

# A Preliminary Survey on the Biodiversity of Wasps in Eastern Kentucky

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## ABSTRACT

Biodiversity is the measure of variability of interactions between living organisms within an area. Biodiversity contributes significantly to the production of different life sustaining resources and supports a diversity of ecological life. A greater biodiverse area can help maintain environmental balance and maintain ecological diversity and health. There are multiple economic, cultural, and scientific reasons as to why biodiversity is important. When assessing biodiversity, mammals and birds are commonly used as surrogates. The problem with mammals and birds is that there are relatively few species and relatively few individuals in an area, so quantitative assessment can be difficult. However, insects are extremely diverse, ubiquitous, and important components of ecosystems, which makes them effective surrogates to assess biodiversity. Few studies have used wasps to measure biodiversity. However, wasps can be an effective surrogate to assess biodiversity as they provide essential ecological roles such as pollination, pest regulation, and general insect population control. There are both positive and negative aspects of using wasps to assess biodiversity. Advantages include wide species diversity, host specificity, and specialist roles in their environment. Downsides include few resources on wasp identification and most wasps are minute, smaller than 3 mm, which make them difficult to identify. We collected wasps from leaf litter and yellow pan traps at several localities near Morehead Kentucky. So far, we have collected several thousand specimens. Most samples contain 30-70 species of wasps. We are still sorting and identifying wasps.

## INTRODUCTION

### What is Biodiversity

While the term "biodiversity" can be found used in many different fields, there is a common dispute in the scientific world about what biodiversity is. However, many would agree that biological diversity focuses on the variety of both abiotic and biotic organisms in a specified area. Biodiversity measurements are not limited to any one field or scale of study and are a crucial part of any research. Classification is a core part of biodiversity, as the different families and classes are the main makeup of determining how diverse something is. The study of biodiversity among anything is also something that requires concise communication, with both the immediate research team, scientists around the world, and everyday citizens. Communication is a crucial key in conservation efforts and could reveal more variances among the subject of interest. As a topic to study, biodiversity has a wide range of points to cover, all of which are important to the ending results.

### Why is Wasp Biodiversity Important

While often overlooked and passed off as household pests, wasps greatly contribute to the world around us and the everyday functions of life. Wasps perform a great number of environmental services that not only benefit countless ecosystems but as well as the economy of the United States. It was estimated by a study published in 2006 that the value of these environmental services performed by insects was over 57 billion USD every year. This value is created by the products and processes insects create and perform. Having a high wasp biodiversity allows these creation and processes to continue and flourish throughout an environment. Wasps specifically greatly contribute to these environmental services as they play a key role in plant pollination, the recycling of animal waste and organic matter, and agricultural and forest pest control.

## MATERIALS AND METHODS

### Pan Traps

Pan traps are small baking pans painted yellow and placed on the forest floor. The pans were filled with a mixture of a liter of water, 150-200 grams of salt, and a squirt of dawn dish detergent. After one week, the contents of the traps were collected into a jar of 70% ethanol. The pan trap method is primarily used to capture small Hymenoptera.



Fig. 1 Collecting samples from pan traps and sorting at microscopes

### Leaf litter

Leaf litter from the forest floor was collected using a sifting tool. The leaf litter was placed into the top of the tool and shaken through screens to filter the smaller pieces from large leaves and twigs. The smaller mulch and insects were able to fall through to a collecting sleeve. After a sufficient sample has been collected, it can be taken back to the lab for sorting. Mulch collected from leaf litter was placed in a Berlese funnel. The substrate was placed on top of layers of cheese cloth over a metal screen. A collecting jar of ethanol was placed directly under the funnel. A lightbulb was placed on the top of the funnel and covered. The heat from the lightbulb caused the insects to burrow away further into the substrate, eventually falling into the collecting jar.



Fig. 2 collecting leaf litter and sorting through a Berlese funnel

## RESULTS

### Ichneumonoidea

Ichneumonidae wasps are parasitoid wasps, meaning the wasps of the ichneumon family paralyze other arthropods after developing in or on them. Parasitoids are separated into two groups, known as idiobiont parasitoids and koinobiont parasitoids.

Characteristics	# Fam	# Spp	Behavior and Ecology
Ichneumonoidea	3	25,000	Feeds internally and allows hosts to continue development upon parasitization, or feeds externally and kills hosts upon parasitization



Fig. 3 Examples of Ichneumonoid wasps

### Chalcidoidea

Wasps of the Chalcidoidea superfamily are small, often metallically colored wasps that can be found in all zoogeographical regions and in all terrestrial habitats. In the present time, the Chalcidoidea superfamily is divided into 19 families and more than 90 subfamilies. 22,000 valid species have been cataloged worldwide, with some 2,600 described species being found in North America. Despite their prevalence in all regions, Chalcidoidea wasps are among the most difficult of wasps to identify due to the lack of sufficient keys and the minute size of the wasps themselves.

Characteristics	# Fam	# Spp	Behavior and Ecology
Chalcidoidea	19	22,000	Parasitize eggs of other insects and arachnids. Non-parasitic Chalcidoidea wasps feed on plant tissues such as flowers, stems, seeds, and leaves.



Fig. 4 Examples of Chalcidoid wasps

### Chrysoidea

The superfamily Chrysoidea is composed of cuckoo wasps and allies. There are estimated to be 16,000 species in the world, most of which are undescribed. In North America, there are 550 described species. There are three larger common families (Bethyidae, Chrysididae, and Dryinidae) and four smaller rare families (Embolemyidae, Plumariidae, Sclerogibbidae, and Scolebythidae).

Characteristics	# Fam	# Spp	Behavior and Ecology
Chrysoidea	7	16,000	External parasitoids of Lepidoptera and Coleoptera

### Cynipoidea

Cynipoidea is a superfamily that includes 6 families: Ibaliidae, Liopteridae, Figitidae, Eucolidae, Charipidae, and Cynipidae. It is composed of over 600 species in North America, most of them being phytophagous and others are parasitoids.

Characteristics	# Fam	# Spp	Behavior and Ecology
Cynipoidea	6	2,000	Most species are phytophagous, others are parasitoids

### Evanoidea

The superfamily Evanoidea contains three families: Evaniidae, Gasteruptionidae, and Aulacidae. This is a poorly known group with approximately 1,100 described species, and many more undescribed species. They are found in tropical forests and commonly collected from leaf litter samples. All species are parasitoids with restricted host ranges, most parasitize cockroach egg capsules.

Characteristics	# Fam	# Spp	Behavior and Ecology
Evanoidea	3	1,100	Most are parasitoids on cockroach eggs



Fig. 5 Examples of Chrysoidea, Cynipoidea, and Evanoidea

### Platygasteroidea

The superfamily Platygasteroidea is composed of two families: Scelionidae and Platygastriidae. There are about 4,000 species described and an estimated 10,000 species. It was recently separated from Proctotrupoidea.

Characteristics	# Fam	# Spp	Behavior and Ecology
Platygasteroidea	2	10,000	All species are parasitoids

### Ceraphronoidea

The superfamily Ceraphronidae consists of over 800 described species in two families: Megaspilidae and Ceraphronidae. Little is known of the hosts of Ceraphronids; however, they have been reared as both parasitoids and hyperparasitoids.

Characteristics	# Fam	# Spp	Behavior and Ecology
Ceraphronoidea	2	800	Some species are parasitoids, others are hyperparasitoids

### Proctotrupoidea

All members of the superfamily Proctotrupoidea are parasitoids, most being internal parasitoids of Diptera or Coleoptera larvae. There are 2,500 described species and 8 families: Peleciniidae, Vanhorniidae, Proctotrupidae, Heloridae, Peradeniidae, Roproniidae, Austroniidae, and Monomachidae.

Characteristics	# Fam	# Spp	Behavior and Ecology
Proctotrupoidea	8	2,500	Most are internal parasitoids of Diptera or Coleoptera larvae



Fig. 6 Examples of Platygasteroidea, Ceraphronoidea, and Proctotrupoidea

### Vespoidea

Vespoidea contains the most well-known species of wasps, such as paper wasps, hornets, and yellow jackets. Within the superfamily, there are a variety of behaviors including social and solitary species. Five families are represented in the study sample. Vespidae, Pompilidae, and Tiphiidae are the three most prevalent. The remaining two are Scoliidae and Mutillidae.

Characteristics	# Fam	# Spp	Behavior and Ecology
Vespoidea	10	48,000	May be highly social or solitary. Can be parasitic, predatory, or herbivorous.



Fig. 7 Examples of Vespid wasps

### Apoidea

Included are species of bees and a group called the sphecoid wasps. These are wasps with very thin waists, such as mud daubers. Five families are represented in the study samples. These include Sphecidae, Colletidae, Anthophoridae, Nyssonidae, and Halictidae.

Characteristics	# Fam	# Spp	Behavior and Ecology
Apoidea	20	28,000	Can be carnivorous, helpful in pollination



Fig. 8 Examples of Apoid wasps

## DISCUSSION

We have collected thousands of samples of wasps. The more commonly known Vespoidea wasps are easy to identify. However, the parasitoid wasps are harder to identify due to their small sizes and few resources. Parasitoid wasps serve as a biodiversity metric because they are specialists and there are many out there.

## ACKNOWLEDGEMENTS

We want to thank Dept. of Biology and Chemistry for providing space and equipment, as well as Daniel Boone National Forest Service personnel for permission to collect insects.

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