

# SQUAM LAKE'S WATER QUALITY THROUGH TIME



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## Introduction

There have been many studies on Squam Lake's water quality in the past few years. But there has not been a study that can provide details of Squam Lake's past water quality. Diatoms are a great way to understand the water quality of lakes and rivers because they are sensitive to very subtle changes in environmental conditions and disturbances (Omar 2010). Diatoms integrate changes in water chemistry, including nitrogen, phosphates, and other pollutants as well as water quality parameters such as pH and conductivity. They are excellent indicators of eutrophication especially when identified to the species level. Diatoms can be used to for past water quality because when they die, their silicate frustules settle onto the bottom of the lake bottom and are preserved in sediments as fossils. Lake bottom sediments accumulate in chronological order and so record the sequence of the diatom species present in the lake through time (National Park Service 2011). In this study diatoms were analyzed from a sediment core from Squam Lake in 2014 which has sediments that date back to the 1800s. These results are then compared to diatoms in a pond that is undergoing eutrophication.

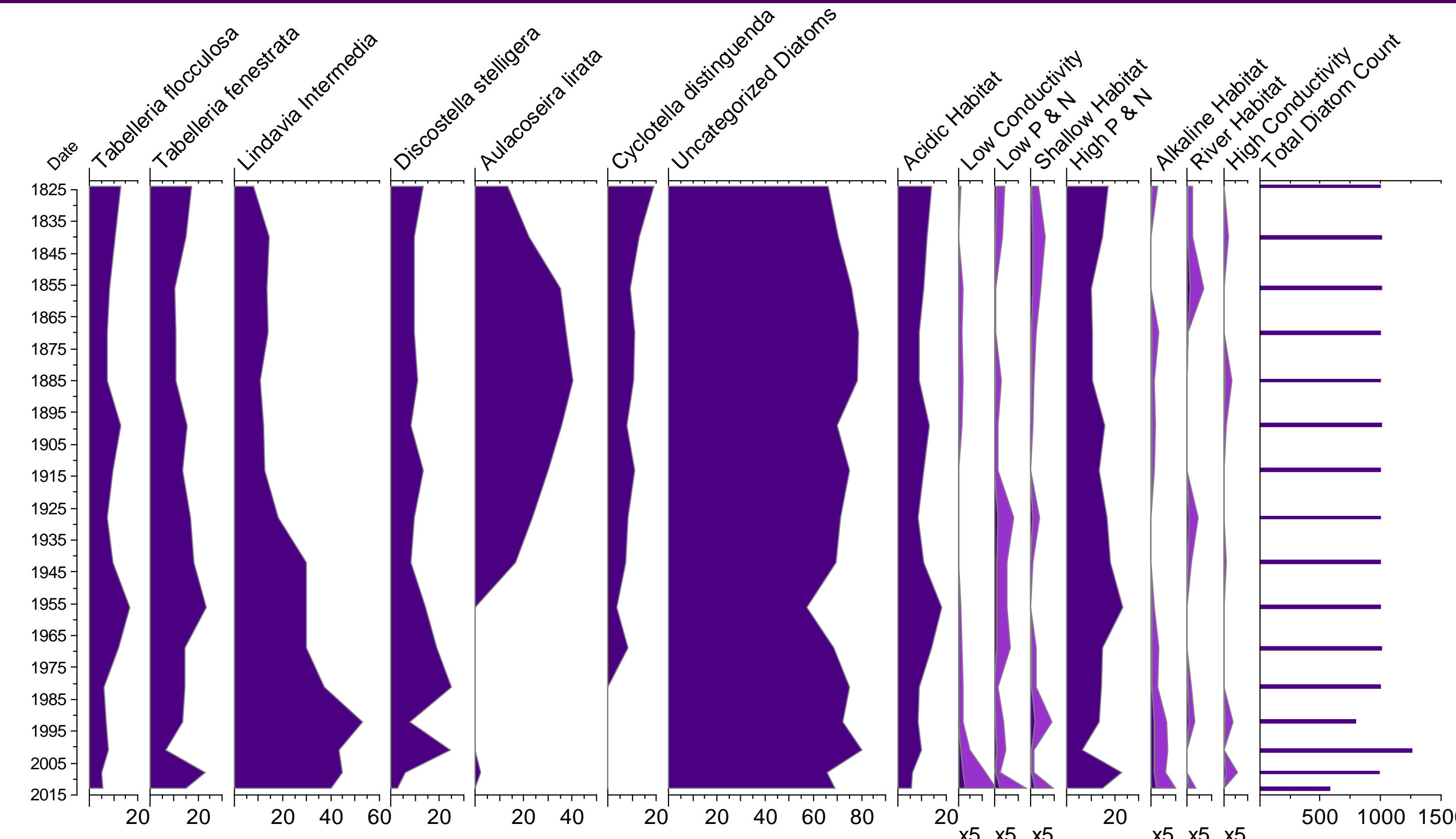


Location of the Sediment Core taken at Squam Lake

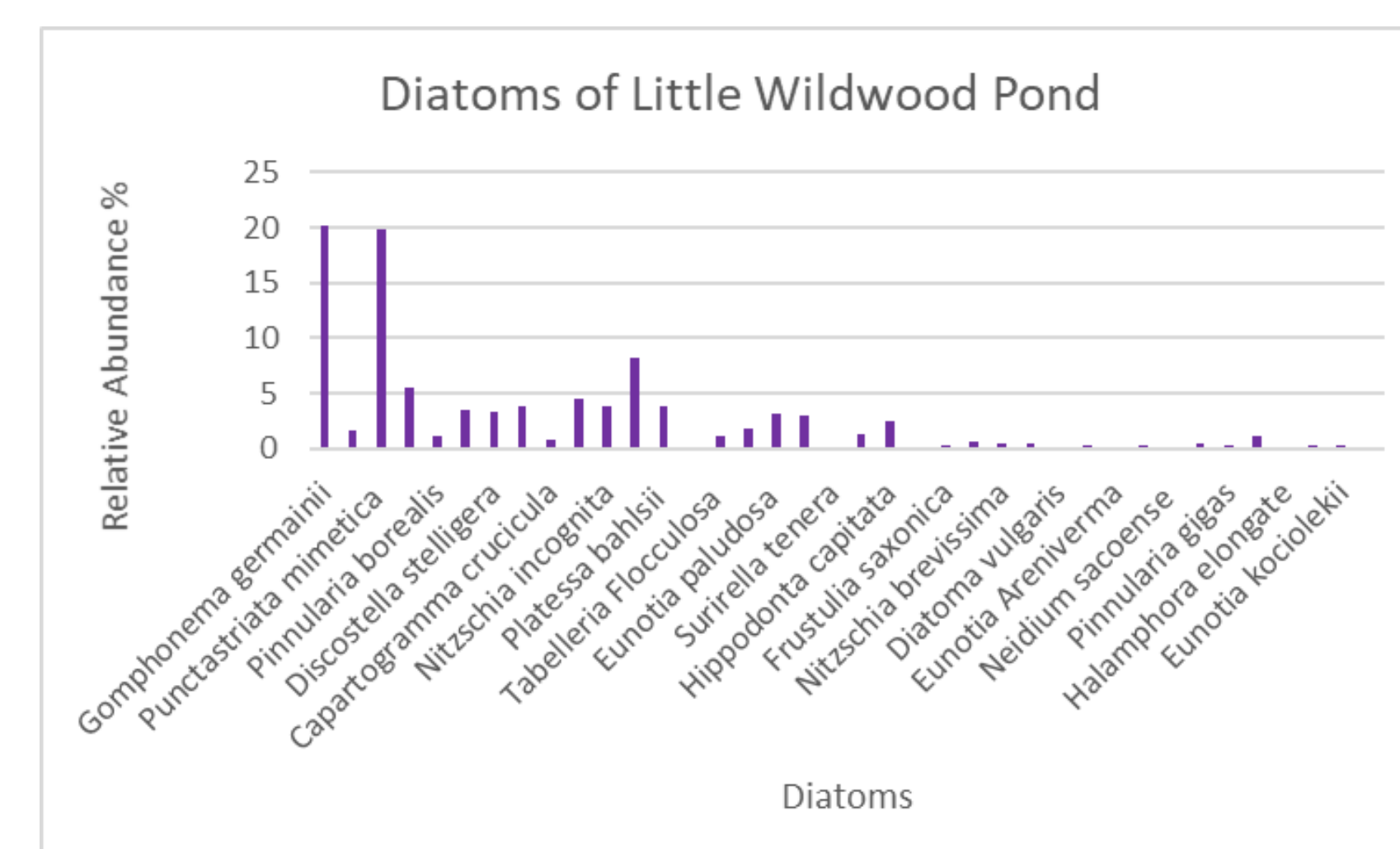
## Methods

The method used to collect the diatoms at the Little Wildwood Pond was to go around by canoe to different areas around the pond and do vertical plankton tows. Diatoms were also collected near the edge of the pond for benthic diatoms. The samples were prepared on microscope slides by a standard procedure (Freshwater Algae of North America: Ecology and Classification). Diatoms from Squam Lake were extracted from a sediment core and analyzed every two centimeters down-core. To identify the diatoms, I used a dichotomous key in the Freshwater Algae of North America: Ecology and Classification to identify the species at the family level, and then, to identify to the species level, a dichotomous key in the book: The Diatoms of The United States Exclusive of Alaska and Hawaii and the website: North American Diatoms. To make sure the sample was representative, I identified about one thousand diatoms or counted diatoms along ten transects (half the slide), whichever came first After they were identified, I took microscope images of most of the species. Then researched each species' habitat preferences to understand the water quality.

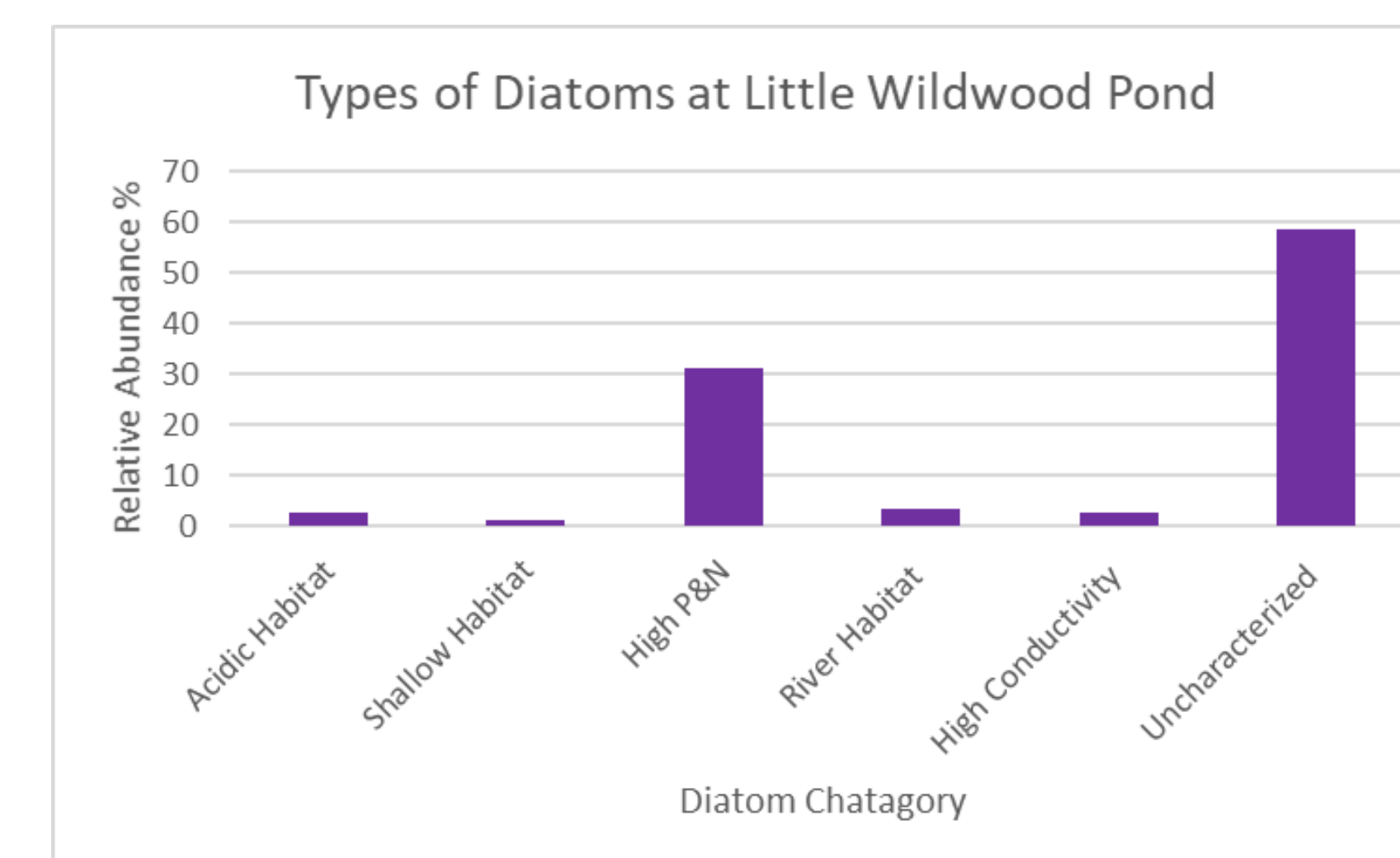
## Results



Graph 1 Most abundant Diatoms and Categorized Diatoms of Squam Lake . Taken from a 32cm sediment core dated from 2014 to 1825



Graph 2 Diatoms collected at Little Wildwood in August of 2018 with a vertical plankton tow.



Graph 3 Diatoms collected at Little Wildwood grouped together to characterize the type of diatoms found.

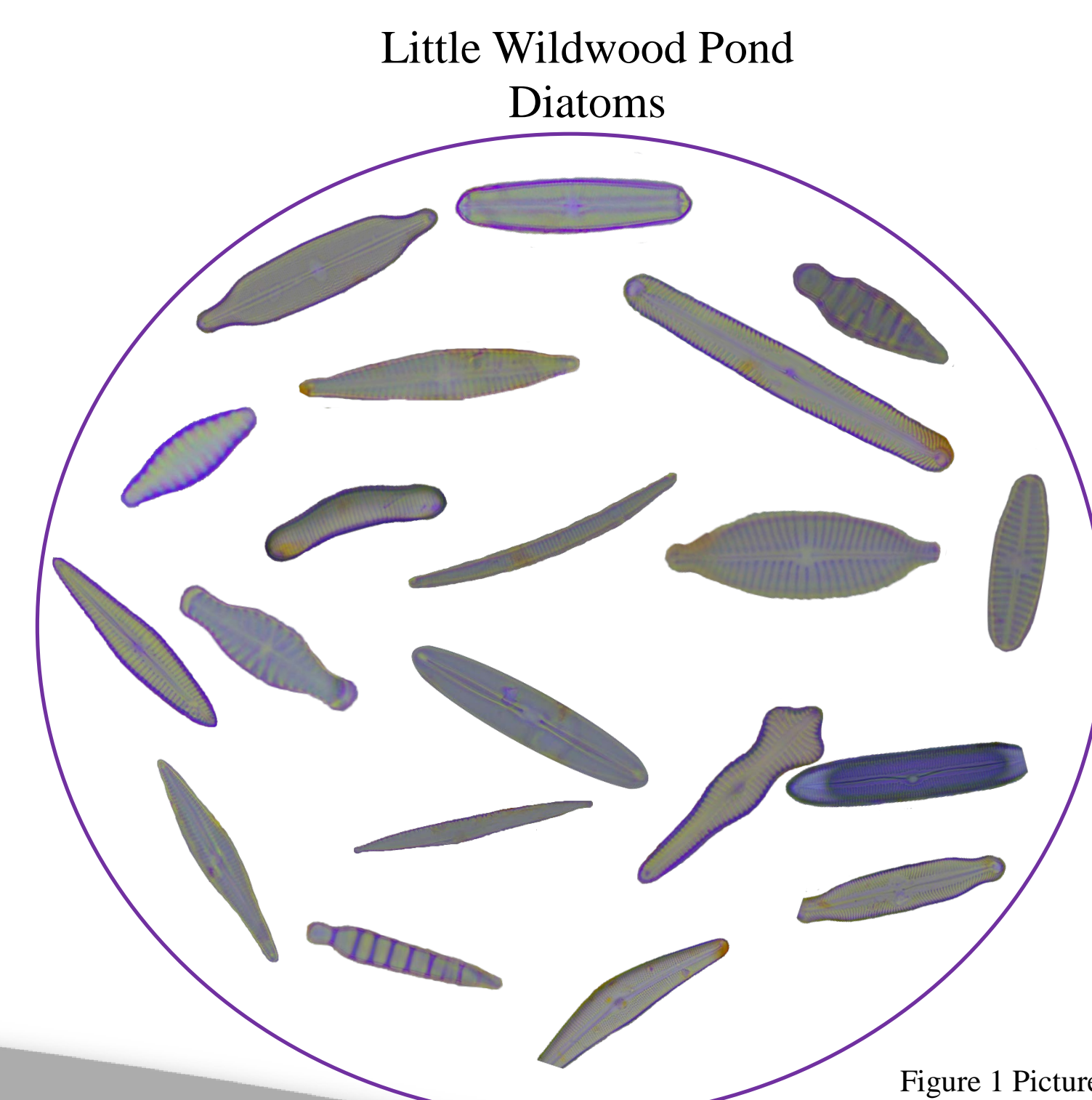


Figure 1 Pictures of the diatoms from Little Wildwood Pond

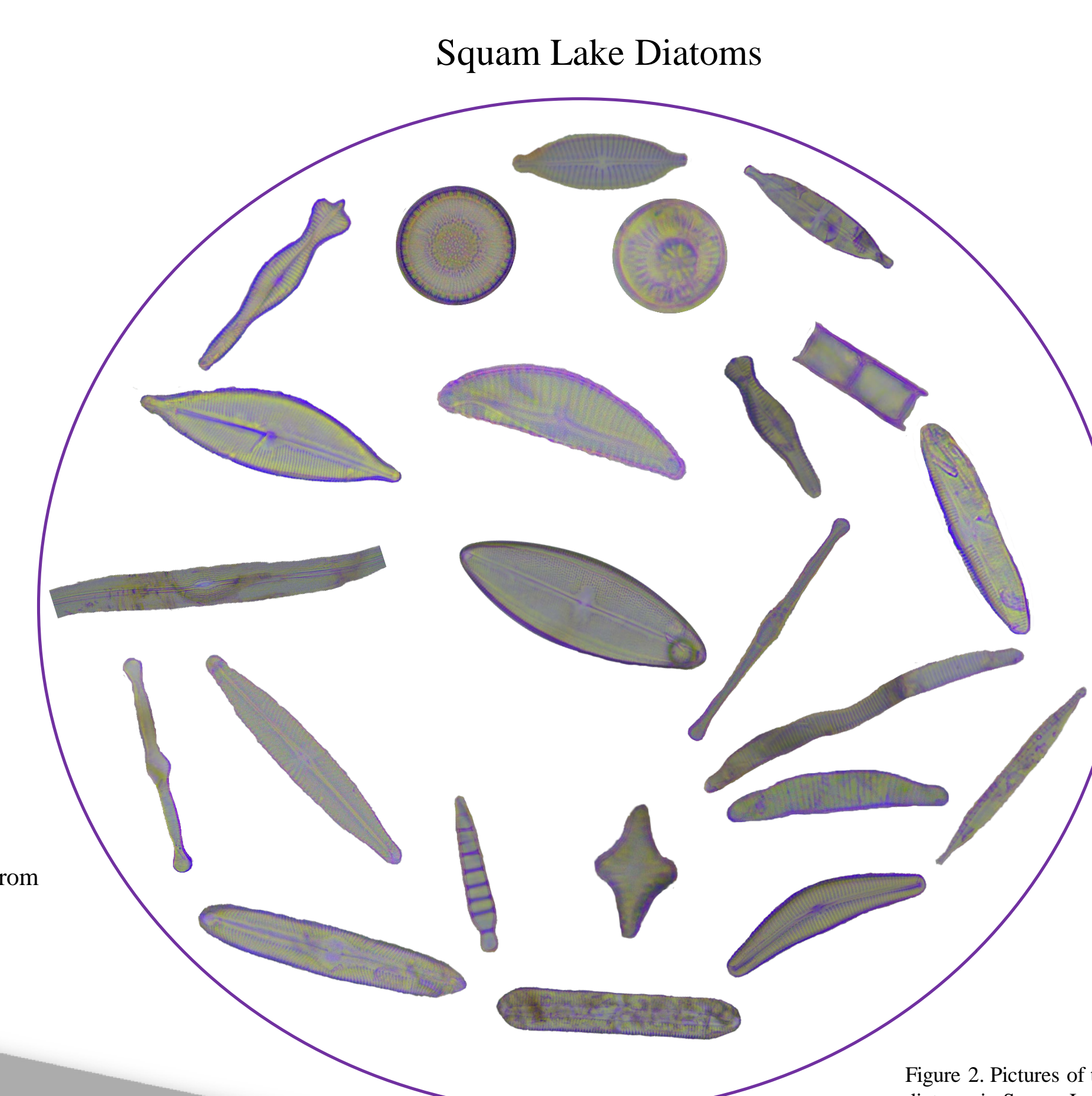


Figure 2. Pictures of the diatoms in Squam Lake's sediment core

## Conclusion

Identifying diatoms can help show environmental impacts, which can show history of the water quality. For Squam Lake there have been many storm events and land management issues affecting the water quality. The 1830s was the beginning of major land clearance for sheep farming. The sheep boom lasted about 30- 40 years which ended as the civil war was starting. Between the 1840s to the 1850s, many of New Hampshire's forest were cleared (about 70% of the land south of the White Mountains). There were massive storms between 1840 to 1848. The clearing of trees for the sheep farming and clear cutting for agriculture caused more storm water runoff and increased the river inputs. This is seen in the core as an increase in river diatoms. In the 1880s, logging became part of the major industry in New Hampshire. This effected Squam Lake's water quality by bringing in high nitrogen and phosphorus. This coincides with an increase in diatoms that prefer N- and P-rich and acidic habitats. In 1927 there was a historic flood that occurred in the White Mountain area of New Hampshire, which also shows an increase in the river diatoms in Squam Lake. In the 1930s, conservation of the White Mountain National Forest and the Great Depression reduced logging, allow most of New Hampshire's forest to regrow. This shows as improved the water quality in Squam Lake and increases in more sensitive, alkaline, diatoms.

In 1954 Hurricane Carol and Edna hit New Hampshire and New England. During this time there was an increase in acidic habitat diatoms and high Phosphorus and Nitrogen diatoms. With these two hurricanes coming one after another, there was most likely an increase in erosion into the tributaries. Storm water runoff from local farms in the Squam watershed picked up nutrients from fertilizer and spiked the nitrogen and phosphorus concentration in the lake water causing an increase in diatoms that live in high concentration of these nutrients. In 1991 Hurricane Bob hit New Hampshire. In that year, can see an increase in river and high conductivity diatoms. The river diatoms could have swept into the lake from the flooding of the tributaries coming into Squam Lake. In 1999 Hurricane Florence hit New Hampshire, there was a spike in the acidic habitat diatoms from this hurricane. In 2011 Hurricane Irene caused extreme flooding in Central New Hampshire and is associated with a big spike of river diatoms and an increase in diatoms that require high nitrogen and phosphorus habitats. Generally, before the 1930's, the water quality of Squam appears to have been worse than now.

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