

Community Assembly Dynamics:

*Tracing Planktonic Colonization and
Community Structure in Freshwater
Lakes from Paleo-ecological Records*

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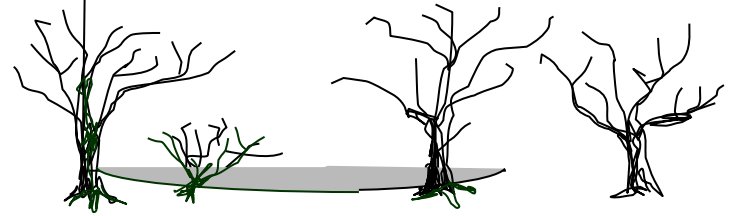
Work at the University of Illinois

1. Zooplankton dispersal
2. Prolonged dormancy in *Daphnia* populations
3. *Daphnia* genetic structure and adaptation
4. Historical community and trait structure

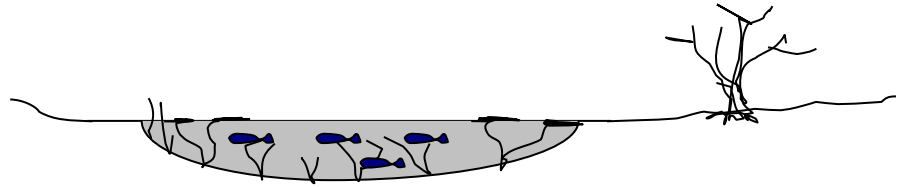




Size & depth are major determinates of food web structure

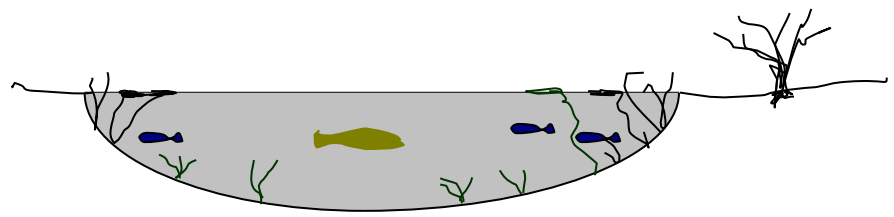


Temporary ponds



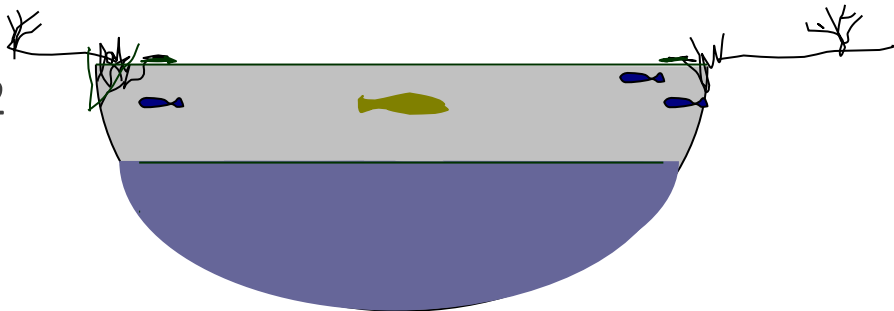
High planktivory

Predator populations affect prey species composition



Shallow

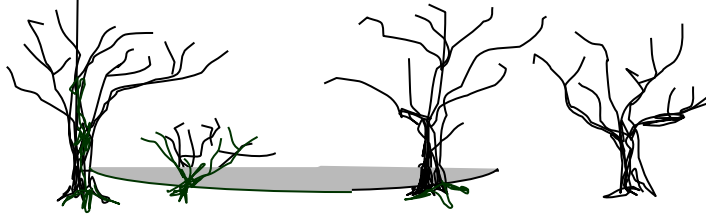
Tessier and Woodruff 2002



Deep refuge

Smaller species
(< 1.5 mm)

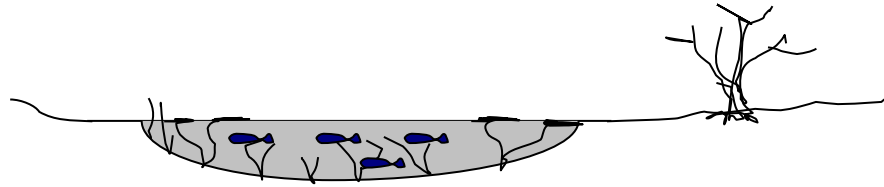
Ceriodaphnia



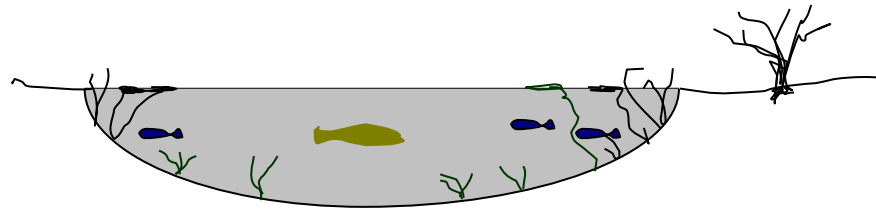
Larger species
(> 2 mm)

Daphnia pulex,
D. ephemeralis

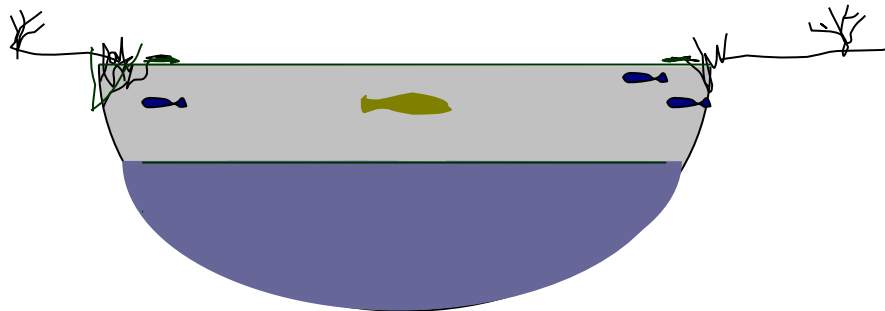
Bosmina, *Ceriodaphnia*



Daphnia ambigua, *D.*
parvula, *Bosmina*,
Ceriodaphnia,
Diaphanosoma



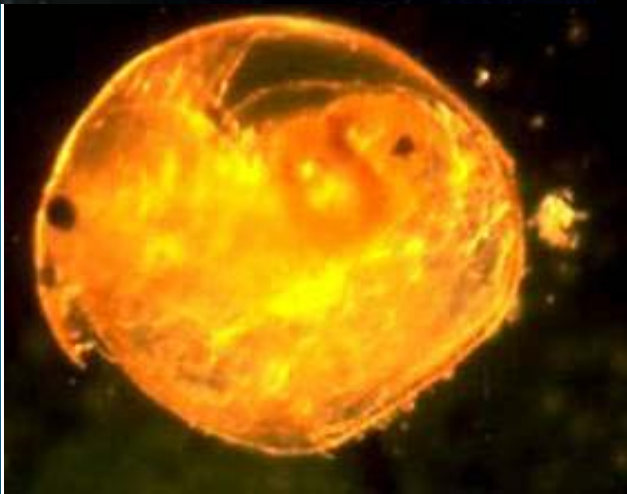
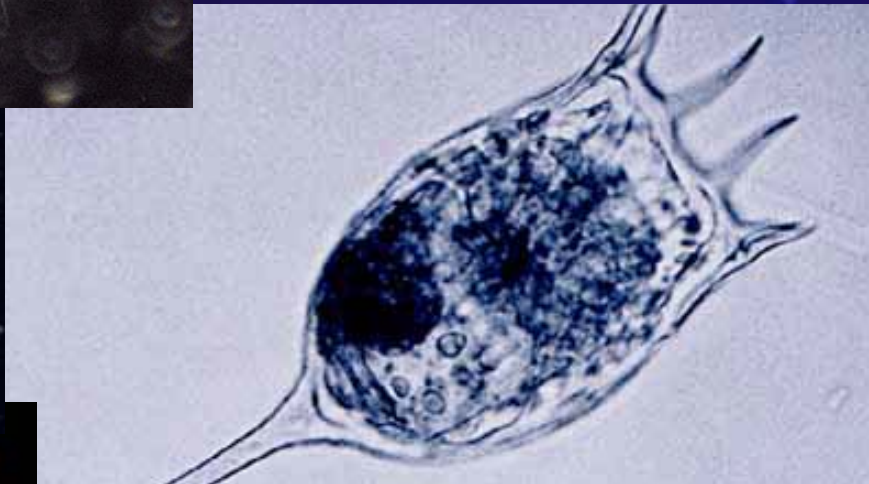
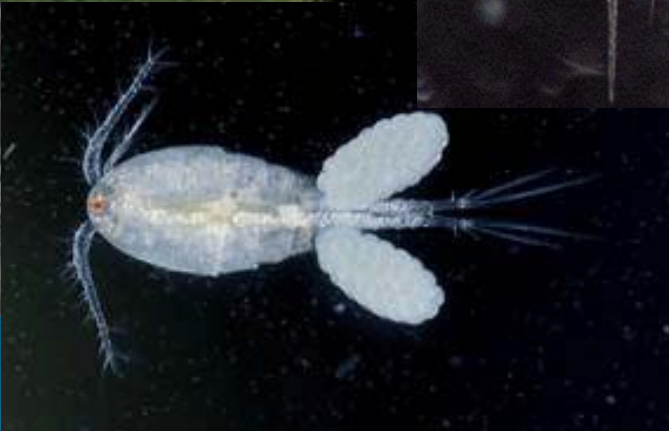
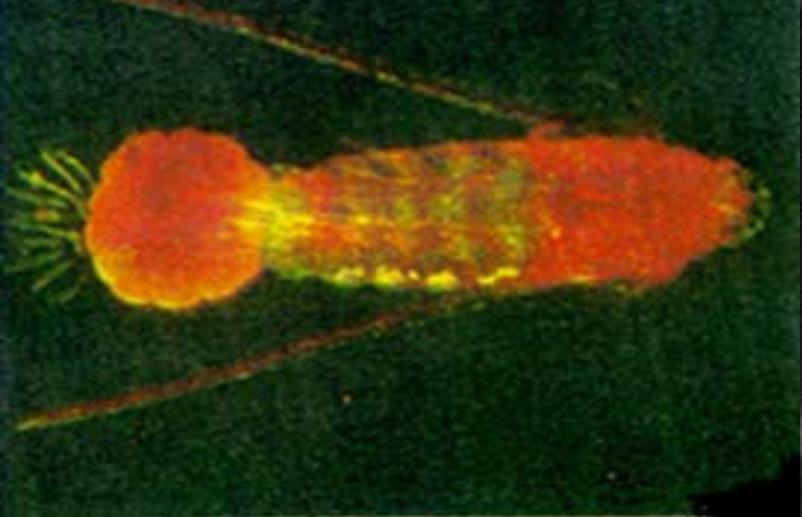
D. ambigua, *D. parvula*,
Bosmina, *Ceriodaphnia*



D. pulicaria, *D.*
dentifera

Talk Outline

- Study system
- How are current communities structured?
- Reconstructed historical community structure
 - How has community structure changed through time?
 - What explains community structure changes?



Kickapoo State Park

Sportsmans



A

Inland Sea



C

B

Clear



D

Long



F

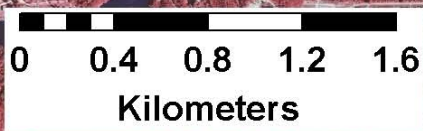
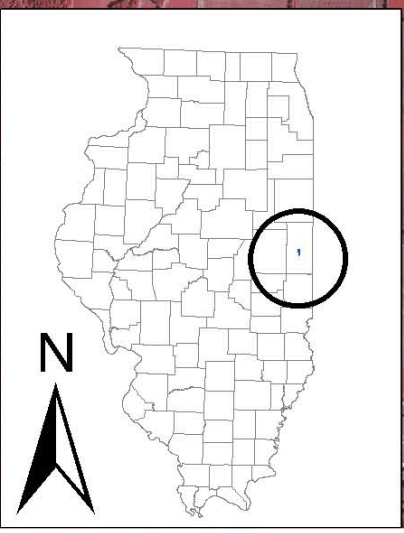
E

No. 6



H

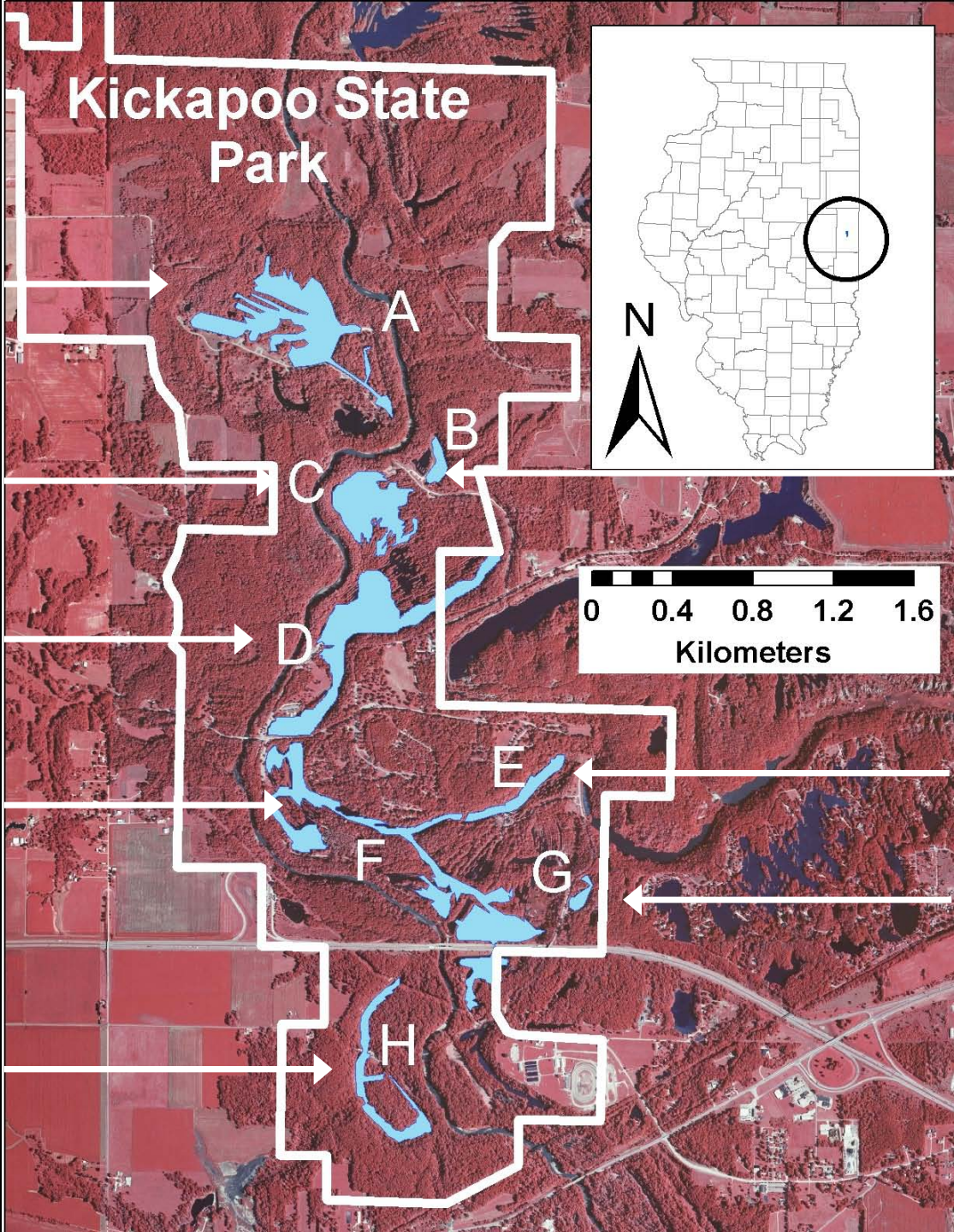
G



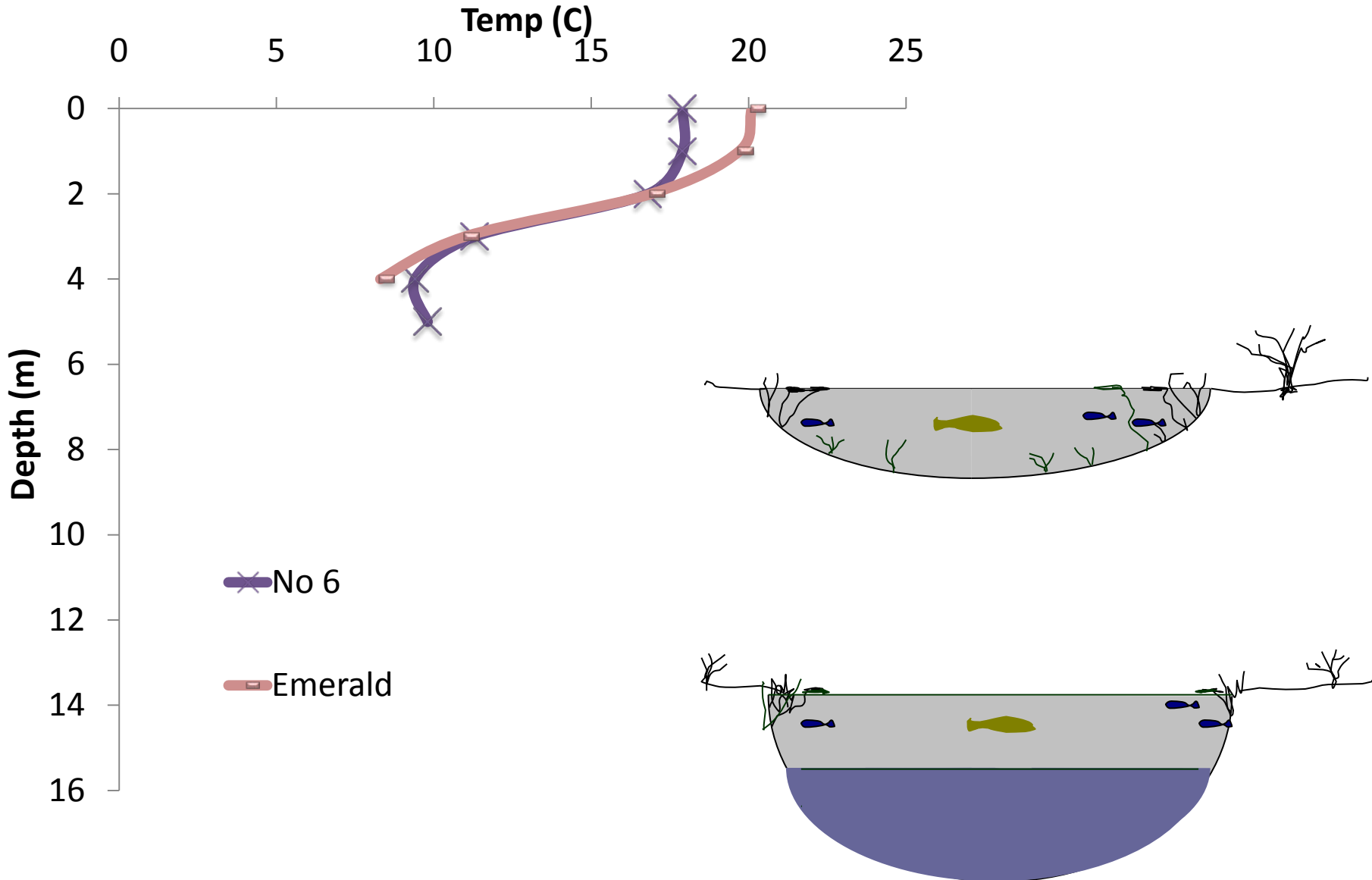
Emerald

High

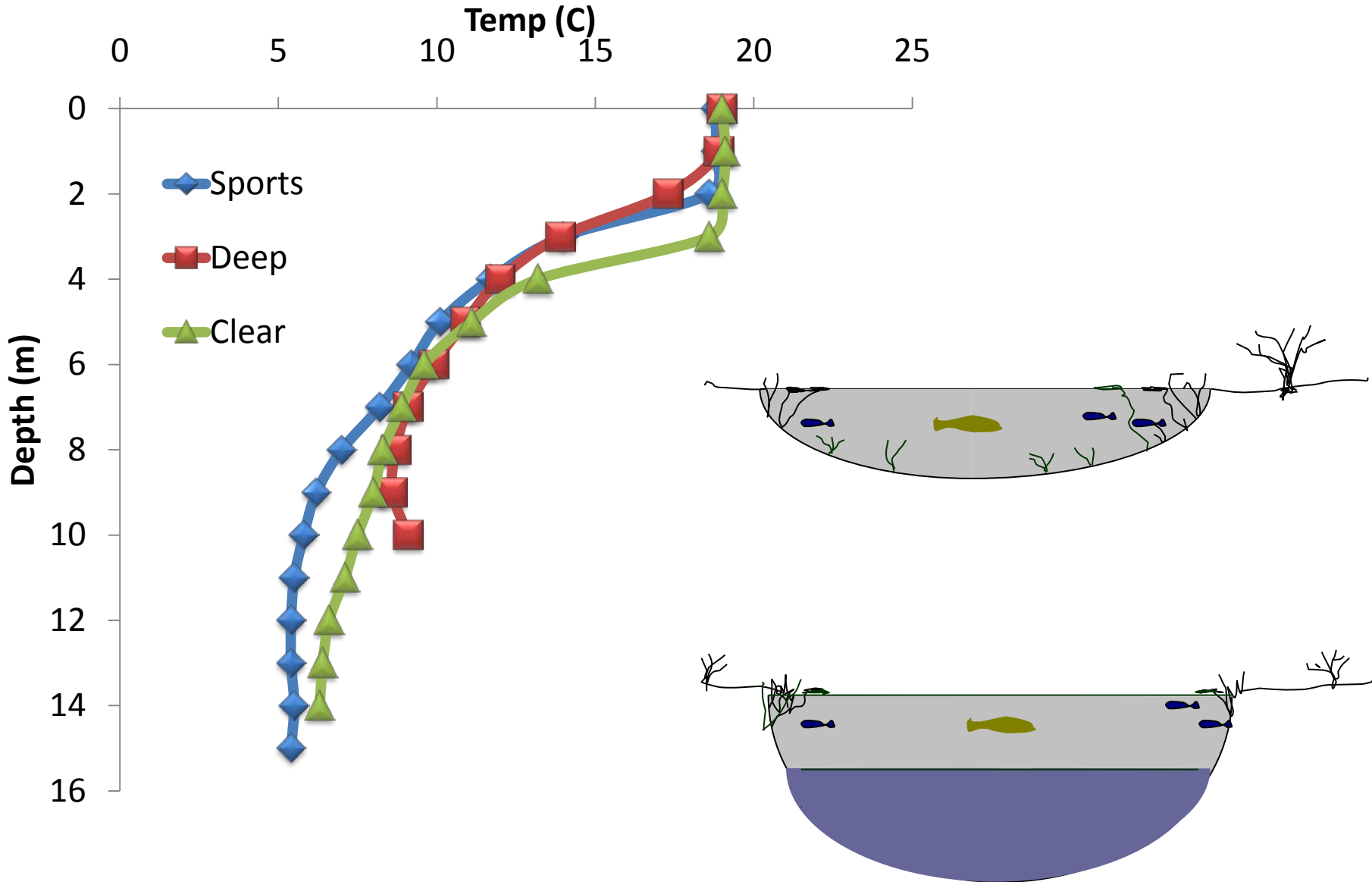
Deep



May Temperature – Depth Profiles



May Temperature – Depth Profiles

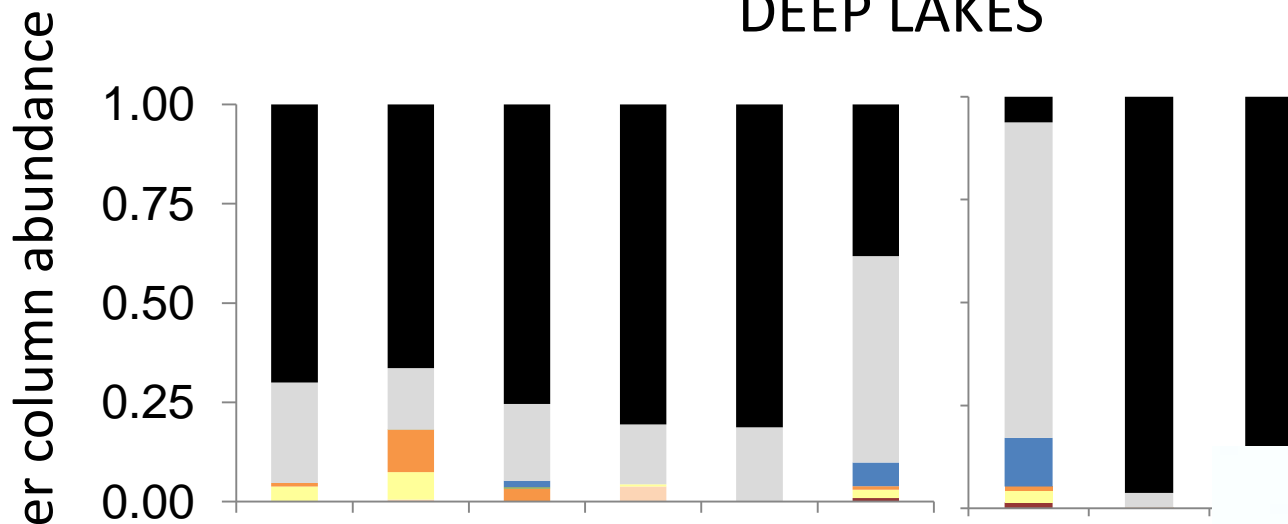




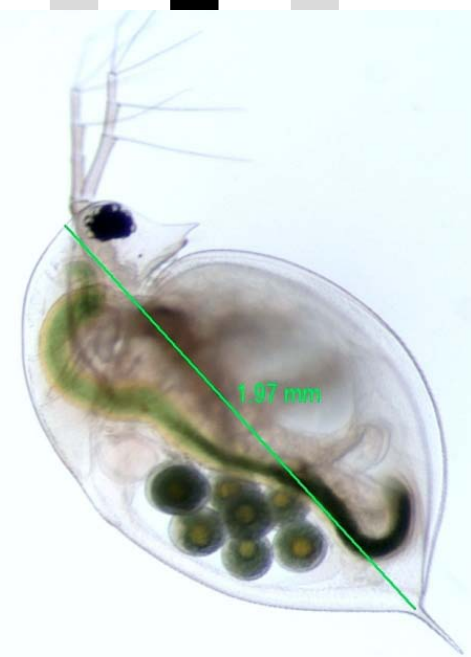
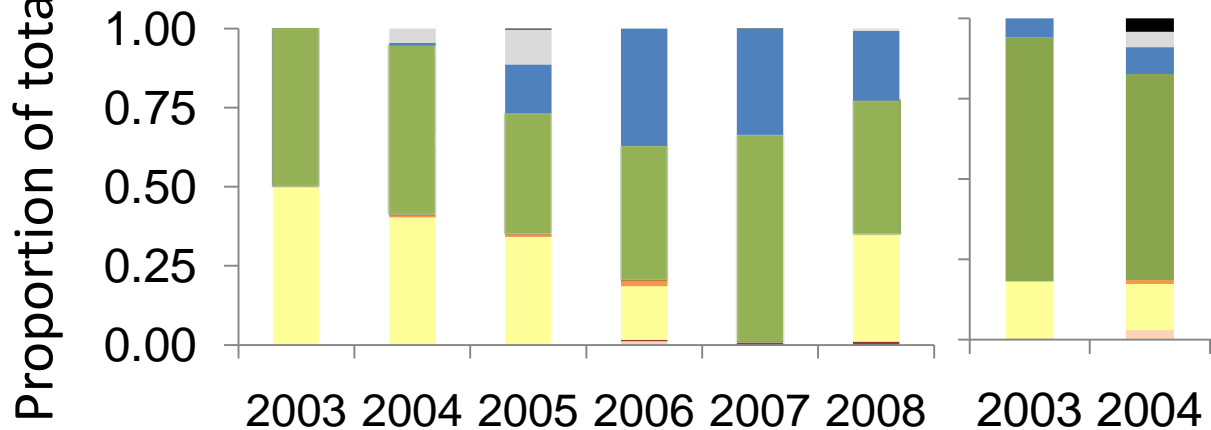
Question: How are current communities structured?

Is 50 years long enough for communities to look “typical”?

DEEP LAKES



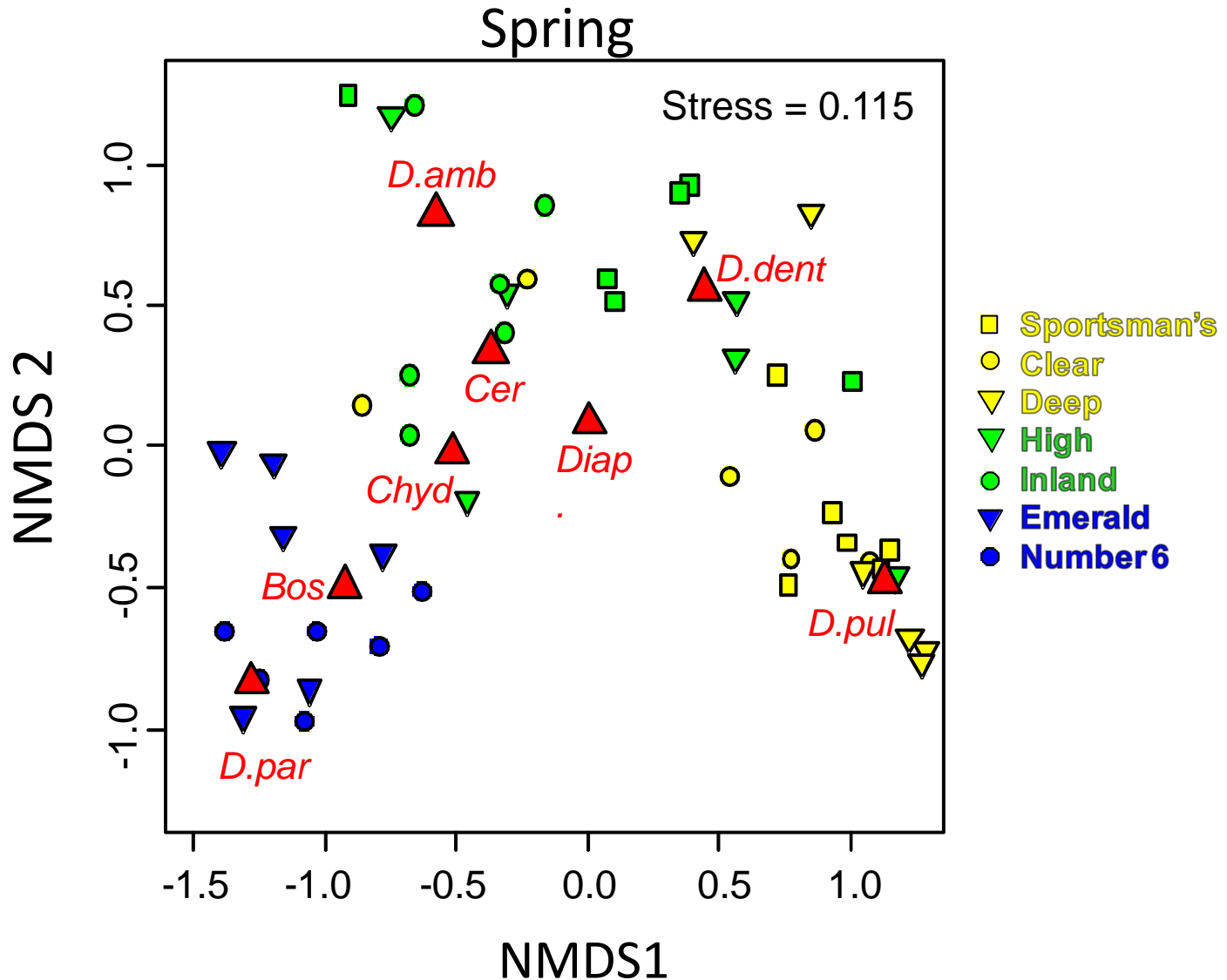
SHALLOW LAKES

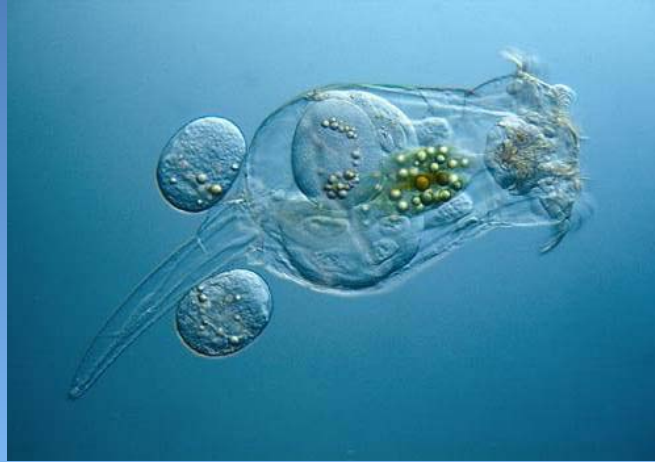


Year

- D. pulicaria*
- D. dentifera*
- D. ambigua*
- Ceriodaphnia*
- D. parvula*
- Bosmina*
- Chydorids
- Diaphanosoma*

Spring Community Ordination





Current communities are largely structured by physical / biological properties of lakes, but differences remain within lake classes and among years

Reconstructed Historical Community Structure:

How has community structure changed through time?

Sediment Core Sampling



Reconstructed Historical Community Structure:

How has community structure changed through time?

Sediment Core Sampling

Identify cladoceran remains in sediments and calculate ephippial abundance per cm

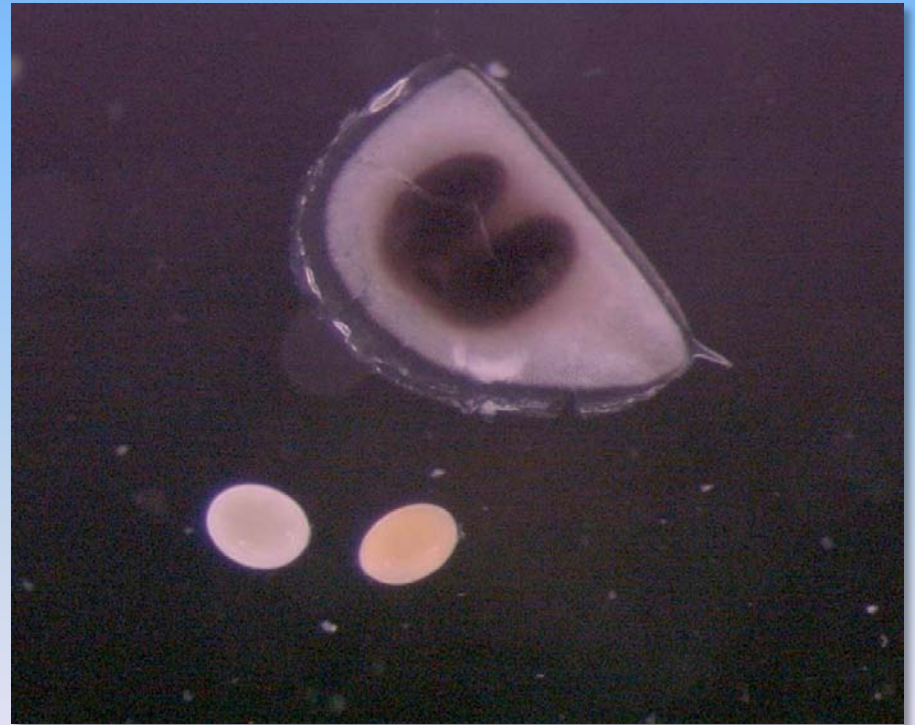


Reconstructed Historical Community Structure:

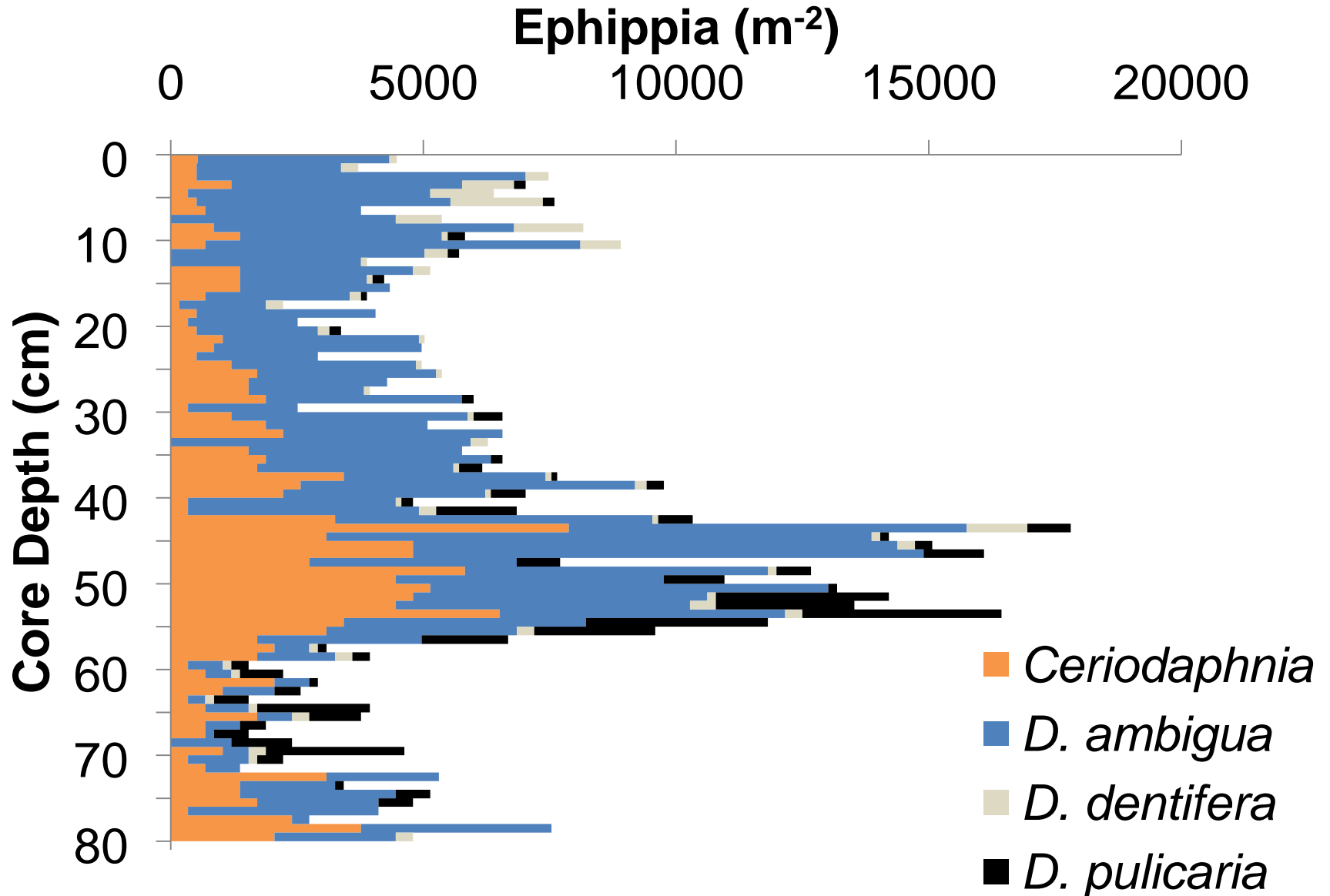
How has community structure changed through time?

Sediment Core Sampling

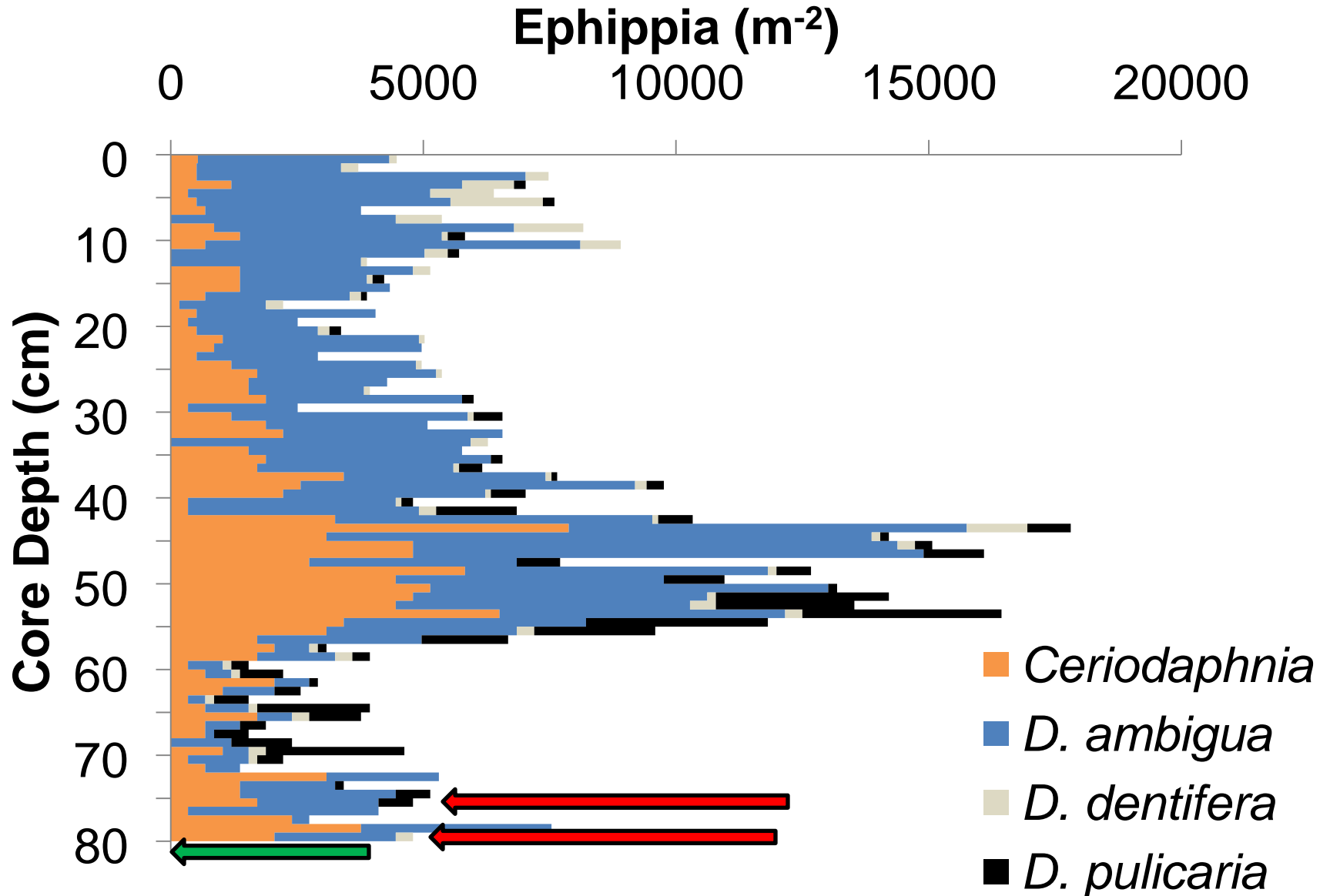
Identify cladoceran remains in sediments and calculate ephippial abundance per cm



Example: Inland Sea



Example: Inland Sea



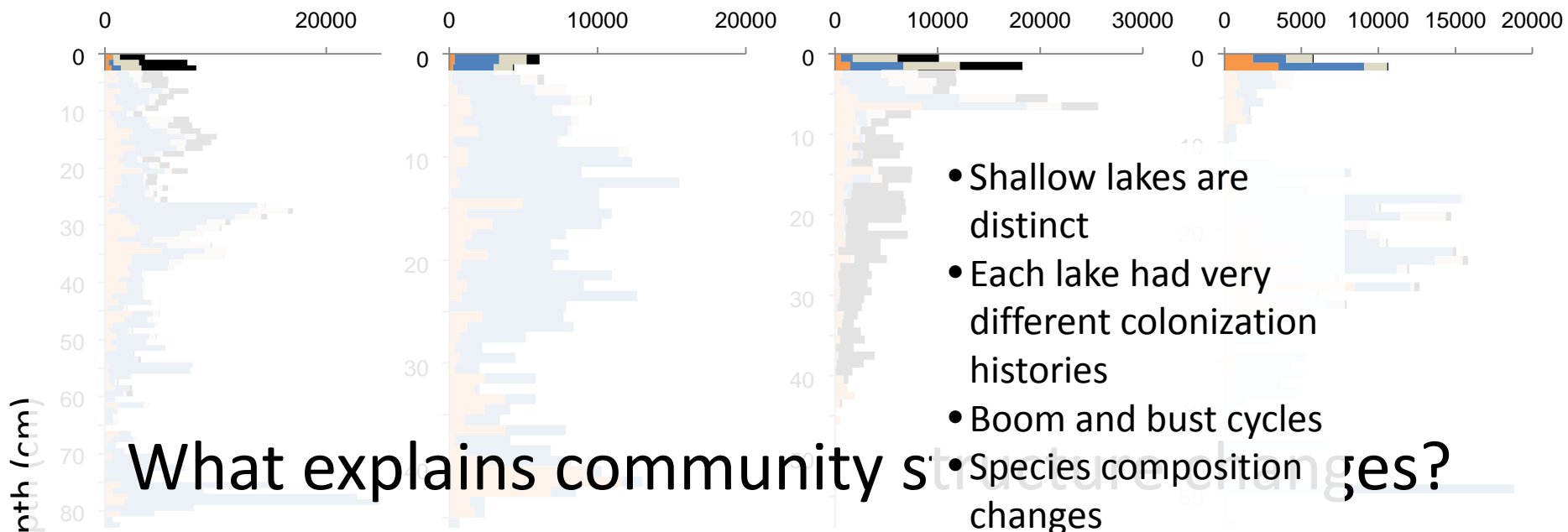
Ephippia (m⁻²)

Sportsman's Lake

Clear Lake

Deep Lake

Long Lake



What explains community structure changes?

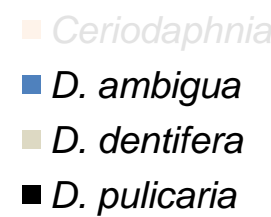
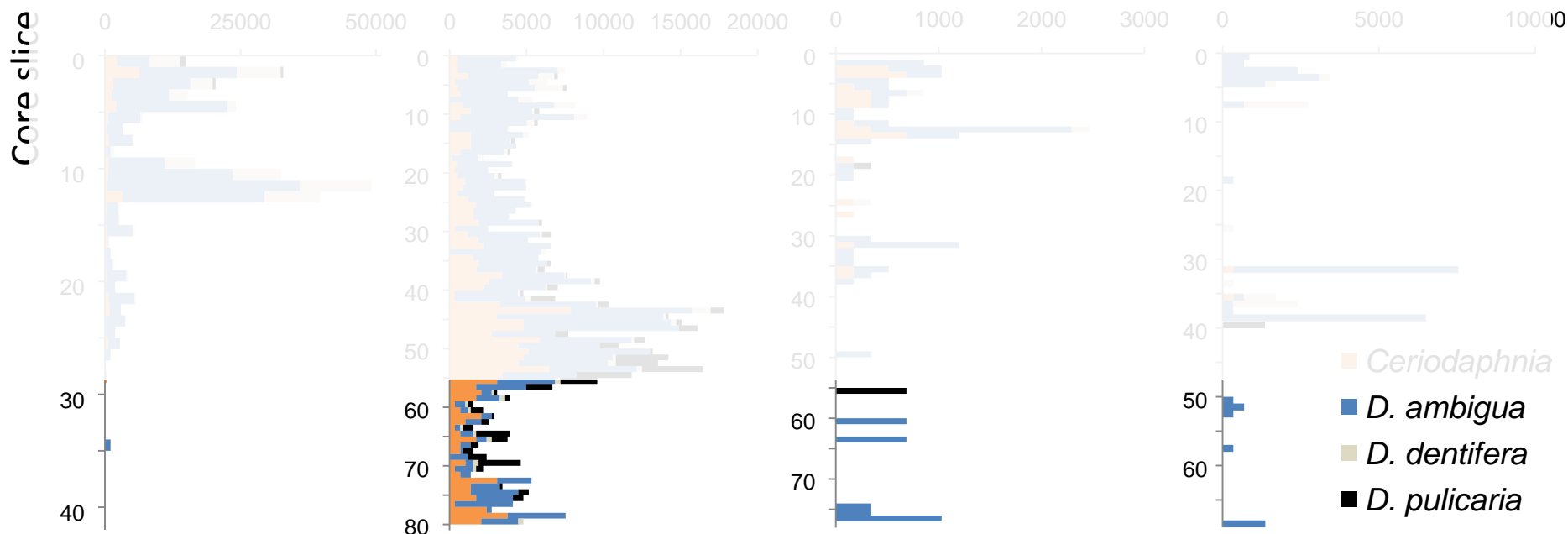
- Shallow lakes are distinct
- Each lake had very different colonization histories
- Boom and bust cycles
- Species composition changes

High Lake

Inland Sea

Number 6 Lake

Emerald Lake



Community analysis: Paleo-ordination

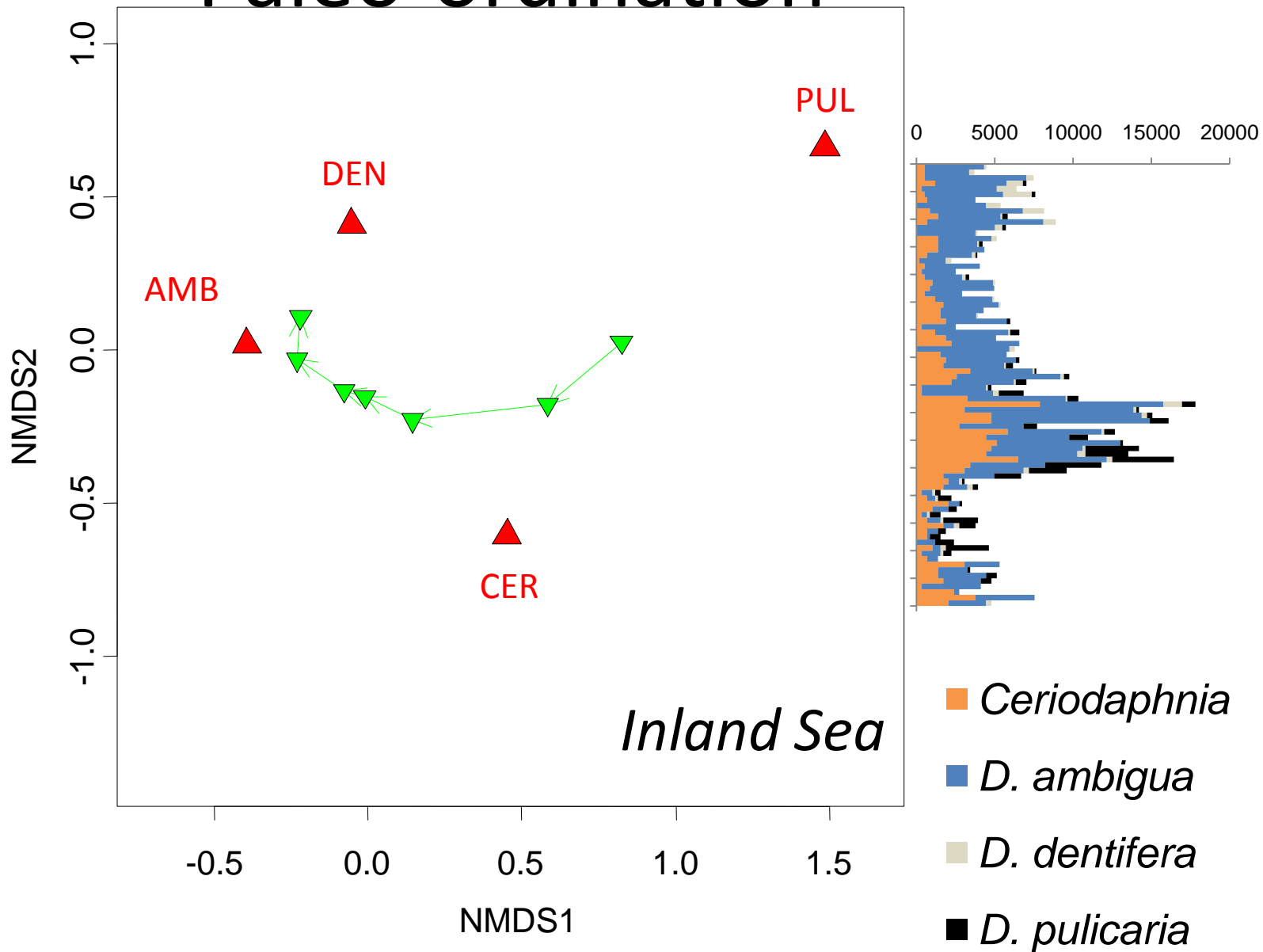
Q: What explains community structure changes?

History or physical environment

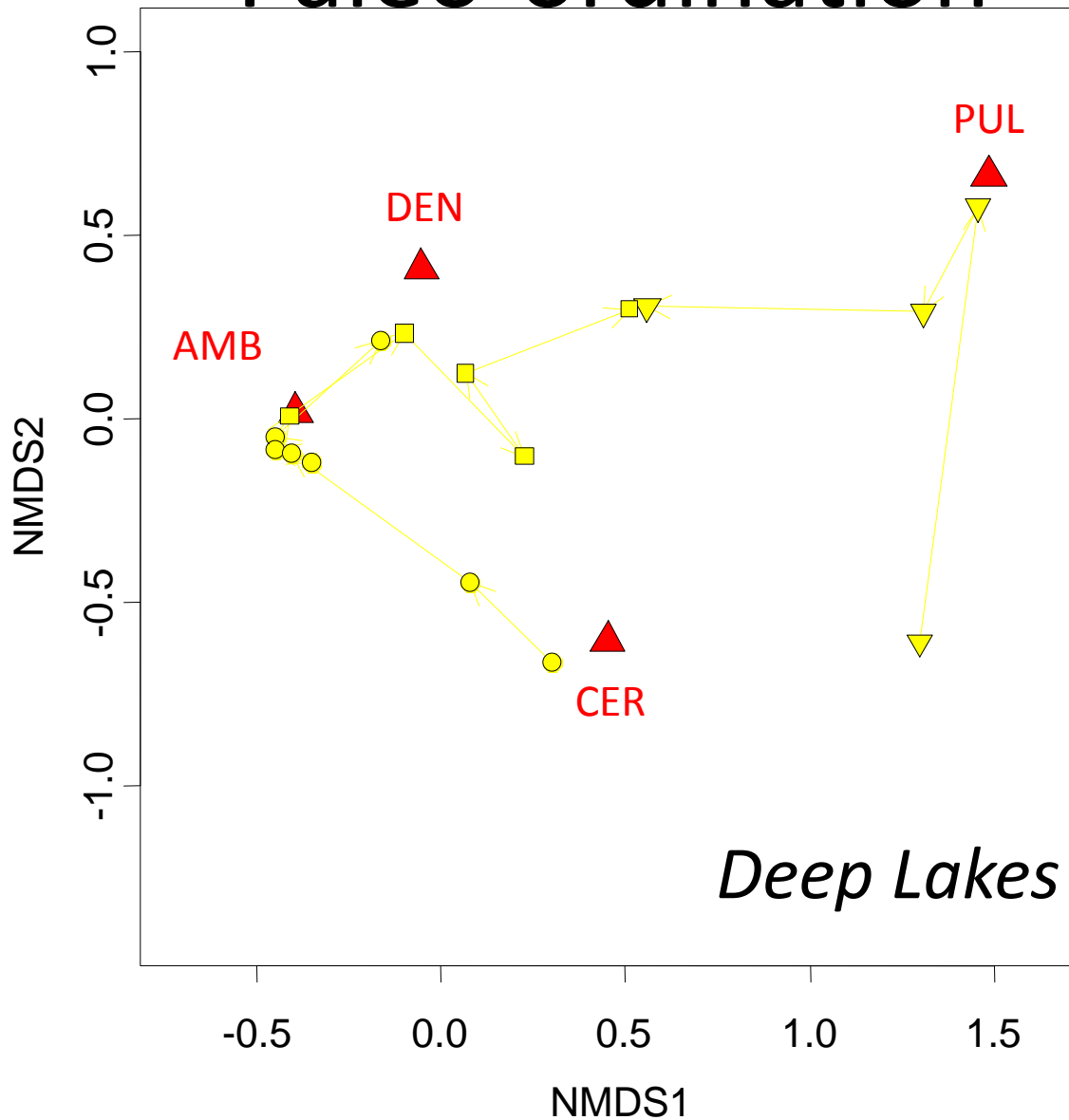
Goal: plot community composition in multiD space and track changes through time

- Community dissimilarity index (Bray-Curtis)
 - 10 year intervals to average over interannual variation

Paleo-ordination



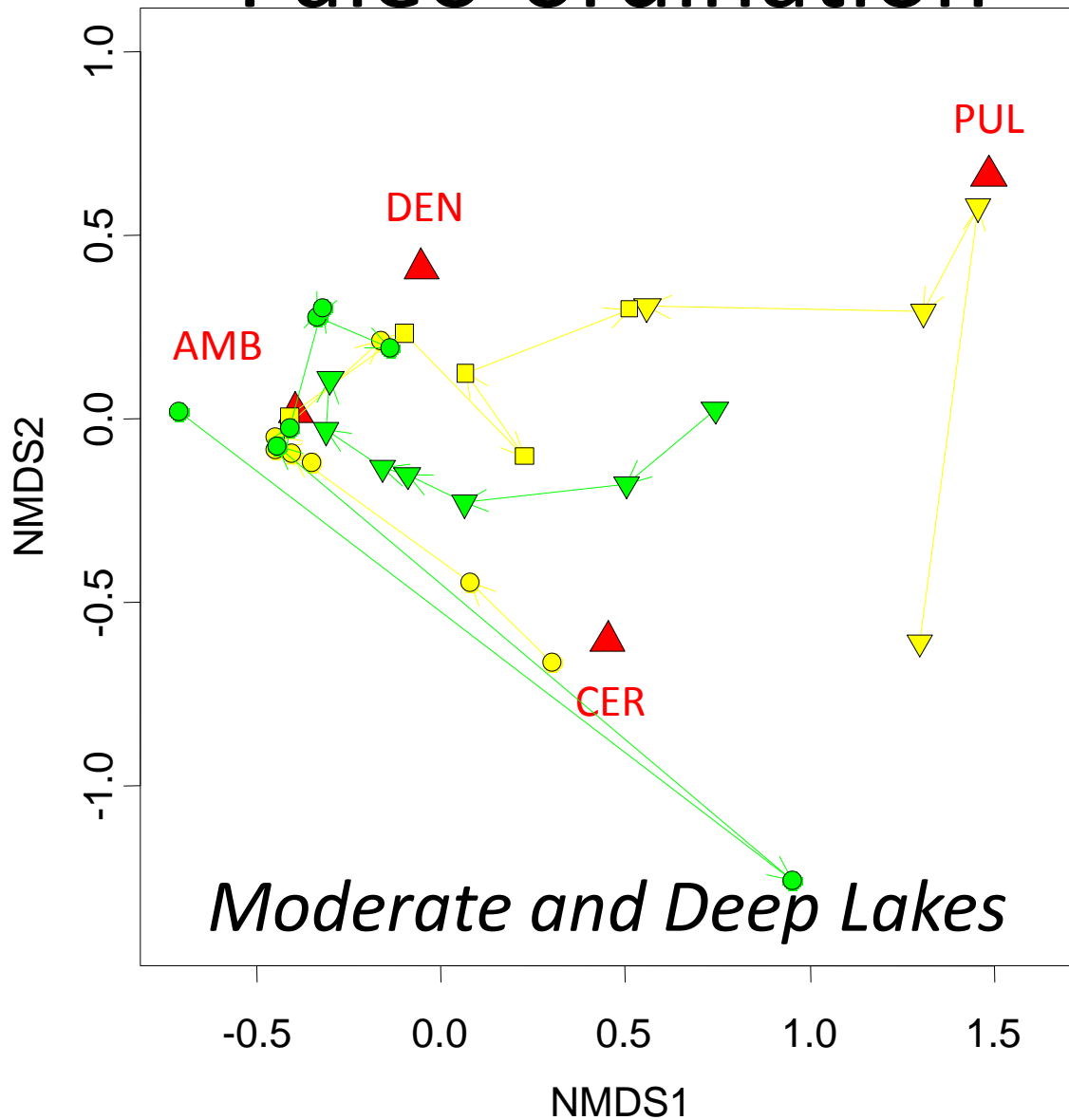
Paleo-ordination



- Unique starting points
- Unique trajectories
- Converge in similarity near center

Deep Lakes

Paleo-ordination



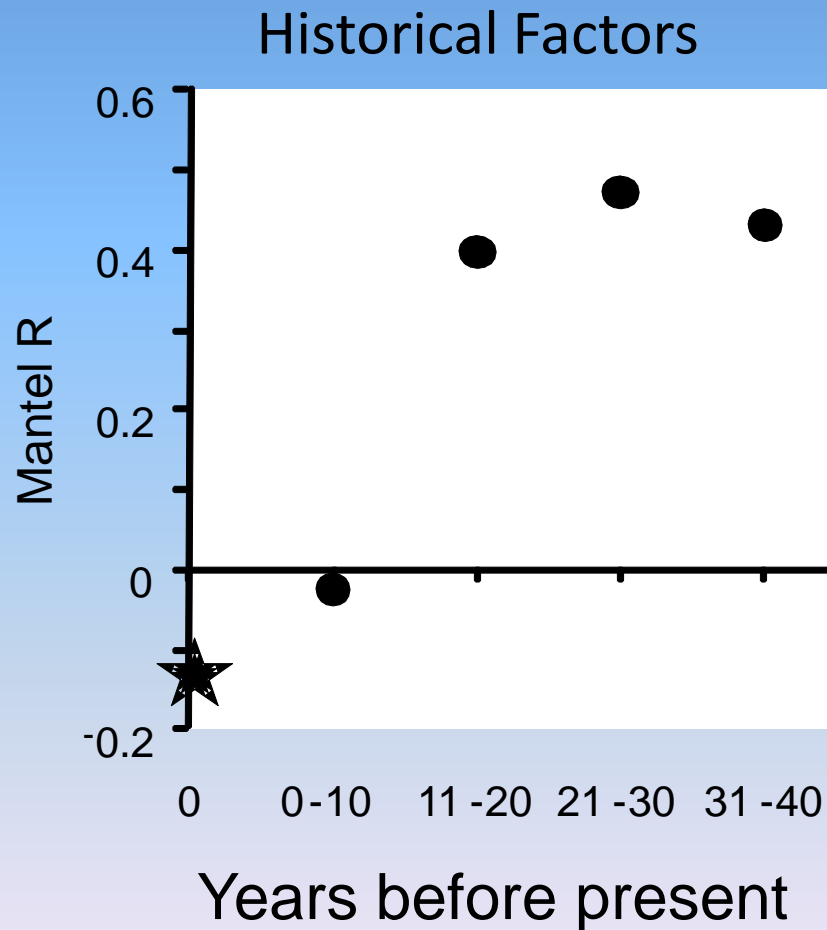
- Unique starting points
- Unique trajectories
- Converge in similarity near Dent/Amb
- Each on a trajectory – priority effects

Q: What explains community structure changes?
History or physical environment

- Community changes through time... increase in community similarity
- Different trajectories between Deep and Moderate depth lakes



Q: What explains community structure changes? *History or physical environment*



History:

Dispersal limitation and
priority effects

tested by Spatial
Structure

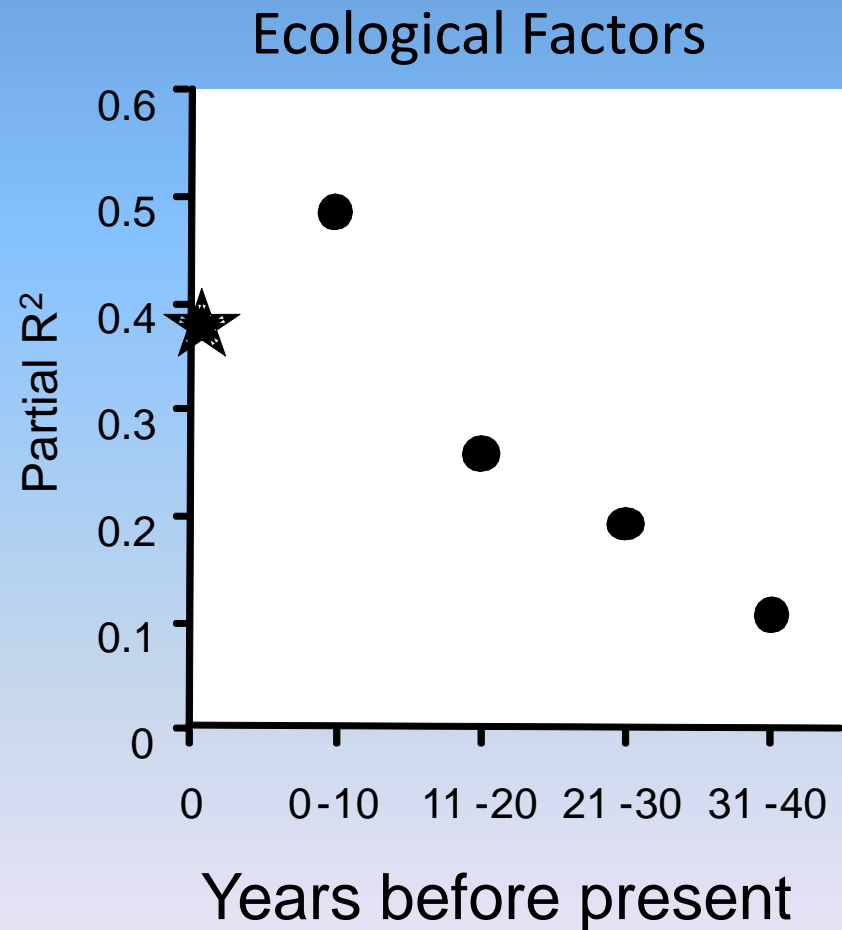
Q: What explains community structure changes?

History or physical environment

Physical environment:

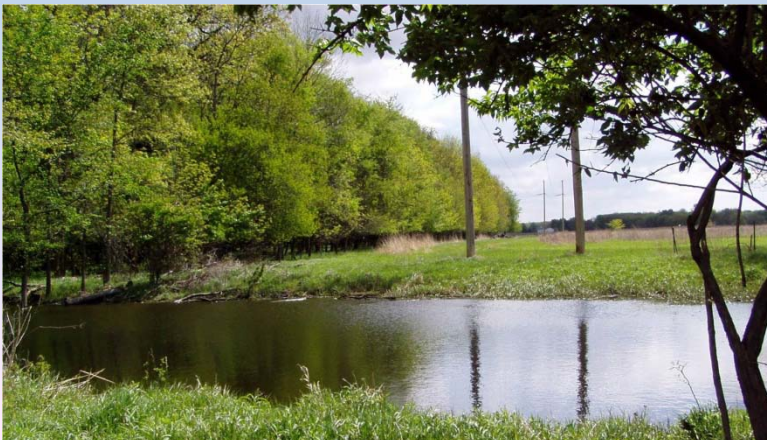
tested by basin shape grouping

Ecological sorting – structure determines species composition

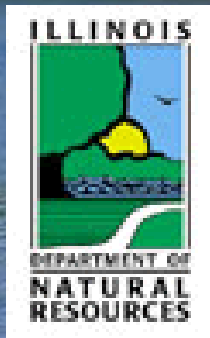


Conclusions

- Current communities largely structured by physical limnology of lakes
- Yet communities are unique, and the history of colonization and community formation has influenced community composition through time



Acknowledgements



Carla Càceres, Jessica Smith, Kim Paczolt, Sam Mulvany, Sigrid Smith, Chris Bertram and scores of undergraduates

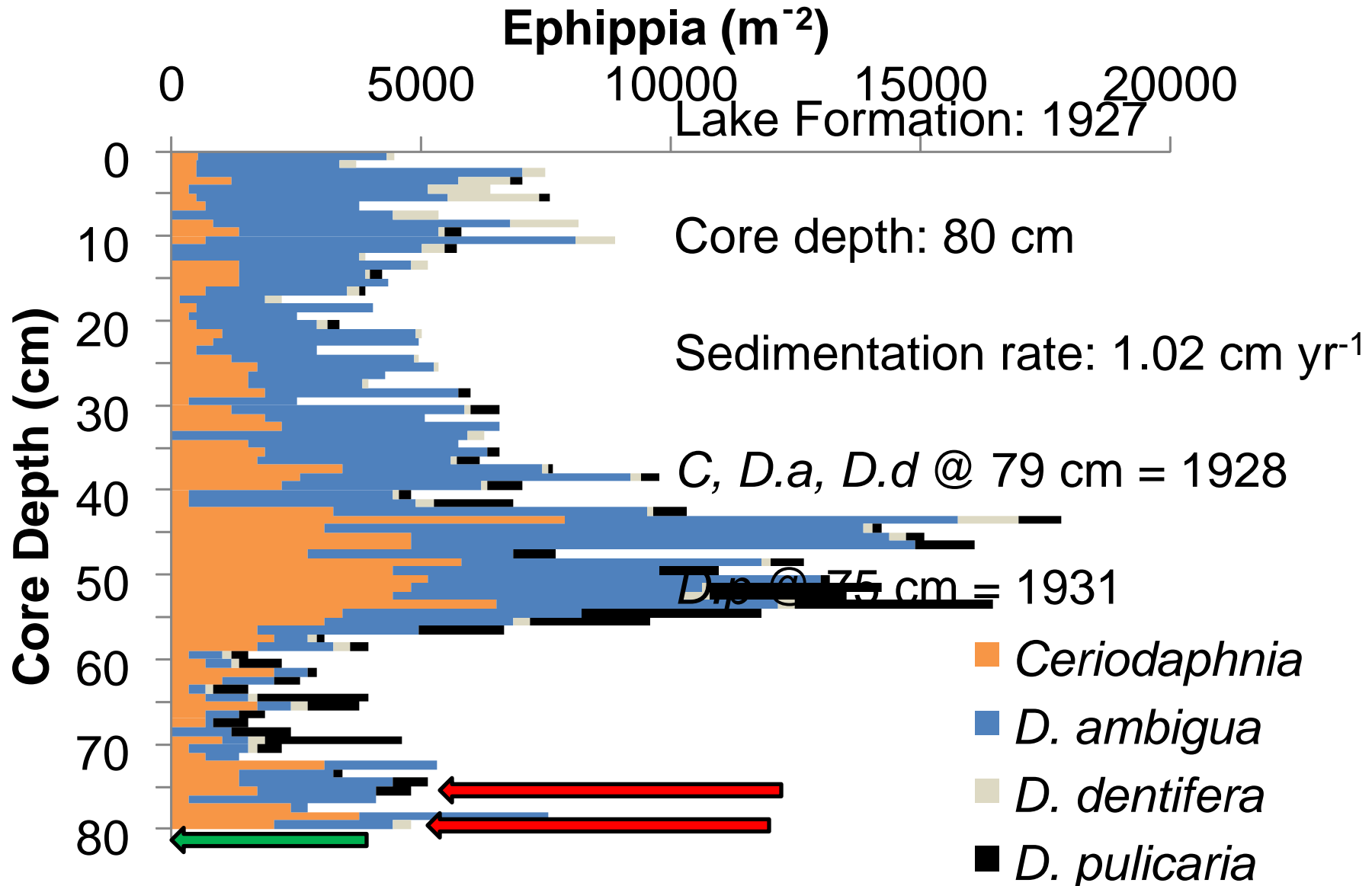


Supplemental material

Metacommunity Concept

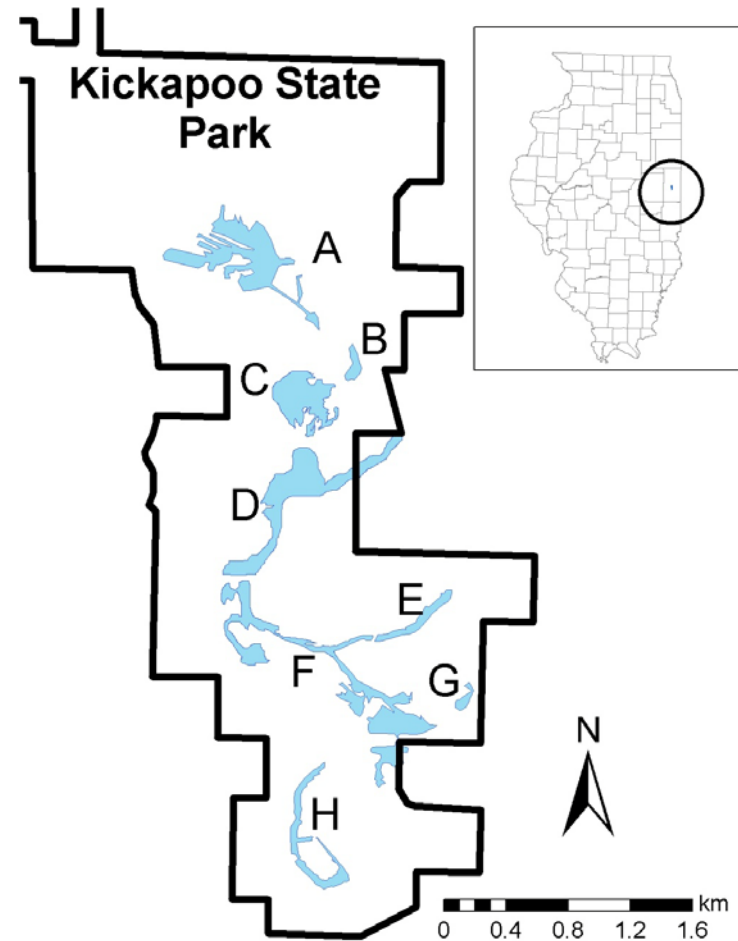


Example: Inland Sea



Colonization History

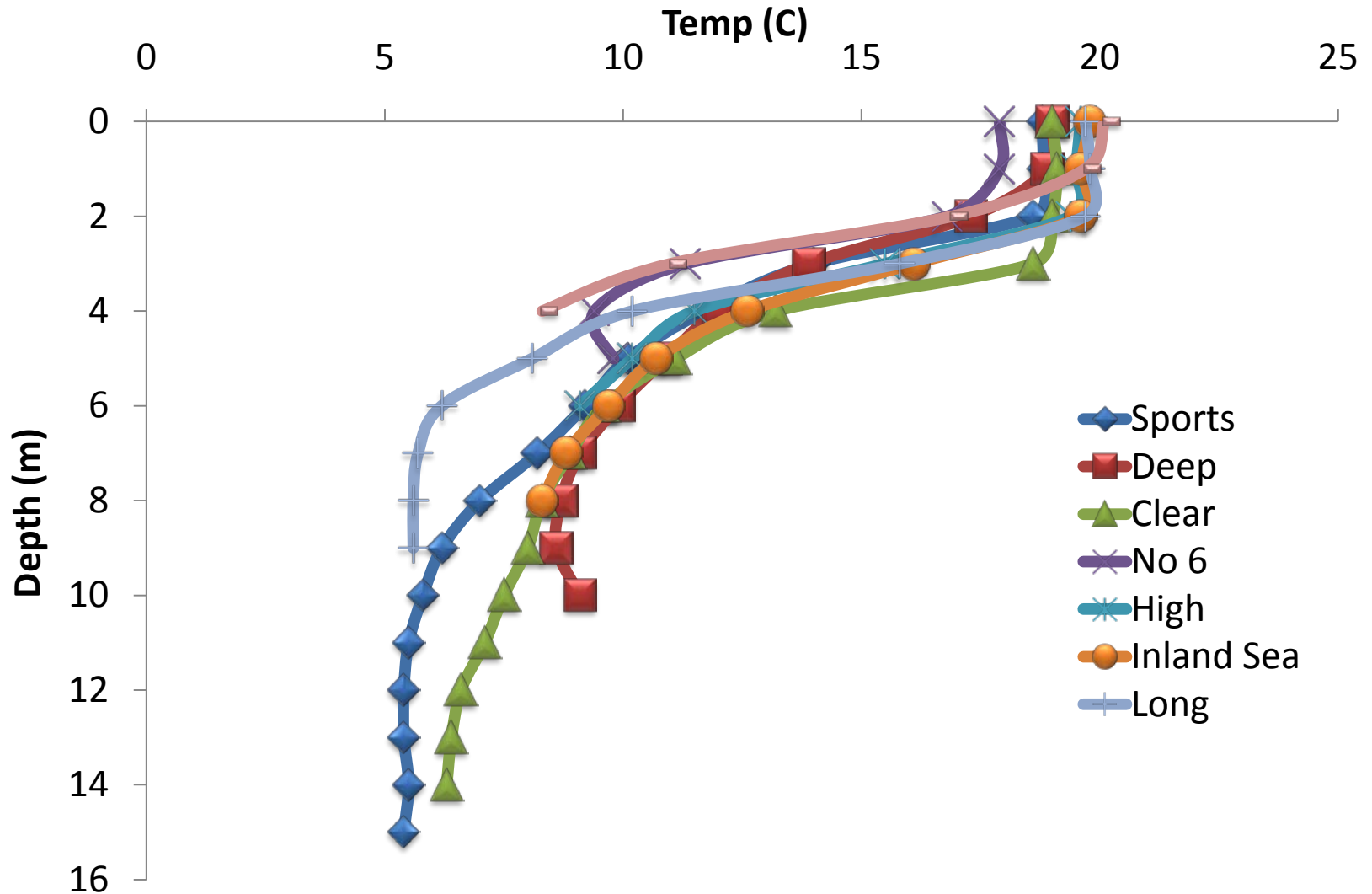
Lake	<i>D. pulicaria</i>
A) Sports	1966
B) Emerald	1959
C) Inland	1931
D) Clear	1996
E) High	1998
F) Long	*
G) Deep	1971
H) #6	1949



Colonization History

Lake	Origin Date	Ceriodaphnia reticulata	D. ambigua - parvula	D. dentifera	D. pulicaria
#6	1927	1968	1928	1980	1949
Clear	1926	1928	1926	1987	1996
Deep	1959	1969	1980	1985	1971
Emerald	1926	1964	1926	1963	1959
High	1926	1950	1939	1967	1998
Inland	1926	1927	1927	1927	1931
Long	1927	1	1	3	4
Sports	1953	1954	1954	1963	1966

Temperature – Depth Profile May 2007



Community Analysis: *Problems with paleorecord*

- Variation from year to year in investment in sex for each species
- Sedimentation rate likely varies through time and among lakes

