

Spider Diversity (Araneae) at Bamboo Village Campus, Golewa Subdistrict, Ngada Regency, East Nusa Tenggara Indonesia

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ABSTRACT: Bamboo Village Campus is an agroforestry area located in the districts of Turetogo Village Ratogesa, Golewa District, Ngada Regency, East Nusa Tenggara, Indonesia. Within the bamboo campus area, there is also a sustainable bamboo forest as well as a habitat filled with various types of bamboo and mollusk plants, including traditional shrubs and dye plants. As a bamboo forest area, many animals, especially insects, inhabit the area. One of the most common insects found in bamboo forests is spiders (Araneae). The aim of this research is to find out the variety of species of spiders (Araneae) that are found in the campus area of Bamboo Village Agroforestry Turetogo. The method used is combined with the transect quadrant, a data collection technique using observations and documentation on each transect. Each transect has four plots measuring 25 × 25 meters with a distance of 5 meters between plots. The results showed that the total number of spiders obtained was 11 species belonging to 5 families, for a total of 900 individual spiders. The spider's diversity index of 2.1774 belongs to the medium index, the diversity index of 0.908 belongs to the high index, the dominant index of 0.1451 belongs to the low index, and the spider abundance index of 0.12 belongs to the medium index.

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INTRODUCTION

The Bamboo Village Campus is located in the Turetogo area of Ratogesa Village, Golewa District, Ngada Regency. Standing on one hectare of land, the campus was built by Yayasan Bambu Lestari (YBL), a non-profit organization that since 1993 has been actively campaigning for and realizing bamboo as an environmental and economic solution for rural communities in NTT. The Bamboo Village Campus functions as the location of the Bamboo Field School (SLB), a YBL educational initiative for individuals, village communities, indigenous communities, as well as women and youth organizations. Within the bamboo campus area there is also a preserved bamboo forest and a nursery area filled with various types of bamboo and intercrops, including porang and traditional coloring plants (Yayasan Bambu Lestari, 2021).

Spiders have an important role in agriculture, plantations and settlements by preventing destructive insects (Mahalakshmi & Jayaparvathi, 2014). According to Aswad *et al.*, (2016) spiders are organisms belonging to the phylum Arthropoda whose body consists of two parts, namely the abdomen and cephalothorax. Spiders have an important role as predators (preying on insect pests) in this case as potential biological control agents and are environmentally friendly, play a role in the material cycle, and also as a heterogeneous component of a habitat (Chen & Tso, 2004).

The study of spiders at the Bamboo Agroforestry Village Campus, Golewa District, Ngada Regency, Flores, as one of the constituent components of the ecosystem is worth doing because spiders are one of the components that have an influence on the life cycle of an ecosystem. The presence of spiders in an ecosystem can be used as an indicator in measuring the quality of an ecosystem. The balance or sustainability of biological natural resources in TWAB needs to be maintained because it is a form of improving the quality of biodiversity. Ecosystem conservation efforts are essentially an absolute right and obligation for every generation because an ecosystem stores a number of biodiversity, one of which is spiders (*Araneae*) (Limbu *et al.*, 2018).

Bamboo Village Campus, Golewa Sub-district, Ngada Regency, Flores, has the potential for a number of unknown biodiversity including the existence of spider species. So far, studies related to spider diversity and abundance have not been conducted and published, and data on spider community structure in ecosystems are not yet available. Whereas data related to spiders can be used as a diversity database and conservation strategy. Starting from this description, the author is interested in

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conducting research with the title "Spider Diversity (*Araneae*) at the Bamboo Agroforestry Village Campus, Golewa District, Ngada Regency, Flores". The purpose of the study was to determine the diversity of spider species (*Araneae*) found in the Bamboo Village Campus Agroeducation Area.

METHOD

This research was conducted in the Bamboo Agroeducation Village Campus area in Golewa District, Ngada Regency, Flores from February 10 to March 15, 2024. The tools used in this research consist of: Digital camera, meter roll, gloves, raffia rope, clamp tool, knife or machete, net, paper, eraser and pen. The material used in this study is the type of spider (*Araneae*).

Data collection techniques used observation and documentation on each transect. The *belt transect* method was combined with quadrant transect (Iskandar, 1998) to obtain data. Each transect has four plots measuring 25 × 25 meters with a distance of 5 meters between plots (Mistar, 2003). The number of transects installed in the area to be studied was three. Each transect is placed in a different place which means it will be placed in different vegetation, where transect one will be paired with vegetation close to settlements. While transect two and three will be placed in plantation vegetation and bush vegetation. Species (spiders) were obtained in trees, rocks, lopo, and dry leaf layers. Species (spiders) that have been caught will be documented in the form of taking pictures, observing their morphological characteristics then recorded in the observation table and the species that have been observed will be released back into their habitat.

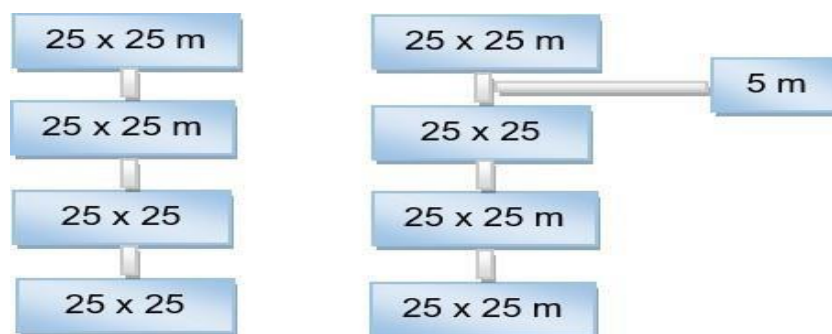


Figure 1. Side plot design of each observation transect (Limbu et al., 2018).

Samples obtained during the study will be identified by referring to the book Identification of Spiders by Dhiya'ulhaq et al (2022) and the National Journal. The data that has been obtained is then analyzed for species diversity, uniformity, dominance and abundance of spiders (*Araneae*).

Diversity Index

Species diversity was calculated using the Shannon-Wiener index (Odum 1993) in (Ulum et al, 2012).

$$H' = -\sum P_i \ln(P_i)$$

Description:

H' = Species diversity index

P_i = The proportion of individuals of a species to all individuals encountered, with P_i obtained from: P_i = N_i/N_{total}

Ln= Natural logarithm

Uniformity Index

Species diversity was calculated using the Shannon-Wiener index (Odum, 1993) in (Ulum et al., 2012).

$$E = \frac{H'}{\ln S}$$

Description:

E = Species uniformity index

H' = Species diversity index

Ln= Natural logarithm

S = Number of species

Dominance Index

Dominance was calculated using the Simpsons Dominance index formula (1949) in (Ulum et al., 2012).

$$C = \sum(P_i)^2$$

Description:

C = Species dominance index

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Pi = The proportion of individuals of a species to all individuals encountered, with Pi obtained from: $Pi = Ni/Ntotal$

Abundance Index

The abundance index of the data obtained, the abundance formula (Heryanto, 1986) was modified.

$$Pi = \frac{\text{number of species}}{\text{total area of the plot}}$$

Description:

Pi = Abundance value

RESULTS

Spider Species Found at Bamboo Village Campus

The following table is the research results on spider species found at the research site (table 1):

Table 1. Species found at the Bamboo Village Campus

No.	Family	Species	Habitat			
			BT	BL	S	ST
1.	Araneidae	<i>Argiope appensa</i>	35	-	42	22
		<i>Argiope versicolor</i>	26	-	32	29
		<i>Macracantha hasselti</i>	23	-	38	-
2.	Nephilidae	<i>Nephila pilipes</i> (Male)	43	-	47	23
		<i>Nephila pilipes</i> (Female)	58	-	62	37
3.	Sparassidae	<i>Heteropod venatoria</i>	-	-	-	39
4.	Lycosidae	<i>Tigrosa aspersa</i>	-	27	-	-
		<i>Pardosa milvina</i>	-	45	37	-
5.	Tetragnathidae	<i>Leucauge tessellata</i>	47	-	36	-
		<i>Leucauge argyra</i>	19	-	31	-
		<i>Tylorida ventralis</i>	21	-	28	-
		<i>Opadometa fastigata</i>	28	-	25	-

Description: BT = Bamboo tree, BL = Bamboo litter, S = Shrubs, ST = Settlement

Index of Diversity, Uniformity, Dominance and Abundance of Spiders

The diversity, uniformity, dominance and abundance indices of spiders at the Bamboo Agroforestry Village Campus can be seen in the table below:

Table 2. Diversity (H'), Uniformity (E), Dominance (C) and Abundance (D) Index of Spiders at the Bamboo Village Campus

No.	Family	Species	Number of Individuals	(H')	(E)	(C)	(D)
1	Araneidae	<i>Argiope appensa</i>	99	0,2428	0,1013	0,0121	0,0132
2		<i>Argiope versicolor</i>	87	0,2259	0,0942	0,0093	0,0116
3		<i>Macracantha hasselti</i>	61	0,1824	0,0761	0,0046	0,0081
4	Nephilidae	<i>Nephila pilipes</i>	270	0,3612	0,1506	0,09	0,036
5	Sparassidae	<i>Heteropod venatoria</i>	39	0,136	0,0567	0,0019	0,0052
6	Lycosidae	<i>Tigrosa aspersa</i>	27	0,1052	0,0439	0,0009	0,0036
7		<i>Pardosa milvina</i>	82	0,2183	0,091	0,0083	0,0109
8	Tetragnathidae	<i>Leucauge tessellata</i>	83	0,2198	0,0917	0,0085	0,0110
9		<i>Leucauge argyra</i>	50	0,1606	0,067	0,0031	0,0067
10		<i>Tylorida ventralis</i>	49	0,1585	0,0661	0,003	0,0065
11		<i>Opadometa fastigata</i>	53	0,1668	0,0696	0,0035	0,0071
Total			900	2,1774	0,908	0,1451	0,12

DISCUSSION

The Morphology of Spider Species Found at Bamboo Village Campus



Figure 2. *Argiope appensa*, Family Araneidae

Description: The head is black and white like batik, the dorsal part is bright yellow to faded and has black dots, while the ventral part, especially the abdomen, is yellow in an inverted U shape. Males of this species are smaller in size and plain light brown in color. The black legs have white stripes on each segment. Female spiders reach a body length of up to 6 cm and are black and yellow, while males are brown with a length of up to 2 cm (Asriani et al., 2010).



Figure 3. *Argiope versicolor*, Family Araneidae

Description: The body is blackish white and brownish. The back is black with several horizontal white stripes, the legs are brownish black, the chest is blackish, and the entire body is covered with fine hairs. Family Araneidae sits in its net displaying dramatic brownish-black markings. In contrast to research conducted by Limbu *et al.* (2018) found the spider family Araneidae with a description of a blackish white and yellow body, legs and chest and abdomen equipped with fine hairs.



Figure 4. *Macracantha hasselti*, Family Araneidae

Description: The head is black, the body is hairy, the back is white mixed with reddish, there are also reddish black spots, the abdomen and chest are dominant in red color and fine hairs on body parts. In contrast to research conducted by Limbu *et al.* (2018), found spiders of the Araneidae family with a description of a black head, a hairy body, a greenish yellow back, there are also reddish black spots and fine hairs on the body.



Figure 5. (a) *Nephila pilipes* (Male), (b) *Nephila pilipes* (Female), Family Nephilidae

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Description: Male and female *Nephila pilipes* have different characteristics. Females tend to be darker in color, the cephalothorax and abdomen are black while the legs of each joint are yellow. Male nephila are lighter brownish-red in color and have a smaller body size (Taek et al., 2020). This species is easily recognized by its very large size and black color with a pair of yellow stripes on the abdomen and this spider experiences extreme sexual dimorphism where the size of the female is larger than the male (Dhiya'ulhaq et al., 2022).



Figure 6. *Heteropod venatoria*, Family Sparassidae (Researcher, 2024).

Description: It has a hairy brown body from the cephalothorax to the legs and between males and females there is no difference in body color, the abdomen is elongated round with slightly tapered ends (Taek et al., 2020). Females are light brown in color and in front of the eyes there is a horizontal white line. Males are white with black markings on the cephalothorax and spotted markings on the legs that resemble leopard markings (Dhiya'ulhaq et al., 2022).



Figure 7. *Tigrosa aspersa*, Family Lycosidae (Researcher, 2024).

Description: This spider has a blackish body, blackish legs with brownish color lines on the joints. The abdomen is elongated with a blunt tip. Males have a smaller body size than females ((Dhiya'ulhaq et al, 2022).



Figure 8. *Leucauge tessellata*, Family Tetragnathidae (Researcher, 2024).

Description: It has a long cephalothorax with a cephalic region that can be raised and covered with hair. The lateral eye is smaller than the median eye and is located on a prominent tubercle. The anterior median eye is smaller than the posterior median eye. Cheliverae are strong, large and dark brown in color. Abdomen curved with two front and one rear hump, silver-white with white and black spots and stripes. Legs are smooth, long and covered with hair and bone (Gupta et al., 2015).



Figure 9. *Leucauge argyra*, Family Tetragnathidae (Researcher, 2024).

Description: It has a long cephalothorax with a cephalic region that can be raised and covered with hair. The lateral eyes are smaller than the median eyes and are located on prominent tubercles. The anterior median eye is smaller than the posterior

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median eye. Cheliverae are strong, large and dark brown in color. Abdomen curved with two front and one rear hump, silver-white with white and black spots and stripes. Legs are smooth, long and covered with hair and bone (Gupta et al., 2015).



Figure 10. *Tylorida ventralis*, Family Tetragnathidae (Researcher, 2024).

Description: Can be distinguished from other species of Tetragnathidae because it has an oval abdomen with a slightly tapered tip on the upper side so that the abdomen looks almost rectangular from the side. The white abdominal color is decorated with dark spots on the upper side of the side (Dhiya'ulhaq et al., 2022).



Figure 11. *Pardosa milvina*, Family Lycosidae (Researcher, 2024).

Description: It has four large eyes in a trapezoidal shape at the top of the skeleton. The two central eyes are largest and face forward, the two smaller eyes at the back face sideways or backwards. In front of the four eyes is a row of four small eyes. Body coloration varies but is usually gray or brown. There is a light band on the cephalothorax that shows contrast behind the head. The abdomen has a light mark followed by a series of paired light dots. It has banded colored legs. Males have black coloration around the eyes (Guarisco, 2020).



Figure 12. *Opadometa fastigata*, Family Tetragnathidae (Researcher, 2024).

Description: The head is orange with black pattern while the dorsal part is orange mixed with black, while the ventral part is black and there are 2 orange dots. The 4th leg has black coarse hairs that gather, the legs are black with orange stripes with an orange base (Asriani, 2010).

Index of Diversity, Uniformity, Dominance and Abundance of Spiders at Bamboo Village Campus

Based on the result, it can be seen that there are eleven species of spiders found, namely *Argiope appensa*, *Argiope versicolor*, *Macracantha hasselti*, *Nephila pilipes*, *Heteropoda venatoria*, *Tigrosa aspersa*, *Pardosa milvina*, *Leucauge tessellata*, *Leucauge argyra*, *Tylorida ventralis*, and *Opadometa fastigata*. The species belong to five families namely Araneidae, Nephilidae, Sparassidae, Lycosidae, and Tetragnathidae. Of the eleven spider species found, *Nephila pilipes* species is the dominant spider species in the Turetogo Agroforestry Bamboo Village Campus area. Spiders of this species generally live in trees, shrubs and settlements. Families Araneidae and Nephilidae were found living in bamboo trees, shrubs and residential habitats with large webs. The Tetragnathidae family was found living in bamboo trees and shrubs. The Lycosidae family was found living in bamboo litter and shrubs, while the Sparassidae family was only found in residential habitats.

Based on the data in the table above, the species *Nephila pilipes* from the Nephilidae family has the highest number of species, which is 270 individuals consisting of 113 males and 157 females. In the Bamboo Village Campus area, this species was found in the habitat of bamboo trees, shrubs and settlements. This spider is known as a silk ball weaver where the silk threads are used to wrap around the body of its prey, especially its main food, insects. This spider species has an important role for the

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environment, namely as a predator of insect pests related to biological activities to increase soil fertility (Annisa & Syazali, 2022).

The diversity index of spider species in the Tureto Agroforestry Bamboo Village Campus area is 2.1774 which shows a medium level of diversity. The spider uniformity index obtained is 0.908 which indicates a high level of uniformity. The dominance index obtained was 0.1451 which showed a low level of dominance while the abundance index obtained was 0.12 which showed a high level of the abundance is medium. Based on these four indices, the distribution pattern of spiders in the Tureto Agroforestry Bamboo Village Campus area is influenced by several factors, namely temperature, availability of prey or food, wind, humidity and light intensity (Kurniawan et al., 2014). Air temperature is a limiting factor for spider life, spiders can live optimally in the temperature range of 27-30°C. Air humidity also affects the life of spiders where these animals can live optimally at 70-80% humidity and in areas that have a fairly wide tree canopy cover. The large area of the Bamboo Village Campus covered by dense bamboo vegetation makes it an optimal area for spiders due to low sunlight intensity. The dense bamboo vegetation in the area also makes the wind speed in the area slow, making it ideal for spiders to build webs. The last factor, the availability of prey or food, is also an important factor, the large area of bamboo forest allows many small insects in the area which become the main prey or food of spiders.

CONCLUSION

Based on the results of research in the Tureto Bamboo Agroforestry Village Campus area, the number of spiders obtained was 11 species belonging to 5 families with a total of 900 spider individuals. The spider species diversity index of 2.1774 is classified as a medium index, the uniformity index of 0.908 is classified as a high index, the dominance index of 0.1451 is classified as a low index and the spider species abundance index of 0.12 is classified as a medium index.

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