

**Comparison of Arthropod Diversity
between Perennial
Shrub vs. Evergreen Tree Habitats
at Sites near Gothic, Co.**

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Abstract

There are numerous species of organisms that live in woody vegetation. Their species diversity will be equal to the total number of species and their relative abundance. This study compared the species diversity of arthropods between perennial shrubs and evergreen trees. I hypothesized that a larger surface area found in the perennial shrubs would provide more niches for the arthropods to utilize, giving them greater species richness. Five different sites for each vegetation class located near Gothic, Colorado were selected. Large willows were selected and measured in order to equalize the area of conifer being sampled. Two trees were sampled per vegetation class, by using a beat-sheet to collect arthropods and beating the vegetation for a total of two minutes. All specimens collected were sorted and identified to morpho-species. The Shannon Diversity Index analysis demonstrated that there was a significant difference in species diversity between the two vegetation classes. The number of species in the conifers was greater than willows. Statistical analysis by an ANOVA test, also demonstrated that there is significant difference between the number of species between conifers and willows, conifers having larger numbers of species and greater abundance.

Introduction:

Species diversity depends on a number of different factors, such as area, temperature, and availability of food and shelter. Species diversity of any community is equal to the total number of species (species richness) it contains and their relative abundance evenness. On the planet, the number of species increases as you move closer to the equator, since the tropics offer more stable habitats (Putman, 1994). Each habitat will provide conditions for species to live in, but the size of each habitat will also determine how many species are found in it.

Arthropods are the most diverse group of animals on earth. They can inhabit any type of environment and habitat, such as water, land or air, which is one of the reasons they are so successful. Analyses of relations among plant and arthropod trophic groups indicated that herbivore diversity was influenced by plant, parasite, and predator diversity (Siemann et al. 1998). These factors will determine the species richness of arthropods found in a given habitat. Also, it has been suggested that structural components in the habitat may be especially important for the composition and evolution of plant-living arthropod communities (May, 1978).

Evergreen conifers and perennial willows are a major habitat source for arthropods in the Gothic, Colorado, area. These two vegetation classes are found in great abundance. The structural differences between the two habitats allow for an interesting comparison for species diversity of each. There are several structural differences between willow and conifer habitats i.e., willows have more surface area as opposed to conifers which are tall structures. Gunnarsson (1990), found that there is a positive correlation between spider abundance and the proportion of needles in each branch of spruce conifers. Looking at the differences between the two habitats may help scientists understand how niche selection is achieved by arthropods.

A habitat with more surface area may suggest that there are different numbers of niches for arthropods to live in. On the other hand, a habitat with year-round leaves could be more useful for arthropods in contrast to willows that are perennial and have no leaves during the winter season. This study estimated the species richness in willows and conifers, compared the two of them, to see if there is a significant difference between the two vegetation classes. I hypothesized that the larger surface area of perennial shrubs would contain greater species diversity and richness than conifers.

Materials and Methods

The study was conducted between July 30 and 31, 2004. Five sites were selected randomly in Gothic, Co. For each vegetation class, two trees were selected and measured. Both conifers and willows were located in the same general area, and they each were hit for a total of two minutes. An aspirator was used to collect small specimens. Sites one and two were located east of the Rocky Mountain Biological Laboratory across the East River. The first vegetation class sampled (S1C) were two conifers, approximately 4.5 meters in diameter and about 5 meters

away from each other. Each tree was sampled up to 2.5 meters by hitting the vegetation part only. Willows in the first site (S1W) were about 4 meters apart and had a surface area of approximately 4 meters. The distance between S1C and S1W was 57 meters. Site number two conifers (S2C) were two trees fairly close together with about 4.5 meters in diameter each and a height of 2.5 meters was hit. For site two willows (S2W) an area of approximately 2x2m was hit in each of the two trees that were 2.5m apart and that were 30 meters away from S2C. Willow number three (S3W) was located east of Copper Creek Road, across the Copper Creek river behind Becky Irwin's cabin. The two trees were 4.5 meters apart and 57 meters from the third conifer (S3C). S3C conifers were 10 meters apart and close to the river. Conifers for site number four (S4C) were located north of South Gothic; these trees were along a trail, and 5 meters apart. Willows (S4W) were 18 meters away from the conifers, and between the two trees there were 3 meters away from each other. Finally willow number five (S5W) were located in the research meadow south of Gothic, and the two trees sampled were 7 meters apart. 19 meters away from S5W the two conifers were sampled, these two trees were located along an 8 meter trail. At the base of all the trees there were a variety of flowering plants and herbs. Under the conifers the most common plants were: composites, *Potentilla* sp., *Delphinium*, columbines, *Eriogonum*, and other unidentified herbaceous plants. Beneath the willow there were found *Apiaceae*, composites, *Delphinium*, *Achillea*, grass, *Potentilla* sp., *Geranium* sp., and some green herbs. After the two minutes of hitting the vegetation, all samples were collected and then sorted into morpho-species.

The species diversity was calculated for each vegetation class by using the Shannon Index ($H' = -\sum (p_i)(\log p_i)$). In order to compare the diversity and species number in evergreen and perennial shrub sites, an ANOVA test was performed.

Results

At the time of collection of the specimens from the beat-sheet, it was observed that there were a greater number of arthropods in conifers. This was also demonstrated numerically: mean H' for the conifers was 1.32 and $s=0.0678$. The large H' value in conifers demonstrates that there is no one species more abundant than others, and that all species are evenly distributed. Willows had an H' value of 0.851 and $s=0.1342$. A low value for the H' suggests that there is one species more abundant than others in this habitat type and that not all species are evenly distributed. Mean species number (S) for the evergreen conifers was equal to 35 with $SD=6.124$. In the case of the perennial shrubs, the mean number of species was 14.8 with $SD=5.586$. The species diversity is obvious at first glance; conifers have greater species richness than willows. To compare the two vegetation classes, an ANOVA was performed between the H' of each site of the two tree types. This resulted in $F=49.26$, p -value of 0.000111, $df=9$. between the H' in both trees. The values for the mean species numbers were: $F=29.7$, p -value: 0.00069, $df=9$, $p>.05$. The result for both the ANOVA for the H' and S tell us that there is a statistical difference between conifers and willows. This allows us to reject the null hypothesis of equal numbers of species in both perennial shrubs and evergreen trees.

A total of 113 morpho-species were found between the two vegetation types. Some overlap of species was found, but was not a rule of thumb over the sample. The total number of individuals collected was 1,043 specimens. Overall in the willows there was one dominant species, which was the Cicadellidae family.

Discussion

Contrary to my hypothesis, the greater numbers of species were not found in the perennial shrubs, but in evergreen trees. Species richness was almost two times greater in the conifers, demonstrating that the vegetation structure may contribute to differences in the diversity of many plant-inhabiting insect communities (Lawton, 1983). Perhaps each of the needles of the conifers provides a niche for arthropods, whereas the large leaves of the perennial shrubs may only be occupied by one arthropod. In addition the large numbers of galls in the leaves of the willows prevent other organisms from inhabiting such leaves. These galls may be induced by Hymenopterans of different species, since there were three different types of galls observed.

It was observed that the conifers also had a greater number of arachnids, which would make sense since they are predators and their success depends in the amount of prey found in a habitat. A more stable, healthy and mature habitat may be preferred by a higher number of species (Brower et al. 1990). This is something I observed at the time of sampling, where S3C, S4C, and S5C were taller and older trees than S1C and S2C. In the older trees the number of species collected was greater than in the younger trees.

Future studies should focus on studying each vegetation class individually and increasing the number of trees sampled. An experiment having equal numbers of older and younger trees could help determine which one has a greater diversity. Also the leaf structure and parasite load could help determine if any of these is a factor affecting the species diversity between perennial shrubs (willows) and evergreen trees (conifers).

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