Purdue University - Senior Undergraduate Capstone

Soil Microarthropod Community of McCormick Woods with Special Reference to Collembola.

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Introduction

Soil microarthropods can help researchers understand the ecosystem of organisms that live in the forest soil by assessing open and closed sites based on the depth and moisture levels. The microarthropod taxa found in soil are Collembola, Diplura, Protura, Acarina, Diplopoda, Chilopoda, Araneae and many more. These taxas of arthropods are more commonly found within nutrient rich top soils. Their ecosystems range from the tundra of North America to the tropical rainforests of South America, so long as there is enough humidity to survive soil microarthropods can live almost anywhere on the planet. (Rusek, 1998) Collembola, more commonly known as Springtails, are found in these areas based on their ability to breakdown and recycle organic matter and nutrients within soil. Collembola thrive in high humidity regions especially in places such as leaf litter, damp soil, and algae.

There are over 6,500 known collembolan species listed around the world, most likely many more undescribed, making them the most common terrestrial arthropod. They range in size from 0.2 mm to 10 mm, making collembolans and other microarthropods not quite visible to the naked eye. (Kerstin, 2007) Springtails are named for the appendage located underneath the abdomen called the furcula which is tightly clasped to the body by a structure known as the tenaculum. This structure is able to release the furcula instantaneously causing it to ‘spring’ into the air. By being able to propel itself, 100 times the length of its body, springtails are able to avoid predators within the area and travel greater distances.

Soil microarthropods are both beneficial and pests to their ecosystem. Ticks and mites in the order Acarina are mostly pests as they can be disease vectors, cause painful bites, or infections. Most Collembola are beneficial by having the ability to recycle nutrients and are able to redistribute spores and bacteria across the top soil. Some species of Collembola can be pests to agriculture however by feeding on tuberous plants and harming the rhizosphere. (Kerstin, 2007) Therefore, I hypothesize that Collembola and other related soil microarthropods are likely to be found in forests and places rich in vegetation based on soil moisture and soil depth.

Objectives

• Provide ENTM 335 students in where to look for soil microarthropods, especially Collembola

• Understanding family composition of Collembolan families in McCormick Woods

• Determine family differences within sites A (open canopy) and B (closed canopy) based on a three-month sampling period, soil moisture level, and soil temperature based on depth

Materials and Methods

Specimen Collection

Data and specimens were collected at McCormick Woods in Tippecanoe County, Indiana from May 2017-July 2017. These months were chosen based on days that would potentially receive the most rainfall and humidity. The soil samples containing the microarthropods were obtained by using a golf hole cutter with dimensions of 15.24 cm in length and 10.80 inches in diameter coming to a volume of 1,396.12 cm^3. Samples A were taken from areas with minimal leaf litter, shrubs, and with open light. Samples B were taken from areas crowded with shrubs, more moist ground, and little light on the forest floor. A and B soil samples were collected twice a month, about every two weeks, adding up to 3 samples of each. Before the samples were extracted, a soil thermometer was used to test the first three inches and bottom three inches temperature.

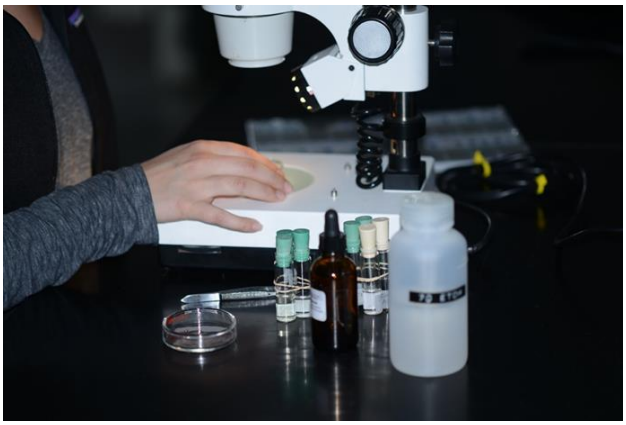
Site A Site B

Measurements and Preparations

Soil samples containing microarthropods were collected and stored in plastic Tupperware and brought back to Smith Hall, Purdue University. Each sample site (A and B) were cut in half to give the top 7.6 cm of soil and bottom 7.6 cm of soil. Both were weighed immediately to later calculate the moisture level within the soil. The two halves of both A and B were then set into a Berlese funnel to separate the organisms from the soil. Moisture level was then calculated by letting the light of the Berlese naturally dry out the soil for about 3-5 days to be weighed again. Moisture level was finally calculated by using the equation [(total-final)/total].

Taxonomy and Slide Mounts

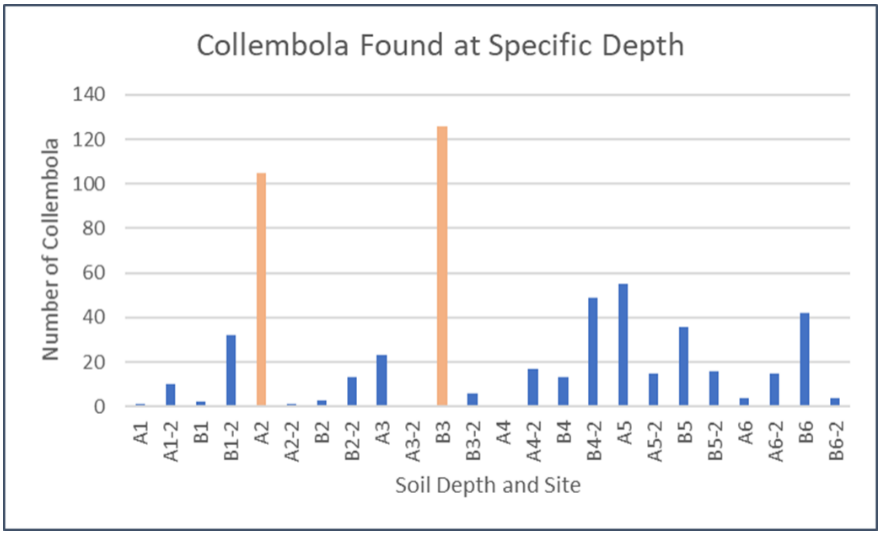
The Berlese funnel causes the soil microarthropods to escape the heat and stay in the moist soil, dropping the organisms into the 70% ethanol mixture. After the collection season from May-July was finished, the vials of preserved microarthropods were separated into their designated taxa's using a dissecting microscope. The Collembola Order was classified down to family and the only order that was mounted. Keeping the sites separated, the Collembolan were cleared using lactophenol which contains lactic acid, a clearing agent, and glycerol which prevents drying. The lactophenol is heated to start the process of stripping the collembolan of color to later be more easily identified to family. Once cleared, the Collembolan were transferred to a mounting medium, PVA, on a slide mount with cover slip to protect the specimen. 572 slide mounts were created and later identified by using taxonomical keys provided by Professor Oseto's ENTM 335 course material.



Discussion and Results

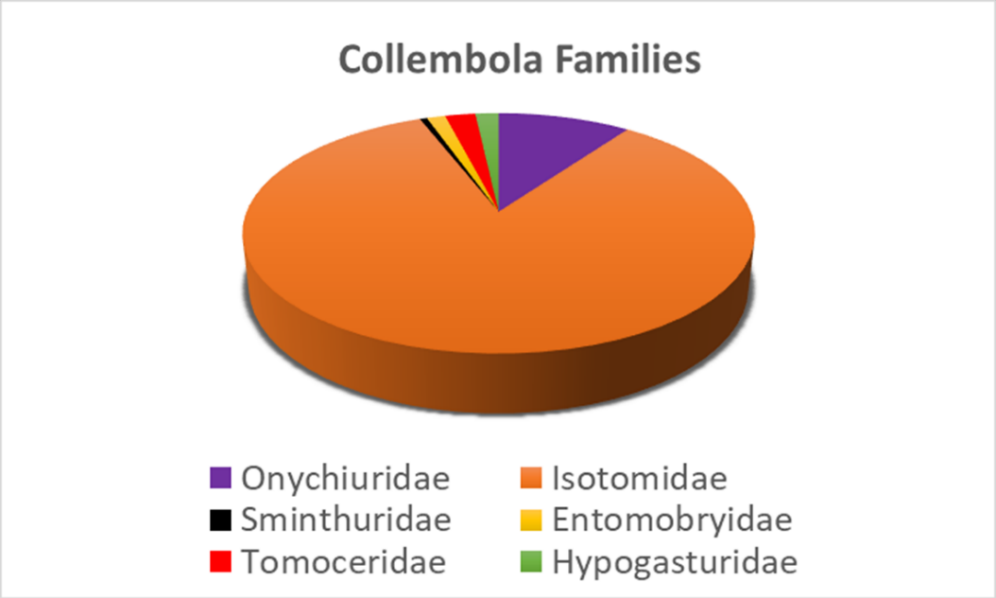
Date	Site	Moisture Level	Soil Temperature	Collembola	Diplura	Acarina	Pseudoscorpion	Araneae	Chilopoda	Diplopoda	Insecta
10-May-17	A1	37.70%	60° F	1		1			2		
10-May-17	A1-2	46.90%	47° F	10		16			1		2
15-May-17	B1	34.90%	58° F	2							
15-May-17	B1-2	37%	54° F	32		32					6
15-May-17	A2	37.70%	61° F	105	1	98					18
15-May-17	A2-2	24.90%	54° F	1							1
23-May-17	B2	22.40%	53° F	3					1		
23-May-17	B2-2	44.50%	51° F	13		27					1
14-Jun-17	A3	36.40%	68° F	23		32			3		
14-Jun-17	A3-2	31.80%	63° F			11					1
14-Jun-17	B3	35%	68° F	126		103			1		4
14-Jun-17	B3-2	31.10%	65° F	6		3					
29-Jun-17	A4	20.70%	66° F								2
29-Jun-17	A4-2	25.90%	62° F	17		35			1		
29-Jun-17	B4	20.40%	66° F	13		13		1	1		3
29-Jun-17	B4-2	32.60%	61° F	49		58			2		5
19-Jul-17	A5	31.90%	74° F	55		78		3	2	1	
19-Jul-17	A5-2	20.60%	69° F	15		27			3		
19-Jul-17	B5	27.40%	74° F	36		34		4	2		1
19-Jul-17	B5-2	23.50%	70° F	16		14	1	1			
31-Jul-17	A6	28.30%	77° F	4		22	2		1		
31-Jul-17	A6-2	24.20%	67° F	15		15		1	2	1	
31-Jul-17	B6	26.50%	70° F	42		79		1	1		
31-Jul-17	B6-2	20.70%	65° F	4		23					

The spreadsheet above shows the data over the course of the summer months, May-July 2017. As temperatures rose the soil heated up as well causing the moisture levels to drop gradually over the three months. The first and most obvious correlation within the spreadsheet was the amount of Acarina and Collembola found in the same site and depth. This is most likely due to the fact that ticks and mites have been known to prey and feed on Collembolans. In total, there were 1,393 soil microarthropods found within the samples with both Collembola and Acarina being the highest amount recorded.



70% of the Collembola were located in the top 7.6 cm of soil, indicating that these species prefer to be closer to the surface near leaf litter. The figure above shows the number of collembolans found over the course of the summer with respect to their location and depth. The two highest peaks located in the top 7.6 cm of soil, which are highlighted, had over 100

collembolans in each sample. It rained heavily before these days which could account of the high increase in numbers.



572 collembolans were mounted and identifies into six different families displayed below. Isotomidae, the second largest family of collembolans, were the most abundant at 84% of total identified. There are eleven collembola families found in North America, possibly more, and McCormick Woods hosted over half them in a small area. (Mari Mutt & Bellinger, 1990) Overall, McCormick Woods located off of Purdue University's campus in Tippecanoe county is rich in soil microarthropods and can be useful for the future ENTM 335 students of Professor Oseto's course.

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