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Spider diversity in the Bukit Timah Nature Reserve, Singapore

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ABSTRACT. This paper discusses the preliminary results of the first comprehensive survey of the spiders of the Bukit Timah Nature Reserve (BTNR) in Singapore. Two plots were established in each of the three zones of vegetation, viz., primary forest, old secondary forest, and maturing secondary forest. They were repeatedly sampled over an 18-month period. Sorting of the collection so far suggests that the three vegetation zones harbour rather different spider assemblages. Only ~9% of the total spider fauna recovered was shared by all three zones. The results have also yielded a preliminary picture of dominance, abundance and rarity. Although first intended to obtain a baseline for future quantitative analyses, the survey became a testing ground to modify and refine methodology so as to conduct future quantitative surveys with greater scientific rigour. Taxonomic work on the samples so far shows that the spiders in the BTNR span over 43 families, of which six families are listed for the first time in Singapore. The tally is summarised in an interim checklist of BTNR spiders. The checklist, with a total of 317 entries, shows that there are 158 described species of spiders in BTNR, of which 25 species are new records for Singapore. Another 159 morphospecies are provisionally recognised as distinct species, some of which may be new to science. Our observations during the survey have allowed us to provide a narrative of BTNR spider diversity against a backdrop of their microhabitat specialisation.

Keywords. Arachnida, Araneae, biodiversity, conservation.

Introduction

Previous studies on the spiders of 163 ha Bukit Timah Nature Reserve (BTNR) have been sporadic, focussing mostly on taxonomy, and usually embedded in research involving just a few taxa (Zhang et al., 2003; Raven, 2008; Huber, 2011; Dankittipakul et al., 2012; Baehr et al., 2012; Eichenberger et al., 2012; Kranz-Baltensperger, 2014; Thoma et al., 2014; Huber et al., 2016a, 2016b; Tong et al., 2016a, 2016b; Huber, 2017; Lin et al., 2017; Yamasaki et al., 2017). Other records of BTNR spiders have appeared either as parts of a Singapore checklist (Song et al., 2002) or mentioned in passing in books covering a range of Southeast Asian spiders (e.g., Davison et al., 2008; Murphy & Murphy, 2000). So far, the ecology and behaviour of spiders in BTNR have only been studied by Murphy (1993), as part of a broader study on the

fauna in the BTNR forest system. Information on these topics from nearby areas is also limited (e.g., Robinson, 1982).

As none of these studies has been quantitative, they do not provide an overview of species richness and diversity of the spiders in BTNR. This project to survey the spiders of BTNR was thus initiated as a component of a more comprehensive biodiversity survey of the BTNR (Chan & Davison, 2019). As far as the spider survey was concerned, there were three fundamental objectives:

- Spider inventory: To build an inventory of the spiders in BTNR that will serve as a baseline for long-term monitoring of BTNR diversity, and a template for future replicable and quantifiable surveys.

- Management inputs: To provide NParks management with inputs on the biological, physical and other requirements crucial to the conservation of spiders and their habitats in the BTNR. We hoped to develop and refine the methodology to build up baseline datasets for future temporal-scale and spatial-scale comparisons, e.g., for the comparison of species richness and diversity within BTNR after any rehabilitation programme or the comparison of species richness and diversity in BNTR with those in the Central Catchment Nature Reserve (CCNR), including the effects of eco-links.

- Capacity building: To train NParks staff and volunteers in spider collection and identification techniques and to talent-spot and groom a cadre of potential Singapore arachnologists.

Methods

Survey Sampling Sites

Systematic sampling of spiders was carried out by a team of 20 personnel in the three zones defined by NParks based on vegetation type (Fig. 1). These were designated Zone I (primary forest), Zone II (old secondary forest) and Zone III (maturing secondary forest).

Two spatially-separated 16 × 16 m plots were established in each zone. At the outset, these plots were placed in areas that best represented their respective zone. Criteria included safety (e.g., no steep slopes), ease of access, and the presence of at least leaf litter, tree trunks and vegetation. Their locations are shown in Fig. 1, with details as follows:

- Zone I: Plots with primary forest vegetation
  Both plots were chosen in an area north of Catchment Path. Plot I-1 was to the east of the junction between Cave Path and Catchment Path. One of the corners of I-1 was pinpointed by hand-held GPS as at 01º21′14.9″N 103º46′32.8″E. Plot I-2 was to the west of Catchment Hut, between the Cave Path and Rock

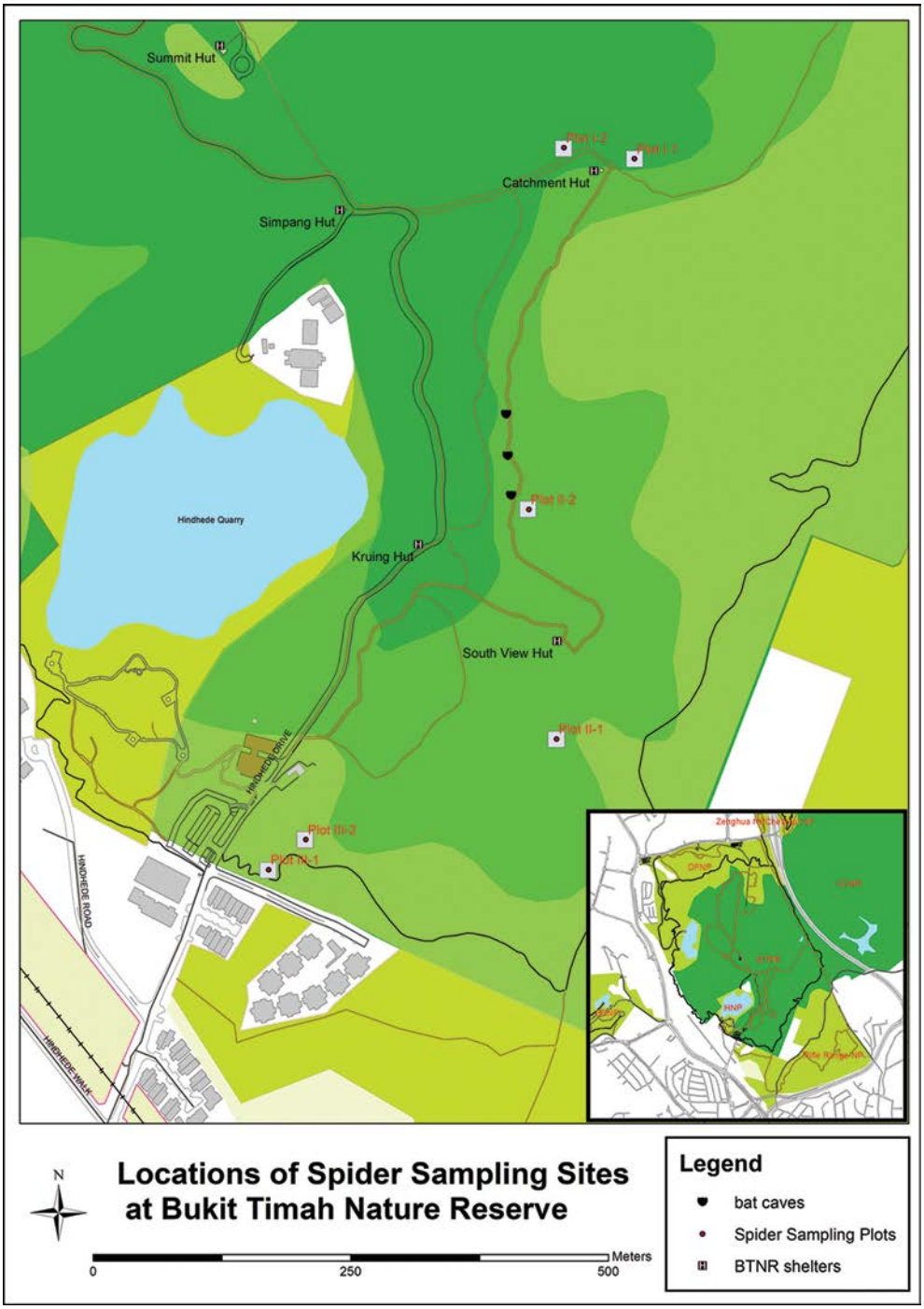

Fig. 1. Map of sampling sites for the Spider survey in Bukit Timah Nature Reserve. (Source: NParks)

Path junctions, near the CTFS Primary Forest Plot. One of the corners was at 01º21′15.5″N 103º46′30.6″E. The plot included a fallen log.

- Zone II: Plots with old secondary forest vegetation: The first plot, designated II-1 within the old secondary forest zone, was at the Taban Valley. One of the corners was near 1°20’54.7”N 103°46’45.3” E. The second plot, designated II-2, was located to the east of Cave Path, about 20 steps from the Bat Cave. One of the corners was at 01°21’05.8”N 103°46’ 28.0”E.

- Zone III: Plots with young secondary forest vegetation: These were to the north of Senapang Link (biking trail), outside the hoarding gate that was erected during the BTNR closure in 2015. Part of the Senapang Stream meandered through Plot III-1, with a corner at 01º20′53.3″N 103º46′20.1″E. A fallen log straddled Plot III-2 B. It was to the north of Plot III-1, in the direction away from the gate, with a corner at 01º20′53.6″N 103º46′21.7″E

Each plot was divided into 16 quadrats measuring 4 × 4 m. During each sampling cycle, two squares in each plot were randomly selected and sampled.

Survey Methods

The surveyors adopted a sampling protocol modified slightly from the widely-accepted design proposed by Coddington et al. (1991) to estimate biodiversity in tropical ecological systems. Spiders were only sampled on the ground and lower vegetation, including tree trunks at reachable heights. There was no use of fogging, no Tullgren funnels, collection by sweep nets, or bark traps.

In each quadrat, participants worked in pairs, adopting a consistent and standardised, and therefore repeatable, collection strategy involving the following methods within or adjacent to the chosen quadrats:

- Visual search (Day). Both participants visually combed all microhabitats within the entire 4 × 4 m quadrat – foliage, branches, bark, crevices at tree bases, ground, under stones, under fallen logs and mud banks. Duration (including catching time) was standardised at 20 minutes.

- Vegetation shaking over inverted umbrella (Day). One of the two participants carried out 20 “shakes” at randomly selected sites within the quadrat. The other participant captured the specimens in separate vials.

- Leaf litter collection (Day). Two heaps of leaf litter and topsoil were gathered from two randomly chosen 50 × 50 cm frames within each quadrat: they were either sifted on site or were taken home for closer examination.

- Visual search (Night). As for visual search by day, but both participants searched with the aid of head-lamps, some with additional torch lights. Duration of search (including catching time) was standardised at 30 minutes.

Sessions and sampling frequency

It was important to ensure that each zone was sampled as frequently as the others and that the two plots within each zone were also sampled with similar frequency. A team coordinator prepared the sampling programme ahead of each session. Once she had confirmed the availability of sufficient numbers of volunteers, she emailed the relevant details to each participant before each sampling day. The slight unevenness in sampling was due to delays caused by wet weather and manpower constraints.

Specimens and Field Records

All spiders, including juveniles, were collected, identified and counted. Specimens were preserved in 70% ethanol and labelled individually with a unique specimen serial number, incorporating date of collection and the zone and plot codes. These data, along with tentative identification, are being archived and tracked in a master database in Microsoft Excel®.

Identification

Specimens were identified by J.K.H. Koh and D.J. Court with the help of some of the participants as part of their capacity-building. The names used in this report follow those listed in the online World Spider Catalog (2019).

Despite recent advances in Southeast Asian spider systematics, and even with assistance from foreign specialists on selected taxa, it was still difficult to identify a high proportion of the specimens to species level. For undetermined adult specimens, the following nomenclature procedures were adopted in the master database:

- Where a morphologically distinct adult specimen could not be positively identified down to the species level, but where its generic affiliation was clear, it was counted as a morphospecies of that particular genus, e.g., "*Clubiona* sp. BT" where BT is a double-letter code of its nickname, e.g., "Bukit Timah".

- Where even the generic affiliation could not be determined, then it was counted as a morphospecies of a particular family, e.g., "Gnaphosidae sp. MG for an unidentified gnaphosid spider nicknamed "Mousey Grey".

- While identification of juveniles in many cases was difficult, juveniles in the samples were still counted to obtain a better sense of abundance and species diversity. This was important as juveniles often made up a large component of many of the samples. In addition, some juveniles could be determined down to species level, and to leave them out would have distorted abundance figures. We are currently exploring the possibility of matching juveniles with identified adults using molecular analysis techniques.

Custody of Specimens

All collected specimens are being consolidated by the principal investigator, J.K.H. Koh who, as and when necessary, in consultation with NParks, may be arranging loans of selected taxa to foreign specialists who might help in their identification.

After processing, all specimens will be deposited at the Lee Kong Chian Natural History Museum (LKCNHM), National University of Singapore.

Results

Overall family diversity and species richness

More than 3000 specimens were collected during the survey. A total of 317 species, including 158 named species and a further 159 distinct morphospecies were distinguished among slightly more than 1000 of the specimens that had been studied up to 31 Jan 2019. These are shown in the checklist in Appendix 1. The number far exceeds the combined total of 57 species previously documented from BTNR in the publications cited in the Introduction.

These spiders are spread across 44 families, against the combined record of 23 families in the previously published records we have been able to examine. The 21 spider families found to be represented for the first time in BTNR were the Clubionidae, Corinnidae, Dipluridae, Gnaphosidae, Liocranidae, Mimetidae, Miturgidae, Mysmenidae, Nemesiidae, Nephilidae, Nesticidae, Ochyroceratidae, Philodromidae, Pisauridae, Psilodercidae, Segestriidae, Stenochilidae, Telemidae, Theraphosidae, Theridiosomatidae and Trachelidae.

Most of these families have previously been recorded from elsewhere in Singapore in the literature cited in the Introduction. Nevertheless, this survey has surfaced the first country record of seven families, viz., Dipluridae, Gnaphosidae, Mimetidae, Mysmenidae, Psilodercidae, Segestriidae, and Trachelidae. Taxonomic changes affect this analysis, e.g., specimens that were collected in the past and previously recorded under the families Clubionidae or Eutichuridae are now considered to belong to the Cheiracanthiidae. In addition, the previously recorded family Cryptothelidae is now considered to belong to the Zodariidae. Some other taxonomic changes have occurred.

Notable finds and absentees

Among the specimens identified so far, nine described species are endemic to Singapore, with some known only from BTNR. These are highlighted in the Checklist (Appendix 1). Another 25 species have been described and recorded elsewhere in Southeast Asia, but are recorded for the first time in Singapore. They are highlighted in the last column in Appendix 1. These “New records” are derived from the fact that their presence in Singapore had not been previously documented in any of the papers cited in the Introduction, as well as in other published records on Southeast Asian spiders (Deeleman-Reinhold, 1993, 2001; Koh & Leong, 2014; Koh & Bay 2019). Some of the spiders recorded for the first time in Singapore are pictured in Fig. 2.

Fig. 2. Some new Singapore records from spiders collected at BTNR spiders survey. **A.** ♀ *Ogdenia mutilla* (Peckham & Peckham, 1907) (9 mm). **B.** ♂ *Mintonia silvicola* Wanless, 1987 (5.5 mm). **C.** ♀ *Utivarachna phyllicola* Deeleman-Reinhold, 2001 (4.5 mm). **D.** ♀ *Apochinomma nitidum* (Thorell, 1895) (4.5 mm). **E.** ♂ *Ctenus argentipes* Hasselt, 1893 (12 mm). **F.** ♀ *Hersilia lelabah* Rheims & Brescovit, 2004 (7 mm). (Photos: J.K.H. Koh)

Of the 57 species previously recorded in published records of BTNR spiders, seven species were not recovered. These absentees are indicated as "Not collected" in the Checklist (Appendix 1).

Many of the remaining species cannot be identified to species level at this stage of investigation. They cannot be placed under any of the species already described from Singapore, but we have not been able to compare them with any species described outside Singapore, hence the term "Not applicable" under the column for "Singapore records" in Appendix 1. Included in this group are some morphospecies that have unique patterns and genitalia that appear to be distinct from any of the

described spiders. They may well be new to science and will be investigated further. Some of them are pictured in Fig. 3.

Abundance & common species

At this stage of sorting, it is premature to provide a picture of relative abundance in each of the three zones. Nevertheless, a picture has emerged for the more common species. These are noted in the Checklist in Appendix 1. They are often associated with specific niches within BTNR and are discussed in the next section.

Singletons and rare species

Certain impressions of the "rare" species in BTNR have emerged during the survey. "Rare" species are defined as those described species and undescribed morphospecies represented by a single specimen in the collection sorted so far *and* the species or morphospecies have not previously been collected in Singapore. These are shown in the Checklist in Appendix 1.

Some of these rare species are prospective new species as discussed in earlier paragraphs and pictured in Fig. 3.

Zonal similarities and differences

In regard to overall species richness (absolute number of species), the three zones did not differ greatly from one another. The absolute and relative number of species in each zone are illustrated in Fig. 4. Altogether 150 species have been recorded so far from Zone I (primary forest), 149 species from Zone II (old secondary forest) and 130 species from Zone III (maturing secondary forest).

Fig. 4 also shows the number of species shared between the different zones based on the specimens sorted so far. Although there was considerable overlap of spiders between the three zones, each zone contained many unique species. Zone I (primary forest, on or near a higher ridge) yielded the highest number of undescribed species, often from poorly-known taxa. Some of them appear to be forest dwellers surviving only in more pristine environments. Zones II and III have both been rather disturbed and their spider constituents tended to overlap more with each other than with that of Zone I.

Zoogeography

Among the identified species from the BTNR collection, there appear to be several zoogeographical components.

- Singapore endemics: We have so far identified 15 species, including four species of Oonopidae, endemic to Singapore. The five species *Mintonia protuberans* (Salticidae), *Monodontium bukittimah* (Barychelidae), *Paculla bukittimahensis* (Pacullidae), *Sulaimania brevis* and *Singaporemma lenachanae* (both Tetrablemmidae), each described from BTNR, have not been seen elsewhere in Singapore.

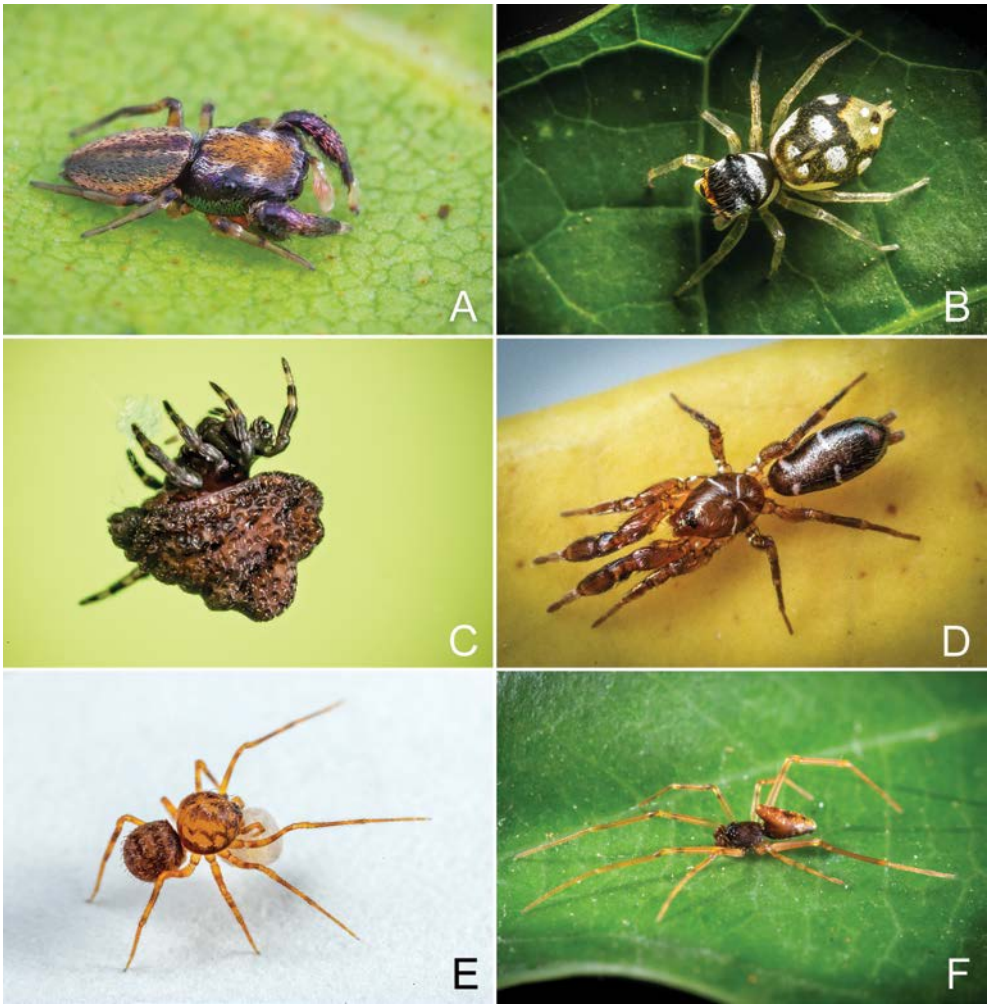

Fig. 3. Examples of some suspected new species from the BTNR spider survey. **A.** "♂ Simaetha sp. (Salticidae) (2.3 mm). **B.** ♀ *Phintella* sp. (Salticidae) (3.5 mm). **C.** ♀ *Phoroncidia* sp. (Theridiidae) (2.5 mm). **D.** ♂ Suspected *Hitobia* sp. (Gnaphosidae) (3 mm). **E.** ♀ *Dictis* or *Scytodes* sp. (Scytodidae) (2 mm). **F.** ♂ Theridiidae (Subfamily Spinthariinae) (3 mm). (Photos: A, J.K.H. Koh; B–F, D.J. Court)

- Spiders confined to the Sunda or "Malay Archipelago" region: Examples include *Ctenus argentipes, Hersilia deelemanae, Heteropoda boiei* and *Nusatidia camouflata.*

- More widespread, eurytopic species: These include species whose range includes parts of Wallacea, or even the Sahul shelf, or the southern parts of China, Japan, and parts of South India. The more common ones include *Araneus mitificus, Acusilas coccineus, Argyrodes flavescens,*

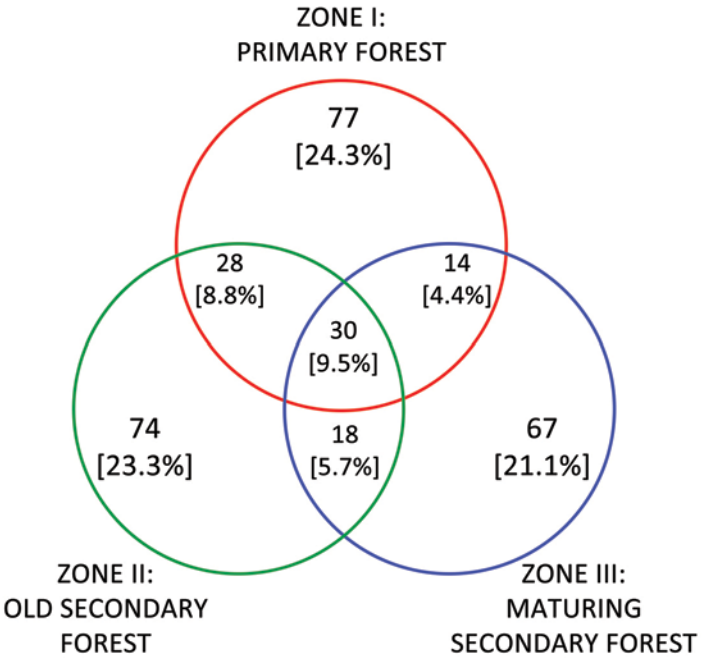

Fig. 4. Species richness compared between vegetation zones, showing the absolute number of species and the respective percentage of the total species count (317 species, of which ten were not re-collected during the present survey).

Bavia sexpunctata, Cyrtophora cylindroides, Eriovixia excelsa, Nephila pilipes, Nephilengys malabarensis, Nihonhimea mundula, Oedignatha scrobiculata, Parawixia dehaani, Poltys illepidus, Scytodes pallida and *Tylorida ventralis.*

- Pantropical synanthropic species: These were not frequently found, and appeared more confined to the more disturbed zone III. They include *Hasarius adansoni, Platnickina mneon, Scytodes fusca,* and *Theotima minutissima.*

An overview of the species in each of these categories is given in the Checklist (Appendix 1). The overview does not cover morphospecies that we have not been able to identify to species level, as it would be obviously premature to determine their range before they are described and established as valid species.

Ecological observations

In the course of the survey, we were able to make additional observations to supplement those made by Murphy (1993) on the distribution of spiders in terms of the diurnal cycle and in terms of vertical and horizontal stratification within the BTNR ecosystem.

Amongst lower vegetation

During the day-time, the lower vegetation was very much the realm of the roaming jumping spiders, among which several species of the genera *Epeus* and *Parabathippus* were the most prominent.

Among the most common web-building species found in the lower vegetation during daylight in all three zones were *Theridion t-notatum* (Theridiidae) and *Tylorida ventralis* (Tetragnathidae). They were frequently found in their three-dimensional tangle webs and horizontal orbwebs respectively in drier and more exposed niches, along with the relatively common orbweb builder *Cyclosa insulana* (Araneidae). Another araneid, *Cyrtophora cylindroides,* which wove a characteristic inverted bowl-shaped orbweb with an irregular superstructure, appeared to prefer a similar environment but was confined to areas with plenty of vertical and horizontal branchlets in the young secondary forest in Zone III.

Yet another common horizontal orbweb builder, *Leucauge argentina* (Tetragnathidae), appeared to prefer more shady and moist niches nearer the forest floor. Several other species of diurnal web builders were also found barely a metre above the ground. They included *Cyclosa bifida* and *Gea spinipes* (both Araneidae). Both appeared to be capable of trapping flies hovering close to the litter surface and intercepting small jumping crickets.

Several species of daddy-long-legs spiders (Pholcidae) showed a distinct preference for building their three-dimensional tangle webs under broad leaves in shady parts of the forest beneath a dense canopy. These included an unidentified *Belisana* sp. and an unidentified *Calapnita* sp., both found only in the primary forest in Zone I. Other leaf-dwelling daddy-long-legs included *Cantikus halabala, Cantikus ubin,* and *Pribumia atrigularis* which also appeared in other zones. The underside of leaves also appeared to be the preferred habitat of a minute goblin spider *Orchestina codalmasi* that could leap like a flea.

After sunset, some araneid spiders emerged from their retreats and started building their orbwebs. The most commonly seen ones included *Araneus mitificus*, *Cyphalonotus* sp., *Neoscona vigilans, Parawixia dehaani,* and a *Poltys* sp.

The heavy huntsman spiders of the genus *Thelcticopis* were among the most conspicuous free-ranging nocturnal hunters on the foliage. They were often seen sitting on leaves and petioles, capturing prey by a sudden grabbing action. A *Thelcticopis* was seen feeding on quite large foliage-dwelling cockroaches and crickets. The spitting spiders *Scytodes pallida* were often seen away from their under-leaf silk-laced retreats, roaming over the leaf surfaces apparently in search of prey. Other leaf-dwellers that became active at night included the sac spiders *Nusatidia borneensis* and *N. camouflata* (Clubionidae), as well as the long-legged sac spider *Cheiracanthium* sp. (Cheiracanthiidae).

Tree trunks and buttress roots

It took a trained eye to spot the spiders living on tree trunks and buttress roots, as they were often well camouflaged or well concealed, presumably as an adaptation to mitigate against the risk of living in such highly exposed microhabitats. However,

with a careful visual search, it was still possible to discern the presence of the well-camouflaged long-tailed spiders (Hersiliidae), viz., the more common *Hersilia deelemanae* and the less common *H. lelabah.* They habitually positioned themselves on the slightly more shaded bark surfaces, extending their very thin legs in all directions, and ready to rotate at high speed around passing insects, binding the insect with a swathe of fine silk from their extremely long posterior spinnerets.

The ornamental coin spider *Herennia multipuncta* and the Malabar hermit spider *Nephilengys malabarensis* (both Nephilidae) built orbwebs that differed from the more typical aerial webs built by the related *Nephila pilipes* among trees and branches. *Herennia multipuncta* trapped insects landing on its tree-hugging "ladder web" with stiles and rungs around a sunken cup on which the spider sat. *Nephilengys malabarensis* built a modified orbweb supported between the tree trunk and a branch but hid itself in a funnel retreat made of an irregular tangle of silky threads.

Where the buttresses protected deep and sheltered crevices, the pholcid *Uthina luzonica* constructed a tangled-looking web in and out of which moved small spiders of other species, and in and out of which flew a variety of small moths and midges. Less sheltered cavities and other areas near trunks were sometimes occupied by the web complexes established by the bright orange subsocial orbweaver *Philoponella*. Some of these web complexes were also inhabited by *Leucauge argentina* and other spiders such as the spider-predators *Mimetus* sp. and *Rhomphaea* sp. Where the cleavage between two buttresses up against the trunk was particularly incised and sheltered, a microhabitat existed for a suspected new species of *Dolichognatha.* This orb-weaver wove small horizontal webs of extremely fine silk which could intercept very small leaping or flying prey. When disturbed or pulled sideways, these webs appeared like a regular silken sheet. These webs intercepted very small leaping or flying prey.

At night, the litter crab spider *Borboropactus cinerascens* emerged from the litter and took up a hunting station on the trunks and buttresses, facing downward. With its front pairs of legs extended it was ready to seize small crickets and similar prey moving from litter to foliage. The highly camouflaged lichen sparassid *Pandercetes* sp., sometimes seen midway up shaded trunk surfaces during the day, became active. Sometimes the large corinnid *Medmassa* sp. could be seen searching for *Camponotus* ants, away from the day-time tubular retreat woven between bark furrows.

The forest floor

In the litter layer, several species of Oonopidae, two species of wolf spiders, viz., *Venonia coruscans* and *Ovia macritchie,* and the banded-legged zodariid *Mallinella annulipes* were frequently encountered. *Nannenus syrphus* could be regarded as the most dominant species among the jumping spider inhabitants of the litter layer, although they occasionally ranged upwards into the lower vegetation. A m other long-bellied jumper *Bavia sexpunctata* was found once with its egg sac within a curled leaf. There were also many juveniles of unidentified jumping spiders in the litter layer. While it is tempting to suggest that the litter layer could be a "nursery"

for jumping spiders living higher in the vegetation, more studies would be required to support such a theory.

Shortly after sunset, the litter layer became the hunting ground of several species of wandering spiders (Ctenidae) and huntsman spiders (Sparassidae). Some of these are large and conspicuous, such as *Ctenus argentipes* and *Heteropoda tetrica*, each with the body length of 20 mm or more.

We also found an amazing variety of minute species in the litter layer, including *Telema fabata*, some ochyroceratids, oonopids and pholcids, as well as an undescribed scytodid and a diplurid *Masteria* sp. Of these, the tiny ochyroceratids and many oonopids proved highly sensitive to any decrease in humidity. Collected specimens in tubes died within two or three hours of collection unless they were provided with moistened tissue or leaf litter. Their extreme sensitivity to drying strongly suggested to us that the activity of these two groups, if not the others, is strictly confined to deep litter during the day and limited to roaming further beyond the deep litter solely during night-time hours in non-drought periods of the year.

A number of the litter spiders were found with an armoured carapace, sternum and abdomen. These included the newly-described pacullid *Paculla bukittimahensis,* the tetrablemmid *Singaporemma lenachanae* and the goblin spiders (Oonopidae) of the genera *Aposphragisma, Gamasomorpha* and *Xiphinus*. Such armour, particularly that of the tetrablemmid, is likely related to radical respiratory system modifications associated with the reduction of water loss (Kropf, 2016).

The lace web weavers, *Psechrus singaporensis,* often established themselves over mud banks or ground hollows created by fallen trees, spinning a large sheet web connected to a funnel-like retreat. The sheet web was supported by guy lines attached to surrounding vegetation and dead sticks. During the day, the spiders were just visible in the funnel but moved out below the surface of the sheet web at night.

Rotting logs were found to be a microhabitat for several taxa of spiders. The segestriid *Ariadna* sp. were often collected inside abandoned insect burrows. Soft rotten wood was often associated with open tubular retreats excavated by certain juvenile selenocosmiine tarantula species. Trapdoor spiders *Rhianodes atratus* were seldom seen in their trapdoor retreats, but they were frequently collected among the leaf litter, even during the daytime. With our limited observations in the field, it would be premature to speculate that they were diurnal.

Discussion

Assessment of BTNR spider diversity

Our latest checklist of 317 species should be regarded as nothing more than an interim and provisional enumeration of the spider fauna in BTNR. There are several sources of uncertainty:

- Our sorting and identification of the specimens is still ongoing.

- Nocturnal spiders are under-represented as we were unable to carry out as many night surveys as we had hoped.

- We avoided the use of fogging and therefore were unable to sample the spiders living in the higher canopy. From the results of work done in Borneo and elsewhere, reported by Deeleman-Reinhold (2001, 2009a, 2009b) and other workers, it is expected that there is also a rich canopy fauna of spiders in Singapore.

- We may also have included some 'double-counts', especially in cases where sexual dimorphism has not been recognised, and where we assigned nicknames to spiders that we could not recognise due to poor published descriptions.

- Unpublished past records of BTNR spiders were excluded in building the checklist.

With further sorting and taxonomic work, we hope to obtain a much more complete and accurate dataset so that we can apply rigorous statistical tools such as Shannon and Chao 1 to better estimate BTNR's species richness, diversity, abundance and evenness, and make more meaningful comparisons of such data for Zones I, II and III. We are particularly interested in verifying our hypothesis that the primary forest in Zone I is a hotspot of the rarer species associated with more pristine forests, i.e., not found in secondary forests within BTNR or other localities outside BTNR but within Singapore.

Our species abundance numbers remain incomplete as many juveniles could not be identified to species level. More reliable estimates for abundance could be possible if molecular analysis using COI is used to match unidentified juveniles and adults. A similar application of molecular analysis could minimise double counting of sexually dimorphic species. Some of the collected specimens are being analysed in this way but the results are still pending.

We are not too concerned about the absence of some of the more common species from the samples that we have identified so far. They may eventually be represented as more specimens are identified. In any case, there should be no conservation issues so long as these spiders continue to be seen outside BTNR. We believe that some of the apparent absentees were not found because their previous records were, we suspect, based on misidentification, confusing the species found in BTNR with similar species found only in the Palearctic parts of China.

We are encouraged that we may have found some species that may be new to science. Nevertheless, we are concerned that we were unable to recover from the sorted samples some of the rarer species and more 'iconic' species whose type locality is BTNR. These include the goblin spider *Aposphragisma stannum,* the recently described armoured spider *Paculla globosa*, and the squat jumping spider *Simaetha deelemanae.*

Conclusions

The BTNR spider checklist, as it stands today based on the specimens sorted so far plus those in published records, adds up to 317 species, comprising 158 named species and a further 159 morphospecies. The figure includes seven species previously recorded from BTNR that were not collected during our survey. We expect to reach a higher number of species once the sorting and identification is completed. Even if we give some allowance to previous misidentification and possible double-counting, the net total is still a staggering one for such a small patch of nature reserve. It is however premature to conclude that the BTNR is more speciose in spiders than the nearby CCNR and other protected areas. For this we will require more than checklists. To make such a comparison, standardised sampling programmes with comparable man-hours of effort will be required.

The total species tally for BTNR would have been much higher had we not intentionally avoided some of the more pristine areas (e.g., Fern Valley, Jungle Fall Path) for fear of causing excessive trampling through frequent sampling there. The number was also suppressed as we had eschewed collection strategies that may be deemed more damaging to the habitat (e.g., fogging to collect spiders in the canopy).

With rigorous statistical tools, we should be able to provide firmer indications of spider species richness, diversity and evenness in BTNR. However, we will need to study more carefully if the final statistical findings from the current survey should form the baseline of future quantifiable surveys. To begin with, the templates of future surveys may need to be radically revised, with equal weight given to night collection. Both field and laboratory equipment need to be in place before the survey begins. We should also find alternative plots in Zone I. The two current plots are tick-infested (*Ambylomma* sp.) and are relatively disturbed and exposed, compared to other more pristine parts within Zone I. Our plot size of 16 × 16 m is also unrealistically small for intensive surveys; 25 × 25 m would have been better. Another key lesson learnt was that for the survey to be sustainable, there must be enough manpower to satisfy a roster for not only field duties, but also laboratory work (to sift leaf litter and identify specimens). This may require some reduction in frequency of field trips.

The survey highlights not only the need to look at BTNR spider diversity from a holistic and quantifiable perspective, but also the need to zero in on some of the spiders requiring attention for conservation reasons. These should include species that are endemic, rare, iconic (e.g., described from BTNR or Singapore), and vulnerable (e.g., poor dispersal ability, confined to certain microhabitats). Examples include the trapdoor spider *Monodontium bukittimah* and others that are recorded from BTNR and nowhere else.

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Appendix 1. Provisional checklist of spiders recorded from Bukit Timah Nature Reserve, Singapore. Names in *CAPITAL ITALICS* are those for which BTNR is the type locality. Names in ***Bold italics*** are the species (additional to those with BTNR as type locality) whose presence in BTNR has previously been documented. Species listed as ZZ are those not yet identified to family or genus level.

Under Status, Common refers to species of which more than ten specimens were collected during the 2014–2018 survey, and Rare refers to (a) any singleton collected during the year and (b) such a specimen has not been found elsewhere in Singapore.
** Previous record in Singapore may have been based on misidentification; @ Cosmopolitan synanthropic species.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Araneidae	***Acusilas coccineus* Simon, 1895**	Y		Y	–	No
Araneidae	***Anepsion depressum* (Thorell, 1877)**			Y	–	No
Araneidae	*Araneus mitificus* (Simon, 1886)	Y			–	No
Araneidae	*Argiope dang* Jäger & Praxaysombath, 2009		Y		–	No
Araneidae	*Argiope jinghongensis* Yin, Peng & Wang, 1994	Y			–	New record
Araneidae	*Argiope versicolor* (Doleschall, 1859)	Y	Y	Y	–	No
Araneidae	*Chorizopesoides wulingensis* Yin, Wang & Xie, 1994		Y	Y	–	No
Araneidae	*Cyclosa bifida* (Doleschall, 1859)			Y	–	No
Araneidae	*Cyclosa bulla* Tanakawa & Petcharad, 2018	Y			–	No
Araneidae	*Cyclosa insulana* (Costa, 1834)	Y	Y	Y	–	No
Araneidae	*Cyphalonotus* z sp. BT	Y	Y	Y	–	Not applicable
Araneidae	*Cyrtophora cylindroides* (Walckenaer, 1841)		Y	Y	–	No
Araneidae	*Eriovixia excelsa* (Simon, 1889)		Y	Y	–	New record
Araneidae	*Eriovixia laglaizei* (Simon, 1877)	Y	Y	Y	–	No
Araneidae	*Eriovixia* sp. WW		Y		–	Not applicable

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Araneidae	*Eriovixia* sp. YU		Y		–	Not applicable
Araneidae	*Gea spinipes* (C.L. Koch, 1843)	Y	Y		Common	No
Araneidae	*Neoscona punctigera* (Doleschall, 1857)	Y	Y		–	No
Araneidae	*Neoscona vigilans* (Blackwall, 1865)	Y			–	No
Araneidae	*Parawixia dehaani* (Doleschall, 1859)	Y		Y	–	No
Araneidae	*Poltys illepidus* C.L. Koch, 1843		Y		–	No
Araneidae	*Poltys stygius* Thorell, 1898	Y	Y		–	No
Araneidae	*Singa perpolita* (Thorell, 1892)			Y	–	No
Araneidae	ZZ sp. MP	Y			Rare	Not applicable
Barychelidae	*MONODONTIUM BUKITTIMAH* Raven, 2008	Y			Rare	No
Barychelidae	*Rhianodes atratus* (Thorell, 1890)	Y	Y	Y	–	No
Cheiracanthidae	*Calamopus* sp. VM			Y	Rare	Not applicable
Cheiracanthidae	*Cheiracanthium* sp. UD		Y		Rare	Not applicable
Cheiracanthidae	*Cheiracanthium* sp. SD		Y		Rare	Not applicable
Clubionidae	*Clubiona* sp. PJ			Y	–	Not applicable
Clubionidae	*Clubiona* sp. PA			Y	–	Not applicable
Clubionidae	*Clubiona* sp. SA			Y	–	Not applicable
Clubionidae	*Nusatidia borneensis* Deeleman-Reinhold, 2001			Y	–	New record
Clubionidae	*Nusatidia camouflata* Deeleman-Reinhold, 2001	Y	Y	Y	Common	New record

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Clubionidae	*Nusatidia* sp. XB		Y		–	Not applicable
Clubionidae	*Nusatidia* sp. MW			Y	–	Not applicable
Corinnidae	*Aetius* sp. SC		Y		–	Not applicable
Corinnidae	*Aetius* sp. OB	Y			–	Not applicable
Corinnidae	*Apochinomma nitidum* (Thorell, 1895)		Y		–	New record
Corinnidae	*Corinnomma rapax* Deeleman-Reinhold, 2001	Y			–	New record
Corinnidae	*Corinnomma severum* (Thorell, 1877)	Y	Y		–	No
Corinnidae	*Corinnomma javanum* Simon, 1905	Y		Y	–	No
Corinnidae	*Corinnomma* sp. OT			Y	–	Not applicable
Corinnidae	*Medmassa* sp. UD			Y	–	Not applicable
Ctenidae	*Acantheis longiventris* Simon, 1897	Y			Common	No
Ctenidae	*Anahita* z sp. UD	Y			–	Not applicable
Ctenidae	*Ctenus argentipes* Hasselt, 1893	Y	Y		Common	New record
Ctenidae	*Ctenus* sp. ET	Y	Y	Y	Common	Not applicable
Dipluridae	*Masteria* sp. SC	Y	Y		–	Not applicable
Gnaphosidae	*Hitobia* sp. ON		Y		Rare	Not applicable
Gnaphosidae	ZZ sp. MG	Y	Y		Rare	Not applicable
Gnaphosidae	ZZ sp. TR				Not collected	Not applicable
Gnaphosidae	ZZ sp. PD		Y		Rare	Not applicable

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Hahniidae	***Alistra stenura* (Simon, 1898)**		Y		–	No
Hersiliidae	*Hersilia deelemanae* Baehr & Baehr, 1993		Y	Y	–	No
Hersiliidae	*Hersilia lelabah* Rheims & Brescovit, 2004	Y		Y	–	New record
Hersiliidae	*Hersilia* sp. AG	Y			–	Not applicable
Hersiliidae	***Hersilia yunnanensis* Wang, Wong & Qiu, 1993**				Not collected	No**
Linyphiidae	*Erigone bifurca* Locket, 1982	Y			Rare	No
Linyphiidae	*Knischatiria longispina* Wunderlich, 1995		Y	Y	Rare	New record
Linyphiidae	***Prosoponoides sinensis* (Chen, 1991)**				Not collected	No**
Linyphiidae	ZZ sp. OF	Y			–	Not applicable
Liocranidae	*Oedignatha scrobiculata* Threll, 1881	Y		Y	–	No
Liocranidae	*Sphingius* sp. XP			Y	–	Not applicable
Liocranidae	*Teutamus* sp. UD	Y	Y		–	Not applicable
Lycosidae	*Ovia macritchie* Lu, Koh, Zhang & Li, 2018	Y	Y	Y	–	No
Lycosidae	***Venonia coruscans* (Thorell, 1894)**	Y	Y	Y	Common	No
Mimetidae	*Mimetus* sp. UD			Y	–	Not applicable
Mimetidae	*Mimetus* sp. WT	Y			–	Not applicable
Miturgidae	*Systaria bifida* Dankittipakul & Singtripop, 2011	Y			–	New record
Mysmenidae	*Simaoa* sp. UD		Y		Rare	Not applicable
Nemesiidae	*Damarchus workmani* Thorell, 1891	Y			–	No

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Nephilidae	*Herennia multipuncta* (Doleschall, 1859)	Y			–	No
Nephilidae	***Nephila pilipes* (Fabricius, 1893)**	Y	Y	Y	–	No
Nephilidae	***Nephilengys malabarensis* (Walckenaer, 1841)**	Y	Y		–	No
Nesticidae	ZZ sp. SP	Y			Rare	Not applicable
Ochyroceratidae	*Theotima minutissima* (Petrunkevitch, 1929)		Y	Y	–	New record
Oonopidae	*APOSPHRAGISMA SALEWSKI* Thoma, 2014	Y	Y	Y	–	No
Oonopidae	*APOSPHRAGISMA STANNUM* Thoma, 2014				Not collected	No
Oonopidae	***Gamasomorpha lalana* Suman, 1965**				Not collected	No
Oonopidae	*Gamasomorpha camelina* Simon, 1893		Y		Rare	No (endemic)
Oonopidae	*Gamasomorpha coniacris* Eichemberger, 2011	Y			Rare	New record
Oonopidae	***Gamasomorpha insomnia* Eichenberger, 2012**	Y	Y	Y	–	No
Oonopidae	*Ischnothyreus an* Tang & Li, 2016	Y			–	No
Oonopidae	*Ischnothyreus brunneus* Ton & Li, 2016		Y		–	No
Oonopidae	***Ischnothyreus dactylinus* Tang & Li, 2016**	Y	Y		–	No
Oonopidae	*ISCHNOTHYREUS POCULUM* Tong & Li, 2016				Not collected	No
Oonopidae	***Ischnothyreus tectorius* Tong & Li, 2016**	Y		Y	–	No
Oonopidae	*Opopaea* sp. 4S	Y	Y		–	Not applicable
Oonopidae	*Opopaea* sp. BT	Y	Y	Y	–	Not applicable
Oonopidae	*Opopaea* sp. GH	Y			Rare	Not applicable

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Oonopidae	*Orchestina codalmasi* Wunderlich, 2011	Y			Rare	New record
Oonopidae	*Orchestina* sp. UD	Y			Rare	Not applicable
Oonopidae	***Prethopalpus schwendingeri* Baehr, 2012**		Y		–	No
Oonopidae	***Xiphinus hystrix* Simon, 1893**		Y		–	No
Oonopidae	ZZ sp. 4S	Y			–	Not applicable
Oonopidae	ZZ sp. 6S	Y			–	Not applicable
Oonopidae	ZZ sp. CW	Y			–	Not applicable
Oxyopidae	*Hamataliwa incompta* (Thorell, 1895)	Y	Y		–	No
Oxyopidae	*Hamataliwa* sp. 2T			Y	–	Not applicable
Oxyopidae	*Oxyopes auratus* Thorell, 1890	Y	Y		–	No
Pacullidae	*PACULLA BUKITTIMAHENSIS* Lin & Li, 2017		Y	Y	Common	No
Palpimanidae	***Boagrius pumilus* Simon, 1893**	Y	Y		–	No
Palpimanidae	*Sarascelis raffrayi* Simon, 1893				Not collected	No
Philodromidae	*Gephyrota* sp. WA	Y			Rare	Not applicable
Philodromidae	ZZ sp. TD	Y			Rare	Not applicable
Pholcidae	*Belisana* sp. B			Y	–	Not applicable
Pholcidae	*Belisana* sp. FP	Y	Y		–	Not applicable
Pholcidae	*Belisana* sp. LB			Y	–	Not applicable
Pholcidae	*Belisana* sp. XN	Y			–	Not applicable

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Pholcidae	*Calapnita* sp. SJ	Y			–	Not applicable
Pholcidae	*Cantikus halabala* (Huber, 2011)		Y		–	No
Pholcidae	*Cantikus ubin* (Huber, 2016)	Y		Y	–	No
Pholcidae	*Pholcus gracillimus* Thorell, 1890			Y	–	No
Pholcidae	***Pribumia atrigularis* (Simon, 1901)**	Y	Y	Y	Common	No
Pholcidae	*Pribumia* sp. XA	Y			Rare	Not applicable
Pholcidae	*Spermophora* sp. UD			Y	–	Not applicable
Pholcidae	*TISSAHAMIA BUKITTIMAH* (Huber, 2016)		Y		–	No
Pholcidae	***Uthina luzonica* Simon, 1893**			Y	–	No
Pisauridae	*Dolomedes* sp. WS			Y	–	Not applicable
Psechridae	***Psechrus singaporensis* Thorell, 1894**	Y			Common	No
Psilodercidae	*Althepus* sp. SC			Y	–	Not applicable
Psilodercidae	*Althepus* sp. UD			Y	–	Not applicable
Salticidae	***Agorius constrictus* Simon, 1901**		Y		–	No
Salticidae	*Agorius* z sp. BW			Y	–	Not applicable
Salticidae	*Anarrhotus fossulatus* Simon, 1902	Y			Rare	No
Salticidae	*Artabrus erythrocephalus* (C.L. Koch, 1846)	Y			Rare	No
Salticidae	*Bavia capistrata* (C.L. Koch, 1848)	Y			Rare	New record
Salticidae	***Bavia sexpunctata* (Doleschall, 1859)**	Y	Y	Y	–	No

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Salticidae	*Bavia* sp. XC		Y		–	Not applicable
Salticidae	*Emathis* sp. BF	Y			–	Not applicable
Salticidae	***Epeus flavobilineatus* (Doleschall, 1859)**	Y	Y	Y	–	No
Salticidae	*Epeus furcatus* Zhang, Song & Li, 2003	Y	Y	Y	–	No
Salticidae	*Euryattus* sp. UD	Y			–	Not applicable
Salticidae	***Harmochirus brachiatus* (Thorell, 1877)**			Y	–	No
Salticidae	***Hasarius adansoni* (Audouin, 1826)**			Y	–	No @
Salticidae	*Hyllus keratodes* (Hasselt, 1882)		Y		–	No
Salticidae	***Idastrandia orientalis* (Szombathy, 1915)**		Y	Y	–	No (endemic)
Salticidae	*Laufeia daiqini* (Proszynski & Deeleman-Reinhold, 2012)		Y		–	No
Salticidae	*Laufeia* sp. EB	Y			–	Not applicable
Salticidae	*Laufeia* sp. TC	Y			–	Not applicable
Salticidae	*MINTONIA PROTUBERANS* Wanless, 1984	Y			Rare	No (endemic)
Salticidae	*Mintonia silvicola* Wanless, 1987	Y			Rare	New record
Salticidae	*Myrmarachne comuta* Badcock, 1917		Y		–	No
Salticidae	*Myrmarachne turriformis* Badcock, 1918			Y	Rare	New record
Salticidae	*Myrmarachne* sp. UD		Y		–	Not applicable
Salticidae	***Nannenus lyriger* Simon, 1902**		Y		–	No

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Salticidae	***Nannenus syrphus* Simon, 1902**	Y	Y	Y	Common	No
Salticidae	*Ogdenia mutilla* (Peckham & Peckham, 1907)	Y		Y	–	New record
Salticidae	***Pancorius magnus* Zabka, 1985**			Y	–	No
Salticidae	***Pancorius thorelli* (Simon, 1899)**	Y	Y	Y	–	No
Salticidae	*Pancorius* sp. BT		Y	Y	–	Not applicable
Salticidae	*Pancorius* sp. CP		Y	Y	–	Not applicable
Salticidae	*Pancorius* sp. GO			Y	Rare	Not applicable
Salticidae	*PARABATHIPPUS DIGITALIS* Zhang, Song & Li, 2003		Y		Rare	No (endemic)
Salticidae	*PARABATHIPPUS RECTUS* (Zhang, Song & Li, 2003)			Y	Rare	No (endemic)
Salticidae	*Parabathippus* sp. NS		Y		–	Not applicable
Salticidae	*Phintella debilis* (Thorell, 1891)			Y	–	No
Salticidae	*Phintella vittata* (C.L. Koch, 1846)	Y			–	No
Salticidae	*Phintella* sp. LC		Y		Rare	Not applicable
Salticidae	*Phintella* sp. TS	Y			Rare	Not applicable
Salticidae	***Portia fimbriata* (Doleschall, 1859)**	Y		Y	–	No
Salticidae	***Portia labiata* (Thorell, 1887)**	Y	Y		–	No
Salticidae	***Ptocasius weyersi* Simon, 1885**	Y	Y	Y	Common	No
Salticidae	***Pystira ephippigera* (Simon, 1885)**	Y	Y		–	No
Salticidae	*Rhene* sp. WR	Y			Rare	Not applicable

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Salticidae	*Siler* sp. UD	Y			Rare	Not applicable
Salticidae	*SIMAETHA DEELEMANAE* Zhang, Song & Li, 2003				Not collected	No (endemic)
Salticidae	*Simaetha* sp. GB			Y	–	Not applicable
Salticidae	***Telamonia dimidiata* (Simon, 1899)**		Y	Y	–	No
Salticidae	***Thorelliola ensifera* (Thorell, 1877)**			Y	–	No
Salticidae	***Viciria praemandibularis* (Hasselt, 1893)**			Y	–	No
Salticidae	ZZ sp. AT	Y			–	Not applicable
Salticidae	ZZ sp. BC	Y	Y		–	Not applicable
Salticidae	ZZ sp. BE		Y		–	Not applicable
Salticidae	ZZ sp. BM	Y			–	Not applicable
Salticidae	ZZ sp. BO	Y			Rare	Not applicable
Salticidae	ZZ sp. BS	Y			–	Not applicable
Salticidae	ZZ sp. BW	Y			–	Not applicable
Salticidae	ZZ sp. CB	Y			–	Not applicable
Salticidae	ZZ sp. DF	Y			Rare	Not applicable
Salticidae	ZZ sp. FH	Y	Y		–	Not applicable
Salticidae	ZZ sp. HH	Y			–	Not applicable
Salticidae	ZZ sp. LB		Y	Y	–	Not applicable
Salticidae	ZZ sp. LF			Y	–	Not applicable

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Salticidae	ZZ sp. PE		Y		–	Not applicable
Salticidae	ZZ sp. RK			Y	–	Not applicable
Salticidae	ZZ sp. ST			Y	–	Not applicable
Scytodidae	*Scytodes fusca* Walckenaer, 1837		Y		–	No @
Scytodidae	***Scytodes pallida* Doleschall, 1859**	Y	Y	Y	Common	No
Scytodidae	*Scytodes venusta* (Thorell, 1890)		Y		–	No
Scytodidae	*Scytodes* sp. LL	Y			–	Not applicable
Segestriidae	*Ariadna* sp. UA	Y	Y	Y	–	Not applicable
Sparassidae	*Gnathopalystes kochi* (Simon, 1899)			Y	–	No
Sparassidae	*Gnathopalystes* sp. BT	Y	Y		–	Not applicable
Sparassidae	*Heteropoda boiei* (Doleschall, 1859)	Y			–	No
Sparassidae	*Heteropoda laai* Jaeger, 2008		Y		–	No
Sparassidae	*Heteropoda tetrica* Thorell, 1897	Y	Y		–	No
Sparassidae	*Heteropoda* sp. UD		Y		–	Not applicable
Sparassidae	*Olios* sp. UD	Y			Rare	Not applicable
Sparassidae	*Pandercetes* sp. FF	Y			Rare	Not applicable
Sparassidae	*Pandercetes* sp. LS			Y	–	Not applicable
Sparassidae	*Stasina planithorax* Simon, 1897			Y	Rare	No (endemic)
Sparassidae	*Thelcticopis* sp. AA	Y		Y	–	Not applicable

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Sparassidae	*Thelcticopis* sp. BB			Y	–	Not applicable
Sparassidae	*Thelcticopis* sp. CC			Y	–	Not applicable
Sparassidae	ZZ sp. AB		Y		–	Not applicable
Sparassidae	ZZ sp. GS		Y		–	Not applicable
Stenochilidae	*Colopea malayana* Lehtinen, 1982			Y	–	New record
Telemidae	*Telema fabata* Wang & Li, 2010	Y		Y	–	No
Tetrablemmidae	*SINGAPOREMMA LENACHANAE* Lin & Li, 2017	Y	Y		Common	No (endemic)
Tetrablemmidae	*SULAIMANIA BREVIS* Lin & Li, 2017			Y	–	No (endemic)
Tetragnathidae	*Dolichognatha* sp. UD			Y	Rare	Not applicable
Tetragnathidae	*Dolichognatha* sp. DS	Y			Rare	Not applicable
Tetragnathidae	*Guizygiella nadleri* Heimer, 1984		Y		–	No
Tetragnathidae	***Leucauge argentina* (Hallest, 1882)**	Y	Y	Y	Common	No
Tetragnathidae	*Mesida* sp. GB		Y		Rare	Not applicable
Tetragnathidae	*Mesida* sp. SA		Y		Rare	Not applicable
Tetragnathidae	*Opadometa fastigata* (Simon, 1877)		Y	Y	–	No
Tetragnathidae	*Tylorida ventralis* (Thorell, 1877)	Y	Y	Y	Common	No
Tetragnathidae	ZZ sp. SS			Y	Rare	Not applicable
Theraphosidae	*Phlogiellus* sp. UD	Y	Y		–	Not applicable
Theridiidae	*Argyrodes fasciatus* Thorell, 1892			Y	–	No

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Theridiidae	*Argyrodes fissifrons* O. Pickard-Cambridge, 1880			Y	–	No
Theridiidae	*Argyrodes flavescens* O. Pickard-Cambridge, 1880		Y		–	No
Theridiidae	*Argyrodes* sp. PF			Y	–	Not applicable
Theridiidae	*Argyrodes* sp. UD			Y	–	Not applicable
Theridiidae	*Argyrodes* sp. XK			Y	Rare	Not applicable
Theridiidae	*Ariamnes flagellum* (Doleschall, 1857)		Y		–	No
Theridiidae	*Ariamnes* sp BS		Y		–	Not applicable
Theridiidae	*Brunepisinus selirong* Yoshida & Koh, 2011	Y	Y	Y	–	No
Theridiidae	*Brunepisinus* sp. QD	Y			–	Not applicable
Theridiidae	*Chrysso* sp. LE			Y	–	Not applicable
Theridiidae	*Chrysso* sp. TD		Y		–	Not applicable
Theridiidae	*Chrysso* sp. TT		Y	Y	–	Not applicable
Theridiidae	*Episinus yoshidai* Okuma, 1994	Y	Y	Y	–	New record
Theridiidae	*Episinus* sp. EB		Y		–	Not applicable
Theridiidae	*Janula triangularis* Yoshida & Koh, 2011		Y	Y	–	No
Theridiidae	*Janula triocellata* Yoshida & Koh, 2011			Y	–	No
Theridiidae	*Janula* sp. RC			Y	Rare	Not applicable
Theridiidae	*Janula* sp. YF		Y	Y	Common	Not applicable
Theridiidae	*Meotipa* sp. 4N	Y			–	Not applicable

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Theridiidae	*Meotipa* sp. SF		Y	Y	–	Not applicable
Theridiidae	*Molione triacantha* Thorell, 1892		Y		–	No
Theridiidae	***Moneta mirabilis* O. Pickard-Cambridge, 1870**				Not collected	No**
Theridiidae	*Moneta* sp. FA	Y			–	Not applicable
Theridiidae	*Moneta* sp. BD		Y		–	Not applicable
Theridiidae	*Moneta* sp. BL	Y			–	Not applicable
Theridiidae	*Nihonhimea mundula* (L. Koch, 1872)		Y		–	No
Theridiidae	*Parasteatoda kompirensis* (Boesenberg & Strand, 1906)	Y		Y	–	Not applicable
Theridiidae	*Parasteatoda* sp. BF	Y			–	Not applicable
Theridiidae	*Parasteatoda* sp. GE			Y	–	Not applicable
Theridiidae	*Parasteatoda* sp. IC	Y			–	Not applicable
Theridiidae	*Parasteatoda* sp. WW	Y	Y	Y	–	Not applicable
Theridiidae	*Phoroncidia* sp. LU		Y		Rare	Not applicable
Theridiidae	*Phoroncidia* sp. UD		Y		Rare	Not applicable
Theridiidae	*Phycosoma amamiense* (Yoshida, 1985)	Y			–	New record
Theridiidae	*Phycosoma hana* (Zhu, 1998)	Y			–	New record
Theridiidae	*Phycosoma* sp. BB		Y		–	Not applicable
Theridiidae	*Phycosoma* sp. BF			Y	–	Not applicable
Theridiidae	*Phycosoma* sp. BH		Y		–	Not applicable

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Theridiidae	*Phycosoma* sp. GB		Y		–	Not applicable
Theridiidae	*Phycosoma* sp. HB	Y	Y		–	Not applicable
Theridiidae	*Phycosoma* sp. HE	Y			–	Not applicable
Theridiidae	*Phycosoma* sp. UD	Y			–	Not applicable
Theridiidae	*Phycosoma* sp. WR			Y	Rare	Not applicable
Theridiidae	*Platnickina mneon* (Boesenberg & Strand, 1906)	Y	Y		–	New record @
Theridiidae	*Rhomphaea labiata* (Zhu & Song, 1991)		Y	Y	–	New record
Theridiidae	*Rhomphaea sinica* (Zhu & Song, 1991)			Y	–	New record
Theridiidae	*Rhomphaea* sp. SP			Y	Rare	Not applicable
Theridiidae	***Theridion t-notatum* (Thorell, 1895)**	Y	Y	Y	Common	No
Theridiidae	*Theridion zonulatum* Thorell, 1890		Y		–	No
Theridiidae	ZZ sp. PA		Y		–	Not applicable
Theridiidae	ZZ sp. 2P		Y		–	Not applicable
Theridiidae	ZZ sp. 4B		Y		–	Not applicable
Theridiidae	ZZ sp. FA		Y		Rare	Not applicable
Theridiidae	ZZ sp. FB		Y		–	Not applicable
Theridiidae	ZZ sp. LF			Y	–	Not applicable
Theridiidae	ZZ sp. MT			Y	–	Not applicable
Theridiidae	ZZ sp. OS		Y		–	Not applicable

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Theridiidae	ZZ sp. SC			Y	–	Not applicable
Theridiidae	ZZ sp. SF			Y	–	Not applicable
Theridiidae	ZZ sp. SH	Y			–	Not applicable
Theridiidae	ZZ sp. SO		Y		–	Not applicable
Theridiidae	ZZ sp. WF		Y		–	Not applicable
Theridiidae	ZZ sp. WS		Y		–	Not applicable
Theridiidae	ZZ sp. YP	Y			–	Not applicable
Theridiidae	ZZ sp. LA		Y		–	Not applicable
Theridiosomatidae	*Theridiosoma fasciatum* Workman, 1896		Y		–	Not applicable
Thomisidae	*Alcimochthes limbatus* Simon, 1885	Y			–	No
Thomisidae	***Borboropactus cinerascens* (Doleschall, 1859)**	Y			Common	No
Thomisidae	*Cebrenninus rugosa* Simon, 1887		Y		–	No
Thomisidae	*Lycopus rubropictus* Workman, 1896		Y		–	No
Thomisidae	*Oxytate virens* (Thorell, 1891)		Y		–	No
Thomisidae	*Pharta bimaculata* Thorell, 1891			Y	–	No
Thomisidae	*Phrynarachne tuberosa* (Blackwall, 1864)		Y		–	No
Trachelidae	*Utivarachna fukusawana* Kishida, 1940			Y	–	New record
Trachelidae	*Utivarachna phyllicola* Deeleman-Reinhold, 2001			Y	–	New record
Trachelidae	*Utivarachna* sp. ND		Y		–	Not applicable

Appendix 1. Continuation.

Family	Genus & Species	Zone I	Zone II	Zone III	Status	New record for Singapore
Uloboridae	*Miagrammopes oblongus* Yoshida, 1982	Y	Y		–	No
Uloboridae	*Miagrammopes singaporensis* Kulzynski, 1908	Y			–	No
Uloboridae	*Miagrammopes* sp. CB		Y		–	Not applicable
Uloboridae	*Miagrammopes* sp. GB		Y		–	Not applicable
Uloboridae	*Philoponella raffrayi* (Simon, 1891)			Y	–	No
Uloboridae	*Philoponella* sp. BB			Y	–	Not applicable
Zodariidae	*Asceua* sp. 5B		Y		–	Not applicable
Zodariidae	*Asceua* sp. AB	Y			–	Not applicable
Zodariidae	*Asceua* sp. CF	Y	Y		Common	Not applicable
Zodariidae	***Cryptothele sundaica* Thorell, 1890**	Y	Y	Y	Common	Not applicable
Zodariidae	***Mallinella allorostrata* Dankittipakul, Jocque & Singtripop, 2012**	Y		Y	–	No
Zodariidae	***Mallinella annulipes* (Thorell, 1892)**	Y	Y	Y	Common	No
Zodariidae	*Mallinella* sp. DM	Y			–	Not applicable
Zodariidae	***Workmania botuliformis* Dankittipakul, Jocque & Singtripop, 2012**	Y	Y		–	No
Zodariidae	***Workmania juvenca* (Workman, 1896)**	Y		Y	–	No
ZZ	ZZ sp. CE	Y			–	Not applicable
ZZ	ZZ sp. UE	Y			–	Not applicable
ZZ	ZZ sp. TW		Y		–	Not applicable