Species richness of spiders in the Kebun Wisata Pendidikan Universitas Negeri Semarang

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Abstract. This study aims to explore the Species Richness Spiders (Arachnida) in the Kebun Wisata Pendidikan Universitas Negeri Semarang. Sampling was carried out by the roaming method, in June-July 2020 during the dry season. Spiders are collected using a pitfall trap (PFT) for spiders on the ground, and photographed for spiders that make their webs at a certain height. During sampling, the types of spiders were recorded, the number of individuals per species, the microhabitat of the spiders, with measurements of the abiotic conditions: temperature, humidity, light intensity. Data analyzed by using spider functional dendrogram and be collected regarding to the level of family, genus, and species. Quantitative data analysis includes analysis of Species Richness Index using the Margalef formulation. Species Diversity Index, using Shannon-Wiener. The results of the study concluded that: (1) there were 21 species of spiders caught on the ground, while others, 68 species, were found making nests in trees (2) The species richness of the spider in the UNNES KWP was moderate to high. Meanwhile, diversity index value of spider was high. (3) effort in species richness conservation of spider could be done in their natural habitat, also by adding various kinds of fruit plants to invite insects and spiders to come will effect on increasing species richness.

1. Introduction

Spiders belong to the Phylum Arthropoda and the Arachnid class and the Order Araneae. It has eight limbs and can be found in various types of habitats, except the sea. Morphologically, spiders are different from other arthropods because these creatures only consist of two body segments, namely prosoma (cephalothorax) and ophistoma (abdomen). The two parts are connected by a pedicel, which is a narrow part like the waist [1]. The number of spider species that have been found and described are 43,678 species of spider, classified into 111 families and 3,600 genera [2].

Generally, regarding to the use of thread, the spiders are classified into two groups. The first group uses threads to trap prey, which is dominated by the Araneidae group (orb-web, cob-web, and sheet-web weaver). The second group does not use threads to ensnare prey, including jumping spiders (Salticidae), wolf spiders (Lycosidae), Sparassidae, and Thomisids [3]. Spiders have an important role as insect predators, so they are natural potential biological control agents for various insect species so that they help nature in regulating insect population densities. Different types of spiders employ different strategies to catch their prey. Some types of spiders make webs to trap prey. In addition, the net also serves as a place to live. Spiders are found almost everywhere: gardens, fields, rice fields, buildings, cable wires, and so on. Research by Sosromarsono & Untung stated that spiders are found on the fringes of rice plantations and prey on various species of pests. Spiders will live and survive in agricultural ecosystems every growing season through gradual immigration from surrounding habitats by walking

or jumping, also through the air (carried by the wind) [4]. Spiders eat insects and other arthropods such as Colembola, Diptera, Homoptera, Orthoptera, Coleoptera, Lepidoptera, and fellow spiders [5]. The families of Order Araneae (spiders) that are often found in agroecosystems and play an important role in natural pest control are member species of Araneidae, Lyniphiidae, Lycosidae, Oxyopidae, Saltecidae, Tetragnatidae, and Thomosidae [6] Susilo, 2007)

Spiders live in an environment that has slightly limited quarry or food supply, so that each spider has its own strategy to survive there such as selection of microhabitat and hunting behavior. Different species of spider belonging to the same functional group will have similarities in microhabitat selection and hunting behavior. The existence of the distribution of microhabitat and differences in hunting behavior makes the prey of each species of spider also different, so this research was conducted to determine spider niches and grouping spiders into functional groups.

Kebun Wisata Pendidikan UNNES (KWPU) has an area of 2.2 ha with a variety of plant collections. KWP was developed by UNNES through the Biology Department. KWP provide facilities and infrastructure to support Biology learning activities. The types of plants grown at KWP have various functions including maintaining the hydrological cycle and preventing soil erosion, rare plants, medicinal plants, host plants and food to support bird and butterfly life, and rare plants in Indonesia [7]. However, research on spiders has never been done.

According to those potential factors, several problems formulated in this research, namely (1) How is spider's species richness in KWP UNNES? (2) What is the diversity of species richness of spider species in each habitat type (zona)? and (3) What are the recommendations for the conservation of species richness of spiders in KWP UNNES?

2. Methods

The study lasted for 2 months in KWP UNNES. Sampling was carried out 3 times at intervals of 3 weeks, at the beginning of the dry season on June-July 2020. Spiders were collected using two tools, namely: trap traps (Pitfall Trap / PFT) and swing nets for sampling for identification purposes [3]. Once the spiders have been identified, subsequent sampling is only photographed. The researcher records the type of spider (webmaker or not), the spider's microhabitat (being in the upper / middle / lower part of the plant, measures the height of the webs or its presence in the soil, and measures abiotic conditions: temperature, humidity, and light intensity). The data obtained were identified with several literatures. Qualitative data analysis refer to 'Introduction to Insects Lessons' by DJ author. Borror, C.A. NF. Jhonson, C.A. Triplehorn. and Riceland Spider of South and Southeast Asia book written by A.T. Barrion and J.A [1]. Classification analysis according to type of spider's microhabitat. Quantitative data analysis includes the analysis of the Species Richness Index using the Margalef formulation and the Shannon Species Diversity Index.

3. Results and Discussion

Study conducted at KWPU discovered 21 species of spiders caught on the ground, while others, 68 species, were found making nests in trees caught by pitfall traps. The details shown in Table 1. The results of the calculation of the species diversity index (Shannon-Wiener) of spiders on the tree shwn in Table 1 obtained a value of 3.65. This value is in the high category. The high diversity value is influenced by the evenness index of 0.86, including the even category, and the dominance index of 0.06, which means there is no dominant species. Spider's species richness in KWPU was moderate.

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Table 1. Results of calculation of the species richness index and species diversity index

Measurements	Ground Spiders	Tree Spiders
Individual Total	21	68
Species Richness (Dmg)	4,16	13,72
Diversity Index (H')	2,41	3,65
Dominance (D)	0,14	0,06
Evenness (E)	0,79	0,86

Based on Table 1, it can be explained that the total number of individuals among tree spiders that make nets is more than land spiders. The diversity index for the species of spiders in the soil was obtained a value of 2.41. This value is included in the medium category. The diversity value is influenced by the evenness index of 0.79 included in the evenly distributed category, and the dominance index of 0.14 which means there is also no dominant species. Diversity index and species richness per habitat in biotic and abiotic environment during the dry season June-July 2020 at KWPU could be seen in Table 2. Differences in species richness of spiders in several zone caused by differences vegetation types and environmental factor conditions.

Table 2. Diversity index and species richness per habitat type / zone with the abiotic and biotic environment (Zoning area can be seen in Figure 1).

Environment	Measurements	Zone I	Zone II	Zone III	Zone IV	Zone V	Zone VI
Biotic	Number of individuals	56	60	34	37	18	58
	Species Richness	3,36	3,60	2,04	2,22	1,08	3,48
	Diversity Index	0,85	0,70	0,48	0,53	0,26	0,82
Abiotic	Light Intensity (lux)	403-629	138-729	355-812	355-560	364-598	138-556
	Air humidity (%)	30-54	33-46	29-43	43-46	46-62	51-60
	Air temperature (°C)	26-30	27-30	29-30	25-30	26-29	27-30

The results of this study indicate that the richness and diversity of spider species is much higher than a study in the National Park area of Mount Merbabu Boyolali, which found that there were at most 9 types of spiders with a diversity index of 0.0826, including low criteria [8]. Another research on the diversity of spiders and web models in Samata Village, Gowa Regency obtained 11 types of spiders [9]. However, when compared to the research of spiders on Sangihe Island, the species richness of spiders in KWP UNNES was lower because in there 117 species were found [10].

Another research estimated species richness in Rače and Marjeta plot exceeds the previous estimation of spider diversity in the north-western Slovenia which the spider diversity was estimated to between 72 to 86 species [11]. With and average diversity estimation of 103 species, the diversity of Marjeta plot is comparable to the forests of sub-Mediterranean region in south-western Sloveni, while spider richness in Rače plot with 142 estimated species is so far the highest one recorded in Slovenian forests [12,13]. Compared to similar studies in other regions, the diversity of the surveyed plots is comparable to Appalachian hardwood coves, which is one of the biotically richest regions of temperate North America and considerably exceeds the diversity of the deciduous forests in northern Europe [14,15].

Figure 1. Zoning area in KWPU UNNES [7]

The main consideration for web-making spiders (Arachnids) to occupy a habitat is the physical structure of the habitat and other factors such as the source of food in the habitat. The altitude of a location will affect climatic conditions. The altitude of the KWPU is around 500 meters above sea level with temperatures ranging from 25-31, so this is an ideal condition for the life of spiders.

Vegetation characteristics are closely related to spider habitat. This is a prerequisite for netting. Several studies have stated that habitat structure and microclimate characteristics are influenced by plant diversity [16,17]. Tree species richness plays an important role in determining canopy cover. Shading is important because it can affect the microclimate conditions on the forest floor [18]. The abundance of spiders is influenced by the physical structure of the vegetation and the availability of space for laying webs [19]. Undisturbed wild bush and subsoil vegetation covered with vegetation sub-layers in secondary forest, can support spider populations that require more space for web construction [20].

Leaf litter on the KWPU floor also affects the presence of spiders. Research conducted during the dry season with teak and mahogany causes a slow process of decay, and affects the diversity of soil fauna as a source of food for spiders. Secondary forest is one of the habitats that has a higher leaf litter depth than other habitats [21]. Leaves that fall onto the forest ground provide a suitable habitat for spiders that live in leaf litter. The number of spiders will increase as the leaf litter layer increases. The leaf litter provides more room for the spider to hide and avoids extreme temperatures. Weaver spiders such as members of the Araneidae create circular silk webs in the air between leaves and branches and in front of rock fragments [22]. Differences in the physical structure of leaf litter and their complexity can affect species composition, abundance and diversity of spiders, this generally increases with increasing litter depth in several studies [23,24]

In general, increased habitat disturbance will also lead to species decline. The spider habitat in KWPU is relatively undisturbed by human activities, unless it is used for student observation. Changes in the physical structure of the environment have a major influence on the habitat preferences of spiders, especially the types of spiders that make webs [25]. Another study also states that clove plantation areas show the lowest diversity because it is dominated by one plant only [13]. Furthermore, sampling is carried out at harvest time of cloves so that the habitat is disturbed by human activities. Cleaning activities under the clove trees disturb the spiders. There are several environmental disturbances that

have a negative impact on the abundance and diversity of spiders. among others: soil cultivation, pruning plans and use of synthetic pesticides [26,27].

Research on species richness of spiders at KWPU also utilizes the diversity of soil fauna as a data source for planning and conservation management. This can provide a step towards a credible biodiversity assessment based on a comprehensive set of criteria for efficient conservation planning. Our study also exploits the terrestrial arthropod diversity, as a rich data source for conservation planning and management [28-30] and provides a step towards a credible assessment of the biodiversity based on a comprehensive set of criteria, required for efficient conservation [31]. As a short-termed study providing sufficient amount of data by simple and affordable sampling approach, our survey fulfills most of the requirements of conservation studies [15,32] at one side and avoids the puzzling effect of phenological changes caused by seasons [15].

4. Conclusion

The results of the study concluded that there were 21 species of spiders caught on the ground, while others, 68 species, were found making nests in trees. The species richness of the spider in the UNNES KWP was moderate to high. Meanwhile, diversity index value of spider was high. Effort in species richness conservation of spider could be done in their natural habitat, also by adding various kinds of fruit plants to invite insects and spiders to come will effect on increasing species richness. For the conservation of species richness of spiders, we should not disturb its habitat. At the same time, species richness can be increased by adding various kinds of fruit plants to invite the presence of insects and spiders.

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