

Species diversity of Spiders (Araneae) in Mimbilisan Protected Landscape, Misamis Oriental, Philippines

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ABSTRACT

Spiders have a potential role as bioindicator of ecological health. Yet, little is known about them especially in forested areas of the Philippines. This study determined the species diversity of spiders in three different sampling sites established in Mt. Mimbilisan Protected Landscape. A combination of beat-netting and vial-tapping methods was used to collect samples. One hundred eight species of spiders belonging to 17 families were recorded. Fifteen species are a new record to the Philippines. Highest species richness and abundance were observed in the riparian forest (Site 2) and lowest in the mixed dipterocarp forest (Site 1). Salticidae is the spider family with the highest species richness and abundance. *Opadometa fastigata* of family Tetragnathidae was the most abundant species. A great number of adult spiders (82.42%), which were mostly females (88.00%), was documented. Even distribution ($E=0.7676$) was recorded in the whole study area. Leaf surfaces and branches or stem of plants were the most recurring microhabitat types of spiders. The spiders were found to belong to seven guilds with the orb weavers as the most dominant guild (37%). The highest diversity was recorded in Site 2 ($H^{\circ}=3.781$). Results indicate high spider diversity in Mt. Mimbilisan which highlights the conservation importance of the protected landscape.

KEY WORDS Araneidae; conservation; forest; orb-weavers; Salticidae.

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INTRODUCTION

Spiders belong to a special group of invertebrates comprising the largest order Araneae. They are sensitive to environmental changes and influence neighboring populations. They are abundant and diverse in nature (Wilder, 2011). They encompass the class Arachnida that utilizes a wide range of niches (Puja, 2014). Spiders are a mega-diverse group comprising 47,445 described species (World Spider Catalog, 2018) and are considered as the seventh most diverse order worldwide (Cardoso,

2012). They can be found all around except in air and water (Foelix, 2011), from trees, under stones and logs, in garbage, and on the forest floor (Mathew et al., 2009).

Spiders are considered as an important group from both an economic standpoint in their use as biological control agent and in their diversity and adaptation to a number of differing habitats (Mahalakshmi & Jeyaparuathi, 2014). They respond rapidly to alterations in environment and thus, used as indicators of ecological change (Hodge & Vink, 2010). They serve as limiting factors in the increase

of pest populations in different ecosystems through their predatory behavior (Sharma, 2014). Spider silk nowadays is used to make bullet proof vest, parachutes, surgical threads, artificial tendons, and even biodegradable bottles (Hinman et al., 2003). Venom of spiders is being studied in the field of medicine (Clarke, 2002).

According to Chen & Tso (2004), a lot of scientific studies on spiders were conducted in temperate regions while tropical areas have relatively less investigation. Species richness and their relative abundance help in describing spider communities (Sorensen et al., 2002). Without being affected by their high diversity and ubiquity, large quantities of species have restricted distribution and biogeographic patterns of assemblages (Carvalho et al., 2011). Royauté & Buddle (2012) reported that in agricultural fields, there are evidences that synchronization with habitat changes and disturbances are present in species that are dominant. Areas near or with human settlements in Brazil have higher spider diversity indices and evenness values when compared to undisturbed areas (Freitas et al., 2013). Environment alterations may affect their distribution and assemblages by variations of plant community structure, disturbance, and abiotic factors (Juario et al., 2016). According to Hore & Uniyal (2009), spiders are utilized as bioindicators for evaluating the impact of anthropogenic disturbances on natural ecosystems. They face an exceptionally high risk of extinction (Thomas et al., 2004) caused by human disturbance and climate change.

The Philippines, a tropical country, is among the 17 mega diverse countries which constitutes 70-80% of the world's biodiversity. For many parts of the Philippines, little is known of the arthropod fauna. One of the most diverse groups of organisms in the Philippines is the spiders (Wankhade et al., 2012) consisting of about 517 species belonging to 225 genera and 38 families. Studies on spiders in the country are limited only to agricultural areas, particularly rice fields, but they have the highest record in all of Asia's tropical rice fields (Workman, 1896; Barrion & Litsinger, 1995; Barrion, 2001). In Mindanao, the second largest island in the Philippines, recent studies on spiders were reported in Pulacan falls, Zamboanga del Sur (Dacanay et al., 2014), Mt. Matutum, South Cotabato (Garciano et al., 2014), Mt. Pinukis, Zamboanga del Sur (Lalisan

et al., 2015), Marilog District, Davao City (Patiño et al., 2016), Sacred Mountain in Marawi City (Juario et al., 2016), Imbayao, Bukidnon (Mondejar & Nuñez, 2016), and caves in Mindanao (Enriquez & Nuñez, 2014).

Of the remaining forest in the country, 26% can only be found in protected areas (Ong, 2002). Mimbilisan Protected Landscape is among the 240 protected landscape areas of the Philippines. However, there is no spider fauna data in this protected landscape and thus, this research is significant as this will provide baseline data of spider fauna and will indicate the present ecological health status of Mimbilisan Protected Landscape. It will also contribute to the existing studies on spiders in the Philippines especially on the island of Mindanao. The study aimed to determine species diversity, guild structure, and microhabitats of spiders in Mimbilisan Protected Landscape.

MATERIAL AND METHODS

Study area

Based on the IUCN Protected Area Management Category System, Mimbilisan Protected Landscape (Figs. 1-3) belongs to Category 5, areas that are managed for landscape conservation or recreation. It serves as a watershed that provides water to its nearby communities. It is composed of mixed dipterocarp forest that covers 66.515 hectares in Brgy. Mapua, municipality of Balin-gaoan, Misamis Oriental. Mimbilisan Protected Landscape is located at 8.94617 latitude; 124.8676 longitude. The Mindocdocan Creek can be found at its base. In some areas outside of the protected area, agricultural activity was observed.

Sampling sites

Three sites in Mimbilisan Protected Landscape were sampled for 10 days for a total of 186 work hours. The sampling sites were selected based on the following criteria: accessibility, habitat structure, degree of exposure to human activities, and geographical position. Disturbances in the sampling sites were qualitatively categorized as low, intermediate, or high based on the accessibility, presence of facilities, and presence of human dis-

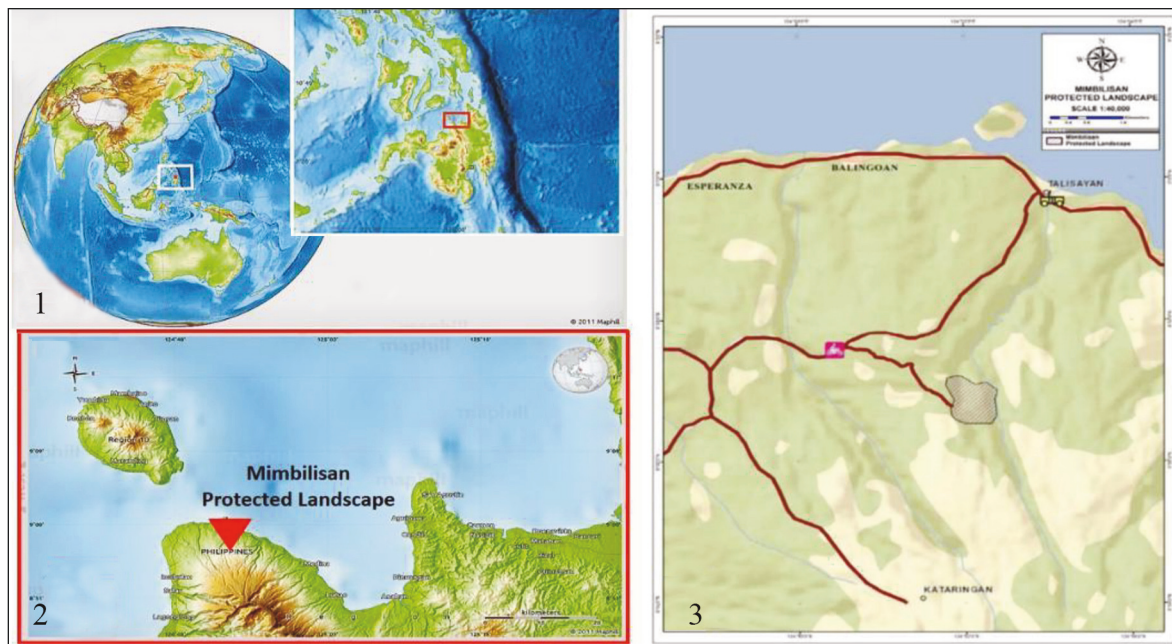


Figure 1. Map of Australasia and central-southern Philippines (Maphill, 2018). Figure 2. Map of northern Mindanao (Maphill, 2018). Figure 3. Location of the study area (BMB-DENR, 2015).

turbance. Transect lines were established along trails due to the gorge shape of the mountain.

Sampling site 1 is a mixed dipterocarp forest with coordinates of $8^{\circ}56.820'N$, $124^{\circ}52.042'E$. Its elevation ranges from 415–465 meters above sea level. The site has a mountainous slope and secondary vegetation type. Sunlight cannot easily penetrate through the ground due to the presence of high density of emergent and canopy trees. Emergent trees were *Shorea* sp. whereas canopy trees include *Shorea negrosensis*, *S. contorta*, *Pterocarpus indicus*, *Swietenia mahogany*, *Dracontomelon dao*, *Artocarpus sericicarpus*, and *Ficus gul*. Understory plants include the family Areaceae, *Costus igneus*, and *Caryota mitis*. Most of the ground cover plants were *Schismatoglottis calypttrata* and ferns. Leaf litter depth measures about 2 cm. The covering canopy trees have epiphytes such as ferns and vines coiling in their trunks. Orchids were also observed. Site 1 has a clay soil where exposed rocks and few fallen logs were present which may have been caused by a storm. A freshwater stream was located 100 m away. Its distance to anthropogenic clearing was 450 m. Rubber plantation was near the area. Site 1 is where the main access is located which serves as the initial pathway in accessing the freshwater stream

and thus high disturbance, mainly human-made, can be observed in the site.

Sampling site 2 is a riparian forest with coordinates of $8^{\circ}56.834' N$ and $124^{\circ}52.124' E$. Its elevation ranged from 350–450 m a.s.l. The site has an undulating slope and covered with secondary vegetation. A freshwater stream with shallow pools of water serves as a faunal corridor, connecting Sites 1 and 3. The site was dry, revealing large rocks due to the diversion of water for the water system of the people in the locality. Rocks were mainly covered with *Bryophyta* sp., especially near pools of water. The emergent tree was *Shorea* sp. while canopy trees were *Dracontomelon dao*, *Bosscheria minahassae*, and *Artocarpus odoratissimus*. The canopy epiphytes present include moss, vines, and ferns. Fruit-bearing tree taxa include *Lansium parasiticum*, *Averrhoa carambola*, and *Artocarpus odoratissimus*. Ferns, grasses, and sedges were rarely observed. Other plants include bamboo, *Ficus benjamina*, *Pandanus yvonii*, *Cheilocostus speciosus*, *Poikilospermum suaveolens*, *Clerodendrum paniculatum*, *Alocasia princeps*, and *Aglaonema nitidum*. Presence of *Musa* sp. was also noted. Forest floor near the stream is characterized by leaf litter, abundance of exposed rocks, humus, mosses, ferns, and fallen logs. Its

distance to the anthropogenic clearing was about 500 m. Intermediate disturbance was observed as indicated by the presence of plastic waste within the boundary of the freshwater stream. On-site disturbance also includes natural tree-fall.

Sampling site 3 is a mixed dipterocarp forest with neighboring agroecosystem. It has coordinates of 8°56.913'N, 124°52.109'E with elevation of 430-485 meters above sea level. The site has mountainous slope and secondary vegetation type. The emergent tree was *Shorea* sp. while canopy trees include *Shorea negrosensis*, *S. contorta*, *S. polysperma*, *Dipterocarpus validus*, and *Ficus benjamina*. Understory plants in the area include *Diplodiscus paniculatus*, family *Arecaceae*, *Demonorops ochrolepis*, *Calamus caryota*, and *Calamus mitis*. Neighboring agroecosystem is partly used for growing coconuts, *Cocos nucifera* and coffee, *Coffea* sp. Forest floor is covered with moderate leaf litter measured to be about 1 centimeter in depth and few exposed rocks and fallen logs which are common microhabitats of ground-dwelling spiders. Ground was wet, covered with plants like mosses, ferns, and *Schismatoglottis calyptrata*, the dominant ground cover plants present in this site. The distance of the site to anthropogenic clearing was about 1 km. Site disturbances were human-made and natural tree-fall. Huge water pipes that extend to the community area for water source were present. Compared to Site 1, Site 3 is difficult to access due to the presence of enormous vegetation so very few anthropogenic disturbances were observed and thus it has low disturbance.

Collection, processing, identification of samples, and analysis

Sampling was conducted on July 18–27 2018 for 10 field days for a total of 186 work hours. Sampling starts every morning from 900 hours to 1300 hours, in the afternoon from 1400 hours to 1600 hours, and evening from 1800 hours to 2100 hours. Different sampling areas with different habitat structure, disturbance level, accessibility, and geographical position were established within the transect line. Collection in every point was extended up to 10 meters (m) to the left and 10 m to the right of the transect line. For arboreal spiders, leaves, bushes, tree trunks, ferns, and grass lands

were explored. Microhabitats of spiders such as fallen logs and leaf litter were examined for ground-dwelling spiders. Beat-netting and vial tapping methods were done to collect samples. Captured samples were placed in plastic cups and plastic bags to prevent escape of the motile spiders. Samples were then photographed. Voucher specimens were placed in vials with 90% ethanol. World Spider Catalog (WSC) created by world renowned arachnologist, Norman Platnick, and hosted by Natural History Museum of Bern was used to determine the general geographic region that a spider species is known to be distributed. For the spiders of the Philippines, the website insectoid.info and some published papers were used. Collection date, compartment name, and habitat were recorded on each vial. Specimens were identified by the third author.

Biodiversity indices which include species richness, relative abundance, Shannon-Weiner Diversity Index, and Pielou's evenness were calculated using Paleontological Statistics Software Package version 3.16.

RESULTS AND DISCUSSION

Species Composition

A total of 108 species belonging to 17 families under 96 genera were collected during the sampling period in different sampling sites (Table 1). This number is higher compared to other areas in Mindanao, Philippines such as spiders recorded in Mt. Matutum, South Cotabato (Garciano et al., 2014) with 23 species under 19 genera and nine families; Mt. Pinukis, Zamboanga del Sur (Lalisan et al., 2015) with 99 species, 16 families, and 64 genera; and in Sacred Mountain in Marawi City (Juario et al., 2016) with 43 species belonging to 11 families under 31 genera. However, the present record is relatively low compared to the spider fauna in Marilog District, Davao City (Patiño et al., 2016) which consists of 171 species under 25 families. Species richness is significantly affected by flooding and vegetation cover within the surrounding areas (Galle & Schweger, 2014). Rocha-Filho & Rinaldi (2011) reported that different vegetation types with varying microhabitat structures affect spider distribution. Site 1 had 44 individuals. Site 2 had the

| SPIDERS FAMILY AND SPECIES | SITE 1 | SITE 2 | SITE 3 | TOTAL | RA (%) |
|--|--------|--------|--------|-------|--------|
| ARANEIDAE (True Orb weavers) | | | | | |
| <i>Anepision depressum</i> (Thorell, 1877)^ | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Anepision roeweri</i> (Chrysanthus, 1961) | 1♀ | 0 | 0 | 1 | 0.549 |
| <i>Anepision</i> sp. | 1♂SA | 0 | 0 | 1 | 0.549 |
| <i>Araneus</i> sp. | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Argiope aemula</i> (Walckenaer, 1841) | 0 | 0 | 1i♀ | 1 | 0.549 |
| <i>Cyclosa</i> sp. 1 | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Cyclosa</i> sp. 2 | 0 | 0 | 2♀ | 2 | 1.099 |
| <i>Cyrtophora</i> sp. | 0 | 2♀ | 0 | 2 | 1.099 |
| <i>Eriovixia laglaizei</i> (Simon, 1877) | 1♀ | 1♀ | 0 | 2 | 1.099 |
| <i>Eriovixia cf. laglaizei</i> (Simon, 1877) | 1 | 1 | 1♀ | 3 | 1.648 |
| <i>Eriovixia</i> sp. 1 | 0 | 0 | 2♀ | 2 | 1.10 |
| <i>Eriovixia</i> sp. 2 | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Gasteracantha doriae</i> (Simon, 1877) | 0 | 2♀ | 1♀ | 3 | 1.648 |
| <i>Hyposinga</i> sp. | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Neoscona nautica</i> (L. Koch, 1875) | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Neoscona cf. nautica</i> (L. Koch, 1875) | 0 | 1i | 0 | 1 | 0.54 |
| <i>Neoscona punctigera</i> (Doleschal, 1857) | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Neoscona</i> sp. | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Polys</i> sp. | 0 | 0 | 1i♀ | 1 | 0.549 |
| <i>Singa</i> sp. | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Thelacantha brevispina</i> (Doleschall, 1857) | 1♀ | 0 | 0 | 1 | 0.549 |
| <i>Verrucosa</i> sp. | 0 | 1i,2♀ | 1♀ | 4 | 2.198 |
| CLUBIONIDAE (Sac spiders) | | | | | |
| <i>Clubiona biembolata</i> (Deeleman-Reinhold, 2001)^ | 1♂SA | 0 | 0 | 1 | 0.549 |
| <i>Clubiona corticalis</i> (Walckenaer, 1802)^ | 1♀SA | 0 | 0 | 1 | 0.549 |
| <i>Clubiona cf. japonicola</i> (Bösenberg et Strand, 1906) | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Clubiona</i> sp. | 0 | 1i | 0 | 1 | 0.549 |
| Clubionidae immature | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Nusatidia camouflata</i> (Deeleman-Reinhold, 2001)^ | 1♀ | 1♀ | 0 | 2 | 1.099 |
| <i>Pristidia cf. longistila</i> (Deeleman-Reinhold, 2001) | 0 | 1♀ | 0 | 1 | 0.549 |
| CTENIDAE (Wandering spiders) | | | | | |
| <i>Ctenus sarawakensis</i> (F.O. Pickard-Cambridge, 1897) | 2♂ | 2♀ | 1♀ | 5 | 2.747 |

| SPIDERS FAMILY AND SPECIES | SITE 1 | SITE 2 | SITE 3 | TOTAL | RA (%) |
|---|--------|----------|--------|-------|--------|
| <i>Ctenus</i> sp. | 0 | 0 | 1♀ | 1 | 0.549 |
| DEINOPIIDAE (Net-casting/Ogre face Spiders) | | | | | |
| <i>Deinopis</i> sp. | 1♀ | 0 | 0 | 1 | 0.549 |
| EUTICHURIDAE (Dark Sac Spiders) | | | | | |
| <i>Cheiracanthium</i> sp. | 0 | 1♀ | 0 | 1 | 0.549 |
| LINYPHIIDAE (Sheet web weavers) | | | | | |
| <i>Plectembolus</i> sp. | 0 | 1♀ | 0 | 1 | 0.549 |
| NEPHILIDAE (Golden Silk Orb-weavers) | | | | | |
| Nephilidae immature | 0 | 0 | 1i | 1 | 0.549 |
| <i>Nephila pilipes</i> (Fabricius, 1793) | 0 | 2♀i,3♀SA | 0 | 5 | 2.747 |
| <i>Herrenia</i> sp. | 0 | 1♀SA | 0 | 1 | 0.549 |
| OXYOPIIDAE (Lynx Spiders) | | | | | |
| <i>Hamadruas</i> cf. <i>hierophlyphica</i> (Thorell, 1887) | 1♀ | 0 | 0 | 1 | 0.549 |
| <i>Oxyopes lineatipes</i> (C.L. Koch, 1847) | 0 | 0 | 1♂ | 1 | 0.549 |
| PHOLCIDAE (Cellar spider/daddy long legs) | | | | | |
| <i>Calapnita deelemanae</i> (Huber, 2011) | 1♀ | 0 | 0 | 1 | 0.549 |
| <i>Calapnita subphyllicola</i> (Deeleman-Reinhold, 1986)* | 1♂ | 0 | 2♀ | 3 | 1.648 |
| <i>Pholcus</i> sp. 1 | 1♀ | 0 | 0 | 1 | 0.549 |
| PISAURIDAE (Nursery web spider) | | | | | |
| <i>Hygropoda</i> sp. | 0 | 1♂ | 0 | 1 | 0.549 |
| PSECHRIDAE (Lace-sheet weavers) | | | | | |
| <i>Psechrus</i> sp. | 1♂,1♀ | 1♀ | 1i,3♀ | 7 | 3.846 |
| SALTICIDAE (Jumping spider) | | | | | |
| <i>Bavia aericeps</i> (Simon 1877) | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Bavia sexpunctata</i> (Doleschall 1859) | 1♀ | 0 | 1♀ | 2 | 1.099 |
| <i>Burmattus pococki</i> (Thorell 1895)^ | 1♀ | 0 | 0 | 1 | 0.559 |
| <i>Cosmophasis</i> sp. 1 | 1♂ | 0 | 1♀ | 2 | 1.099 |
| <i>Cosmophasis</i> sp. 2 | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Evarcha</i> sp. | 0 | 0 | 1♂ | 1 | 0.549 |
| <i>Epeus</i> sp. | 1♀ | 0 | 0 | 1 | 0.549 |
| <i>Hasarius adansonii</i> (Audouin 1826) | 0 | 0 | 1♂ | 1 | 0.549 |
| <i>Myrmarachne malayana</i> (Edmunds et Proszynski 2003)^ | 0 | 2♂ | 1♂,1♀ | 4 | 2.198 |
| <i>Myrmaplata plataleoides</i> (O. Pickard-Cambridge 1869)^ | 0 | 1♀ | 2♀ | 3 | 1.648 |
| <i>Omoedus</i> sp. | 1♀ | 0 | 0 | 1 | 0.549 |

| SPIDERS FAMILY AND SPECIES | SITE 1 | SITE 2 | SITE 3 | TOTAL | RA (%) |
|---|---------|---------|--------|-------|--------|
| <i>Phintella versicolor</i> (C.L. Koch 1846)^ | 0 | 1♂,2♀ | 0 | 3 | 1.648 |
| <i>Plexippus paykulli</i> (Audouin 1826) | 1♀ | 0 | 1♂,1♀ | 3 | 1.648 |
| <i>Portia</i> sp. | 0 | 1♂ | 0 | 1 | 0.549 |
| <i>Pristobaeus jocosus</i> (Simon 1902)^ | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Pseudeuophrys</i> sp. | 0 | 0 | 1♀ | 1 | 0.549 |
| Salticidae immature | 0 | 0 | 1i | 1 | 0.549 |
| <i>Telamonia dimidiata</i> (Simon 1899)^ | 0 | 0 | 2♀ | 2 | 1.099 |
| <i>Telamonia</i> cf. <i>festiva</i> (Thorell 1887) | 3♀ | 0 | 1♀ | 4 | 2.198 |
| <i>Thiania bhamoensis</i> (Thorell 1877) | 1♀ | 0 | 0 | 1 | 0.549 |
| <i>Thyene</i> cf. <i>manipisa</i> (Barrion et Litsinger 1995) | 1♀ | 0 | 0 | 1 | 0.549 |
| SPARASSIDAE (Giant Crab/Hunstan spiders) | | | | | |
| <i>Heteropoda boiei</i> (Doleschall 1859)^ | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Heteropoda</i> cf. <i>boiei</i> (Doleschall 1859) | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Heteropoda davidbowie</i> (Jager 2008)^ | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Heteropoda</i> cf. <i>davidbowie</i> (Jager 2008) | 1♀SA | 0 | 0 | 1 | 0.549 |
| <i>Heteropoda natans</i> (Jager 2005)^ | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Heteropoda</i> cf. <i>natans</i> (Jager 2005) | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Heteropoda tetrica</i> (Thorell 1897)^ | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Heteropoda venatoria</i> (Linnaeus 1767) | 1i♀,1♀ | 1♀ | 0 | 3 | 1.648 |
| <i>Heteropoda</i> sp. 1 | 1i♀ | 1♂,1♀ | 0 | 3 | 1.648 |
| <i>Heteropoda</i> sp. 2 | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Heteropoda</i> sp. 3 | 0 | 1♂SA | 0 | 1 | 0.549 |
| <i>Thelcticopis</i> sp. 1 | 1♀ | 0 | 0 | 1 | 0.549 |
| <i>Thelcticopis</i> sp. 2 | 1♀ | 0 | 0 | 1 | 0.549 |
| <i>Thelcticopis</i> sp. 3 | 1♀SA | 0 | 1♀ | 2 | 1.099 |
| <i>Thelcticopis</i> sp. 4 | 0 | 1♂SA,3♀ | 0 | 4 | 2.198 |
| <i>Thelcticopis</i> sp. 5 | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Thelcticopis</i> sp. 6 | 0 | 0 | 1♀ | 1 | 0.549 |
| TETRAGNATHIDAE (Long-jawed orb weaver) | | | | | |
| <i>Leucauge argentina</i> (Hasselt 1882) | 0 | 3♀ | 0 | 3 | 1.648 |
| <i>Leucauge</i> cf. <i>argentina</i> (Hasselt 1882) | 1♀ | 0 | 0 | 1 | 0.549 |
| <i>Leucauge</i> cf. <i>granulata</i> (Walckenaer 1841) | 0 | 3♀ | 0 | 3 | 1.648 |
| <i>Leucauge</i> sp. | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Opadometa fastigata</i> (Simon 1877) | 1♂SA,4♀ | 5♀ | 4♀ | 14 | 7.692 |

| SPIDERS FAMILY AND SPECIES | SITE 1 | SITE 2 | SITE 3 | TOTAL | RA (%) |
|---|-----------|-----------|-----------|------------|--------|
| <i>Opadometa</i> sp. | 1♂ | 0 | 0 | 1 | 0.549 |
| <i>Orsinome</i> sp. | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Orsinome vethi</i> (Hasselt 1882) | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Tetragnatha hasselti</i> (Thorell 1890) | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Tetragnatha</i> sp. 1 | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Tylorida ventralis</i> (Thorell 1877) | 0 | 1♀ | 0 | 1 | 0.549 |
| THERAPHOSIDAE (Tarantulas) | | | | | |
| <i>Phlogiellus baeri</i> (Haupt et Schmidt 2004)* | 0 | 0 | 1♀SA,2SA | 3 | 1.648 |
| THERIDIIDAE (Comb footed/Sheet line Spiders) | | | | | |
| <i>Argyrodes</i> sp. | 0 | 0 | 1i | 1 | 0.549 |
| <i>Latrodectus</i> sp. | 0 | 1♀ | 1♀ | 2 | 1.099 |
| <i>Parasteatoda</i> sp. 1 | 0 | 1♀ | 1♀ | 2 | 1.099 |
| <i>Parasteatoda</i> sp. 2 | 0 | 1♀ | 1♀SA | 2 | 1.099 |
| <i>Parasteatoda</i> sp. 3 | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Parasteatoda</i> sp. 4 | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Phoroncidia</i> sp. | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Steatoda</i> sp. | 1♀ | 0 | 0 | 1 | 0.549 |
| <i>Theridion</i> sp. 1 | 0 | 0 | 1♀SA,1♀ | 2 | 1.10 |
| <i>Theridion</i> sp. 2 | 0 | 1i | 0 | 1 | 0.549 |
| <i>Theridula</i> sp. | 0 | 1♀SA | 0 | 1 | 0.549 |
| THOMISIDAE (Crab spiders) | | | | | |
| <i>Borboropactus</i> sp. | 0 | 1♀ | 0 | 1 | 0.549 |
| <i>Misumena</i> sp. | 0 | 0 | 1♀ | 1 | 0.549 |
| <i>Thomisus callidus</i> (Thorell 1890)^ | 1♀ | 0 | 0 | 1 | 0.549 |
| Total no. of Individuals | 44 | 76 | 63 | 182 | |
| Total no. of Species | 35 | 52 | 47 | 108 | |
| Total no. of Genera | 26 | 33 | 37 | 96 | |
| Total no. of Families | 12 | 13 | 12 | 17 | |
| Total no. of Males | 9 | 7 | 5 | 21 | |
| Total no. of Females | 34 | 62 | 52 | 149 | |
| Total no. of Unclassified | 1 | 5 | 6 | 12 | |

Table 1. Species richness and relative abundance of spiders in different sampling sites. Legend: Site 1 = Mixed Dipterocarp Forest. Site 2: Riparian forest. Site 3: Mixed Dipterocarp Forest with neighboring Agroecosystem. ♀- Female, ♂- Male, UC- unclassified, A- adult, SA- sub-adult, i- immature, RA (%) - Relative Abundance, ^- New record * Philippine endemic.

most abundance (74 individuals), whereas site 3 had 63 individuals. Site 1 had the least number of species (35 species), while Site 2 had the highest species richness (49 species).

Tsai et al. (2006) reported that the spatial structure of the environment influences spider habitat preferences. This could explain the high spider species richness observed in both Sites 2 and 3 where vegetation seems more diverse due to the availability of freshwater stream in site 2 providing resources such as habitat and potential preys for spiders. In Site 3, the presence of neighboring agroecosystem provides the spiders an additional habitat. As the vegetation matures, becoming denser and stratified, more species and families of spiders are present (Lowrie, 1948). Spiders relocate webs in response to web destruction and rebuild them in sites where enough stable structure is provided (Hodge, 1988) and thus, it may explain why the neighboring site, Site 1, is more diverse.

Opadometa fastigata of Tetragnathidae emerged to be the most abundant spider species making up 7.692% of the total species collected including the fact that it is the most observed species during the sampling. It was evenly distributed in the sites.

Fifteen spiders were found to be new record species in the Philippines based on the World Spider Catalog (World Spider Catalog, 2018) and research studies. New records include *Anepision depressum* (Thorell, 1877), *Clubiona biembolata* (Deeleman-Reinhold, 2001), *Clubiona corticalis* (Walckenaer, 1802), *Nusatidia camouflata* (Deeleman-Reinhold, 2001), *Burmattus pococki* (Thorell, 1895), *Myrmarachne malayana* (Edmunds & Proszynski, 2003), *Myrmaplata platalaeoides* (O. Pickard-Cambridge, 1869), *Phintella versicolor* (C.L. Koch, 1846), *Pristobaeus jocosus* (Simon, 1902), *Telamonia dimidiata* (Simon, 1899), *Heteropoda boiei* (Doleschall, 1859), *Heteropoda davidbowie* (Jager, 2008), *Heteropoda natans* (Jager, 2005), *Heteropoda tetrica* (Thorell, 1897), and *Thomisus callidus* (Thorell, 1890). So far, none of the species reported is classified as threatened in the International Union for Conservation of Nature red list of threatened species (IUCN, 2018). Two of the spiders are Philippine endemic based on the World Spider Catalog (World Spider Catalog, 2018). They are the *Calapnita subphyllicola* (Deeleman-Reinhold, 1986) and *Phlogiellus baeri* (Haupt & Schmidt, 2004).

Abundance and species richness of spider families

In terms of relative abundance, Table 2 shows that the major families are Salticidae (19.78%), Araneidae (18.13%), Tetragnathidae (15.39%), and Sparassidae (13.74%). Family Salticidae comprised most of the overall population. It dominated Sites 1 (25%) and 3 (26.98%). According to Lima-Peres et al. (2014), family Salticidae is the third most abundant family of spiders. Most of the spiders under this family were widely distributed in Site 3 with secondary growth and adjacent agroecosystem and thus providing a range of microhabitats. They occur in many microhabitats from under or below leaf litter up into the canopy (Richman et al., 2005). In Site 2, both families Araneidae (18.42%) and Tetragnathidae (18.42%) are the most abundant. Family Araneidae (18.13%), the orb weavers, ranked second in terms of overall population. The spiders of this family are evenly distributed both in Sites 3 and 2. According to Dacanay et al. (2014), Araneidae prefers locations that are highly influenced by the presence of vegetation and even near water systems, shaded vegetation,

| Family | Relative Abundance (%) | | | |
|----------------|------------------------|--------|--------|--------|
| | SITE 1 | SITE 2 | SITE 3 | Total |
| Araneidae | 11.36 | 18.42 | 22.22 | 18.13 |
| Clubionidae | 6.82 | 6.58 | 0 | 4.396 |
| Ctenidae | 4.55 | 2.63 | 3.17 | 3.297 |
| Deinopidae | 2.27 | 0 | 0 | 0.549 |
| Eutichuridae | 0 | 1.32 | 0 | 0.549 |
| Linyphiidae | 0 | 1.32 | 0 | 0.549 |
| Nephilidae | 0 | 7.89 | 1.59 | 3.846 |
| Oxyopidae | 2.27 | 0 | 1.59 | 1.099 |
| Pholcidae | 6.82 | 0 | 3.17 | 2.747 |
| Pisauridae | 0 | 1.32 | 0 | 0.549 |
| Psechridae | 4.55 | 1.32 | 6.35 | 3.846 |
| Salticidae | 25 | 10.53 | 26.98 | 19.78 |
| Sparassidae | 15.91 | 17.11 | 7.94 | 13.736 |
| Tetragnathidae | 15.91 | 18.42 | 11.11 | 15.385 |
| Theraphosidae | 0 | 0 | 4.76 | 1.648 |
| Theridiidae | 2.27 | 10.53 | 9.52 | 8.242 |
| Thomisidae | 2.27 | 1.32 | 1.59 | 1.648 |

Table 2. Relative abundance of spider families per site and overall study area. Site 1 = Mixed Dipterocarp Forest. Site 2: Riparian forest. Site 3: Mixed Dipterocarp Forest with neighboring Agroecosystem.

traces of logs, trunks of trees, and fallen trees. Araneidae spiders are common on the foliage or canopy of the plant vegetation which serves as anchors to stabilize their webs (Barrion et al., 2012). All sites have with secondary vegetation and thus provide high opportunity for the family araneidae to build orb-webs and also provide high number of prey. Site 2 is a riparian forest with freshwater stream that provides nutrition for potential prey for spiders and thus attracts spiders to build their webs near the site.

Figure 4 shows that family Araneidae ranked first in terms of species richness (22 species) while Salticidae ranked second (21 species). Per site, Salticidae dominates both the forested sites, Site 1 (9 species) and Site 3 (13 species). The foliage runners have 21 species from 16 genera. In Site 2, the riparian forest, family Sparassidae has the most species (9 species). Spider families with low species richness include: Ctenidae (2 species), Deinopidae (1 species), Eutichuridae (1 species), Linyphiidae (1 species), Nephilidae (3 species), Oxyopidae (2 species), Pholcidae (3 species), Pisauridae (1 species), Psechridae (1 species), Theraphosidae (1 species), and Thomisidae (3 species). Low species richness of these families is attributed to the rainy condition during sampling which makes it harder for the spiders to be seen. Species richness may vary across seasons. This might have also affected the total spider family richness of the Mimbilisan Protected Landscape

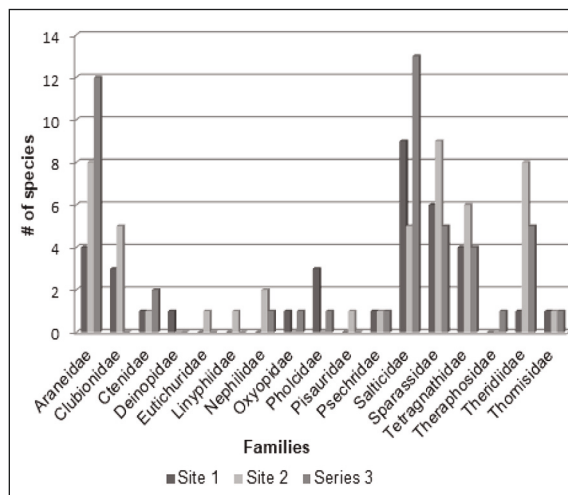


Figure 4. Number of species and family composition in each sampling site.

since sampling was carried out during the month of July, a rainy month. Thus, species richness in the area may be greater than the actual data generated.

Eight families, namely Araneidae, Ctenidae, Psechridae, Salticidae, Sparassidae, Tetragnathidae, Theridiidae, and Thomisidae, were found to be present in all three sites indicating that they are well-adapted to these areas. Spider's ubiquity in different sites can be attributed to the good dispersal behavior of spiders. An act called ballooning allows spiders to travel from hundreds of meters to several kilometers (Bell et al., 2005). Four families, namely Clubionidae, Nephilidae, Oxyopidae, and Pholcidae, were observed in at most two sites. Spiders may have dispersed to another site due to the disturbances present which serve as their defense mechanism. One major key in surviving disturbances is through the ability of spiders to disperse (Moir et al., 2005). The families Deinopidae, Eutichuridae, Linyphiidae, Pisauridae, and Theraphosidae were only found at a single site but they are not considered as rare. Due to being cryptic or having a patchy distribution they may not have been adequately sampled (Patiño et al., 2016). It might also be due to the presence of a biotic and abiotic factors preferred by a species that cause it to be present only in a single site. According to Seyfulina (2005), both biotic and abiotic factors have different influences on the distribution of the different spider groups. It indicates that spatial variety of the vegetation may effect the spider diversity. For instance, *Phlogiellus baeri* can only be found in site 3 since in this site, light cannot easily penetrate due to high density of vegetation. The resulting low temperature and the presence of coconut husks are both preferred by *P. baeri* explaining its presence in this site.

Age and Sex Structure

Figure 5 shows the age and sex composition of recorded spiders. Collected spiders were a mixture of adults (82.32%), sub-adults (9.94%), and immatures (7.73%). Among the adult spiders, females were dominant (81.77%) and males are of low percentage (12.15%). The same findings were observed in a study on Mt. Matutum, South Cotabato (Garciano et al., 2014), Mt. Pinukis, Zamboanga del Sur (Lalisan et al., 2015), and in Marilog Dis-

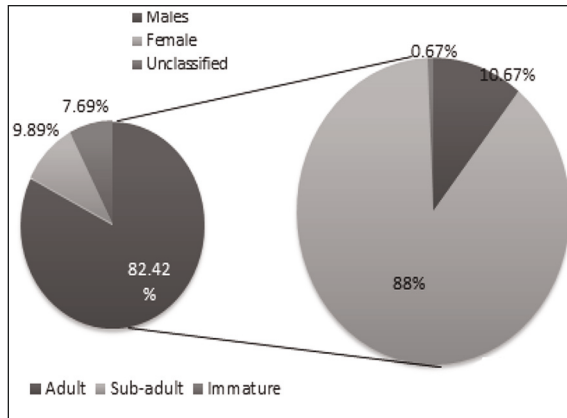


Figure 5. Age and sex percentage composition of collected individuals.

| Indices | Site 1 | Site 2 | Site 3 | Total |
|-------------|--------|--------|--------|--------|
| Species | 35 | 52 | 47 | 108 |
| Individuals | 44 | 76 | 63 | 182 |
| Shannon | 3.432 | 3.781 | 3.739 | 4.418 |
| Evenness | 0.8838 | 0.8437 | 0.8946 | 0.7676 |

Table 3. Biodiversity indices of the three sampling sites.

trict, Davao City (Patiño et al., 2016). However, findings differed with the study in Rajah Sikatuna Protected Landscape, Bohol (Quiñones et al., 2016), where males dominated the area. Presence of dominant female spiders may be due to their morphological feature where male spiders are smaller (Wegner, 2011) and thus hard to be detected. Cannibalism behavior of female spider after mating is another factor where it is most widely observed in spiders (Elgar, 1992). Fatal encounter of males with potential predators during mate-searching is often ascribed to abundance of female spiders (Gaskett et al., 2004). Considering the fact that male spiders reach maturity faster than females, Romero & Vasconcellos-Neto (2005) observed that female spiders are more frequently observed during adult and sub-adult stages while male spiders are frequent during the juvenile stage. High number of collected adults were observed since female spiders oviposit throughout the entire year (Nieto-Castañeda et al., 2012). Female spiders typically

have larger abdomens than males. The epigynum that can only be found in female spiders lies near the epigastric furrow and bears the openings to the seminal receptacles while the male reproductive system of spiders has a pair of coiled tubular testes in the opisthosoma, which lead to a common sperm duct that opens into the epigastric furrow (Foelix, 2011). According to Wegner (2011) males of some families have the first pair of legs longer and/or more stocky and hairy in proportion to their size. Males have species-unique pedipalps with enlarged tips serving as sex organ (Brown & Merchant, 2015).

Biodiversity Indices

Considering the importance of spiders in controlling insect pests and as bio-indicators, serious efforts are required in understanding their diversity (Umarani & Umamaheswari, 2013). Table 3 shows the biodiversity indices in the three sampling sites of Mimbilisan Protected Landscape, Misamis Oriental. High diversity and even species distribution were observed in all sites. Site 2 had the most abundant spiders with 76 individuals comprising 52 species. Site 3 had 63 individuals in 47 species. Site 1 had the least abundance of 44 individuals with 35 species. A riparian forest serves as a faunal corridor, connecting adjacent ecosystems (Raizer et al., 2005). Site 2 serves as the transition zone between Sites 1 and 3. Edge effect hypothesis states that species richness increases at the border between different habitats (Odum, 1971) and thus, Site 2 has the highest species richness. Presence of the stream in Site 2 provides nutrients to nearby vegetation allowing it to grow enormously which then provides adequate habitat for the spider fauna particularly for the orb weavers.

According to Murcia (1995), the edges lead to variations in plant physiological response, vegetation structure, and forest species composition. The stream also attracts potential prey for the spiders. Site 3 was second in terms of species richness due to the presence of cultivated crops introduced in the area. The physical structure and species composition of vegetation define diversity of species and abundance through habitat availability (Malumbres-Olarte et al., 2013). This indicates that Site 2 vegetation structure is favorable to spi-

ders. Site 1 with the highly disturbed vegetation had the lowest species diversity compared to the other sites because it serves as the main port in accessing the stream near Site 2. Moreover, Site 1 was the most accessible and visited site with higher disturbance to potential prey and the spiders themselves therefore decreasing spider richness and abundance. Low species richness is attributed to disturbed sites (Maya-Morales et al., 2012). As disturbance increases, the spider species richness decreases (Pinkus et al., 2006). Dacanay et al. (2014) reported low spider abundance and richness in very disturbed areas. Following Pielou's evenness index, all three sampling sites were found to be evenly distributed, although Site 2 got the lowest value compared to the two sites, which means that a species dominates the area. In this case, it was dominated by the species *Opadometa fastigata*, the most abundant species in Mimbilisan Protected Landscape. In addition, although Site 2 had the highest species richness and species diversity, Site 3 still has the highest evenness. Changes in ecological gradients due to human activities influence spider distribution and alter the community's composition (Uetz, 1976). Even though the different sites vary in biodiversity indices, the overall diversity of Mimbilisan Protected landscape is relatively high ($H' = 4.36$). Typically, values of Shannon-Wiener diversity index generally ranged from 1 to 3 which means that the diversity is moderate, low diversity if the index value is below 1, and high diversity if the index value is greater than 3 (Richardson, 1977). The value of H' increases as species richness and evenness increase.

Guild Structure

Guild structure of spiders is useful in studying ecology in describing diversity in communities (Freitas et al., 2013). The presence of this guild may be explained by the type of vegetation in the area which could provide adequate space of varying extent for building webs. Figure 4 shows the different guilds present in Mimbilisan Protected Landscape. The most dominant guild is the orb weavers comprising 37% of the distribution in the area. This guild is composed of families Araneidae and Tetragnathidae which were mostly collected in forest vegetation and bushes near the riparian for-

est, mostly in sites 3 and 2, respectively, which provided wider expanse for web building such as building web between branches/stems of plants. The same observation was obtained in the Philippines by Patiño et al. (2016) in Marilog District, Davao City and Juario et al. (2016) in Sacred Mountain in Marawi City and in China by Barrion et al. (2012) in their study in the rice agricultural landscape of Hainan Island,. Garciano et al. (2014) found the orb weavers to be the most abundant comprising 61% of their total collected specimens. They were mostly found in shrubs, best for anchoring their webs. Richardson & Hanks (2009) reported that the diversity of orb weavers is influenced by the floral community species composition. In this study (Fig. 6), web-building spiders are expected to be abundant because of the existence of bushes in the forested areas. Furthermore, since the forest is a secondary vegetation it provides more opportunity for the orb-weavers to build their webs around. The differences in web support structures brought about by the differences in microhabitats also affect spider density (Balfour & Lypstra, 1998). Foliage runners formed the next dominant guild (26%) in Sites 1 and 2 and the dominant guild in Site 3 which were commonly found above or beneath leaves. The spatial complexity of the leaf litter facilitates the existence of several species because it provides high surface

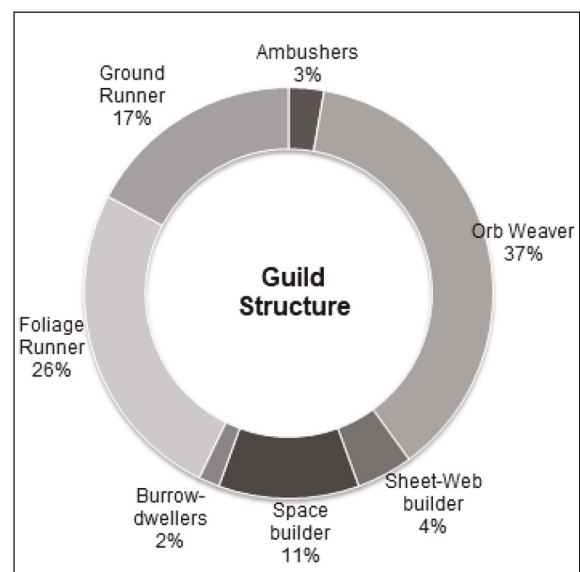


Figure 6. Percentage distribution of the different spider guilds at Mimbilisan Protected Landscape.

area and foraging spaces within the leaves (Uetz, 1991). Most of the vegetation in the forest consisted of high surface leaves and thus provide more opportunity for the foliage runners. The most abundant ground vegetation was *Schismatoglottis calyprata* locally called “dalili” which has high surface area. Ground runners (Ctenidae and Sparassidae) have 17% of the total relative abundance. Forest areas have leaf litter and provide opportunity for the ground runners. Space builders (Theridiidae and Pholcidae) have 11% relative abundance while sheet web weavers (Linyphiidae and Psecridae) have 4%. Branches/stem of plants and rocks provide these space builders and sheet web weavers spaces/areas to anchor their webs. Ambushers (Deinopidae, Thomisidae and Pisauridae) have 3% and burrow-dwellers (Theraphosidae) have 2% of the guild distribution. Mosses, humus, cover plants, and rocks on forest floor provide habitats for ambushers and burrow dwellers. In addition, according to Freitas et al. (2013), the dry climate and exposure to sunlight favor nocturnal ground hunters and runners.

Spider Microhabitats

Mimbilisan Protected landscape provides a variety of possible microhabitats for the spider fauna. Microhabitats include the branches/stem of plants, leaf surfaces/foilage, *Schismatoglottis calyprata* locally called “dalili”, forest floor, rocks, leaf litter, coconut husk, and fallen logs. The branches/stem of plants were used by spiders to anchor their webs and most of the jumping spiders were found hiding on or under leaf surfaces/foilage. *Schismatoglottis calyprata* was the most observed ground vegetation providing a high surface area for the foliage runners. Mosses, humus, rocks, and cover plants on the forest floor provide opportunity for ambushers and burrowing spiders to hide on. Rocks serve as microhabitat for the ground dwelling spiders and some orb weavers. Leaf litter provides the ground dwelling spiders a microhabitat. Coconut husks serve as microhabitat for *Phlogiellus baeri* and it is here where *Phlogiellus baeri* can only be found. Some of the spiders such as the burrowing spiders were found on fallen logs. It seems that Site 1 with high disturbance and low diversity provides high number of microhabitats for the spiders. Foliage, stems, and

fallen logs were found in all sites. Leaf litter and forest floor serve as the general microhabitat for ground-dwelling and burrowing spiders. *Schismatoglottis calyprata* that was only found in forested area greatly provides microhabitat for spiders especially for leaf-dwelling spiders. In riparian forest, rocks are the microhabitat for both ground-dwelling and orb-weaver spiders. Lastly, in agro-ecosystem part of Site 3, coconut husk provides microhabitat for numerous *Phlogiellus baeri*.

Table 4 shows the different species of spiders documented with their respective microhabitats. Studies of relationships between spiders and the structure of habitats have shown that spiders use structures in their environment as cues to habitat quality, architectural foundations for prey-catching webs, and as vibration-conducting and monitoring surfaces in communication and prey capture (Uetz, 1991). The most utilized microhabitats by the spiders are between branches/stem of plants and leaf surfaces/foilage. This explains why the orb-weavers and foliage runners were the most abundant guilds in the area to which the families Araneidae and Salticidae, the most abundant families with high species richness, belong, respectively. Possible factors that affect microhabitat selection include prey availability, leaf toxicity, and suitability of leaf structure for web attachment. According to Huber & Schutte (2009), underlying mechanism is difficult to resolve due to the presence of factors influencing the spider's microhabitat choice.

CONCLUSIONS

Mimbilisan Protected Landscape has a relatively high species richness and high overall diversity of spiders. One-hundred eight species of spiders across the sampling sites were evenly distributed. Fifteen spider species are new record to the Philippines. Two spider species are Philippine endemic. About 82.32% of spiders are adult and mostly female (81.77%). There were 17 families recorded in which Salticidae was the most abundant family. In terms of species richness, family Araneidae ranked first (22 species) and Salticidae was close behind (21 species). Of the seven guilds recorded, orb weavers were the most distributed,

| Spider species | Microhabitat |
|--|---|
| Araneidae | |
| <i>Anepion depressum</i> | <i>Schismatoglottis calyprata</i> (locally called "dalili") leaf surface |
| <i>Anepion roeweri</i> | <i>Schismatoglottis calyprata</i> leaf surface |
| <i>Anepion</i> sp. | On the web between branches/stem of plants |
| <i>Araneus</i> sp. | On the web between branches/stem of plants |
| <i>Argiope aemula</i> | On the web between branches/stem of plants |
| <i>Cyclosa</i> sp. 1 | On the web between branches/stem of plants |
| <i>Cyclosa</i> sp. 2 | <i>Schismatoglottis calyprata</i> locally leaf surface, Leaf surfaces/foilage |
| <i>Cyrtophora</i> sp. | Leaf surfaces/foilage, On the web between branches/stem of plants |
| <i>Eriovixia laglaizei</i> | Leaf surfaces/foilage |
| <i>Eriovixia</i> cf. <i>laglaizei</i> | Leaf surfaces/foilage |
| <i>Eriovixia</i> sp. 1 | On the web between branches/stem of plants |
| <i>Eriovixia</i> sp. 2 | Leaf surfaces/foilage |
| <i>Gasteracantha doriae</i> | On the web between branches/stem of plants |
| <i>Hyposinga</i> sp. | Forest floor |
| <i>Neoscona</i> cf. <i>nautica</i> | On the web between branches/stem of plants |
| <i>Neoscona nautica</i> | Leaf surfaces/foilage |
| <i>Neoscona punctigera</i> | On the web between branches/stem of plants |
| <i>Neoscona</i> sp. | On the web between branches/stem of plants |
| <i>Poltyis</i> sp. | On the web between branches/stem of plants |
| <i>Singa</i> sp. | On the web between branches/stem of plants |
| <i>Thelacantha brevispina</i> | Leaf surfaces/foilage |
| <i>Verrucosa</i> sp. | Leaf surfaces/foilage, On the web between branches/stem of plants |
| Clubionidae | |
| <i>Clubiona biembolata</i> | On the web between branches/stem of plants |
| <i>Clubiona corticalis</i> | Forest floor |
| <i>Clubiona</i> cf. <i>japonicola</i> | Leaf surfaces/foilage |
| <i>Clubiona</i> sp. | Leaf surfaces/foilage |
| Clubionidae immature | On the web between branches/stem of plants |
| <i>Nusatidia camouflata</i> | <i>Schismatoglottis calyprata</i> , On the web between branches/stem of plants |
| <i>Pristidia longistila</i> | On the web between branches/stem of plants |
| Ctenidae | |
| <i>Ctenus sarawakensis</i>) | Forest floor, Leaf litter, Fallen logs |
| <i>Ctenus</i> sp. | Forest floor |
| Deinopidae | |
| <i>Deinopis</i> sp. | On the web between branches/stem of plants |
| Eutichuridae | |
| <i>Cheiracanthium</i> sp. | On the web between branches/stem of plants |
| Linyphiidae | |
| <i>Plectembolus</i> sp. | On the web between branches/stem of plants |
| Nephilidae | |
| Nephilidae immature | On the web between branches/stem of plants |
| <i>Nephila pilipes</i> | Leaf surfaces/foilage, On the web between Branches/stem of plants |
| <i>Herrenia</i> sp. | On the web between branches/stem of plants |
| Oxyopidae | |
| <i>Hamadruas</i> cf. <i>hieropolyphica</i> | On the web between branches/stem of plants |
| <i>Oxyopes lineatipes</i> | Leaf surfaces/foilage |
| Pholcidae | |
| <i>Calapnita deelemanae</i> | <i>Schismatoglottis calyprata</i> , Leaf surfaces/foilage |
| <i>Calapnita subphyllicola</i> | <i>Schismatoglottis calyprata</i> , Leaf surfaces/foilage, On the web between branches/stem of plants |
| <i>Pholcus</i> sp. 1 | Forest floor |
| Pisauridae | |
| <i>Hygropoda</i> sp. | Leaf surfaces/foilage |
| Psechridae | |
| <i>Psechrus</i> sp. | On the web between branches/stem of plants, Forest floor |
| Salticidae | |
| <i>Bavia aericeps</i> | <i>Schismatoglottis calyprata</i> , Leaf surfaces/foilage |
| <i>Bavia sexpunctata</i> | Leaf surfaces/foilage, On the web between Branches/stem of plants |
| <i>Burmattus pocoocki</i> | Leaf surfaces/foilage |
| <i>Cosmophasis</i> sp. 1 | Leaf surfaces/foilage, On the web between branches/stem of plants |
| <i>Cosmophasis</i> sp. 2 | Leaf surfaces/foilage |
| <i>Evarcha</i> sp. | Leaf surfaces/foilage |
| <i>Epelus</i> sp. | On the web between branches/stem of plants |
| <i>Hasarius adansoni</i> | Leaf surfaces/foilage |
| <i>Myrmarachne malayana</i> | On the web between branches/stem of plants, Forest floor |
| <i>Myrmaplata platalaeoides</i> | On the web between branches/stem of plants, Leaf litter |
| <i>Phintella versicolor</i> | Leaf surfaces/foilage, On the web between branches/stem of plants |
| <i>Plexippus paykulli</i> | Leaf surfaces/foilage, On the web between branches/stem of plants |
| <i>Portia</i> sp. | Leaf surfaces/foilage |
| <i>Pristobaeus jocosus</i> | On the web between rocks |
| <i>Pseudeuophrys</i> sp. | On the web between branches/stem of plants |
| Salticidae immature | On the web between branches/stem of plants |
| <i>Telamonia dimidiata</i> | Leaf surfaces/foilage |
| <i>Telamonia</i> cf. <i>festiva</i> | Leaf surfaces/foilage, On the web between branches/stem of plants |
| <i>Thiania bhamoensis</i> | Leaf litter |
| <i>Thyene</i> cf. <i>manipisa</i> | Leaf surfaces/foilage |
| Sparassidae | |
| <i>Heteropoda boiei</i> | Forest floor |
| <i>Heteropoda</i> cf. <i>boiei</i> | Leaf litter |
| <i>Heteropoda davidbowie</i> | On the web between branches/stem of plants |
| <i>Heteropoda</i> cf. <i>davidbowie</i> | Forest floor |
| <i>Heteropoda</i> cf. <i>natans</i> | Leaf surfaces/foilage |
| <i>Heteropoda natans</i> | Leaf surfaces/foilage |
| <i>Heteropoda venatoria</i> | On the web between branches/stem of plants, Forest floor |
| <i>Heteropoda</i> sp. 1 | Forest floor, On the web between rocks |
| <i>Heteropoda</i> sp. 2 | On the web between rocks |
| <i>Heteropoda</i> sp. 3 | On the web between rocks |
| <i>Thelcticopis</i> sp. 1 | Leaf litter |
| <i>Thelcticopis</i> sp. 2 | Forest floor |
| <i>Thelcticopis</i> sp. 3 | Forest floor, Leaf litter |
| <i>Thelcticopis</i> sp. 4 | Forest floor, Leaf litter |
| <i>Thelcticopis</i> sp. 5 | On the web between branches/stem of plants |
| <i>Thelcticopis</i> sp. 6 | Forest floor |
| Tetragnathidae | |
| <i>Leucauge argentina</i> | Leaf surfaces/foilage, On the web between branches/stem of plants, On the web between rocks |
| <i>Leucauge</i> cf. <i>argentina</i> | On the web between branches/stem of plants |
| <i>Leucauge</i> cf. <i>gramulata</i> | Leaf surfaces/foilage, On the web between branches/stem of plants |
| <i>Leucauge</i> sp. | Leaf surfaces/foilage |
| <i>Opadometa fastigata</i> | Leaf surfaces/foilage, On the web between branches/stem of plants, On the web between rocks |
| <i>Opadometa</i> sp. | Leaf surfaces/foilage |
| <i>Orsinome</i> sp. | Leaf surfaces/foilage, On the web between branches/stem of plants |
| <i>Orsinome vethi</i> | Leaf surfaces/foilage |
| <i>Tetragnatha hasselti</i> | <i>Schismatoglottis calyprata</i> , Leaf surfaces/foilage |
| <i>Tetragnatha</i> sp. 1 | <i>Schismatoglottis calyprata</i> , Leaf surfaces/foilage |
| <i>Tylorida ventralis</i> | Leaf surfaces/foilage |
| Theraphosidae | |
| <i>Phlogiellus baeri</i> | Coconut husk |
| Theridiidae | |
| <i>Argyrodes</i> sp. | Leaf surfaces/foilage |
| <i>Latrodectus</i> sp. | Leaf surfaces/foilage |
| <i>Parasteatoda</i> sp. 1 | Leaf surfaces/foilage, On the web between branches/stem of plants |
| <i>Parasteatoda</i> sp. 2 | Leaf surfaces/foilage, On the web between branches/stem of plants |
| <i>Parasteatoda</i> sp. 3 | Leaf surfaces/foilage |
| <i>Parasteatoda</i> sp. 4 | Leaf surfaces/foilage |
| <i>Phoroncidia</i> sp. | <i>Schismatoglottis calyprata</i> leaf surface, Leaf surfaces/foilage |
| <i>Steatoda</i> sp. | On the web between branches/stem of plants |
| <i>Theridion</i> sp. 1 | Leaf surfaces/foilage, On the web between branches/stem of plants |
| <i>Theridion</i> | On the web between branches/stem of plants |
| <i>Theridula</i> | Leaf surfaces/foilage |
| Thomisidae | |
| <i>Borboropactus</i> sp. | On the web between branches/stem of plants |
| <i>Misumena</i> sp. | On the web between branches/stem of plants |
| <i>Thomisus callidus</i> | On the web between branches/stem of plants |

Table 4. Microhabitats used by the spiders in Mimbilisan Protected Landscape.

being found in all sites. *Opadometa fastigata*, an orb-weaver, appears to be the most widely distributed species. Microhabitats were mostly branches/stems of plants and leaf surface/foilage. Results indicate that Mimbilisan Protected landscape is a highly diversified area which indicates a healthy ecosystem. Habitat structure, availability of microhabitat, and habitat disturbances appear to influence the diversity, distribution, and abundance of the spider species.

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