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Survey of spiders at Mt. Hamiguitan, Davao Oriental, Philippines

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Abstract

A survey of spiders was done to provide information about spiders in the Mt. Hamiguitan, Davao Oriental, Philippines, a unique mountain range that houses the 100,000 hectares bonsai forest. This study was done to identify spiders up to the lowest taxonomic level. There were four sampling stations established in dipterocarp forest, grassy, pygmy forest and secondary growth forest. In each station, a belt transect line measuring 100m by 10m was established extending 5 m on both sides of the transect belt. There were forty-seven different specimens collected in all station and was found out to belong to nine families. These were Araneidae, Clubionidae, Ctenizidae, Lycisidae, Oxyopidae, Pisauridae, Salticidae, Tetragnathidae and Thomisidae. Out of the nine families, 2 were orb weaver, 4 were ground spiders and 3 were aero-terrestrial. Abiotic factors were also determined during the time of collection such as temperature, relative humidity and altitude. The highest temperature recorded was in station 1 with 26.5°C and highest relative humidity was recorded in Station 2 with 92% humidity. Highest elevation was recorded in the third station with 1172masl. With this gathered data, it is also relevant to conduct further study to compare the presence of spiders during wet and dry season.

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Introduction

Arachnids are eight legged-arthropods related to insects and crustaceans. Their body is divided into two parts. The cephalothorax, also known as prosoma, contains the mouth area with the chelicerae, pedipalps and legs. The second part is the abdomen or opisthoma. They differ from insects primarily in the absence of wings and antennae (Garciano *et al.,* 2014; Caduto *et al*, 1997).

Arachnids are considered as the largest and most successful group of Chelicerates. Identified organisms that belonged to this group approximately reach up to 65,000 to 73,000. Among the arachnids, the order Araneida is the largest group (Leroy, 2003; Cloudsley-Thompson, 2015). Knapp and Řezáč (2015), states that there are more than 30,000 species of spiders known.

Spiders lived in various habitats, from sea level to high mountains. They also lived in desserts, in rocky regions, forests, bushes and grasses (Storer, 1979; Knapp and Řezáč,2015; Picchi *et al.,* 2016;). Tsutsui (2016) stated that there are spiders inhabiting in aquatic habitats.

Spiders are known for their ability in weaving webs. These webs are produced by the voluminous glands and dispensed through the spinning organs called spinnerets (Storer, 1979; Knapp and Řezáč, 2015; Picchi *et al.,* 2016;). Spiders come in a variety of shapes, sizes and colors.

Their size ranges from minute, 0.5 mm up to 9cm. Most spiders are predators and nocturnal. They feed and digest there food externally by secreting digestive enzymes and take up the liquefied food (Fuzita *et al*, 2016; Walter *et al*., 2017).

Spiders play an important role in the general economy of nature, for they are quite numerous and their predatory habitats serve to keep other animals, specifically the insects, in check. In turn, they are preyed upon by other various animals particularly wasps (Cloudsley-Thompson, 2015).

Mt. Hamiguitan is in the north-south mountain ridge alongside the Pujada Peninsula in the southeastern of the Eastern Mindanao Biodiversity Corridor. It lies between the three towns of Davao Oriental; San Isidro, Mati and Gov. Generoso where it serves as an important habitat for numerous plants and animals. Many of which are endemic to the Philippines and to Mt.Hamiguitan itself. It is unique for its century old bonsai covering an area of 1000 hectares (PCAARD, 2007; UNESCO, 2019).

The important contribution of spiders to the balance of the ecosystem and prompted this study in Mt. Hamiguitan. Furthermore, relevant information on spider diversity in the Philippines is incomplete and scattered among institutions and private individuals. This created information gap about spiders, hence, this study was conducted to fill such gap.

Materials and methods

Study site

The study was conducted in Mt. Hamiguitan, a well-known mountain for its unique bonsai forest. It stands less than 1,051 meters above sea level.Atype4 in climate classification representing rainfall more or less evenly distributed throughout the year.

Establishment of sampling sites

Four sampling stations were determined. In each sampling station, a belt transect line measuring 100 m was stretched and extending 5 m on both sides of the belt transect was established. Measured strips were used to mark the established area.

Station 1 is at N 6.71680E126.2196° to N6.7164° E 126.2195°.Characterized by rocky lower dipterocarp forest. It was situated near a river. The area grows trees up to 25meters with rocks scattered measuring 2-3 feet in diameter.

Station 2 was located N 6.7073° E 126.1953° to N6.7071° E126.1962° characterized by a wide grassland surrounded by tall trees. According to Smith (1996), grasses are distinctive because their stem, called culms produce narrow leaves that grow

from their bases. Grasses grow up to waist high (2-4 ft). The area is muddy and it is said that the area was submerged in water few months before the collection. The transect line is approximately 100 meters from Tinagong Dagat, a body of water nearby the wide grassland areas.

Station 3 was located N6.7259° E126.18460 to N6.7251° E126.1852° characterized by a bonsia or pygmy forest. Bonsai plant measures 1-5 ft. tall with ferns and mosses as the ground cover plant that grew in spaces between pygmy trees. The belt transect line is near a river.

Station 4 was located (N6.7301 E 126.1669° to N 6.7311° E126.1673°). Characterized by a secondary growth forest near. A river situated few meters away from the sampling area.

Collection of specimen

Collection of specimen was done at dawn and dusk with the aid of a flashlight. Two collection dawns and two collection dusks were spent in every stations. Gloves were used in handling the specimen. Web making spiders were collected using the "hands to cups" by getting it from its web. A pole with cloth attached to the end forming a net was used to collect spiders above human reach.

The most effective way of collecting spiders was active search during night time. Methods employed to collect non-web making spiders were pitfall trap method and sticky plaster method. Pitfall traps were composed of materials such as a container with 70% alcohol. Jars were burrowed in the ground with its lid on the ground level. Soil surrounding the lid of the jars was compacted properly to prevent the spiders from detecting the trap. There were 10 traps in each belt transect. Ten sticky plaster were placed at random in each belt transect.

Preservation of samples

All the specimens were preserved in a container with 70% ethyl alcohol. Containers were labeled accordingly.

Identification of spiders

Samples collected were identified in the Ecology Laboratory, Biological Sciences Department, USM, Kabacan, Cotabato. Identification was done by viewing arrangement of the eyes with the use of a stereoscope. Identification was followed from eye arrangement of spiders provided by the Bugguide.Net hosted by the Iowa State University, description of An Introduction to the Study of Insects by Borror *et al.* (1976) and Barrion and Litsinger (1995). Morphometric measurements were determined using a ruler. Body measurement was measured from the anterior most part of the cephalothorax to the tip of abdomen. Leg measurement was measured from the coxae to the tip of the tarsus.

Determination of abiotic factors

Temperature: Temperature was measured using a thermometer. Thermometer was exposed to the air four feet above the ground. Getting the temperature was done randomly selected site within each transect line. The procedure was done three times at selected sites within each transect line.

Relative Humidity: Relative humidity was measured using a sling psychrometer. The instrument was rotated at six feet above the ground for three minutes. The difference of the reading of the wet and dry bulb was solved. The difference of the two bulbs and the dry will be plotted on the table of Brower and Zar (1977). The point where the two readings intersect was recorded as the reading for relative humidity.The procedure was done three times at selected sites within each transect line.

Results and discussion

The study on the survey of spiders at Mt. Hamiguitan, Davao Oriental was conducted to characterize and identify spiders and determine the abiotic factors-temperature, relative humidity and altitude of the area.

Characterized and identified spiders

Forty-seven samples were collected belonging to nine familes namely: Araneidae, Clbionidae, Lycosodae,

Oxyopidae, Salticidae, Tetragnathidae, Thomisidae and Ctenizidae. Of the nine families identified, eight belonged to Suborder Araneomorpha. Suborder Mygalomorphida was solely represented by the family Ctenizidae. Table 1 shows the identified samples collected under different families. Under family Araneidae, commonly known as the orb-weavers, these were 25 samples. These were *Argiope, Cyclosa, Gasterocantha, Larinia, Neoscona, Nephila* and *Tukaraneus*. Four of the 25 samples were undetermined up to the genus level.

Table 1. Families identified in the four different stations at Mt. Hamiguitan, Philippines.

Family	Scientific Name	Dipterocarp Forest	Grassy Area	Pygmy Forest	Secondary Forest
Araneidae	*Argiope sp*	+	+	+	
	Argiope sp2			+	
	Argiope sp3			+	
	Argiope sp4			+	
	Cyclosa sp			+	
	Cyclosa sp2	+			
	Cyclosa sp	+			
	Gasterocantha janopol		+		+
	Gasterocantha parangdiadesma	+		+	+
	Gasterocantha sp3	+			
	Larinia sp			+	+
	Larinia sp2			+	
	Larinia sp3			+	
	Neoscona sp			+	
	Neoscona sp2			+	
	Neoscona sp3			+	
	Neoscona sp4			+	
	Nephila maculate	+			+
	Nephila sp2				+
	Nephila sp3	+			
	Tukaraneus sp			+	
	Undetermined 1	+			
	Undetermined 2	+			
	Undetermined 3				+
	Undetermined 4	+			
Clubionidae	Undetermined 1			+	
Lycosidae	*Pardosa sp*	+	+	+	
Oxyopidae	*Oxyopes sp*	+			
	Oxyopes sp2			+	
	Oxyopes sp3				+
Salticidae	*Gangus sp*	+			
	Harmochirus sp		+		
	Undetermined 1				+
	Undetermined 2			+	
Tetragnathidae	*Dyschiriognatha sp*				+
	Opadometa sp	+			
	Tetragnatha sp				+
	Tetragnatha sp2		+		
	Tetragnatha sp3		+		
	Tetragnatha sp4			+	
	Tetragnatha sp5		+	+	
	Tetragnatha sp6		+		
Thomisidae	*Misumenops sp*		+		
	Lysitiles sp	+			
	Undetermined 1	+			
Ctenizidae	Undetermined 1	+			

Legend: + - Occurrence.

Under the family Tetragnathidae, there were eight samples identified up to the genus level. One belonging to genus *Dyschiriognatha,* another belonging genus Opadometa and the six other samples under genus Tetragnatha. Under family Salticidae, of the four genus samples collected, two were identified as *Gangus* and *Harmochirus* and up to the genus level two were undetermined. Under the family Oxypidae, three samples were collected and identified to belong to genus *Oxyopes*. There were two samples identified namely genus *Misumenops* and genus *Lysitiles* and one is undetermined under family Thomisidae. Under family Lycosidae and Pisauridae, each had one sample identified.

These were Pardosa and Pisaura respectively. There were two undetrmined samples belonging to family Clubionidae and family Ctenizidae.

Table 2. Families of spider grouped according to capability of building webs.

Categories of Spiders		Common Name
Web Making Spider	Araneidae	Orb- weaver Spider
	Tetragnathidae	Long-jawed Orb Weaver
Non-web Making Spider	Ground Spider	
	Ctenizidae	Trap door Spider
	Clubionidae	Sac Spider
	Lycosidae	Wolf Spider
	Pisauridae	Nursery Web Spider
	Aero-terrestrial Spider	
	Oxyopidae	Lynx Spider
	Salticidae	Jumping Spider
	Thomisidae	Crab Spider

The Table 1 reveals collected and identified under different family. Of the nine families identified, there were three families commonly found in all stations. These are the Araneidae, Salticidae and Tetragnathidae. Acoording to Argañaraz *et al.*, 2017 and Foelix (1996), Araneids are one of the most diverse families of spiders together with the Salticids. He further added that they are observed in almost all habitats except Arctic areas. The locations of the four stations were suited for the Tetragnathids. Since all stations were near and over a water source and over a marshy area.

The observance of a flower crab spider, genus *Misumenops* in the grassy area was expected for there were flowering trees found near the margin separating the grassy from the forested area. Similar findings was described by Fourie *et al.* (2013) and Romero and Vasconsellos-Neto (2003) wherein families Araneidae, Philodromidae, Salticidae and Thomisidae were found abundantly high percentage plant cover.

On the other hand, ground spiders belonging to Family Lycosidae was observed in dipterocarp forest, grassy area and in the pygmy forest. Family Pisauridae was observed in the dipterocarp and pygmy forest. deHart *et al.,* 2017 expressed a general finding that spiders are present in grassland and early successional to old mature forests. Furthermore, deHart *et al.,* 2017 emphasized that spiders as both a generalist species and a predator, they are most likely to be found in all trophic level. Family Ctenizidae was unique in the dipterocarp forest and family Clubionidae was unique in the pygmy forest. They were called ground spider since they build burrows on soil, for the Ctenizidae and wander on ground and leaf litters to look for prey. Meriste *et al.* (2016).

It was found out that Araneidae family had the most number of representatives described in dipterocarp forest, grassy area and pygmy forest except in grassy

area where the Tetragnathids have the highest number of representatives observed. The Araneidae, thus proved to be the most abundant family as stated by Foelix (1996).

Table 2 shows spiders grouped according to their capability of building webs. Non-web making spiders are categorized into ground and aero-terrestrial. Of the nine families, four families were identified to be ground spiders namely, family Clubionidae, Ctenizidae, Lycosidae and Pisauridae. The table also reflects the web making spiders, namely, the Family Araneidae, orb weaver and Tetragnathidae, the long-jawed orb weavers. They build orb webs sometimes with different designs to attract prey. There were also identified spiders that do not build webs nor considered also as ground spider. They were identified as aero-terrestrial spiders. They were called aero-terrestrial since they stay up on branches and sometimes foliage leaves looking for prey. These families were family Oxyopidae, Salticidae and Thomisidae.

Table 3. Abiotic factors determined during data collection last at Mt. Hamiguitan, Davao Oriental Philippines.

Abiotic Factors	Sampling Station			
	Dipterocarp Forest	Grassy Area	Pygmy Forest	Secondary Forest
Temperature (°C)	26.17	22.17	19.33	21.33
Relative Humidity (%)	91	92	91	91
Altitude (masl)	352	1080	1167	945

Araneidae together with family Tetragnathidae have orb-web building trait (Borror, 1976; Cloudsley-Thompson, 2015). This may explain their presence in all stations that helped survive in all habitat. The Araneidae family which has the highest number of species described in the pygmy forest could be justified by the fact that prey availability in a more humid areas and low temperature is low. Hence, only orb weavers can have high tendency to capture its prey.

Abiotic factors

The abiotic factors measured included temperature, relative humidity and altitude. The abiotic factors obtained from the four stations are shown in Table 3. Based on the results, temperature ranged from 19°C to 26°C with the highest temperature recorded from Station 1 and the lowest was from Station 3. The temperature obtained in the four station fitted in the growth requirement of spiders which is from 21°C-26°C (70°F-80°F) as listed by Tansely (2003) and not exceeding extreme temperature of <15°C (60°F) and >32°C (90°F). Herberstein (2003) stated that the temperature affects the web building behavior of spiders. He further stated that spiders add decorations to attract prey to the web since prey availability is reduced at low temperature. The physiological sustainability of a given environment is determined by accessibility to open waters (Gillepsi, 1987). Thus, all locations of stations are suitable for life and of the probable presence of prey.

The relative humidity gathered in the four stations showed that the station with the highest humidity with 92% was in Station 2. This could be attributed by the lake, Tinagong Dagat, near the station. Station 1 with the lowest elevation, 352 masl had the highest mean temperature, 26°C. Station 3 with the highest elevation, 1167 masl, had the lowest mean temperature, 19°C.

Conclusion and Recommendations

A survey of spiders was done to provide information about spiders in the Mt. Hamiguitan, Davao Oriental, Philippines. There were 9 families of spiders identified. They were Araneidae, Clubionidae, Ctenizidae, Lycosidae, Oxyopidae, Pisauridae, Salticidae, Tetragnathidae and Thomisidae. The family Araneidae outnumbered other families identified in the dipterocarp forest, pygmy forest, and

secondary growth forest while family Teragnathidae is abundant in the grassy sampling area. From the nine families, two were orb weavers, four ground dwellers and three were aerial-terrestrial families.

Orb weavers were Araneidae and Tetragnathidae. Ground dwellers were Clubionidae, Ctenizidae, Lycosidae, and Pisauridae. Aero-terrestrial spiders were Oxyopidae, Salticidae, and Thomisidae. Further, the study recommends establishment of sampling stations in other parts of Mt. Hamiguitan not covered in study for more characterization and identification of species of spider.

It is further recommended that study be conducted during summer time to compare whether seasons and/precipitation can influence abundance and distribution of spiders.

References

Argañaraz CI, Rubio GD, Gleiser RM. 2017. Jumping spider (Araneae: Salticidae) diversity in the understory of the Argentinian Atlantic Forest. Ecologia Caldasia **39(1),** 157-168. https://dx.doi.org/10.15446/caldasia.v39n1.60527

Barrion AT, Litsinger JL. 1995. Riceland Spiders of South and Southeast Asia. CAB International in association with International Rice Research Institute.

Borror DJ. 1976. An Introduction to the Study of Insects (4th Ed), USA: Holt, Rinehart & Winston.

Brower JA, Zar JH. 1977. Field and Laboratory Methods for General Ecology. William C. Brown Company, Dubuque.

Bugguide. 2017. Hosted by Iowa State University. Retrieved December **16,** 2017, from. http://bugguide.net/node/view/3/bgpage

Cloudsley-Thompson JL. 2015. Spiders, Scorpions, Centipedes and Mites: The Commonwealth and International Library: Biology. Elsevier Division. ISBN 1483139670, 9781483139678.

Caduto MJ, Bruchac J. 1997. Keepers of Animals. Fulcrum Publishing, p 32-34.

deHart PAP, Taylor JM, Doran JM, Howell O, Hurd LE. 2017. Trophic Niche Differences in Arachnid Predators Between Field and Forest Ecosystems. Entomological News **126(4).** https://doi.org/10.3157/021.126.0401

Foelix RF. 1996. Biology of Spiders (2nd Ed). Oxford University Press.

Fourie R, Haddad CR, Dippenaar-Schoeman AS, Grobler A. 2013. Ecology of the plant-dwelling spiders (Arachnida: Araneae) of the Erfenis Dam Nature Reserve, South Africa. Koedoe **55(1),** ISSN 2071-0771.

Fuzita FJ, Pinkse MWH, Patane JSL, Verhaert PDEM, Lopes AR. 2016. High throughput techniques to reveal the molecular physiology and evolution of digestion in spiders. BMC Genomics **17,** 716. https://doi.org/10.1186/s12864-016-3048-9

Garciano DMP, Nuñeza OM, Barrion-Dupo AL. 2014. Species richness of Spider in Mt. Matutum, South Cotabato, Philippines. Journal of Biodiversity and Environmental Science **4(6),** 214-224.

Herberstein ME, Fleisch AE. 2003. Effects Of Abiotic Factors On The Foraging Strategy Of The Orb-web Argiope keyserlingi Volume **28(6),** 622-628.

Knapp M, Řezáč R. 2015. Even the smallest non-crop habitat islands could be beneficial: Distribution of Carabid Beetles and Spiders in Agricultural Landscape. PLOS ONE **4,** e0123052. https://doi.org/10.1371/journal.pone.0123052

Leroy J. 2003. Spiders of South Africa (2nd Ed.) Struik, p 7-8.

PCARRD Feature: San Isidro's Bonsai Haven. 2005. Retrieved December 16, 2007.

Picchi MS, Bocci G, Petacchi R, Entling MH. 2016. Effects of local and landscape factors on spiders and olive fruit flies.Agriculture, Ecosystems and Environment Volume **222,** p 238-147. https://doi.org/10.1016/j.agee.2016.01.045

Smith RL. 1996. Ecology. Harpers Collins College Publishers.

Storer T. 1979. General Zoology (6th Ed). McGraw-Hill, Inc.

Tsutsui MH, Tanaka K, Baba YG, Miyashi T. 2016. Spatio-temporal dynamics of generalist predators (Tetragnatha spiders) in environmentally friendly paddy fields. Applied Entomology and Zoology **51(4),** p 631-640. https://doi.org/10.1007/s13355-016-0440-5

United Nations Educational, Scientific and cultural Organization (UNESCO). 2018. Mount Hamiguitan Range Wildlife Sanctuary. Date retrieved: December 20, 2018. https://whc.unesco.org/en/list/1403

Romero GQ, Vasconsellos-Neto. 2003. Natural History of Misumenops argenteus (Thomisidae): Seasonality and Diet on Trichogoniopsis adenantha (Asteraceae). The Journal of Arachnology **31(2).** https://doi.org/10.1636/02-19

Walter A, Bechsgaard J, Scavenius C, Dyrlund TS, Sanggaard KW, Enghild JJ, Bilde T. 2017. Characterisation of protein families in spider digestive fluids and their role in extra-oral digestion. BMC Genomics **18,** 600. https://doi.org/10.1186/s12864-017-3987-9