

Spider composition at Hulu Langat Recreational Forest Parks, Selangor, Malaysia

Fateen Noorasyiqin Sarkowi¹, Lau Wei Hong²

¹(Plant Protection Department, Universiti Putra Malaysia, Malaysia)

²(Plant Protection Department, Universiti Putra Malaysia, Malaysia)

Abstract: A study was done to investigate the spider composition at Sungai Gabai and Sungai Tekala Recreational Forest Parks located at Hulu Langat, Selangor, Malaysia. The sampling was done along the riparian area of the river stream. A total of 26 individuals of spiders were collected from both recreational forest park and comprised of 8 families: Tetragnathidae, Oxyopidae, Araneidae, Salticidae, Sparassidae, Nephilidae, Theridiidae and Lycosidae. There were 142 individuals and 14 species collected from the Sungai Gabai Recreational Forest Park, and 119 individuals and 14 species collected from Sungai Tekala Recreational Forest Park. Tetragnathidae spiders have dominated both Sungai Gabai and Sungai Tekala Recreational Forest Park with 81% and 61% of total relative abundance, respectively. Shannon's index indicates that Sungai Tekala Recreational Forest Park (1.164) has higher diversity index compared to Sungai Gabai Recreational Forest Park (0.767). Simpson's index has revealed that Sungai Gabai Recreational Forest Park has more diverse spider family than Sungai Tekala Recreational Forest Park which was dominated by only one spider family, namely Tetragnathidae.

Keywords: Diversity, Hulu Langat, recreational forest park, spiders

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I. Introduction

Sungai Gabai and Sungai Tekala at Hulu Langat are recreational forest park listed under the Forest Eco Park of Selangor. Sungai Gabai located 21 km and 23 km away from Cheras City, respectively. While Sungai Tekala located 13 km away from Semenyih City. Sungai Tekala and Sungai Gabai located at Hulu Langat Reserved Forest. These Forest Eco Parks are under the surveillance of Forestry Department Peninsular Malaysia and it is open to society for picnic and to carry out any recreational activities. Other than recreation and ecotourism, these parks are also providing a place for research and education purpose. Although the areas are very well known, very little information on the flora and fauna presence especially on spiders. No inventory was done at these Forest Eco Park on the compositions of spiders. Thus, sampling of spiders was done at Sungai Gabai and Sungai Tekala riparian areas to compare the spider communities found in riparian area of these two locations and providing information on the biodiversity of the Forest Eco Park. Morphological identification was done to identify the spider species, so that the spiders can be preserved and protected for future.

II. Material and Methods

Sampling Location and Time

The sampling of spiders was conducted at Sungai Gabai Recreational Forest Park (N03° 09.97' E101° 54.52') and Sungai Tekala Recreational Forest Park (N03°03.62' E101° 52.13') in Hulu Langat, Selangor, Malaysia. These recreational forest parks are under the management of Department of Forestry, Daerah Selangor Tengah. The forest tracks were built along the river stream. The inventory was done along the riparian area of the river stream. Three samplings were done from November 2014 until January 2015 (Table 1). Due to safety reasons, the samplings were only carried out during daytime. Due to the raining season during the sampling period the sampling was only successfully carried out from 0800 to 1200. The track was 50 m long and 5 m width.

Table 1: List of sampling sites and sampling period

Number	Sampling site	1 st sampling	2 nd sampling	3 rd sampling
1.	Sungai Gabai Recreational Forest Park	28/11/2014	27/12/2014	28/1/2015
2.	Sungai Tekala Recreational Forest Park	29/11/2014	28/12/2014	29/1/2015

Sampling Method

Spiders were caught by hand picking method using small plastic containers (11.5 cm diameter x 6.5 cm height) for spiders with body length of 1 mm to 10 mm, and bigger container (23 cm diameter x 7 cm height) for spiders with body length of 10 mm and above. Only one spider was placed in each container to prevent predation. A wet cotton ball was placed inside each container to provide humidity to the spider. Holes were made on the cover of the plastic containers for air ventilation.

Spiders and Flies Maintenance

All the spiders collected were reared in the insectary at Ladang Dua, Universiti Putra Malaysia. The spiders were maintained inside plastic containers at $27\pm 1^{\circ}\text{C}$. A wet cotton ball was placed inside the container to retain the humidity and also to provide water for the spider. The spiders were fed with adult flies once a week. The flies were reared in plastic containers (23 cm diameter x 7 cm height) at the Insect Pathology Laboratory. The maggots were fed with chicken liver while the adult flies were given 10% (v/v) of honey solution.

Spider Morphological Identification

Spiders were viewed under a digital microscope (Dino-Lite, Taiwan) with high resolution for the preliminary morphological identification. The identification was done based on taxonomy keys of Ubick and Cushing (2005), Murphy and Murphy (2000) and World Spider Catalog (2017). The taxonomy characteristics include the eyes, abdomen, cephalothorax, carapace, sternum and pedipalp of the spider.

Data Analysis

The diversity index and evenness of the spider families were analysed by using Simpson's index and Shannon's index, respectively (Begon, Harper, & Townsend, 1986; Magurran, 1988). The indices were analysed by ANOVA and LSD's test using SAS software with significant difference at the 0.05 level.

III. Result

A total of 261 spiders from 8 different families of spiders (Tetragnathidae, Oxyopidae, Araneidae, Salticidae, Sparassidae, Nephilidae, Theridiidae and Lycosidae) were recorded in this study. Among them, 54% of spiders were collected from Sungai Gabai Recreational Forest Park while 45% of spiders were collected from Sungai Tekala Recreational Forest Park (Figure 1). Sungai Gabai Recreational Forest Park is more abundant with spiders compared to Sungai Tekala Recreational Forest Park. Most of the spiders were collected along the riparian area of the stream in which their webs were found on tree branches and bushes. Some spiders were wandering on the ground.

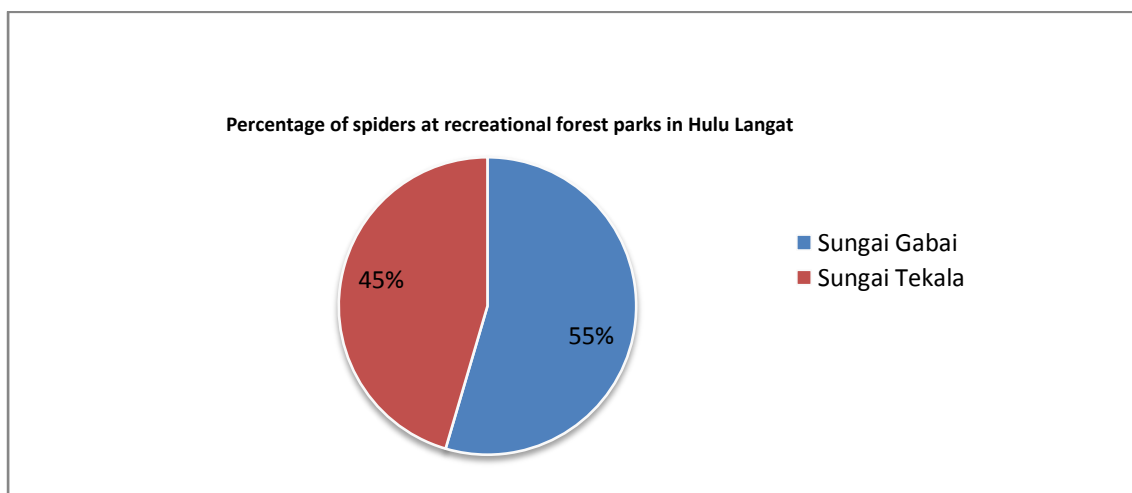


Figure 1: Percentage of spiders collected from Sungai Gabai and Sungai Tekala Recreational Forest Parks.

Among the 142 individual spiders recorded in Sungai Gabai Recreational Forest Park, 7 families and 11 species of spiders have been confirmed (Table 2). Sungai Tekala Recreational Forest Park has recorded 119 individual spiders with 6 families and 14 species identified (Table 2). Sungai Gabai Recreational Forest Park was dominated by Tetragnathidae spiders which constituted up to 81% of total relative abundance, followed by Araneidae (8.5%), Oxyopidae (4.9%), Salticidae (1.4%), Nephilidae (1.4%), Lycosidae (1.4%) and Sparassidae spiders (1.4%) (Figure 2). Sungai Tekala Recreational Forest Park was also dominated by Tetragnathidae spiders with 61.3% of total relative abundance, followed by Araneidae (16.8%), Nephilidae (12.6%), Salticidae

(5%), Lycosidae (3.4%) and Theridiidae (0.8%). Theridiidae spider was not found in Sungai Gabai Recreational Forest Park while Oxyopidae and Sparassidae spiders were not found in Sungai Tekala Recreational Forest Park during the sampling periods.

Table 2: Record of spiders collected from Sungai Gabai and Sungai Tekala Recreational Forest Parks

Family	Species	Sungai Gabai	Sungai Tekala
Tetragnathidae	<i>Leucauge</i> sp. 1	93	28
	<i>Leucauge argentina</i>	20	44
	<i>Leucauge tessellata</i>	2	0
	<i>Leucauge</i> sp. 2	0	1
Araneidae	<i>Argiope versicolor</i>	5	3
	<i>Argiope aemula</i>	4	4
	<i>Gea spinipes</i>	3	2
	<i>Macracantha arcuata</i>	0	6
	<i>Gasteracantha diardii</i>	0	3
	<i>Cyclosa</i> sp.	0	2
Oxyopidae	<i>Oxyopes birmanicus</i>	7	0
Nephilidae	<i>Nephila pilipes</i>	2	9
	<i>Nephila</i> sp.	0	6
Salticidae	<i>Pancorion</i> sp.	2	6
Sparassidae	<i>Sparassidae</i> sp.	2	0
Lycosidae	<i>Pardosa caliraya</i>	2	4
Theridiidae	Theridiidae sp. 2	0	1
Total		142	119

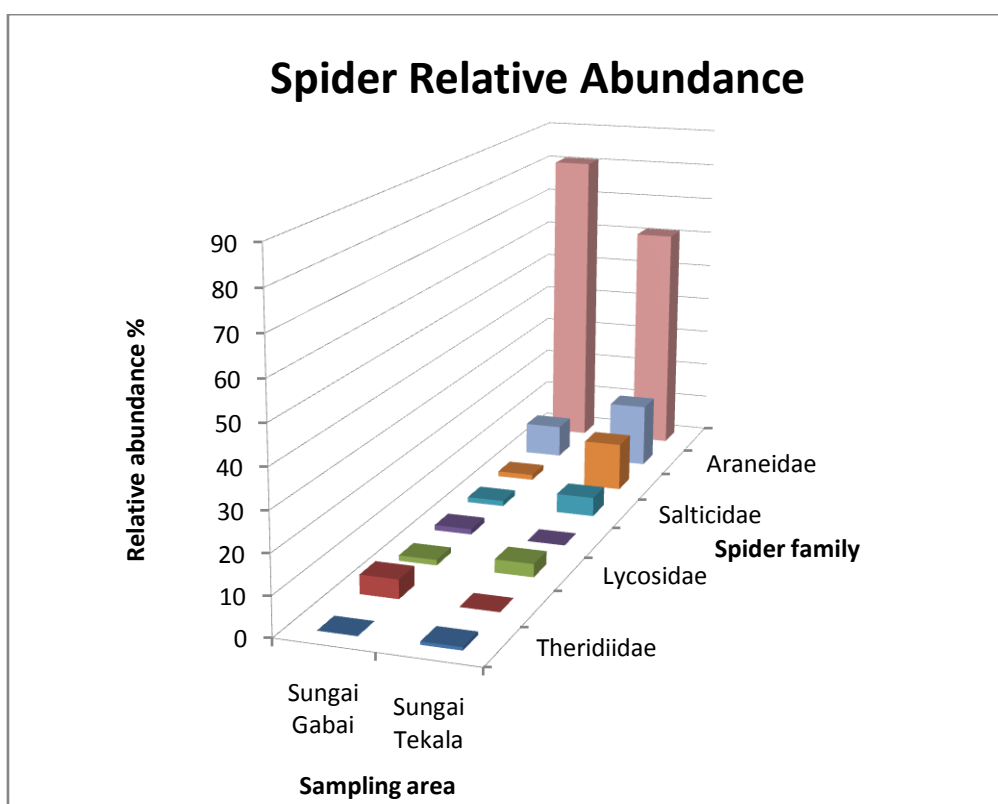


Figure 2: Spider relative abundance (%) collected from Sungai Gabai and Sungai Tekala Recreational Forest Park after three trips of sampling from November 2014 until January 2015.

Shannon's and Simpson's diversity index were used to measure the spider family diversity at both recreational forest parks. The Shannon's index indicates a higher diversity index (1.164) in Sungai Tekala Recreational Forest Park compared to Sungai Gabai Recreational Forest Park (0.767). Simpson's index also indicates that Sungai Gabai Recreational Forest Park has a higher dominance index (0.667) compared to Sungai

Tekala Recreational Forest Park (0.424). However, Sungai Tekala Recreational Forest Park has recorded a higher evenness index (0.598) compared to Sungai Gabai Recreational Forest Park (0.394).

IV. Discussion

Sungai Gabai Recreational Forest Park has a higher total relative abundance of spiders compared to Sungai Tekala Recreational Forest Park. The architectural structures of the habitat areas at both of the recreational forest parks were different. Most of the spiders from Sungai Gabai Recreational Forest Park were found on the bushes and forest trees along the riparian areas while spiders at Sungai Tekala Recreational Forest Park were found on the bushes, dead trees and mostly on the ornamental plants. Sungai Gabai Recreational Forest Park has less development compared to Sungai Tekala Recreational Forest Park, with most of the flora were remained untouched. Sungai Tekala Recreational Forest Park has a lot of ornamental plants planted along the periphery of the stream inside the forest. Part of the stream was modified from its natural structure as to facilitate the design of recreational forest park. Fewer spiders were found in Sungai Tekala Recreational Forest Park could be due to the alteration of the natural habitat of spiders. According to Chen and Tso (2004), low amount of spider individuals can be affected by various kinds of disturbances, either by human or the nature itself. An alteration and fragmentation of a natural habitat can cause reduction or extinction of a population in a habitat (Fahrig, 1997; Fahrig, 2002).

The sampling data showed that both the recreational forest parks have different spider composition and abundance. Some families were widely distributed throughout the sampling area while others were restricted to certain areas. Tetragnathidae, Araneidae, Nephilidae and Salticidae spiders were found in both recreational forest parks. Sparassidae spiders were only found in Sungai Gabai Recreational Forest Park. There was no sighting of this spider at Sungai Tekala Recreational Forest Park may be due to its sensitivity to disturbance. This spider is a fast runner anytime it can sense presence of threat (Chevis, 2012). No sign of Oxyopidae spider at Sungai Tekala Recreational Forest Park and no Theridiidae spider was found at Sungai Gabai Recreational Forest Park. Oxyopidae spider is a hunting spider and it won't stay at a single place for prey hunting (Avilés, 1994). Theridiidae spider is a web-spider and its web is built somewhere dark or with shelter (Levi, 2005). Empty spider webs were found during the sampling. The Theridiidae spiders might already leave their webs due to no presence of prey or the web itself was attacked by other spider.

The highest total individual abundance of spiders collected from both Sungai Gabai Recreational Forest Park and Sungai Tekala Recreational Forest Park was Tetragnathidae spiders. At Sungai Gabai Recreational Forest Park, the spiders and their webs were found on the bushes along the riparian area of the recreational forest parks. While at Sungai Tekala Recreational Forest Park, they were found on bushy ornamental plants along the riparian area. In Duffin Creek, Canada, 91% of spiders occupying a bank area were spiders from the Tetragnathidae family. The open water area provides an optimum relative humidity and temperature suitable for the Tetragnathidae spiders or else they will suffer from dehydration (Gillespie, 1987). Dead flies were found on all the spider webs during the sampling period. The Tetragnathidae spider webs were built near to a dustbin full with flies. This may be an attraction for the spiders to choose that area as their living area.

Araneidae spiders were also abundance at both of the recreational forest parks. Most of the Araneidae spiders were found on the herbaceous plants like ferns, grass and short woody ornamental plants in Sungai Gabai Recreational Forest Park and Sungai Tekala Recreational Forest Park. Herbaceous vegetation provides a suitable height range for the Araneidae spiders to build the web in their natural habitats (Grill, Knoflach, Cleary, & Kati, 2005). Their ballooning habit helps these spiders to disperse by air easily (Dean & Sterling, 1985; Bishop, 1990).

The Nephilidae spider webs can be easily spotted during the sampling sites. Their web was enormous and very strong compared to other spider web (Chooi, Tan, & Lau, 2014). Other than flying insect, some Nephilidae spider webs could also trap small birds and bats and feed upon them. During sampling, the Nephilidae spiders were found on their web which was built between the trees and fence, therefore they can trap their prey easily. Nephilidae spiders were easily spotted at Sungai Tekala Recreational Forest Park than Sungai Gabai Recreational Forest Park. There are a lot of opened areas between the trees in Sungai Tekala Recreational Forest Park while Sungai Gabai Recreational Forest Park has a dense forest. The females were found staying at the middle of the web while the males were surrounding it. Nephilidae spiders were sensitive to the change of the climate. They prefer a low temperature and high humidity environment. Their numbers were low during dry season yet getting higher during rainy season (Pinkus- Rendón, León- Cortés, & Ibarra- Núñez, 2006).

Salticidae spiders were found jumping from leaf to leaf at both recreational forest park and some were spotted under the leaf. No web was found at the area where Salticidae spiders were found. They have eyes designed for predatory purpose. It means that they will not stick at one place for a long time (Hadley, 2017). Most of Salticidae spiders prefer a complex environment as a habitat such as leaf litters, damp leaves or branches (Jackson & Pollard, 1996). Some species of salticids have their own host-plant preference, vegetations types and open areas of interior of forest (Rossa-Feres, Romero, Gonçalves-de-Freitas, & Feres, 2000). They are

well known as jumping spiders or hunting spider. They do not wait and trap their prey, yet they actively chased after them. Their webs were not sticky like others. When insect hit their web, they will jump and catch it. Sometimes, they wonder on other spider's web to eat the trapped prey available on the web (Jackson & Pollard, 1996).

Oxyopidae spiders were sighted at Sungai Gabai Recreational Forest Park but not at Sungai Tekala Recreational Forest Park. They were found on the leaves of a plant with flowers. These plants may provide shelter and the flowers may provide nectar as the food source to the spiders. Arango, Rico-Gray and Parra-Tabla (2000) reported that some of the oxyopids have a fondness on plant with flowers. Oxyopidae spiders are also called lynx spiders. They have similar habit like the Salticidae spiders. These spiders did not normally build a web (Avilés, 1994). They moved very fast and ambushed their prey without using web.

Lycosidae spiders were not easy to be spotted at both Sungai Gabai Recreational Forest Park and Sungai Tekala Recreational Forest Park. This spider prefers an open habitat with very low vegetation. They can be found scattered on grassland (Jocqué & Alderweireldt, 2005). However, both of the recreational parks are a quite dense forest, thus lycosids can be very rare in this kind of ecology.

Sparassidae spider was found only at Sungai Gabai Recreational Forest Park. It was found resting on a tree bark. It can be found camouflage on dead trees, under a rock or on the ground covered with leaf litters at Sungai Dusun Wildlife Reserve in Selangor, Fraser Hill Wildlife Reserve in Selangor and Tasek Bera Ramsar Site in Pahang (Chooi et al., 2014; Chooi, Cheong, Tan, & Lau, 2014). Chevis (2012) reported that Sparassidae spiders are common at the riparian area of stream areas. These spiders do not trap their prey by web but by hunting and foraging. They are very sensitive to disturbance and become extremely fast runner when they sense any movement. This could be the reason why the sparassids were not easily spotted in both Sungai Gabai Recreational Forest Park and Sungai Tekala Recreational Forest Park.

Theridiidae spiders were only found at Sungai Tekala Recreational Forest Park during the sampling periods. This spider built a three-dimensional web. Theridiidae spiders are called with different names like tangle-web spiders, cobweb spiders or comb-footed spiders depending on the form of web built by different species (World Spider Catalog, 2017). They usually built their web under rock, tree branch or leaves. Levi (2005) reported that their habitats are diverse either on ground, plant or anywhere available for them to spin their web. They prefer somewhere dark, at a corner or anywhere they can take shelter.

Both the recreational forest parks were dominated by one or two spider family. The Simpson's index indicates that Sungai Gabai Recreational Forest Park has a high-dominance, low-diversity ecosystem compared to Sungai Tekala Recreational Forest Park. While the Shannon's index indicates that Sungai Gabai Recreational Forest Park has a higher amount of rare spider families compared to the Sungai Tekala Recreational Forest Park.

Both recreational forest parks are considered to have a low evenness of spider family. Evenness and richness are the parameters that define the diversity index. Low evenness indicated that the community has an uneven distribution of family (Magurran, 1988). As family become evenly distributed in total abundance, the greater the diversity (Price, 1970). Sungai Tekala Recreational Forest Park has three spider families (Tetragnathidae, Araneidae and Nephilidae) that have high total relative abundance which make the evenness index higher compared to Sungai Gabai Recreational Forest Park which only dominated with Tetragnathidae spiders. Some spider families were not found at certain sites or some with a very low abundance does not mean that the species is rare. It might be due to the species is cryptic or the patchiness distribution of the spider (Whitmore, Slotow, Crouch, & Dippenaar-Schoeman, 2002).

V. Conclusion

The species distribution and abundance of spiders are different between the sampling sites in Sungai Gabai Recreational Forest Park and Sungai Tekala Recreational Forest Park. Based on the diversity indices, spider distribution at all sampling sites were unevenly distributed with the presence of dominance of certain spider families. Tetragnathidae is the most abundance family as it is widely distributed and dominating both recreational forest parks.

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