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# Beetle Diversity: A Comparison of the Biodiversity of Ecotone vs. Woods Surrounding Morehead State's Eagle Lake

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## ABSTRACT

Biodiversity is an important indicator of health within an ecosystem. Coleoptera (beetles), which comprise twenty percent of known, described species, inhabit a wide variety of habitat types making them excellent study organisms to address biodiversity-related questions. To study this phenomenon, we compared the biodiversity of Coleoptera within Morehead State University's Eagle Lake. We collected leaf-litter samples from wooded habitat and its associated ecotone between the wooded area and more disturbed, open field surrounding Eagle Lake to assess whether there were any differences in biodiversity richness and abundance. Through our data we discovered that the leaf litter from the wooded regions of Eagle Lake featured many morphologically diverse organisms, and the inhabitants of the forest floor approaching the ecotone can change dramatically over a distance of only a few meters. When data were compared to levels of other indicator species of mites and ants, we were able to gain an overall understanding of the biodiversity of the area and its sustainability for local wildlife.

## INTRODUCTION

Eagle Lake on Morehead State University's campus is an 18-acre lake that was created in the 1950's by the impoundment of Evans Branch. Since this time, Eagle Lake and the adjacent lands have served as a habitat and home for thousands of species within Rowan County. In addition to its pristine image, Eagle Lake also serves as a recreational, hiking and fishing site for the community of Morehead State University. To determine the actual health of Eagle Lake as a natural habitat, we utilized beetles as an indicator species.

Beetles are a good indicator of environmental health because they serve a variety of roles within an ecosystem. Beetles can fill virtually every ecological niche. In addition, with over 400,000 beetle species known in the world, beetles are easy to collect and categorize. When considering species richness in an area, or the relative amount of different species represented in an ecological community, it becomes possible to categorize the overall relative health of two or more areas in relation to each other. When species richness is combined with statistical analysis, we can accurately judge the ecological health of specific areas.

## Materials and Methods

### Leaf Litter Collection:

Beetles were collected by sorting leaf litter from the forest floor and ecotone through a specialized sifting apparatus (Fig. 1). Leaf litter was placed in the top of the apparatus on a wire grate and shaken. Larger twigs and organic material were sifted back out the top, while smaller mulch and the beetles it contained fell through the grate and into a long collecting sleeve. The material that could not make it through the grate was returned to the environment where it was collected. Once the collection sleeve was full, the leaf litter sample was placed in a pillow case, tied, and returned to the lab to be run through a Berlese funnel to extract the beetles.

Figure 1: Leaf litter sampling at Eagle Lake

### Collection areas

Two separate areas surrounding Eagle Lake were used as collection locations. These areas were the Ecotone between the forest and the meadow at the far end of the lake, and the Woods in proximity to this ecotone (Fig. 2). Although the Woods and Ecotone sampling location were chosen to be approximately 50 yards from each other, the habitat was vastly different in each location and therefore produced vastly different beetle samples.

Figure 2: Beetle sampling locations surrounding Eagle Lake – Ecotone (Left) and Woods (Right)

### Berlese Funnel:

The Berlese Funnel (Fig. 3) consists of a large metal funnel containing wire grate and cheesecloth, upon which the collected leaf litter sample was placed. Once the sample was placed in the funnel, a lid containing a standard lightbulb was placed over the sample. A collection jar of ethanol was placed at the bottom of the funnel. The light continuously ran on the funnel for 7 days, during which time the substrate became dry and warm. Beetles who live in leaf litter prefer cool dry conditions. Because of this, they burrowed deeper into the leaf litter and eventually fell through the funnel and into the collection jar.

Figure 3: Berlese funnel set up in the lab.

### Coarse Sort

A coarse sort was completed to separate beetles from other insects in the sample. The coarse sort helped to reduce identification error later in the project.

### Pointing:

The vast majority of beetles collected from leaf litter are far too small to be mounted using standard pinning techniques. Therefore, after the beetles were sorted from the leaf debris using the Berlese funnel, and separated from other insects, they were affixed on specialize triangles of paper known as "points" and mounted on standard #3 pins. The specimens were then labeled with information about the location and date that they were collected (Fig. 4).

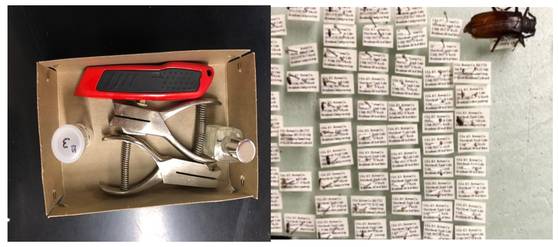


Figure 4: Punches and pins used for pointing

### Sorting:

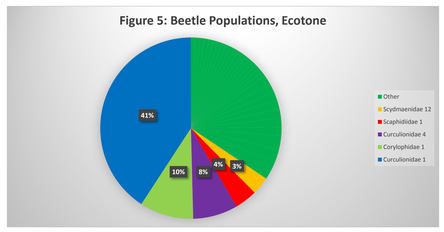
After the beetles were pointed, they were sorted according to family. They were then sub-sorted into individual morphotypes that corresponded to genera within the families by using differences in physical appearance. These groups of morphotypes were labeled according to their family followed by a numeric numbering, for example *Elateridae 1*, *Elateridae 2*, *Elateridae 3*, etc.

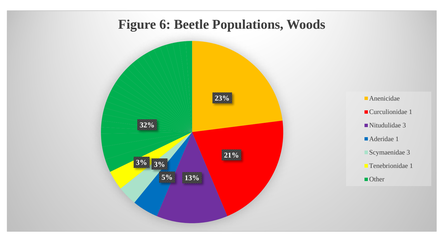
### Statistical Analysis:

Once sorted into morphotypes, the beetle samples were analyzed using the Shannon Diversity Index and Simpson's D index. The Shannon Diversity Index accounted for both abundance and evenness within the sampling area, which allowed us to distinctly quantify the difference between distribution of beetle morphotypes within and among the Woods and Ecotone sampling regions. Simpson's D Index was used to calculate the diversity of beetles within and among the sampling regions. When the Shannon Diversity Index and Simpson's D Index were both used in relation to each other, it allowed us to gain a larger understanding of the overall diversity of our sampling regions through a multi-factorial approach.

## RESULTS

Once the beetles were categorized, the data were analyzed according to location collected. The data for this information can be found in Figures 5 and 6, and Tables 1 and 2.




Figures 5-6. Beetle abundance in ecotone vs woods.

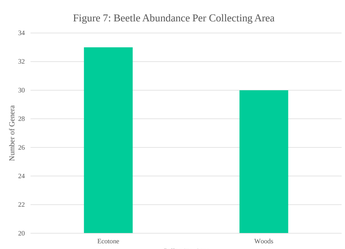



Figure 7. Beetle diversity in ecotone vs woods.

**Table 1: Numbers of Morphotype Genera Among Ecotone Samples**

| Genus | Number | Genus | Number |
|---|---|---|---|
| *Carabidae 4* | 1 | *Curculionidae 4* | 1 |
| *Cleridae 1* | 1 | *Scydmaenidae 7* | 2 |
| *Curculionidae 5* | 1 | *Carabidae 1* | 2 |
| *Curculionidae 7* | 1 | *Carabidae 3* | 2 |
| *Curculionidae 9* | 1 | *Chrysomelidae 1* | 2 |
| *Erotylidae 1* | 1 | *Nitidulidae 3* | 2 |
| *Hydrophilidae 1* | 1 | *Scaphidiidae 2* | 2 |
| *Leiodidae 2* | 1 | *Scymaenidae 6* | 2 |
| *Nitudulidae 1* | 1 | *Tenebrionidae 1* | 3 |
| *Phalycridae 1* | 1 | *Aderidae 1* | 3 |
| *Scydmaenidae 8* | 1 | *Scydmaenidae 10* | 4 |
| *Scymaenidae 1* | 1 | *Other* | 4 |
| *Scymaenidae 13* | 1 | *Scydmaenidae 12* | 5 |
| *Scymaenidae 2* | 1 | *Scaphidiidae 1* | 10 |
| *Scymaenidae 4* | 1 | *Curculionidae 4* | 12 |
| *Scymaenidae 5* | 1 | *Corylophidae 1* | 51 |
| *Throscidae* | 1 | | |

**Table 2: Numbers of Morphotype Genera Among Woods Samples**

| Genus | Number | Genus | Number |
|---|---|---|---|
| *Anenicidae* | 20 | *Curculionidae 9* | 4 |
| *Curculionidae 1* | 89 | *Erotylidae 2* | 1 |
| *Nitudulidae 3* | 17 | *Leiodidae 2* | 1 |
| *Aderidae 1* | 4 | *Nitidulidae 1* | 1 |
| *Scymaenidae 3* | 3 | *Nitudulidae 2* | 1 |
| *Tenebrionidae 1* | 10 | *Ptilidae 1* | 1 |
| *Other* | 2 | *Ptilidae 2* | 1 |
| *Scymaenidae 13* | 2 | *Scaphidiidae 2* | 13 |
| *Scymaenidae 4* | 2 | *Scydmaenidae 10* | 1 |
| *Carabidae 2* | 2 | *Scydmaenidae 11* | 1 |
| *Chrysomleidae 1* | 1 | *Scydmaenidae 12* | 2 |
| *Corylophidae 1* | 1 | *Scydmaenidae 9* | 1 |
| *Curculioinidae 6* | 1 | *Scymaenidae 1* | 1 |
| *Curculionidae 2* | 2 | *Scymaenidae 2* | 9 |
| *Curculionidae 3* | 1 | *Scymaenidae 5* | 1 |

## DISCUSSION

The beetles of each testing area were diverse in number. Overall, we observed 33 different genera in the Ecotone samples, and 30 different genera among the samples from the Woods. However, while the genera from the ecotone exhibited more unique individuals, as shown by Figures 5 and 6, the overall diversity of the Woods was greater, as a larger number of genera contained multiple individuals, compared to a distribution where a large number of genera contained only one or two individuals in the ecotone. Additionally, the ecotone experienced a situation where one genus, *Curculionidae 1*, comprised 42% of individuals sampled. This shows that, while many genera can be found in the ecotone, there is an overwhelming abundance of *Curculionidae 1* that monopolizes the area.

One possible issue with analysis using family-level taxa is that many families, such as *Staphylinidae*, included more than ten genera. Altogether, the *Staphylinidae* is very abundant in both sampling areas, but when divided into morphotype they were not as common as other genera. However, overall, the genus-level taxon was a good measure of the diversity of the regions.

## ACKNOWLEDGEMENTS

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