Summer UROP
Grant Recipients: Brian Roddy and Matthew Williams
Primary Advisor: Professor Anthony S. Serianni
19 September 2014

"Stakeholder Values and Lake Ecology: Motivating Adjoining Lake Communities in a Common Watershed Through Improved Communication and Best Management Practices"

Final Report

Brian Roddy and Matthew Williams worked under the advisement of Professor Anthony Serianni to conduct ecological research in Syracuse, IN on Lake Papakeechie (LP), Lake Wawasee (LW), and several smaller local lakes in their watershed, and social psychological research involving the residents of the aforementioned lakes. Collaboration was also done with two relevant local organizations: Lake Papakeechie Sustainability Initiative (LaPSI) and Wawasee Area Conservancy Foundation (WACF). This research was a continuation and expansion of classmate Hannah Becker's past research in the area, and was supported by the University of Notre Dame's Undergraduate Research Opportunity Program's (UROP) DaVinci Grant Program.

The objectives of the research can be divided into two main parts: ecological and social psychological. Within these two categories there were specific goals that aimed to both continue and expand the research already performed. In addition to gathering another set of data to add to the data gathered in 2013, four main limitations to the limnological research were addressed from the previous summer's work to this year's.

(1) Expand water testing to smaller lakes in LP's watershed to get a better idea of the quality of water feeding into LP.

(2) Expand testing from Secchi, *E. coli*, and dissolved oxygen and temperature (DO/T) to include nitrogen (N) and phosphate (P) testing to get a more complete understanding of lake health.

(3) Purchase, calibrate, and use a new DO/T meter to improve reliability of results and reduce reliance on third parties for equipment.

(4) Lines of communication were opened between LP and LW to work together and share testing information, again providing a more complete understanding of the overall health of the watershed.

Our goals for the social psychology side of the research focused on both extending the reach of the survey to a less biased and higher percentage of lake residents, and revamping the survey to provide us with a broader and deeper understanding of residents' views on lake health and sustainability.

We were able to accomplish each of the four listed limnological research goals. N and P tests were conducted on Allen Lake, Barrel-and-a-Half Lake, Hammond Lake, Redhead Lake, Shock Lake, and Spear Lake. These lakes were identified as some of those having the most direct impact on LP, and N and P tests were chosen because N and P levels are the factors of lake health most easily attributed to water flow through the watershed. Redhead, Spear, and Hammond lakes were found to have high levels of dissolved nitrates. N and P tests were also performed at sites across LP. Several of the sites returned high readings for nitrates, while others did not. This should be a focus of further testing, and if the levels remain high for another year, it may be worth addressing through some mitigation effort. Phosphate levels were comparatively low, but because N and P levels usually correspond with one another, additional factors may be involved.. We suspect that not all of the phosphate is being detected, because our current tests can only test for dissolved phosphates, and cannot detect phosphates locked in organic solids. A

more robust test could help clarify this apparent discrepancy in relative N and P levels. In addition to these new N and P tests, the DO/T testing was done with a new, calibrated meter. Our confidence in these readings is much stronger than that after the previous summer's work. DO/T testing showed a sharp drop in DO around 4.5 m, which was expected from examining last year's data. Temperature dropped somewhat more slowly, but exhibited a similar pattern. *E. coli* testing gave no cause for concern, with very few or no colonies appearing at sites across LP. According to Secchi testing, water clarity is slightly below where we would like to see it, and lower than it has been in previous seasons. This could be due to a number of factors, and should again be continued in the following years to establish whether or not this summer was an anomaly.

Work was done with both LaPSI and the WACF this summer, and we plan to exchange testing data and discuss future plans to improve our overall understanding of the watershed's health and how to continue to improve it.

The social psychology side of our research has also been successful to this point. The survey has been expanded to include more questions about sustainable practices and attitudes towards lake health and sustainability. We have also translated the survey to a Google Doc Form that can be easily distributed to residents of LP and LW via a link on the PPA website. This form will automatically compile the data for the researchers and advisors in a form that is easy to parse and analyze with software. It is also simple to share these data with LaPSI, the WACF or any future collaborators.

This research is ongoing, and more data being collected in the following years would drastically improve the reliability of the results and help in establishing trends, but there are additional potential further developments that could be made to improve the research in addition

to this continued work. Hannah Becker plans to extend this work in five primary directions as a part of her capstone project for the Sustainability minor.

(1) Establish a lake coalition of representatives from lakes around LP or within Kosciusko County to compare work done on neighboring lakes and identify "unhealthy" lakes.

(2) Compare data gathered during each of the past two summers and put them in forms easy to compare to future results.

(3) Prepare and present an academic poster with either the Indiana Academy of Science or the Indiana Lakes Management Society.

(4) Attend a LaPSI meeting each semester to stay in touch with work being done on the lake and provide updates on progress and future plans.

(5) Prepare a public draft of research for lake residents, either as a full report or a generalized presentation if the results are to be kept private until further research is completed.

After the survey has been available to the public for a suitable amount of time, some statistical analysis should be performed to make sense of the results and help establish a plan for future work. If this research is continued next summer, it would be beneficial to extend the testing to even more lakes in the watershed. Further insights into the somewhat confusing decoupling of N and P levels could be gained by adding a test for phosphates locked in solid, organic matter, in addition to the current test for dissolved phosphates. Overall, continuing to expand this project in duration and scope would serve to provide a clearer understanding of overall water health in the area.

The summer's research was successful in expanding the existing dataset and making a number of improvements to the way data on the lakes is obtained. We were also successful in

preparing and distributing a much more robust survey to a far larger set of potential participants. We would like to thank LaPSI, the WACF, Professor Serianni, and the University of Notre Dame for all of their assistance and the opportunity for us to enjoy this research experience.

Hannah Becker contributed to the “Potential Further Developments” portion of the report.

This research was made possible in part by support from the Undergraduate Research Opportunity Program, Institute for Scholarship in the Liberal Arts, College of Arts and Letters, and the University of Notre Dame.