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Microhabitat Preference of *Coremiocnemis cunicularia* and *Chilobrachys andersoni* in Pulau Pinang, Malaysia

(Pilihan Mikrohabitat *Corecmiocnemis cunicularia* dan *Chilobrachys andersoni* di Pulau Pinang, Malaysia)

IRHAM RAZAK[1], MUSHAHRIL SHUKOR[2], DZULHELMI MUHAMMAD NASIR[3], AHMAD ZAFIR WAHAB[4], CHAI MIN HIAN[5] & AMIRRUDIN AHMAD[1,*]

[1]*Biology and Ecology Research (BERes), Faculty of Science and Marine Environment, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia*
[2]*Pencinta, No. 092, Kampung Mengkuang Hujung, 09110 Kuala Pegang, Kedah, Malaysia*
[3]*Institute of Biological Sciences, Faculty of Science, University of Malaya, 50603 Kuala Lumpur, Malaysia*
[4]*The Habitat Foundation, 488A-20-02 & 03, Penas Tower, One Stop Midlands Park Complex, Jalan Burma, 10350 Pulau Pinang, Malaysia*
[5]*Faculty of Veterinary Medicine, Universiti Sultan Zainal Abidin Kampus Besut, 22200 Besut, Terengganu, Malaysia.*

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ABSTRACT

The Theraphosidae, commonly known as tarantulas, is one of the families under the infraorder of Mygalomorphae. Untill today, information regarding the ecology of Theraphosidae in Pulau Pinang, Malaysia, has been lacking, particularly concerning their ecology and natural history. This study aimed to investigate and compare the microhabitat parameters of *Chilobrachys andersoni* and *Coremiocnemis cunciularia* in Pulau Pinang across six sampling sites from May 2022 to September 2022. Thirteen different microhabitat parameters related to the burrows of the Theraphosidae were examined to examine if the two tarantula species have specific microhabitat preference. The collected parameters data were analyzed using the chi-square test and T-test. The variations and similarities of the microhabitat parameters of *Coremiocnemis cunicularia* and *Chilobrachys andersoni* were illustrated using principal component analysis (PCA) and non-metric multi-dimensional scaling (nm-MDS). It was shown that the type of trail near to the burrow, the height and diameter of the door entrance, soil and surrounding temperature, the distance of the burrow from the trail, plant species richness, and altitude difference between the burrows of *Coremiocnemis cunicularia* and *Chilobrachys andersoni* were statistically significant. PCA and nm-MDS analyses demonstrated that the habitat preferences of these two Theraphosidae species differed. In conclusion, this study contributed significant ecological knowledge regarding Theraphosidae, particularly on Pulau Pinang, Malaysia. Further studies on various aspects of Theraphosidae are important for improved conservation management in the future.

Keywords: Conservation; ecology; microhabitat parameters; Mygalomorphae; Theraphosidae

ABSTRAK

Theraphosidae, yang lebih dikenali sebagai Tarantula, adalah salah satu famili di bawah infraorder Mygalomorphae. Sehingga hari ini, maklumat mengenai ekologi Theraphosidae di Pulau Pinang, Malaysia masih kurang, terutamanya berkaitan dengan ekologi dan sejarah semula jadi mereka. Penyelidikan ini dijalankan untuk mengkaji dan membandingkan parameter mikrohabitat *Chilobrachys andersoni* dan *Coremiocnemis cunciularia* di Pulau Pinang di enam tapak persampelan Pulau Pinang dari Mei 2022 hingga September 2022. Tiga belas parameter mikrohabitat berbeza yang dikaitkan dengan sarang Theraphosidae telah diperiksa untuk menentukan sama ada kedua spesies tarantula tersebut mempunyai kegemaran habitat yang berbeza. Data parameter yang dikumpul dianalisis menggunakan ujian khi kuasa dua dan ujian-T. Variasi dan persamaan parameter mikrohabitat *Coremiocnemis cunicularia* dan *Chilobrachys andersoni* telah diterangkan menggunakan analisis komponen utama (PCA) dan penskalaan multidimensi bukan metrik (nm-MDS). Telah didedahkan bahawa jenis denai yang dekat dengan sarang, ketinggian dan diameter pintu masuk, tanah dan suhu sekeliling, jarak lubang dari denai, kekayaan spesies tumbuhan dan perbezaan ketinggian antara sarang *Coremiocnemis cunicularia* dan *Chilobrachys andersoni* adalah signifikan secara statistik. Analisis PCA dan nm-MDS menunjukkan bahawa keutamaan habitat kedua-dua spesies Theraphosidae ini adalah berbeza. Kesimpulannya, kajian ini memberikan sumbangan pengetahuan ekologi yang penting mengenai Theraphosidae di Pulau Pinang, Malaysia. Kajian lanjut mengenai pelbagai aspek Theraphosidae adalah penting untuk pengurusan pemuliharaan yang lebih baik pada masa hadapan.

Kata kunci: Ekologi; Mygalomorphae; parameter mikrohabitat; pemuliharaan; Theraphosidae

INTRODUCTION

Theraphosidae or 'Tarantula' is one of the families under the infraorder of Mygalomorphae. It is a big-sized, hairy spider with fangs pointing downward. With limited dispersal ability, Mygalomorphs have a high tendency towards endemicity (Raven 2010). Most of these spiders are terrestrial, but some species are arboreal in nature. Living a sedentary lifestyle, Mygalomorph spiders make their home in a burrow lined with silk lines, serving both as shelter and traps for catching prey. Their habitat can vary greatly, including under rocks, tree barks, within moss, burrow in soil, or any other place that the Mygalomorph spider finds fit to be their shelter (Bertani 2013).

Generally, spiders are sensitive towards local environmental changes, and their species diversity is frequently used as a measurement of environmental status (Batáry et al. 2008; Cardoso et al. 2011; Entling et al. 2007; Haddad et al. 2011). The presence and composition of spiders depend on habitat structure and types of vegetation (Hore & Uniyal 2008). Abiotic factors such as sunlight, duration of the day, land-related factors, sunlight intensity, temperature level, rainfall pattern, and humidity also influence spiders' assemblage (Arango, Rico-Gray & Parra-Tabla 2000; Cardoso et al. 2007; Langlands, Brennan & Pearson 2006; Lo Man Hung et al. 2011; Pinto-Leite & Rocha 2012). Other environmental features that affecting spider diversity include leaves cover on land, percentages of fallen trees, and distance between the trees (Baldissera, Ganade & Fontoura 2004).

Pulau Pinang is among the fastest growing areas with a high human density of 1,663 humans per square kilometer (Penang Institute 2017). According to the Department of Statistics Malaysia (2010), human population in the Pulau Pinang state is increasing at a rate of 1.3% annually. Since the 1960s, urbanization of Pulau Pinang has led to the habitats loss for various species, including the Theraphosidae (Chee et al. 2017; Elmahdy, Marghany & Mohamed 2016). While many animals and plants in the region have been targeted for conservation, arthropods, including Theraphosidae, have received less attention in Malaysia. However, conserving arthropods is crucial to ensure the success of multi species habitat conservation plans (Redak 2000). Furthermore, several past studies have suggested that Theraphosidae has the potential to be serve as sentinel or indicator species to assess the health and stability of the ecosystem (Borkar & Qureshi, 2023; Nanayakkara et al. 2015; Razak et al. 2024; Schwerdt, de Villalobos & Pérez-Miles 2018; Wilson et al. 2012). Nevertheless, developing a comprehensive conservation plan for Theraphosidae is challenging due to limited understanding of their diversity and habitat preference (Razak et al. 2023; Wilson et al. 2012).

To date, three species of Theraphosidaes have been reported on Pulau Pinang, including *Omothymus schioedtei* (arboreal), *Coremiocnemis cunicularia* (terrestrial), and *Chilobrachys andersoni* (terrestrial) (Karsch 1892; Thorell 1897). In 2010, West and Nunn (2010) briefly mentioned the fossorial nature, preferred habitat and burrow structure of *Coremiocnemis cunicularia*. However, comprehensive studies on the ecology and habitat preference of Theraphosidaes on Pulau Pinang are lacking. Therefore, this study was conducted to investigate the microhabitat parameters of *Chilobrachys andersoni* and *Coremiocnemis cunciularia* on Pulau Pinang. Additionally, the microhabitat parameters of *Coremiocnemis cunciularia* and *Chilobrachys andersoni* were compared to determine the variations or similarities of their preferred habitat.

MATERIALS AND METHODS

SAMPLING AREAS

The samplings were conducted between May and September 2022 at selected locations within the Bukit Bendera Biosphere Reserve, encompassing approximately 12,481 hectares or 41% of the total area on Pulau Pinang, Malaysia. The study areas comprised Penang Hill, Ayer Hitam, Alvira Hill, Telok Bahang National Park, and Balik Pulau as illustrated in Figure 1.

SAMPLING

In this study, sampling was conducted in the night-time (from 2000 to 2200 h) as Theraphosidaes are nocturnal animals (Fukushima et al. 2019). During the night-time, the Theraphosidae will typically remain in front of the burrow, with the spider extending its legs waiting at the entrance (Figure 3(a) & 3(b)). Additionally, the presence of silk webbing covering the burrow entrance and wall was used to detect the burrow of Theraphosidae (Machkour-M'Rabet et al. 2007). Typical habitats for both species in this area are sloped hills near trails as shown in Figure 2(c). The different Theraphosidae species were then differentiated based on their physical morphology. In this study, microhabitat preference data of two Theraphosidae species, including *Coremiocnemis cunciularia* and *Chilobrachys andersoni* were identified. Both adults and juveniles from the same species were found in the same sampling site. *Coremiocnemis cunciularia* has finer hairs and shorter legs, with stouter and black femurs, a cinnamon color carapace, and long hair on its hind legs (West & Nunn 2010). *Chilobrachys andersoni* generally have long legs, a carapace slightly shorter than protarsus number IV, coarser hair, and light brown body coloration (Pocock 1900).

After a burrow was found, a flashlight was used to observe the interior of the burrow. In this study, data regarding the microhabitat parameters were excusively collected from burrows with the presence of the Theraphosidae at that moment as shown in Figure 3. The findings on microhabitat parameters were categorized

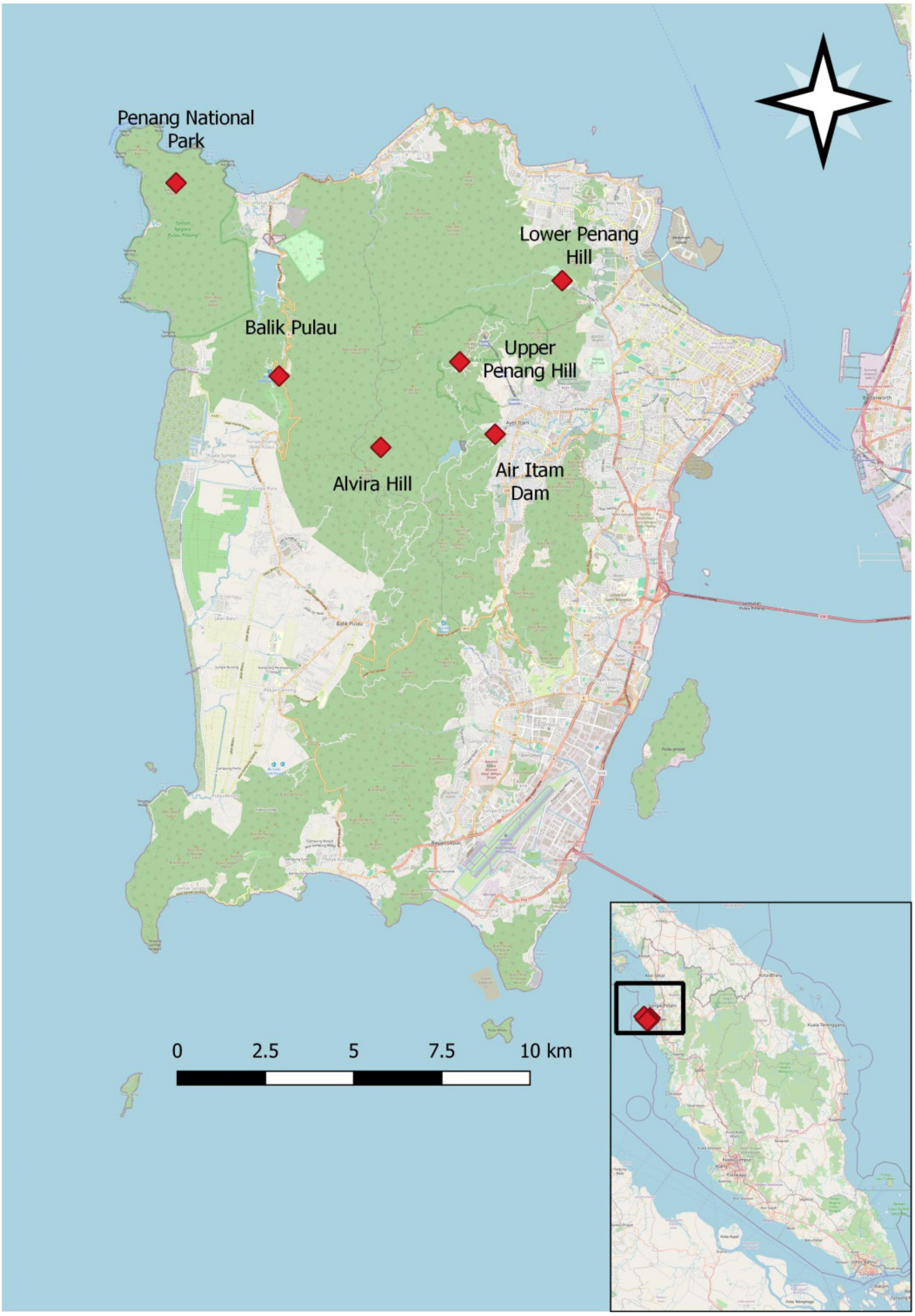

FIGURE 1. Map illustrating the study sites of this study

into two groups, which include abiotic and biotic factors. For abiotic factors, the parameters comprised of i) compass bearing of the burrow entrance, ii) canopy cover, iii) height of door entrance from ground, iv) door entrance diameter, v) distance of burrow from the trail, vi) soil temperature, vii) surrounding humidity, viii) surrounding temperature, ix) burrow entrance characteristic, and x) altitude of the burrow were collected. The height of the door entrance from ground was measured using measuring tape from the ground to the burrow vertically, whereas altitude of the burrow refers to the elevation of the burrow location above sea level, measured in meters. Burrow entrance characteristic were categorized as leaf litter, bare soil,woody vegetation or grass following Canning, Reilly and Dippenaar-Schoeman (2014). Regarding biotic factors, three different parameters that were assessed, including i) type of forest, ii) type of trail in close proximate with the burrow, and iii) plant species richness at the burrow site. A plant soil survey instrument was used to determine the soil temperature, pH value, and humidity of the soil. A thermometer was utilized to ascertain the surrounding temperature of the burrows, while a hygrometer was used to determine the surrounding humidity of the burrows. The height and diameter of the burrows, as well as the distance of the burrows from the trails were measured using a measuring tape.

DATA ANALYSIS

Descriptive analysis was applied to the collected datasets using Minitab 20 software. Besides, chi-square and T-test were used to compare the microhabitat parameters between the two Theraphosidaes species using Minitab 20 software. Multivariate analysis was done to assess the relationship between the habitat parameters (Türkmen & Kazanci 2020). Principal component analysis (PCA) was applied to continuous data to determine the most significant parameter that contributed to the highest variation of the burrows between *Coremiocnemis cunicularia* and *Chilobrachys andersoni*. The PCA was carried out based on the variance-covariance matrix using PAST 4.03 software. Non-metric multi-dimensional scaling (nm-MDS) analysis was carried out to determine the similarity of the burrows of *Coremiocnemis cunicularia* and *Chilobrachys andersoni* based on their microhabitat parameter (Bahtiar & Purnama 2020). A nm-MDS scatter plot illustrating the similarities between the species was generated based on the Grower index using PAST 4.03 software.

RESULTS AND DISCUSSION

DISTRIBUTION OF BURROWS OF *Coremiocnemis cunicularia* AND *Chilobrachys andersoni*

In this study, *Coremiocnemis cunicularia* was detected in three out of seven sampling sites while *Chilobrachys andersoni* was found in four different locations as shown in Table 1. The total number of burrows of *Coremiocnemis cunicularia* and *Chilobrachys andersoni* observed in this study were 36 and 38, respectively.

OVERALL DESCRIPTION AND COMPARISON OF HABITAT PARAMETERS OF *Coremiocnemis cunicularia* AND *Chilobrachys andersoni*

The summary of compass bearing, burrow entrance characteristics, type of forest, and type of trail in close proximity to the burrows of *Coremiocnemis cunicularia* and *Chilobrachys andersoni* is presented in Table 2. It was found that the number of burrows of Theraphosidae varied significantly based on the type of trails. Table 3 summarizes the canopy cover, height of door entrance from the ground, burrow diameters, distance of burrow from the trail, soil temperature, surrounding humidity, surrounding temperature, altitude, and plant species near burrows of *Coremiocnemis cunicularia* and *Chilobrachys andersoni*. T-test analysis showed that burrows of *Coremiocnemis cunicularia* were significantly different from the burrows of *Chilobrachys andersoni* in terms of the height of the burrow entrance from the ground, burrow diameters (both horizontal and vertical diameter), distance of burrow from the trail, soil temperature, the surrounding temperature, and altitude. Specifically, the burrow of *Chilobrachys andersoni* has a higher entrance and larger dimension as compared to the *Coremiocnemis cunicularia*. Additionally, the average for soil temperature and surrounding temperature of the burrows for *Chilobrachys andersoni* were significantly higher. Lastly, the average altitude for the burrow of *Coremiocnemis cunicularia* is higher than *Chilobrachys andersoni*. However, no significant differences were observed in regards to the canopy cover and surrounding humidity of the burrows between the two species.

PCA AND nm-MDS ANALYSIS OF MICROHABITAT PARAMETERS OF BURROWS

Regarding the PCA test of the continuous microhabitat parameters, Principal Component 1 (PC1) and Principal Component 2 (PC2) explain the variance at 96.0% and 2.8%, respectively. It was observed that PC1 is strongly associated with the altitude of the burrows. Meanwhile, PC2 shows the strongest association with the distance of the burrow from the trail as shown in Table 4. Since the percentage of variation explained by PC2 is low, it is reasonable to conclude that the differences between the microhabitat parameters of the two species of Theraphosidae can be primarily explained by the altitude of the burrows alone. A scatter plot based on PC1 and PC2 was generated as illustrated in Figure 4. The plot showed that all the burrows of *Coremiocnemis cunicularia* situated at an altitude higher than the burrows of *Chilobrachys andersoni*. However, no significant variation

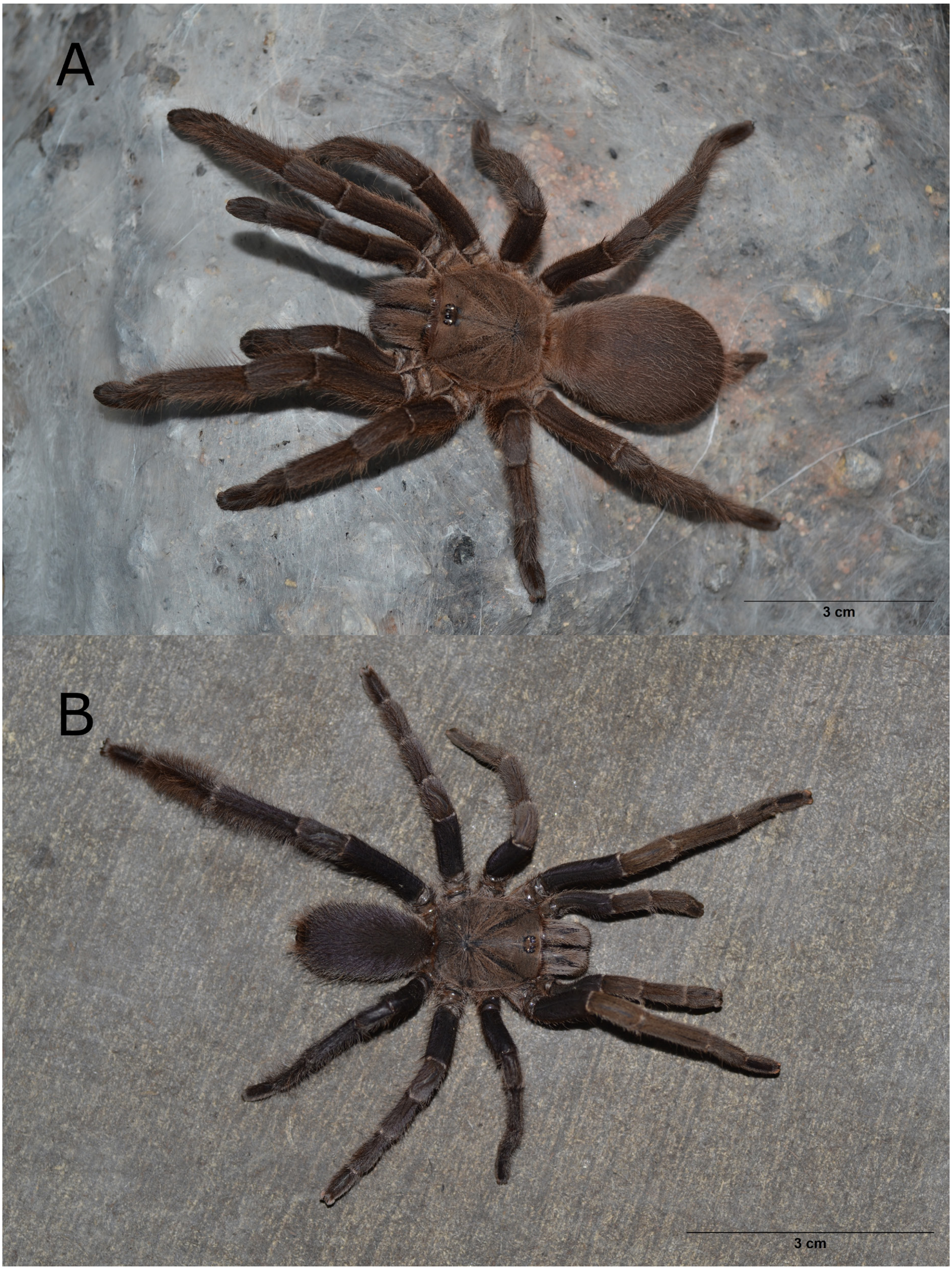

FIGURE 2. A) Adult female *Chilobrachys andersoni* and B) Adult female *Coremiocnemis cunicularia*

FIGURE 3. A) Adult female *Coremiocnemis cunicularia* resting on the entrance of its burrow, B) Adult *Chilobrachys andersoni* resting on the entrance of its burrow, and C) Typical habitat for *Coremiocnemis cunicularia* that is also similar with *Chilobrachys andersoni* habitat

TABLE 1. Distribution of *Coremiocnemis cunicularia* and *Chilobrachys andersoni* according to the sampling sites

No.	Localities	GPS	*Coremiocnemis cunicularia*	*Chilobrachys andersoni*
1.	Penang Hill > 400 m a.s.l	5°25’22.0”N 100°15’54.6”E	Yes	No
2.	Penang Hill < 400 m a.s.l	5°24’30.7”N 100°16’37.3”E	No	Yes
3.	Penang National Park	5°27’21.4”N 100°11’50.0”E	No	Yes
4.	Balik Pulau	5°25’36.1”N 100°13’10.6”E	No	Yes
5.	Air Itam Dam	5°23’57.2”N 100°16’28.9”E	No	Yes
6.	Elvira Hill	5°23’27.2”N 100°14’26.6”E	Yes	No

N=North; E=East

was observed when comparing the distance of the burrow from the trail between these two species. Nevertheless, the *Chilobrachys andersoni* exhibit a looser clustering compared to *Coremiocnemis cunicularia*, indicating greater variation in terms of habitat parameters (altitude and burrow from the trail) within *Chilobrachys andersoni* group compared to the *Coremiocnemis cunicularia* group.

The nm-MDS analysis showed that the burrows of *Coremiocnemis cunicularia* and *Chilobrachys andersoni* formed two major clusters, indicating differences in the microhabitat parameters of burrows for these two species, as shown in Figure 5. The stress value of the nm-MDS scatter plot was low at 0.1266, suggesting the plot is a good representation of the relationship between *Coremiocnemis cunicularia* and *Chilobrachys andersoni*. The nm-MDS analysis also demonstrated that the burrows of *Coremiocnemis cunicularia* have a tighter cluster than the *Chilobrachys andersoni*, indicating that the burrows of *Coremiocnemis cunicularia* displayed higher similarity than those of *Chilobrachys andersoni*.

TABLE 2. Distribution of burrows of *Coremiocnemis cunicularia* and *Chilobrachys andersoni* according to categorical microhabitat parameters

Microhabitat Parameters		Number of burrows (%)		Chi-Square test
		Coremiocnemis cunicularia	*Chilobrachys andersoni*	*P*-value
Compass bearing	North	11 (30.5)	15 (39.5)	0.345
	East	3 (8.3)	4 (10.5)	
	South	11 (30.5)	14 (36.8)	
	West	11 (30.5)	5 (13.2)	
Burrow entrance characteristics	Bare soil	22 (61.1)	31 (81.6)	N. D.
	Leaf litter	13 (36.1)	1 (2.6)	
	Woody vegetation	1 (2.7)	5 (13.2)	
	Grass	0 (0)	1 (2.6)	
Type of forest	Lowland dipterocarp	0	38 (100)	N. D.
	Hill dipterocarp	33 (91.7%)	0 (0)	
	Upper dipterocarp	3 (8.3%)	0 (0)	
Type of trail that is close to the burrow	Vehicle trail	29 (80.6)	37 (97.4)	0.020*
	Hiking trail	7 (19.4)	1 (2.6)	

*Significantly different; N. D. = No data

TABLE 3. Description of microhabitat parameters of burrows of *Coremiocnemis cunicularia* (n=36) and *Chilobrachys andersoni* (n=38)

Microhabitat parameters	*Coremiocnemis cunicularia*		*Chilobrachys andersoni*		T-test
	Mean ± SD	Range	Mean ± SD	Range	*P*-value
Canopy cover (%)	31.4 ± 11.3	13.2 - 59.0	28.0 ± 14.3	11.0 - 63.7	0.26
Height of door entrance from the ground (cm)	105.0 ± 31.0	40.0 - 153.0	157.4 ± 46.9	41.0 - 170.8	0.00*
Burrow diameter, horizontal (cm)	2.1 ± 1.0	0.6 - 4.5	2.6 ± 1.3	1.1 - 5.2	0.04*
Burrow diameter, vertical (cm)	2.0 ± 0.9	0.7 - 4.1	2.7 ± 1.4	1.5 - 6.2	0.01*
Distance of burrow from the trail (cm)	165.9 ± 37.4	85.0 - 230.0	188.3 ± 43.2	122.0 - 293.0	0.02*
Soil Temperature (°C)	23.9 ± 0.5	23.0 - 25.0	28.3 ± 1.0	27.0 - 29.0	0.00*
Surrounding humidity (%)	86.6 ± 3.0	77.0 - 89.0	82.5 ± 5.4	74.0 - 88.0	0.26
Surrounding temperature (°C)	25.3 ± 0.7	24.0 - 26.0	28.2 ± 1.2	26.0 - 30.0	0.00*
Altitude (m)	687.5 ± 31.0	649.0 - 771.0	140.2 ± 49.1	85.0 - 233.0	0.00*
Plant species near burrow	3.6 ± 1.3	1.0 - 6.0	2.8 ± 1.4	1.0 - 7.0	0.01*

* Significantly different

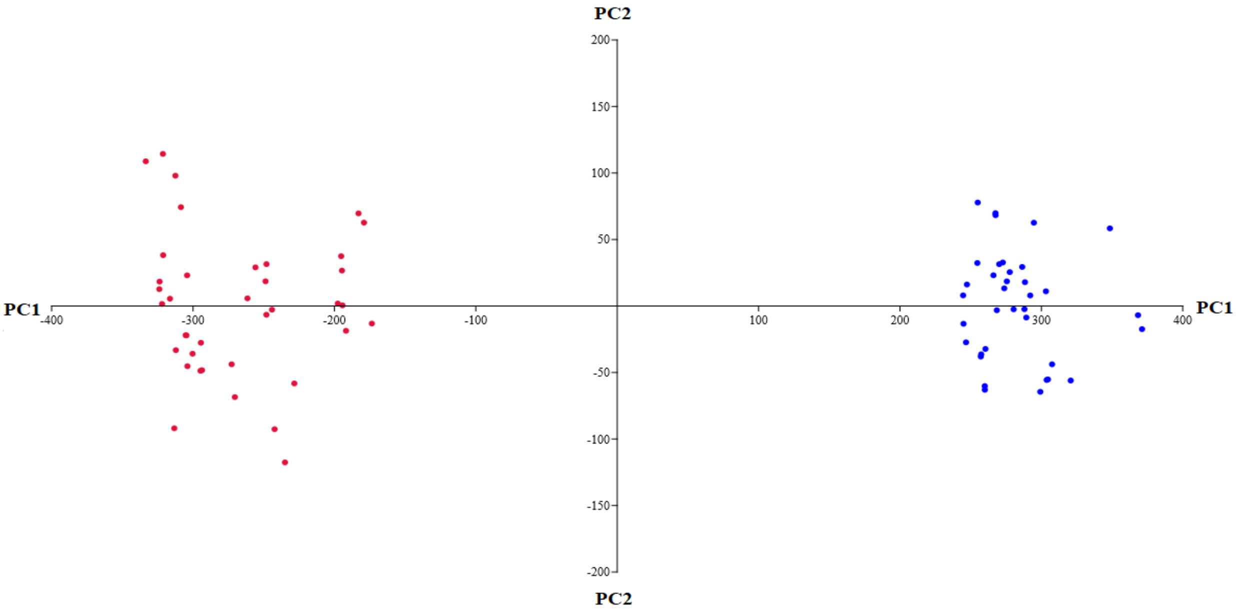

FIGURE 4. PCA scatter plot (PC1 vs PC2) for the continuous microhabitat parameter of *Coremiocnemis cunicularia* (blue dots) and *Chilobrachys andersoni* (red dots)

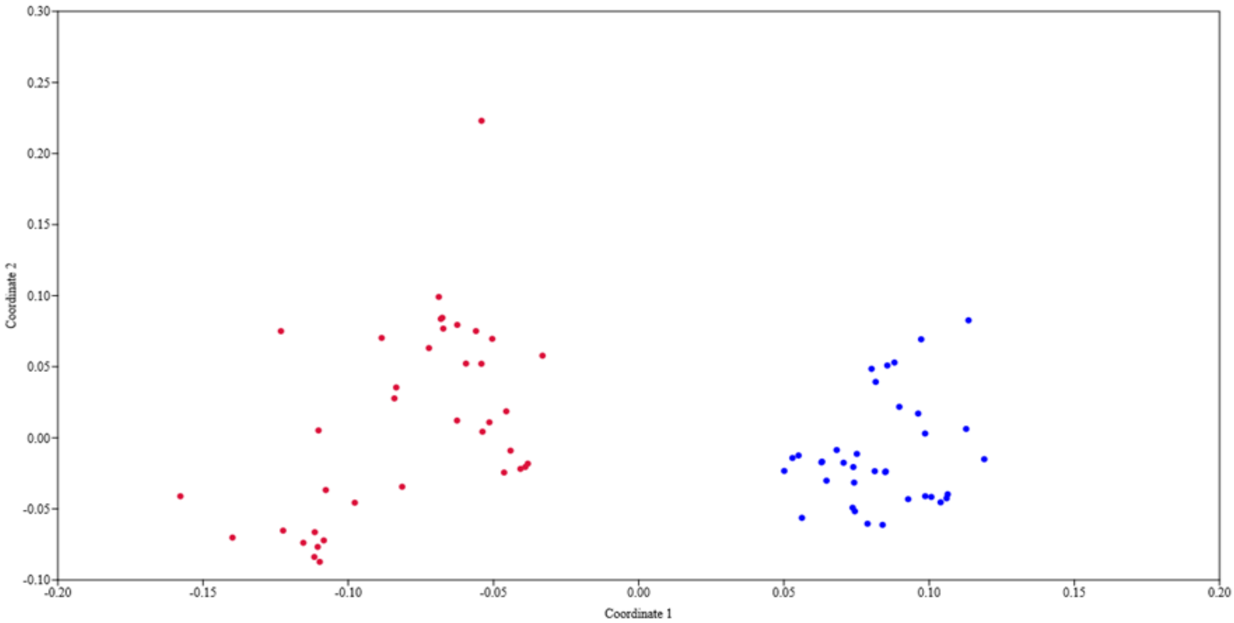

FIGURE 5. The nm-MDS scatterplot (stress value 0.1266) is based on the microhabitat parameters of *Coremiocnemis cunicularia* (blue dots) and *Chilobrachys andersoni* (red dots)

TABLE 4. Loadings showing the association between the habitat parameters with the PC1 and PC2

No.	Habitat parameter	PC 1	PC 2
1.	Canopy cover (%)	0.007	-0.023
2.	Height of door entrance from the ground (cm)	-0.101	0.665
3.	Door entrance diameter horizontal (cm)	-0.001	0.004
4.	Door entrance diameter vertical (cm)	-0.001	0.004
5.	Distance of the burrow from the trail (cm)	-0.038	0.740
6.	pH	0.000	0.002
7.	Soil temp (°C)	-0.008	0.002
8.	Surrounding humid (%)	0.008	-0.013
9.	Surrounding temp (°C)	-0.005	0.004
10.	Altitude	0.994	0.096

DISCUSSION

In general, native species tend to assemble based on their adaptation to local and abiotic factors (Mayfield & Levine 2010). More than often, animal species prefer habitats similar abiotic and biotic conditions to those of their previous habitat (Emerson & Gillespie 2008). Therefore, data regarding the abiotic and biotic factors of the Theraphosidae burrow are crucial for the conservation of the species within the specific region. Hence, this study examined the habitat preference and soil preference of two Theraphosidae species, *Coremiocnemis cunicularia* and *Chilobrachys andersoni* on Pulau Pinang. Additionally, the presence and abundance of tarantulas can serve as bioindicators to assess forest health (Schwerdt, de Villalobos & Pérez-Miles 2018). Since tarantulas are sedentary, individuals can be monitored over time. The choice of microhabitat by dispersing spiderlings is a critical initial step towards successful establishment of a life-long burrows, as burrows require a significant investment of time and effort to develop (Mason, Bateman & Wardell-Johnson 2018). To the best of our knowledge, this study is the first to report the microhabitat parameters of *Coremiocnemis cunicularia* and *Chilobrachys andersoni* in Malaysia.

From the findings collected in this study, both species exhibit distinct habitat preferences across several microhabitat parameters. Specifically, significant differences were observed in term of the height and vertical size of the burrow entrance, the distance of the burrow from the trail, soil temperature, plant species richness near the burrow entrance, surrounding temperature, and altitude of the burrows.

Coremiocnemis cunicularia and *Chilobrachys andersoni* are burrowing Theraphosidae known for their tendency to remain in their burrows for extended periods. Burrowing Theraphosidae typically seek retreat in sloped and shaded forest areas (Aguilera, Montenegro & Casanueva 2019; Marshall & West 2008; West, Nunn & Hogg 2012). In this study, it was observed that the average height of the door entrance of *Chilobrachys andersoni* was higher compared to that of *Coremiocnemis cunicularia*. The difference in door entrance height may be attributed to the varying sizes of the species, as bigger tarantulas often require burrows with larger entrances. However, the size of the two Theraphosidae species required further investigation as the present study did not measure the size of the tarantula that occupying, to prevent harm to the Theraphosidae during the sampling. Nonetheless, a previous study reported that adult female size of *Coremiocnemis cunicularia* was approximately 45.48 mm (West & Nunn 2010). However, there are no published findings available regarding the body size of *Chilobrachys andersoni*.

In the current study, the average altitude of burrows of *Coremiocnemis cunicularia* (687.5 m) was higher than *Chilobrachys andersoni* (140.2 m). This finding aligns with the observations made by West and Nunn (2010), who stated that *Coremiocnemis cunicularia* can be found at elevations ranging from 600 m to 790 m. Notably, this study represent the first report of the average altitude of burrows of *Chilobrachys andersoni* in Malaysia. The differences in altitude may account for the variations in the soil and surrounding temperature of the burrows of these two species, as altitude plays significantly influences the temperature of the surroundings, especially at higher elevations (Ohmura 2012). Interestingly, it was found that the average plant species richness around the burrows of *Coremiocnemis cunicularia* was higher compared to *Chilobrachys andersoni*. Past studies have highlighted the importance of plant species richness as a habitat parameter for tarantula, as it can impact the availability of prey for Theraphosidae (Yáñez & Floater 2000). Moreover, it is known that species abundance typically declines with increasing elevation (Adedoja, Kehinde & Samways 2020). Therefore, *Coremiocnemis cunicularia* which inhabits at higher altitudes may prefer habitats with high plant species richness to facilitate access to food sources. Additionally, vegetation or leaf litter characteristic have been suggested as predictor to detect the presence of the spider's burrow. For example, Marshall and West (2008) reported that a species of Theraphosidae, *Ephebopus murinus* was strongly associated with a specific type of vegetation named *Bromelia* spp. However, in this study, it appeared that the Theraphosidae species prefer burrow entrances with bare soil, followed by leaf litter. Nevertheless, another study reported that *Nesiergus insulanus* prefers burrow entrance with leaf litter and bare soil (Canning, Reilly & Dippenaar-Schoeman 2014).

In this study, certain habitat parameters such as canopy cover and surrounding humidity of the burrows between these two species showed minimal differences. Both *Coremiocnemis cunicularia* and *Chilobrachys andersoni* species exhibited a preference for hilly and forested areas with dense tree canopy, likely due to their inclination inhabit forested areas with high humidity. A study in 2017 reported that *Phlogiellus longipalpus* from Thailand displayed a preference towards habitats with high humidity (Chomphuphuang et al. 2017). Moreover, canopy cover is recognised as an essential habitat requirement for spiders (Košulič & Vichitbandha 2016). Additionally, this study showed slight differences in habitat parameter between the two species, including the bearing of the burrow, type of forest, type of trail, and characteristic of the burrow entrance. However, both Theraphosidae species shared a similar habitat topography, predominantly favoring hilly areas. Despite their shared preference for hilly terrain, there was a notable elevation distinction between the two species. *Chilobrachys andersoni* showed a preference for lowland dipterocarp forest habitats, whereas *Coremiocnemis cunicularia* was found in hill dipterocarp and upper dipterocarp forest habitats. The factor contributing to this differences between the two species could be their adaptability to specific temperature ranges. Species from highland area (*Coremiocnemis cunicularia*) can only live in the area higher than 500 m elevation with colder temperature, whereas *Chilobrachys andersoni* can only live in places lower than 400 m elevation with higher surrounding temperature.

CONCLUSIONS

This study highlighted that microhabitat parameters of *Coremiocnemis cunicularia* and *Chilobrachys andersoni* were not similar, indicating distinct microhabitat perefences for these two species of Theraphosidae. Nonetheless, both Theraphosidae species are delicate and sensitive spiders that depends on healthy forests to provide suitable habitats for their survival. Therefore, it is imperative to undertake proper conservation work to ensure the stability of the forest ecosystem and the survival of Theraphosidae on Pulau Pinang. Regular monitoring of the burrows of these remarkable creatures should be conducted to support in the implementation of the national conservation plan.

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*Corresponding author; email: amirrudin@umt.edu.my