Seasonal Variations in the Assimilation of Phytoplankton Biomass by Zebra Mussels *(Dreissena polymorpha)* in Lakes of Different Productivities

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Zebra Mussels

- Non-native
- Small size (5mm to 4cm)
- Filter feeders (up to 1 gallon per mussel per day)
- Attach to hard objects
- Form large colonies
Approach

- Collected zebra mussels & phytoplankton from lakes of different productivities
- Measured fatty acid and stable isotope composition

Here we are

Keuka Lake

Seneca Lake
Fatty Acids

• All organisms produce fatty acids
  – Structural and metabolic components

• Polyunsaturated fatty acids (PUFAs)
  – Mainly produced by primary producers
  – Consumers obtain them from their diet
  – Can be used as markers of consumption
Total Fatty Acid Concentration

Zebra Mussels

- Seneca
- Keuka

Particulate Organic Matter

- Seneca
- Keuka

Similar amounts in zebra mussels from both lakes

Significantly higher concentrations of fatty acids in Seneca POM
Similar Fatty Acid Composition of Zebra Mussels in Seneca and Keuka Lakes

Polyunsaturated fatty acids

Fatty acids

14:0 16:0br 16:1ω7 17:0 n18:0 18:0 18:1ω9 18:1ω7 18:2ω6 18:3ω3 18:4 20:1ω11 20:1ω9 20:2ω0 20:4ω6 20:5ω3 22:1ω9 22:2ω0 22:3 22:4ω6 22:5ω3 22:6ω3
Similarity in Zebra Mussels

• Zebra mussels from Keuka and Seneca Lakes contained similar
  – Total fatty acid content
  – Fatty acid distribution
  – PUFA content
  – Weight % carbon and nitrogen

• HOWEVER – amount of POM available in two lakes is different
Similarity in Zebra Mussels

• **Filter feeders** (up to 1 gallon per mussel per day)
  – Passive process

• **If they filter similar amounts of water**

• **Zebra mussels in Keuka Lake must be more efficient at assimilating organic matter**
Stable Carbon Isotopes

- Stable isotope ratio $^{13}\text{C}/^{12}\text{C}$ can be used as an indicator of assimilation efficiency.

**Efficient assimilation**

$^{13}\text{C}/^{12}\text{C}$ ratio similar or less than $^{13}\text{C}/^{12}\text{C}$

- Zebra mussel
- Phytoplankton diet

**Inefficient assimilation**

$^{13}\text{C}/^{12}\text{C}$ ratio higher than $^{13}\text{C}/^{12}\text{C}$

- Zebra mussel
- Phytoplankton diet
Stable Isotope Ratio of Zebra Mussels Relative to POM

More $^{13}$C

Less $^{13}$C

Less efficient

More efficient

$\Delta^{13}$C$_{ZM-POM}$

June

July

August

Seneca

Keuka
Summary

• Fatty acid contents of zebra mussels are similar in Seneca and Keuka Lakes

• Differences in productivity of lake is not reflected in their fatty content

• Stable isotope ratios indicate that mussels in Keuka are more efficient at assimilating phytoplankton organic matter

• Zebra mussels are highly adaptable to their environment and may increase their assimilation efficiency
Seasonal mg Org. C/L - Keuka

Month

Seasonal $^{13}$C - Keuka Lake - Zebra Mussels

Month
Decrease in organic matter available to zebra mussels

Increase in $\delta^{13}C$ values of zebra mussels

- Decrease in organic matter available to zebra mussels
- Increase in $\delta^{13}C$ values of zebra mussels