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

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Pyganodon grandis growth along a trophic state gradient
in eastern South Dakota lakes

Katherine M. Wollman & Nels H. Troelstrup, Jr.



SOUTH DAKOTA STATE UNIVERSITY

Department of Natural Resource Management

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



Eutrophication

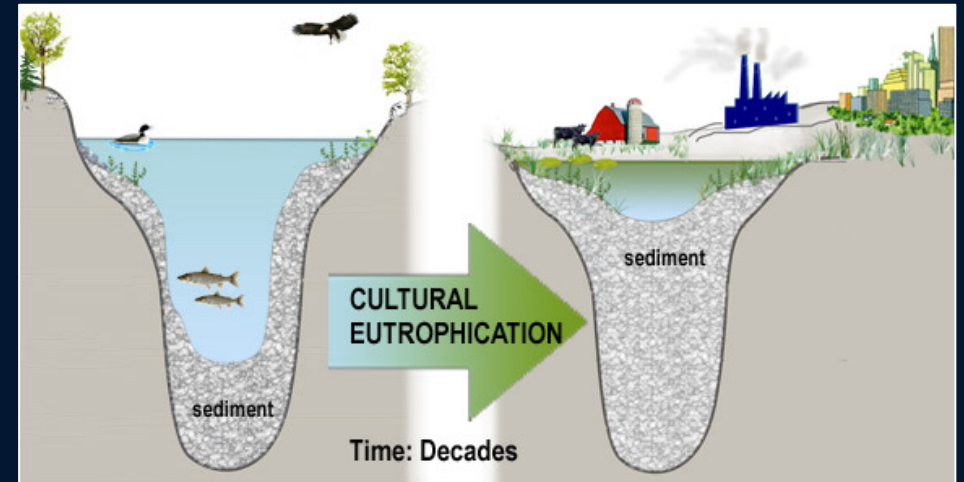
- A nutrient enrichment process
 - Algae growth and nutrient loading

Stressors

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

Benefits

- Increased food availability
 - Growth
 - Total length



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



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Questions

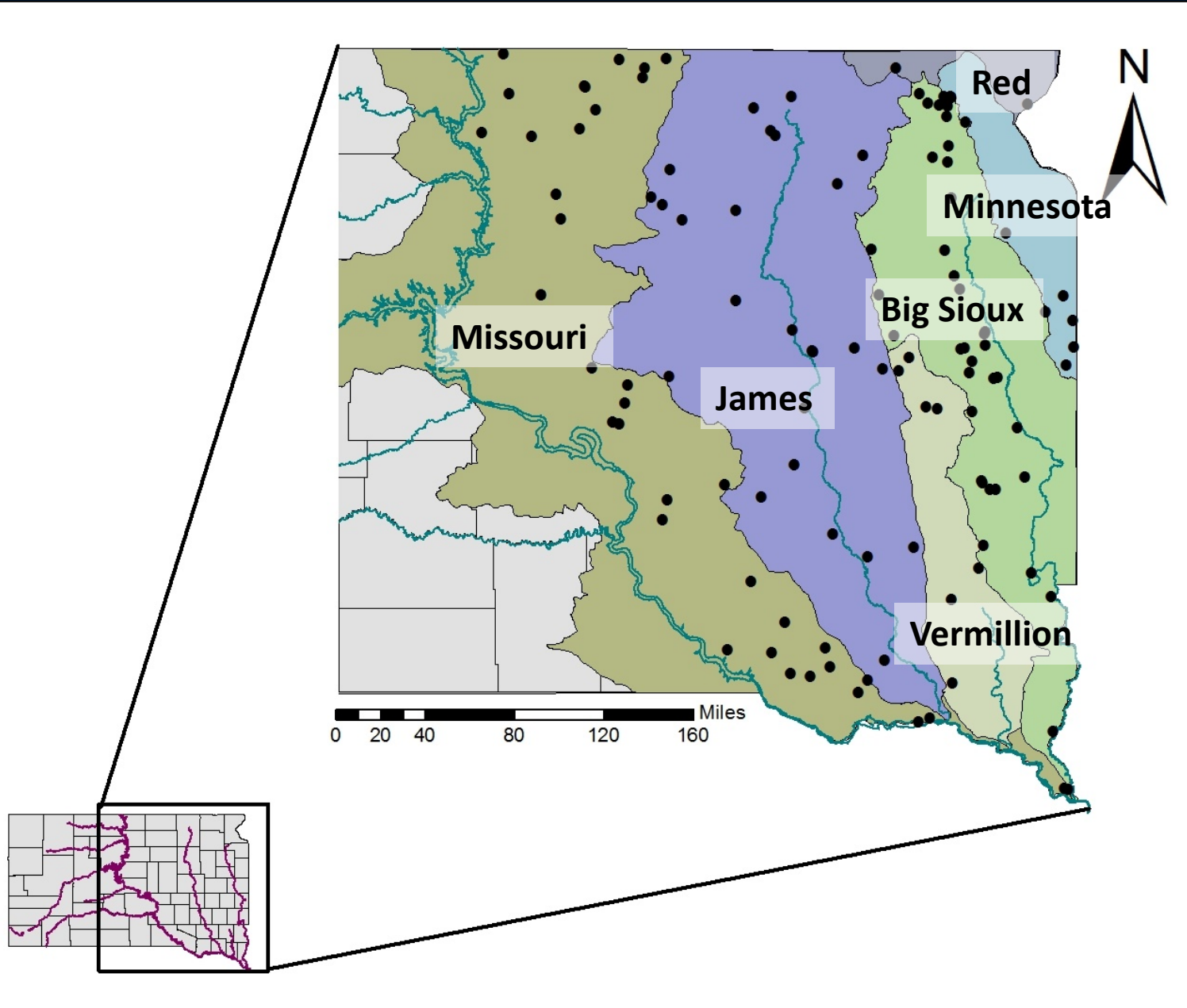
- 1) Is there a significant relationship between *Pyganodon grandis* age and trophic state of a lake?
- **2) Do *Pyganodon grandis* growth rate and estimated maximum size vary among lake trophic states?**
- 3) Is there a significant relationship between *Pyganodon grandis* survival rate and trophic state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



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



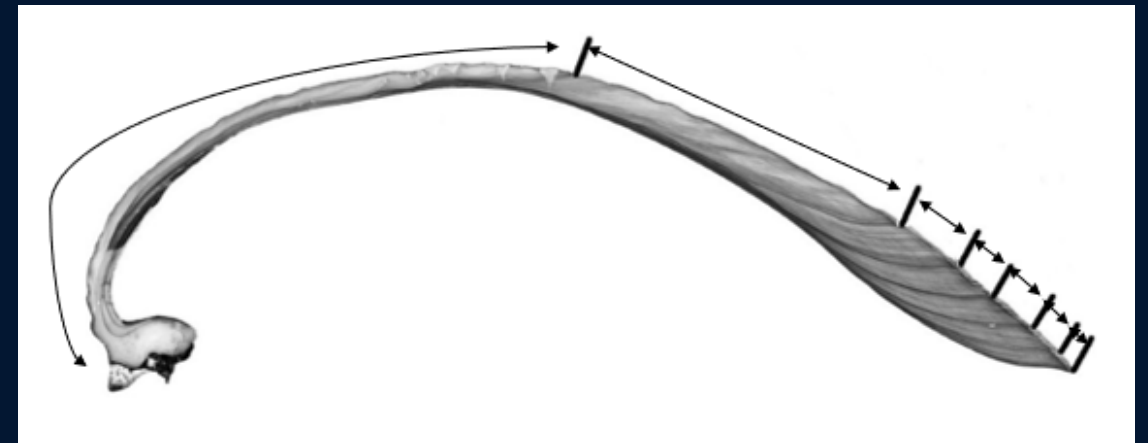
Data Collection

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.



Age & Growth Analysis

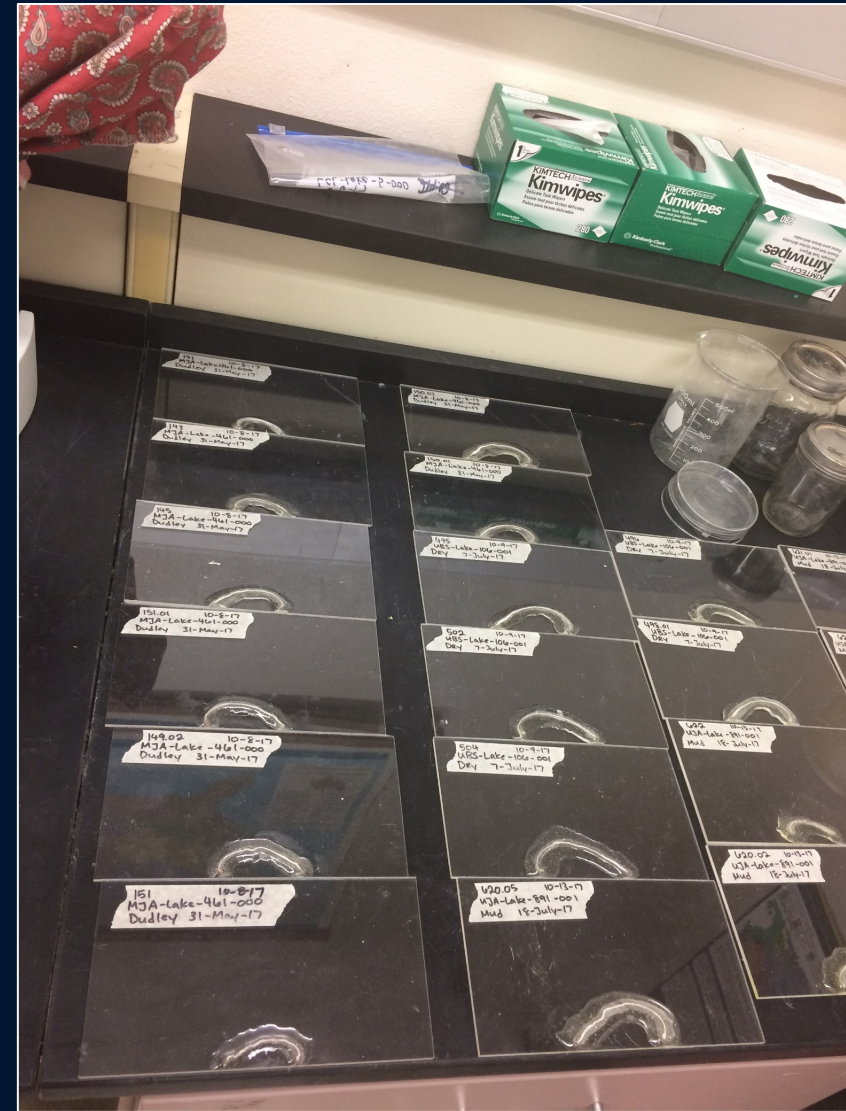
- Data Analysis
 - Trophic State Index (SD) = $60 - 14.41 * \ln(SD)$
 - Von Bertalanffy: $L(t) = L_{inf} (1 - e^{-K(t-t_0)})$
 - L_{inf} = estimated maximum mean size
 - K = growth rate
- Comparisons among trophic states
 - ANOVA

<u>Trophic State Index</u>	
<u>Class</u>	<u>Range</u>
Mesotrophic:	35-50
Eutrophic:	51-65
Hypereutrophic:	65-100

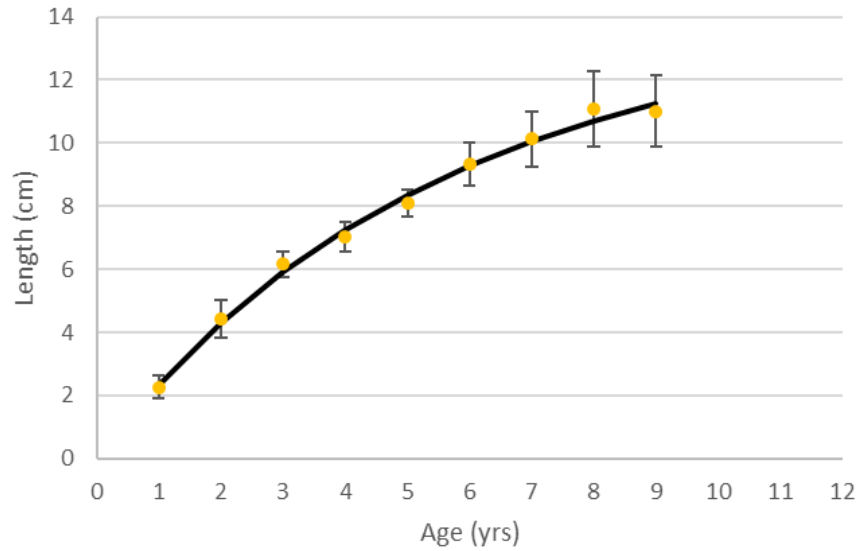


Results

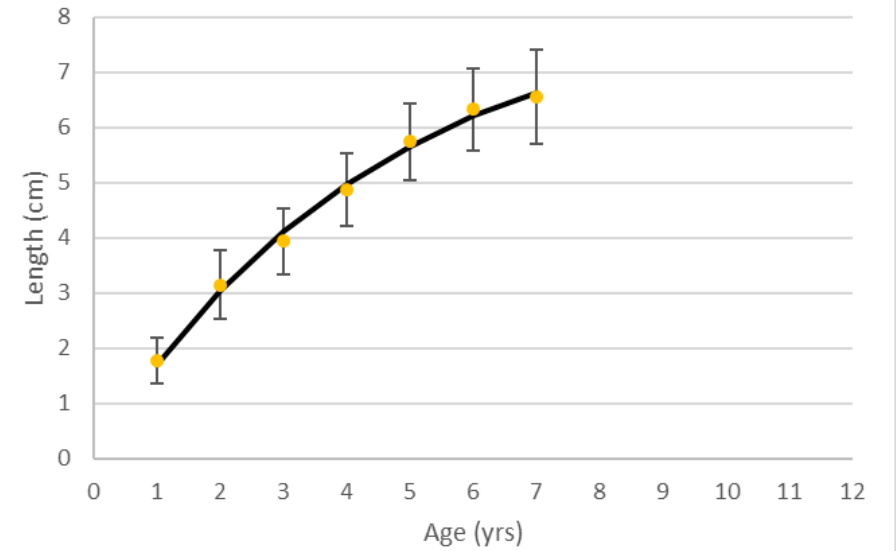
- 2017 Survey
 - 9 total species found
 - 43% of lakes had freshwater mussels
 - 36% of lakes had *Pyganodon grandis*
- 192 specimens
 - Average age of 6.4 years
 - Average total length of 7.6 cm
- 21 lakes (18% of lakes)
 - 3 mesotrophic lakes
 - 13 eutrophic lakes
 - 5 hypereutrophic lakes



P. grandis Growth in Dakotah Lake

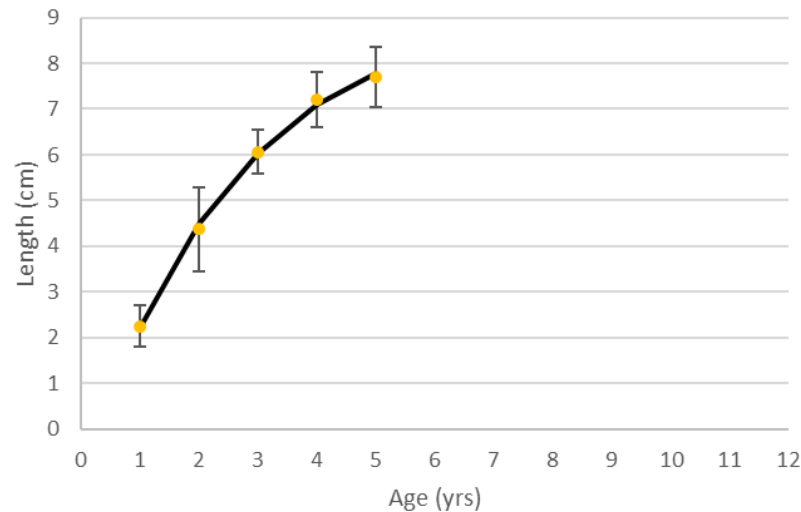


P. grandis Growth in Clear Lake



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

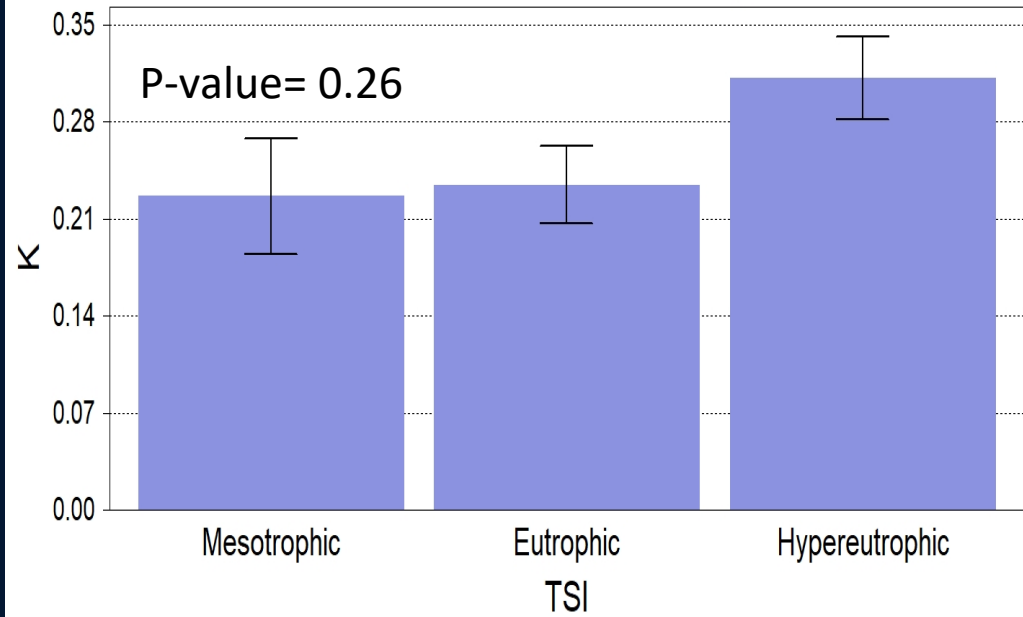
P. grandis Growth in Dry Lake



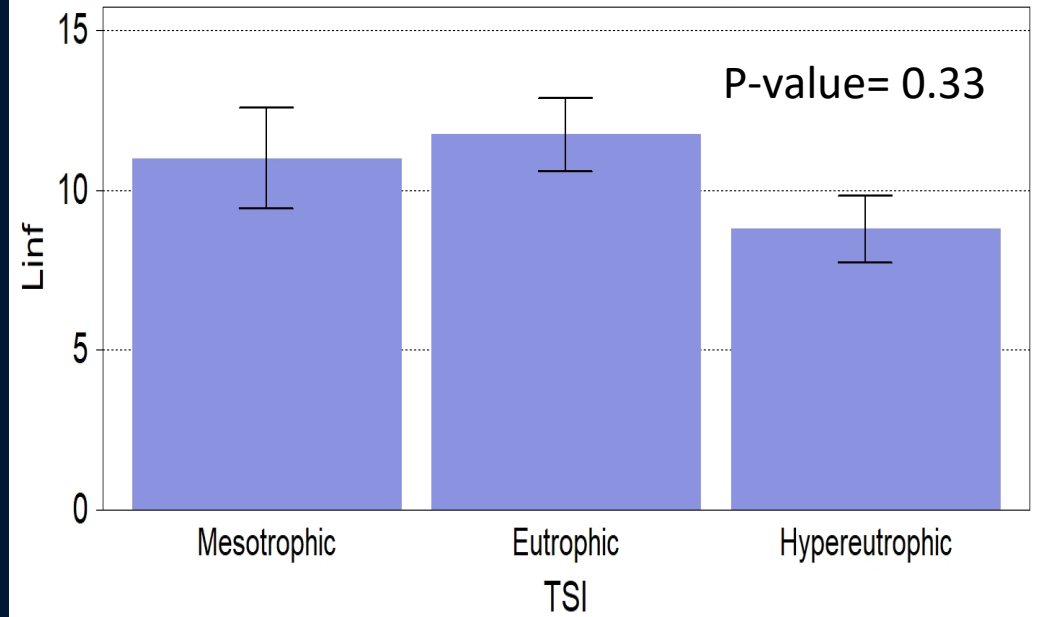
- Eutrophic
- $L_{inf} = 8.36$
- $K = 0.23$
- Hypereutrophic
- $L_{inf} = 9.29$
- $K = 0.39$



Estimated Growth Rate of *P. grandis*



Estimated Mean Size of *P. grandis*



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.



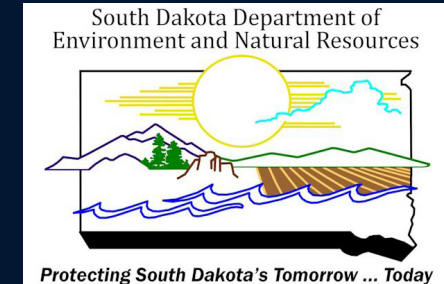
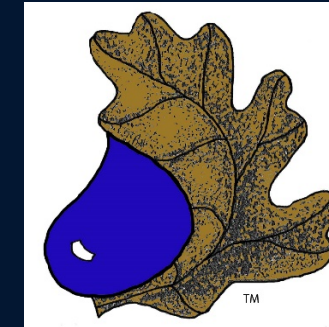
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