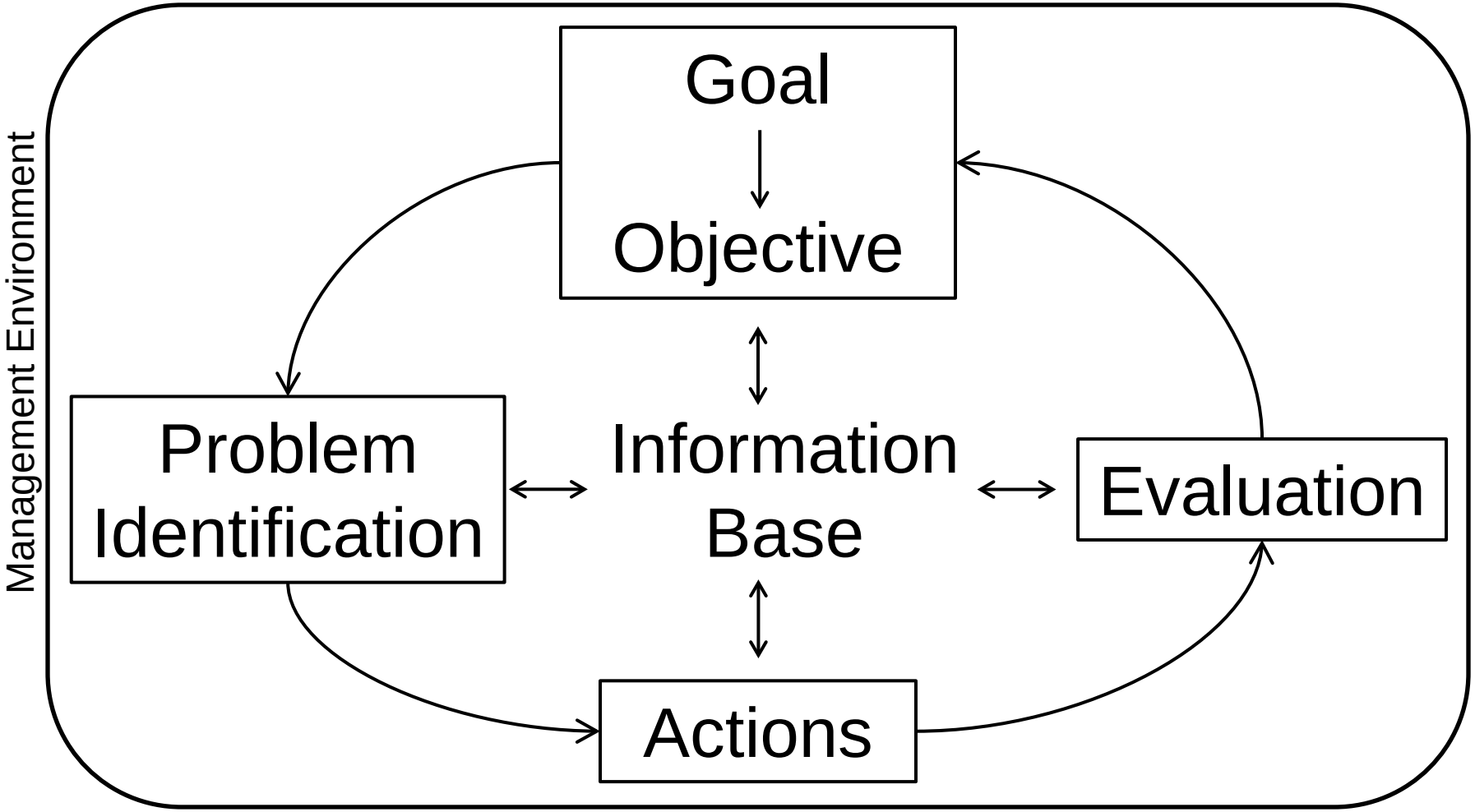
Quantifying Relationships between Fish Assemblages and Nearshore Habitat Characteristics of the Niagara River

Kevin Kapuscinski & Derek Crane
State University of New York
College of Environmental Science and Forestry

Habitat Enhancement & Restoration: an Investment

- Habitat enhancement & restoration actions are investments in the health of the Niagara River & the ecosystem services it provides to the community

Habitat Enhancement & Restoration Process



Building on Previous & Ongoing Research

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- Spawning muskellunge select sites with vegetation & mixed sand/mud substrates, never observed using finer silt substrates

Crane et al. in progress

Building on Previous & Ongoing Research

- Age-0 muskellunge feed on particular prey species, especially banded killifish, cyprinids, & darters

Kapuscinski et al. 2012, NAJFM

Building on Previous & Ongoing Research

- Fish assemblages differ along habitat gradients at muskellunge nursery sites

vs.

Kapuscinski & Farrell 2013, JGLR

Rudd Dominate Trap-net Catches

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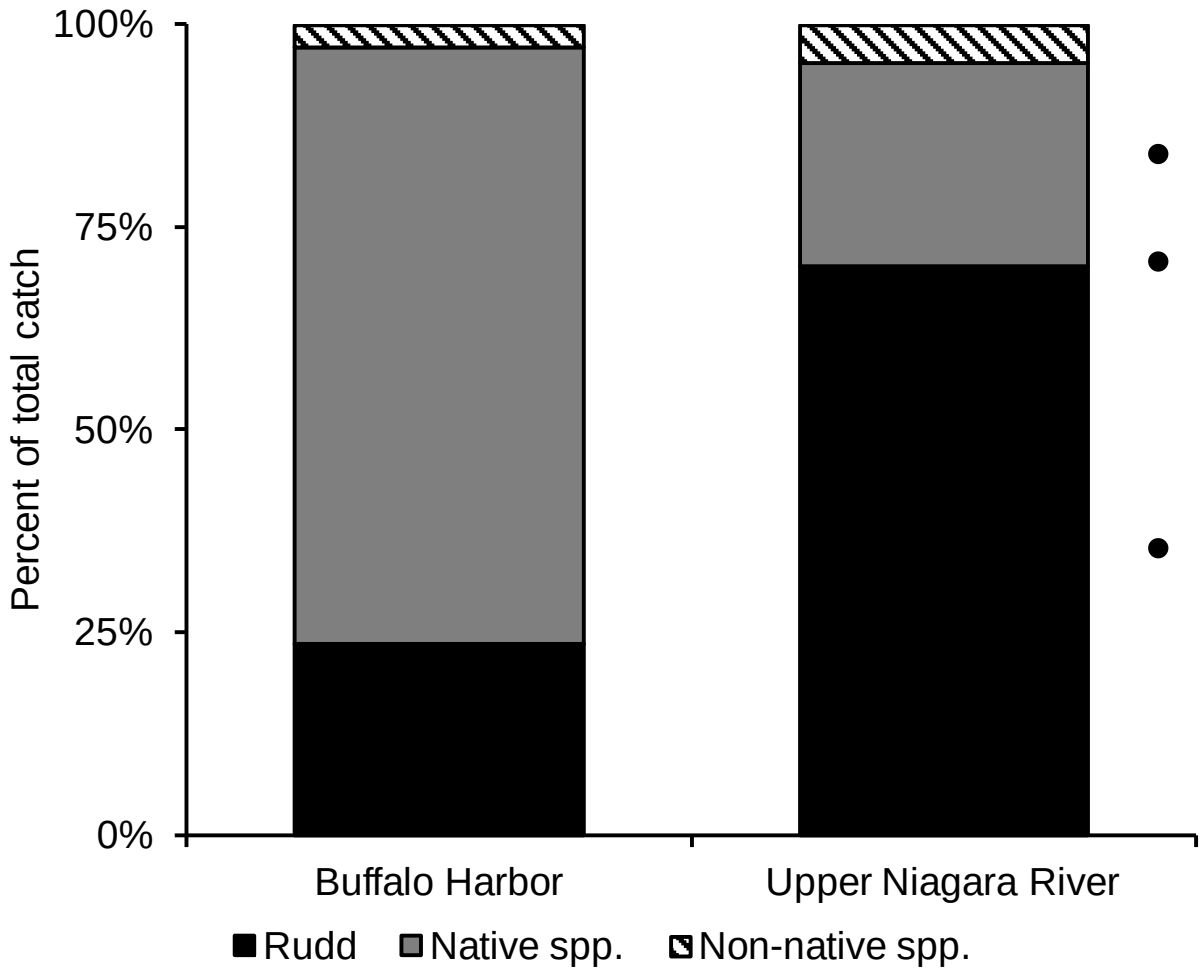
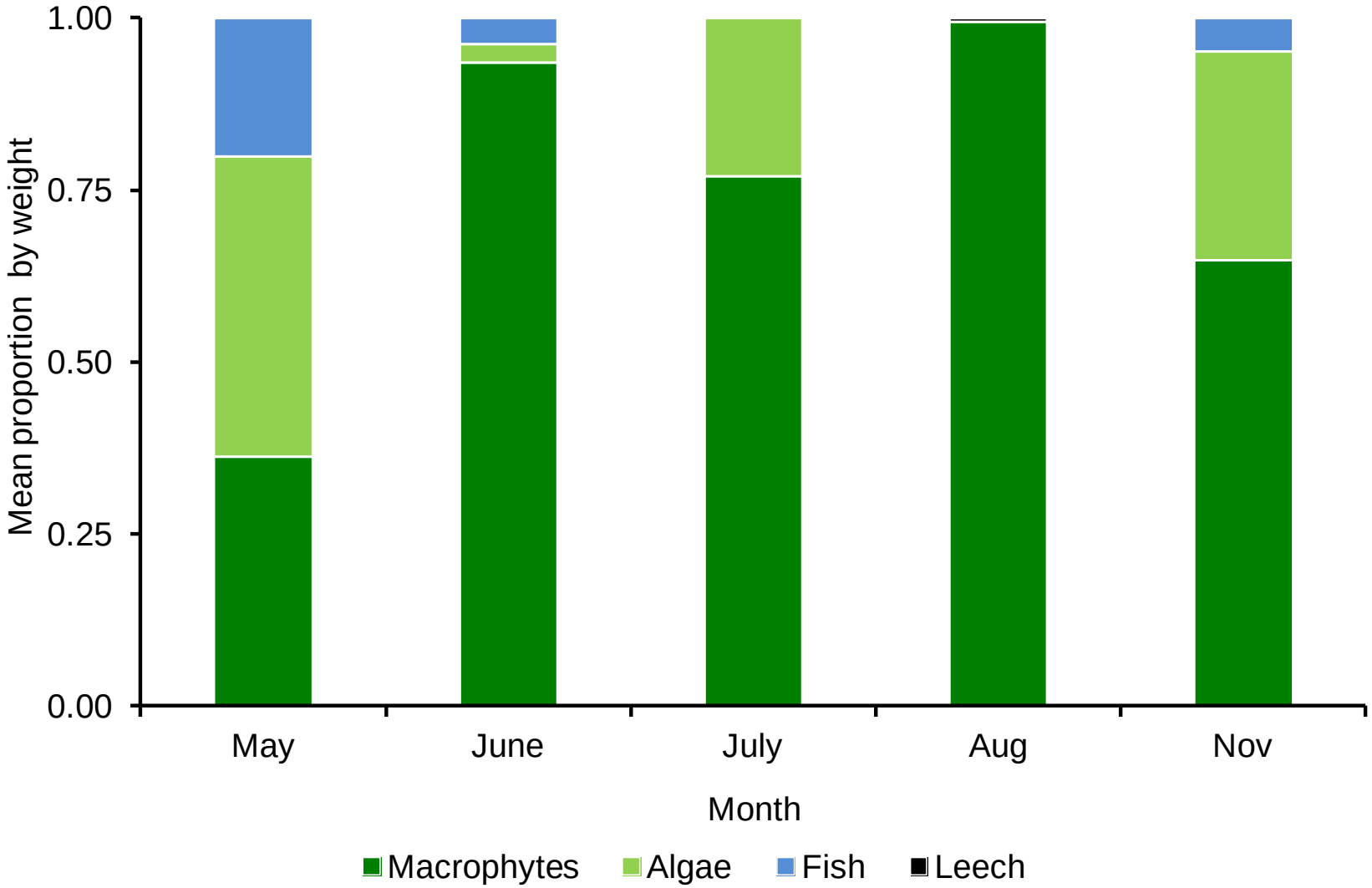


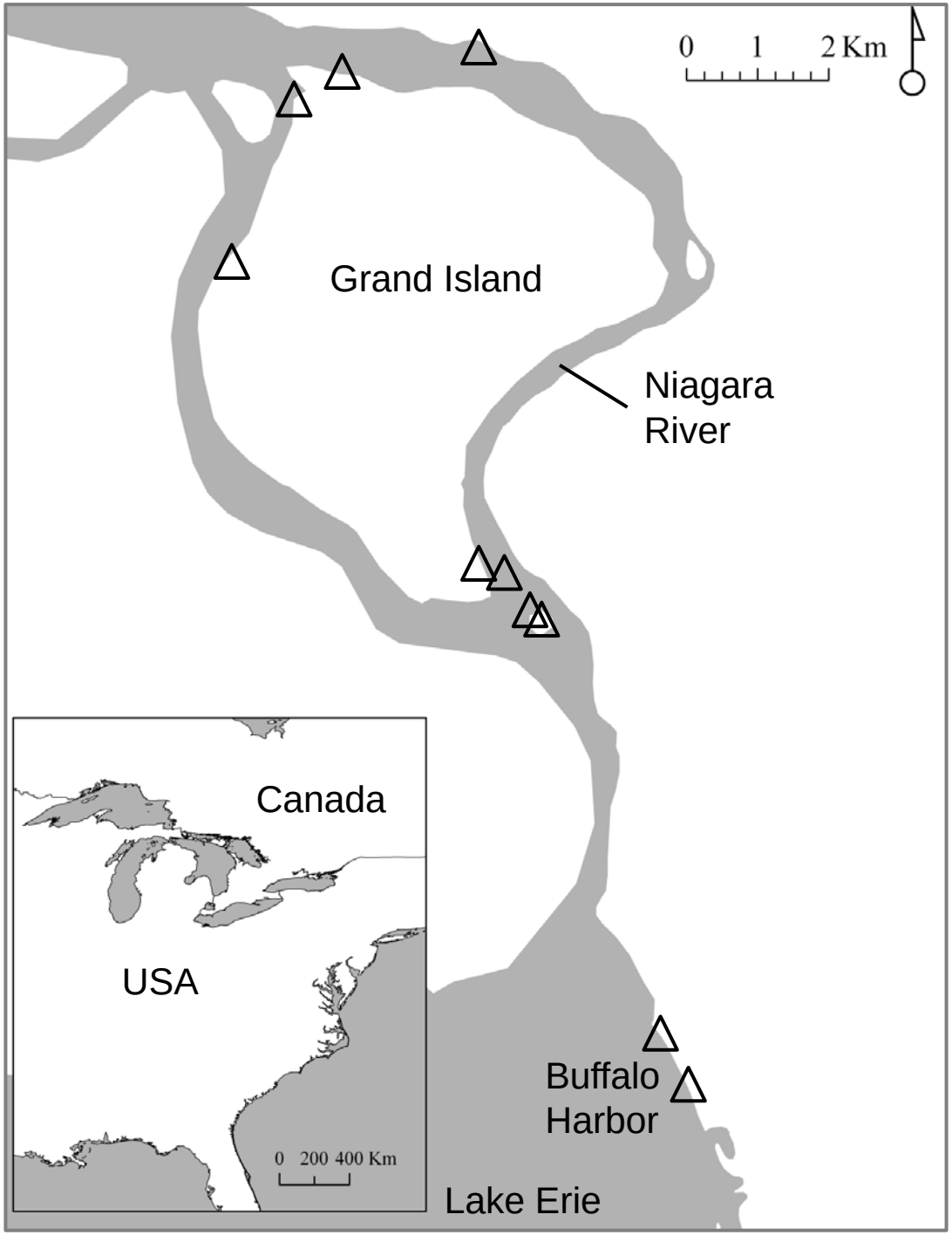
2007-2008

- 49% of total catch
- 6,887 of 14,131 fish, 17 per 24 hr net soak
- Brown bullhead = 1,903 or 13% of total catch

Kapuscinski et al. 2012, NAJFM

Rudd Diet


1.00
0.75
0.50
0.25
0.00
Mean proportion by weight
May
June
July
Aug
Nov
Month
Macrophytes
Algae
Fish
Leech


0 1 2 Km
Grand Island
Niagara River
Canada
USA
0 200 400 Km
Buffalo Harbor
Lake Erie

Proposed Project Objectives

- Objective 1: Develop a model to predict occurrences of Niagara River fishes from habitat characteristics
  - a: Predict the occurrence of age-0 muskellunge from habitat characteristics
  - b: Predict the occurrence of native and non-native fishes from habitat characteristics

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- Objective 3: Monitor nearshore fish assemblages

Objective 1a: Model Occurrence of Age-0 Muskellunge

- Purpose
  - Develop models that predict the occurrence (relative probability of presence) of age-0 muskellunge from habitat characteristics of the upper Niagara River

Objective 1b: Model Occurrence of Native & Non-native Fishes

- Purpose
  - Develop models that predict the occurrence (relative probability of presence) of native & non-native fishes from habitat characteristics of the upper Niagara River

Geof Eckerlin

Objective 1a & b: Species Occurrence Modeling

- Methods
  - Conduct surveys of physical habitat & vegetation characteristics at nearshore sites, including existing restoration sites

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  - Models can be applied in a spatially explicit manner & projected on maps in GIS

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  - Prioritize areas for protection…most effective restoration practice is conservation!

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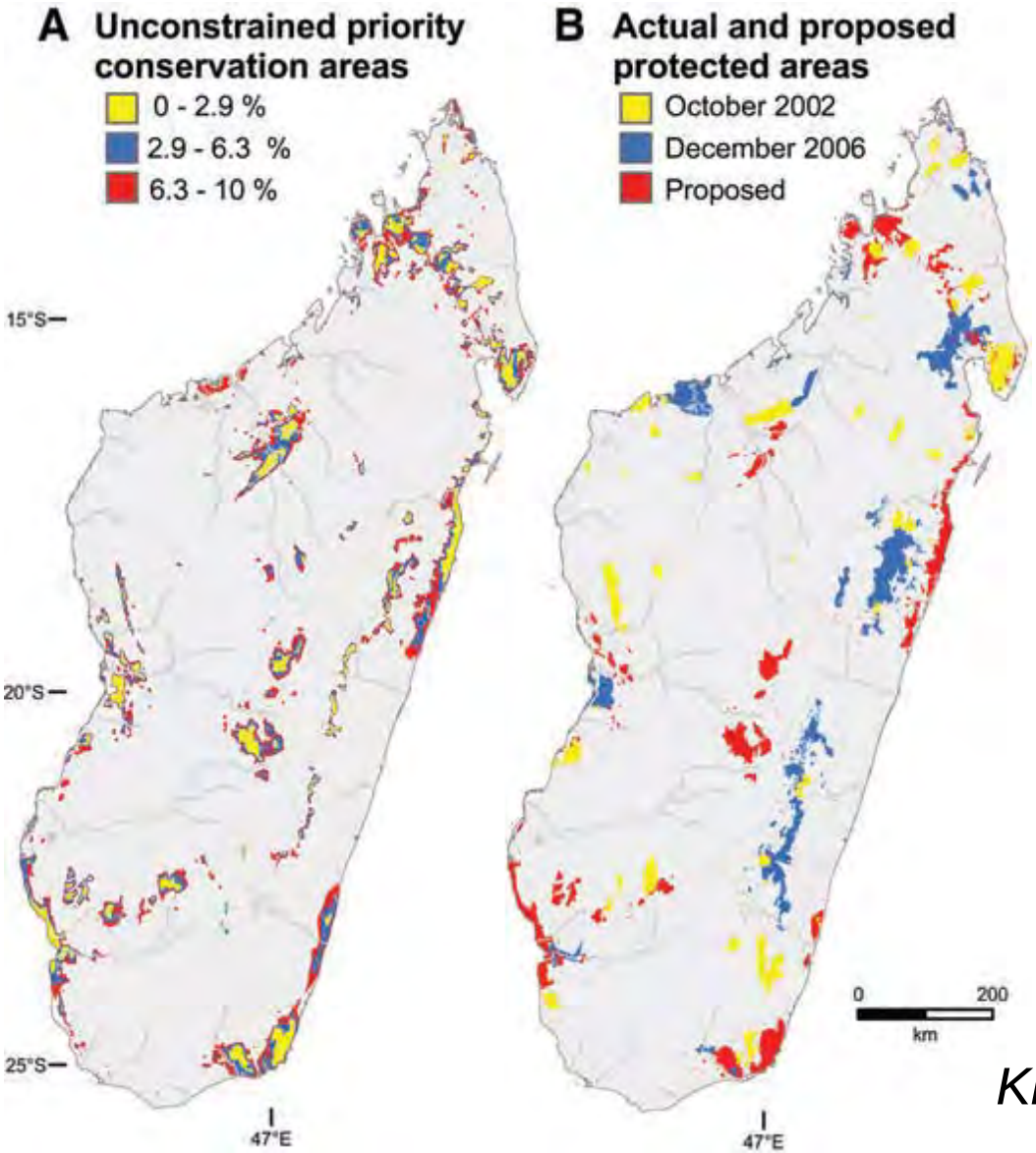
E River Rd
382 ft
© 2013 Google
Google earth

Objective 1a & b: Species Occurrence Modeling

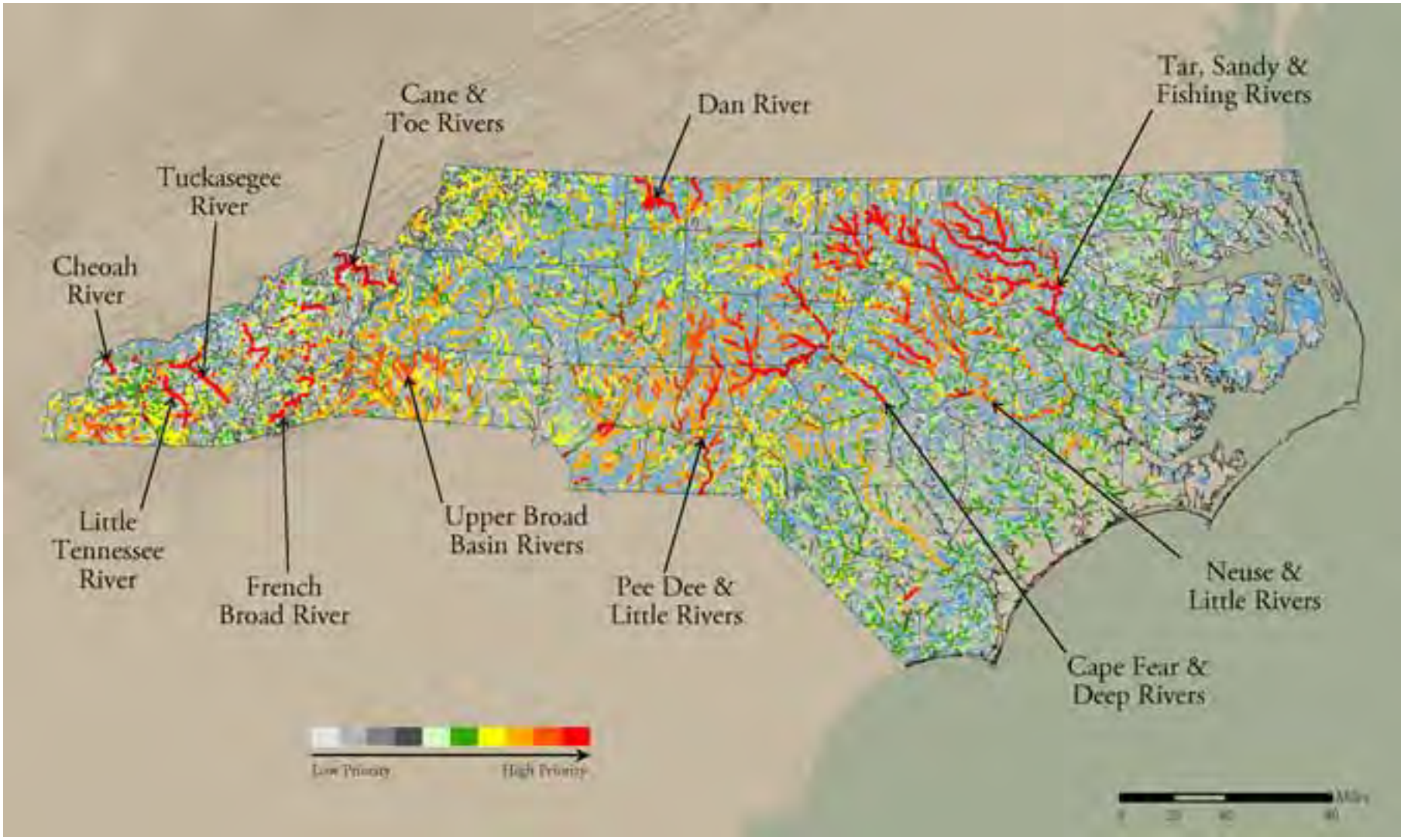
- Utility
  - Prioritize areas for protection…most effective restoration practice is conservation!
  - Identify areas needing habitat enhancement & restoration (if GIS layers are available)
  - Guide designs of habitat enhancement projects, maximizing benefits to native spp. & minimizing benefits to non-natives

Ex: Prioritizing Protected Areas



Kremen et al. 2008

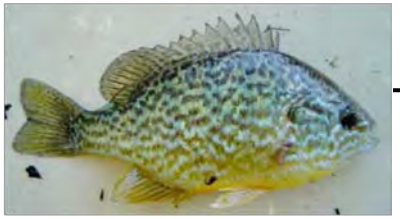
Ex: Conservation of Stream Fishes



Endries 2012

Objective 2: Quantify Prey Selection by Age-0 Muskellunge

- Purpose
  - Determine if age-0 muskellunge feed selectively among prey species



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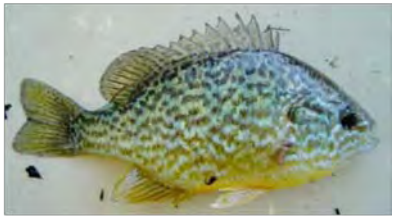

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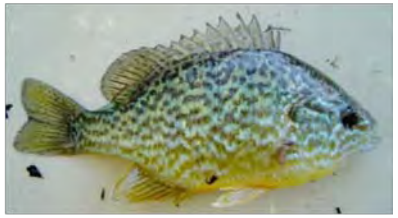
  - Determine if age-0 muskellunge feed selectively among prey species
  - Identify mechanisms driving selective feeding (e.g., capture efficiency, caloric content, anti-predator defenses or behavior, etc.)



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  - Use video to analyze anti-predator behaviors, measurements of prey morphology, & bomb calorimeter to determine mechanisms

Objective 2: Quantify Prey Selection by Age-0 Muskellunge

- Utility
  - Integrate results with knowledge of fish spp.-habitat relationships (Objective 1) to enhance growth & survival of age-0 muskellunge through management actions (e.g., protect high quality habitat or enhance poor habitat)

Objective 3: Monitor Nearshore Fish Assemblages

- Purpose
  - Monitor the relative abundance of fishes at nearshore sites of Buffalo Harbor & the upper Niagara River that are used by muskellunge as nursery areas, continuing a standardized survey that began in 2007

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  - Examine trends in relative abundance data

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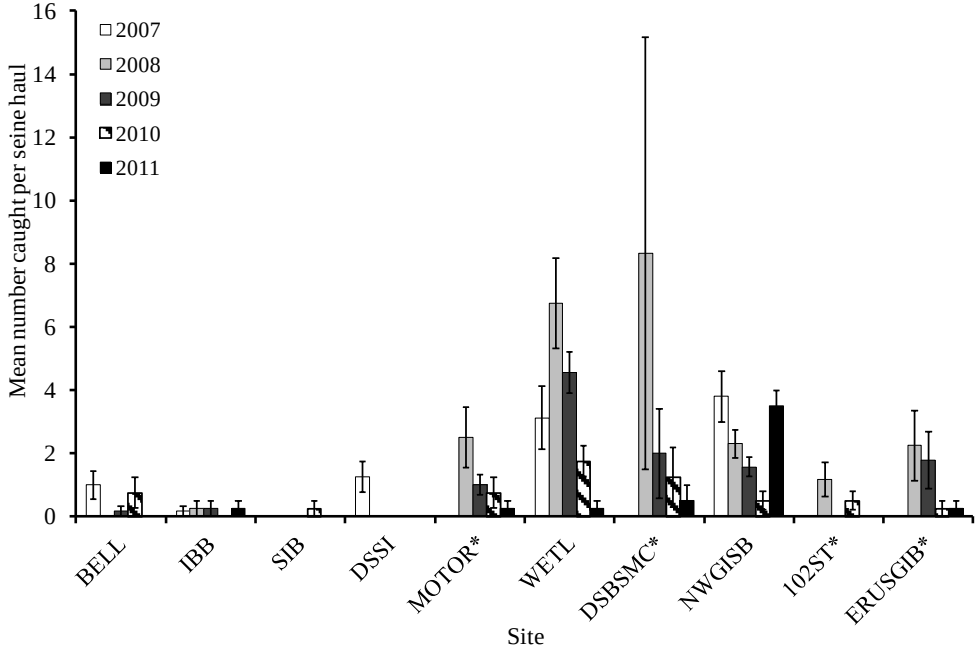
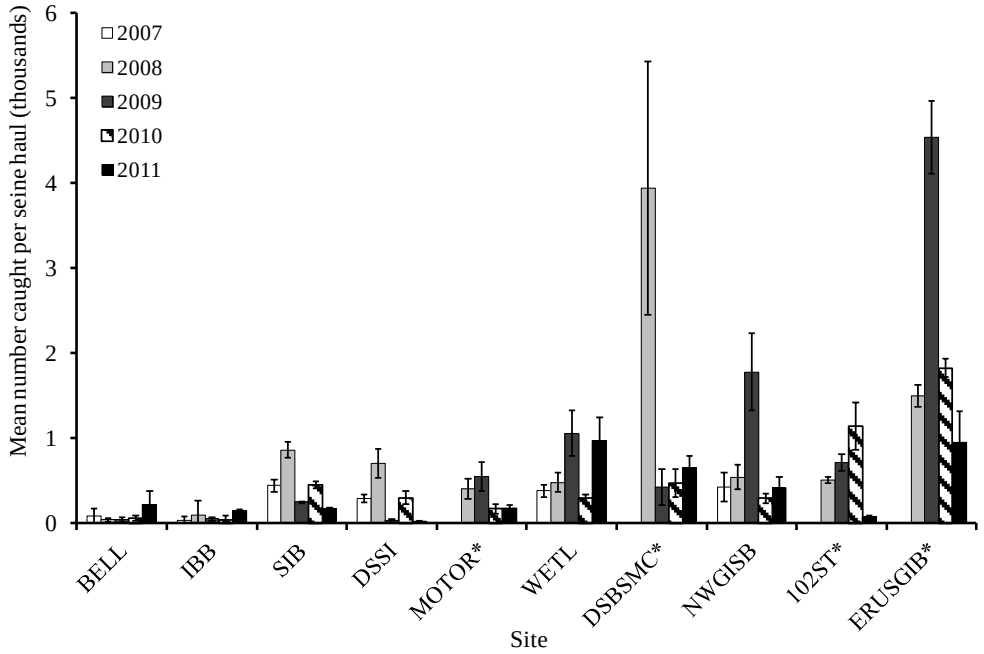
  - Measure response of fishes (i.e., production of young) to ecosystem changes, including habitat enhancements

Age-0 muskellunge



All fishes



Kapuscinski et al. 2013, JGLR

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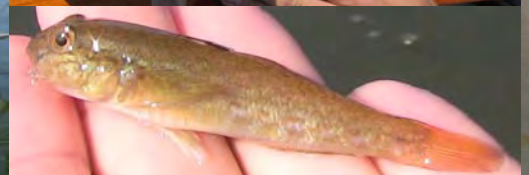
  - Sample rare native species
  - Monitor abundances of non-native species & detect new invaders



Links to Restoration of Niagara River

- Standards for ecologically successful river restoration (from Palmer et al. 2005)
  1) Guiding image of dynamic, healthy river
     - Goal dependent upon reliable information base

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  2) Measurable improvement
     - Restoration targets based on “best” sites
     - Index seining will measure response of fishes

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  3) River must be more resilient & self-sustaining
     - Increasing native spp. = increased biotic resistance to invasion

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  1) Guiding image of dynamic, healthy river
  2) Measurable improvement
  3) River must be more resilient & self-sustaining
  4) Do no lasting harm
     - "Fishery managers must be cautious in their selection of habitat modification choices to avoid favoring undesirable species"

Jude & DeBoe 1996, CJFAS

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  1) Guiding image of dynamic, healthy river
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  3) River must be more resilient & self-sustaining
  4) Do no lasting harm
  5) Rigorous evaluation
     - Identify corrective measures & guide future designs

Deliverables

- Models for predicting occurrences of fishes based on habitat variables
  - Manual for using the model
  - Training sessions for practitioners

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- MS thesis & publications in peer-reviewed scientific journals

Leveraging Opportunities

- Partnership with USACE
  - Collection of bathymetry, substrate, & aquatic vegetation data => GIS layers
  - Planning for habitat enhancement projects (3-5?) based on our research findings

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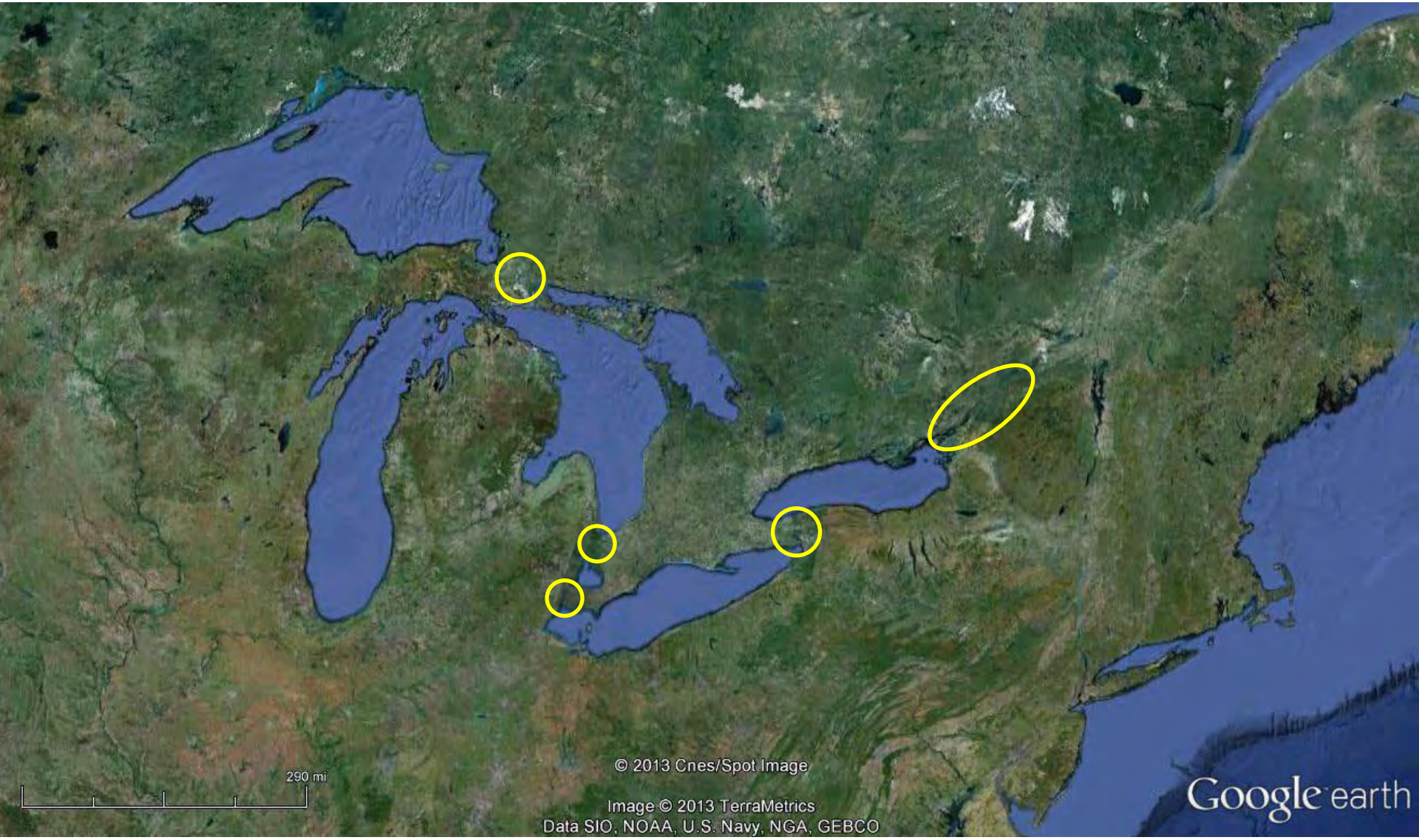
- University of Michigan Water Institute RFP
  - Expand species occurrence modeling effort (Objective 1) to include all Great Lakes connecting channels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