ANTHROPOGENIC EFFECTS ON DIATOM POPULATIONS WITHIN FALLEN LEAF LAKE, SIERRA NEVADA, CALIFORNIA

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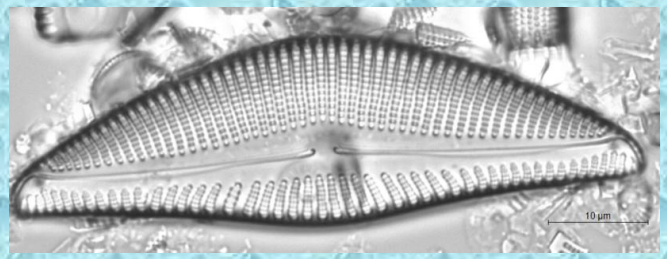
Objective

To use paleolimnological proxies to assess the impact of atmospheric nitrogen deposition, land use changes, and climatic variability on Fallen Leaf Lake over the past ~200 years



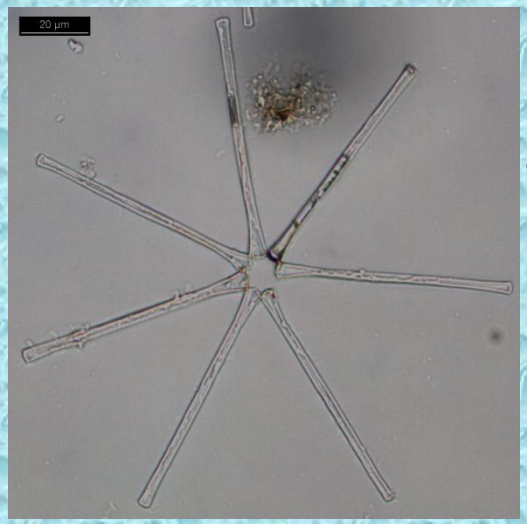
Diatoms

- Diatoms are unicellular siliceous golden algae that live in any moist habitat
- Diatoms in sediment cores can be used to determine past lake level, water chemistry, & paleoecology
- They are sensitive to biological, chemical, & physical changes in water
  - Eutrophication
  - pH
  - Salinity/Alkalinity

Diatom Community Changes

Anthropogenic Nitrogen Deposition

- **Beartooth Mountians** (Wolf et al. 2001; 2003)
- **Colorado Front Range** (Saros et al. 2003; 2005)
  - Increasing *A. formosa* & *Fragilaria crotonensis*



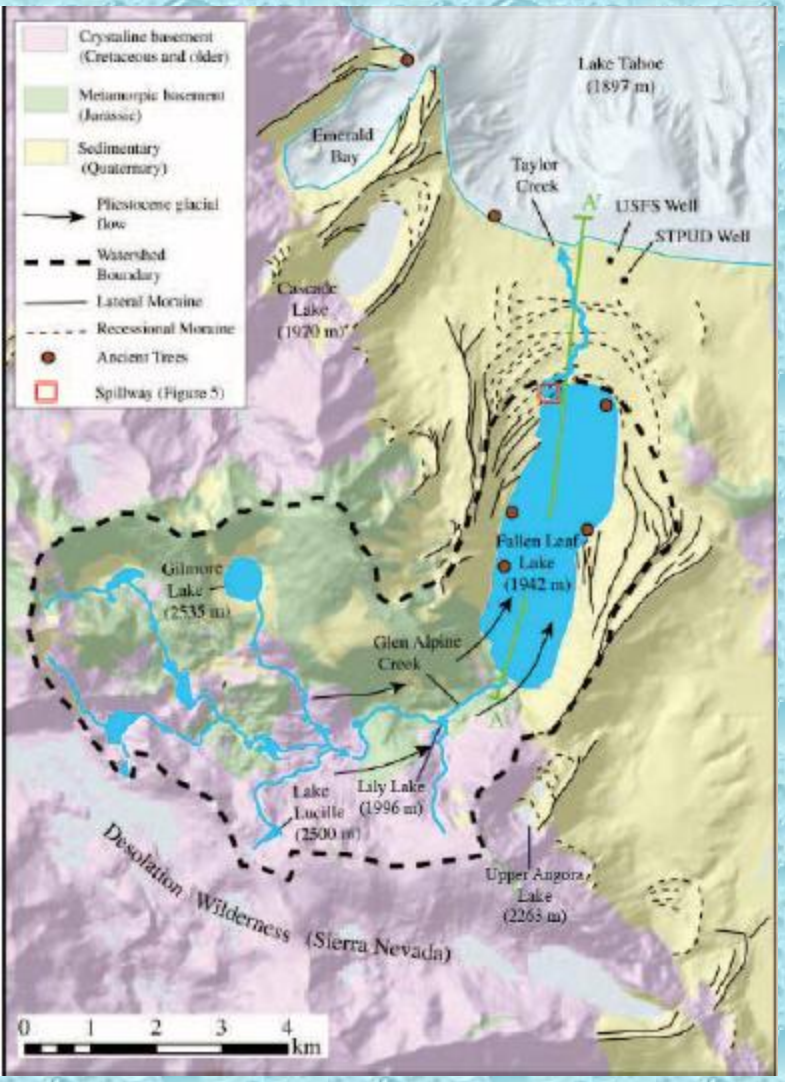
Asterionella formosa

- **Lake Tahoe**
  - Increasing *F. crotonensis* (Byron & Eloranta, 1984)
  - Increasing shoreline algae and araphid pennate diatoms (Winder & Hunter, 2008)

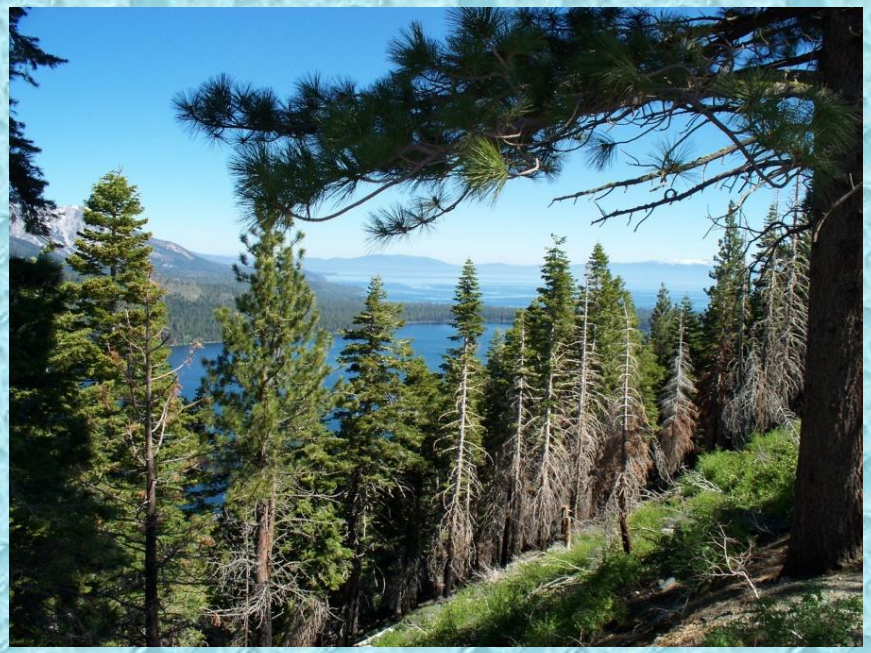
Climate Change & Nitrogen Deposition

- **Arctic Lakes**
  - *Discostella* spp. & *Cyclotella* spp. has replaced small benthic taxa (Hobbs et al., 2010)

Study Area



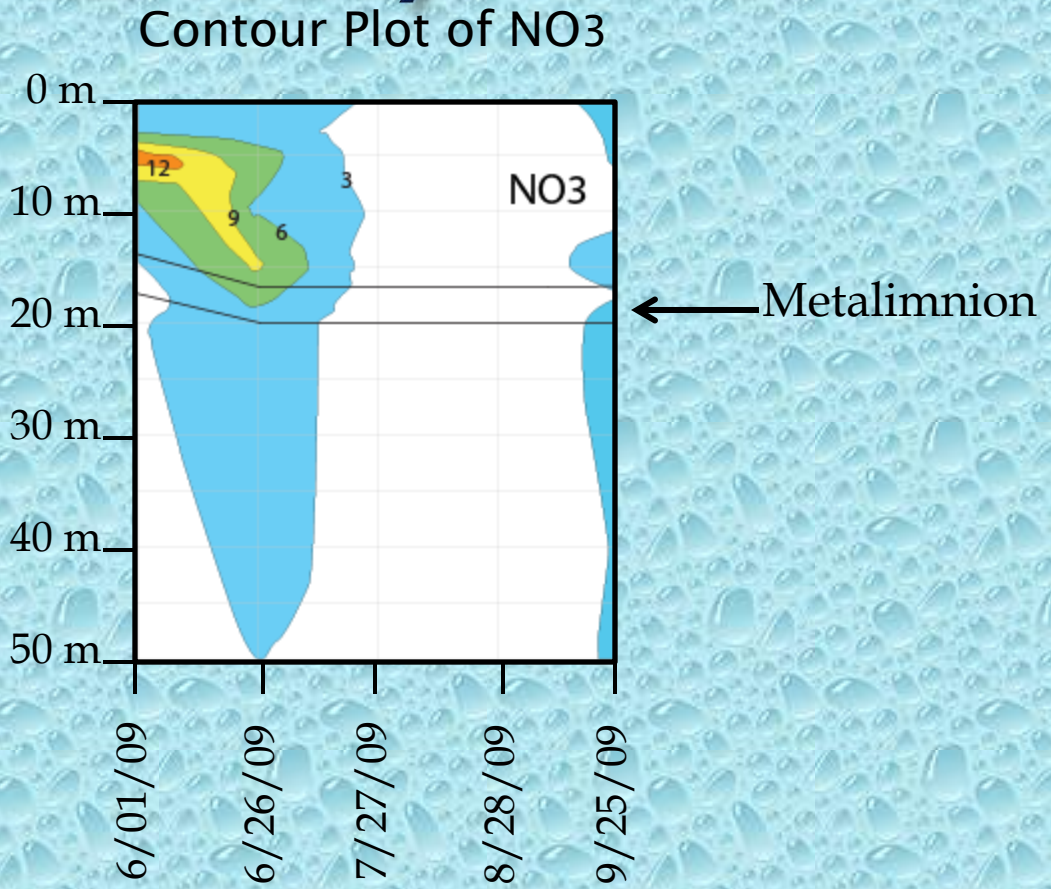
Modified from Kleppe et al., (2011)



- Near ultra-oligotrophic (Reuter et al., 1996)
- Moderately impacted by homes and motorized activities
- Gravity core from lake center taken in 2010

A. formosa - a dominant component of FLL today

09/02/2011



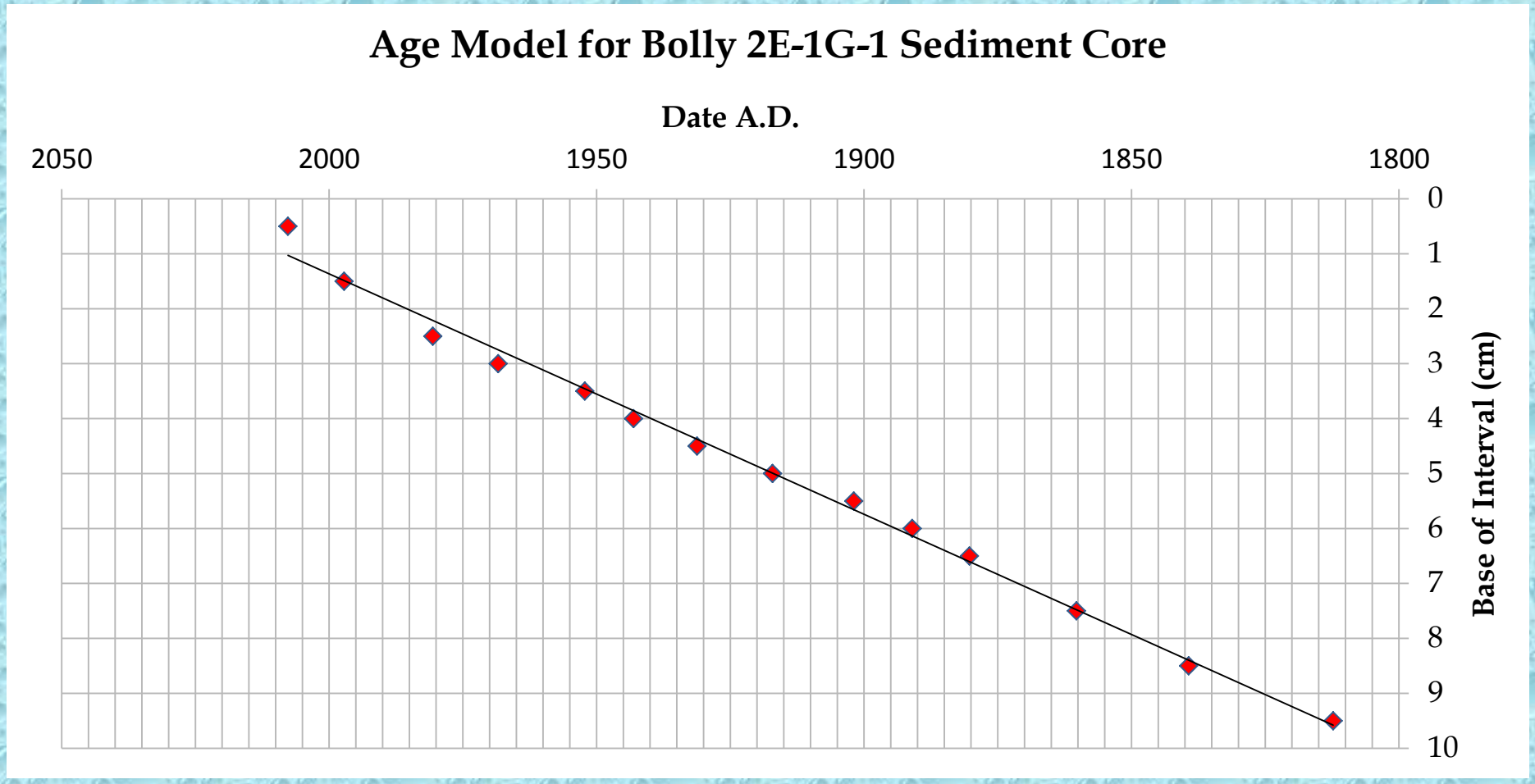
A. formosa comprises a large component of the phytoplankton and is also found in Gilmore Lake.

- Is this related to N-deposition?

Overview of Methodology

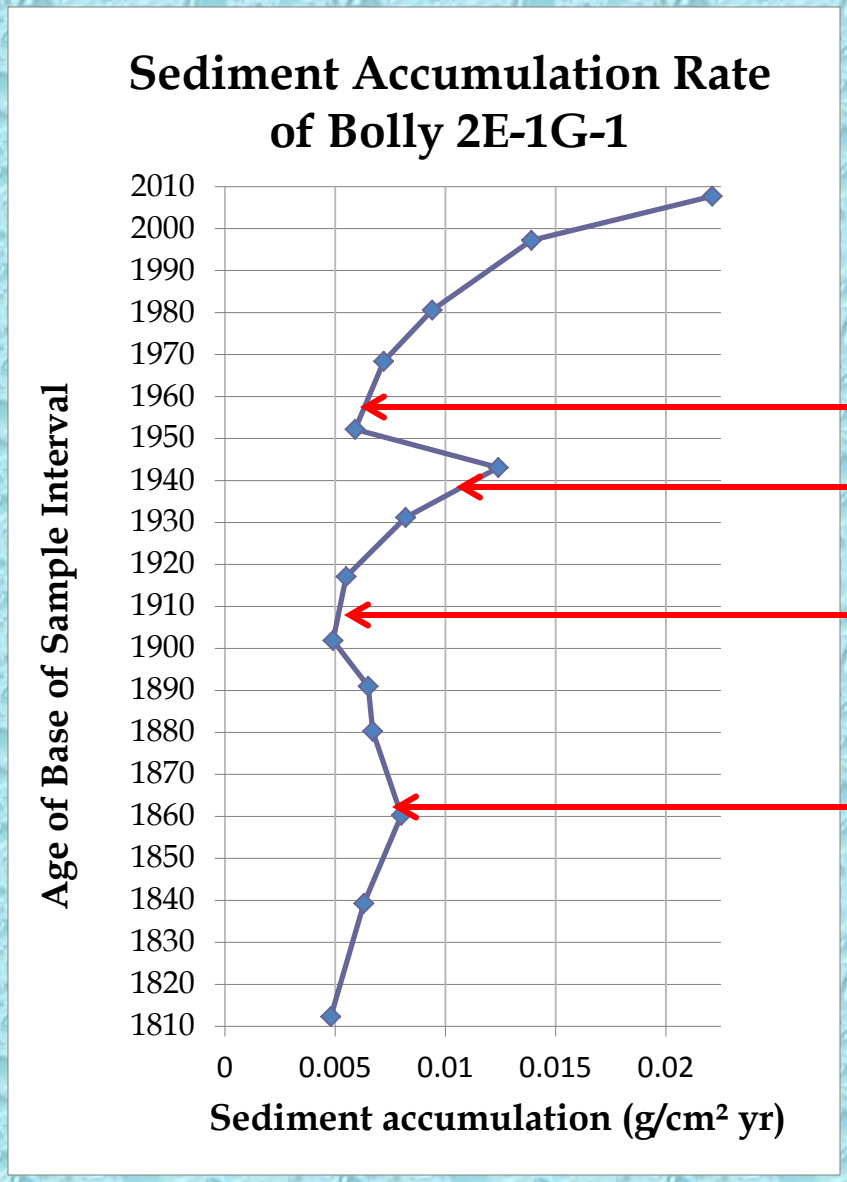
- Processed the top 10 cm of the ~40 cm sediment core Bolly FLL10 2E-1G-1 in 0.5 cm increments
- Completed 200 valve counts of diatoms for 10 samples in the top 10 cm of the core
- Identified diatom species present and any species composition changes
- Water quality data collected during run-off

^{210}Pb Age Model



Analyses run at Harmon Research Center by Dan Engstrom.

Sediment Accumulation in FLL



1955-Dams for reservoir below Lily Lake washed away in storm

1938-Glen Alpine Creek rerouted by storm near FLL

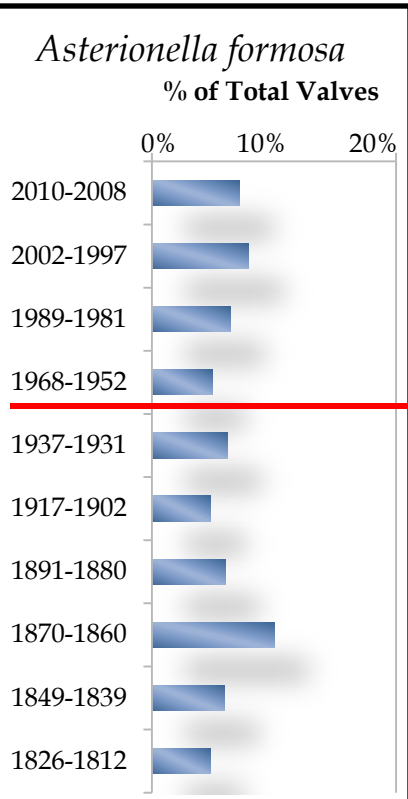
1908-Anita Baldwin built 1st dam at FLL outlet

1861-Nathan Gilmore brought cattle to FLL

Analyses run at Harmon Research Center by Dan Engstrom

Preliminary Diatom Results from Gravity Core

- The gravity core shows that *A. formosa* has been persistent since at least 1812
- *Aulacoseira subarctica* has declined over the past 60 years in favor of *F. tenera* group



Water Quality Doesn't Support N-deposition

Sample Location	Sample Depth (m)	Date Sampled	NH4-N (ppb)	NO3/NO2-N (ppb)	DP-P (ppb)	Secchi Depth (m)
Gilmore Lake	0	8/7/2011	5	1	7	13 m (8/7/2011) & 11.5 m (10/15/2011)
Gilmore Lake	10	8/7/2011	2	1	3	
Gilmore Lake	20	8/7/2011	1	1	3	
Gilmore Lake	30	8/7/2011	1	1	5	
Gilmore Lake	40	8/7/2011	1	1	4	
Gilmore Lake	50	8/7/2011	1	35	4	
Lily Lake	0	6/27/2011	3	21	3	3.5 m (10/1/2011)
Upper Angora Lake	0	6/27/2011	2	21	3	6.5 m (6/27/2011) & 6.25 m (10/1/2011)
Upper Angora Lake	5	6/27/2011	2	22	3	
Upper Angora Lake	8	6/27/2011	9	23	2	
Upper Angora Lake	10	6/27/2011	24	24	3	

Although FLL has higher NO_3 values during spring run-off, data from Gilmore Lake show NO_3 may not be coming from the snowpack.

Summary

- **The sedimentation rate at FLL has increased since 1950 while *F. tenera* group has increased in and *A. subarctica* has decreased**
- ***A. formosa* is not a newcomer; chronic high abundance (5-10%) since 1812**
- **Abundant in Gilmore Lake water column (10/15/2011)**
- **The data does not support anthropogenic N-deposition as a factor in the recent diatom community composition**

Continuing Work

Fallen Leaf Lake

Sediment & Geochemical Analyses

- Sediment Core Bolly 2E-1G-1
  - ➢ Carbon & Nitrogen Concentration & Isotopes
  - ➢ Phosphorous Concentration
  - ➢ Diatom Analysis & Ecologic Interpretation

Gilmore Lake (Low Impact)

- Sediment core - summer 2012

Questions for the Future

- **What other factors may account for chronic A. formosa in FLL & Gilmore Lake?**
  - **Land use changes**
  - **Climate**
  - **Fish manipulations**

- **Are any of the changes seen in FLL also seen in other similar lakes inside and outside of the Tahoe basin?**

Acknowledgments

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LacCore.org
National Lacustrine Core Facility