Pertanika J. Trop. Agric. Sci. 24(1): 43 - 48 (2001) ISSN: 1511-3701

Preliminary Study on Diversity and Abundance of Ichneumonids and Braconids (Insecta: Hymenoptera) at the Ayer Hitam Forest Reserve

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Keywords: Diversity, abundance, Hymenoptera, Ayer Hitam Forest Reserve

ABSTRAK

Satu kajian awal tentang kepelbagaian dan kelimpahan ichneumonid dan braconid (Insecta: Hymenoptera) di Hutan Simpan Ayer Hitam (AHFR), Universiti Putra Malaysia telah dijalankan dari 4 – 11 April 2000. Hasil kajian ini menunjukkan bahawa AHFR didiami oleh pelbagai spesies ichneumonid dan braconid. Secara keseluruhannya, didapati bahawa spesies ichneumonid adalah hampir dua kali lebih melimpah dan pelbagai berbanding braconid. Walau bagaimanapun, kedua-dua kumpulan serangga ini mempunyai kepelbagaian spesies yang lebih tinggi dan signifikan di bahagian tengah hutan berbanding di kawasan pinggir hutan. Dua lagi tambahan subfamili ichneumonid (Adelognathinae dan Orthopelmatinae) untuk Malaysia telah ditemui dari hutan ini.

ABSTRACT

A *preliminary study on diversity and abundance of ichneumonids and braconids (Insecta: Hymenoptera) of Ayer Hitam Forest Reserve (AHFR) of Universiti Putra Malaysia was conducted from 4 – 11 April 2000. Results showed that AHFR houses a variety of ichneumonid and braconid species. Generally, the ichneumonids were nearly twice as abundant and diverse than braconids. However, both insect groups were significantly more diverse in the middle than in the forest fringes. Two more additions of ichneumonid subfamilies (Adelognathinae and Orthopelmatinae) for Malaysia were discovered from this forest.*

INTRODUCTION

Insects are the most abundant animals on earth and two-thirds of insects inhabit the tropical rain forest. In Peninsular Malaysia, majority of these insects occupy the lowland forests. These forests provide habitats for thousands of insect species that are functionally important to the forest ecosystems. Insects can be pollinators, decomposers, herbivores, predators or parasitoids. Most parasitoids are in the order of Hymenoptera. They use or parasitize other insects for reproduction. As such, they are important regulators of other insect populations, mostly herbivores feeding on various parts of plants.

In recent years however, the rate of deforestation in the lowland forests is rather alarming. The destruction of natural habitats due to logging and development pose the greatest threat to insect communities in the forests. Since the parasitoid reproduction depends on other insects, their own population and role will be severely affected by the reduction of host population as a consequent of habitat destruction. In view of the changing ecosystem of Ayer Hitam Forest Reserve and its vicinity, a study on the diversity of Ichneumonids and Braconids, the two important group of parasitic Hymenoptera was conducted. Presently, scanty information is available on these in Malaysia except those of Idris (1996a and 1996b), Idris and Nur Azura (1998) and Nor Azura and Idris (1998).

MATERIALS AND METHODS

The study was conducted at Ayer Hitam Forest Reserve (AHFR), Puchong, Selangor, about 20 km southwest of Kuala Lumpur and 6 km from Universiti Putra Malaysia (UPM), Serdang Campus, Selangor, Malaysia, at latitudes between 20° 57' N to 30° 04' N and longitudes 101° 38'E to 101° 41'E. The AHFR is an undulating lowland dipterocarp forest ranging from 15 m to 157 m above sea level, managed as a forest reserve by the Forest Office of Central Selangor and was selectively logged between 1936 and 1965 (Mohamad Zakaria and Rahmat Topani 1999). The study sites were located within compartments 1, 2, 12, 13, 14 and 15 of AHFR that has been leased to UPM for 80 years under an agreement between Universiti Putra Malaysia and the state government of Selangor.

Two transects were established within the compartments, both were parallel to each other and 200 m apart. There were three sampling points (= treatments) chosen along each transect across the compartments viz., two each at both ends and one in middle. The distance between the points was between 200 and 250 m, and 30 - 50 m from the outer sampling point to forest edge. A total of six malaise traps were used and one trap was placed at each sampling point beginning 4 until 11 September 2000. Traps were left in the forest for eight days before insects were collected and brought to the laboratory for sorting and identification. The specimen identification was made based on Wahl and Sharkey (1993) and Townes and Chiu (1970).

In reducing error and getting a more representative data, the insects collected from similar sampling point of two transects were pooled before analysis. Data were analyzed using GW Basic program to get differential species diversity between sampling points (Robinson, 1991) while χ^2 was used to analyze differences in species and individual abundance among sampling points

RESULTS AND DISCUSSION

Abundance

The ichneumonids and braconids collected are shown in Tables 1 and 2. There were eight ichneumonid subfamilies collected viz., Cryptinae, Anomaloninae, Cremastinae, Adelognathinae, Diplazontinae, Orthopelmatinae, Pimplinae, Collyriinae and the seven braconid subfamilies include Agathidinae, Rogadinae, Microgastrinae, Gnamptodontinae, Opiinae, Cheloninae and Doryctinae. A total of 38 morphospecies and 95 individual ichneumonids were collected. The braconids on the other hand had only 14 morphospecies and 27 individuals (Table 2), 3 – 4 times less abundant than ichneumonid. Braconids also seemed to be less abundant than ichneumonids in the Permanent Forest Reserve of Universiti Kebangsaan Malaysia (PFR-UKM) (Idris 1996b). As such, results of this study tend to disagree with universal claim that in tropical regions braconids are more abundant than ichneumonids (Noyes 1989, La Salle and Gauld 1993).

Of the eight ichneumonid subfamilies collected, the cryptine had the most numbers of morphospecies (22) and individuals (58) as compared with other subfamilies and morpho-species numbered 22, seemed to be the most abundant in AHFR (Table 1). This tends to agree with what was reported by Wahl and Sharkey (1993) as the majority of cryptine species are generalist and/or idiobiont parasitoid having wide host ranges irrespective of habitats. The morpho-species numbered 21 (Table 1) seemed to occur at all sampling points, indicating they are the least group that could be severely affected by habitat disturbances. As for braconids, however, no single subfamily seemed to have more number of morphpospecies over the others (Table 2). This indicates that AHFR does not have much resource to support braconid populations.

Although the collection was made for a period of one week, this study was successful in adding two more ichneumonid subfamilies for Malaysia, i.e., Adelognathinae and Orthopelmatinae, from 18 as listed by Idris (2000) to 20 subfamilies (55% of the total subfamilies recorded in the world). Interestingly, these two subfamilies were not collected from the PFR-UKM located only 15 km away from AHFR although studies at PFR-UKM was conducted for almost three consecutive years (Idris 2000, Hasnah 1999). This indicates that AHFR has plants and food sources that support the insect hosts of Adelognathinae and Orthopelmatinae as well as the parasitoids.

There was a significant difference in the number of species and total individuals of ichneumonids or braconids collected among

TABLE 1
List of Ichneumonidae collected from Ayer Hitam Forest Reserve, UPM

Subfamily	Sampling Point[a]	Morphospecies	Number of Individuals
Cryprinae	I	1	1
		10	1
		14	3
		16	3
		17	1
		18	1
		19	4
		21	1
		22	8
	II	2	1
		3	1
		4	1
		5	1
		6	1
		7	1
		8	1
		9	1
		11	1
		12	1
		13	1
		15	5
		19	1
		20	1
		21	4
		22	13
	III	21	3
Anomaloninae	I	1	2
		2	3
		3	1
		4	1
Cremastinae	I	1	1
Adelognathinae	I	1	6
Diplazontinae	I	1	2
Diplazontinae	II	1	1
		2	1
Orthopelmatinae	II	1	1
		2	1
		3	1
Pimplinae	II	1	1
		2	5
		3	4
Collyrinae	II	1	2
Pimplinae	III	1	1
Total	8	39	95

a I, Inner, II (middle), III(near forest fringes)

TABLE 2
List of Braconidae collected at Ayer Hitam Forest Reserve, UPM

Subfamily	Sampling Point[a]	Morphospecies	Number of Individuals
Agathidinae	I	1	1
Rogadinae	I	1	1
Microgastrinae	I	1	1
		2	5
Agathidinae	II	1	1
		2	1
Gnamptodontinae	II	1	3
		2	1
Opiinae	II	1	1
		2	1
		3	1
Microgastrinae	II	1	1
		2	1
		3	3
Cheloninae	II	1	1
Doryctinae	II	1	2
		2	1
Microgastrinae	III	1	1
Total 7		14	27

a I, Inner, II (middle), III(near forest fringes)

sampling points (χ^2 = 22.3 or 15.3, df = 2) (Tables 1 and 2). Both parasitoid populations tend to be lower at the forest fringes than in the middle (Tables 1 and 2). This is probably due to the abundance of insect hosts and food sources which increases from the forest fringe towards the interior forest. The ground-dwelling insects in AHFR were also found to be more abundant in the middle of the forest (Sajap *et. al.* 1999). In Sulawesi, Indonesia, parasitic hymenopterans are more abundant along the forest edge than in the inner forest (Noyes 1989). This was said to be due to plenty of nectar sources along the forest edge as compared to the inner forest.

Diversity

The diversity (Shannon index, H') for ichneumonid and braconid species is shown in Table 3. For ichneumonid species, H' was significantly higher ($P < 0.05$) at the sampling points 'I' (innermost) and 'II' (middle) than at the sampling point 'III' (forest fringes). In contrast, the braconid species was significantly more diverse at 'II' (H' = 2.45) than at 'I' (H' = 1.07) or 'II' (H' = 0). Generally, species diversity is influenced by the combination of two important factors i.e., the species evenness (E) and species richness (R) (Pielou 1975). However, our results suggest that 'E' plays a more important role in determining diversity than that of 'R'. As shown in Table 3, the ichneumonid species was less abundant at sampling point 'I' (R = 4.09) than at 'II' (R = 6.07) but its evenness was just slightly higher at 'I' (E = 0.89) than at II (0.86). Similarly for the braconids, the low H' value at 'I' may due to the low E rather than R value. There was no H' value for braconid species at 'III'. This was simply due to only one species or individual collected. Higher diversity in the middle of the

TABLE 3
Shannon index for species diversity (H'), evenness (E) and Margalef's index (richness, R) among plots for Ichneumonids and Braconids collected from Ayer Hitam Forest Reserve

Family	Sampling Point[a]	H'	E	R
Ichneumonids	I	2.49a	0.89	4.09
	II	2.76a	0.86	6.07
	III	0.56b	0.81	0.72
Braconidae	I	1.07b	0.77	2.44
	II	2.45c	0.95	4.15
	III	0a	0.00	0.00

[a] I, Inner, II (middle), III(near forest fringes).
In Column, the H' values with same letters are not significantly different (paired t-test, $P > 0.05$)

AHFR than in the forest fringes is expected as availability of life support resources (insect hosts and food/nectar sources) are more in the middle than in forest fringes. As discussed in the 'abundance' section above, the resource availability in the interior than at the edge of AHFR may play a big role in determining the H' value of the parasitoids. The abundance of insect hosts and food sources are important for the life and reproduction of most parasitic Hymenoptera such as ichneumonid and braconids (Jervis and Kidd 1996, Jervis *et al.* 1993). Sajap *et al.* (1999) also reported that the diversity of ground-dwelling insects increases from the forest fringes toward the centre of the forest.

It is interesting to note that H' of braconids at 'I' was significantly less diverse than at 'II' (Table 3). Unlike ichneumonids, the braconids are generalist parasitoids, and most probably they have high numbers of insect host species available around point 'II' than point 'I'. The specialist parasitoids such as ichneumonids are very mobile and actively find its hosts that are scattered in the landscape or forest (Hawkin and Sheehan 1994). Therefore, they have a higher probability of being trapped than the braconids.

CONCLUSION

Results of our preliminary study indicated that AHFR has diverse ichneumonid and braconid species. AHFR currently acts as a refuge for many animals including insects nearby that are adversely affected by loss of habitats due to forest destruction and fragmentation. However, the current diversity of these parasitoids may decline if their life supports' resources continue to deplete as a result of forest disturbances. The longevity and fecundity of many parasitoids is highly correlated with the availability of nectar sources (Idris and Grafius 1995). The on-going and future projects such as housing estates and infrastructure construction occurring around the AHFR may also change the forest environment conditions that may be unfavorable to the ichneumonids and braconids, their insect hosts and associated food plants.

It is expected that more insects will be collected if the experiment is prolonged for at least a year. By so doing, information on the distribution pattern and presence of some new species could be recorded. This information may help us to understand which species may be a keystone species, endemic to AHFR or useful to be used as an indicator of habitat disturbance. Since Adelognathinae and Orthopelmatinae species have only been recorded in temperate areas, it is worthwhile to further investigate these taxa together with their hosts and plants that associate with them.

ACKNOWLEDGEMENT

We are grateful to the Faculty of Forestry, Universiti Putra Malaysia for allowing us to conduct the study in AHFR. Many thanks to Mrs Nor Azura and Ms Normala, Faculty of Science and Technology, Universiti Kebangsaan Malaysia for their assistance in the laboratory. This study was funded by IRPA grants 09-02-02-022 and 09-02-02-0170.

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