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# CURRENT STATUS ON THE DIVERSITY AND ABUNDANCE OF ICHNEUMONIDS (HYMENOPTERA: ICHNEUMONIDAE) IN KUALA LOMPAT FOREST RESERVE, PAHANG

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**Abstract**
*The ichnuemonids (Hymennoptera: Ichneumonidae) are parasitic wasps which play a key role in maintaining insect population dynamics in forest and agricultural ecosystems. Due to this fact, some species are being used as important biological control agents of insect pests of economic importance and proved to be one of the best biological indicators of forest disturbance. As such, a study on the diversity and abundance of ichnuemonids (Hymennoptera: Ichneumonidae) in Kuala Lompat Forest Reserve, Pahang (KLFR) was conducted. In this study, the ichnuemonids were collected continuously for three months using Malaise trap. A total of five malaise traps were located at different plots in the surrounding area. The collected specimens were identified up to morphospecies level. Data was analyzed using Bio-DAP software to get the ecological indexes (Shannon-Wiener diversity Index (H'), the Evenness Index (E) and the Margalef Index (R')). A total of 350 individuals from 14 subfamilies and 45 morphospecies were successfully collected from KLFR. The subfamily collected were Adelognathinae, Anomaloninae, Campopleginae, Cremastinae, Cryptinae, Ichneumoninae, Lycorininae, Mesochorinae, Metopiinae, Ophioninae, Orthocentrinae, Phrudinae, Pimplinae and Poemeniinae. The ecological index values were 3.18, 0.85 and 7.51 for the H'. E' and R', respectively, indicating high ichneumonid species diversity and individual abundance at KLFR. The highest number of individuals and morphospecies collected was from the subfamily Cryptinae (123, 10) and followed by Pimplinae (104,9). However, further investigation should be conducted in the near future to measure human interventions, biotic and abiotic factors that influence the diversity and abundance of ichneumonids in KLFR.*

**Keywords:**Diversity, Abundance, Ichneumonids, Primary Forest.

## 1. Introduction

Diversity can be defined as a total number of species, community or population in a given area, while abundance as a total number of individual or biomass for certain species in a certain area (Cracraft, 2002). The highest diversity among the animal kingdom is dominated by the insect's species (Davidson & Lyon, 1987) because they are very dynamic and produce large number of progenies due to their fertile reproduction (Gullan & Cranston, 2005). It comprises of about 75 percent of known animals and covers approximately more than one million species (Morisma, 1983). Besides that, insects also have high adaptability toward the earth`s fluctuating climates.

Hymenopterans, are abundant, naturally occurring predators and parasitoids in undisturbed forests that regulate insect pests within the balance of nature (Idris *et. al*., 2001). He also reported ichneumonids to be significantly more abundant in undisturbed habitat. Earlier reports by Wahl & Sharkey (1993), La Salle & Gauld (1993) and Goulet & Huber (1993) observed ichneumonids prefer cool moist climates than warm and dry making them highly host-specific and thus according to Idris *et. al* (2001) may contribute to them being highly sensitive to environmental changes. Ichneumonids need for protein-rich host for their reproduction and larval development as parasitoids was the key factor for their significant role in regulating the population dynamics of other insect hosts in most ecosystems (Jervis *et al*. 1993; Jervis & Kidd, 1996). For the past thirty years, ichneumonids have been utilized successfully as biological control agents in crop protection programs (Van Lenteren 2000). They have also successfully contributed to the protection of the flora and fauna of natural ecosystems (Causton, 2001).

Ichneumonids can be used as biological indicators of habitat disturbance (Idris *et.al.,* 2001a). Many parasitoids may respond to disturbance faster than vertebrates or other insect groups, giving them a potential of early indicators of environmental and ecological change (Kremen et al., 1993). Species richness and abundance of ichneumonids can be hypothesised to indicate plant diversity, structural complexity, availability of food and nesting resources (Sobek et al. 2009). Observations by La Salle & Gauld (1993) recorded ichneumonids was more abundant and diverse in the temperate regions than in the tropical regions.

The Kuala Lompat Forest Reserve (KLFR) (N 03º42.810', E 102º17.127') is a wildlife reserve area in Jerantut Pahang, Malaysia. It is managed by the Department of Wildlife and National Park Malaysia. In view of the changing ecosystem in the vicinity of Kuala Lompat Forest Reserve (Siti Khairiah *et. al*., 2011), it is imperative that some study on insects in their natural habitats be conducted systematically to document the diversity and abundance. Several earlier insect diversity studies have been conducted in KLFR for last 10 years such as on hymenoptera where Idris *et. al.,(*2001) recorded H'=2.9, 2.4 and 2.0 for braconid, chalcid and ichneumonid respectively. Siti Khiriyah *et. Al.,* (2011) recorded H'=1.88 for orthoptera and 2.65 for diptera in her studies.

In this study, special emphasis was given to documenting the diversity and abundance of ichneumonids (Insecta: Hymenoptera). It is hoped that this study will be a useful input for conservation program of parasitoids (ichneumonids).

## 2. Materials and Methods

The method used to intercept ichneumonid wasps in this study was the Malaises trap. The Malaises traps used were based on standard Townes-type, with a 180-cm long, 120-cm wide, and 200-cm high tent-like trap made of fine mesh material (Sueyoshi *et al*. 2003 and Makino *et al*. 2006). Five traps were set and arranged in transect lines beginning from the edge of the KLRF to the interior at 50- meter intervals. The Malaises traps were made of two wide mouthed plastic bottles (6cm X 16cm) with one inverted over the other. They were fitted at the edge of the tent-like roof structure. A 5 cm diameter hole was cut at the top bottle to fit a 5 cm plastic hose to serve as entry point for the insects. The bottom plastic bottle served as the collecting bottle which was half-filled with 300ml 70% ethanol. The traps were left in the study area for 3 months (March, April and May 2010) and samples were collected every month. The collecting bottles were replenished with new ones after every collection.

In the laboratory, the ichneumonid wasps were sorted out and separated from the other insect families which were trapped together in the Malaise traps. The collected specimens were identified to the subfamily up to morphospecies level referring to Townes (1969) and Broad (2006) by using dissecting microscope. The number of individuals and also the number of subfamily of ichneumonids were analysed using the Bio-DAP software (Thomas 2000) to obtain Shannon-Weiner diversity index, *H'*, Evenness Index, *E'* and the Margalef Index on richness, *R'*. The results were tabulated, discussed and concluded based on the collected data.

## 3. Results and Discussion

The results showed that a total of 350 individuals with 45 morphospecies of ichneumonids were successfully collected consisting of 14 subfamilies, namely Adelognathinae, Anomaloninae, Campopleginae, Cremastinae, Cryptinae, Ichneumoninae, Lycorininae, Mesochorinae, Metopiinae, Ophioninae, Orthocentrinae, Phrudinae, Pimplinae and Poemeniinae. The 14 subfamilies collected in the KLFR sampling sites turned out to be only 36% or 14 out of a total of 39 known ichneumonid discovered worldwide (Porter 1998; Yu & Horstmann 1997). This result concurred with previous studies by Idris *et al.* (2003), Idris (2000), Goulet & Huber (1993), La Salle & Gauld (1993) that stated all the subfamilies listed above can usually be found in the tropical regions.

Table 1: Number of individuals of the Ichneumonidae per subfamily collected from Kuala Lompat Forest Reserve, Pahang

| Subfamily | Morphospecies | No. of individuals (Morphospecies) |
|---|---|---|
| Adelognathinae | 1 | 7 (1) |
| Anomaloninae | 5 | 19(5) |
| Campopleginae | 4 | 20 (4) |
| Cremastinae | 1 | 6 (1) |
| Cryptinae | 10 | 123 (10) |
| Ichneumoninae | 4 | 18 (4) |
| Lycorininae | 1 | 3 (1) |
| Mesochorinae | 1 | 9 (1) |
| Metopiinae | 3 | 19 (3) |

| | | |
|---|---|---|
| Ophioninae | 1 | 5 (1) |
| Orthocentrinae | 2 | 5 (2) |
| Phrudinae | 2 | 11 (2) |
| Pimplinae | 9 | 104 (9) |
| Poemeniinae | 1 | 1 (1) |
| Total individuals | | 350 |
| Total no. of morphospecies | 45 | |
| Total no. of subfamilies | | 14 |

The largest individual collected from Kuala Lompat Forest Reserve sites was subfamily Cryptinae which consisted of 123 individuals (35.14%) with 10 morphospecies (Table 1 and Figure 1). According to Wahl & Sharkey (1993), Idris (2000) and Idris *et a*l. (2001), Cryptinae is the richest subfamily in terms of morphospecies and also highly abundant across most of the tropical areas. Pimplinae is the second largest consisting of 104 individuals (29.71%). This tends to agree with previous claims where both subfamilies of Cryptinae and Pimplinae highly correspond to the tropical regions (Townes & Chiu 1970 and LaSalle & Gauld 1993). Pimplinae was also said to be highly abundant in undisturbed forests (Idris, 2000). Pimplinae was also abundant in this study (29.71%) followed by Anomaloninae (5.43%), Metopiinae (5.43%), Ichneumoninae (5.14%), Phrudinae (3.14%), Mesochorinae (2.57%), Adelognatinae (2%), Cremastinae (1.71%), Ophioninae (1.43%), Orthocentrinae (1.43%) and Lycorininae (0.86%) [Figure 1]. Whereas, the lowest individuals collected came from the subfamily Poemeniinae, presenting only single individual (0.29%).

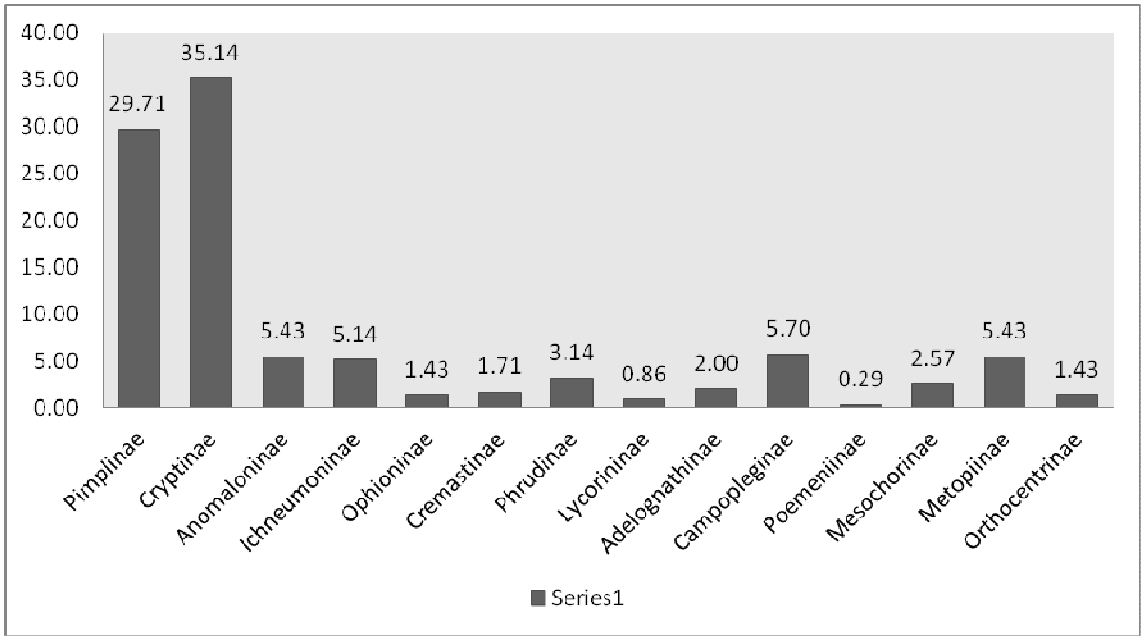


Figure 1: Percentage number of individuals of the Ichneumonidae per subfamily collected from Kuala Lompat Forest Reserve

Species diversity and abundance at Kuala Lompat Forest Reserve are presented in Table 2 where the Shannon Diversity Index (H'), Evenness Index (E') and Margalef's Index (R') recorded to be 3.18, 0.85 and 7.51, respectively. Since the evenness (H'= 0.85) and richness (E'= 7.51) indices were considered high, they are positively highly correlated with the diversity index. This means to indicate high diversity in terms of Ichneumonid population in the KLFR area. The populations uniformity in distribution reinforced the fact that the area had little or no disturbance. Species richness with 7.51 seemed to reflect the 350 individuals collected in the study.

Table 2: The Shannon diversity index (H`), species evenness (E) and species richness (R`) of ichneumonid subfamilies collected at the Kuala Lompat Forest Reserve

| Sites | Shannon`s Diversity Index (H`) | Shannon`s Evenness (E') | Margalef`s index (Richness, R`) |
|---|---|---|---|
| Kuala Lompat Forest Reserve | 3.18 | 0.85 | 7.51 |

## 4. Conclusion and Recommendation

The presence of ichneumonids in an area is a very important indicator to show signs of balance of the ecosystem. This has been proven by Townes and Chiu (1970) in their study area, where the presence of highly abundant ichneumonids was evident of little interference of the forest. Our assessment in KLFR, which is gazetted wildlife area, comprised of a substantial number of subfamilies and morphospecies of ichneumonids similar to those found by other researchers such as Idris *et al*. (2003), Idris (2000), Goulet & Huber (1993) and La Salle & Gauld (1993). These results seemed to indicate that the area is still an undisturbed area. This is clearly shown by the Shannon Diversity Index, H' of 3.18 for ichneumonid in our results, which is much higher than recorded by Idris, *et al*., (2001). Therefore, it is imperative that public awareness on the conservation and preservation of the area should be established and maintained. Local authorities and especially the plantation sector should play the leading role in this matter since they are the ones aware of places with human interventions.

It also recommended that this kind of study be continued in the KLFR area from time to time so that a database of beneficial organisms of not only ichneumonids can be recorded accordingly. Neighboring areas (ecosystem) should also be monitored. Seasonal sampling is also recommended to see the differences that exist in terms of climate and habitat.

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