

Species diversity and guild composition of spiders in Tawi-tawi and Basilan Philippines

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Abstract

The study was conducted to determine species diversity and guild structure of spiders in Tawi-tawi and Basilan. Opportunistic sampling was conducted using a combination of pitfall trapping, aerial and ground collection, vial-tapping and beat netting methods. Forty-three spider species were documented belonging to 29 genera and 10 families in Tawi-tawi while 28 species under 24 genera and 11 families were recorded in Basilan. The most prevalent family in Tawi-tawi comprising 35% of the overall total spider collected was Araneidae while family Salticidae was the most widespread family in Basilan with 29% of the total collection. Based on foraging behaviour, spider assemblages were divided into five guilds namely ambushers, stalkers, orb weavers, foliage runners and space web builders. The orb weavers dominated both areas where they comprised 63% of all the guilds in Tawi-tawi and 53% in Basilan. High diversity index was observed in both areas while Basilan had an uneven species distribution because of the high dominance of orb weavers in the area.

Key words : Araneidae, foraging, orb weavers, Salticidae.

INTRODUCTION

Spiders are a dominant group with different morphological and ecological characteristics^[1] differentiated into terrestrial, some freshwater and few marine individuals^[2]. Overall described species worldwide falls under 109 families^[3] and more new species are continually being discovered. Spiders are wide spread predators and among the most diverse faunal group^[4, 5]. The island of Hainan, southernmost part of China, shelters a highly diverse population of spiders wherein keystone species were likely to have served as insect controllers by preying on agro ecosystem pests^[6]. Aside from being pest controllers, spider assemblage in Yukon Territory, Canada also reveals distribution pattern and species richness in varying spatial gradients corresponding to change in climate and in habitat^[7]. A study of spider diversity in Orchid Island, Taiwan revealed that spider abundance is highest in primary forest and lowest in grassland plots formed from forest clear-cutting^[8].

In the Philippines, 14 spider taxa were reported^[9] comprising four hunters and 10 web builders that prey on 198 insect species in rice field. Eight species belonging to six families in 10 cave sites were found in Siargao^[10] while 18 species under two orders, 12 families and 12 genera in 11 caves were documented in two provinces (Bukidnon and Davao Oriental) in Mindanao^[11]. Thirty seven spider species under 22 genera and 10 families were found in Pulacan falls of Zamboanga del Sur^[12] and 13 species under five families were recorded in Kabigan Falls, Ilocos Norte^[13]. Twenty three spider species belonging to nine families were in the protected landscape of Mt. Matutum, South Cotabato^[14].

Spider guilds are grouped according to the ecological characteristics of species like their distinct strategies in foraging, web type, hunting methods and circadian activity^[15]. In the Philippines, riceland spiders are grouped into two guilds, web builders and hunters, based on their feeding method and way of life^[9]. Determining ecological guild is useful in examining

assemblage response to change in climate, habitat disturbance, and management^[15-21].

Although several studies on spiders were already conducted in the Philippines, more areas still need to be explored for further information and occurrence of arachnids in the country. Most spider collections are restricted to rice fields^[9] and recent studies assessed spider composition in terrestrial environments. Two of the unexplored areas are Tawi-tawi and Basilan which are both located in Mindanao, Philippines. Mindanao, the second largest island in the Philippines, still has forest cover. Extra effort in species collection in the area is needed before the habitat would be greatly stripped^[9]. Surveys and inventories of fauna are of great importance in considering management plans to conserve potential diverse spots^[22]. This study is the first in Basilan and Tawi-tawi that would serve as baseline information on spiders in these two provinces. The difficulty in penetrating these areas due to peace and order problem is one of the reasons why very few biological research studies are conducted in these provinces. One of the major struggles in the area is on land ownership and peace agreement^[23]. Many clans had clashed and grievances were almost unending because of land issues and security is upset.

This study aims to determine the species diversity of spiders and identify the spider guilds in Tawi-tawi and Basilan.

MATERIALS AND METHODS

Sampling areas

The sampling sites were in Basilan and Tawi-tawi of the Autonomous Region in Muslim Mindanao (ARMM). Basilan forest cover is only 14.82% (20,001 ha) of its overall land area (134, 960 ha) while Tawi-tawi forest cover is only 23.44% (27, 417 ha) of its overall land area (116, 970 ha)^[24]. Illegal logging, land conversion (agriculture, kaingin), wildlife hunting, human encroachment, and collection of non-timber forest products are some of the nature's threat to these areas. Figures 1 and 2 show the sampling areas in this study.

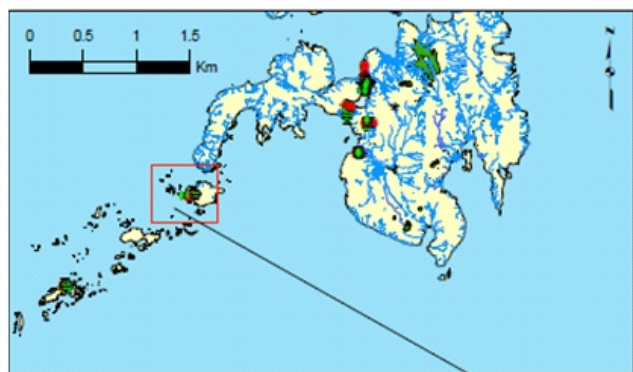


Figure 1: Geographic Information System (GIS) generated map of Basilan area.

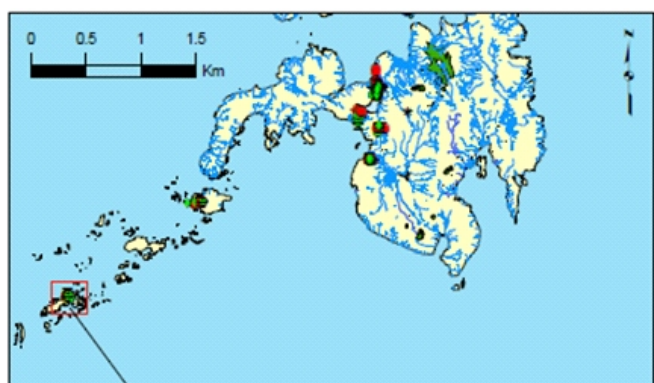


Figure 1: GIS-generated map of Tawi-tawi area.

Sampling Methods

A gratuitous permit (GP) was obtained from the Department of Environment and Natural Resources-ARMM for collection of samples. Sampling was done for 40-man hours on September 4, 5, 7-9 2014 at 800 hours to 1200 hours and 1400 hours to 1600 hours. Sampling hours cannot be extended due to some security precautions especially at night. The sampling site was limited to the lowland area not exceeding 1000 masl. Collection in every sampling area was extended 10 m on each side perpendicular to the 500-metre transect to obtain extensive sampling. Opportunistic sampling was employed where microenvironments of spiders like fallen logs and leaf litters were examined for ground-dwelling spiders. Arboreal spiders were captured from visible webs and leaves of trees. Beat-netting, aerial and ground hand collection, vial tapping, and pitfall trapping methods were done to collect samples. Captured samples were placed in plastic cups and vials to prevent escape of the motile spiders. Samples were then photographed. Voucher specimens were placed in vials with 75% ethanol. A habitat description form adapted from Heaney^[25] was used.

Identification

Collected samples in the field were identified up to family and genus level whenever possible during the sampling period. The third author further identified the voucher specimens up to the species level. Guilds were categorized^[26].

Data Analysis

Biodiversity indices were computed using Paleontological Statistics Software (PAST) version 2.17.

RESULT

Table 1 summarizes the spider families and species composition recorded in the sampling sites of Tawi-tawi and Basilan. Overall, 64 species belonging to 43 genera and 11 families where 41% females, 24% males and 35% juveniles were collected in the sampling sites. Figure 3 illustrates the comparison of number of spider species per family in both areas. The general spider collection in this study was divided into five spider guilds based on foraging strategy. These guilds are: ambushers, stalkers, foliage runners, orb weavers and space web weaver (figure 4). The calculated biodiversity indices are shown in Table 2.

Forty-three species belonging to 29 genera and 10 families were collected in the sampling areas of Tawi-tawi. Families found at all sites were orb weavers (Araneidae), long jawed spiders (Tetragnathidae), jumping spiders (Salticidae), and lynx spiders (Oxyopidae). The other 50% of recorded families comprised nursery web builders (Pisauridae), comb-footed spiders (Theridiidae), family Psecridae, hackled-orbweb spiders (Uloboridae) and cellar spiders (Pholcidae). Family Sparassidae, also known as the huntsman spiders, was documented only in one site of the sampling area. Although this family was found in only one site, it doesn't indicate that this family is rare. It maybe cryptic or less dispersed in the area and was not sufficiently sampled. Fifteen of the 43 species (35%) had only one individual. Family Araneidae emerged to have the most species count comprising 35% among the overall species total in Tawi-tawi. This was followed by families Salticidae and Tetragnathidae both having 16% of the overall species composition. The remaining families comprised 5% (Oxyopidae), 9% (Pisauridae), 2% (Sparassidae), 7% (Pholcidae), 2% (Psecridae), 2% (Uloboridae) and 5% (Theridiidae) of the whole species composition. The guild with the highest percentage (63%) is the orb weaver which includes the families Araneidae, Pholcidae, Psecridae, Tetragnathidae, and Uloboridae while space web builders had the least guild percentage (5%). This is the guild where family Theridiidae belongs.

Twenty eight spider species under 24 genera and 11 families were sampled in the sampling areas of Basilan. The most common families inhabiting the sampling areas were orb weavers (Araneidae), long jawed spiders (Tetragnathidae) and jumping spiders (Salticidae). Other families documented were sac spiders (Clubionidae), wolf spiders (Lycosidae), lynx spiders (Oxyopidae), sheet web weavers (Psecridae), huntsman spiders (Sparassidae), comb-footed spiders (Theridiidae), hackled-orb web spiders (Uloboridae) and orb weavers (Nephilidae). Twelve of the 28 species (43%) were represented by single individuals. Next family to represent the most species count was family Salticidae which makes up 21% of the accumulated spider species. Other families were Clubionidae (4%), Lycosidae (4%), Nephilidae (4%), Oxyopidae (7%), Psecridae (4%), Sparassidae (4%), Tetragnathidae (11%), Theridiidae (4%), and Uloboridae (4%). The orb weavers represented by families Araneidae, Nephilidae, Tetragnathidae and Uloboridae constitute 53% of guild composition.

DISCUSSION

The results here showed that there are more spider families found in Basilan than in Tawi-tawi but the latter has more species and genera documented compared to the former. Family Araneidae exhibited the most number of species consistent with earlier findings^[27]. Some species are limited in a particular area, but it does not mean that these species are rare or endemic because

Table 1: Composition of spider species in the sampling areas of Tawi-tawi and Basilan.

Species name	Tawi-tawi	Basilan
Araneidae		
<i>Araneus</i> sp.	-	3 imm
<i>Argiope catenulata</i>	2 f	-
<i>Argiope</i> sp.	-	1 f
<i>Argiope</i> sp. B	-	1 imm, 1 m
<i>Argiope versicolor</i>	2 f	-
<i>Chrysso</i> sp.	1 imm	-
<i>Cyclosa bifida</i>	3 f	-
<i>Cyclosa hexatuberculata</i>	-	1 f
<i>Cyclosa insulana</i>	4 m	-
<i>Cyrtophora</i> sp.	2 imm	-
<i>Eriovixia</i> sp.	-	1 imm
<i>Gasteracantha kuhli</i>	-	2 f
<i>Gea</i> sp.	2 imm	2 imm
<i>Geaspinipes</i> (C.L. Koch, 1843)	1 imm, 2 f	-
<i>Lariniatus formis</i> (Thorell)	4 f	-
<i>Lariniatus</i> sp.	1 imm	-
<i>Milonia</i> sp.	1 imm	-
<i>Neoscona molemensis</i>	-	1 f
<i>Neoscona punctigera</i>	1 f	-
<i>Neoscona</i> sp.	1 imm	-
<i>Neoscona vigilans</i>	-	1 m
<i>Nephilapilipes</i>	4 imm	-
<i>Polytysillepidus</i>	4 imm	-
<i>Polytys</i> sp.	-	1 imm
Clubionidae		
<i>Clubiona</i> sp. C1	-	2 f
Lycosidae		
<i>Pardosa</i> sp.	-	1 f
Oxyopidae		
<i>Hamataliwa incompita</i> (Thorell, 1985)	-	1 f
<i>Oxyopes javanus</i> (Thorell)	2 f	-
<i>Oxyopes lineatipes</i>	3 m	3 subA f
Pholcidae		
<i>Pholcus bicornutus</i>	1 f	-
<i>Pholcus</i> sp. A1	1 m	-
<i>Pholcus</i> sp. C	1 f	-
Pisauridae		
<i>Dolomedes</i> sp.	1 imm	-
<i>Dolomedes</i> sp. B	1 imm	-
<i>Dolomedes</i> sp. N*	1 f	-
<i>Hygropoda</i> sp.	1 imm	-

Psechridae			
<i>Psechrus</i> sp.	1 imm, 1 m	2 imm	
Salticidae			
<i>Baviasexpunctata</i>	-	3 m	
<i>Baviasp</i>	-	2 f	
<i>Chalcotropissp.</i> B	-	2 imm, 2 m	
<i>Cosmophasisthalassina</i> (C.L. Koch, 1846) NR*	-	3 m	
<i>Epeussp.</i>	2 imm	-	
<i>Hasariussp.</i>	3 f	-	
<i>Palpelius cf. Beccari</i>	2 f	-	
<i>Parabathippussp.</i>	2 m	-	
<i>Phintellasp.</i> N*	-	1 m	
<i>Plexippuspaykulli</i>	3 m	-	
<i>Plexippussp.</i>	2 imm	-	
<i>Telamoniasp.</i>	-	4 imm	
<i>Thianiasp.</i>	3 m	-	
Sparassidae			
<i>Heteropoda</i> sp. (Homstu Jaeger)	2 m	-	
<i>Pandercetes</i> sp.	-	1 imm	
Tetragnathidae			
<i>Argyrodusbonadea</i>	1 imm	-	
<i>Coleosomaoctomaculata</i>	-	1 m	
<i>Leucaugedecorata</i>	5 f	-	
<i>Leucaugesp.</i>	2 imm	3 imm	
<i>Nephilengysmalabarensis</i> (Walckenaer)	-	2 m	
<i>Opadometafastigata</i>	4 f	2 imm, 6 f	
<i>Spheropisthasp.</i> NR*	1 f	-	
<i>Tetragnathamandibulata</i>	3 f	-	
<i>Tetragnathamaxillosa</i>	2 imm	-	
<i>Tyloridasp.</i>	2 f	-	
<i>Tyloridastriata</i>	2 m	1 imm, 1 f	
Uloboridae			
<i>Uloborus</i> sp.	1 f	-	
<i>Uloborussp.</i> B	-	1 m	
			Overall total
Total number of individuals	91	59	150
Total number of females	40	18 (+3 sub Adult)	61
Total number of males	21	15	36
Total number of juveniles	30	23	53
Total number of species	43	28	64
Total number of genera	29	24	43
Total number of families	10	10	11

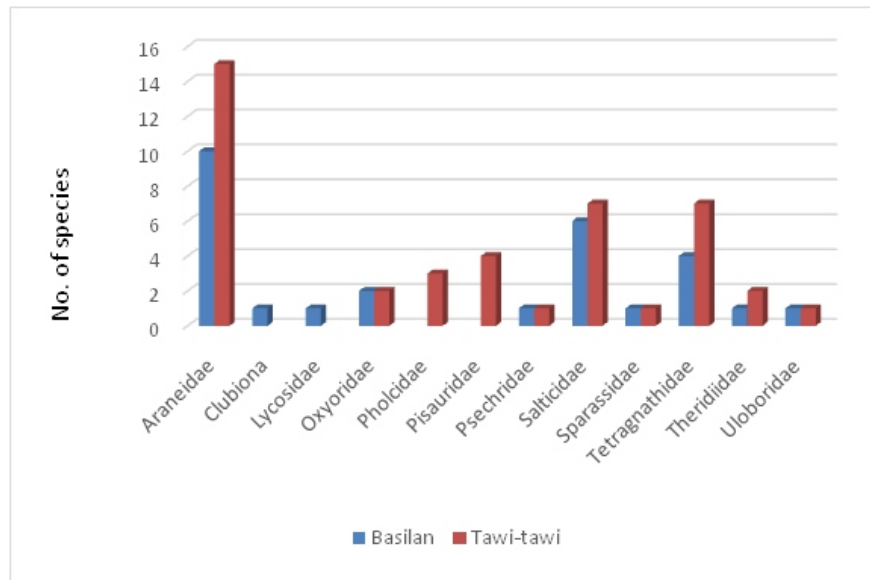


Figure 3: Total number of species collected in each family found in Tawi-tawi and Basilan.

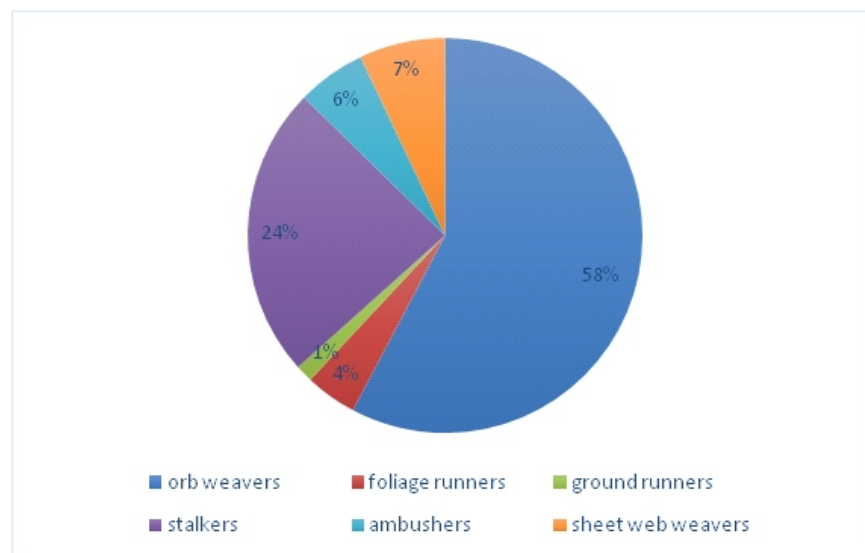


Figure 4: Spider guild composition and percentage in both areas.

Table 2: Tabulated biodiversity indices of the sampling areas.

		Tawi-tawi	Basilan
No. of species		43	28
Shannon (H)		3.636	3.14
Evenness		0.8821	0.0825

according to the study conducted^[22], every habitat type has distinct families and species diversity and spider species composition is affected by the season of sampling. In the current study, the results suggest that the collection of samples may not be very sufficient and some spider specimens have been disregarded or those species are sporadic in nature. Some are also habitat type specialists like the Lycosidae and Theridiidae families which dominantly occur in a particular type of habitat, for example in arable land area or in natural environment^[28]. Here, only one individual of one species was tallied under family Lycosidae which was noted only in Basilan. Also one individual in each of the two species found under family Theridiidae was recorded in Tawi-tawi and only single individual of single species belonging to the same family was observed in Basilan. This was also expected since these families belong to agrobiont families which can be found foremost in cultivated areas. The current study showed that family Salticidae is widespread in all sampling areas agreeing with the outcome of spider collections in Kenya^[29] and in South Africa^[30]. The former also found high prevalence of family Araneidae in the grazed land but they noted that the abundance of this family is affected by vegetation complexity to support weaving of webs and interference in their environment upsets their number. The latter researchers found a diverse species count of family Salticidae in all varying habitat types sampled in South Africa. Families Araneidae, Theridiidae, and Salticidae were abundant in a study conducted in Southern Brazil^[31], which is the same finding in this paper. They also recorded occurrence of families Tetragnathidae, Pholcidae and Uloboridae which were found correlated with the presence of trees and ferns in their study sites. The presence of these families in the current study is associated with shrubs, grass cover and understorey plants. This indicates that these families thrive in a more complex habitat structure. Most of the spider samples were collected by aerial and ground hand-collection. The other sampling methods were found to be lesser effective in capturing spider samples. But in the collection done in Hainan Island, China^[6], sweep net collection was the most effective in gathering spider specimens and the results somehow coincided with the current outcome having family Araneidae as one of the most dominant families along with families Tetragnathidae and Oxyopidae. The presence of many juvenile species also indicate a favorable season for adult species to reproduce and more available prey in the environment as reported^[32] that crop size is a strong factor for prey maturation and reproduction of agricultural spider species.

The categorization of spider guilds also denotes effect of habitat type on spider composition as it is also a tool to describe biodiversity^[33]. Web building spiders and jumping spiders are the most abundant and most common groups observed in both Basilan and Tawi-tawi areas. This result is expected in this study since most of the sampling sites have bushes and shrubs which provide convenient environment^[34] for spiders to build their webs, hunt for food and construct retreats^[22]. In a study regarding the diversity of ground-active spiders in Africa^[28], one of the prevalent families in their collection is family Salticidae which was mostly collected in areas with higher rainfall. This coincides with the high salticid count in this study because gathering of samples was done during rainy season. Web weavers and wanderers are influenced by structure of vegetation for web-building support and accessibility of preys^[35]. Most parts of the sampling areas in this study are composed of shrubs, grasses and understorey plants which are suitable for anchoring webs of web weavers and for hunting of plant wanderers thus, competition

happens and the other guilds cannot fully survive or multiply in the area^[36]. This also agrees with the report on web builders as the most dominant guild in Philippine rice fields^[9]. Spider assemblage is influenced by several environmental factors which include vegetation structure^[37]. Composition of plant life in the sampling area conveniently sustained web builders' lifestyle and foraging characteristics allowing them to be more dominant compared with other guilds. Furthermore, sampling season had to be considered also because spider species have their period of abundance in relation to different season. Oxyopidae and Araneidae were dominant during spring; Clubionidae and Araneidae in autumn; Thomisidae, Clubionidae and Salticidae in summer. Salticids are abundant even in daytime, showcasing their diurnal activity^[38].

Although the reported forest cover remaining in Tawi-tawi and Basilan hardly reach 25%^[24] of their overall land area, the calculated biodiversity indices indicated that these areas are biologically diverse with spiders. The period of the year when the collection occurred in this study also contributed to the species abundance in the sampling areas. Abundance of foraging predators is associated with high count of their prey especially during rainy season when seasonal preys are profuse^[33]. Since web builders are most dominant in the two sampling areas, other guilds were restricted to proliferate. Although both sampling areas displayed a high diversity index, Tawi-tawi showed a more or less even distribution of species while Basilan exhibited an uneven distribution. The dominance of orb weavers in the area particularly families Araneidae and Tetragnathidae may have contributed to the uneven distribution of species in Basilan. Although there are no particular prevalent species, these families were very dominant that they constitute 51% of the overall collected spider individuals. Similar results were gathered in a study conducted in Orchid Island, Taiwan^[8] where plotted primary forest has significant lower evenness compared to cultivated woodlands, plantation, and grasslands because of high relative abundance of orb weaving spiders. The variation among species and environmental factors determine the distribution of species^[39].

CONCLUSION

There were 43 species recorded in Tawi-tawi and 28 species in Basilan which are mostly composed of families Araneidae, Tetragnathidae and Salticidae. Family Araneidae had the highest species richness in Tawi-tawi while family Salticidae had the highest species richness in Basilan. There were five spider guilds in both sampling areas composed mostly of orb weavers. The two sampling areas have high diversity indices but only Tawi-tawi had a more or less even distribution. An uneven species distribution in Basilan is caused by the abundance of orb weavers in the area. Vegetation structure appears to affect the assemblage of spiders in both areas.

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