# Muskellunge *Esox masquinongy* Genetic Structure, Reproductive Ecology, and Interaction with the Fish Community: Acquiring Information Needed for Successful Management

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# Acknowledgments


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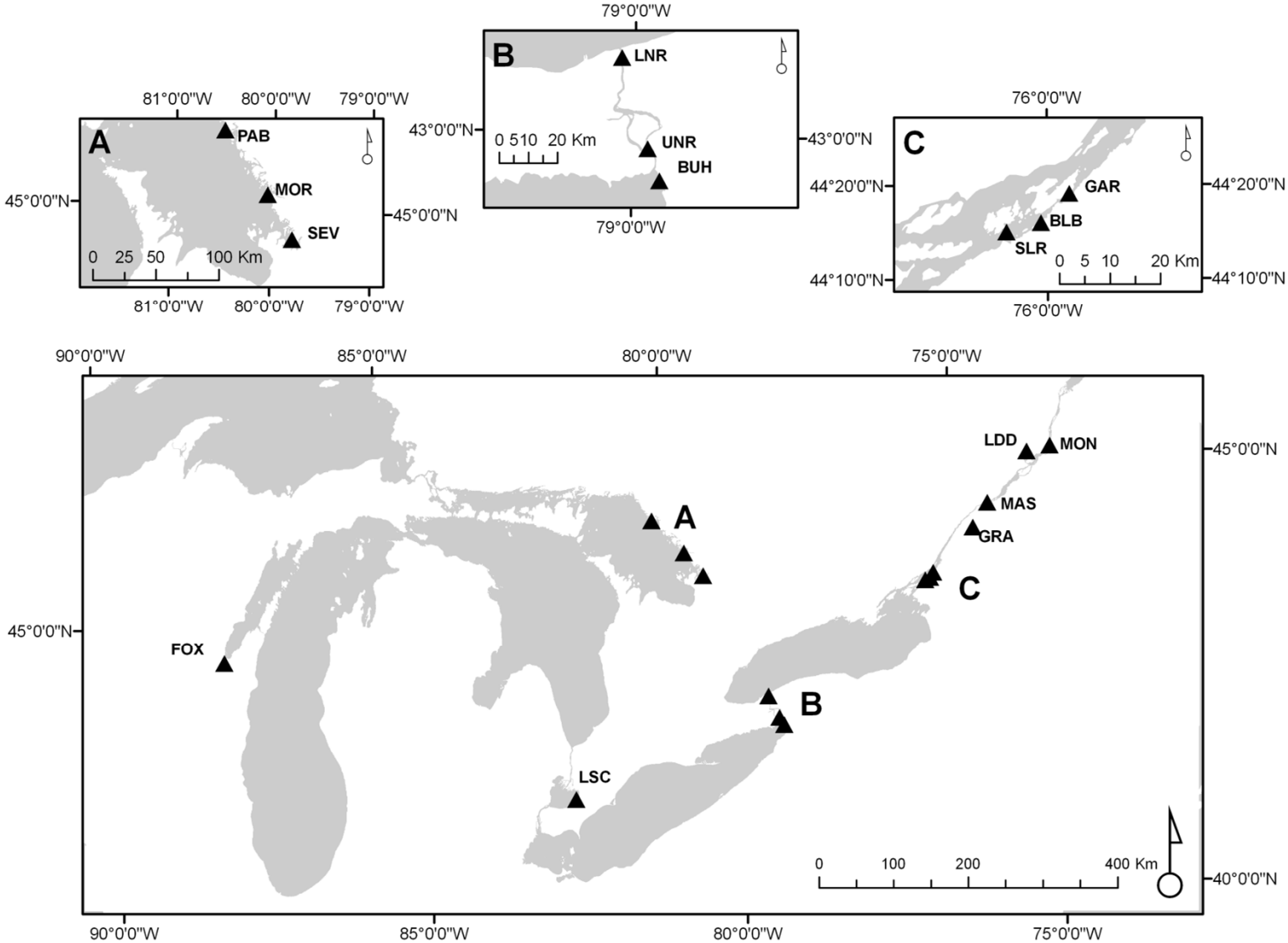
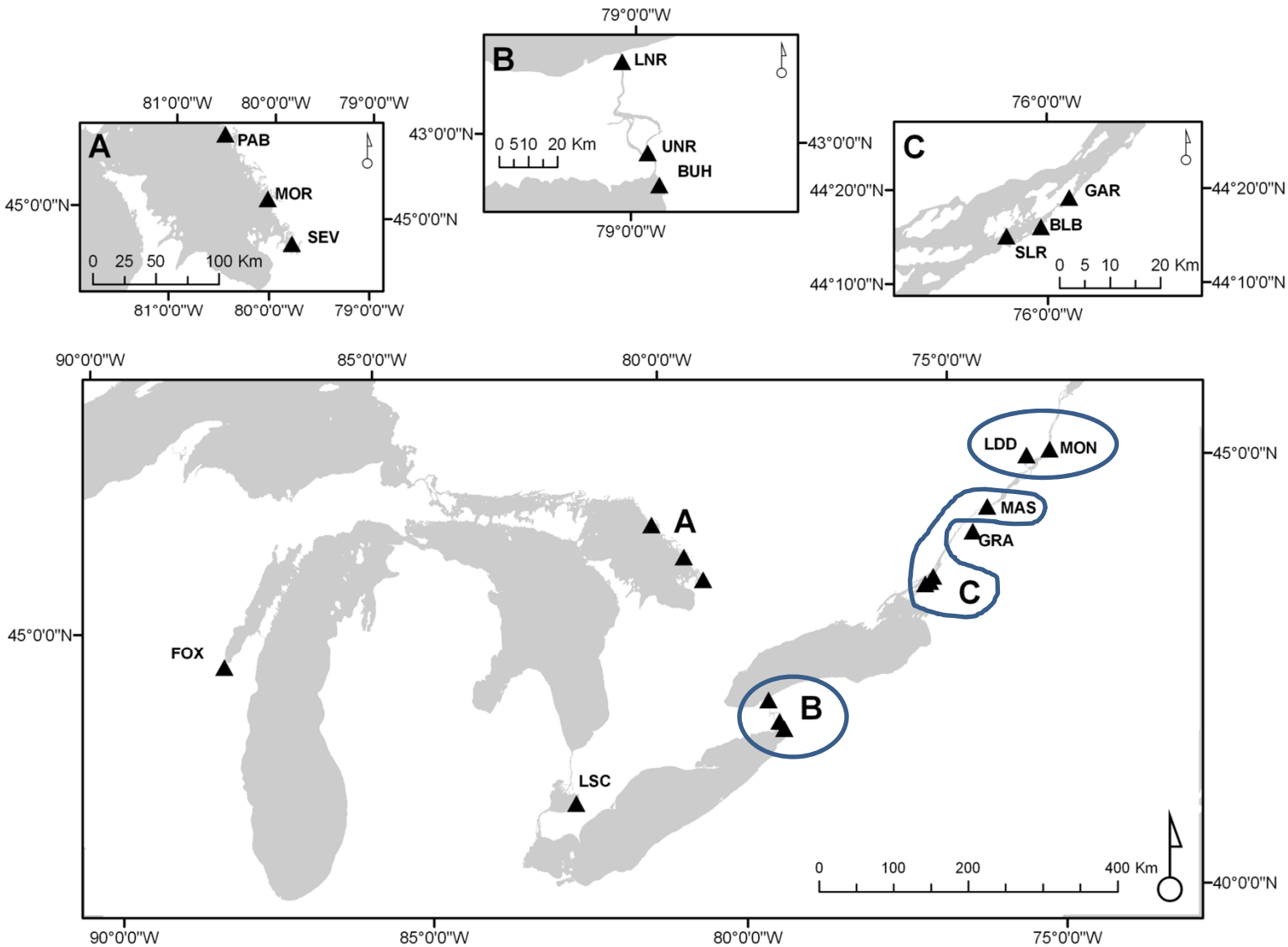
# Outline

- Genetic population structure of muskellunge in the Great Lakes
- Diets of young-of-the-year muskellunge
- The influence of habitat on fish assemblage structure
- Rudd feeding ecology and population structure

# Genetic Population Structure of Muskellunge



# Genetic Population Structure of Muskellunge



# Muskellunge Genetics: Conclusions

- Muskellunge from Buffalo Harbor, upper and lower Niagara genetically very similar, consistent with downstream movement and habitat destruction
- Non-native muskellunge should not be stocked into waters with native populations
- Need to examine legacy of stocking Chautauqua Lake muskellunge in Niagara

# Muskellunge & fish assemblage data collection

MADE IN U.S.A.

# Habitat data collection

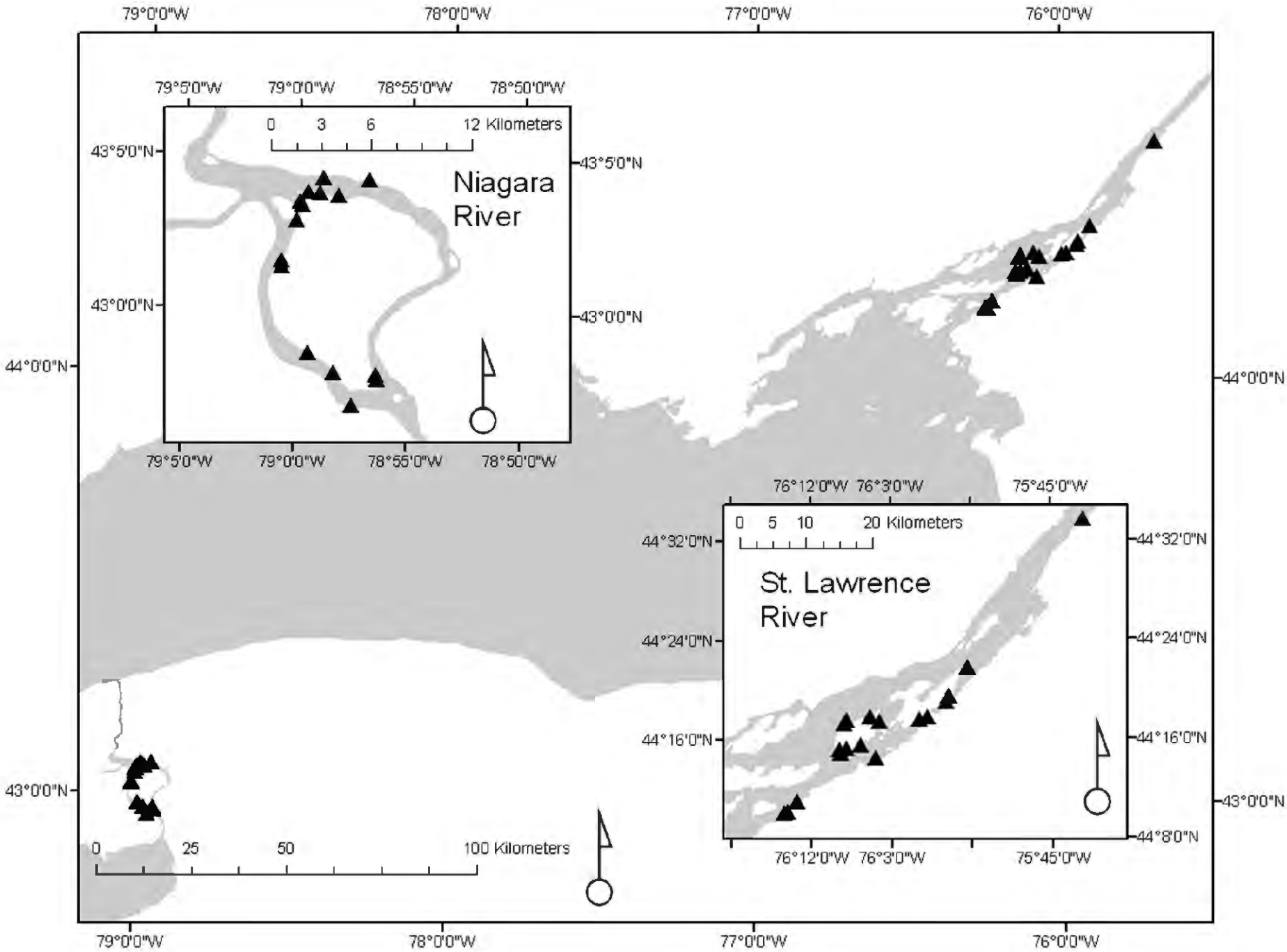
# Which habitat variables did we measure?

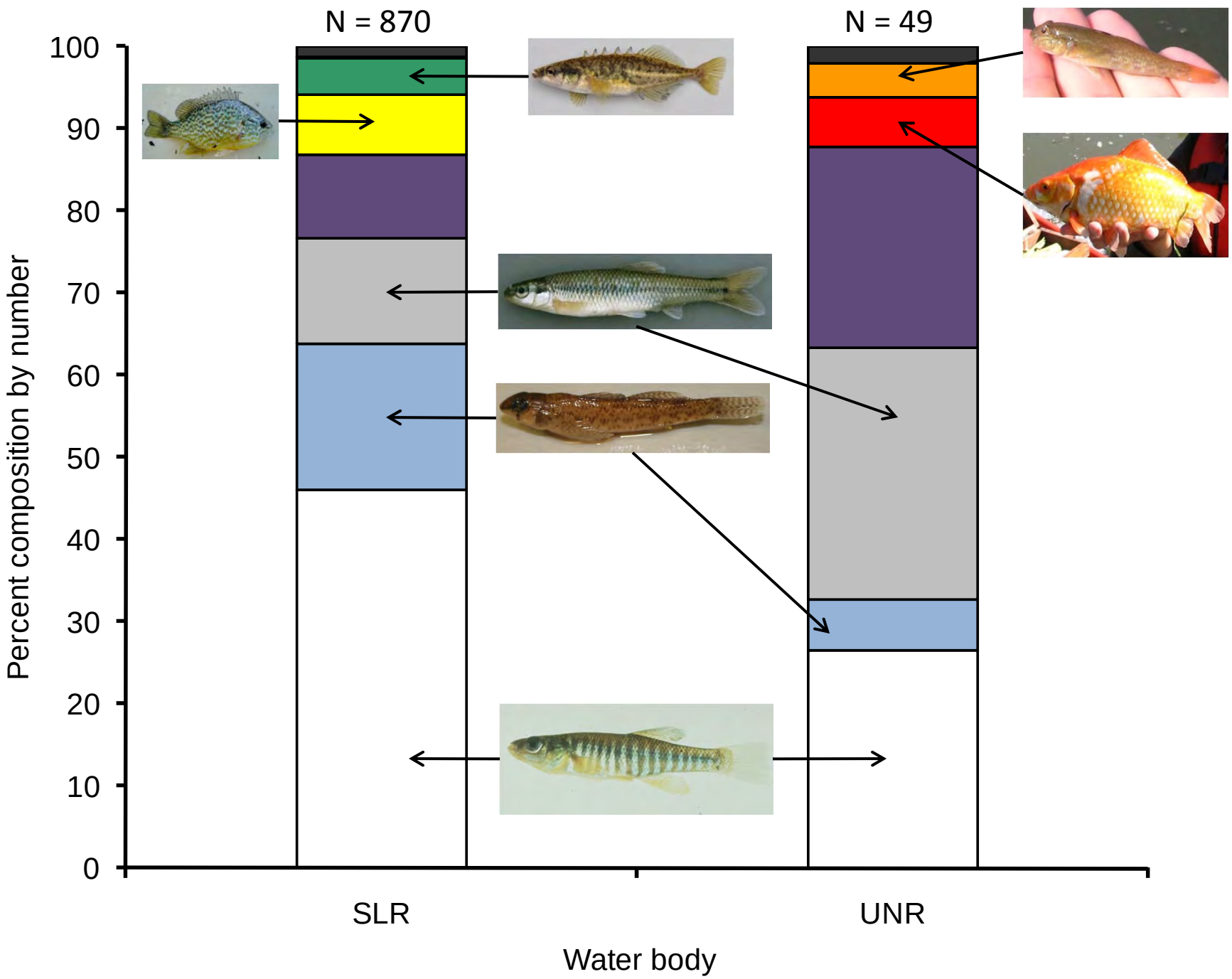
- Flow
  - present or absent
- Substrate type
  - 0-10 scale, 0 = silt & 10 = cobble
- Macroalgae coverage

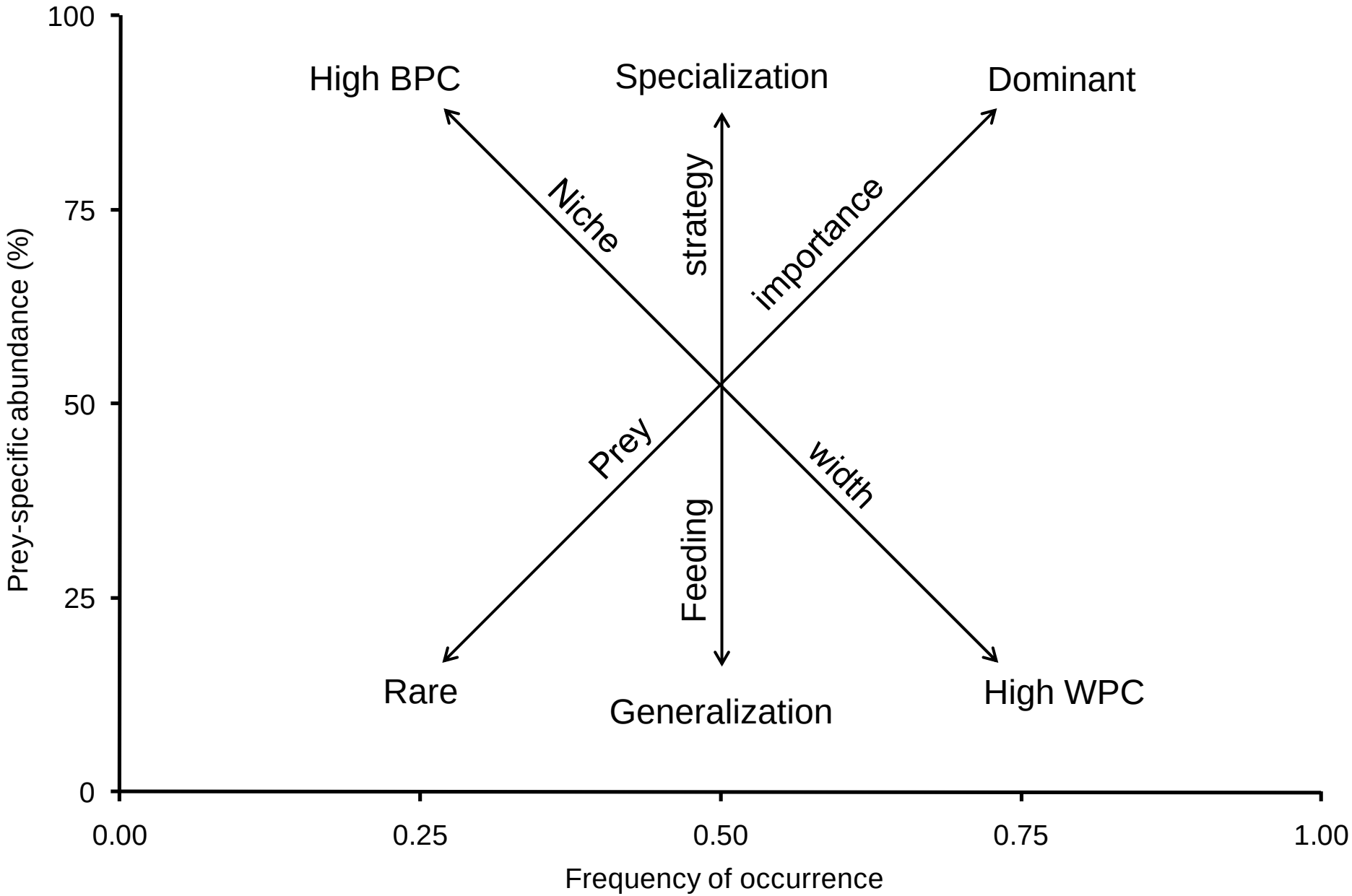
- Macrophyte column density
  - habitat complexity = %coverage * height

# Diets of Young-of-year Muskellunge

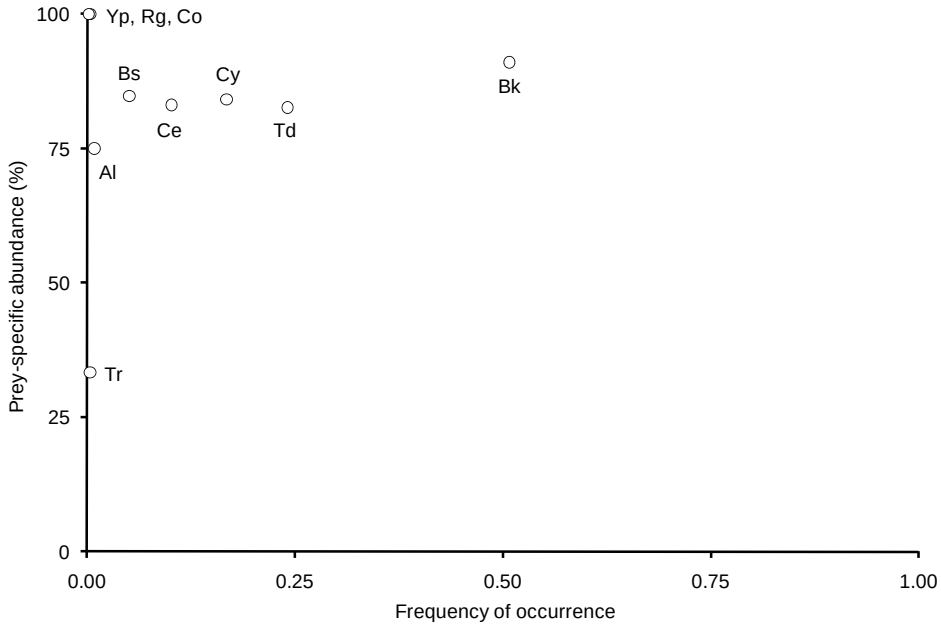
- Which prey fish are most important?
- Are YOY muskellunge specialized or general predators?


79°0'0"W
78°0'0"W
77°0'0"W
76°0'0"W
44°0'0"N
43°0'0"N
0 25 50 100 Kilometers
Niagara River
79°5'0"W
79°0'0"W
78°55'0"W
78°50'0"W
43°5'0"N
43°0'0"N
0 3 6 12 Kilometers
St. Lawrence River
76°12'0"W
76°3'0"W
75°45'0"W
44°32'0"N
44°24'0"N
44°16'0"N
44°8'0"N
0 5 10 20 Kilometers

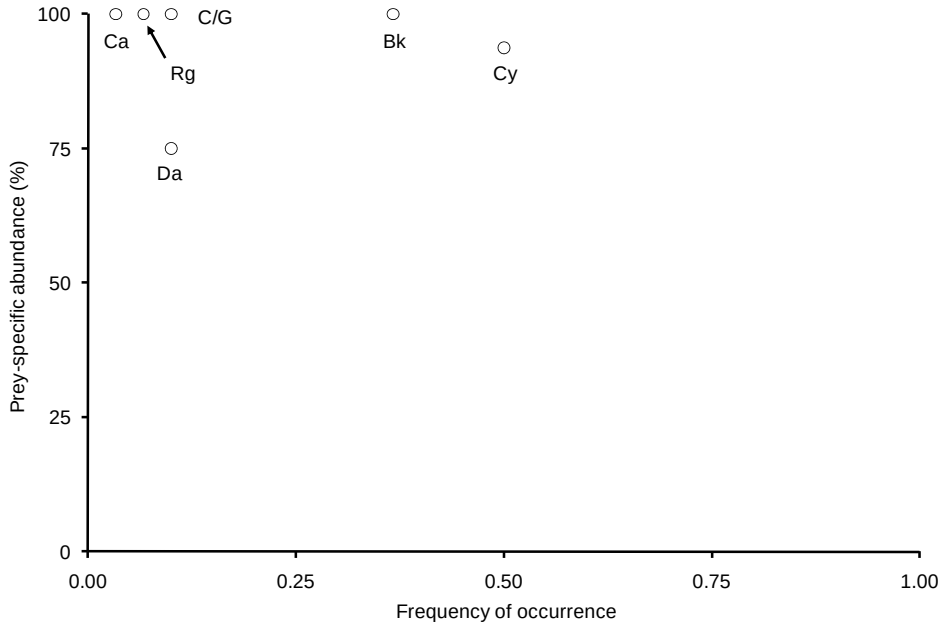

N = 870
N = 49
100
90
80
70
60
50
40
30
20
10
0
Percent composition by number
SLR
UNR
Water body


100
75
50
25
0
Prey-specific abundance (%)
High BPC
Specialization
Dominant
Niche
strategy
importance
Prey
width
Feeding
Rare
Generalization
High WPC
0.00
0.25
0.50
0.75
1.00
Frequency of occurrence

# St. Lawrence River




# Niagara River

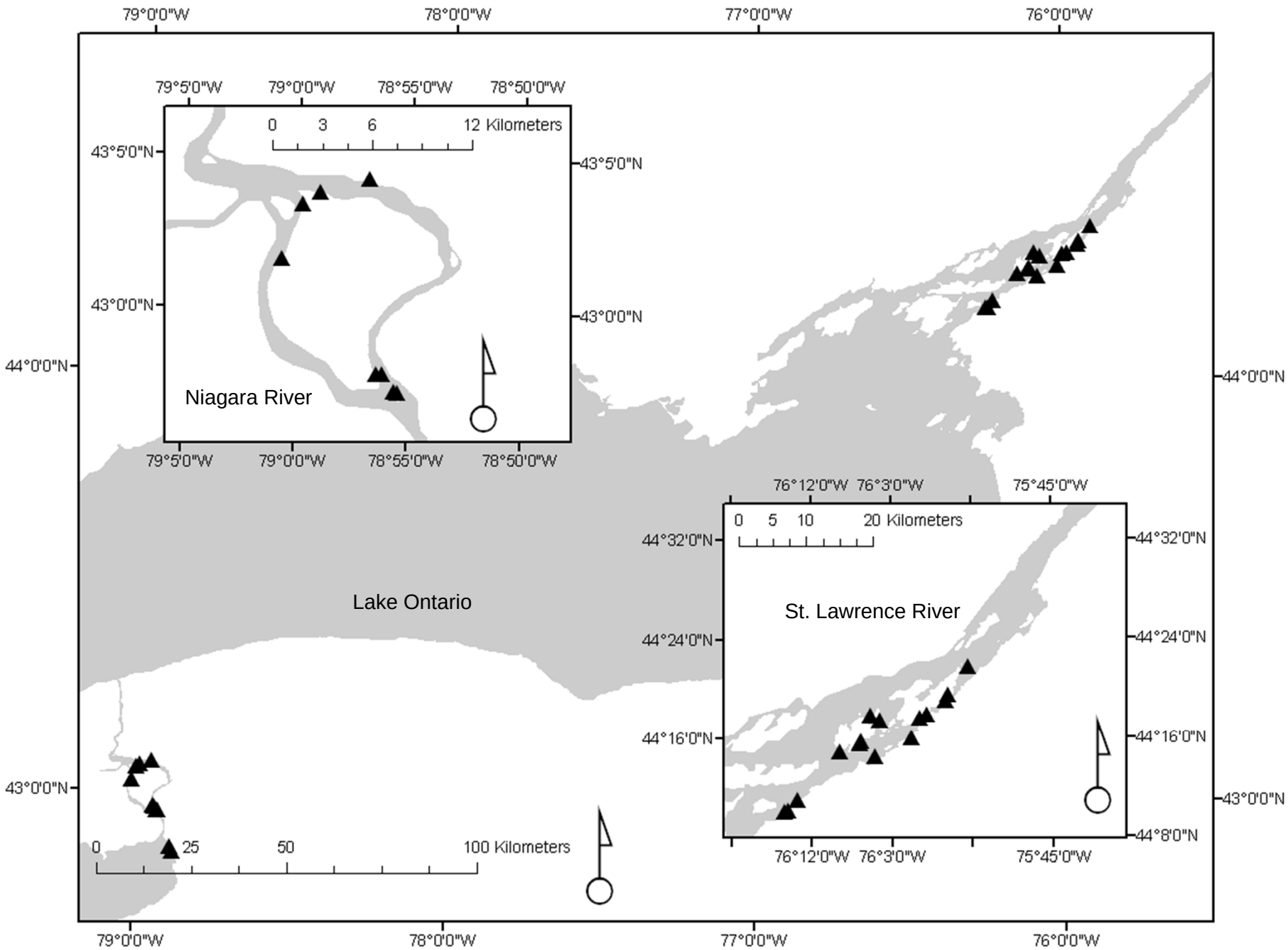


# Diets of Young-of-year Muskellunge: Conclusions

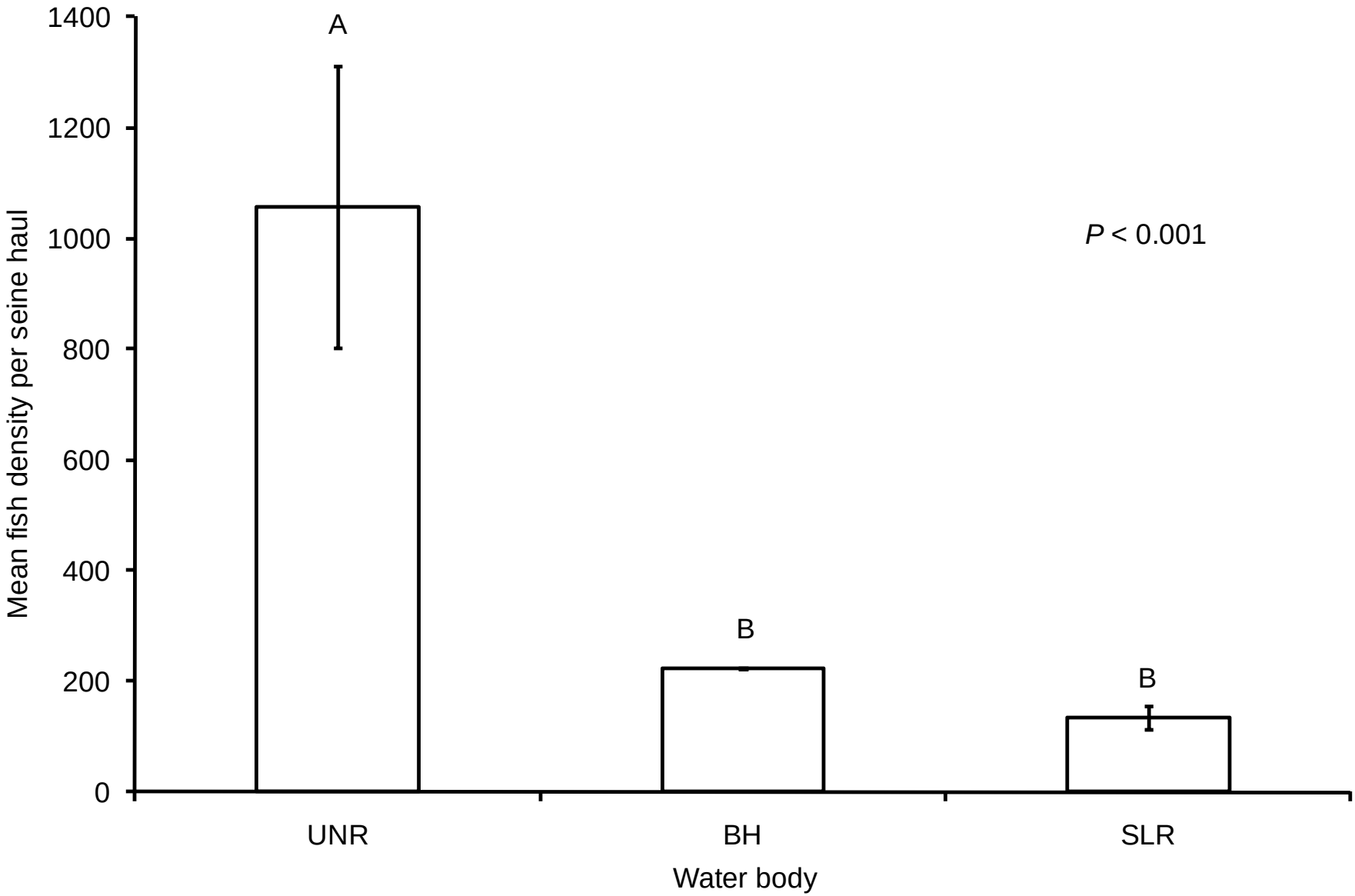
- Specialized feeding strategy
- Banded killifish, cyprinids, and darters most important prey

# Habitat Factors Influencing Nearshore Fish Assemblages

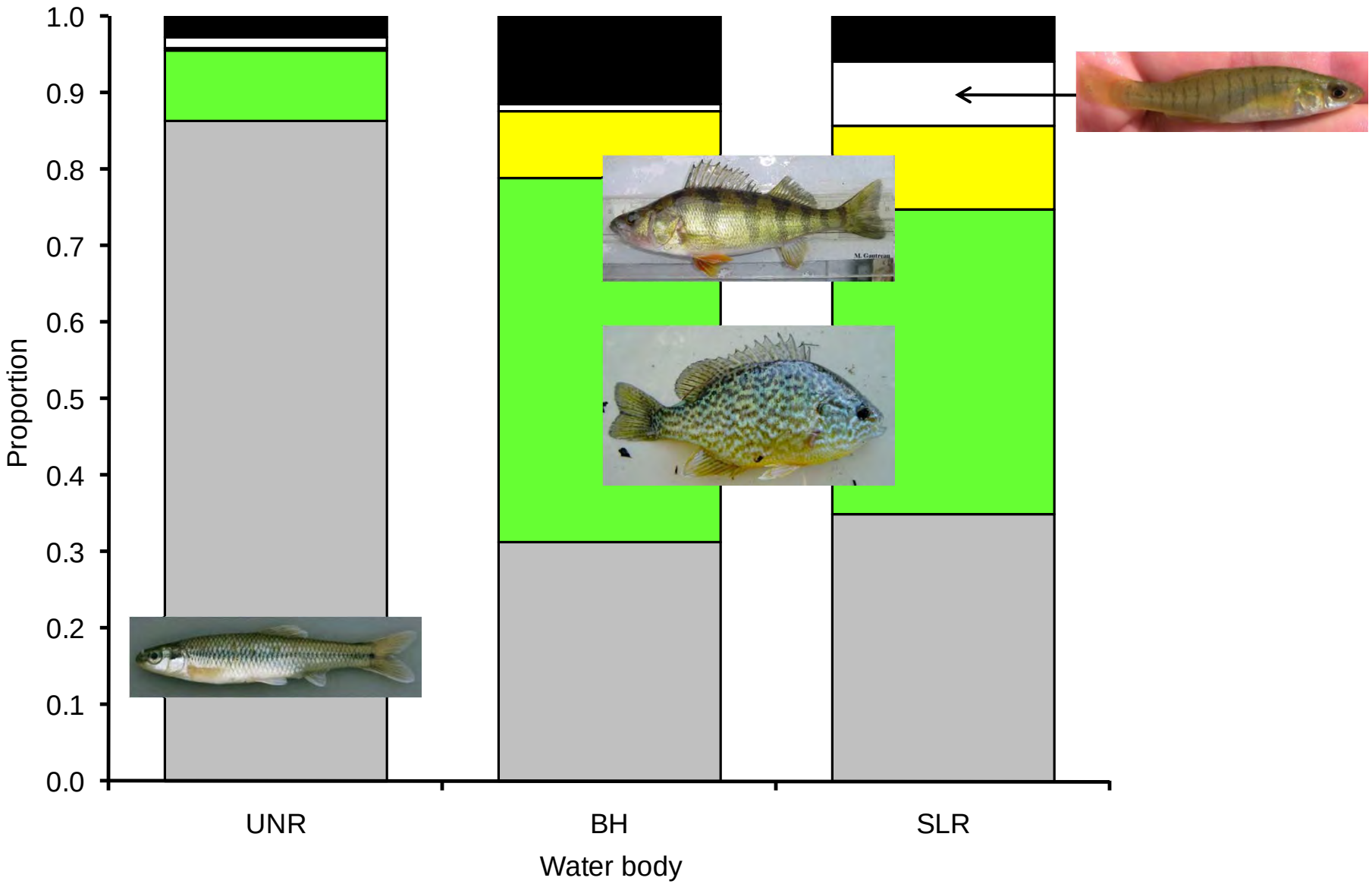
- How do fish assemblages differ among water bodies and sites?
- Are fish assemblage differences related to habitat?

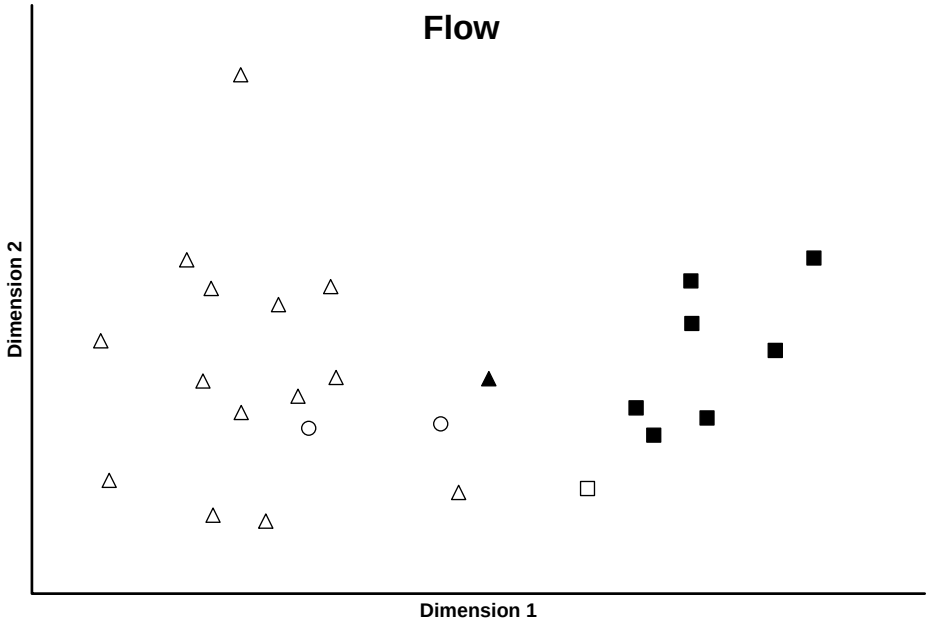

79°0'0"W
78°0'0"W
77°0'0"W
76°0'0"W
44°0'0"N
43°0'0"N
Lake Ontario
0 25 50 100 Kilometers
79°5'0"W
79°0'0"W
78°55'0"W
78°50'0"W
43°5'0"N
43°0'0"N
0 3 6 12 Kilometers
Niagara River
76°12'0"W
76°3'0"W
75°45'0"W
44°32'0"N
44°24'0"N
44°16'0"N
44°8'0"N
0 5 10 20 Kilometers
St. Lawrence River

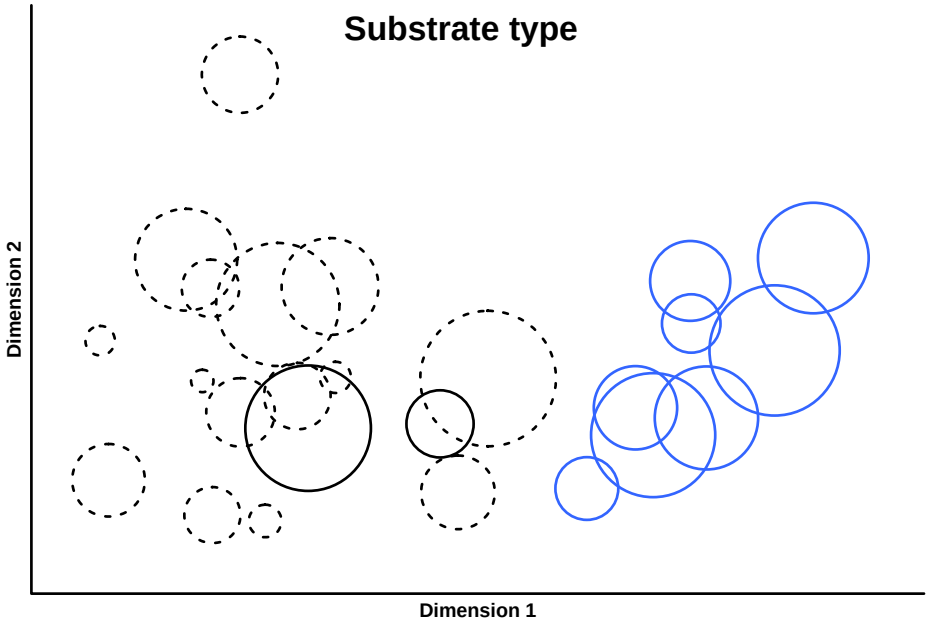
# Differences in Fish Density Among Water Bodies

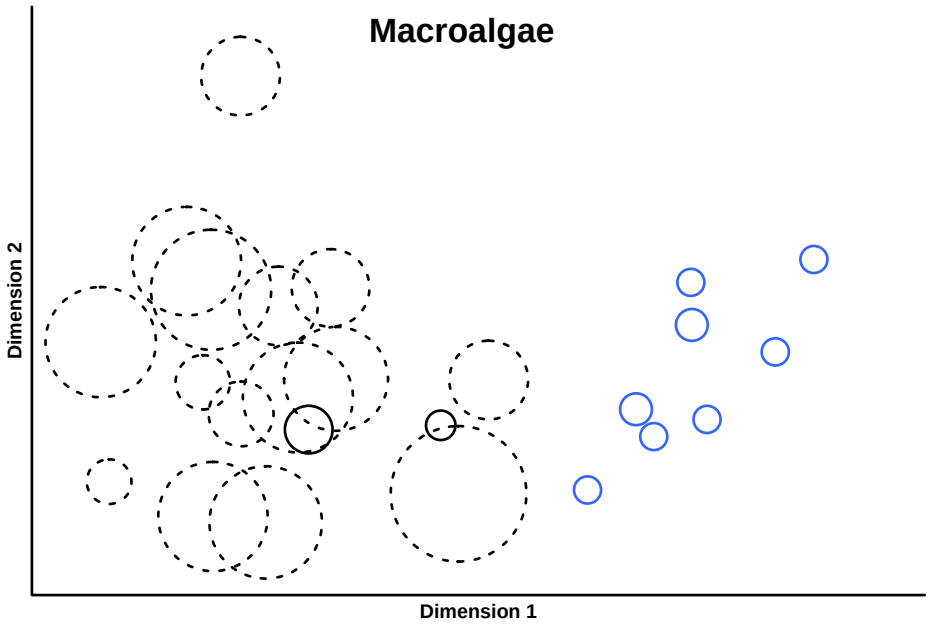


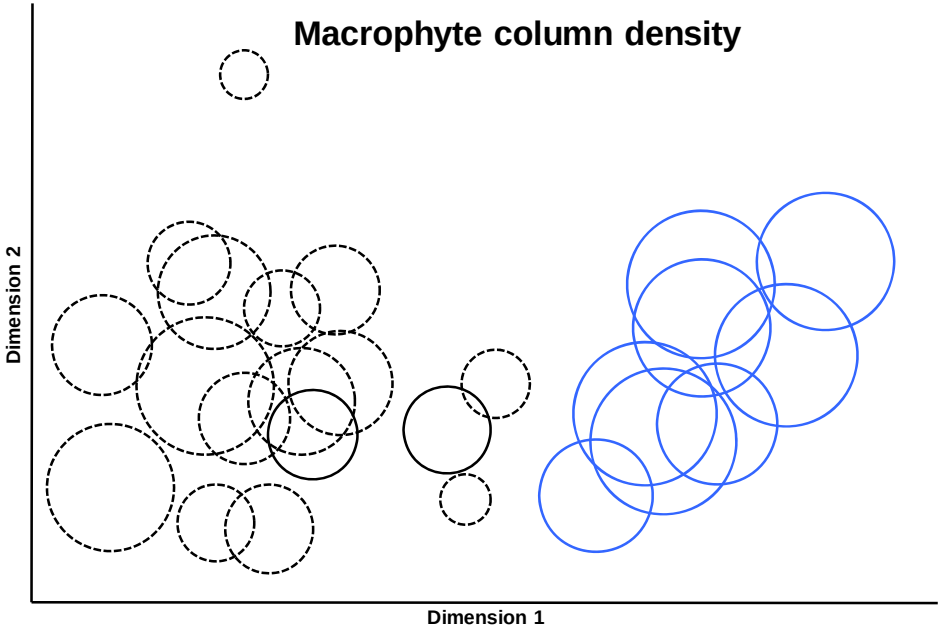
# Differences in Fish Assemblage Structure



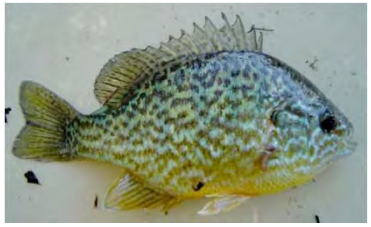

Flow
Dimension 2
Dimension 1


Substrate type
Dimension 2
Dimension 1


Macroalgae
Dimension 2
Dimension 1


Macrophyte column density
Dimension 2
Dimension 1

# Habitat Factors Influencing Nearshore Fish Assemblages: Conclusions

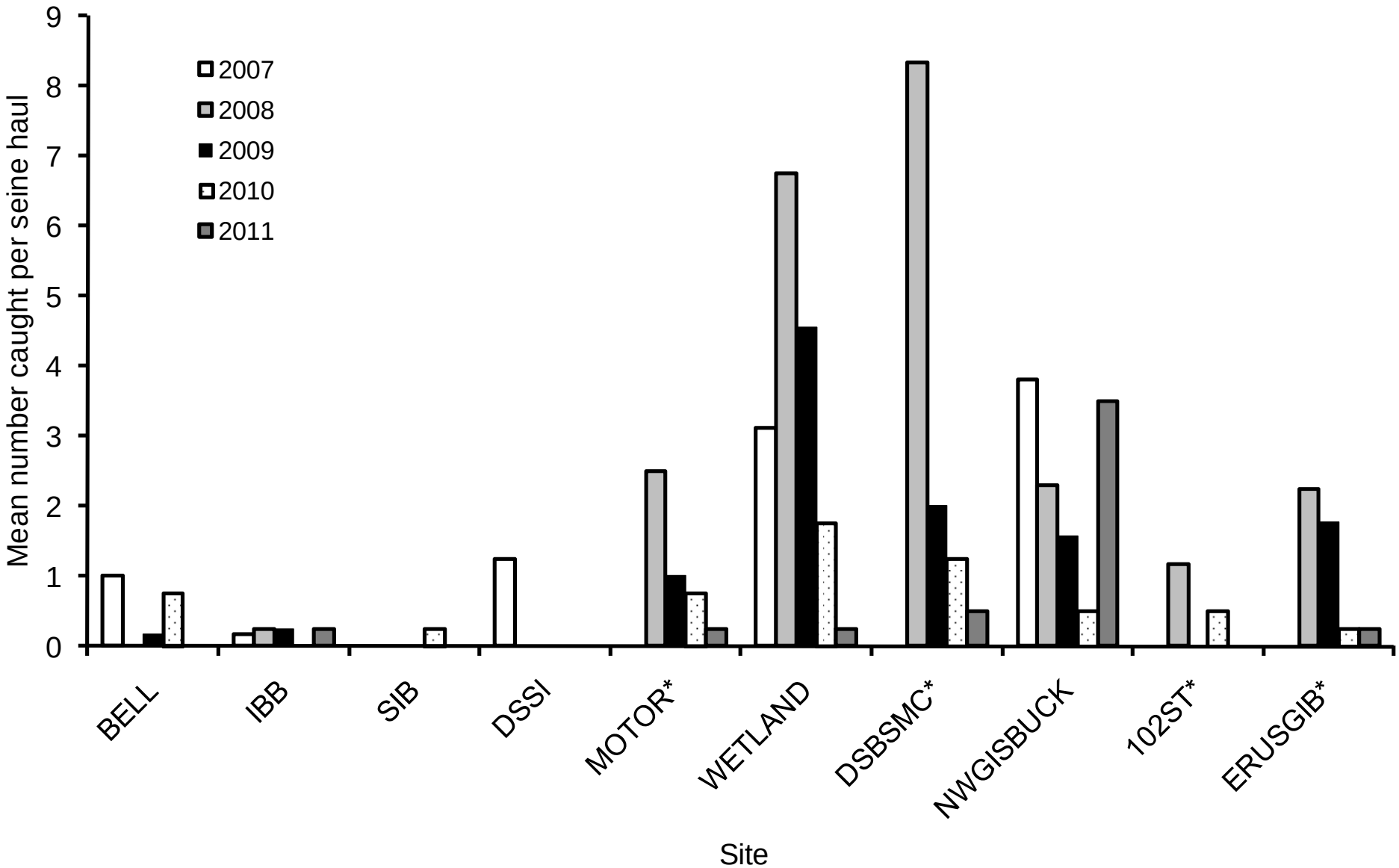


vs.

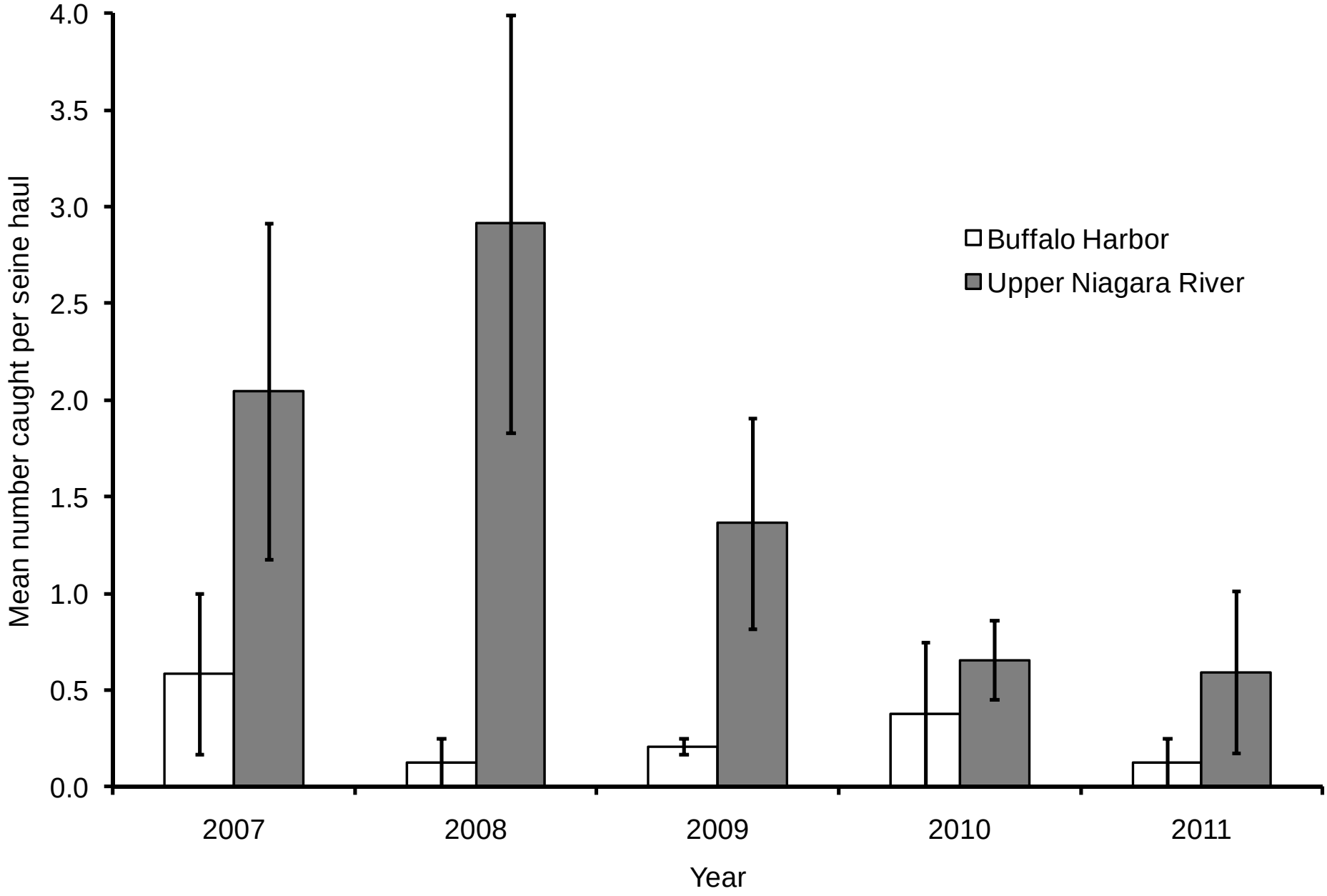
- No flow
- Fine substrates
- Dense macroalgae
- Less vegetation

- Flow
- Coarse substrates
- Little macroalgae
- Dense vegetation

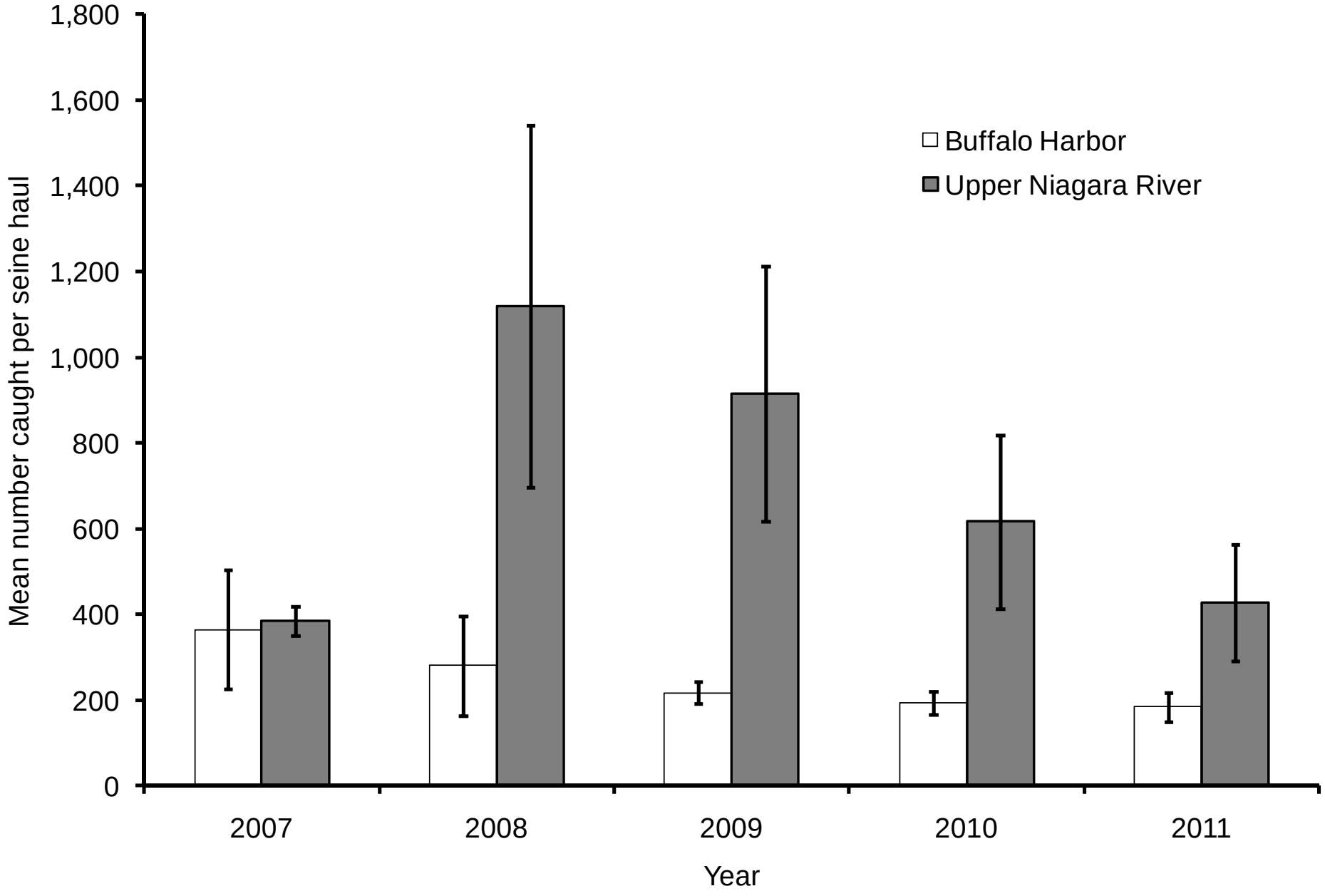
# Young-of-the-year muskellunge



# Young-of-the-year muskellunge



# All fish


1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Mean number caught per seine haul
Buffalo Harbor
Upper Niagara River
2007
2008
2009
2010
2011
Year

# Management Implications

- Think small!
  - Incorporate surveys of prey fish assemblages into muskellunge management plans
  - Banded killifish, minnows, and darters prefer clean substrates & dense aquatic vegetation (silt intolerant)
- Focus on habitat protection and restoration
  - Buffalo Harbor = greatest need

# Is the Rudd a Threat to Habitat & Fish?

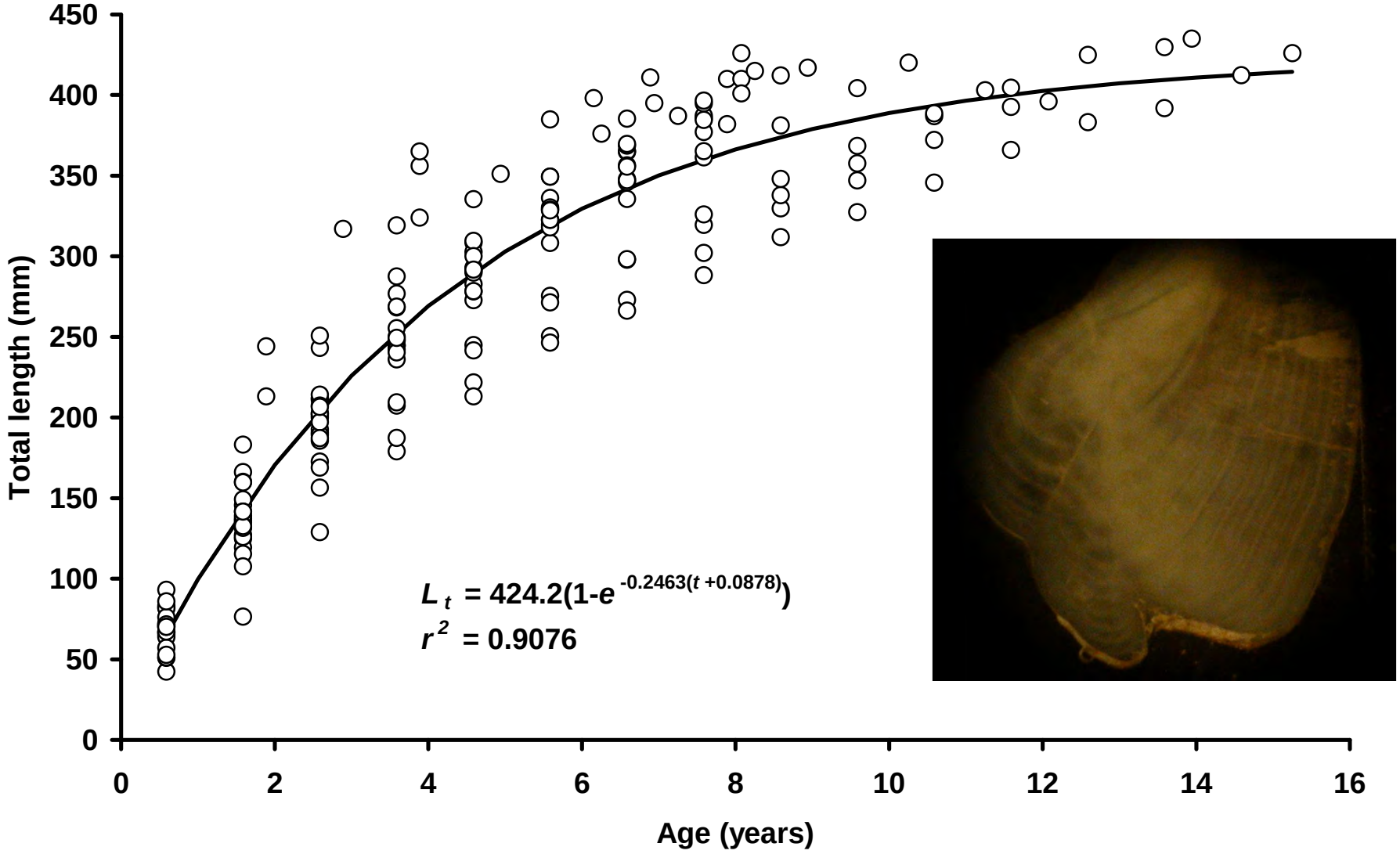
- 38% of 2007 trap-net catch
  - 2,066 of 5,455 fish (Rock bass = 999)
- 56% of 2008 trap-net catch
  - 4,821 of 8,676 fish (Brown bullhead = 1,260)

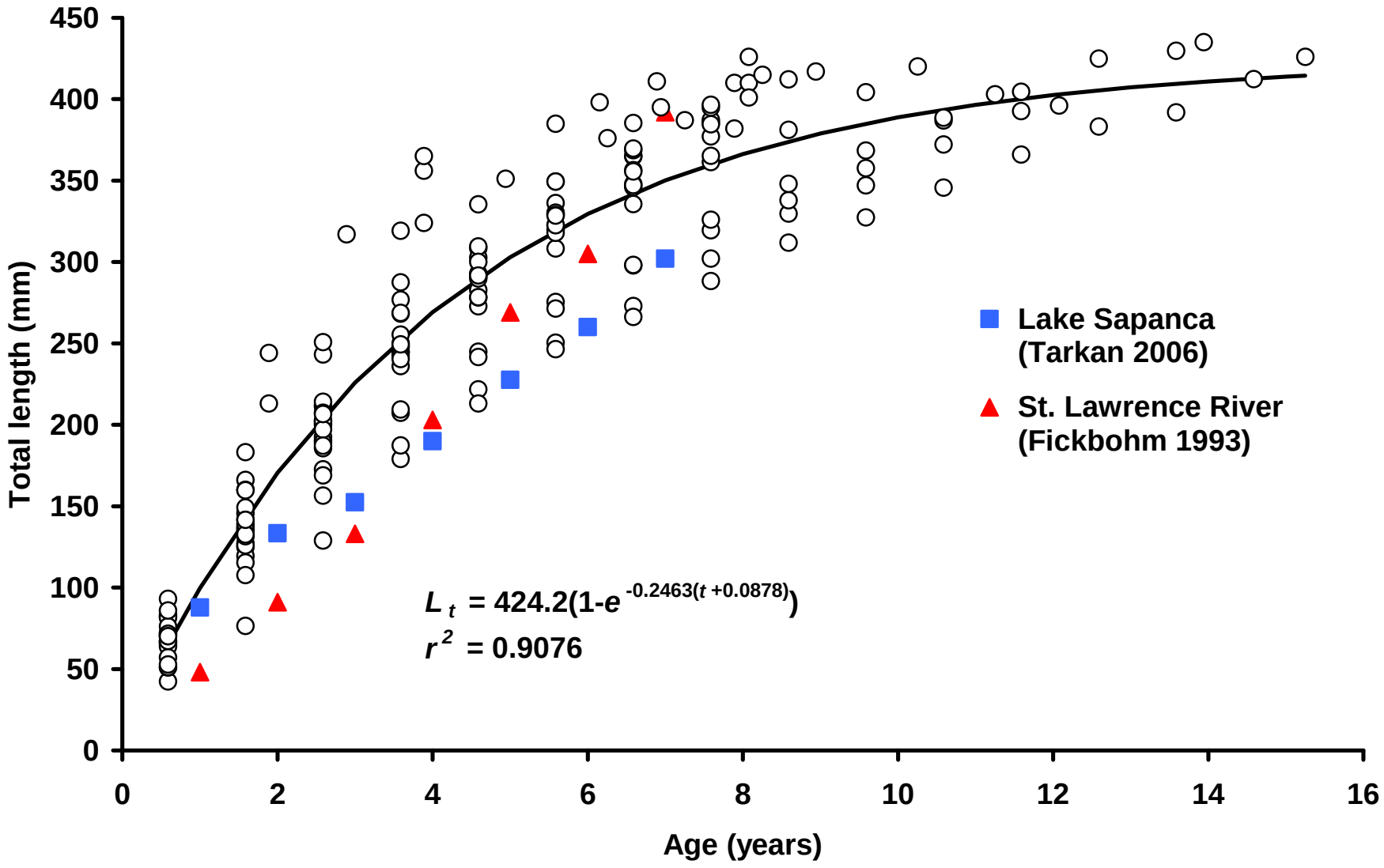
# Rudd Native Range and Introductions

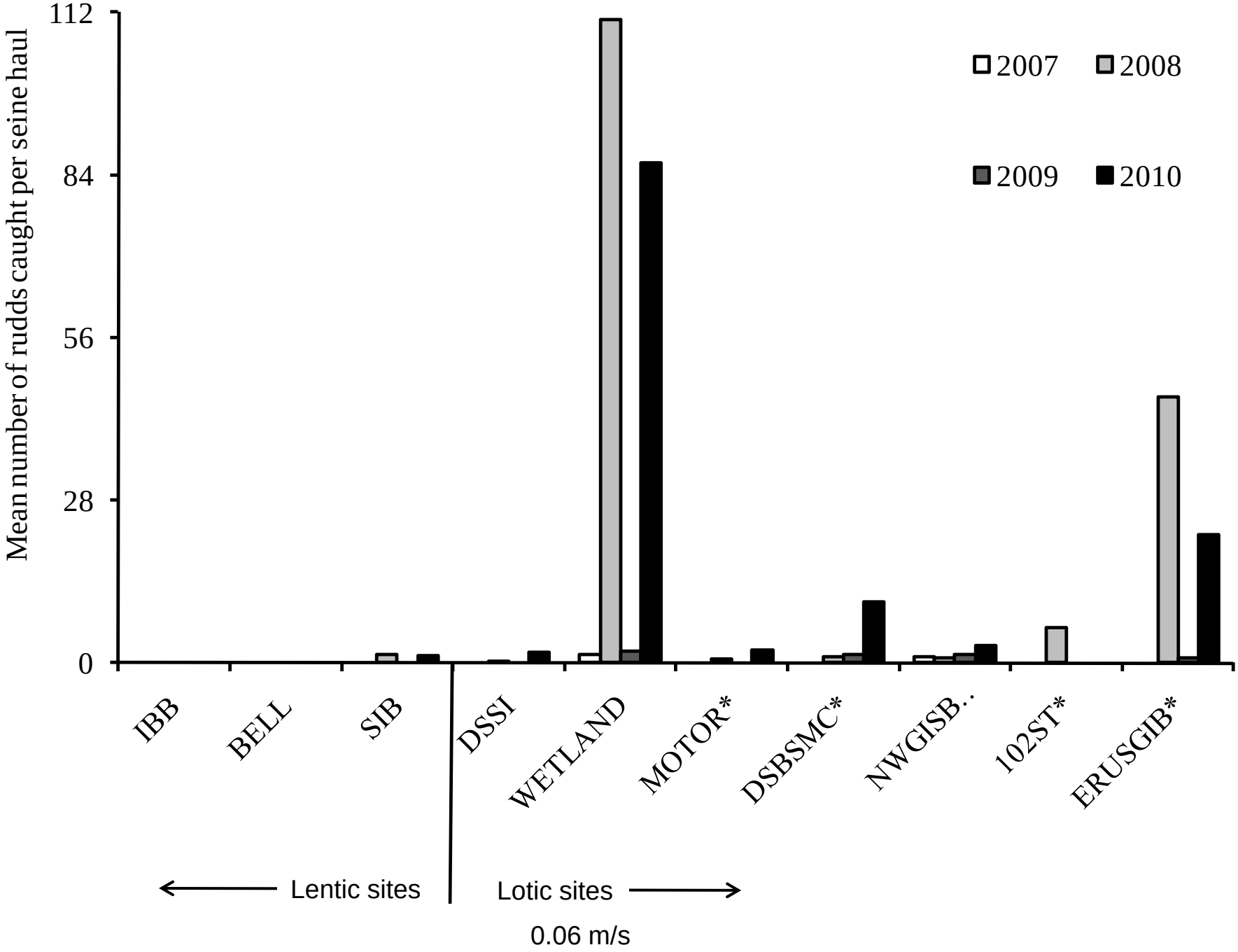
- Native to Europe (Sweden-Italy) & western Asia

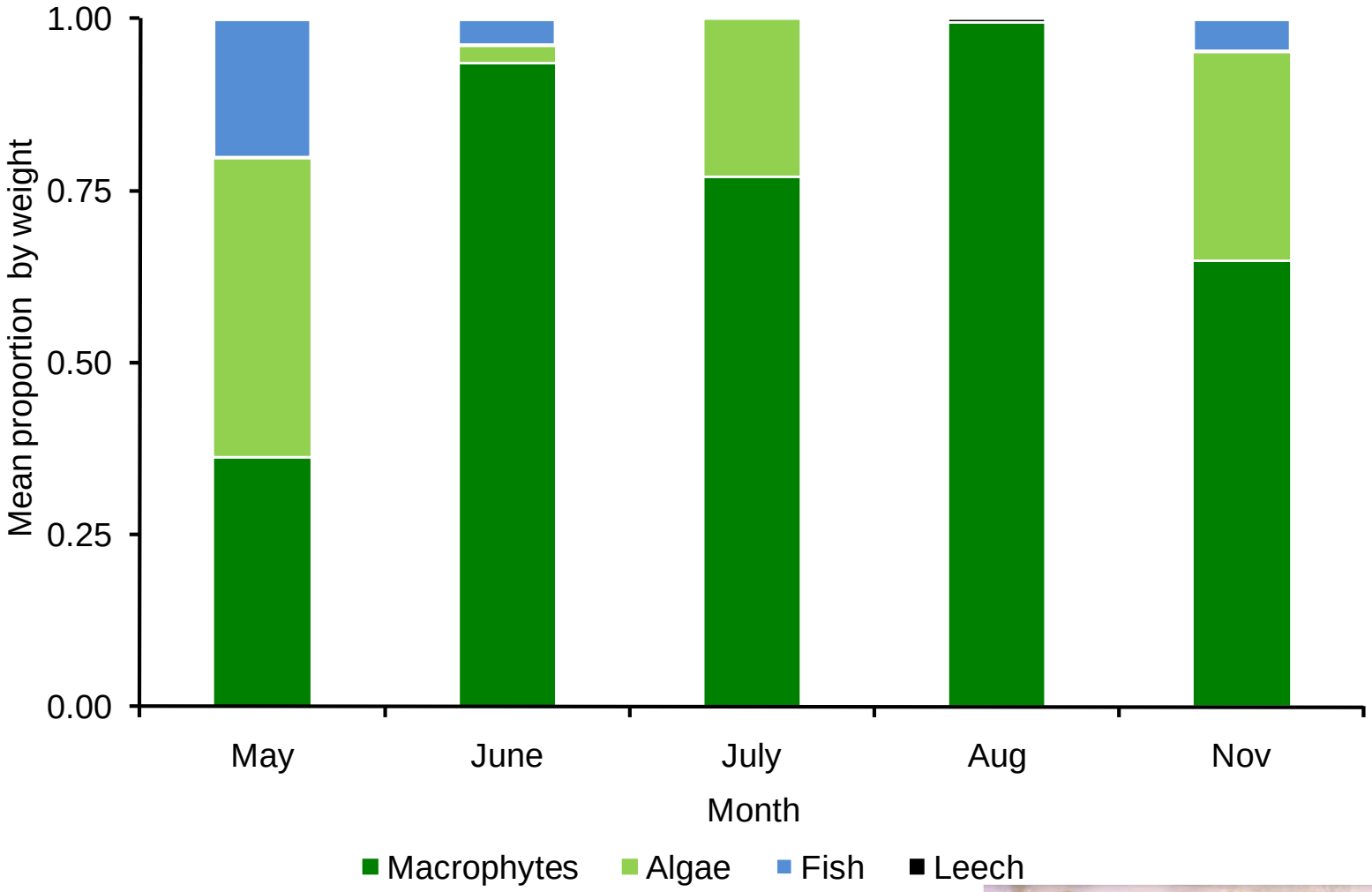
# Rudd Population Structure & Diet

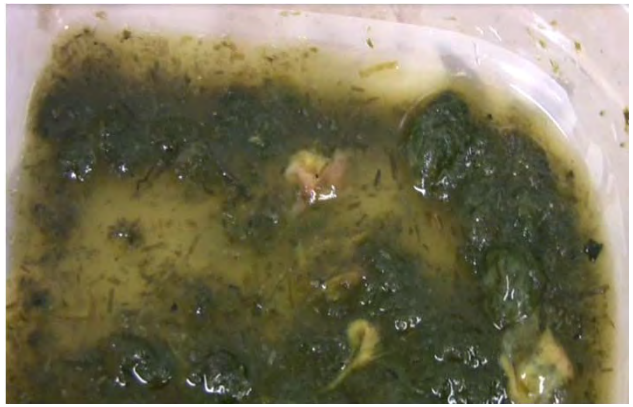
- How long are they living & how fast are they growing?
- Where are they reproducing?
- What are they eating?


Total length (mm)
Age (years)
0
50
100
150
200
250
300
350
400
450
0
2
4
6
8
10
12
14
16
$L_t = 424.2(1-e^{-0.2463(t+0.0878)})$
$r^2 = 0.9076$


Total length (mm)
Age (years)
0
50
100
150
200
250
300
350
400
450
0
2
4
6
8
10
12
14
16
Lake Sapanca
(Tarkan 2006)
St. Lawrence River
(Fickbohm 1993)
$L_t = 424.2(1-e^{-0.2463(t+0.0878)})$
$r^2 = 0.9076$


Mean number of rudds caught per seine haul
112
84
56
28
0
2007
2008
2009
2010
IBB
BELL
SIB
DSSI
WETLAND
MOTOR*
DSBSMC*
NWGISB..
102ST*
ERUSGIB*
Lentic sites
Lotic sites
0.06 m/s


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



# Rudd: Conclusions

- Growth & condition indicate room for population expansion
- Paradigm of optimal rudd habitat needs to include lotic waters
- Rudd diet dominated by macrophytes – what does this mean for native species in the Great Lakes?

# Future directions

- Continue studying habitat-fish assemblage relations in BH / NR / SLR
- Determine influence of rudd herbivory on nearshore habitat and fish assemblages
  - Selection
  - Consumption rates
  - Excretion rates

# Deliverables

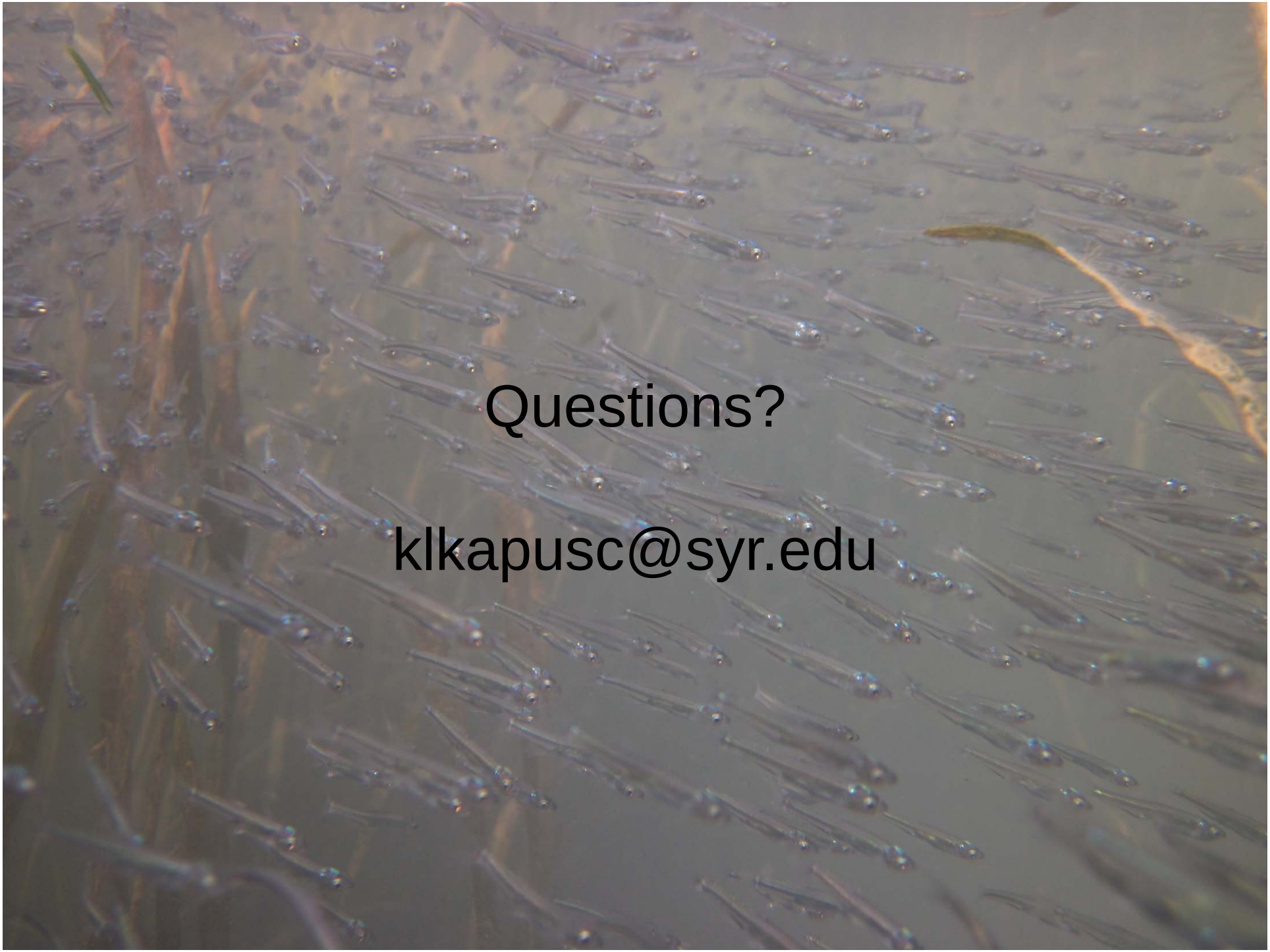
- Dissertation
  - Kapuscinski, K. L. 2011. Comparative Ecology of Muskellunge and Nearshore Fish Assemblages in the Great Lakes. Ph.D. dissertation, College of Environmental Science and Forestry, State University of New York
- DEC reports
  - Kapuscinski, K. L., Wilkinson, M. A., and J. M. Farrell. 2010. Sampling for muskellunge, rudd, and the nearshore fish community of the Buffalo Harbor (Lake Erie) and the upper Niagara River, 2009. Section Q *in* D. Einhouse, editor. NYSDEC Lake Erie 2009 annual report. New York State Department of Environmental Conservation, Albany
  - Kapuscinski, K. L., Wilkinson, M. A., and J. M. Farrell. 2010. Sampling for muskellunge and the nearshore fish community of the lower Niagara River, 2009. Section 19 *in* 2009 Annual Report, Bureau of Fisheries, Lake Ontario Unit and St. Lawrence River Unit to the Great Lake Fishery Commission's Lake Ontario Committee. New York State Department of Environmental Conservation, Albany
  - Kapuscinski, K. L., Wilkinson, M. A., and J. M. Farrell. 2009. Sampling efforts for young-of-year (2006-2008) and adult muskellunge (2008) in the Buffalo Harbor, Lake Erie, and the upper Niagara River. Section R *in* D. Einhouse, editor. NYSDEC Lake Erie 2008 annual report. New York State Department of Environmental Conservation, Albany
  - Kapuscinski, K. L., and M. A. Wilkinson. 2008. Adult muskellunge sampling activities in the Buffalo Harbor and upper Niagara River May and June, 2007. Section U *in* D. Einhouse, editor. NYSDEC Lake Erie Unit 2007 annual report. New York State Department of Environmental Conservation, Albany

# Deliverables

- Articles in scientific journals
  - Kapuscinski, K. L., Farrell, J. M., and M. A. Wilkinson. *In Review*. Feeding ecology and population structure of an invasive cyprinid, the rudd (*Scardinius erythrophthalmus*), in the Buffalo Harbor (Lake Erie) and upper Niagara River. Hydrobiologia
  - Kapuscinski, K. L, Farrell, J. M., and B. A. Murry. *In Review*. Diets of young-of-the-year muskellunge from two large rivers. Transactions of the American Fisheries Society
  - Kapuscinski, K. L., Farrell, J. M., and M. A. Wilkinson. *In Review*. First report of abundant rudd (*Scardinius erythrophthalmus*) populations following 100 years of invasion history in North America. North American Journal of Fisheries Management
  - Kapuscinski, K. L., Sloss, B. L., and J. M. Farrell. Genetic population structure of Great Lakes muskellunge (*Esox masquinongy*)
  - Kapuscinski, K. L., and J. M. Farrell. Habitat factors influencing fish assemblages at nearshore sites of the Buffalo Harbor (Lake Erie), upper Niagara River, and St. Lawrence River: implications for an apex predator
  - Kapuscinski, K. L, and J. M. Farrell. Trends in the muskellunge (*Esox masquinongy*) population and fishery of the Buffalo Harbor (Lake Erie) and upper Niagara River

# Deliverables

- Presentations
  - Kevin L. Kapuscinski, John M. Farrell, and Michael A. Wilkinson. Trends in the muskellunge (*Esox masquinongy*) population and fishery of the Buffalo Harbor (Lake Erie) and upper Niagara River. 54th Annual Conference on Great Lakes Research (2011)
  - Kevin L. Kapuscinski, John M. Farrell, and Michael A. Wilkinson. Feeding ecology and population structure of a non-native cyprinid, the rudd, in the Buffalo Harbor (Lake Erie) and upper Niagara River. 54th Annual Conference on Great Lakes Research (Poster, 2011)
  - Kevin L. Kapuscinski, John M. Farrell, and Michael A. Wilkinson. Feeding ecology and population structure of a non-native cyprinid, the rudd, in the Buffalo Harbor (Lake Erie) and upper Niagara River. New York Chapter of the American Fisheries Society Annual Meeting (2011)
  - Kevin L. Kapuscinski. How habitat influences young-of-year muskellunge and the fishes they prey upon. Invited speaker, Homer Dodge Lecture Series, The Antique Boat Museum (2010)
  - Kevin L. Kapuscinski and John M. Farrell. Feeding ecology of wild-hatched young-of-year muskellunge in lentic and lotic nursery habitats. Invited speaker, EFB 488, Ecology of Adirondack Fishes, Thousand Islands Biological Station (2010)
  - Kevin L. Kapuscinski and John M. Farrell. Description and comparison of fish assemblages at muskellunge nursery sites in the Buffalo Harbor (Lake Erie), upper Niagara River, and St. Lawrence River. 53rd Annual Conference on Great Lakes Research (2010)
  - Kevin L. Kapuscinski and John M. Farrell. A comparison of diets of young-of-year muskellunge from the St. Lawrence and upper Niagara Rivers. New York Chapter of the American Fisheries Society Annual Meeting (2010)



Questions?

klkapusc@syr.edu