USING CENTRIC DIATOMS AS INDICATORS OF CLIMATE-MEDIATED CHANGES N LAKE THERMAL STRATIFICATION IN THE GREAT LAKES REGION

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Increasing surface water temperatures have been observed in over 100 large lakes, including Superior, Tahoe, Tanganyika, and Baikal, raising concerns over declining lake habitat quality. Despite the prevalence of observed increases in water temperatures around the world, long-term trends in lake habitat quality remain unclear. Fossil diatom records can be used to provide insight into long-term changes in lake stratification. A new diatom-inferred mixing depth model has been developed to reconstruct the depth of the mixed layer over time. This method utilizes known diatom ecological preferences, determined from lake surveys and assay experiments, to provide an optimal mixing depth (depth to the thermocline). Three planktonic diatom taxa are used in this model: *Discostella stelligera* (optimal mixing depth of 4 meters), *Cyclotella comensis* (optimal mixing depth of 9 meters), and *Cyclotella bodanica* (optimal mixing depth of 14 meters). The relative abundance of these three target species in lake sediment records is then used to infer changes in lake mixing depth over time.

In the Great Lakes region, modeled projections for Lake Michigan and Lake Erie predict that warmer temperatures will strengthen stratification, result in shallower mixing and increased fish habitat. However, fossil diatom records from lakes located in Isle Royale National Park, an island in the northwest corner of Lake Superior, indicate dynamic change in lake habitat over the 20th century that is counter to these predictions. In two large lakes, the diatom-inferred mixing depth has more than doubled (from 5 meters to 12 meters) since 1940. The modern reconstruction of mixing depth is in agreement with national park monitoring of thermal stratification, where the mixing depth is often observed at approximately 10 meters. Changes in lake mixing depth require considerable changes in lake water clarity or in wind strength, depending on the size of the lake. Thermal stratification is regulated by wind in moderately large lakes (>500 hectares). Over Lake Superior and Isle Royale National Park, wind speeds have been increasing as surface water temperatures warm faster than air temperatures. This increase in regional wind speeds could be responsible for the observed deepening of lake mixing. By pairing modern diatom ecology with long-term sediment records, we were able to gain a better understanding of how regional changes in climate are altering physical lake habitat over time. Fossil algal pigments were used to study the effects of changes in lake mixing on primary productivity. Despite having coherent changes in lake mixing over time, the trends in algal biomass differed between the two lakes. A continued understanding of how paleolimnological records of climate-mediated change vary across a landscape and the range of biological response to these changes is key to interpreting long-term trends in lake response to climate.