

CHECKLIST OF SPIDERS IN KUALA SELANGOR NATURE PARK, KUALA SELANGOR, MALAYSIA

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ABSTRACT

A preliminary assessment of spider diversity was carried out in Kuala Selangor Nature Park (KSNP), a wetland conservation and education center in Kuala Selangor, Malaysia, from 21st to 24th September 2019 by employing manual search method. Spiders were searched by exploring leaf litter, logs, rocks, tree trunks, leaves and branches. Images of live spiders were taken with Canon EOS 600D digital SLR camera with EF 100mm f/2.8L IS USM Macro Lens. A total of 37 species of spiders belonging to 30 genera and 11 families were reported during the study. The most diverse family was Salticidae (11 species) followed by Araneidae and Thomisidae (five species each). A wetland specialist, *Tetragnatha josephi* Okuma (1988) was sighted during the study. Two species are reported for the first time from Malaysia namely, *Eriovixia sakiedaorum* Tanikawa (1999) and *Steatoda cingulata* Thorell (1890). Spiders collected during the study were classified into six functional guilds namely, orb weavers, stalkers, ground runners, space web builders, ambushers and foliage runners. Stalkers were the most dominant guild (40.54% of the total sample) followed by orb weavers (16.22%). The results indicate that KSNP could harbour a rich and varied spider diversity as it provides a heterogenous spectrum of habitats. In order to unravel the true araneid diversity in this ecosystem, a detailed and comprehensive study involving routine seasonal samplings, taking into account the seasonality of different species, their diurnal and/or nocturnal activity, special and temporal distribution, microhabitat preferences etc. is warranted.

Keywords: checklist, Kuala Selangor Nature Park, mangrove, spiders, wetland.

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INTRODUCTION

Spiders (order Araneae) are one of the most ubiquitous animals on earth. They are the largest order of arachnids, rank seventh in total species diversity among all orders of organisms (Sebastian & Peter, 2009). Spiders are found worldwide, except for Antarctica, and have become established in nearly every habitat with the exceptions of air and sea. They are most numerous in tropical rainforests around the globe, which provide some diverse array of habitats and microhabitats. As of December 2019, at least 48,386 spider species belonging to 4152 genera and 120 families have been recorded by taxonomists (World Spider Catalogue, 2019). However, there has been disagreement within the scientific community on how all these families should be classified, as more than 20 different classifications have been proposed since 1900 (Foelix, 1996).

Spiders are an essential part of global biodiversity since they play several important roles in ecosystems, as predators and sources of food for other creatures (Sebastian & Peter, 2009). Spiders also have utilitarian value, as they can be used as model organisms to study and assess biodiversity because spiders are considered excellent indicators of the overall health of terrestrial ecosystems. For many years, spiders have been used as model organisms for research in ecology, behaviour and communication (Sebastian & Peter, 2009). Spiders are food source for a variety of birds, lizards, wasps and other mammals. They are natural biological control agents as they feed on roaches, ear wigs, mosquitoes, flies and other insects. At home, they consume most insects proving effective pest control (Follett & Duan, 2000).

Mangrove ecosystem is a marginal ecosystem inhabiting the estuarine and intertidal regions in both tropical and subtropical latitudes confined largely to regions between 30° North and South of the equator (Vannucci, 2000; Das *et al.*, 2014). It is distributed in almost 123 countries and territories all over the world, comprising diversified mangrove flora and fauna (Kerry *et al.*, 2017). Higher percentages of the world's mangrove ecosystem are distributed in Asian and African countries, followed by South and Central America (Kathiresan, 2010; Saranraj & Sujitha, 2015; Kerry *et al.*, 2017). Mangrove ecosystem is rich in genetic diversity due to the occurrence of both aquatic and terrestrial species and their adaptability to a wide range of rough environmental conditions such as high salinity, high temperature, muddy anaerobic soils, extreme tides and strong winds, which fluctuates violently and frequently (Vannucci, 2000). However, like other wetlands, mangroves are also under particular threat through

destructions of the ecosystems and loss of species, probably due to the biogeographical isolation of wetlands in the larger continents and their tendency to behave as biological islands (Denny, 1994).

The Kuala Selangor Nature Park (KSNP) is one of the well conserved tracts of coastal mangrove swamp forest on the West Coast of Peninsular Malaysia. It is a famous ecotourism destination and is home to a vast array of different species, including several endangered, threatened and near-threatened species. These include the silver- leaf monkey, the smooth otter, pangolin, and the mangrove tiger butterfly. Its wetlands are an important wintering ground for migratory shorebirds from the Northern Hemisphere, on their way to Australia (Malaysian Nature Society, 2016).

Although there exists an inventory of the vertebrate and invertebrate fauna of KSNP (Hambali *et al.*, 2012), a proper documentation of araneofauna of this wetland ecosystem is lacking. Despite their documented ecological role in many ecosystems, high diversity, and threats, spiders received little attention from the conservation community (Sebastian *et al.*, 2005), and KSNP is not an exception. Against this backdrop, an investigation on the spider diversity of KSNP was envisaged, which was primarily intended to assess the diverse spectrum of spiders and the niche they occupy within this ecosystem.

MATERIALS AND METHODS

This study was conducted in Kuala Selangor Nature Park (KSNP) located by the mouth of Selangor River (3°20'16" N; 101°14'56" E) on the west coast of Peninsular Malaysia (Figure 1). The park was established by the Selangor state government in 1987 and has been managed by the Malaysian Nature Society (MNS) ever since. In 1997, KSNP was recognised as a nature reserve for conservation and ecotourism, and recognised as Important Bird Area (IBA) by Birdlife International. The size of the park is 324 ha and consists of variety of habitats such as secondary forest forming from degenerating mangrove forest, the estuary of the Selangor River, mangrove forest, mudflats which opens to the Straits of Malacca and a man-made 25-acre brackish water lake system (Hambali *et al.*, 2012).

This diverse habitat makes the park a wonderful place for animals to feed, roost and breed. The fauna recorded here include; leopard cats (*Prionailurus bengalensis*), smooth otters (*Lutrogale perspicillata*), long-tailed macaques (*Macaca fascicularis*), silver leaf-monkeys (*Trachypithecus cristatus*), 98 species of local birds, 57 species of migratory birds, lizards such as mangrove skink (*Emoia atrocostata*) and monitor lizard (*Varanus salvator*), butterflies and other insects, river dolphins (*Platanista gangetica*), four species of mudskippers

(*Periophthalmodon schlosseri*, *Periophthalmus chrysospilos*, *Boleophthalmus boddarti*, and *Periophthalmus vulgaris*), mud lobsters (*Thalassina anomala*) and 15 species of crabs including the king crab (*Lopholithodes mandtii*) (Hambali *et al.*, 2012). KSNP was aimed to be recognized as a Wetlands of International Importance (Ramsar Site) and is working towards gaining status for the North-Central Selangor Coast as a Flyway Network Site (Malaysian Nature Society, 2016).

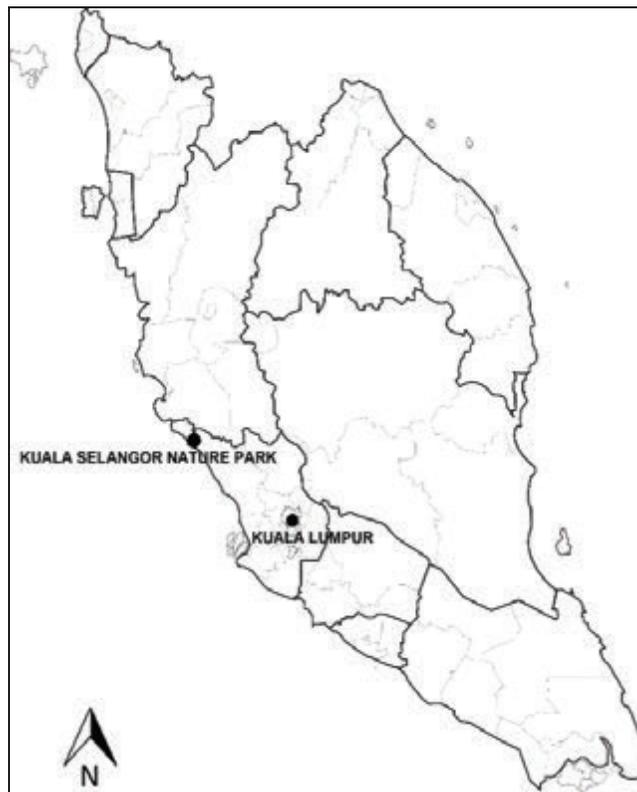


Figure 1 Map of Peninsular Malaysia indicating the study site.

The study was conducted from 21st to 24th September 2019. The weather was very dry with smoky haze created by the forest fires in Indonesia. The manual search method was conducted by two researchers during daytime (0700-1100 h and 1700-1900 h) daily. Spiders were searched by exploring leaf litter, logs, rocks, tree trunks, leaves, and branches. Images of live spiders were taken with a Canon setup (EOS 600D Kit II digital SLR camera with EF 100mm f/2.8L IS USM Macro Lens). The sweeping method was employed to sample spiders found among grasses. Identification of spiders was done with the help of

diagnostic keys and other relevant literature (Tikader, 1987; Barrion & Litsinger, 1995; Dippenaar-Shoeman *et al.*, 1997; Deeleman-Reinhold; 2000). The spider guild classification was also done based on the families collected during the study. The designation of the spider guild was based on the ecological characteristic known to the family (Young & Edwards, 1990; Uetz, 1991; Uetz *et al.*, 1999). Ecological characteristics relating to foraging manner, nature of the web, prey species, microhabitat use, site tenacity, and daily activity were subjected to guild classification.

RESULTS AND DISCUSSION

A total of 37 species of spiders belonging to 30 genera and 11 families have been documented during the four-day study (Table 1). One wetland specialist, *Tetragnatha josephi* (Okuma, 1988) was sighted during the study. Two species are reported for the first time in Malaysia namely, *Eriovixia sakiedaorum* (Tanikawa, 1999) and *Steatoda cingulata* (Thorell, 1890).

The taxonomically diverse family was Salticidae (11 species), followed by Araneidae and Thomisidae (five species each). The higher abundance of salticids during the present study could be due to the fact that they are diurnal spiders and use visual cues to hunt for their prey and being active during daytime allow these spiders to make full use of their ability to see in fine detail (Jackson & Cross, 2011). A similar observation of higher salticid abundance was made by Norma-Rashid *et al.* (2009) in a study conducted on the mangrove spiders of Peninsular Malaysia and in a recent study by Abdullah *et al.* (2019) on the spider fauna of the Riparian Firefly Sanctuary of Sungai Chukai, Terengganu, Malaysia.

Table 1 Checklist of spiders in Kuala Selangor Nature Park, Kuala Selangor, Malaysia.

No.	Family	Species
1	Araneidae Clerck, 1757	<i>Gea spinipes</i> (C. L. Koch, 1843)
2	Araneidae Clerck, 1757	<i>Cyclosa insulana</i> (Costa, 1834)
3	Araneidae Clerck, 1757	<i>Parawixia dehaani</i> (Doleschall, 1859)
4	Araneidae Clerck, 1757	<i>Eriovixia sakiedaorum</i> (Tanikawa, 1999)
5	Araneidae Clerck, 1757	<i>Argiope</i> sp.
6	Filistatidae Simon, 1864	<i>Pritha</i> sp.
7	Liocranidae Simon, 1897	<i>Paratus</i> sp.
8	Lycosidae Sundevall, 1833	<i>Hippasa greenalliae</i> (Blackwall, 1867)
9	Lycosidae Sundevall, 1833	<i>Pardosa pseudoannulata</i> (Bösenberg & Strand, 1906)
10	Lycosidae Sundevall, 1833	<i>Pardosa</i> sp. 1
11	Lycosidae Sundevall, 1833	<i>Pardosa</i> sp.2
12	Oxyopidae Thorell, 1870	<i>Oxyopes birmanicus</i> (Thorell, 1887)
13	Oxyopidae Thorell, 1870	<i>Oxyopes javanus</i> (Thorell, 1887)
14	Oxyopidae Thorell, 1870	<i>Oxyopes</i> sp.
15	Oxyopidae Thorell, 1870	<i>Hamataliwa incompta</i> (Thorell, 1895)
16	Pholcidae C. L. Koch, 1850	<i>Pholcus</i> sp.
17	Salticidae Blackwall, 1841	<i>Phaeacius</i> sp.
18	Salticidae Blackwall, 1841	<i>Epeus flavobilineatus</i> (Doleschall, 1859)
19	Salticidae Blackwall, 1841	<i>Bavia sexpunctata</i> (Doleschall, 1859)
20	Salticidae Blackwall, 1841	<i>Bavia</i> sp.
21	Salticidae Blackwall, 1841	<i>Burmattus pococki</i> (Thorell, 1895)
22	Salticidae Blackwall, 1841	<i>Telamonia dimidiata</i> (Simon, 1899)
23	Salticidae Blackwall, 1841	<i>Plexippus paykulli</i> (Audouin, 1826)
24	Salticidae Blackwall, 1841	<i>Phintella vittata</i> (C. L. Koch, 1846)
25	Salticidae Blackwall, 1841	<i>Portia fimbriata</i> (Doleschall, 1859)
26	Salticidae Blackwall, 1841	<i>Menemerus bivittatus</i> (Dufour, 1831)
27	Salticidae Blackwall, 1841	<i>Harmochirus brachiatus</i> (Thorell, 1877)
28	Scytodidae Blackwall, 1864	<i>Scytodes pallida</i> (Doleschall, 1859)
29	Tetragnathidae Menge, 1866	<i>Tetragnatha josephi</i> (Okuma, 1988)
30	Theridiidae Sundevall, 1833	<i>Nihonhimea mundula</i> (L. Koch, 1872)
31	Theridiidae Sundevall, 1833	<i>Steatoda cingulata</i> (Thorell, 1890)
32	Theridiidae Sundevall, 1833	<i>Chryso</i> sp.
33	Thomisidae Sundevall, 1833	<i>Diaea</i> sp. 1
34	Thomisidae Sundevall, 1833	<i>Diaea</i> sp. 2
35	Thomisidae Sundevall, 1833	<i>Thomisus</i> sp. 1
36	Thomisidae Sundevall, 1833	<i>Thomisus</i> sp. 2
37	Thomisidae Sundevall, 1833	<i>Misumena</i> sp.

Some of the other notable studies conducted in the past that have documented the spider diversity in Malaysia includes Norma-Rashid & Li (2009), listing 425 species.; Nasir *et al.* (2014), reporting 219 species including 70 species as new records; Nasir & Norma-Rashid (2014), documenting 96 species from Rimba Ilmu Botanical Garden, Kuala Lumpur; Nasir *et al.* (2014a) reporting 222 species from Sabah; Nasir *et al.* (2016), identifying 35 species as new records for the State of Sarawak; Nasir *et al.* (2016a), reporting 50 new records of species from Sabah; and Abdullah *et al.* (2019) documenting 149 species in the riparian Firefly Sanctuary of Sungai Chukai, Terengganu. Although the present study is inadequate to reveal the true diversity of spiders in KSNP, documenting only 37 species, the results are indicative of a rich and varied spider diversity in this mangrove ecosystem, as it provides a heterogenous spectrum of habitats ranging from secondary forests to mangrove forests, estuary, mudflats, as well as brackish water lake system providing a greater array of microhabitats, microclimatic features, alternative food sources, retreat sites and web attachment sites. In order to unravel the true araneid diversity of this ecosystem, a detailed and comprehensive study involving routine seasonal samplings, taking into account the seasonality of different species, their diurnal and/or nocturnal activity, special and temporal distribution, microhabitat preferences, etc. is warranted.

Spiders live in a well-sustained environment supported by both physical conditions and biological factors (Foelix, 1996). Based on the relative distribution and predatory methods they can be assembled into specific functional groups (Bultman *et al.*, 1982). Describing the spider diversity in terms of these groups allows greater insights into how habitat differences may be reflected in life history strategies (Lee & Kim, 2003). Guilds are ecological groupings of organisms that exploit a single or similar resource in a similar manner (Root, 1967). Spiders have been subdivided into increasingly finer guild systems (Uetz, 1991; Uetz *et al.*, 1999).

Spiders collected during this study were classified into six ecological guilds (Young & Edwards, 1990; Uetz, 1991; Uetz *et al.*, 1999), namely orb weavers, stalkers, ground runners, space web builders, ambushers and foliage runners (Figure 2). The dominant guild was stalkers, constituting 40.54% of the total sample followed by orb weavers, 16.22% and space web builders, ground runners and ambushers (13.51% respectively). Foliage runners were represented by 2.7% of the total collection.

The dominant guild (stalkers) was composed of 15 species of the families Salticidae and Oxyopidae (Figure 2). Stalkers actively jump over the prey for feeding after quietly pursuing the prey. Orb weavers were represented by six species of the families Araneidae and Tetragnathidae. These spiders construct perfect orb webs for prey capture. Space web builders were represented by five

species under the families Theridiidae, Pholcidae, and Filistatidae, which construct irregular space webs for prey capture. Spiders of the guild ‘ground runners’ mainly feed on the ground layer of the field and rarely come to the foliage or canopy of the plant for prey capture. Spiders of the family Lycosidae, represented by five species, belong to this feeding guild. The guild ‘ambushers’ was represented by five species under the family Thomisidae. Ambushers typically show a “sit-and-wait” type of behavior for prey capture. Foliage runners were represented by just one species from the family Scytodidae, and these spiders hunt on foliage for preys.

The dominance of stalking spiders of the families Salticidae and Oxyopidae in mangroves has previously been documented by Norma-Rashid *et al.* (2009) and the present study conforms to their findings. Probably, heterogeneity in relation to the vegetation structure and habitat complexity offered by KSNP favours the survival of free-living spiders such as salticids and oxyopids, which do not construct web for prey capture, instead use their eyesight and agility for hunting. Salticids can often be observed on the barks of trees and among foliage actively moving in pursuit of the prey, whereas leaf folds provide the perfect sites for the construction of their retreats, where the females can protect their eggs, and also serve as a shelter while moulting. Oxyopids were mainly found among grasses that are luxuriantly distributed along the banks of the waterway which is joined to the man-made lake in the middle of KSNP. Similar to salticids, these spiders resort to their excellent vision to pursue and catch prey.

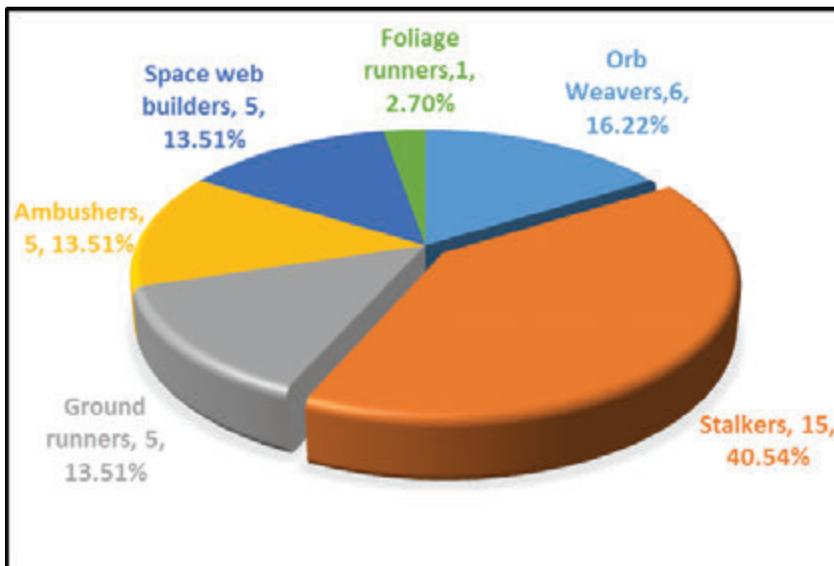


Figure 2 Guild structure of spiders in Kuala Selangor Nature Park, Kuala Selangor, Malaysia.

CONCLUSION

Preliminary study on the spider fauna in Kuala Selangor Nature Park, Kuala Selangor, resulted in the documentation of 37 species of spiders belonging to 30 genera and 11 families. The diversity of this ecotourism destination, both at ecosystem and microhabitat level, including pristine coastal mangroves forest, man-made intertidal lake, freshwater canals and mudflats, would undoubtedly support a much larger number of spiders. It is imperative to undertake extensive faunistic studies to comprehensively analyse and document the araneofauna of this important ecosystem.

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