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Diversity and abundance of Spiders (Araneae) in Mt. Kapayas, Cebu, Philippines

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Abstract

Spiders are essential components of the environment as they serve multiple vital roles in the ecosystem yet the insight from this organism is still insufficient. This study aims to determine the abundance and diversity of spiders in Mount Kapayas from forest and non-forest areas. Search and capture methods with a combination of beat-sheet were used during the sampling period of 80-man hours. A total of 360 individuals in 99 species representing 69 genera and 20 families were recorded. *Araneidae* has the highest record of species richness with 31 species. In terms of abundance, *Chrysso sp.* had the greatest number of individuals with 20, and from the nine recorded guilds, the most abundant are orb weavers. The study recorded twelve endemic species and five threatened ones under DAO 2019-09. These threatened species include *Eriovixia laglaizei* (Simon, 1877), *Neoscona punctigera* (Doleschall, 1857), *Neoscona facundoi* (Barrion-Dupo, 2008), *Neoscona vigilans* (Blackwall, 1865), *Parawixia dehaani* (Doleschall, 1859). Forest sites had a higher species richness and abundance with 225 individuals represented by 91 species compared to non-forest sites with only 135 individuals in 41 species. Forest areas also had a higher Index of Biodiversity of 4.23 and Evenness of 0.94 compared to non-forest with a biodiversity index of only 3.41 and an Evenness of 0.92.

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Introduction

Spiders make excellent models for studies of diversity (Scharff *et al.,* 2003; Cardoso *et al.,* 2010; Nogueira *et al.,* 2021). They are invertebrate animals belonging to the order Araneae, class Arachnida and part of the phylum Arthropoda. Spiders are essential to global biodiversity as they play various functions in our ecosystem (Sharma *et al.,* 2010). They are best known for being a generalist predator in the ecosystem, taking responsibility as biological control of pest species (Schmidt *et al.,* 2005), which are considered the most abundant in taxon around the world, having insects as their main food source (Maloney *et al.,* 2003). The ability of spiders as control agents against agricultural pests like mites has gained interest in learning more about their abundance along its species composition to various ecological systems; as they partake in the role of being the predator to pest species, they also have the role of being the prey that is very important for the balance of the food web (Chua *et al.,* 2014), the members of ground-dwelling spiders takes an important role to transfer the energy directly from the ground to above ground terrestrial predators like birds, amphibians, reptiles, and mammals (Raiz Tabasum *et al.,* 2018). Spiders can be found almost everywhere in the world except in oceans, air, and Antarctica, as they become widespread predators in agricultural ecosystems and tropical areas, and they thrive almost all over every niche (Deltshev, 2008). Anyhow, the role of spiders as a primary predator of taxa in every terrestrial ecosystem habitat is ubiquitous; this carnivorous creature has a feeding diet on arachnids and insects that become very abundant and have high ecological importance in most ever terrestrial habitats (Sharma *et al.,* 2010). Spiders is a mega-diverse group of organisms having the third largest group of species (Platnick and Raven, 2013) and the seventh most diverse order worldwide (Cardoso, 2012; Patiño *et al.,* 2016). Nonetheless, it is among disregarded members of arthropods despite being valuable organisms in controlling the insect population in forest, agricultural, and horticultural ecosystems (Singh and Singh, 2022). Very little is known about the spatial range of spider diversity; hence the need for more thorough species distributional data on a worldwide scale still exists despite recent progress in this field (Dimitrov and Hormiga, 2021).

Based on the World Spider Catalog (World Spider Catalog, 2023), there are more than 51,000 accepted species of spiders, and in the Philippines, 517 species of spiders were identified belonging to 225 genera and 38 families making spiders one of the most diverse groups of organisms in the country (Wankhade *et al.,* 2012; Lucman *et al.,* 2020). Studies of spiders in the Philippines are still limited. Among them were those conducted by Matejowsky (2003), Dacanay *et al.* (2014), Chua *et al.* (2014), Garciano *et al.* (2014), Juario *et al.* (2016a), Juario *et al.* (2016b), Patiño *et al.* (2016), Achacoso *et al.* (2016), Pepito *et al.* (2016), and Lucman *et al.* (2020). None of these studies was conducted in Cebu and all of them were from Luzon and Mindanao. Cebu is located in the central part of the Philippines and ranks as the ninth-largest island in the country with more than 5,000 km^2 of land area (Garces *et al.,* 2016; Quijano *et al.,* 2020). Because of the high endemism of Cebu and its severely denuded landscape, Cebu's native biodiversity is one of the places that have been considered critically endangered worldwide (Miano *et al.,* 2011). It has five terrestrial Key Biodiversity Areas (KBA) namely, Nug-as Forest, Central Cebu Protected Landscape, Mt. Lanaya, Mt. Lantoy, and Mt. Kapayas (Quijano *et al.,* 2020). Mt. Kapayas is a significant area for biodiversity as it is the largest patch of forest remaining on the northern part of the Cebu Island however studies of spiders in this area where not looks into. Hence, this paper provides baseline data on spiders of Cebu, particularly on Mount Kapayas where no previous study has been done.

Material and methods

Study area

The study was conducted in Mt. Kapayas, found in the municipalities of Catmon and Carmen in Cebu. Its highest elevation is at 783 masl. Mt. Kapayas is one of the KBAs of the Philippines and the only one located in the northern part of Cebu. It comprised a forest cover of more than 60 hectares in 2002 (Rosales *et al.,* 2018). The study area is categorized into forest area and non-forest land. Fig. 1 indicates map showing sampling plots of Mt. Kapayas, Catmon, Cebu, Philippines.

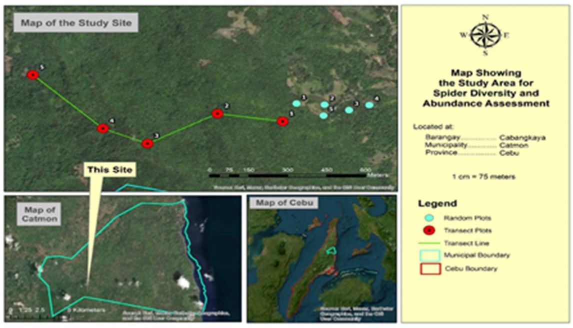

Figure 1. Map showing sampling plots of Mt. Kapayas, Catmon, Cebu, Philippines.

Sampling sites

A 1 km transect was established in the forest area of Mount Kapayas where sampling plots were established at approximately 250 m intervals. Five plots were established in each area, since non-forest areas were discontinuous, the plots were randomly established. The size of plots (10m long × 2m wide × 2.5m high) was based on Pinkus-Rendón *et al.* (2006). Non-forest areas sampled were farms planted with corn and some grassland. Ground coordinates were obtained from each sampling plot (Table 1).

Collection and processing of samples

Sampling was conducted from October 17 - 22, 2022 for a total of 80-man hours. Since spiders can be active at certain times of the day and at night (Green *et al.,* 1999; Achacoso *et al.,* 2016), sampling was made early morning from 6:00 AM to 9:00 AM and in the evening from 7:00 PM to 10:00 PM to capture both diurnal and nocturnal species. Spiders were captured using a flashlight and a hand-crafted net made up of tie wire and white cloth with a diameter of six inches. The collection of specimens was done by search and capture method with a combination of beat-sheet, involving six individuals maneuvering the sampling plots with a total of four man-hours for each plot. Microhabitats were thoroughly searched for spiders. Two samples per species were collected and a photograph was taken on-site. Spiders that were collected were put in plastic containers and later placed in vials containing ethanol for preservation (Chua *et al.,* 2014).

Table 1. Ground coordinates of sampling plots in each transect

Plot No.	Coordinates	
	Forest	Non-forest
1	10° 38. 5640 'N 123° 56. 5920 'E	10° 38. 6100 'N 123° 56. 6210 'E
2	10° 38. 5840 'N 123° 56. 4570 'E	10° 38. 6070 'N 123° 56. 6790 'E
3	10° 38. 5070 'N 123° 56. 3120 'E	10° 38. 5930 'N 123° 56. 7300 'E
4	10° 38. 5460 'N 123° 56. 2190 'E	10° 38. 6060 'N 123° 56. 7720 'E
5	10° 38. 6840 'N 123° 56. 0740 'E	10° 38. 5790 'N 123° 56. 6770 'E

Identification of spiders

Identification of spiders was made through examination of their body namely: eye pattern, nature of the web, legs, body shape, color, and size. Some spiders were described on-site at least at the family level using field guides (Barrion-Dupo *et al.,* 2021; Dupo *et al.,* 2021). Specimens were later brought to the laboratory for further investigation. The use of the World Spider Catalog (WSC) and other online sources like Global Biodiversity Information Facility (GBIF, 2019) and Jumping Spiders of the World Database (Metzner, n.d.).

Preservation of collected spider specimen

Specimens were preserved on glass vials with 90% Ethanol having a volume of more than twice the specimen volume because dry preservation is not advisable for spiders due to their soft bodies which are prone to shrivel and break (Barrion and Latsinger, 1995). Each vial contains only one specimen with labels of identification, place, and date of the collection. Ethanol was replaced after 48-72 hours to eliminate murky solutions.

Statistical analysis

Biodiversity indices were evaluated by considering biodiversity measures, including species richness, relative abundance, Shannon-Wiener index of diversity and Pielou`s evenness.

Results and discussion

Species composition and relative abundance

Table 2. Species Diversity and Abundance in Mt. Kapayas, Catmon Cebu, Philippines. Species with * Philippine endemic, ^ New record.

Family and species	Forest		Non-forest		Total	RA
	N	D	N	D		(%)
Araneidae						
Acusilas dahoneus (Barrion & Litsinger, 1995)*	3	2	0	0	5	1.39
Arachnura cf. melanura (Simon, 1867) ^	2	1	0	0	3	0.83
Araneus sp.	2	0	1	0	3	0.83
Argiope luzona (Walckenaer, 1841)*	2	0	3	1	6	1.67
Argiope sp.	1	0	1	0	2	0.56
Bijoaraneus cf. postilena (Thorell, 1878)	1	1	4	0	6	1.67
Cyclosa bifida (Doleschall, 1859)	2	1	0	0	3	0.83
Cyclosa sp.1	2	1	2	0	5	1.39
Cyclosa sp. 2	0	1	0	0	1	0.28
Cyclosa sp. 3	1	0	0	0	1	0.28
Cyrtophora exanthematica (Doleschall, 1859)	1	0	2	0	3	0.83
Cyrtophora unicolor (Doleschall, 1857)	1	0	0	0	1	0.28
Eriovixia laglaizei (Simon, 1877)	0	0	1	0	1	0.28
Eriovixia sakiedaorum (Tanikawa, 1999)^	1	0	0	0	1	0.28
Gasteracantha parangdiadesmia (Barrion & Litsinger, 1995)*	1	1	4	2	8	2.22
Gea sp.	1	0	2	0	3	0.83
Herennia tone (Kuntner, 2005)*	2	2	0	0	4	1.11
Larinia sp.	0	0	1	0	1	0.28
Neoscona cf. vigilans (Blackwall, 1865)	0	0	1	0	1	0.28
Neoscona facundoi (Barrion-Dupo, 2008) *	1	0	0	0	1	0.28
Neoscona molemensis (Tikader & Bal, 1981)	3	0	8	3	14	3.89
Neoscona punctigera (Doleschall, 1857)	2	0	4	0	6	1.67
Nephila pilipes (Fabricius, 1793)	2	3	1	0	6	1.67
Parawixia dehaani (Doleschall, 1859)	2	0	3	0	5	1.39
Parawixia sp.	1	0	0	0	1	0.28
Phonognatha sp.	3	3	0	0	6	1.67
Poltys sp. 1	1	0	0	0	1	0.28
Poltys sp. 2	4	0	0	0	4	1.11
Poltys stygius (C. L. koch, 1843)	1	0	3	0	4	1.11
Talthybia depressa (Thorell, 1898)	3	0	0	0	3	0.83
Thelacantha brevispina (Doleschall, 1857)	0	1	2	1	4	1.11
Cheiracanthiidae					0	
Cheiracanthium sp.	2	0	2	0	4	1.11
Clubionidae					0	
Matidia sp.	1	4	0	0	5	1.39
Ctenidae					0	
Bowie sp.	2	0	0	0	2	0.56
Deinopidae					0	
Asianopis sp.	0	1	0	0	1	0.28
Hersiliidae					0	
Hersilia sp.	0	1	0	0	1	0.28
Linyphiidae					0	
Erigone sp.	1	0	0	0	1	0.28
Lycosidae					0	
Hippasa holmerae (Thorell, 1895)	0	0	2	0	2	0.56
Pardosa sp.	0	1	0	0	1	0.28
Oxyopidae					0	
Hamataliwa sp.	2	0	0	0	2	0.56
Oxyopes javanus (Thorell, 1887)	1	0	1	3	5	1.39
Oxyopes macilentus	1	0	1	2	4	1.11
Oxyopes sp.1	1	1	0	0	2	0.56
Pholcidae					0	
Pholcus mulu (Huber, 2016)*	4	2	0	0	6	1.67
Pisauridae					0	
Nilus albocinctus (Doleschall, 1859)	0	0	3	0	3	0.83
Psechridae					0	
Psechrus cebu (Murphy, 1986)*	8	5	0	0	13	3.61
Salticidae					0	
Carrhotus sp.	2	1	1	0	4	1.11
Cytaea sp.	2	1	0	0	3	0.83

Lepidemathis sericea (Simon 1899)*	1	1	2	2	6	1.67
Menemerus sp.	1	0	0	0	1	0.28
Myrmarachne sp. 1	1	0	0	0	1	0.28
Myrmarachne sp. 2	1	0	0	0	1	0.28
Myrmarachne sp. 3	2	0	0	0	2	0.56
Nannenus sp. 1	2	2	0	0	4	1.11
Nannenus sp. 2	1	0	0	0	1	0.28
Phintella piatensis (Barrion & Litsinger, 1995)*	1	0	0	0	1	0.28
Portia sp.	3	5	0	2	10	2.78
Simaetha sp. 1	0	0	1	0	1	0.28
Simaetha sp. 2	0	1	0	0	1	0.28
Stagetillus opaciceps (Simon, 1885)^	1	1	0	0	2	0.56
Telamonia masinloc (Barrion & Litsinger, 1995)*	1	0	0	0	1	0.28
Thiania latefasciata (Simon, 1877) *	3	1	0	0	4	1.11
Scytodidae					0	
Scytodes pallida (Doleschall, 1859)	2	5	2	3	12	3.33
Sparacidae					0	
Gnathopalystes sp.	1	0	0	0	1	0.28
Heteropoda sp. 1	1	0	0	0	1	0.28
Heteropoda sp. 2	5	1	1	1	8	2.22
Heteropoda sp. 3	4	2	0	0	6	1.67
Isopeda sp.	0	0	1	0	1	0.28
Olios sp.	5	2	0	0	7	1.94
Tetragnathidae					0	
Leucage fastiga (Simon, 1905)	1	1	3	1	6	1.67
Leucauge argentina (Hasselt, 1882)	2	4	0	0	6	1.67
Leucauge decorata (White, 1841)	0	1	3	5	9	2.50
Leucauge sp.	2	1	4	2	9	2.50
Tetragnatha sp.	1	0	1	1	3	0.83
Tylorida striata (Thorell, 1877)	2	5	0	0	7	1.94
Theraposidae					0	
Orphnaecus sp.	2	0	0	0	2	0.56
Theridiidae					0	
Anelosimus sp.	1	1	1	3	6	1.67
Argryodes sp.	2	1	2	0	5	1.39
Chrysso sp.	2	2	12	4	20	5.56
Janula triangularis (Yoshida and Koh, 2011)^	1	0	0	0	1	0.28
Meotipa sp. 1	2	1	0	0	3	0.83
Meotipa sp. 2	1	0	0	0	1	0.28
Parasteatoda sp. 1	1	1	0	0	2	0.56
Parasteatoda sp. 2	2	0	0	0	2	0.56
Parasteatoda sp. 3	3	1	0	0	4	1.11
Phycosoma sp.	1	0	0	0	1	0.28
Rhomphaea sp.1	2	0	0	0	2	0.56
Rhomphaea sp.2	1	0	0	0	1	0.28
Steatoda sp.	1	0	1	1	3	0.83
Thomisidae					0	
Alcimochthes sp.	0	2	0	0	2	0.56
Miagrammopes sp.	1	0	0	0	1	0.28
Oxytate sp.	1	0	0	0	1	0.28
Phrynarachne tuberosa (Blackwall, 1864)^	0	1	0	0	1	0.28
Pycnaxis guttata (Simon, 1895)*	0	1	1	1	3	0.83
Synema sp.	0	1	0	7	8	2.22
Thomisus sp. 1	0	0	0	2	2	0.56
Thomisus sp. 2	0	1	0	0	1	0.28
Uloboridae						
Uloburos sp. 1	2	1	0	0	3	0.83
Uloburos sp. 2	0	1	0	0	1	0.28
Total no. of Individuals	143	82	88	47	360	100
Total no. of Species	91		40		99	
Total no. of Genera	65		34		69	
Total no. of Families	19		11		20	
Total no. of Unclassified	10		1		10	

A total of 360 individuals representing 99 species in 69 genera and 20 families were recorded during the sampling period from both sites during the day and night collection of spiders. In the daytime sampling, 129 individuals from 56 species were recorded, while in the nighttime sampling, 231 individuals from 89 species were reported. Forty-three species were recorded exclusively during the night and ten species were only recorded during the day sampling, while 46 species had been recorded both day and night sampling (Table 2). The total number of 99 recorded species is relatively higher than the study of Chua *et al.* (2014) in Ilocos Norte, with 13 species belonging to five families, Garciano *et al.* (2014) in Zamboanga Del Sur with 23 species, 19 genera belonging to nine families, Dacanay *et al.* (2014) in Zamboanga Del Sur with 37 species, 22 genera, Juario *et al.* (2016a) in Tawi-tawi and Basilan with 64 species, 43 genera from 11 families, Juario *et al.* (2016b) in Marawi City with 43 species, 31 genera belonging to 11 families, and similar number of species to the study of Lalisan *et al.* (2015) in Zamboanga Del Sur having 99 species, 64 genera under 16 families. However, it is lower compared to the data recorded by Lucman *et al.,* (2020) in Misamis Oriental having 108 species, 96 genera under 17 families and Patiño *et al.* (2016), having 171 species under 25 families of Spiders. It was also found out that the forest area had a higher diversity and species richness of spiders compared to non-forest. Forest area is composed of 225 recorded individuals from 91 species while non-forest area is composed of 135 recorded individuals from 40 species of spiders (Fig. 2).

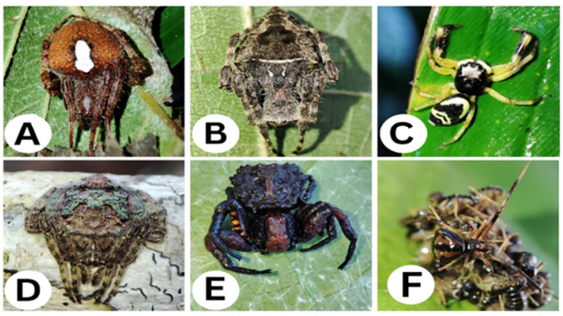

Figure 2. Some of the species recorded (A) *Neoscona facundoi*, (B) *Parawixia dehaani*, (C) *Thiania latefasciata*, (D) *Talthybia depressa*, (E) *Phrynarachne tuberosa*, (F) *Janula triangularis*.

Abundance

As illustrated in Fig. 3 show the three most abundant families include *Araneidae* with 31 species followed by *Salticidae* with 16 species and *Theridiidae* with 13 species. Moreover, the three most abundant species are *Chrysso sp.* 1 with 20 individuals, *Neoscona molemensis* with 14 individuals, and *Psechrus cebu* with 13 individuals.

Based on the World Spider Catalog version 23.5 there have been twelve species that are endemic in the Philippines namely: *Acusilas dahoneus* (Barrion and Litsinger, 1995), *Argiope luzona* (Walckenaer, 1841), *Gasteracantha parangdiadesmia* (Barrion and Litsinger, 1995), *Herennia tone* (Kuntner, 2005), *Neoscona facundoi* (Barrion-Dupo, 2008), *Pholcus mulu* (Huber, 2016), *Psechrus cebu* (Murphy, 1986), *Lepidemathis sericea* (Simon 1899), *Phintella piatensis* (Barrion and Litsinger, 1995), *Telamonia masinloc* (Barrion and Litsinger, 1995), *Thiania latefasciata* (Simon, 1877), *Pycnaxis guttata* (Simon, 1895). Five species are probably new records of spider in the country namely: *Arachnura melanura* (Simon, 1867), *Eriovixia sakiedaorum* (Tanikawa, 1999), *Stagetillus opaciceps* (Simon, 1885), *Janula triangularis* (Yoshida and Koh, 2011), *Phrynarachne tuberosa* (Blackwall, 1864).

According to DENR Administrative Order No.2019 – 09 of the National List of Threatened Philippine Fauna and Their Categories, five species were found to be a threatened species under the category of Other Threatened Species (OTS) namely*: Eriovixia laglaizei* (Simon, 1877), *Neoscona punctigera* (Doleschall, 1857), *Neoscona facundoi* (Barrion-Dupo, 2008), *Neoscona vigilans* (Blackwall, 1865), *Parawixia dehaani* (Doleschall, 1859).

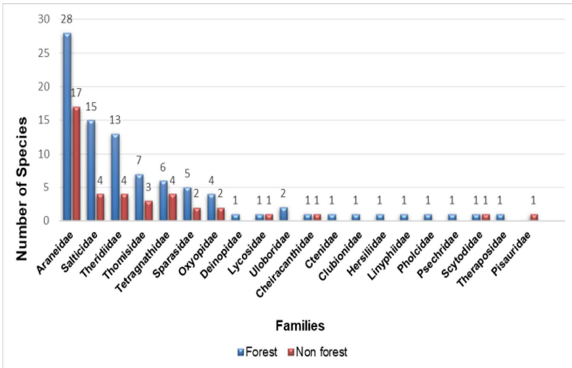

Fig. 3. Number of species and family composition in both sites.

Biodiversity indices

Evaluation of Biodiversity Measures, including Species Richness, Relative Abundance, Shannon-Wiener Index of Diversity, and Pielou's Evenness, were considered.

Table 3. Biodiversity indices of the two sampling sites.

Indices	Forest	Non-forest
Species	91	40
Indiviwual	225	135
Shannon	4.23	3.41
Evennes	0.94	0.92

Table 3 displays the forest area's higher value of both Species richness and relative abundance having 225 individuals from 91 species, with a Shannon-wiener index of 4.23 and Evennes of 0.94, compared to the non-forest having a Species richness and relative abundance of 135 individuals from 40 species with a Shannon-wiener index value of 3.41 and Evenness of 0.92. Evenness is an essential indicator of community structure (Magurran *et al.,* 2013). The forest site has a higher value in both Shannon-wiener and evenness index because of the characteristics of the area having a denser vegetation and plant composition compared to non-forest area. Other factors affecting this data is because of the anthropogenic disturbances in the non-forest as it is an agricultural land and exposed to crofting activities.

Forest

The forest area has higher recorded data on spiders than the non-forest area. The number of individuals recorded in the forest is 62.5% compared to non-forest, which is 37.5% from the total data of 360 individuals. The recorded spiders in the forest are 225 individuals from 91 species under 65 genera belonging to 19 families. Out of 99 species of spiders that have been recorded on Mt. Kapayas, 91 are present in the forest area, and 59 have been recorded only in the forest during the sampling. The forest area has thick vegetation. The dominant trees observed in the forest are *Ficus nota, Leucosyke capitellata, Ficus septica, Dendrocnide platyphylla, Litsea philippinensis, Melicope triphylla, Macarangca tanarius, Gliricidia sepium,* and *Phyllanthus albus.* The most abundant species of spider in this area is *Psechrus cebu*, with 13 individuals that were only recorded in the forest. Based on World Spider Catalog, *Psechrus cebu* is endemic in the Philippines. This species is commonly found under the rocks where they placed their web. The second most abundant species is *Portia sp.*, with eight recorded individuals, followed by *Olios sp.* and *Tylorida striata,* with seven. *Araneidae* is the most abundant family of spiders in the forest area. The family *Clubionidae, Ctenidae, Deinopidae, Hersiliidae, Linyphiidae, Psechridae, Therapisidae, Uloboridae,* and *Pholcidae* can only be found in the forest. Spiders can benefit from the diverse tree species, and it also promotes leaf litter layers that lead to a higher diversity of prey (Oxbrough *et al.,* 2013). Based on the study of Koneri and Nangoy (2017) that the leaf litters on the forest floor have an impact on spider populations since it offers a comfortable environment for those spiders that live there. The richness of plant diversity in the area explains the abundance of spider species in this site. Spiders who build the web have a strong connection and relation to the vegetation structure due to the parameters needed to make a web (Koneri and Nangoy, 2017). The structure of the forest, which has denser vegetation than non-forest, influenced the species of spiders that thrives in the area. According to Malumbres-Olarte *et al.* (2013), the vegetation's characteristics and physical structure determine the presence and abundance of spiders. The outcome of this study, wherein the forest area had a higher species richness and abundance of spiders than the non-forest area, is comparable to the study of Gallé *et al.* (2018) in the south of Hungary that the forest spiders are higher in terms of species richness and abundance compared to grassland sites. It also supports the study of Deeleman-Reinhold, (2021) by her study on forest spiders of South East Asia that the spider species richness in mountainous are higher compared to lowland.

Non-forest

The non-forest site has a total of five plots; three plots are located in the agricultural land that is primarily planted by corn (*Zea mays*), while the other two plots are located outside the corn field that is dominated by mostly *Cratoxylum sumatranum, Chromolaena odorata, ficus septica,* and *Cocos nucifera.* In agricultural environments, spiders are one of the most prevalent and diverse invertebrate species (Pfister *et al.,* 2015; Michalko *et al.,* 2019; Plath *et al.,* 2021). This organism is a member of the predatory arthropods that promotes ecosystem services as it serves as a pest control agent (Riechert and Bishop 1990; Plath *et al.,* 2021). The non-forest area has a total of 135 recorded individuals from 40 species under 34 genera belonging to 11 families of spiders. The family of Araneidae thrives most in this area, having 17 species observed. *Chrysso sp.* has the highest record of 16 individuals in this area, followed by *Neoscona molemensis* with 11 individuals. The family of *Pisauridae* can only be found in non-forest areas, specifically the species of *Nilus albocinctus* that can be observed in this site where it is floating on the body of water. The presence of a stream in the area supports the water supply for agricultural crops, it also influences the abundance of spider individuals in the area. Based on the study of Straka *et al.* (2020), water bodies have a positive impact on insect abundance in forested and agricultural areas; in relation, spiders are known as predominantly insectivorous predators, which is why it is attracted to water bodies that have an abundant population of insects. Spiders in agricultural fields frequently exist in large populations and significantly aid in pest control. However, agricultural intensification resulting in habitat loss has major negative effects on biodiversity (Wersebeckmann *et al.,* 2021). In accordance with the study of Gallé *et al.* (2018) that one of the primary causes of biodiversity loss and ecological change in terrestrial ecosystems is land-use transformation and intensification. Based on the study of Polchaninova *et al.* (2023), spiders generally preferred the study site with undisturbed environments. The recorded data on spider in non-forest areas are lower compared to the forest area. Most agricultural activities, including tillage, pesticide use, and fertilization, have an impact on biodiversity by causing habitat degradation, emigration, and mortality (Thorbek and Bilde 2004; Batáry *et al.,* 2012; Plath *et al.,* 2021).

Guild structure

The similarity pattern in guild composition point to a potential role for plant habitat layout as a factor in the community of spiders (Uetz *et al.,* 1999), and the description of the guild may explain the type of vegetation of the area that could offer sufficient room of various sizes for creating webs (Lucman *et al.,* 2020).

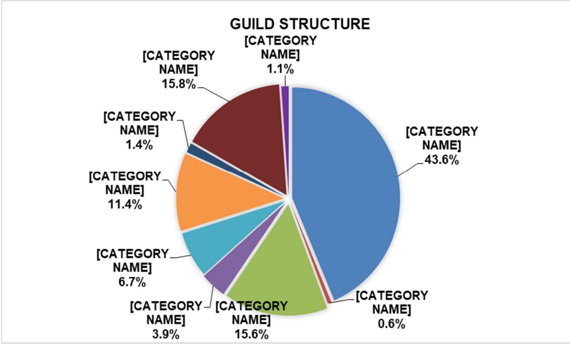

Fig. 4. Relative abundance of spider per guild.

In this study, the most abundant guild is Orb Weavers (43.6%), composed of *Araneidae, Uloboridae,* and *Tetragnathidae* (Figs 4 and 5). This guild is abundant in both sites, especially in a forested area. The orb weavers as the most abundant guild structure are comparable to the Philippine studies, namely: Lucman *et al.,* (2020) in Mimbilisan Protected Landscape, Misamis Oriental, Juario *et al.,* (2016b) in Sacred Mountain, Marawi City, Juario *et al.,* (2016a) in Tawi-Tawi and Basilan, Patiño *et al.,* (2016) in Marilog District, Davao City, and Garciano *et al.,* (2014) in Mt. Matutum, South Cotabato. Space Builder (18.2%), is second in line that is composed of Theridiidae and Pholcidae, followed by Stalkers (14.2%) from the family of Salticidae and Oxyopidae. The guild of Sheet web weavers, Foliage runners, and Burrow dwellers has not been observed in non-forest area. Foliage runners and Burrow dwellers that cannot be found in the non-forest is because of the agricultural activities in the area which serves as a disturbance for the spiders.

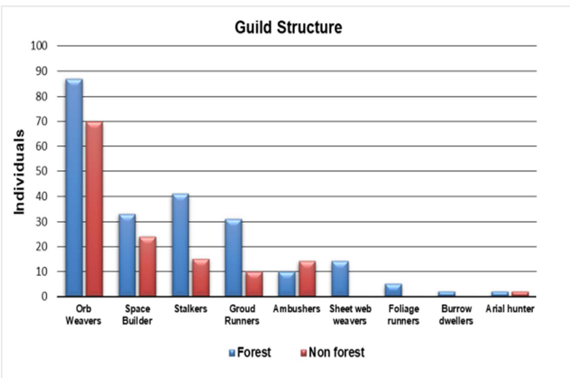

Fig. 5. Spider composition per guild structure in both sites.

Conclusion

Mt. Kapayas is considerably high in diversity and species richness of spiders containing 99 species being observed from 69 genera under 20 families. Twelve species of spiders are found to be endemic in the Philippines and five species were probably a new record in the country. Based on the National List of Threatened Philippine Fauna and Their Categories under DENR Administrative Order No.2019–09, five species were found to be a threatened species under the category of Other Threatened Species. Araneidae is the most abundant family in Forest and Non-forest areas. Forest area has a higher species richness and abundance compared to Non-forest. The diversity and abundance of spiders are influenced by the vegetation of an area and the presence of habitat disturbance.

Recommendations

Further studies on spider diversity in the KBA areas in Cebu, including in-depth taxonomic investigations, exploration of ecological interactions, habitat protection efforts, behavioral studies, and long-term monitoring programs, are essential to comprehensively understand the importance of these organisms and their diverse species in the environment.

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