

# Changes in Species Richness of Odonata Communities in Indiana based on Species Tolerance Levels

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## Introduction

Biodiversity in aquatic ecosystems is currently threatened. Human population increase calls for an increase in urbanization which disrupts, or can completely remove an aquatic ecosystem and affect the species residing in it. With an increase in urbanization there is an increase in water pollution, which further damages the ecosystems organisms (Ball-Damerow et al., 2014).

There are several ways to determine how healthy a freshwater ecosystem is. This can be done by looking at an insect's tolerance levels to pollution, then looking to see what the species richness in the ecosystem is. A population with high tolerance to pollution and with a low species richness indicates the water is highly contaminated, while a population with low tolerance and a high species richness indicates that the ecosystem is healthy with minimal contamination. Tolerance levels are measured by numbers 1↔10, and the higher the number, the more resistant a species is to pollution. Not only do tolerance levels give an indication on how healthy the ecosystem is, but it is also a good indication of how healthy the populations are (Gotelli et al., 2001).

The last surveys on Odonates were done in the early 1900s by Montgomery at Purdue, where he recorded the location of the survey and the species found. This project goes back to three of his locations and attempts to see if there has been any change in species richness since then.

## Hypothesis

Tolerance levels affect species richness in an ecosystem. Species richness will decrease in the 2015 survey compared to Montgomery's survey. This was tested by predicting that there will be more pollution in the ecosystems now, then there was during Montgomery's surveys, and that there will be less species richness for the species with lower tolerance levels.

## Methods

For this project, we compared past surveys for various Odonata species and conducted our own surveys in three different areas. Montgomery performed several surveys at Schlamm Lake in Clark State Forest in the years 1937, 1938, 1939, 1941, 1946, 1947, 1949, 1950, 1952, 1953, and 1954. He also conducted surveys at Old and New Lake in 1929, 1933, 1936, 1937, 1938, and 1939. In June and July of 2015, we went to these three areas to do our own surveys, and to compare what was found now to what Montgomery found during his surveys. After the species were identified the tolerance level for each species was determined. Comparing the two surveys can show whether there was a change in the ecosystem and in the populations due to urbanization of other contributing factors.

The first thing that was done was finding the historical data about Montgomery's surveys. Several papers were found over the internet. In these papers, the locations of his surveys were recorded as well as the species that he had found in those locations. Any other important data, such as amount of species, if it was included in the paper, was also recorded. Three locations that Montgomery had surveyed were chosen to conduct the 2015 survey.

Schlamm, Oak, and Franke Lake in Clark State Forest, were surveyed on June 6, 2015. While New and Old Oakland Lake near Oakland City was surveyed on July 16, 2015. Roughly one hour was spent at each lake, where Odonata that were able to be caught were caught with an aerial net. If the species was identified, but was unable to be caught, it was recorded for later use. If there was more than one member of the same species at the survey sight, the amount was recorded. The Odonata captured were placed in a kill jar with ethyl acetate applied at the bottom of the jar.

The captured specimens were placed in a freezer to slow color loss, which would help with identification, and were identified the following day. Species identification was based on wing venation in consultation with *Triplehorn and Johnson 2004*.

The specimens that were captured were compared to the species that Montgomery had captured at the different survey sights. Once every species was identified, their tolerance levels were determined (Mandaville, 2002). The distribution of tolerance level across species was compared between our surveys and Montgomery's surveys by seeing how many species belonged to each tolerance level.

## Results

Tolerance levels were shown to affect species richness, overall, in an aquatic ecosystem. Each of the 2015 surveys showed lower species richness than the surveys Montgomery had conducted. The Schlamm Lake survey was the only one to show one species in more abundance in 2015 than in Montgomery's survey at a tolerance of 1 (Figure 1). Each survey didn't find species corresponding to all tolerance levels. Schlamm Lake had zero species for both surveys at tolerances 1, 2, and 3. Old Lake shows no species for both surveys at tolerances at 1, 2, 3, 4, and 5 (Figure 4). New Lake has zero species for both surveys at tolerances 1 and 4 (Figure 5). Overall, there is less species richness in 2015 than there was during Montgomery's surveys. There is more species richness in the higher tolerance levels.

Overall, the general trend supports the prediction that there were less species of lower tolerance levels at the survey sights.

### Schlamm Lake Species Richness vs. Tolerance

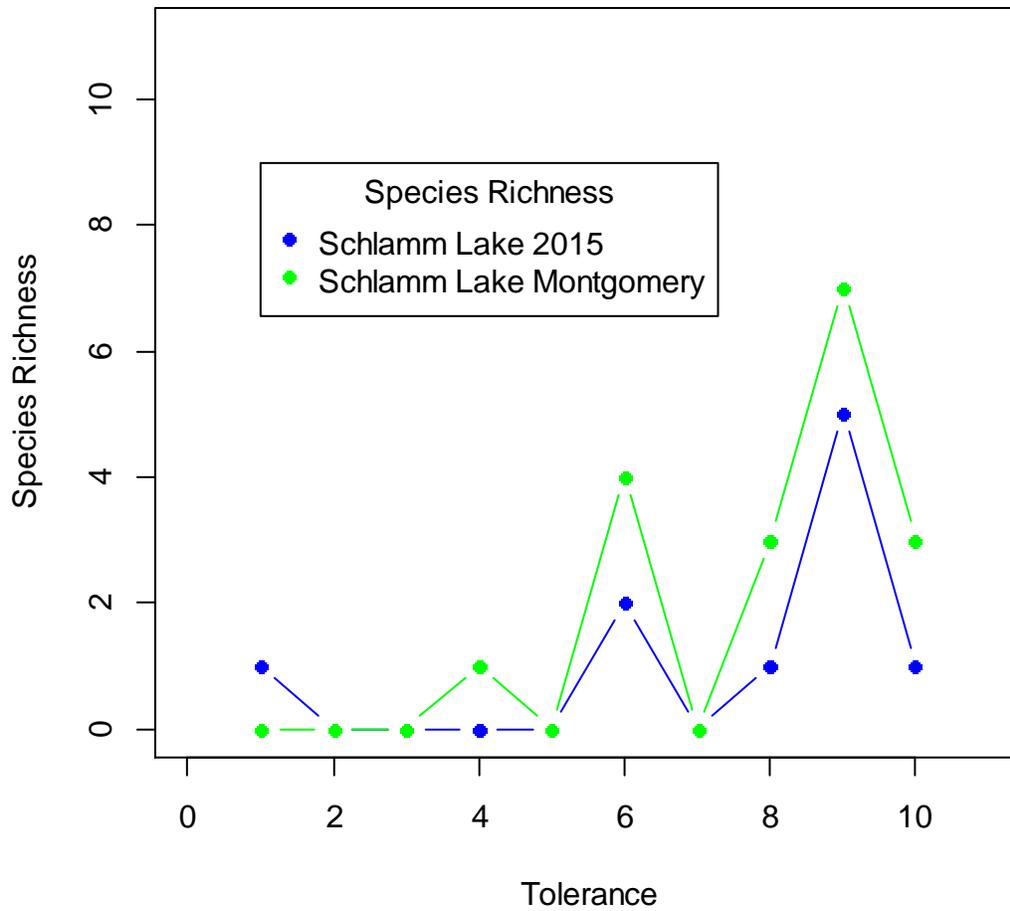


Figure 1: Total number of species vs. their tolerance levels between 2015 survey and Montgomery's past surveys. Both surveys took place at Schlamm Lake in Clark State Forest in Indiana.

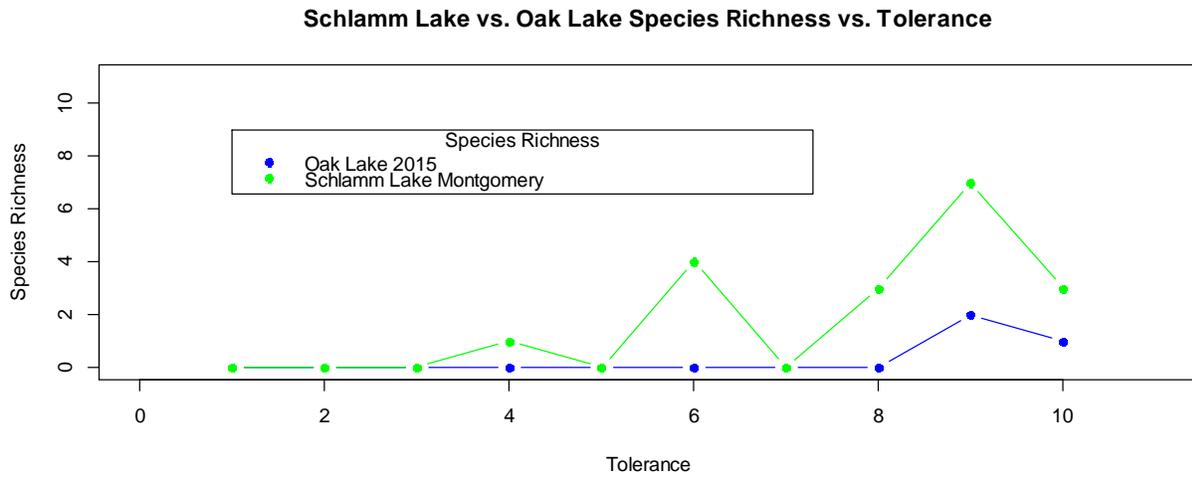


Figure 2: Total number of species vs. their tolerance levels between 2015 survey and Montgomery's past surveys. Montgomery's surveys took place at Schlamm Lake, while the 2015 survey was at Oak Lake. Both lakes are in Clark State Forest in Indiana.

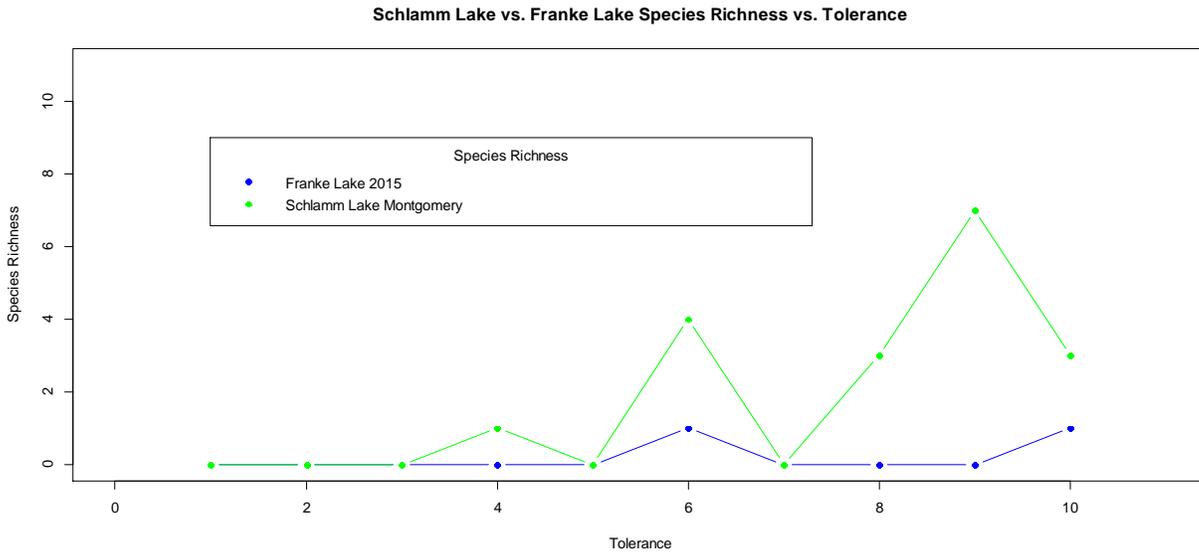


Figure 3: Total number of species vs. their tolerance levels between 2015 survey and Montgomery's past surveys. Montgomery's survey took place at Schlamm Lake, while the 2015 survey was at Franke Lake. Both lakes are in Clark State Forest in Indiana.

### Old Lake Species Richness vs. Tolerance

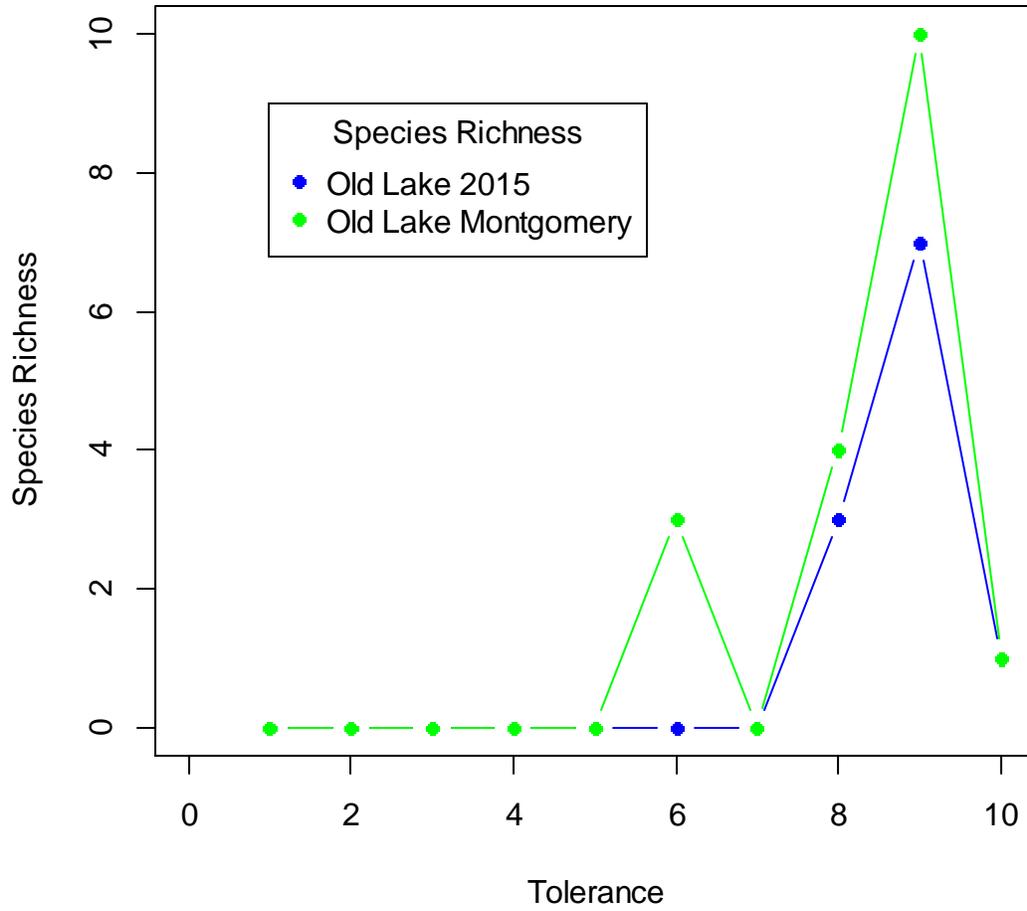


Figure 4: Total number of species vs. their tolerance levels between 2015 survey and Montgomery's past surveys. Both surveys took place at Old Lake near Oakland City, IN.

### New Lake Species Richness vs. Tolerance

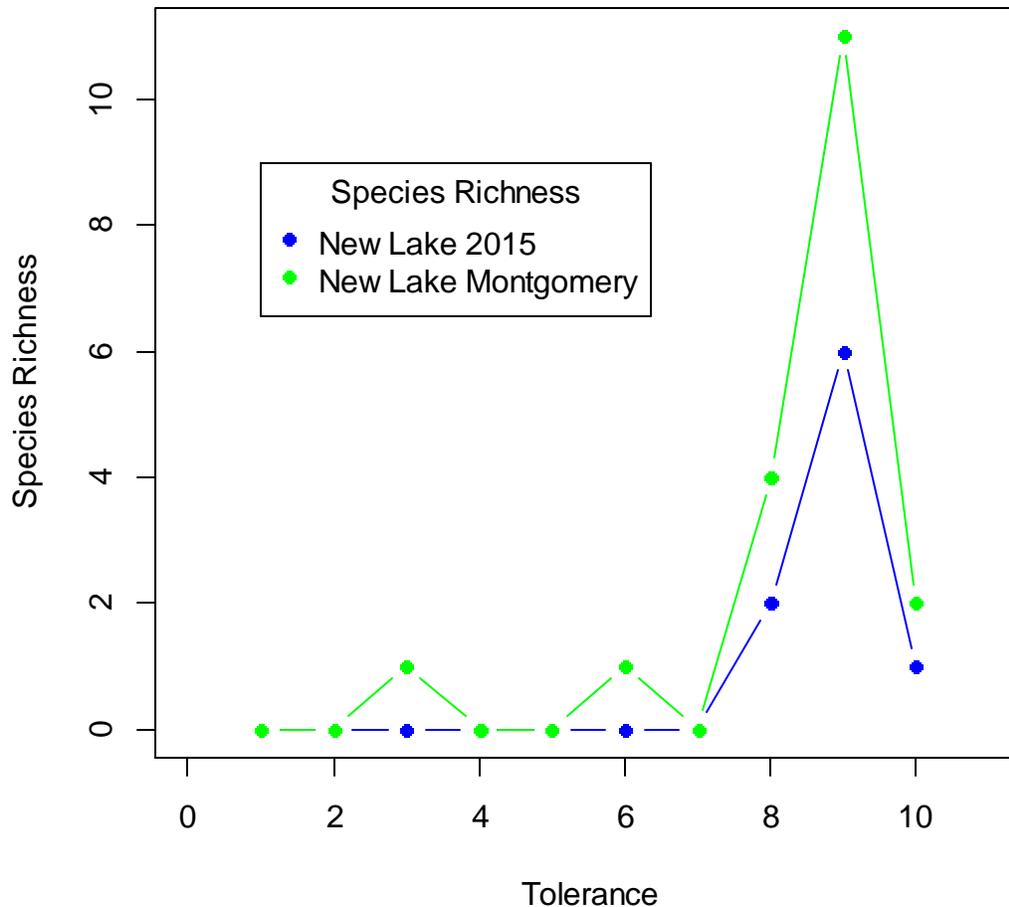


Figure 5: Total number of species vs. their tolerance levels between 2015 survey and Montgomery's past surveys. Both surveys took place at New Lake near Oakland City, IN.

### Discussion

Species richness decreased or remained the same at all sites except Schlamm Lake (Figure 1). At this site, the 2015 survey found one species that had a tolerance of one.

One possible reason for a higher species richness during Montgomery's surveys could have been the lack of urbanization. Near Schlamm Lake, the Henryville Correctional Facility was built in 1961, after all of Montgomery's surveys had concluded in that lake. This could have contributed to the reduction of species richness, though it would not account for the reasons behind a species with a tolerance of 1 in the 2015 survey. Collecting effort was certainly different than Montgomery's surveys. This would have effected how many species were found and recorded.

In order to have done this experiment better besides having more time and funds, it would have been helpful to survey more lakes that Montgomery had surveyed. It would have also been

more helpful to go back to the 2015 sites over the next several years to see if species richness has changed any. We also didn't know how Montgomery had completed his surveys, whether he caught the Odonates or was able to identify them by sight. We were able to see Odonates that were flying, but were unable to catch and identify them, which would have skewed some of the results.

### **Acknowledgements**

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### **References**

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