

Urbanization and Aquatic Invasions: Can Invasion Success be Predicated by Evaluating Anthropogenic Actions?

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BACKGROUND INFORMATION

Invasion ecology theory predicts that invasion success increases with increased propagule pressure and disturbance. Propagule pressure is the number of exotic species introduced into a novel environment, incorporating both the number of exotics released at any one time and the number of discrete introduction events. With increased propagule pressure, it is predicted that invasive species establishment is enhanced due to the addition of individuals, which compensates for challenges faced by small populations by increasing population densities. Disturbance is predicted to increase invasive species establishment by potentially increasing resource availability, altering the integrity of a native systems, or creating additional niche space for invasives.

DESCRIPTION OF PROPOSED RESEARCH

My internship, supported by the Edna Bailey Sussman Foundation, was conducted in the kettle lake district of central New York with the Cortland-Onondaga Federation of Kettle Lake Associations (C-OFOKLA). The research included five kettle lakes (Crooked Lake, Gatehouse Pond, Little York Lake, Song Lake and Tully Lake) that show a gradient in external boat pressure (public vs. private lake access) and population densities surrounding each lake. This gradient made is possible to estimate the role of propagule pressure and disturbance in the establishment of aquatic invasive species. The research focused on invasive macrophytes (large

aquatic plants) and zooplankton. The internship with C-OFOKLA was conducted from May 23rd until September 11th of 2011.

WORK COMPLETED

Two questionnaires were developed to quantify propagule pressure and disturbance, and were approved by the Institutional Review Board at Syracuse University. One questionnaire was administered to boaters using boat launches at public launch sites (Tully Lake, Little York Lake) and one was distributed to homeowners at each of the five lakes. Boat launch questionnaires were administered to boaters at launches for a three hour period at various times of day throughout the summer. A total of 399 homeowner questionnaires were distributed by mail or delivered in person to households.

19 questionnaires were completed at Tully Lake and 18 at Little York Lake, for a total of 37 boat launch questionnaires. Preliminary analyses show that boats brought to the kettle lakes are taken to a number of different lakes through the northeast (Figure 1). Potential propagule pressure to public kettle lakes is higher than initially assumed. Of 399 homeowner questionnaires that were distributed, 127 have been filled out and returned, for a return rate of 31%.

Boat activity observations were made at each lake throughout the duration of the internship in order to estimate propagule pressure. The number of boats on a lake in a three hour period was quantified. Water samples were collected on a single day in June, July and August for chlorophyll a, ratio of carbon to nitrogen, phosphorus levels, total nutrients and total dissolved nutrients. Zooplankton samples were collected on three separate days throughout the field season at five sampling locations for each lake (15 samples per lake, 75 total samples).

Macrophyte sampling consisted of qualitative and quantitative estimates. A total of 10 sampling sites were selected within each lake, following an initial site selection process that incorporated different sediment types within the lake and surrounding land use (in an effort to capture the complete variation at each lake). Total shoreline distances for each lake were calculated from aerial photographs, and the sampling distance at each site was 1% of the total shoreline. Before sampling occurred at a site, buoys were deployed parallel to the shoreline marking the extent of sampling transects.

Qualitative sampling was conducted to generate a species list of exotic and native macrophytes present in each lake. Qualitative sampling was accomplished by snorkeling the sampling distance, starting at one buoy and swimming in the direction of the other. Three transects occurred at each site consisting of three different depths: deep (≥ 2 m), intermediate (1 – 2 m) and shallow (< 1 m). Each new species that was encountered along each transect was collected and identified to species in the laboratory. Thirty qualitative samples were collected for each lake two times through the field season, for a total of 300 qualitative estimates.

Quantitative sampling was conducted to determine invasive and native macrophyte biomass within each lake. At each site, three 0.5 m² quadrats were collected along each depth transect by SCUBA diving, for a total of 90 quadrats per lake. Quadrat samples collected in the field were separated into species in the laboratory, and each species within each quadrat was dried at 60°C, and then weighed to generate estimates of biomass. Quantitative sampling occurred once throughout the field season, starting in August. A total of 450 quadrats were collected, generating a large dataset of biomass estimates.

FUTURE WORK

Due to the amount of sampling that occurred during the internship, an extensive amount of time and effort has been devoted to processing and data collection. Thus, most analyses are still in progress at the time of writing this report, and I will file an updated report in 2012. These analyses will include a comparison of the invasive and native macrophyte communities to estimates of propagule pressure (derived from external boat activity data generated by lake observations and questionnaire responses). Estimates of lake disturbance will be quantified by a combination of water nutrient analyses (nitrogen and phosphorus), population densities and questionnaire responses. Disturbance estimates will be compared to the invasive and native macrophyte communities within each lake. Similarly, the zooplankton community composition within each lake will be compared to propagule pressure and disturbance. It is anticipated that the data analyses will be finished in early 2012.

Upon completion, results will be presented to members of C-OFOKLA and at relevant professional society meetings. A manuscript will be prepared in early 2012 for publication in a peer-reviewed scientific journal.

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FIGURES AND PICTURES

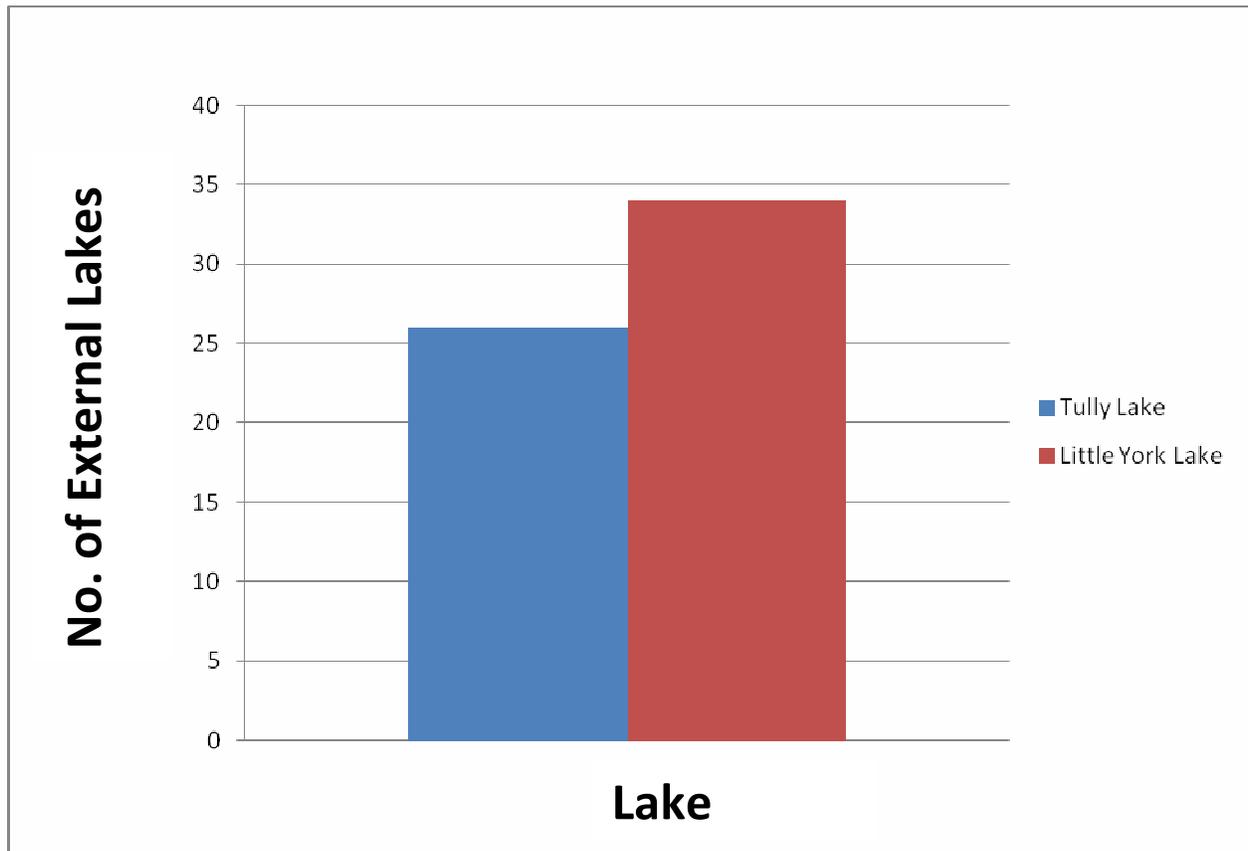


Figure 1. The number of reported external lakes where boats had been taken prior to launching at Tully Lake and Little York Lake, respectively.



Dr. Kimberly Schulz SCUBA diving at Little York Lake.



Chad Walz at Little York Lake.



Jacob Gillette at Gatehouse Pond.