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Pyganodon grandis growth along a trophic state gradient in Eastern South Dakota Lakes

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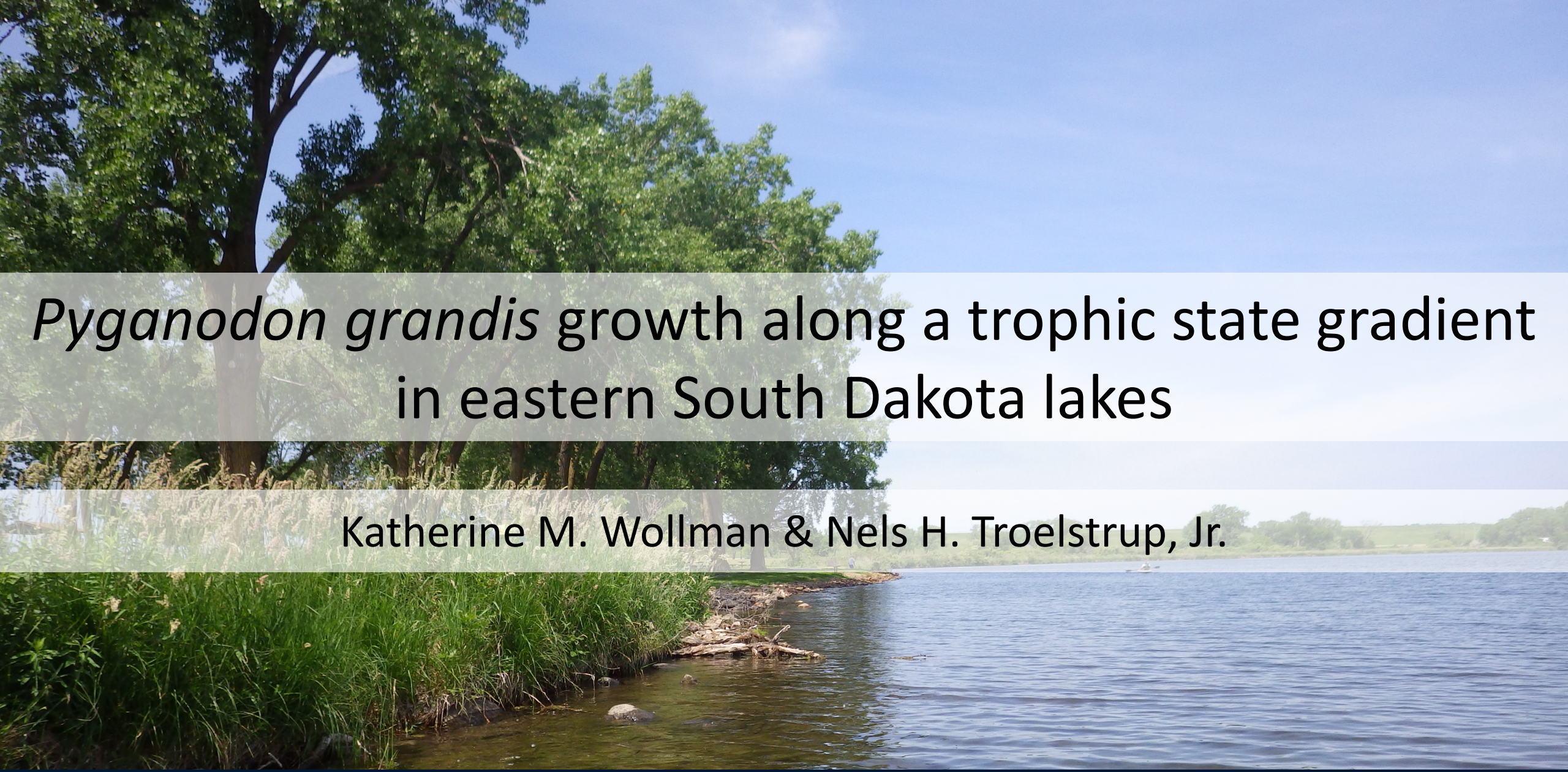

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Unionid Background

- The most imperiled group of freshwater organisms.
- 820 species described worldwide
  - 294 species found in North America
- Declining species richness
- Provide ecosystem services
- Bioindicator
- Freshwater mussels in South Dakota

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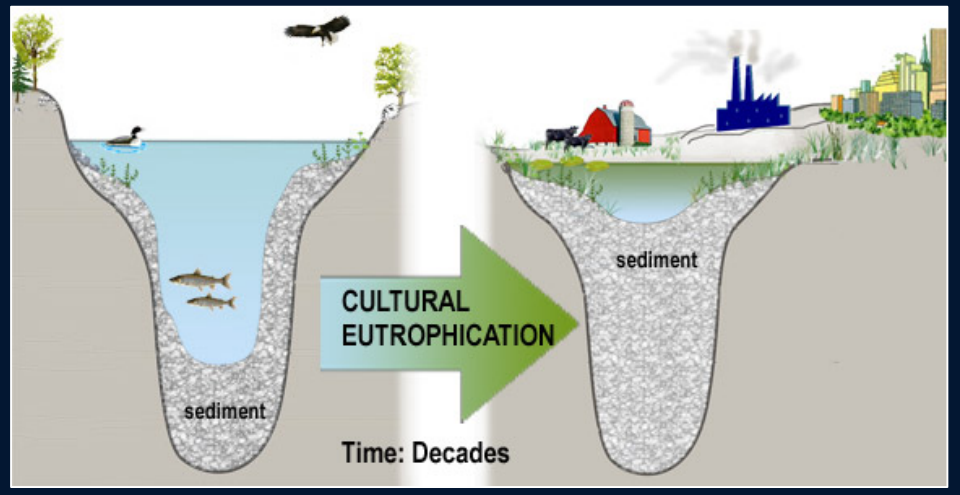
Eutrophication

- A nutrient enrichment process
  - Algae growth and nutrient loading



(Image: https://creeklife.com/blog/cultural-eutrophication-an-accelerator/)

Stressors

- Oxygen depletion
- Cyanotoxins
- Sedimentation
- Reduction or loss of fish host

Benefits

- Increased food availability
  - Growth
  - Total length

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Questions

- 1) Is there a significant relationship between *Pyganodon grandis* age and trophic state of a lake?
- **2) Do *Pyganodon grandis* growth rate and estimated maximum size vary among lake trophic states?**
- 3) Is there a significant relationship between *Pyganodon grandis* survival rate and trophic state of a lake?

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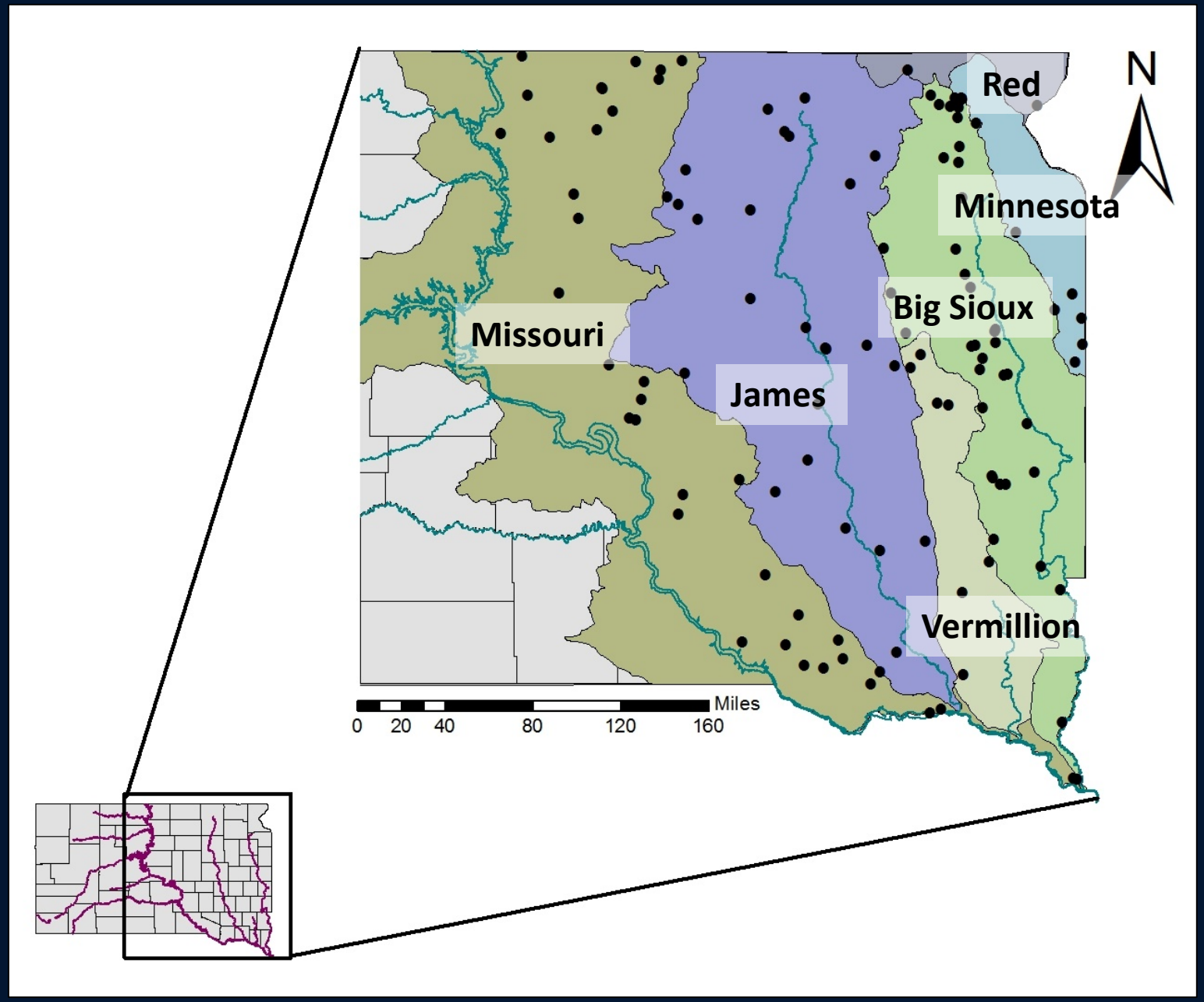
Study Area

- South Dakota D.E.N.R publicly owned and managed lakes.

Sampled Lakes	
River Basin	Number of Lakes
Big Sioux	31
James	33
Minnesota	6
Missouri	37
Red	2
Vermillion	7



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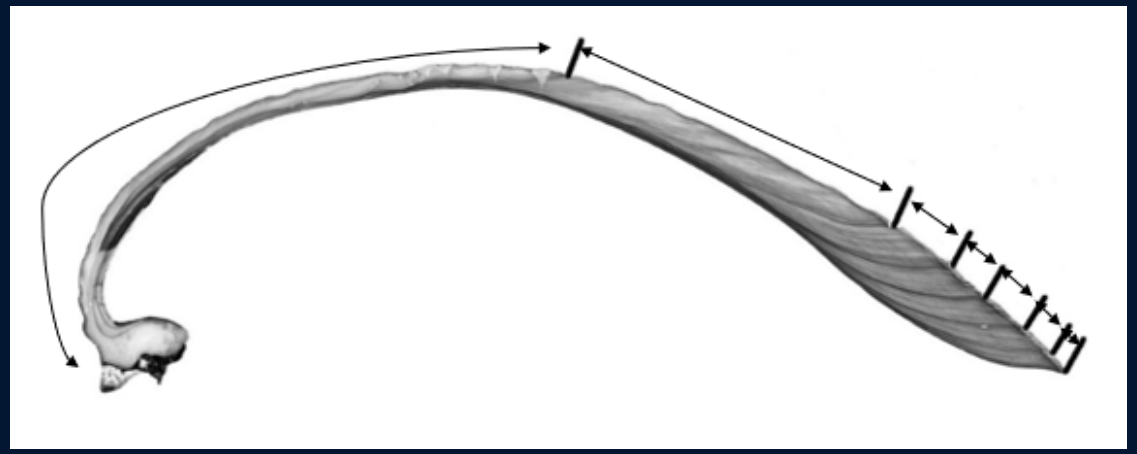
Data Collection

Field Methods

- Two-person- hour search
- Secchi depth
- Shell measurements
- Sacrifice of live *P. grandis* (n=10)

Laboratory Methods

- Thin-sectioning of shells (Neves & Moyer 1988)
- Age (years) and growth (cm) were counted and measured.



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Age & Growth Analysis

- Data Analysis
  - Trophic State Index (SD) = 60 – 14.41*ln(SD)
  - Von Bertalanffy: $L(t)= L_{inf}(1-e^{-K(t-t0)})$
    - L_{inf} = estimated maximum mean size
    - K = growth rate
- Comparisons among trophic states
  - ANOVA

Trophic State Index	
Class	Range
Mesotrophic:	35-50
Eutrophic:	51-65
Hypereutrophic:	65-100

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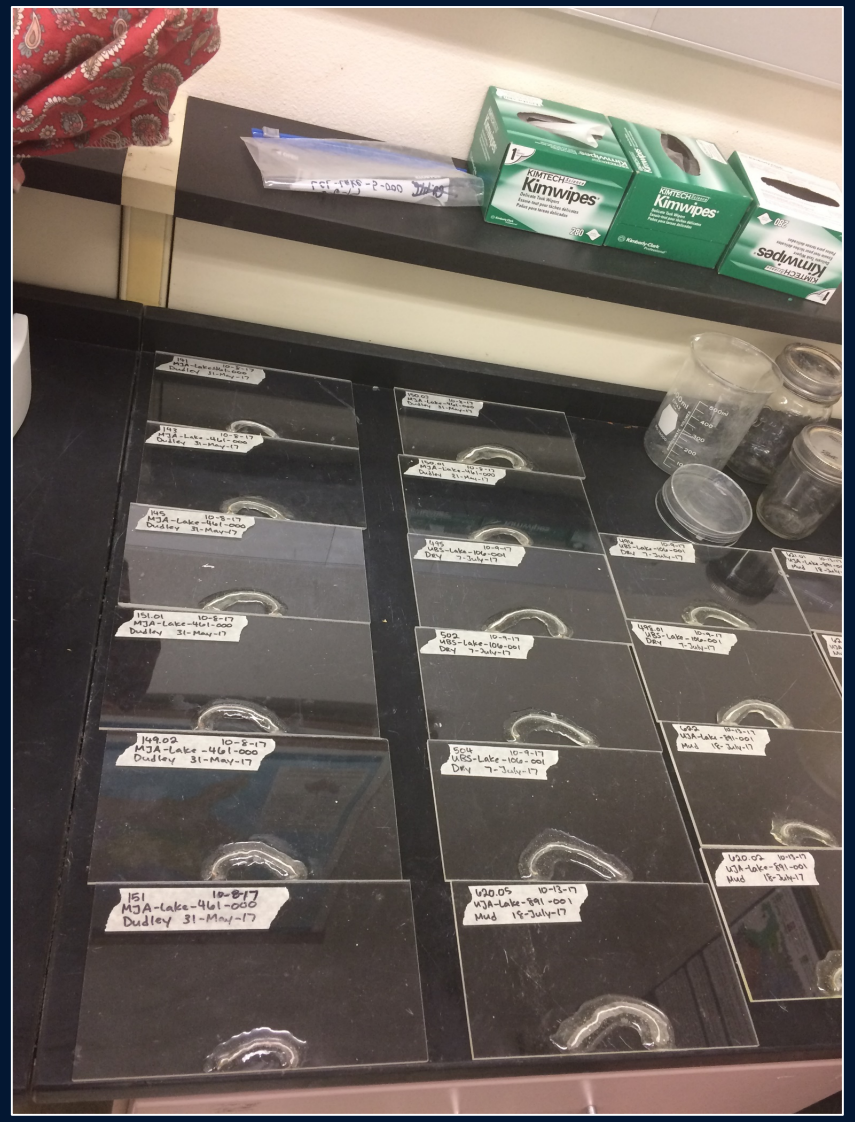
Results

- 2017 Survey
  - 9 total species found
  - 43% of lakes had freshwater mussels
  - 36% of lakes had *Pyganodon grandis*
- 192 specimens
  - Average age of 6.4 years
  - Average total length of 7.6 cm
- 21 lakes (18% of lakes)
  - 3 mesotrophic lakes
  - 13 eutrophic lakes
  - 5 hypereutrophic lakes



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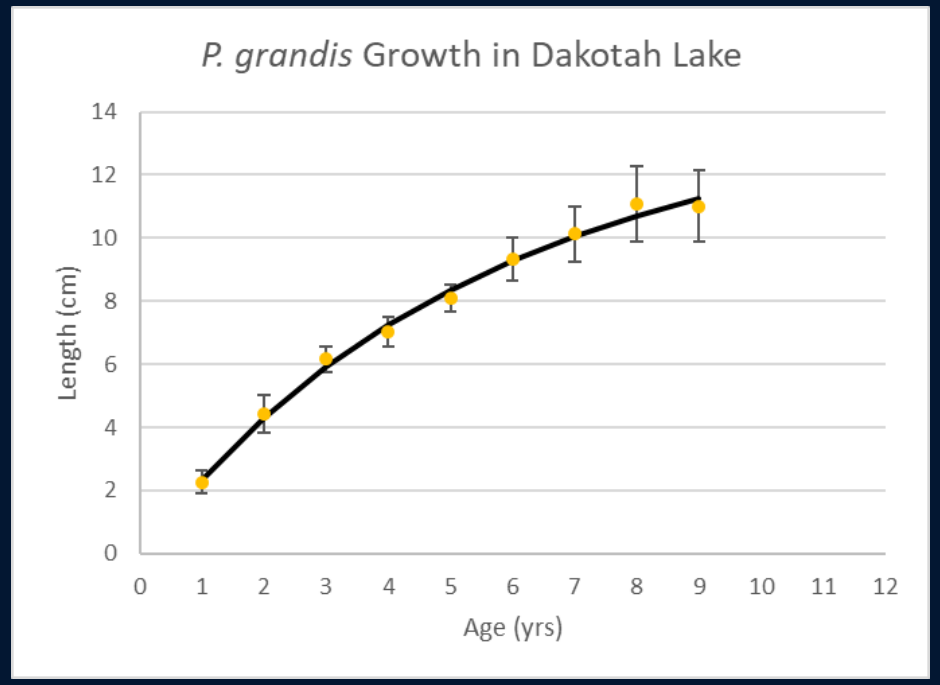
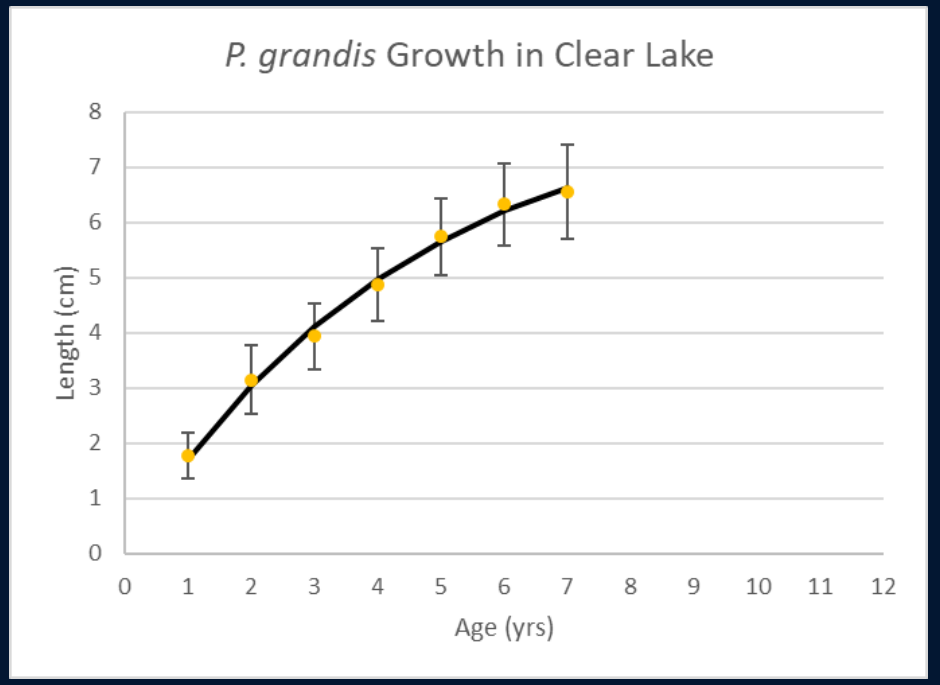
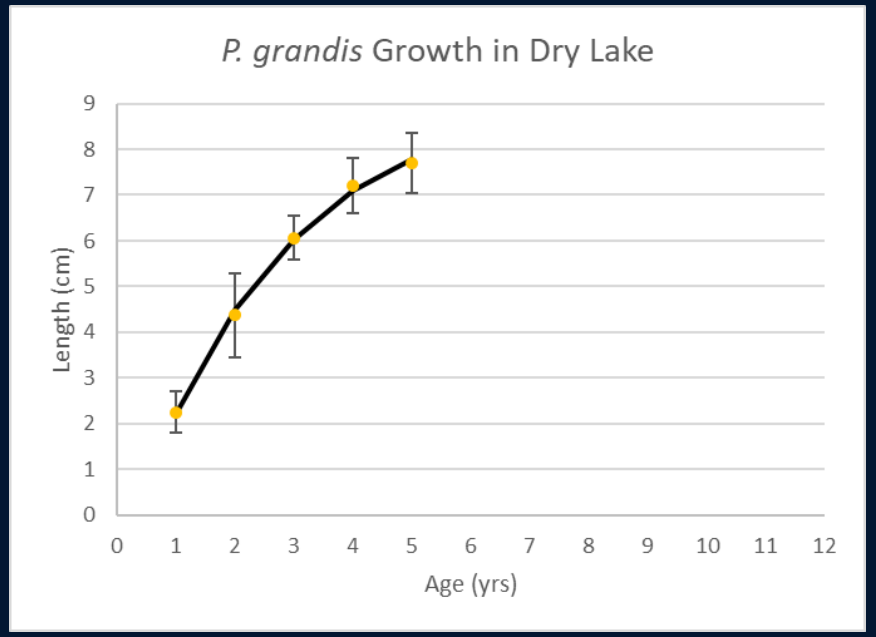


- Mesotrophic
- L_{inf}= 13.85
- K= 0.18



- Eutrophic
- L_{inf}= 8.36
- K= 0.23



- Hypereutrophic
- L_{inf}= 9.29
- K= 0.39

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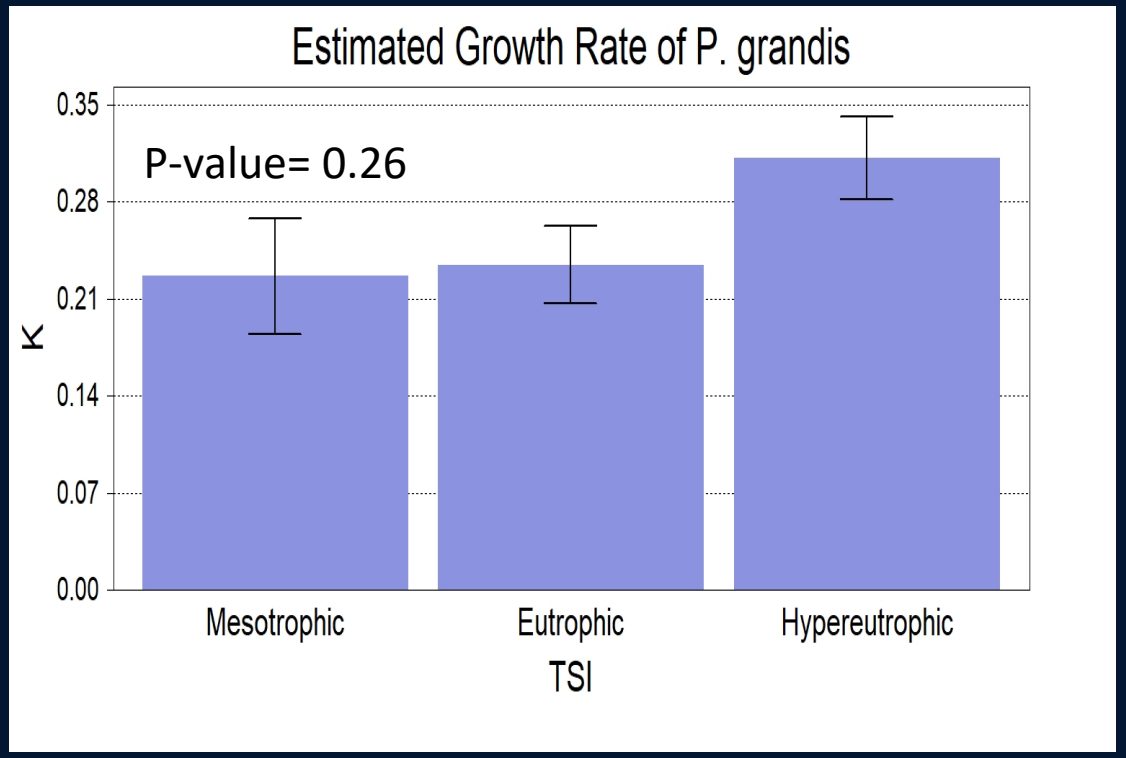

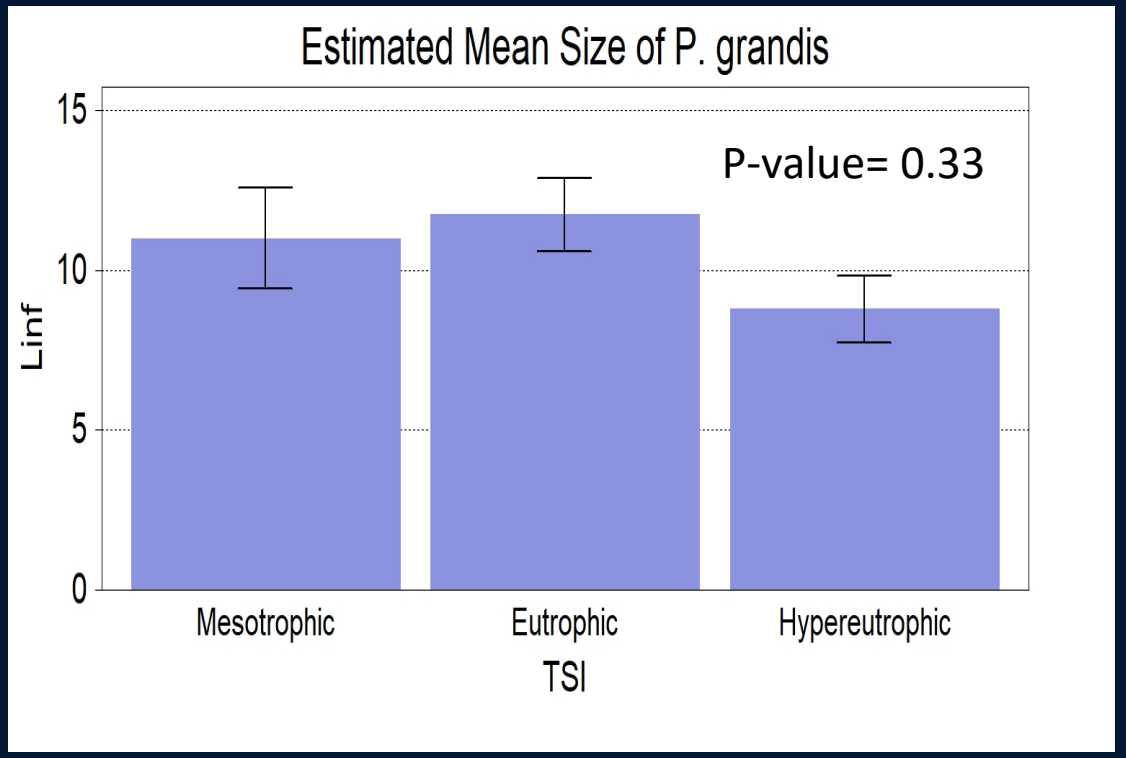

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Conclusions

- Hypereutrophic lakes had the quickest growth rate (K), but had the smallest estimated mean size.
  - Increase in food availability has shown increase in growth rate (Arter 1989, Bauer & Wächtler 2000).
  - Faster growth correlates with shorter life spans (Bauer 1992, Patzner & Müller 2001).
- No statistical differences in growth and estimated mean size among trophic states.

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