Microhabitat of leaf-dwelling Pholcid spiders (Araneae: Pholcidae) in Rajah Sikatuna Protected Landscape (RSPL), Bohol, Philippines

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Abstract. The study was conducted in four sampling sites within Rajah Sikatuna Protected Landscape (RSPL), Bohol, Philippines to determine the microhabitats of pholcid spiders. Using a combination of cruising and visual searching methods, pholcid spiders were searched at 7:00 hours-18:00 hours. Vegetation especially broad-leaf plants and other possible microhabitats were examined. Six plant species were identified as microhabitats of the leaf-dwelling pholcid spiders. The leaf dwelling pholcid spiders under the genera *Belisana, Calapnita, Pholcus* and *Panjange* were found to utilize palm (*Molineria capitulata*), *Schismatoglottis* sp. (Araceae*),* and *Colocasia esculenta* (Araceae). Results indicate that *C. esculenta* was found to be highly utilized by pholcid leaf-dwellers compared to other plants.
Key words: Araceae, cruising method, leaf dwelling, vegetation.

Introduction. Pholcidae occupies a wide range of microhabitats ranging from leaf-litter to tree canopies (Huber 2013). The type of microhabitat causes variation on body shape and coloration in pholcid spiders. For example, leaf-litter dwellers are small, short-legged, and dark (Huber 2005) while leaf dwellers found on the underside of leaves are pale greenish, have long and slender bodies and legs (Huber 2009). Pholcids show high ecological plasticity and occupy a wide range of microhabitats (Huber 2013) from deserts to humid tropical forest where pholcids are the most diverse in tropical regions (Dimitrov 2009). According to Pianka (2000) and De Omena & Romero (2010), microhabitat selection is important to increase survival rate and reproductive success of species inhabiting heterogeneous environments. The dependence on specific habitats ensures optimal temperature environment, prey availability, and protection from predators (Huber & Schutte 2009). However, microhabitat studies of leaf-dwelling pholcids are poorly considered since most of the studies are on taxonomic issues (Huber 2011; Yao & Li 2013). Moreover there are no existing studies in the Philippines with regard to microhabitats of leaf dwelling pholcids.

The study was conducted to determine the microhabitats of pholcid spiders in four sampling sites located at Rajah Sikatuna Protected Landscape (RSPL). It aims to provide baseline data on microhabitats of pholcid spiders in Rajah Sikatuna Protected Landscape (RSPL) in Bohol, Philippines.

Material and Method

Study area. The study was conducted within Rajah Sikatuna Protected Landscape (RSPL), Bohol, Philippines. Four sampling sites were selected, namely: Nanod, Sierra Bullones; Datag, Garcia Hernandez; Marawis, Valencia; and Magsaysay Park, Bilar (Figure 1) and described using the Habitat Description form of Heaney (2011) and chart for estimation of foliage cover (Luttermerding et al 1990).

The descriptions are as follows:

Site 1 - is at Barangay Nanod, Sierra Bullones (9°44′49.8" N, 124°15′55" E). This site has an elevation of 500-650 meters above sea level (masl), near agricultural land particularly a corn field which was 100 meters away from the site and a narrow stream about 5 meters away from the site. Fallen logs were moderately present while exposed rocks were rare. Leaf litter was the ground cover of the site. Man-made trail was present.

Site 2 - is at Barangay Datag, Garcia Hernandez (9°43′2.1" N, 124°15′50.5" E). This site has an elevation of 490-550 masl. Rice and tomato fields were present about 200 meters away from the site and a small water reservoir was present within the site. Fallen logs and exposed rocks were moderately present. Leaf litter was moderately present as the ground cover of the site. Man-made trails and few houses were present.

Site 3 - is at Barangay Marawis, Valencia (9°43′22.8" N, 124°12′7.3" E). This site has an elevation of 300-550 masl. Rice and corn fields were present about 100 meters away from the site. Few houses were present at 200 meters away from the site. Moderate leaf litter was the ground cover of the site. Man-made trails are present.

Site 4 - is at Barangay Riverside, Magsaysay Park, Bilar (9°42′16.5 N", 124°7′26.0" E), a known birding site. This site has an elevation of 300-460 masl. Logarita spring was 200 meters away from the site. Man-made trail, some fallen logs, and exposed rocks were present.

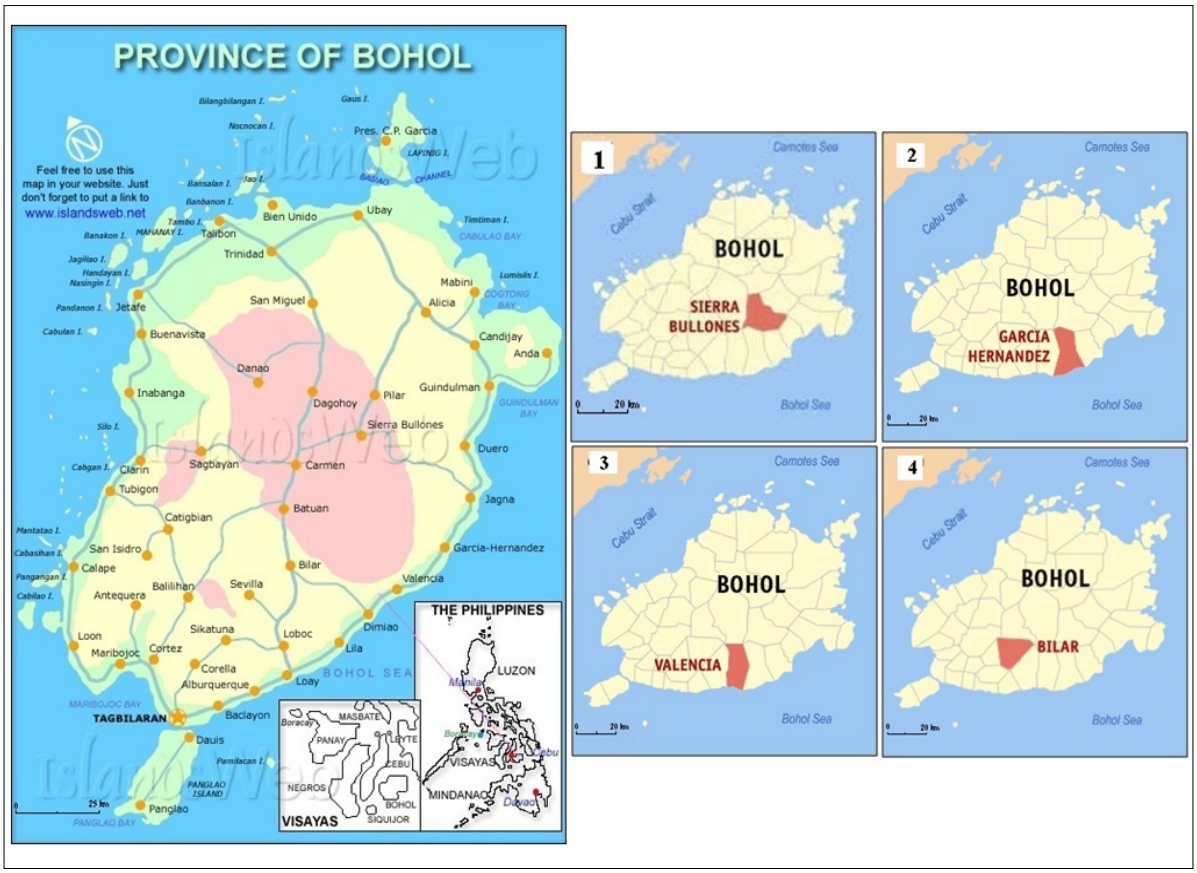

Figure 1. Map of the four sampling sites (1 - Brgy. Nanod, Sierra Bullones, 2 - Brgy. Datag, Garcia Hernandez, 3 - Brgy. Marawis, Valencia and 4 - Brgy. Riverside Magsaysay Park, Bilar) in Rajah Sikatuna Protected Landscape, Bohol, Philippines (http://www.islandsproperties.com/maps/bohol.htm).

Collection, processing, and identification of samples. Cruising method was used during sampling wherein a two kilometer area transect was established per sampling site for extensive visual searching or cryptic searching (Chetia & Kalita 2012; Huber 2009; Sorensen et al 2002) which is a manual technique to collect samples. Vegetation was examined specifically broad-leaf plants.

The collection of pholcids was conducted during the day at 7:00 hours-11:00 hours and from 14:00 hours-18:00 hours for a total of 32 man-hours with eight man-

hours per sampling site on June 4-5, 2015 in Barangay Nanod, Sierra Bullones; June 8-9, 2015 in Barangay Datag, Garcia Hernandez; June 10-11, 2015 in Barangay Marawis, Valencia; and June 14-15, 2015 in Magsaysay Park, Bilar. Sampling activities were carried out as soon as the local permits and the Department of Environment and Natural Resources (DENR) gratuitous permit were issued.

Specimens were photographed first to capture details (e.g. coloration and microhabitat) and were collected by a small disposable sauce cup that was placed underneath the pholcid spider and covered it with the lid. All the caught pholcid spiders were fixed in 75% ethyl alcohol (EtoH) individually in a two milliliter (mL) Eppendorf tubes. Identification of samples was done by Bernhard A. Huber of the Alexander Koenig Zoological Research Museum, Germany.

Statistical analysis. To assess the concentration of leaf dwelling pholcids per plant taxon, Concentration of Relative Dominance (CRD) was calculated using the formula: CRD= (*i*/t) x 100, where: *i*, is the number of pholcids found in a specific plant species, and *t* is the total number of pholcids found in all plants (Silveira-Neto et al 1976). The Bodenheimer's Constancy (1955) apud Silveira-Neto et al (1976) was used to analyze the occupation choice of leaf-dwelling pholcids which is represented by the formula: C= (px100)/N where: *p* is the number of specific plant species occupied by leaf-dwelling pholcids and *N* is the total number of plants with pholcids. Occurrence of leaf-dwelling pholcids per occupied plant species was considered: Constant > 50%; Accessory = 25-50% and Accidental < 25%. The distribution of microhabitats among sampling sites is shown using the multivariate seriation using Paleontological Statistics Software Package (PAST) Software version 2.17.

Results and Discussion. Abundance of species depends upon the microhabitats present in each sampling area for the reason that a habitat may be selected for cover availability, competition, and predation (Krausman 1999). The number of captured pholcid spiders was tabulated in each microhabitat per sampling site (Table 1). The common microhabitats of pholcid species are palm (*Molineria capitulata)*, *Colocasia esculenta,* and *Schismatoglottis* sp. The microhabitats that are not commonly utilized by pholcid spiders are: *Caryota* sp., *Homalomena philippinensis*, and *Xanthosoma* sp.

Table 1

Number of pholcid spiders captured on each microhabitat per sampling site

Plants	*Microhabitats*				*Total*
	Nan-od, Sierra Bullones (site 1)	*Datag, Garcia Hernandez (site 2)*	*Marawis, Valencia (site 3)*	*Magsaysay Park, Bilar (site 4)*	
Molineria capitulata	10	20	17	12	59
Colocasia esculenta	17	1	7	36	61
Caryota sp.	1	0	0	0	1
Schismatoglottis sp.	1	7	17	29	54
Homalomena philippinensis	0	0	2	0	2
Xanthosoma sp.	2	0	0	5	7
Total	31	28	43	82	184

In Table 2, Bodenheimer's Constancy (C) and CRD of leaf dwelling pholicds have shown that *C. esculenta* (32.93%) had the highest value. It means that *C. esculenta* (32.93%), palm (*Molineria capitulata)* (32.32%), and *Schismatoglottis sp*. (29.88%) are utilized by leaf-dwelling pholcids as an accessory form while *Xanthosoma* sp. (3.05%), *H. philippinensis* (1.22%), and *Caryota* sp. (0.61%) are used by leaf-dwelling pholcids as an accidental form. The accidental and accessory form of occupational choice in pholcid spiders might indicate a characteristic of particular plants which is suitable for refuge. Pederassi et al (2012) evaluated the relation of accessory and accidental shelter on physical characteristics of plants. Plants that are used as accessory form may provide

more protection against predators than those that are utilized as accidental form. Pholcid leaf-dwellers usually rest during the day (Huber & Schütte 2009) and pholcids need to choose plant leaves that can provide more protection both from predators and from dehydration. The result on CRD agrees with the result on Bodenheimer's Constancy (C) where *C. esculenta* (33.15%) had the highest value and *Caryota* sp. (0.54%) had the lowest value. According to Huber & Schutte (2009) and Deeleman-Reinhold & Deeleman (1983), leaf-dwelling pholcids utilize monocot, some dicots, and plants under Liliaceae, Araceae, Arecaceae, Cyclanthaceae, Marantaceae, and Heliconiaceae. All plants recorded in this study are monocots which belong to families Hypoxidaceae, Araceae, and Arecaceae.

Table 2

Bodenheimer's Constancy (C) and Concentration of Relative Dominance (CRD) of leaf-dwelling pholcids per plant species

Plant taxon	*Family*	*Monocot/Dicot*	*CRD (%)*	*C (%)*	*Occupation choice*
Molineria capitulata	Hypoxidaceae	Monocot	32.07	32.32	Accessory
Colocasia esculenta	Araceae	Monocot	33.15	32.93	Accessory
Caryota sp.	Arecaceae	Monocot	0.54	0.61	Accidental
Schismatoglottis sp.	Araceae	Monocot	29.35	29.88	Accessory
Homalomena philippinensis	Araceae	Monocot	1.09	1.22	Accidental
Xanthosoma sp.	Araceae	Monocot	3.80	3.05	Accidental

The distribution of microhabitats in the sampling sites is illustrated in Table 3. *M. capitulata*, *C. esculenta,* and *Schismatoglottis* sp. were the shared microhabitats among all four sampling sites. *Xanthosoma* sp. was the microhabitat present in two sites only, Nanod and Magsaysay Park, The presence of shared microhabitats in sampling sites may indicate the presence of particular pholcid species in the area.

Table 3

Multivariate seriation analysis showing the distribution of microhabitats in the four sampling sites

Plant species	*Nanod, Sierra Bullones (site 1)*	*Magsaysay Park, Bilar (site 4)*	*Datag, Garcia Hernandez (site 2)*	*Marawis, Valencia (site 3)*
Caryota sp.	+	-	-	-
Xanthosoma sp.	+	+	-	-
Schismatoglottis sp.	+	+	+	+
Palm (*Molineria capitulata*)	+	+	+	+
Colocasia esculenta	+	+	+	+
Homalomena philippinensis	-	-	-	+

*+ and -, indicate the presence or absence of the microhabitat (plant species) in the area, respectively.

Conclusions. *Caryota* sp., *Xanthosoma* sp., *Schismatoglottis* sp., palm (*Molineria capitulata)*, *Colocasia esculenta,* and *Homalomena philippinensis,* are the microhabitats that are inhabited by pholcid spiders. Monocot plants such as *Schismatoglottis* sp., palm (*Molineria capitulata),* and *Colocasia esculenta* are the commonly utilized plants. Abundance of pholcid species is associated with the type of microhabitat present in the sampling sites.

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