

Quantifying Ant Populations to Measure Biodiversity

in Morehead, KY

Alyssa Turner, Jude Hall, Tayla Lee, Charles Lydeard,
and Sean O'Keefe



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Department of Biology &
Chemistry,
College of Science

ABSTRACT

To effectively conduct conservation efforts, we can use biodiversity to assess the condition of our environment. Biodiversity has been commonly defined as the variety and variability among living organisms within an area. When our ecosystems are at their best, they clean water, purify air, maintain soil, regulate climate, recycle nutrients, and provide food. Everything within an ecosystem is interdependent, so biodiversity is an important factor and indicator of environmental health. Indicators help us to measure and monitor pressures or threats in land and water use, habitat loss or invasive species, the state of species and ecosystems, the conservation response, and the benefits to people. Many different organisms have been used to assess biodiversity, such as plants, mammals, birds, butterflies, beetles, etc. Ants are a great candidate for biodiversity research, as they are found in many types of habitats, are diverse, extremely numerous, fulfill a variety of ecological roles, are sensitive to environmental change, and are conveniently easy to collect. Our most used method of collection is sorting through leaf litter. We collected leaf litter from three sites in Rowan County: Eagle Lake, Stony Cove, and Rodburn Hollow. We used Berlese funnels to extract the specimens from the litter, organized, identified, and counted them in order to analyze the biodiversity. Over the past three years we have collected almost 7,000 ants, including 18 genera. We plan to use the Shannon and Simpson indices to better evaluate alpha and beta diversity among our three study sites using ants.

INTRODUCTION

Biodiversity can be defined as the variety and variability among living organisms in an ecosystem. An effective way to assess the health of the environment is to focus on a single taxonomic group. Surveying ant populations to use as an indicator taxon can be useful in gauging the overall biodiversity and health of an area. Ants are good for quantifying biodiversity for several reasons. They are considered extremely diverse, with over 1,000 confirmed species of ants just within the United States. Importantly, they are easily collected through a variety of techniques such as Winkler's leaf litter extractors, pitfall traps, and soil core sampling. They are also considered to be sensitive to environmental change. In most ecosystems ants are a dominant faunal group, which causes them to be greatly impacted by threatening processes such as fires and mining. This makes ants the perfect standard for measuring the status of ecosystem health. They also function on different ecological levels as herbivores, mutualists, predators and prey, or as detritivores. In this study we used the ants as an indicator taxon to measure the biodiversity of the Rowan County Woodlands. The goal of this study is to identify the genera (variety) and abundance of these genera in the three set locations (variability), and to quantify this data to evaluate alpha and beta diversity.

MATERIALS AND METHODS

Ant populations are prominent and diverse within leaf litter, so we chose to use a sifting method to collect ants. Sifting leaf litter requires the collection of the top layer of debris from the forest floor. We collected this debris by hand and it was then placed into the sifter. The sifter (see fig. 1 A and C) consists of a nylon shoot in which near the top is a screen that is attached to a handle. At the top of the sifter is a wire ring attached to a handle. The sifter is shaken vigorously ants, insects, spiders, and other fine debris fall into the shoot. Once there is 8-10 pounds of siftable it is then placed into a collection bag and brought into the laboratory. We used Berlese funnels to separate living organisms from the debris. A Berlese funnel (see fig. 1 B) consists of a base cone which has a wire or metal screen near the top which is then covered by cheese cloth. At the bottom of the funnel is a collection jar with alcohol. The loose debris is placed onto the cheese cloth. The lid of the Berlese funnel has a 100 W incandescent bulb. Once the lid is placed over the base the heat and light of the bulb drive the ants and other organisms deeper through the debris, finally falling through the screen into the collection jar.



Fig. 1 A-C sifting through leaf litter, Berlese funnel

After each day for the next week the alcohol jars were replaced, and the collected organisms were sorted. Once the unsorted ants were obtained, they were sorted by genera using a dissecting microscope (see fig. 2 A-B). Each morphospecies was placed into its own watch glass in alcohol (see fig. 2 C). Once sorted, each glass was identified to a genus using *Ants of North America Guide* (Fisher and Cover, 2007). Each watch glass of identified morphospecies was then counted, labeled, and stored in a vial of alcohol.



Fig. 2 Sorting ants using the microscope

RESULTS

Our most abundant ant in the woodlands of Rowan County is the *Brachymyrmex*. They were regularly found at all three sites, often in large numbers. *Brachymyrmex* were collected in 13 out of 14 total samples with an average of 211 specimen in each. They typically nest with between 22-125 fellow ants.



Fig. 3 A-C *Brachymyrmex* (antwiki.org)

They're notorious invaders and have been found living both next to and in termite nests. They nest in small plant cavities and leaf litter, and since their nests are relatively fragile, their nests frequently move. Next highest is the *Ponera* ant. *Ponera* are not quite even a mm long, and typically nest with fewer than 100 other individuals, usually only 30-60 workers. Only two species occur in the United States, and they nest in soil or rotting wood. *Ponera* were found in all 14 samples, with an average of 137 specimen per collection. They were least abundant in the Eagle Lake samples, and about equal in numbers in the Rodburn Hollow and Stony Cove samples.



Fig. 4 A-C *Ponera* (antwiki.org)

Another common ant is the *Strumigenys*. This ant nests in colonies ranging anywhere from 15 to 400 ants in soil, rotting, wood, and leaf litter. They are a worldwide genus mainly distributed in the world tropics and subtropics, but abundant in the southeastern United States, and were found in all 14 samples, mostly at Stony Cove, and averaged at 65 ants per sample.



Fig. 5 *Strumigenys* (antwiki.org)

Aphaenogaster are a large and diverse genus found throughout much of the world. These ants measure out to be over 3 mm. Their colonies are typically very large and common in the leaf litter of forested ecosystems. They were found in 11 out of the 14 samples, with an average of 57 specimen per sample. They have been equally populous in the Eagle Lake and Rodburn Hollow samples, and significantly less in the Stony Cove samples.



Fig. 6 *Aphaenogaster* (antwiki.org)

Paratrechina often establish colonies in buildings and other artificial environments such as greenhouses. These ants have a very large mean colony size of 2,000 ants. *Paratrechina* are omnivores, and forage in the soil and leaf litter. They were only collected in 8 of the samples, holding an average of 67 ants per sample. Most abundant in Rodburn Hollow in August of 2020 and September of 2019, as well as at Stony Cove in September of 2019. They numbered over 100 these three times, and significantly less in the other five samples.



Fig. 7 *Paratrechina* (antwiki.org)

Myrmecina are rather diverse, with 101 valid species usually colonizing in soil, in between rocks, in twigs on the ground, and in rotten wood. They are considered fairly uncommon, though they were found in all 14 of our samples. They did average at only 25 per sample. They numbered fairly even between the three sites, the highest abundance being at Stony Cove.



Fig. 8 *Myrmecina* (antwiki.org)

Temnothorax are opportunistic foragers, and often take advantage of small cavities, hollow nut shells, crevices in rocks, or dead twigs as their nest. They were only collected in 8 of the 14 samples, with a low average of 17 ants per sample. They were most abundant at Eagle Lake. These ants are a socially parasitic species, and queens often kill the queens and take over the nests of other *Temnothorax* species.



Fig. 9 *Temnothorax* (antwiki.org)

Genus	Stoney Cove	Eagle Lake	Rodburn Hollow	Total
<i>Amblyopone</i>	9	13	7	29
<i>Aphaenogaster</i>	97	286	244	627
<i>Brachymyrmex</i>	1522	925	297	2744
<i>Dorymyrmex</i>	0	0	1	1
<i>Hypoponera</i>	5	16	2	23
<i>Lasius</i>	0	2	42	44
<i>Myrmecina</i>	148	115	87	350
<i>Nesomyrmex</i>	0	1	0	1
<i>Paratrechina</i>	128	34	373	535
<i>Ponera</i>	808	730	378	1916
<i>Prenolepis</i>	0	0	1	1
<i>Solenopsis</i>	0	3	0	3
<i>Strumigenys</i>	518	172	225	915
<i>Temnothorax</i>	28	80	32	140
<i>Tetramorium</i>	0	1	6	7

Table 1: Data of ants collected at the three sites 2019-2021

DISCUSSION

We've collected approximately 7,000 ants, 17 genera, and relevant insight into species distribution over the course of 2019, 2020, and 2021 at Eagle Lake, Rodburn Hollow, and Stony Cove. The purpose of this study is to contribute data for other biodiversity and environmental research involving the woodlands of Rowan County, KY. Because of the unique clump distribution of ants, what we've collected in the past three years isn't enough. We need more samples to better validate our statistics, and plan to continue collecting and recording data.

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