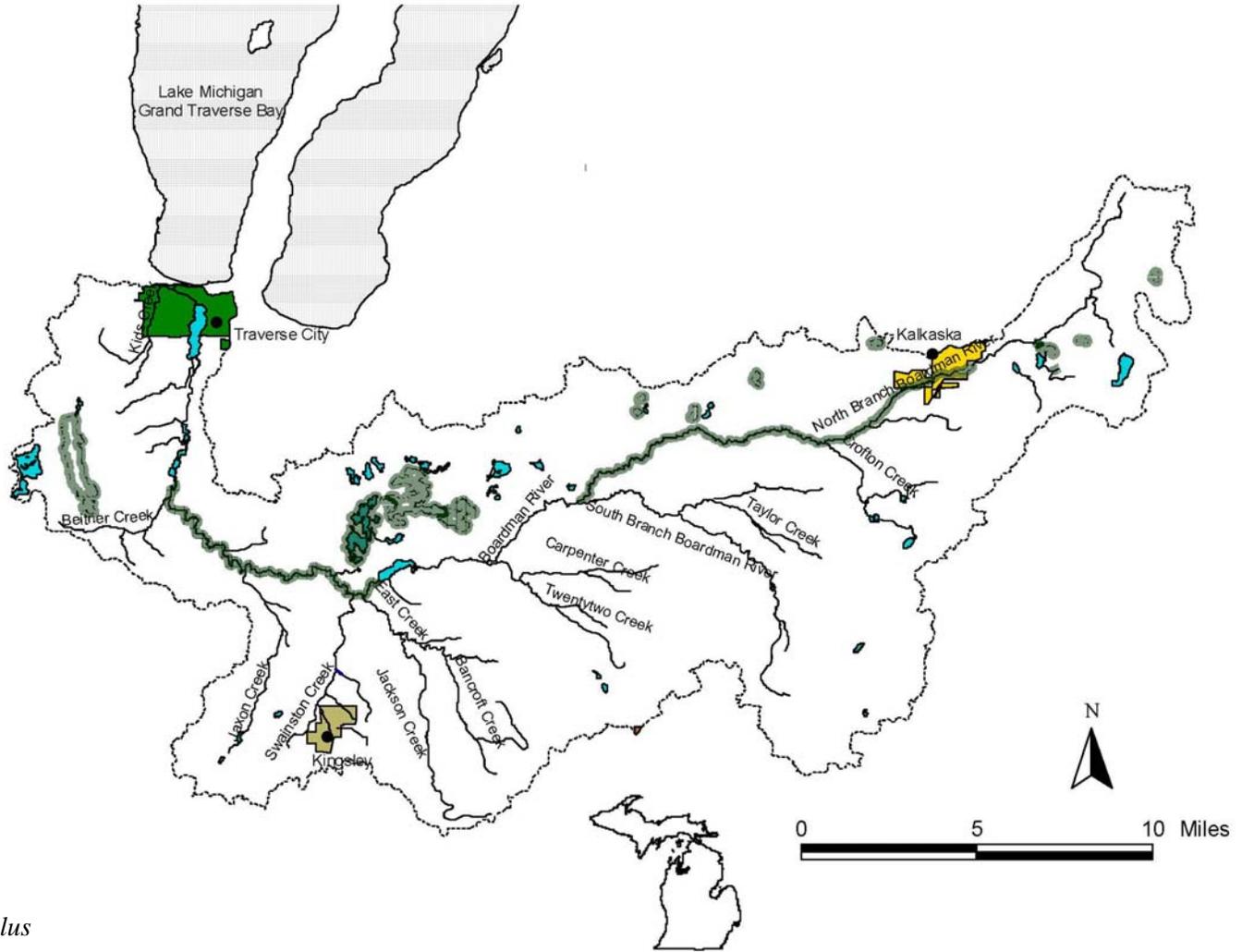
- feeding - cool lakes, impoundments, rivers, and streams
  - gravel or rock substrate
- spawning - nest in shallow areas of lakes
  - gravel substrate or rock ledge
  - male parental care



**Rock bass** *Ambloplites rupestris*

Habitat:

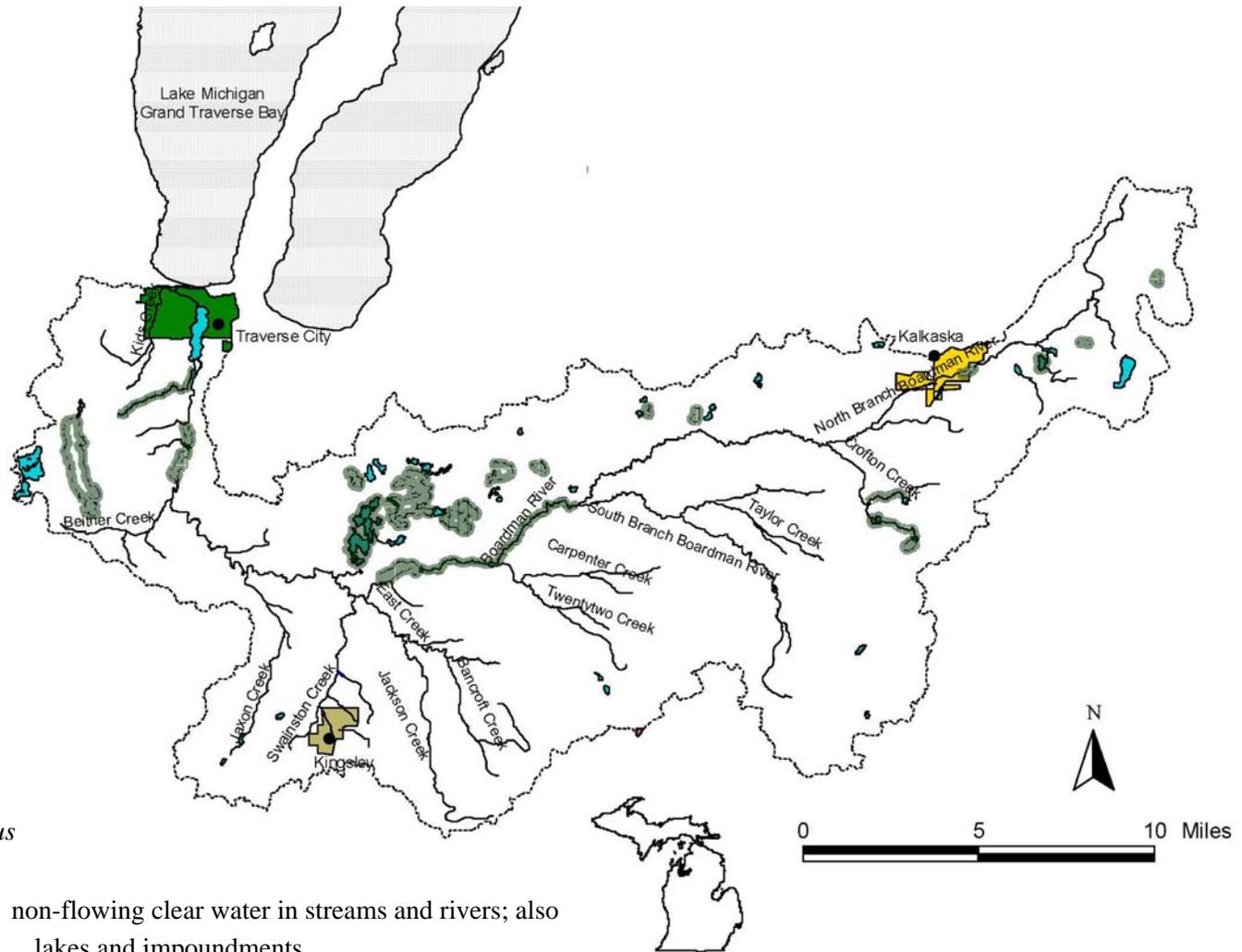
- feeding - clear, cool streams, rivers, and lakes
- rocky to sand substrate
- woody or vegetative cover
- spawning - sand or gravel nests
- shallow water
- winter refuge - deep water



**Green sunfish** *Lepomis cyanellus*

Habitat:

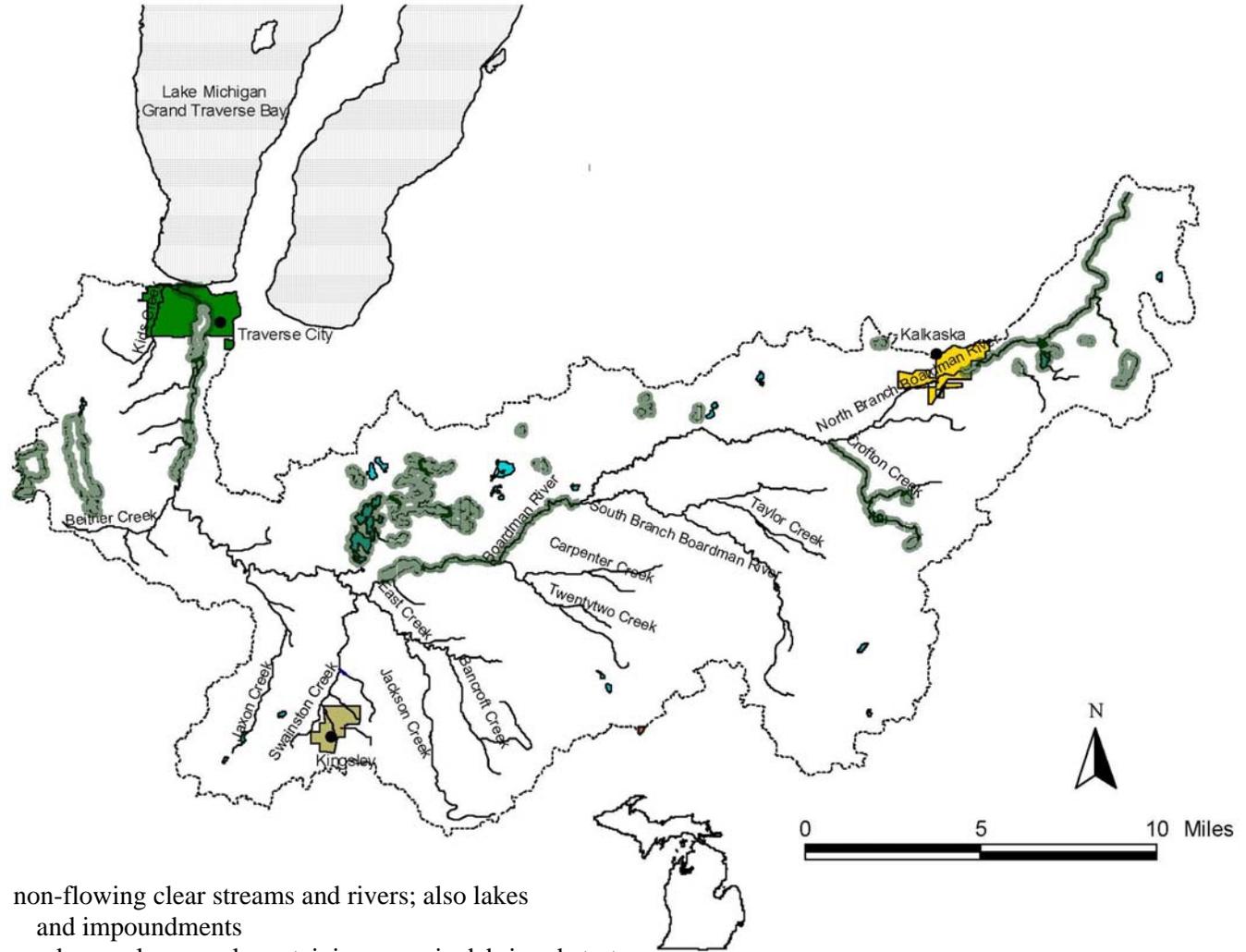
- feeding - impoundments and lakes, and low-current streams and rivers
  - no substrate preference
- spawning - nests in shallow areas sheltered by rocks, logs, or aquatic vegetation



**Pumpkinseed** *Lepomis gibbosus*

Habitat:

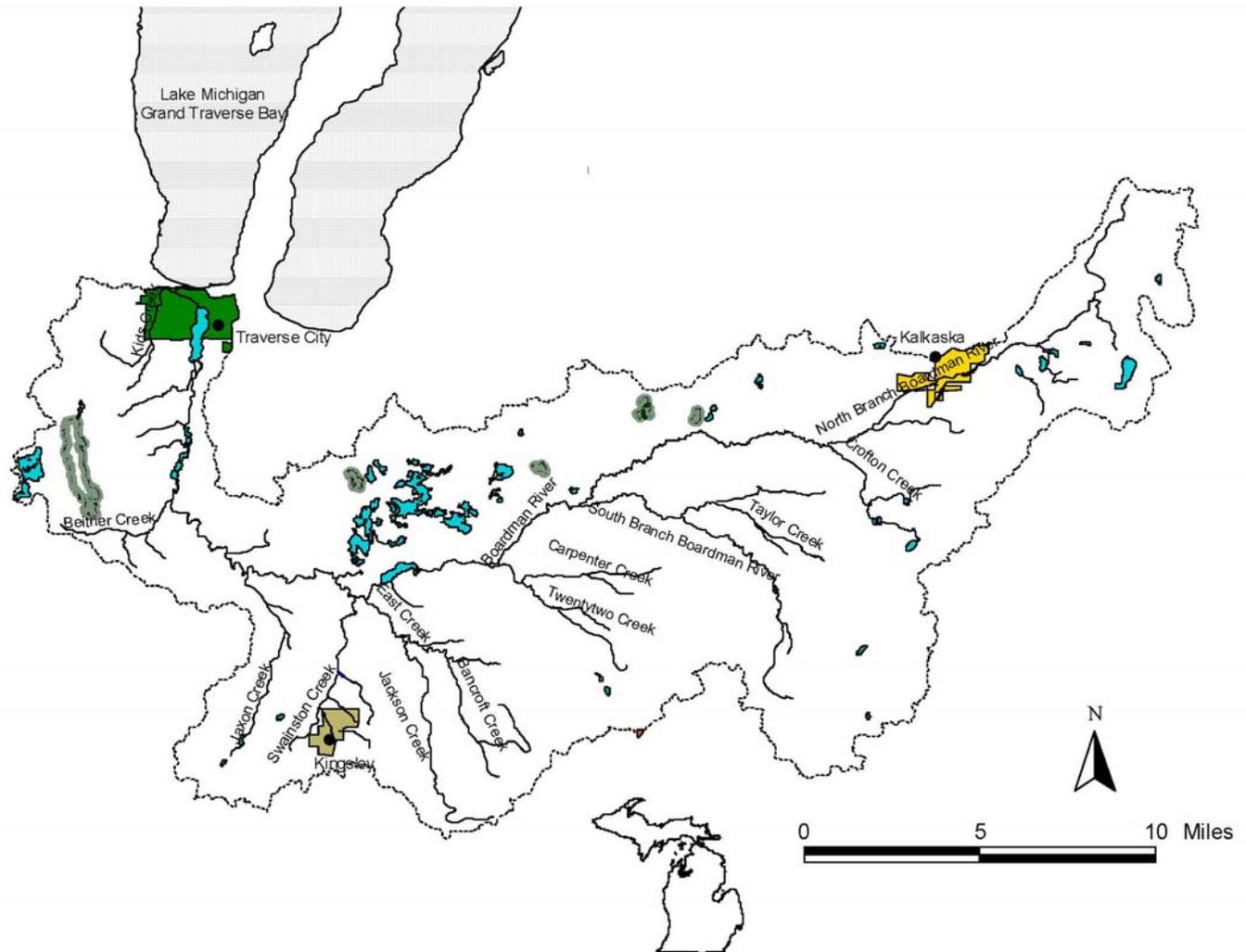
- feeding - non-flowing clear water in streams and rivers; also lakes and impoundments
- muck or sand partly covered with organic debris substrate
- dense beds of submerged aquatic vegetation
- spawning - nest in sand, gravel, or rock substrate
- in shallow water near submerged vegetation



**Bluegill** *Lepomis macrochirus*

Habitat:

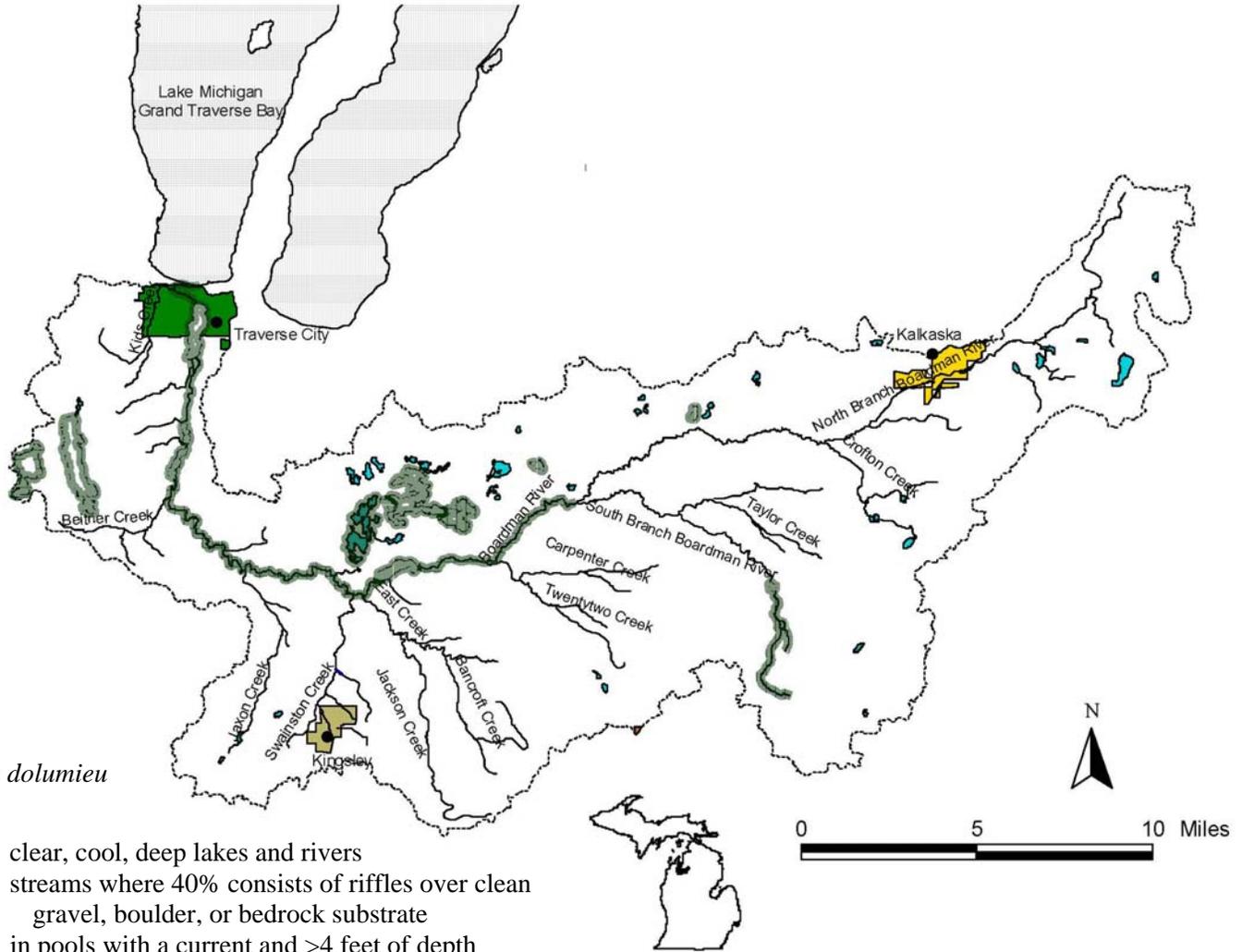
- feeding - non-flowing clear streams and rivers; also lakes and impoundments
- sand, gravel, or muck containing organic debris substrate
- scattered beds of aquatic vegetation
- cannot tolerate low oxygen or continuous high turbidity and siltation
- spawning - nests in firm substrate of gravel, sand, or mud
- winter refuge - deep water



**Hybrid sunfish** *Lepomis macrochirus x Lepomis cyanellus*  
 (typically a cross between a male bluegill and a female green sunfish)

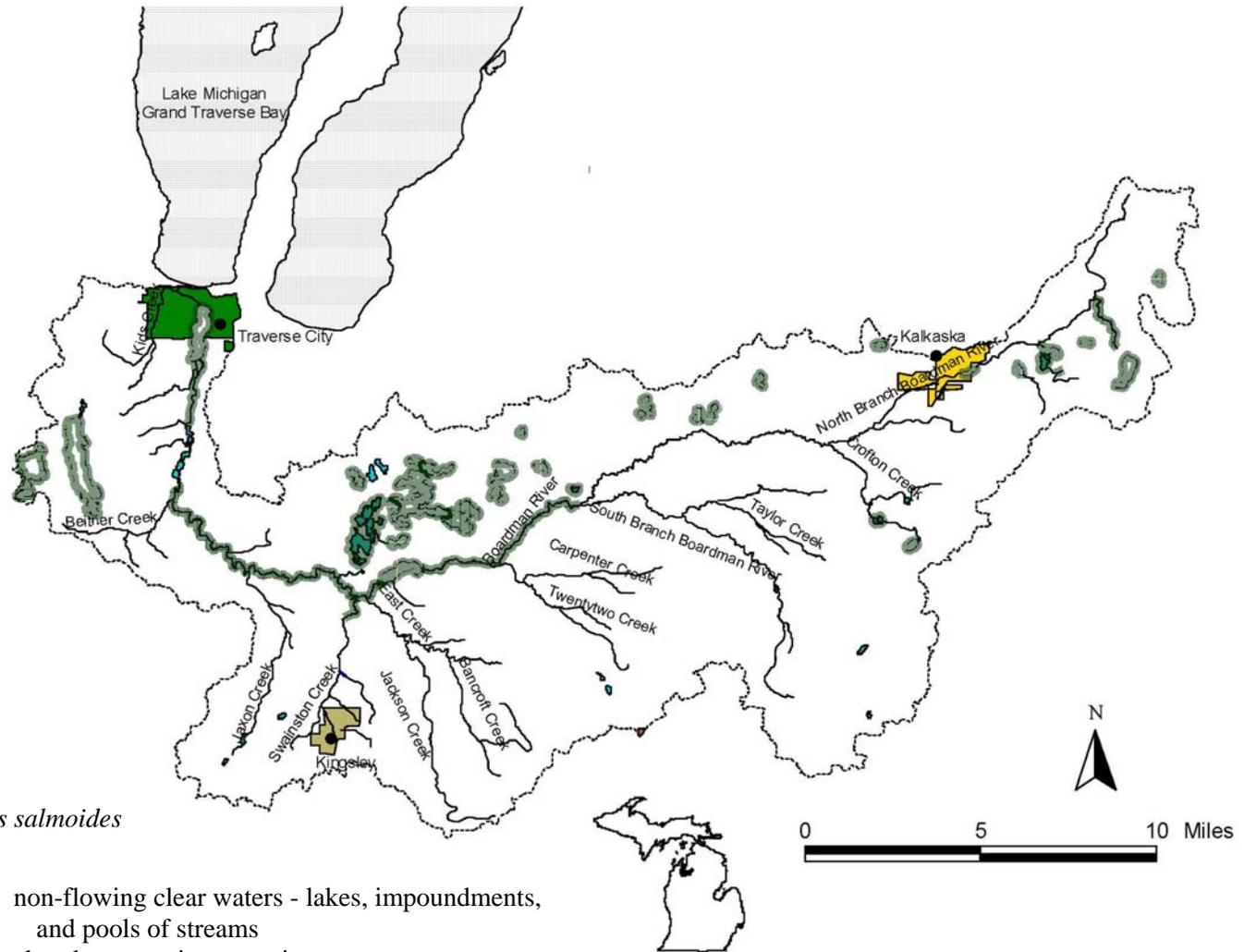
**Habitat:**

- feeding - impoundments and lakes, and low-current streams and rivers
- no substrate preference
- spawning - limited reproductive capacity



**Smallmouth bass** *Micropterus dolomieu*  
 Habitat:

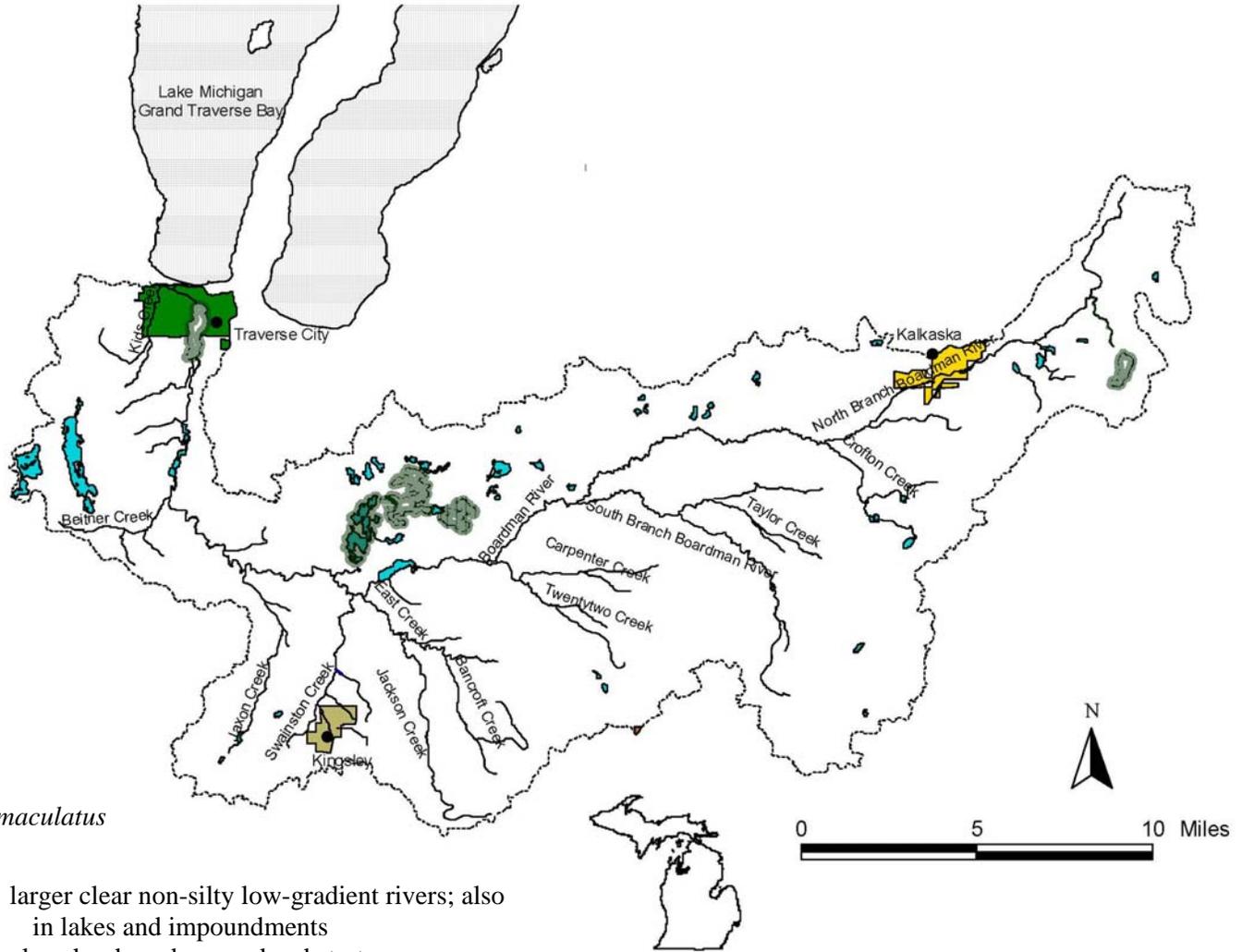
- feeding - clear, cool, deep lakes and rivers
- streams where 40% consists of riffles over clean gravel, boulder, or bedrock substrate
- in pools with a current and >4 feet of depth
- gradients between 4 and 25 feet per mile
- spawning - nest in sandy, gravel, or rocky substrate
- gradients 7 to 25 feet per mile
- streams 20 to 100 feet wide
- winter refuge - larger deeper waters with gradients between 3 to 7 feet per mile



**Largemouth bass** *Micropterus salmoides*

Habitat:

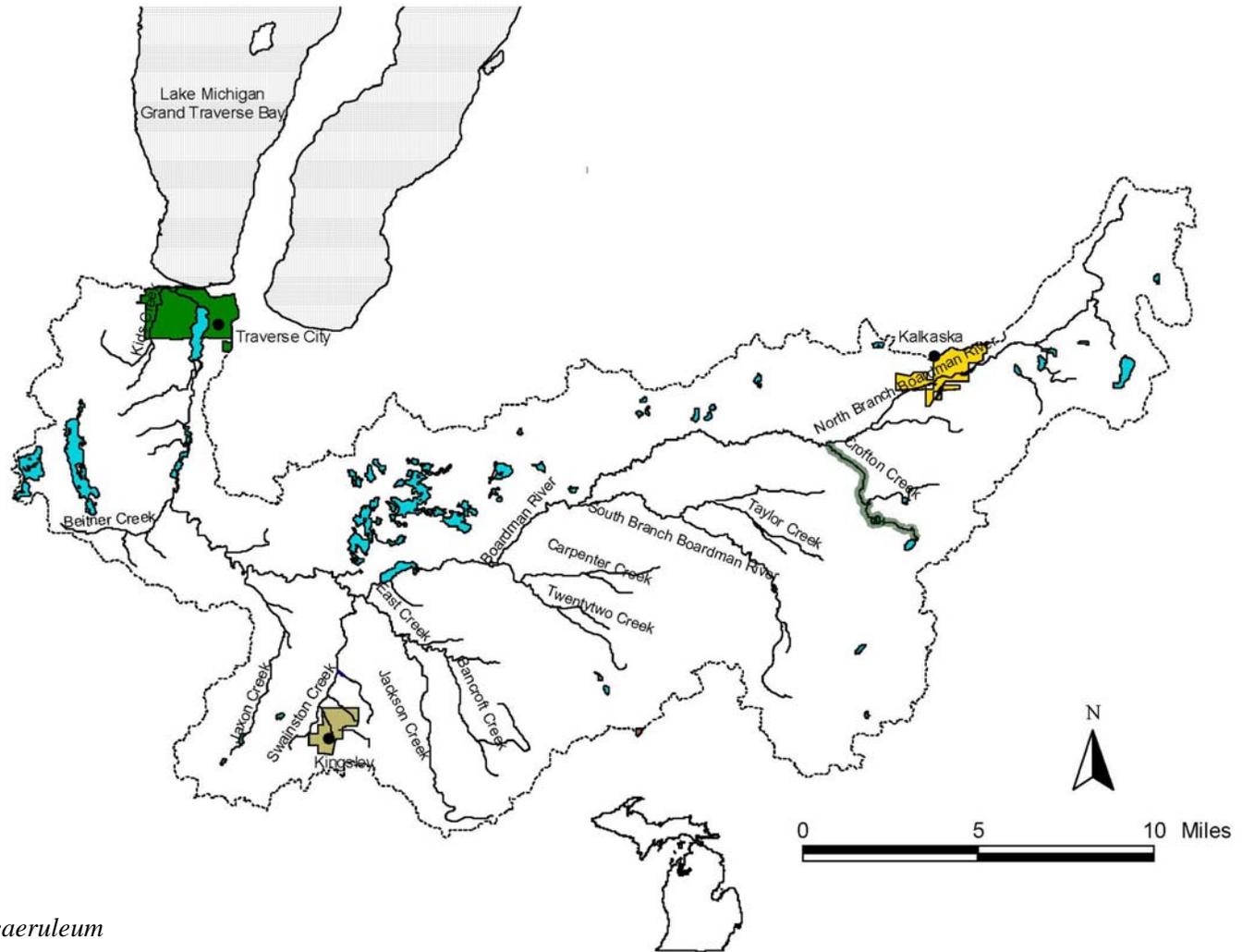
- feeding - non-flowing clear waters - lakes, impoundments, and pools of streams
- abundant aquatic vegetation
- soft muck, organic debris, gravel, sand, and hard non-flocculent clay substrates
- spawning - nest in gravelly sand to marl and soft mud substrates
- emergent vegetation
- quiet shallow bays; no current



**Black Crappie** *Pomoxis nigromaculatus*

Habitat:

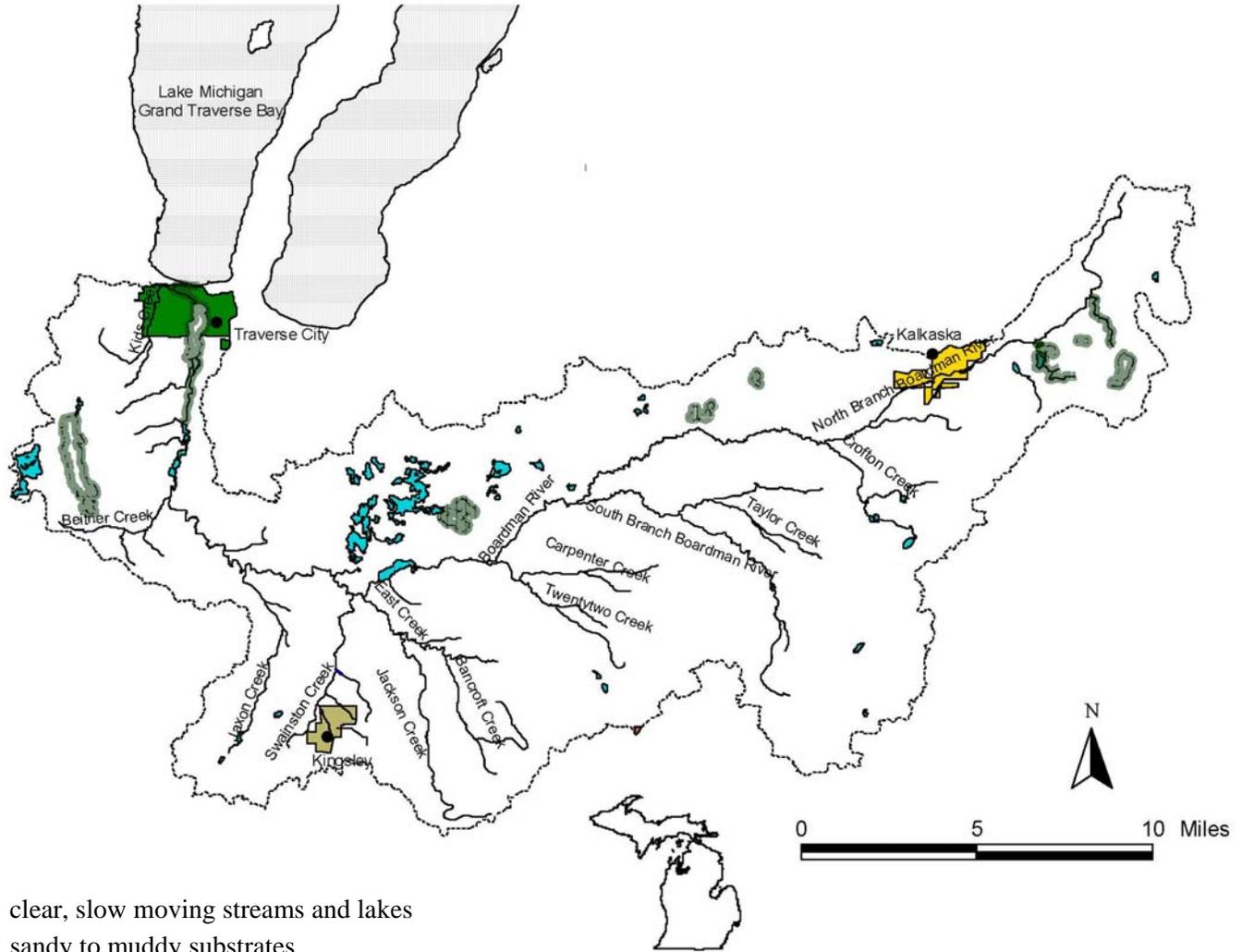
- feeding - larger clear non-silty low-gradient rivers; also in lakes and impoundments
- clean hard sand or muck substrate
- associated with submerged aquatic vegetation
- does not tolerate silt or turbidity well
- spawning - nests in gravel, sand, or mud substrate
- some vegetation must be present
- sometimes nests under banks



**Rainbow darter** *Etheostoma caeruleum*

Habitat:

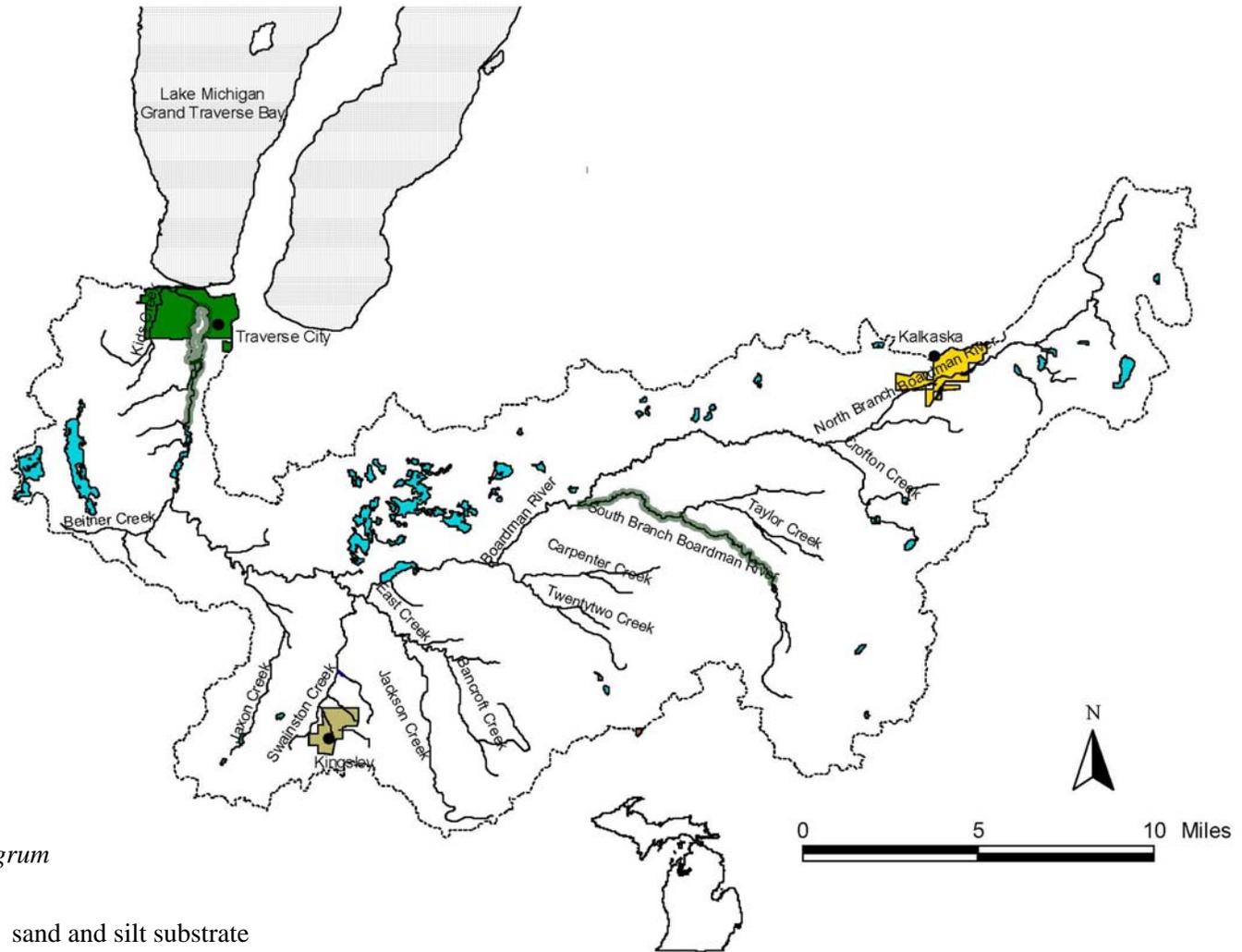
- feeding - gravelly high gradient riffles
- clear, moderate to large streams
- in shallows (average 1 foot)
- spawning - gravel or rubble riffles



**Iowa darter** *Etheostoma exile*

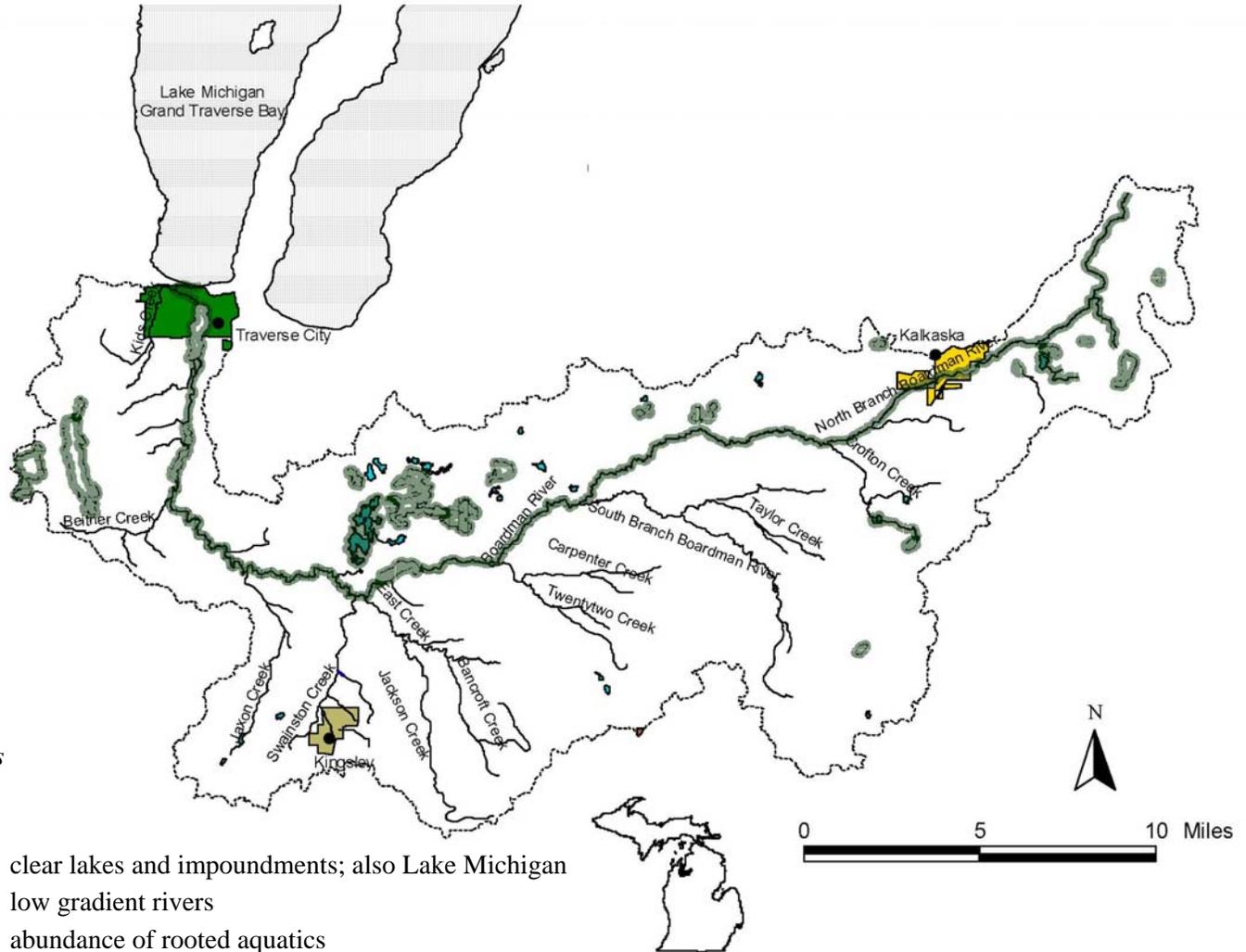
Habitat:

- feeding - clear, slow moving streams and lakes
- sandy to muddy substrates
- intolerant of turbid water
- lives in rooted aquatic vegetation
- spawning - in pond-like extensions of streams on organic matter or roots
- in shallows



**Johnny darter** *Etheostoma nigrum*  
Habitat:

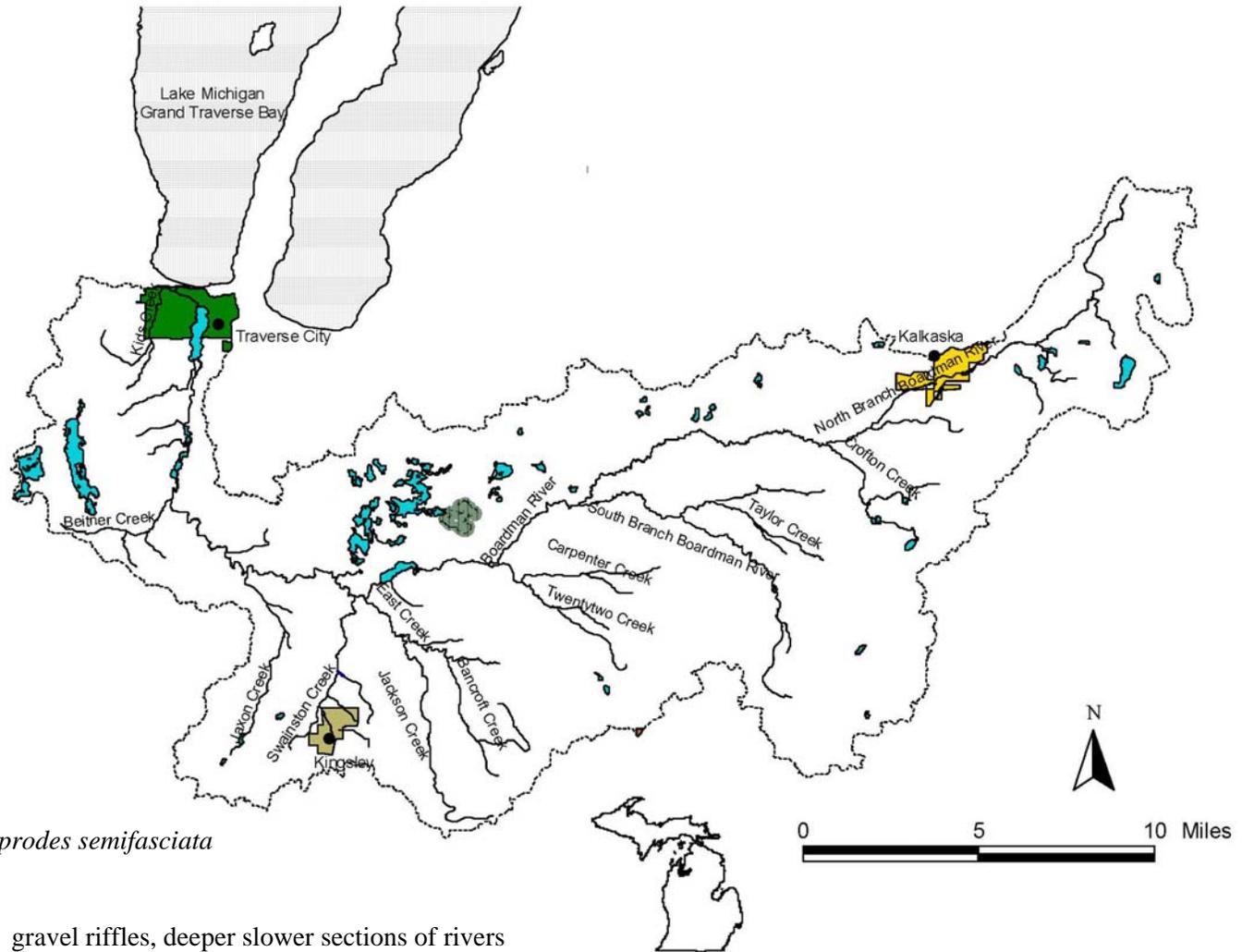
- feeding - sand and silt substrate
- little to moderate current
- shallow areas of streams, rivers, lakes, and impoundments
- tolerant of many organic and inorganic pollutants and turbidity
- spawning - underneath rocks
- in stream pools or protected shallows of lakes



**Yellow perch** *Perca flavescens*

**Habitat:**

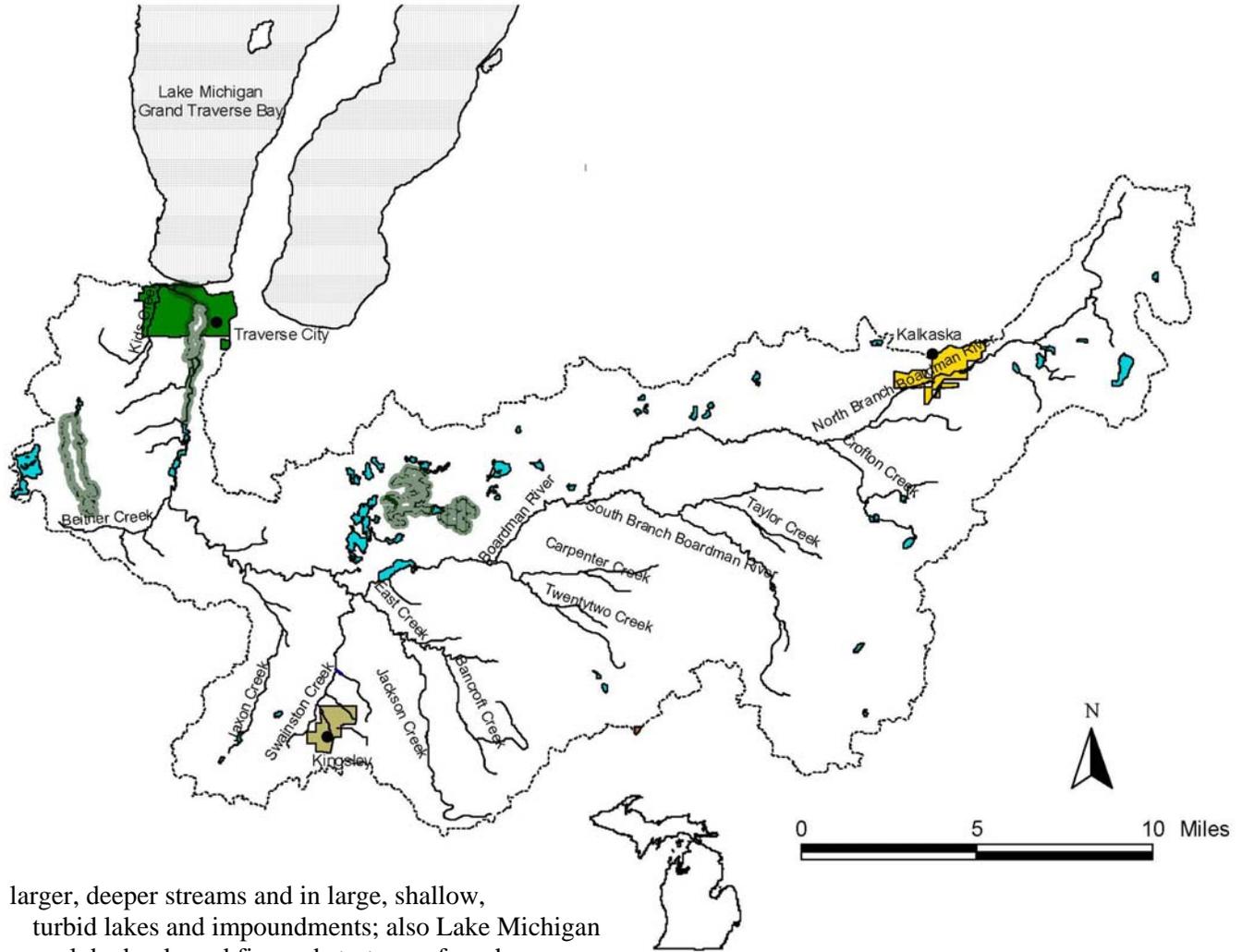
- feeding
  - clear lakes and impoundments; also Lake Michigan
  - low gradient rivers
  - abundance of rooted aquatics
  - muck, organic debris, sand, or gravel substrate
  - does not tolerate turbidity and siltation
- spawning
  - shallows of lakes, tributaries of streams
  - occurs over rooted vegetation, submerged brush, fallen trees
  - may occur over sand or gravel



**Northern logperch** *Percina caprodes semifasciata*

**Habitat:**

- feeding - gravel riffles, deeper slower sections of rivers
- medium size streams; also lakes, impoundments, and Lake Michigan
- sand, gravel, or rock substrate
- avoids turbidity and silt
- spawning - riffles or sandy in-shore shallows



**Walleye *Sander vitreus***  
 Habitat:

- feeding - larger, deeper streams and in large, shallow, turbid lakes and impoundments; also Lake Michigan
- gravel, bedrock, and firm substrates preferred
- does not tolerate a lot of turbidity or low oxygen
- spawning - rocky substrates in high gradient water in rivers
- boulder to coarse gravel shoals in lakes
- winter refuge - avoids strong currents