Update of HERF & GESC Funded Research

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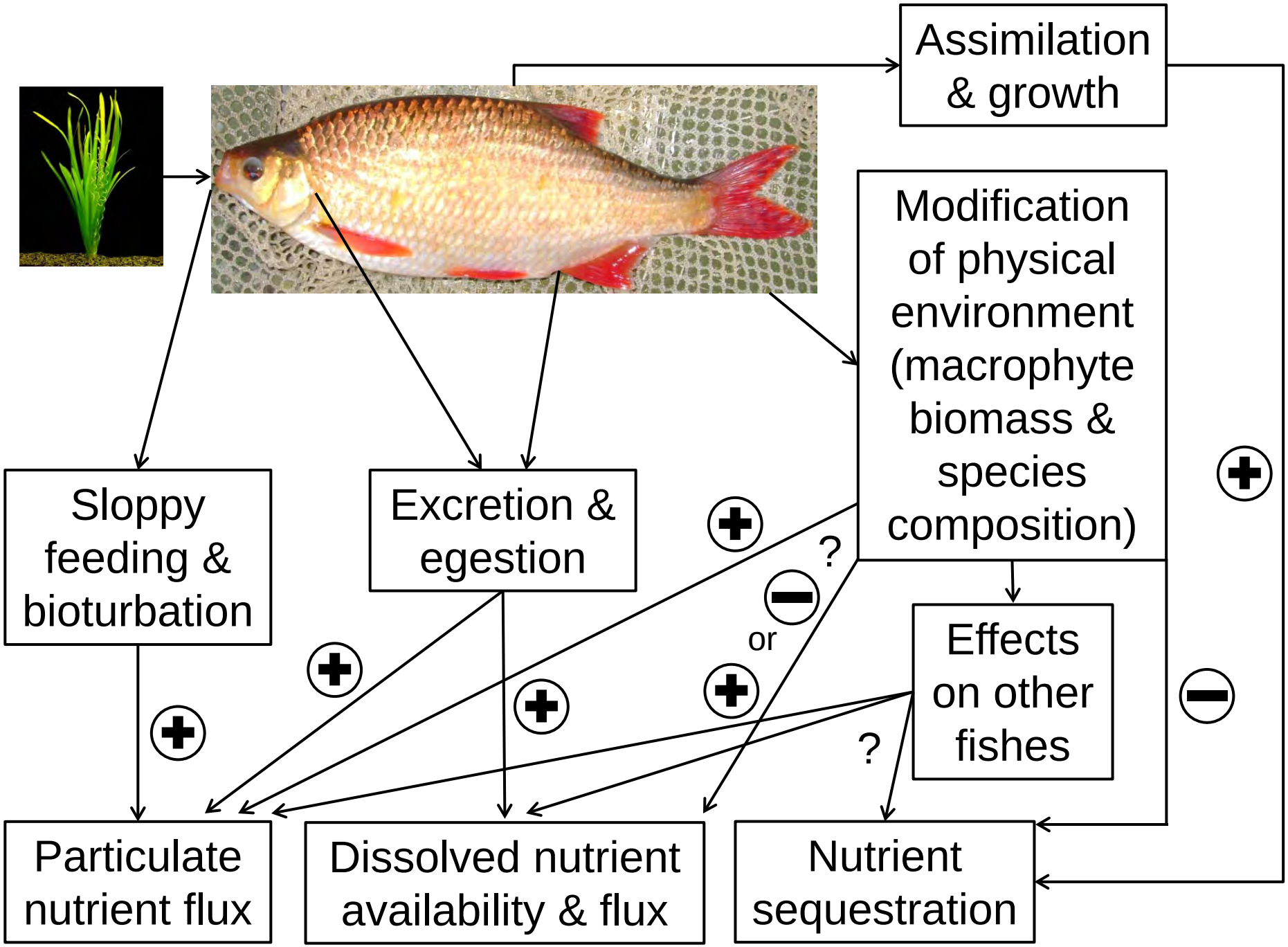
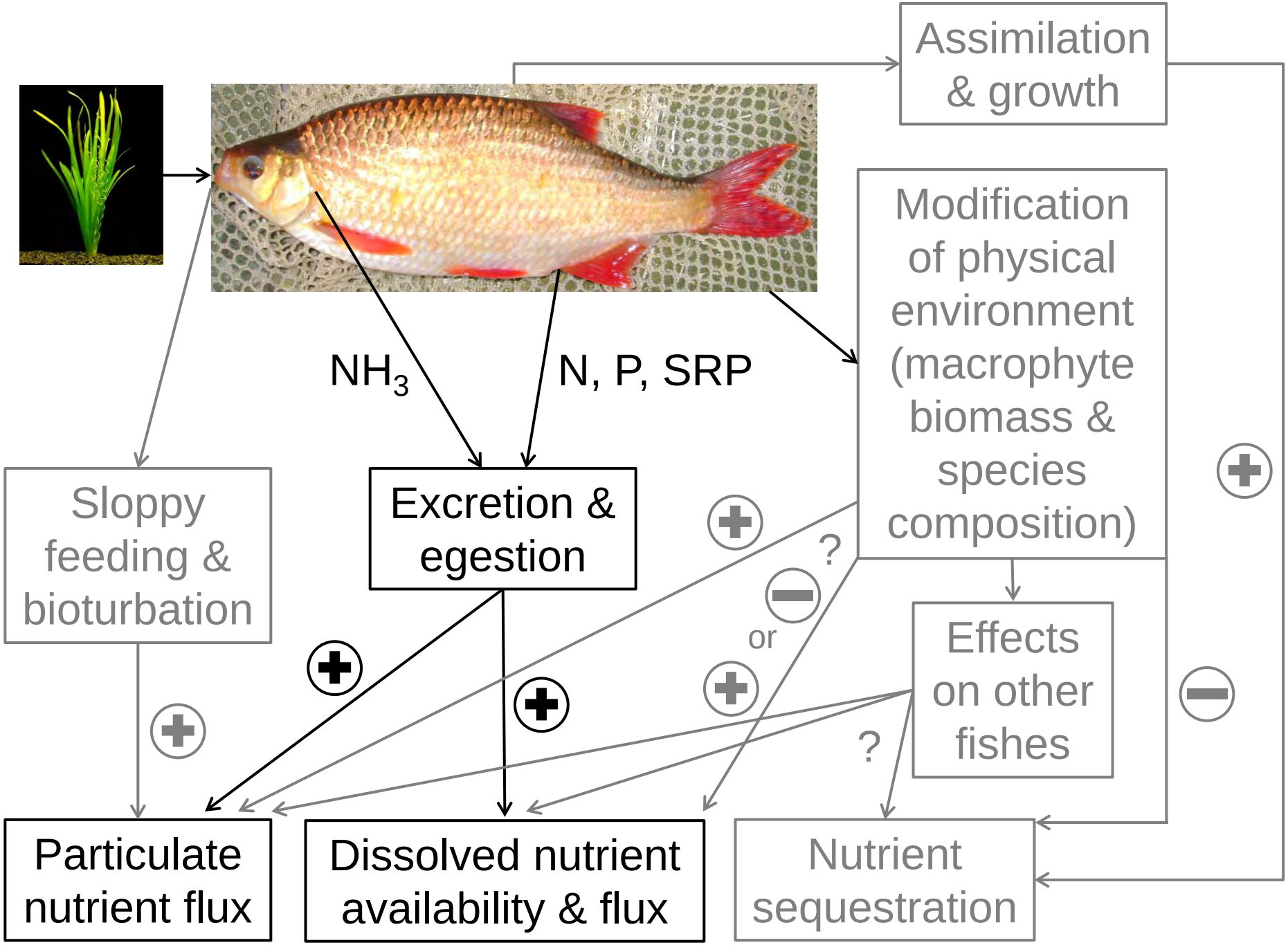
State University of New York

College of Environmental Science and Forestry

Core projects

- Determining the effects of rudd on ecosystem structure & function
- Quantifying relationships between aquatic vegetation & environmental variables
- Index seining at muskellunge nursery sites
- Predicting occurrence of fish species from habitat variables


Assimilation & growth
Modification of physical environment (macrophyte biomass & species composition)
Sloppy feeding & bioturbation
Excretion & egestion
Effects on other fishes
Particulate nutrient flux
Dissolved nutrient availability & flux
Nutrient sequestration
?
or
?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N, P, SRP
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Can rudd excreta negatively affect water quality?

NH_3

N, P, SRP

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- Quantity can affect plankton biomass

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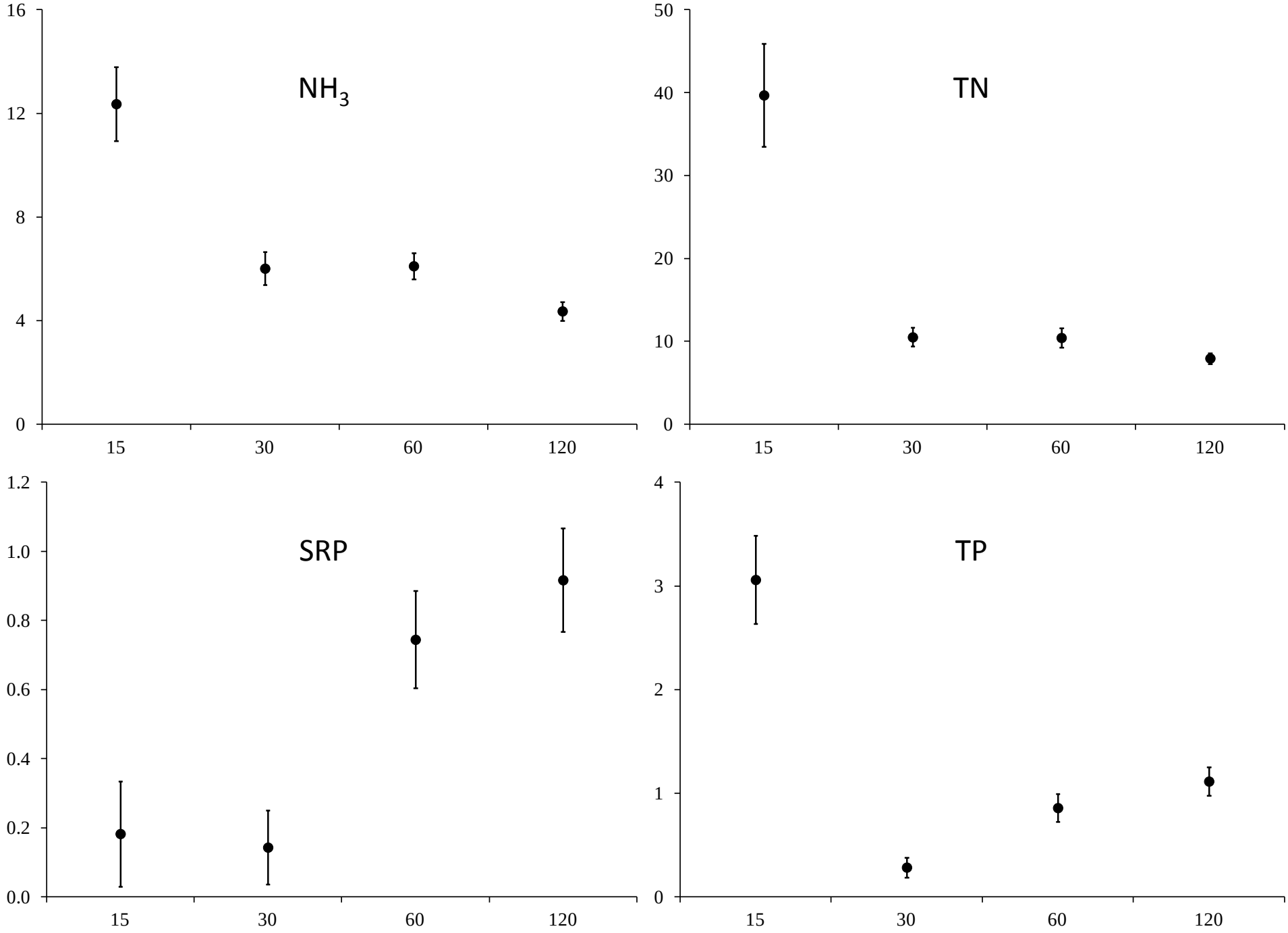
NH_3

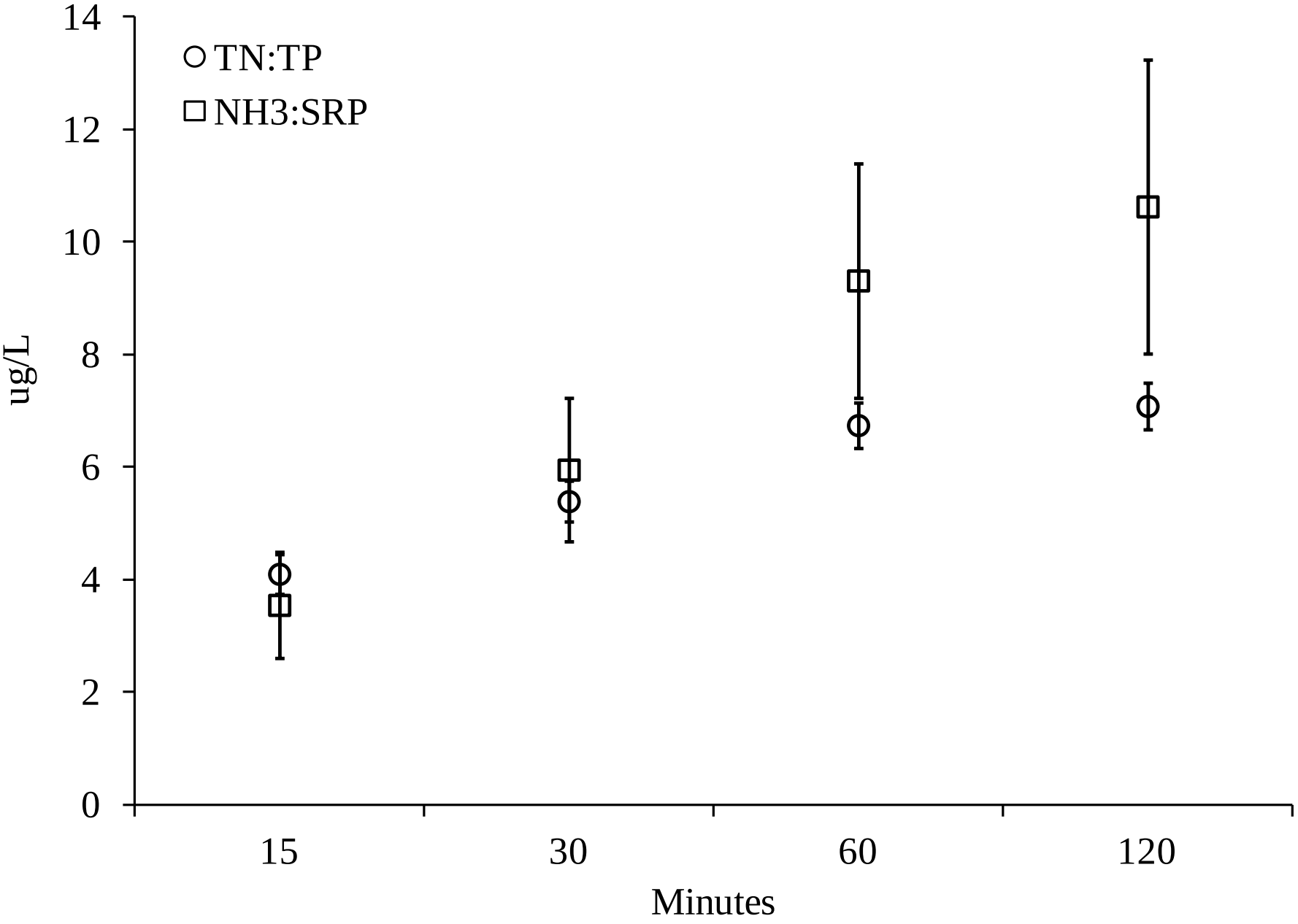
N, P, SRP

- Quantity can affect plankton biomass
- Quality (N:P) can affect plankton species composition

Excretion experiment - 2012-2013

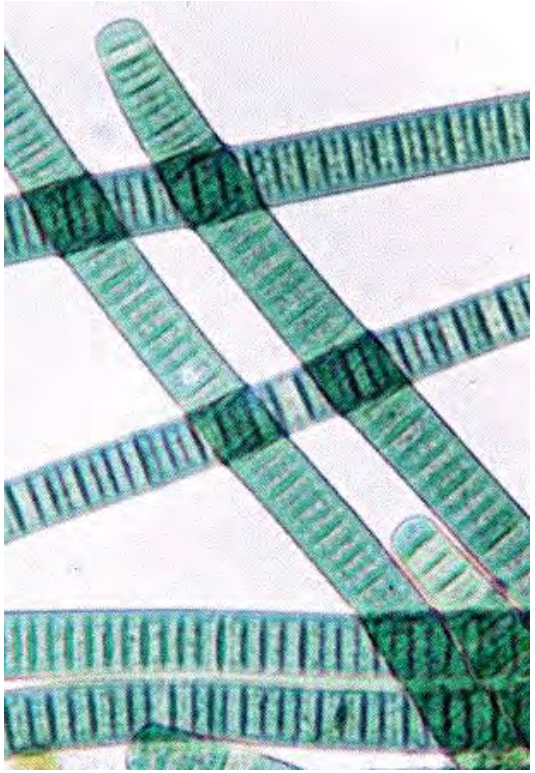
- Quantify excretion rates of NH_3, Total N, SRP, Total P @ 0, 15, 30, 60 & 120 minutes


NH3
16
12
8
4
0
15
30
60
120
TN
50
40
30
20
10
0
15
30
60
120
SRP
1.2
1.0
0.8
0.6
0.4
0.2
0.0
15
30
60
120
TP
4
3
2
1
0
15
30
60
120


14
12
10
8
6
4
2
0
ug/L
TN:TP
NH3:SRP
15
30
60
120
Minutes

Excretion experiment - 2012-2013

- Preliminary results, expect to get data from final round of experiment this month



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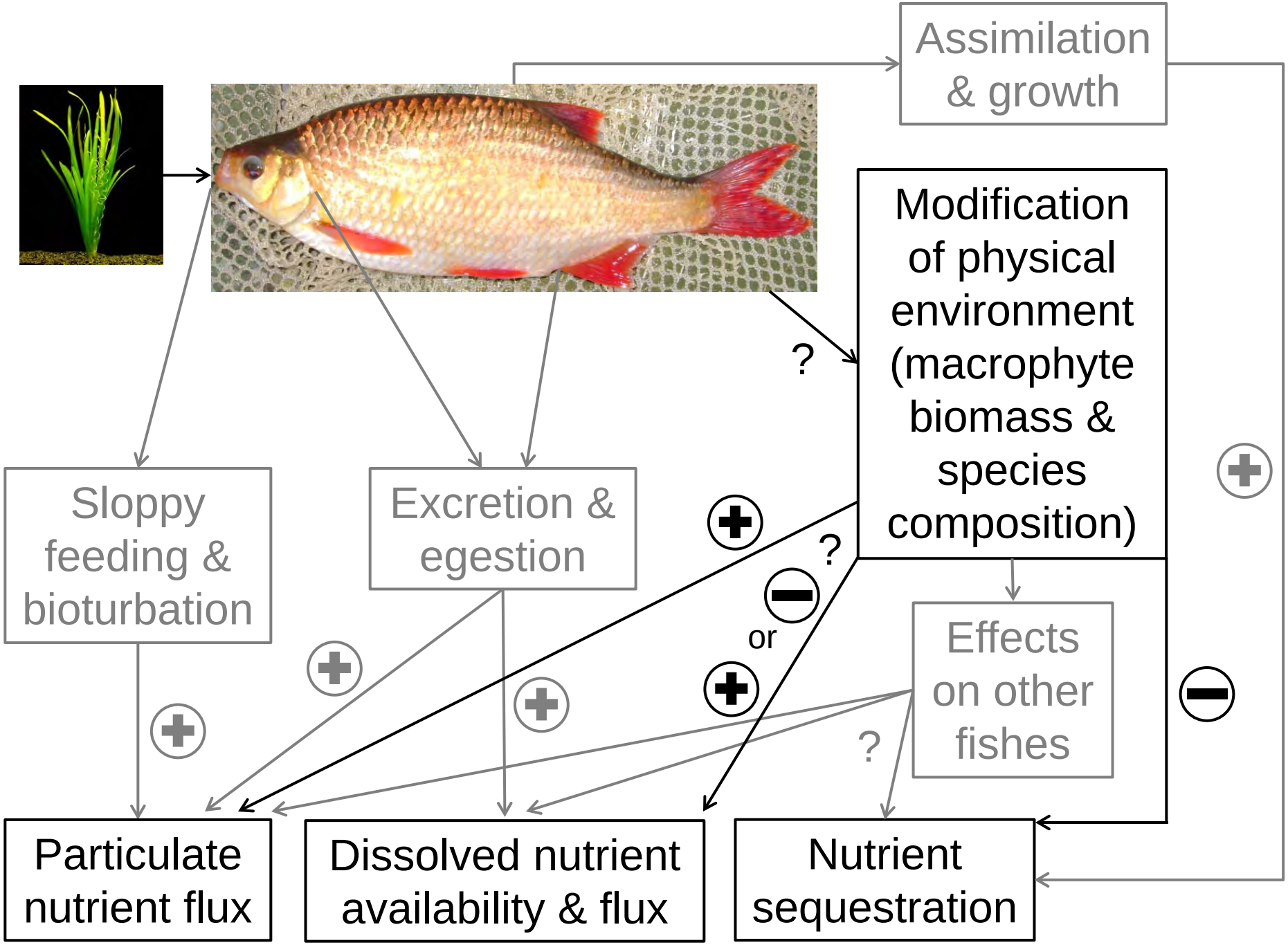
- Need to incorporate data from August, September, & October - expect to get data from final round of experiment this month
- Need to analyze data & determine population-level effects based on rudd abundance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Important for understanding if rudd:

- alter macrophyte assemblages
- pose a threat to restoration projects
- contribute to “invasional meltdown” or “invasional antagonism”?

Selection experiment - 2011

- Quantify selective feeding by rudd among macrophyte species
  - H_0: rudd do not feed selectively among the following species: *Ceratophyllum demersum*, *Vallisneria americana*, *Elodea canadensis*, *Stuckenia pectinata*, and *Najas flexilis*

Selection experiment - 2011

- Quantify selective feeding by rudd among macrophyte species
- Quantify differences among chemical attributes of macrophyte species & assess relation to selective feeding by rudd
  - Dry matter content
  - C, N, C:N, protein
  - Phenolic compounds

Selection experiment methods

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- 4 rudd (mean TL = 283 mm, range 221-231 mm) placed into 15 tanks
- Macrophytes collected from the Niagara River
- One bundle of each macrophyte species blotted dry, weighed, and introduced to each tank 48 hr after rudd

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Selection experiment methods

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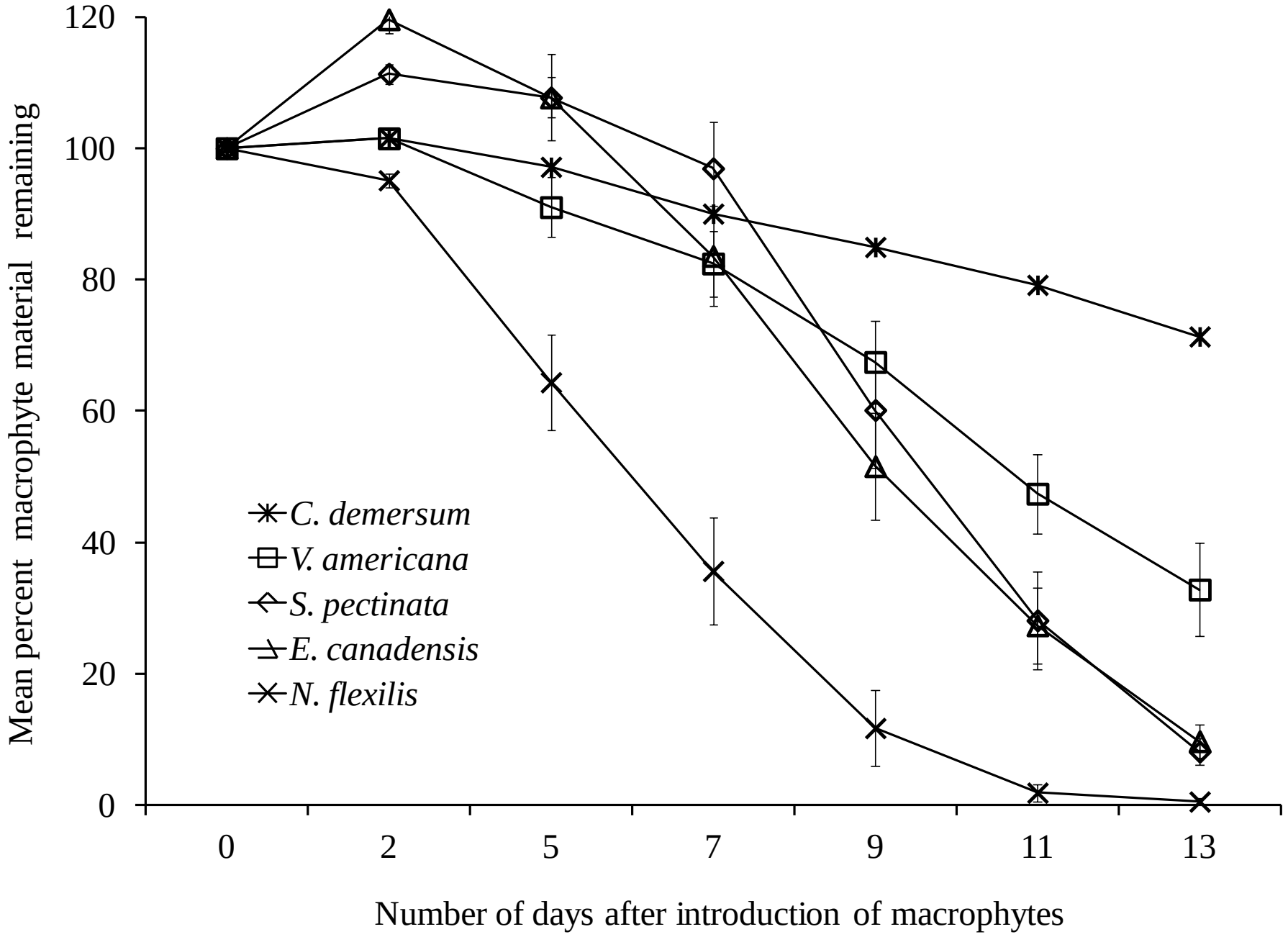
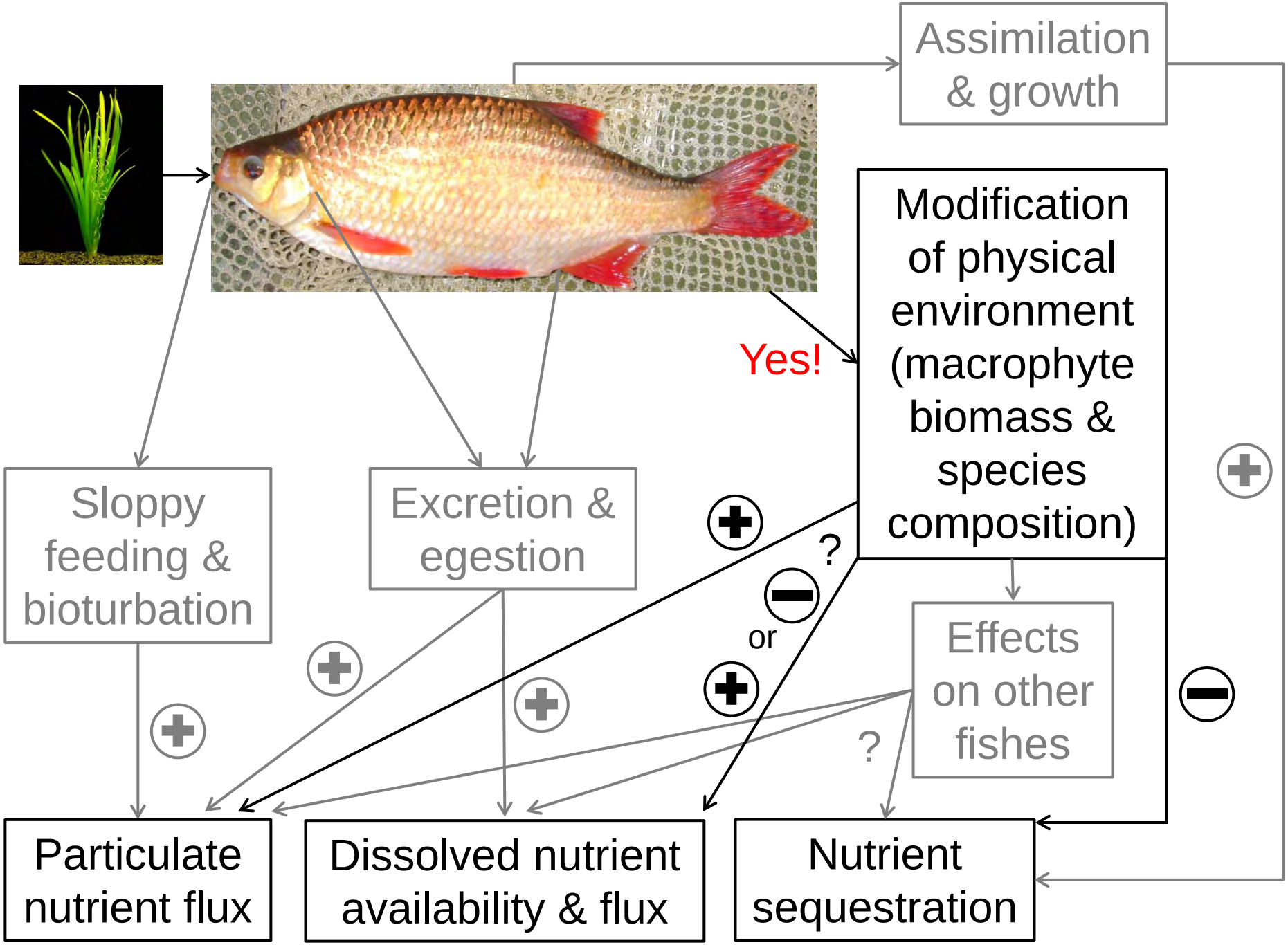
- Repeated measures ANOVA used to test hypothesis that % weight remaining did not differ among macrophyte species


120
100
80
60
40
20
0
Mean percent macrophyte material remaining
0
2
5
7
9
11
13
Number of days after introduction of macrophytes
C. demersum
V. americana
S. pectinata
E. canadensis
N. flexilis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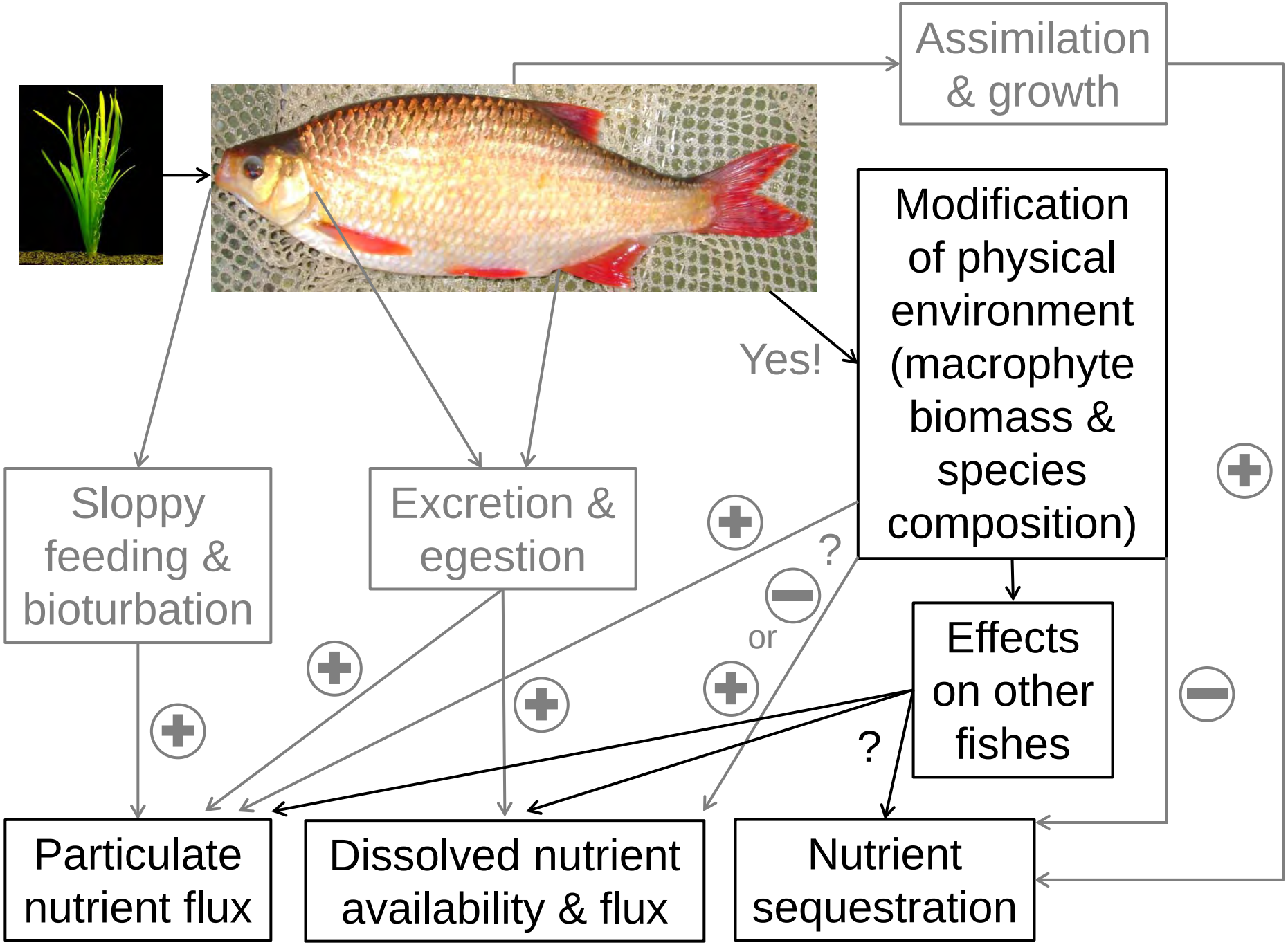
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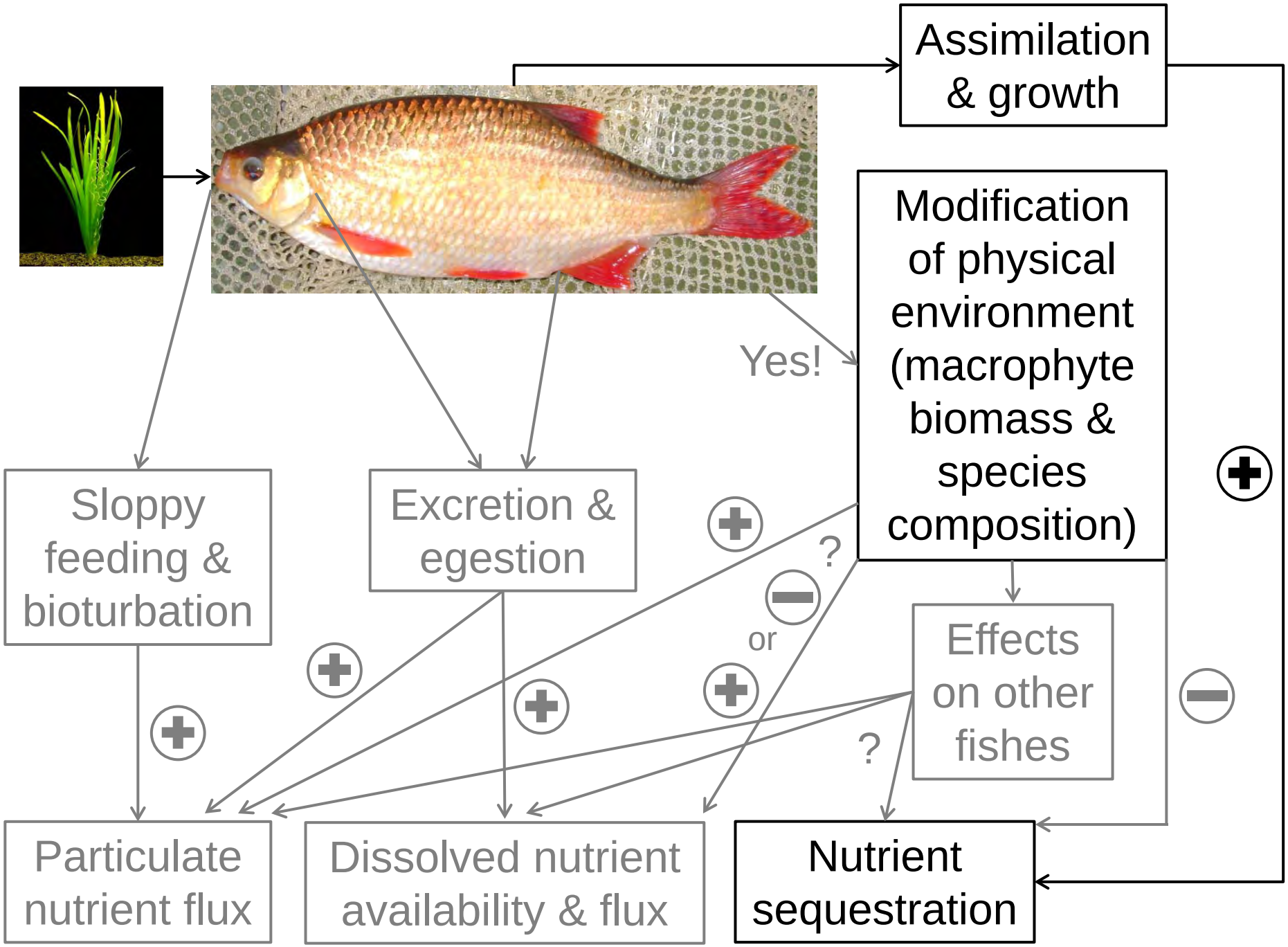
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How many rudd are out there?

Abundance estimation - 2012-2013

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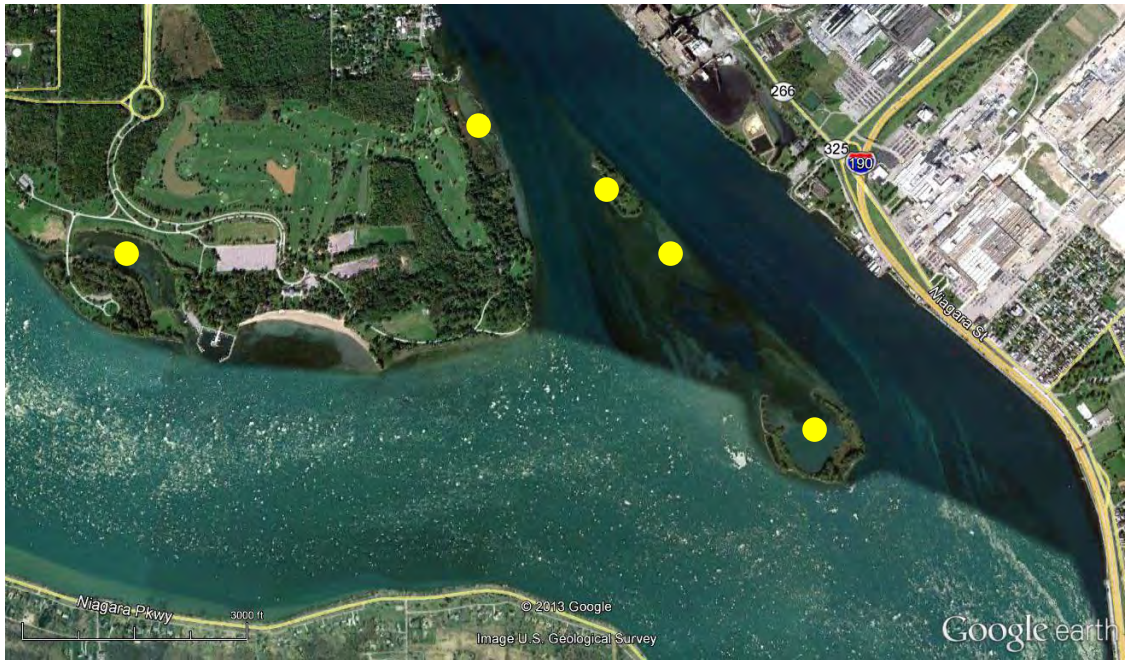
  - Abundance of rudd estimate at 117,403 (95% CI 111,974-123,386)
  - Biomass estimated at 90 mt (95% CI 86-94)

How do rudd affect ecosystem structure & function?

- Rudd feed selectively among macrophytes of Buffalo Harbor & Niagara River, probably alter macrophyte assemblages
  - The Netherlands (van Donk and Gulati 1995; van Donk and Otte 1996)
  - New Zealand (Lake et al. 2002; Hicks 2003)

How do rudd affect ecosystem structure & function?

- Efforts to restore aquatic macrophytes should include multiple species to mitigate herbivory
  - Exclosures needed to allow for establishment of preferred species like *Najas flexilis*?



How do rudd affect ecosystem structure & function?

- Ratio of N:P in excreta of rudd favor cyanobacteria, may alter spp. composition
  - Consistent with studies of zebra mussels (Arnott and Vanni 1996) and gizzard shad (Schaus et al. 1997)

Future directions of rudd research

- Need to wrap up excretion experiment & abundance estimate analysis
- Estimate population-level:
  - Excretion rates of NH_3, TN, SRP, & TP
  - Consumption rates of vegetation based on rudd biomass, annual water temperatures, & literature values of consumption

Aquatic vegetation research

- Quantify relationships between environmental factors & occurrence of aquatic macrophytes in the upper Niagara River
- Quantitatively describe the changing structure & species composition of aquatic macrophytes throughout the growing season

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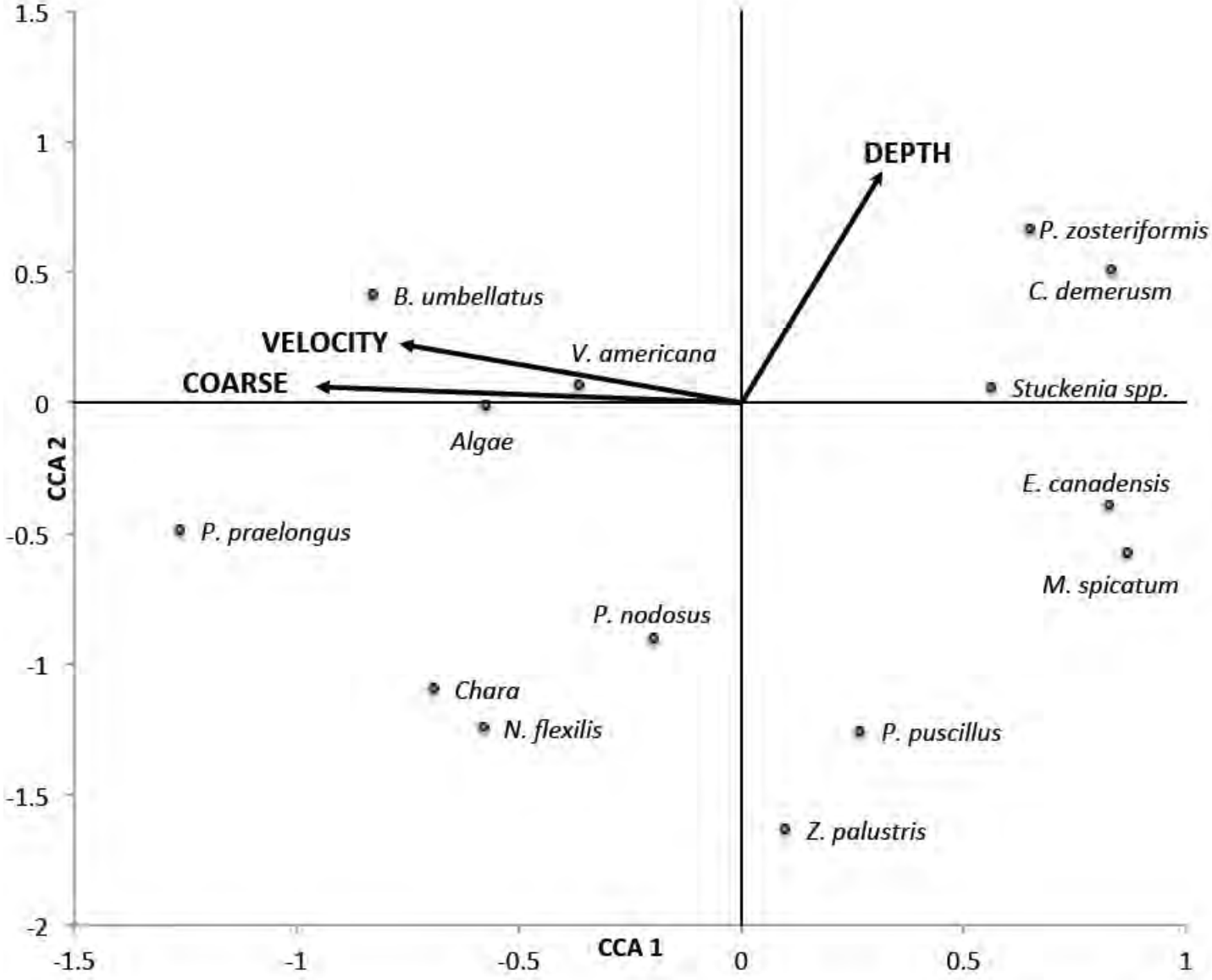
- Substrate sampled for particle size, % organic matter, & nutrients

Relationships between environmental factors & macrophytes

- Macrophytes rooted w/in 25x25 cm grid collected, separated by species, & dried to determine biomass


1.5
1
0.5
0
-0.5
-1
-1.5
-2
CCA 2
-1.5
-1
-0.5
0
0.5
1
CCA 1
DEPTH
VELOCITY
COARSE
P. zosteriformis
C. demerusm
B. umbellatus
V. americana
Stuckenia spp.
Algae
E. canadensis
P. praelongus
M. spicatum
P. nodosus
Chara
N. flexilis
P. puscillus
Z. palustris

Butomus umbellatus rapidly colonized upper Niagara River?

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- Regression model will be developed to predict *B. umbellatus* from habitat characteristics

Seasonal succession of macrophytes

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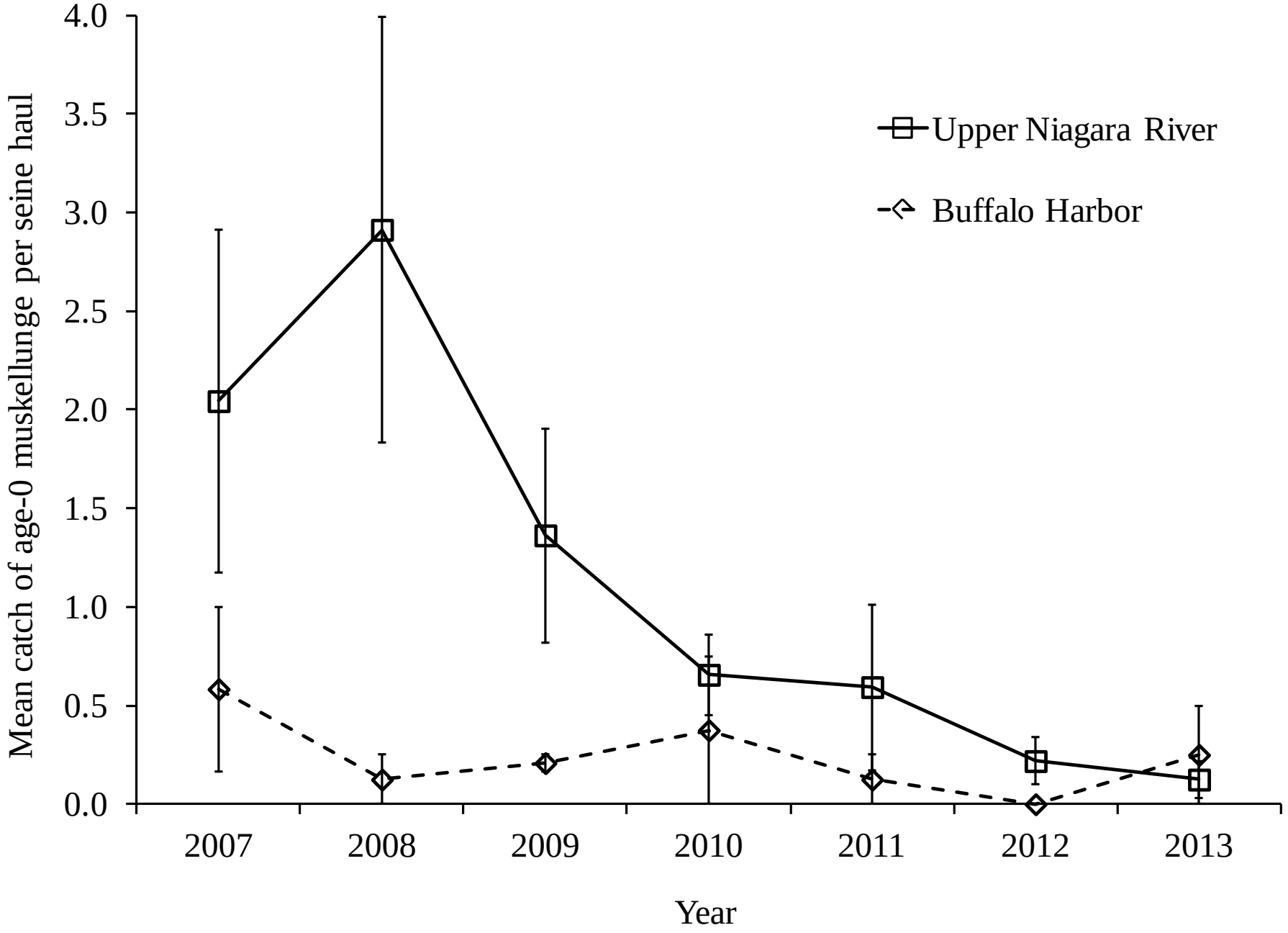
- Data analysis ongoing

Index seining

- Seined 10 index sites during 29-31 July 2013


4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Mean catch of age-0 muskellunge per seine haul
Upper Niagara River
Buffalo Harbor
2007
2008
2009
2010
2011
2012
2013
Year

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- Preserved fish need to be identified

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- Need to compare trends in native & non-native species over time

Predicting occurrence of fish species from habitat variables: objectives

- Describe habitat characteristics associated with productive nearshore areas (water depth < 1.5 m)

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- Develop predictive models of native and non-native species based on habitat characteristics

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  - 2 surveyors to account for variance in visual estimates

Predicting occurrence of fish species from habitat variables: methods

- 15.24 m (50 ft) seine haul conducted at each site, identified & enumerated fish, unknown fish identified in the lab

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- Surveys conducted late July-early September

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- Student volunteer from SUNY-ESF chapter of American Fisheries Society currently entering data

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- Repeat survey at about 120 new randomly selected sites

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- Develop GIS density maps for species of interest
- Begin writing code for predictive model

Acknowledgments

- Steve Stehman (SUNY-ESF), Andrew Panczykowski, Mike Guinan, Justin Zimmerman, Christina Killourhy, Tim Schaufer
- Michael Wilkinson, Paul McKeown, & Tim DePriest (NYSDEC)
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