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Collaborative Research: The Response of Lakes to Disturbance and Climate Change: Calibrating Sedimentary Records to Test the Landscape Position Concept

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Final Report for Period: 09/2008 - 08/2009

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Principal Investigator: Saros, Jasmine .

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Organization: University of Maine

Submitted By:

Saros, Jasmine - Principal Investigator

Title:

Collaborative Research: The Response of Lakes to Disturbance and Climate Change: Calibrating Sedimentary Records to Test the Landscape Position Concept

Project Participants

Senior Personnel

Name: Saros, Jasmine

Worked for more than 160 Hours: Yes

Contribution to Project:

Saros is supervising one M.S. student on this project. She is training the student in diatom taxonomy, and is advising the student on the development of the calibration sets and transfer functions. She is also participating in the collection of sediment cores from the study lakes.

Post-doc

Graduate Student

Name: Erickson, Jarvis

Worked for more than 160 Hours: Yes

Contribution to Project:

Jarvis is developing the diatom calibration set for this project, and he is also testing the calibration sets on cores from the five LTER lakes.

Name: McCulligh, Natalie

Worked for more than 160 Hours: Yes

Contribution to Project:

Natalie prepared and counted diatom slides from two of the sediment cores in the project.

Undergraduate Student

Name: Spinney, Eileen

Worked for more than 160 Hours: Yes

Contribution to Project:

Eileen prepared and counted diatom slides from one of the sediment cores in the project.

Technician, Programmer

Name: Anderson, Dennis

Worked for more than 160 Hours: Yes

Contribution to Project:

Dennis is a research technician supported by the University of Maine who has conducted the diatom counts on one of the sediment cores in the project.

Other Participant

Research Experience for Undergraduates

Organizational Partners

Other Collaborators or Contacts

We are working with Dr. Mark Edlund from the St. Croix Watershed Research Station (MN) to harmonize our diatom taxonomy with that in other regional calibration sets.

Activities and Findings

Research and Education Activities:

The goal of this research is to develop and test a diatom calibration set for the Northern Temperate Lakes LTER site in an effort to assess whether the response of these lakes to climate change can be determined with paleolimnological tools. We collected surface sediment samples from 50 lakes in the area and determined the diatom assemblages in each sample. By analyzing diatom distributions across these lakes with respect to physicochemical parameters, we constructed diatom transfer functions for conductivity and maximum lake depth.

We also collected freeze and extruded, 1-meter cores from the five LTER lakes, which have 25 years of water chemistry data and tested diatom-inferred values from these cores with the LTER data.

This grant funded the education of one M.S. student, Jarvis Erickson. Jarvis constructed the diatom calibration set and tested the transfer functions for his thesis work. His work resulted in two poster presentations:

Erickson, J.M. & J.E. Saros. Feb. 2007. Diatom-based reconstructions of lake water chemistry to test the landscape position concept over longer time scales in lakes of northeastern Wisconsin. Presented at the American Society of Limnology and Oceanography (Santa Fe, NM).

Erickson, J.M. & J.E. Saros. June 2006. Development of a diatom calibration set to test the landscape position concept in lakes of northeastern Wisconsin. Presented at the 10th International Paleolimnology Symposium (Duluth, MN).

Saros has worked with Erickson for the last two years to produce two publications from this work. Due to changes in Erickson's employment and personal life, progress has been slow on these manuscripts; we anticipate their production in the next 6 months.

This grant also provided part of the salary for an additional graduate student, Natalie McCulligh, as well as funds for an undergraduate research experience for Eileen Spinney.

Findings:

Analysis of the diatom calibration set indicated that, out of the 12 tested physicochemical variables, conductivity and maximum lake depth significantly influence the distributions of diatom taxa across these lakes. This has allowed us to construct transfer functions for these two variables and apply them to diatom profiles in the cores. This is very promising for our goal of reconstructing climate from these lake records, as both of these variables are typically coupled to climate change. In addition, because conductivity and depth are expected to be partially controlled by landscape position, there is also much potential in this data set to explore landscape-related issues.

Comparisons of diatom-inferred and measured conductivity for the LTER lakes indicates strong agreement between these data, whereas the depth reconstructions were initially less promising. We are currently working on improving the depth reconstructions.

We reconstructed the Holocene history of Lake Fallison (Wisconsin) and its response to climate change using multiple proxies, including the diatom-inferred conductivity and lake depth. The conductivity reconstructions agreed well with the pollen record for the area.

Training and Development:

This project formed the basis of a thesis for one M.S. student. He learned diatom taxonomy and multivariate statistical techniques over the course of the project. He is also discussing his project with other diatomists who have developed calibration sets to ensure that his taxonomy is consistent. This grant has also funded his travel to two scientific meetings to present his results.

A second graduate student was partially supported by this grant, as well as an undergraduate conducting an independent research project. This provided both of them with an opportunity to learn diatom taxonomy.

Outreach Activities:

The Saros lab participated in a middle school science demonstration day in April 2009 at the University of Maine. The sediment core materials from this project, as well as some of the results in this project, were a key component of the presentation module used in this demonstration.

Journal Publications

Books or Other One-time Publications

Web/Internet Site

Other Specific Products

Product Type:

Physical collection (samples, etc.)

Product Description:

A diatom calibration set, consisting of a reference slide from each of 50 lakes in northeastern Wisconsin, has been constructed in this project. The associated physicochemical data for each lake are compiled in a database.

Sharing Information:

After publication of the results, this calibration set (as well as any diatom profiles from the sediment cores) will be contributed to the Diatom Paleolimnology Data Cooperative, a website maintained by the Academy of Natural Sciences in Philadelphia.

Contributions

Contributions within Discipline:

The developed diatom calibration set has expanded the number of regional data sets available for potentially assessing climate change with diatom fossils. This data set will provide a rare opportunity to assess the accuracy of diatom-based reconstructions, as we have access to 25 years of measured water quality data with which to compare our diatom-inferred values. As these data will be contributed to the Diatom Paleolimnology Data Cooperative, they will be widely available for use by other investigators.

Contributions to Other Disciplines:**Contributions to Human Resource Development:**

This project provided one M.S. student with a full stipend and tuition waiver to conduct the main research objective of the project as his thesis research. Approximately half of the graduate students in the Biology department at UW-L (where Saros conducted most of this project) do not have financial support during their graduate studies, thus this support enhanced the quality of the program and assisted with attracting and retaining students in the program.

This project also provided partial support to one M.S. student at the University of Maine, as well as funding for an undergraduate research experience. The number of funded undergraduate research opportunities is modest at UMaine, hence this provided a key opportunity for a female undergraduate, who has now gone on to an M.S. program in Geosciences.

Contributions to Resources for Research and Education:

The results of this project are currently being prepared for entry into the Diatom Paleolimnology Data Cooperative, an open-access database on the internet.

Contributions Beyond Science and Engineering:**Conference Proceedings****Categories for which nothing is reported:**

Organizational Partners

Any Journal

Any Book

Any Web/Internet Site

Contributions: To Any Other Disciplines

Contributions: To Any Beyond Science and Engineering

Any Conference