Effects of salinity and nutrient loading on species presence, growth, and food web position of fish in Oyster Pond and Salt Pond

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Introduction

How do salinity and nutrient loading affect fish populations in Oyster Pond and Salt Pond?


MAPQUEST
Ransom Rd
Cumloden Dr
Elm Rd
Quonset Rd
Salt Pond Rd
Fresh River Ln
Stratford Rd
Mill Rd
Seagull Ln
0
300m
900ft
Salt Pond
Oyster Pond
Sakonet Rd
Fells Rd
Surf Dr
Oyster Pond Rd
Nantucket Sound
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Why Oyster Pond and Salt Pond?

Salinity and Nutrients

Oyster Pond

- Average salinity 2-3 ppt

Salt Pond

- Average salinity 25 ppt
- Higher nitrogen content

How do salinity and nutrient loads affect...

- Species presence
- Fish growth rate
- Food web position

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Methods: collection

- seining
- day and night

locations:

- Oyster Pond and
- Salt Pond culverts

Abundant Fish Species Present

	Oyster Pond	Salt Pond
White Perch (*Morone americana)*	✓	
American eel (*Anguilla rostrata*)	✓	
Banded killifish (*Fundulus diaphanus)*	✓	
Alewife (*Alosa pseudoharengus)*	✓	✓
Common mummichog (*Fundulus heteroclitus*)	✓	✓
Atlantic silverside *(Menidia menidia*)	✓	✓
Striped killifish *(Fundulus majalis)*		✓
Sheepshead minnow *(Cyprinodon variegatus*)		✓
Total number of species	7	11

How do salinity and nutrient loads affect...

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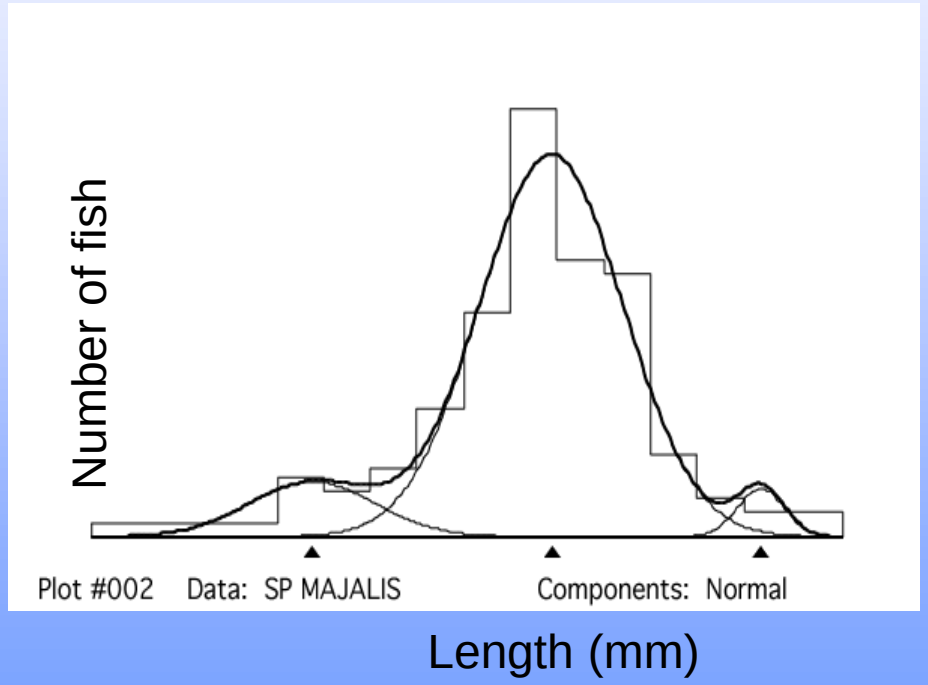
Abundant Fish Species Present

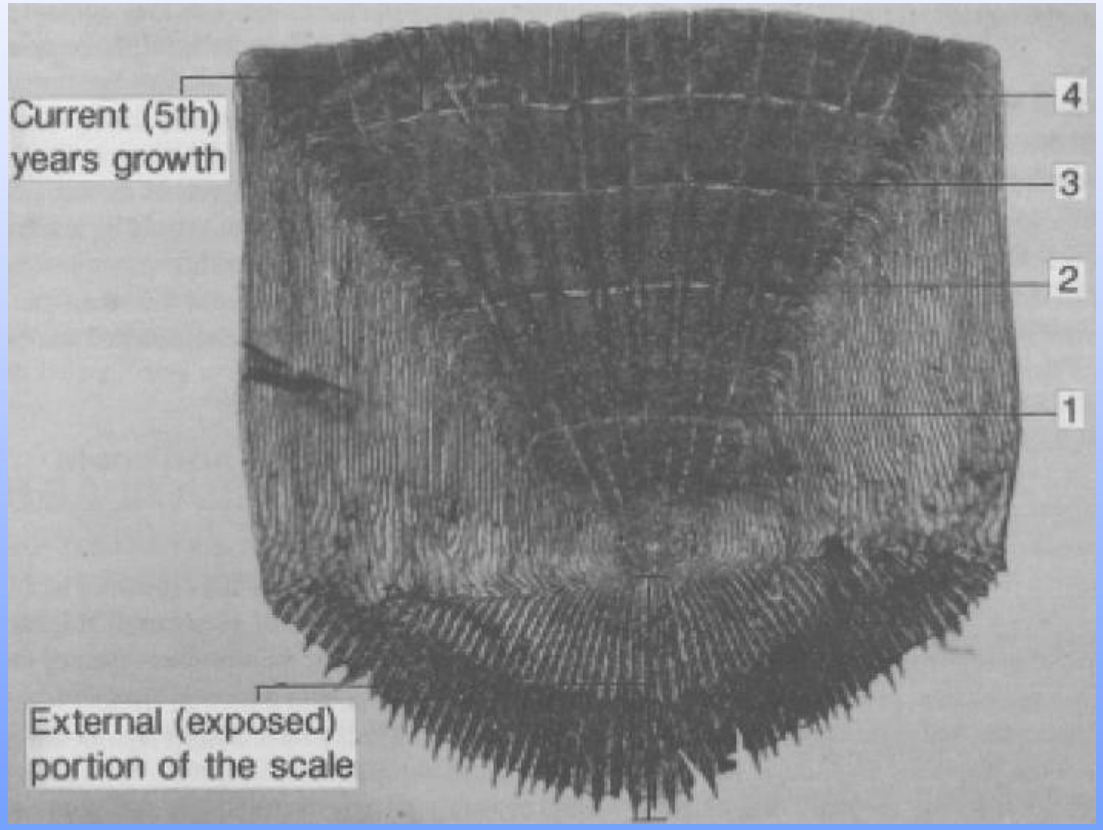
Method: Cohort analysis

- Find number of cohorts (age classes) present.
- Find average length of each cohort.
- Find growth rate from average length.



Method: Scale analysis

Age shown in scales used to verify cohort ages



Growth rates of alewives

		Oyster Pond	Salt Pond
Sample size		**714**	**10**
Growth rate (mm y^{-1}) (mean ± s.e.)			
early cohort		**72 ± 1**	**--**
late cohort		**63 ± 0**	**--**
	mean	**64 ± 0**	**63 ± 5**
Salinity		**2-3**	**17-25**

Length (mean ± s.e.) of two age classes of silversides and common mummichogs from Salt Pond and Oyster Pond

	Silverside		Mummichog	
Age (years)	1	2	1	2
Salt Pond	57 ± 0	67 ± 2	59 ± 5	84 ± 4
Oyster Pond	43 ± 1	48 ± 0	28 ± 0	63 ± 3

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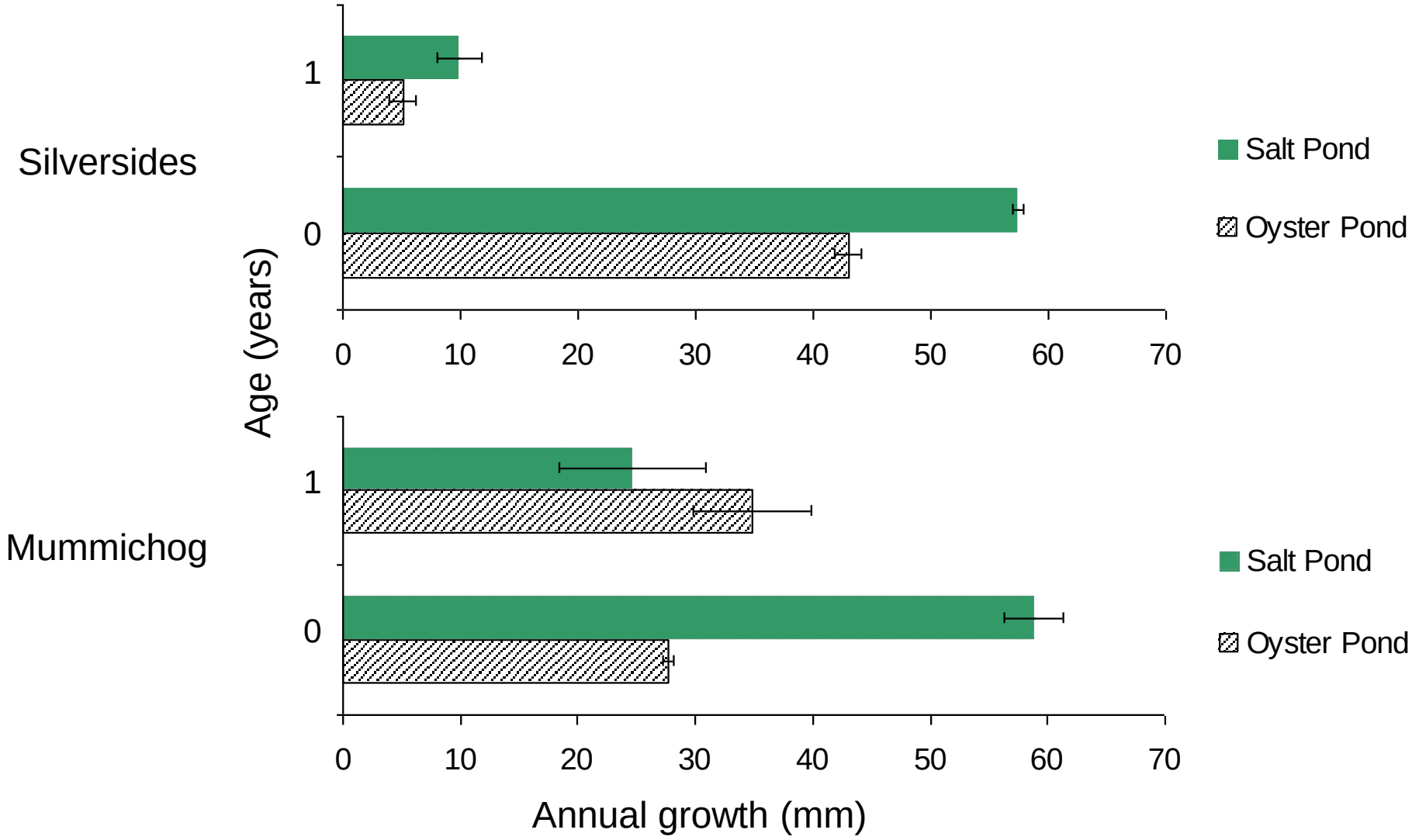
Annual growth of fishes from Oyster Pond and Salt Pond



How do salinity and nutrient loads affect...

- Species presence
- Fish growth rate
- Food web position

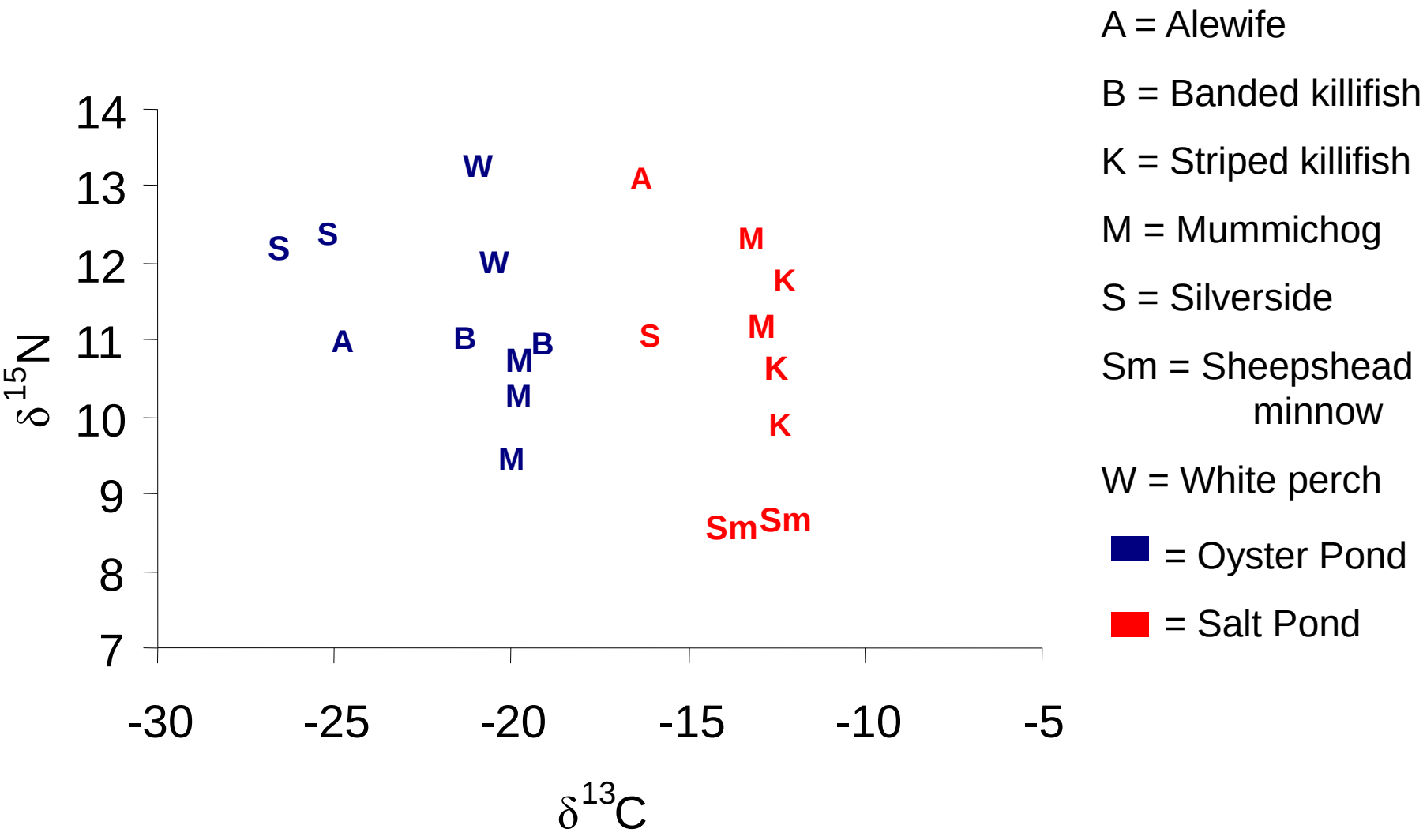
Methods: Stable Isotope Analysis Continued

- Five individuals from each species, size range, and location were dried and ground.
- δ^{15} N and δ^{13} C analyses done by UC Davis Stable Isotope Facility.
- The analysis gives us the ratio of ^{15}N:^{14}N, which is known as the $\delta^{15}N$, and the ratio of ^{13}C:^{12}C, known as the $\delta^{13}C$.

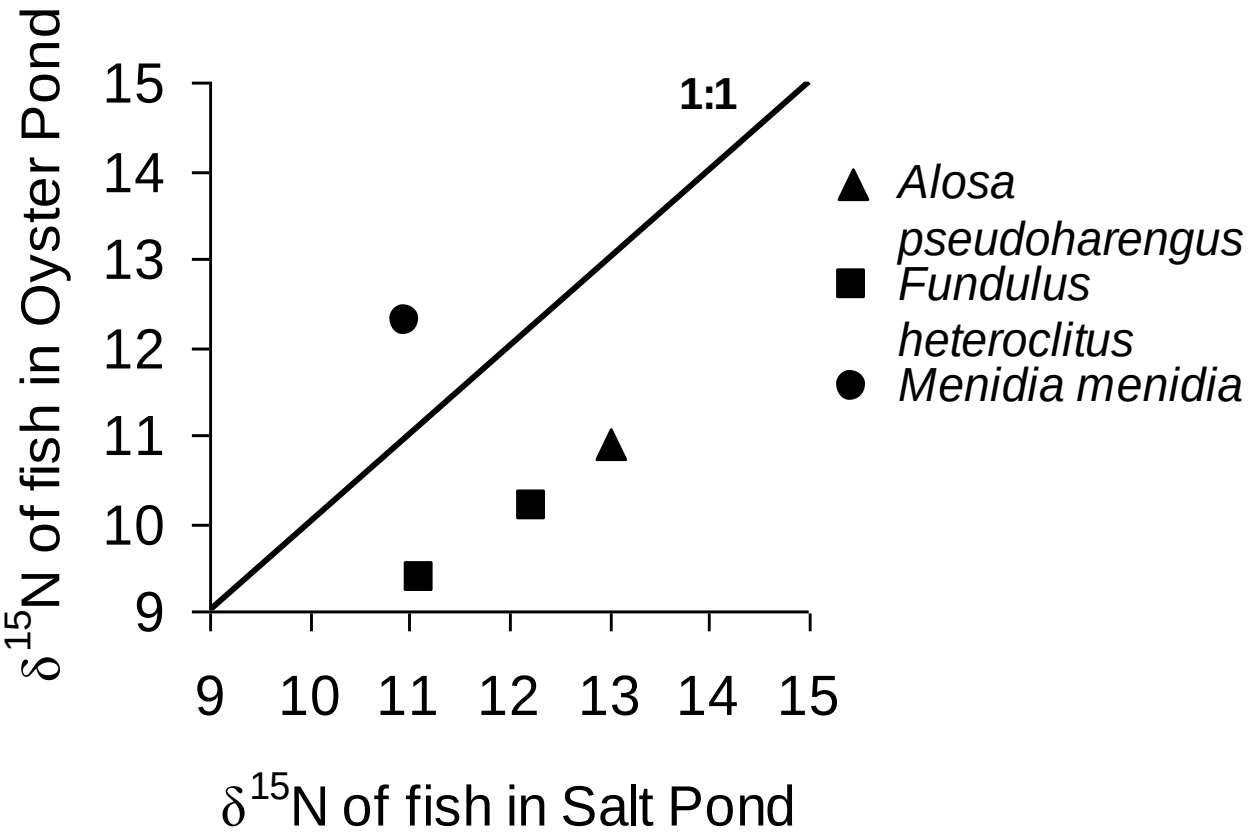
Methods: Stable Isotope Analysis

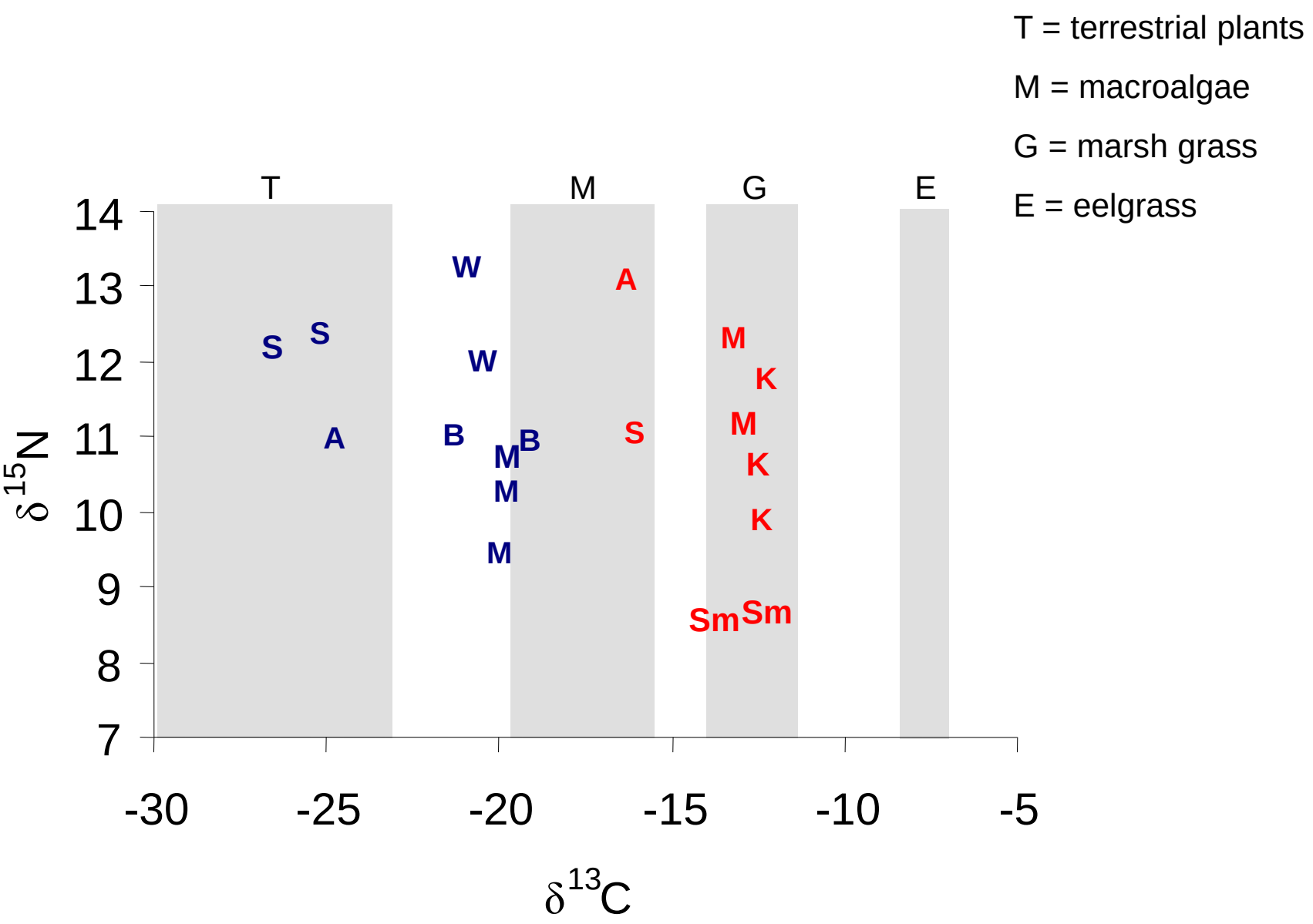
- How do δ^{15} N analyses work?
  - Biological processes use N isotopes differentially, and consumer tissues become enriched with ^{15}N.
  - Organisms higher in the food web have a larger δ^{15} N ratio.
  - Nitrate from wastewater is enriched with ^{15}N relative to ^{14}N
- How do δ^{13} C analyses work?
  - Each type of primary producers has a distinct δ^{13} C ratio.
  - The carbon signature of fish is similar to that of their food sources.

δ^{15} N and δ^{13} C values of fish from Oyster Pond and Salt Pond



Nitrogen entering the food webs of Oyster Pond and Salt Pond




T = terrestrial plants
M = macroalgae
G = marsh grass
E = eelgrass
T
M
G
E
14
13
12
11
10
9
8
7
δ15N
-30
-25
-20
-15
-10
-5
δ13C
W
A
S
S
M
W
K
B
S
M
B
M
K
M
K
M
Sm
Sm

Results Summary

- Species presence:
  - There were more species at Salt Pond.
  - Some species were common to both ponds.
- Comparable species growth rates:
  - Alewife
    - High salinity does not impede alewife growth during the first year.
  - Other comparable species
    - First year fish in Salt Pond had a higher growth rate.
    - After the first year, salinity did not affect growth rate.
- Isotopic Analysis
  - Fish employ a variety of feeding strategies.
  - Some data indicate that there is more waste water nitrogen in the food chain at Salt Pond.
  - The carbon source at the base of each food web differed between ponds.

Acknowledgements

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