OnLine Journal of Biological Sciences 1 (11): 1040-1042, 2001

Does Habitat Disturbance Has Adverse Effect on the Diversity of Parasitoid Community?

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Abstract: The diversity and population abundance of parasitoid community (Chalcids, Braconids and Ichneumonids) were conducted in various habitats in Peninsular Malaysia. The habitat studied were undisturbed forest (Kuala Lompat Wildlife Forest Reserve), disturbed forest (Pasoh Forest Reserve), highly disturbed forest (UKM Permanent Forest Reserve), agricultural (MARDI Fruit Orchard, PORIM Oil Palm and Rubber Estate) and non-forest/agricultural area (bush areas around UKM Campus, Bangi, Selangor). A total of 1420 Chalcids, 1193 Ichneumonids and 1066 Braconids were collected. In an agricultural ecosystem, Chalcids and Braconids were found to be significantly more abundant compared to highly disturbed forests while in an undisturbed forest Ichneumonids were significantly more abundant than in disturbed forest. The value of Shanon-Weiner diversity index (H') of these parasitic hymenoptera varies among habitats. Undisturbed forest exhibits a high H' for Chalcids, agricultural area for Braconids and non-forest/agricultural area for Ichneumonids. This indicates that habitat disturbances to some extent do not negate the abundance or diversity of the parasitic community. Disturbance may increase the abundance and the diversity of a certain parasitic insects while it has a reverse effect on others.

Key words: Diversity, habitat, disturbances, parasitoid, Peninsular Malaysia

Introduction

Sustaining biological diversity has become one of the principle goals of conservation. Gradually the goals have move from concern for specifically threatened species to the broader desire to protect ecosystems, thereby allowing many more species to benefit. As a result a variety of methods has been devised for quantifying the diversity of species within an ecosystem. The most thorough analysis of biodiversity in an ecosystem would be an inventory of all taxa and their relative abundance (Kim, 1993). Insect parasitoids have been focused here, because they provide many critically important ecosystem services (Hammond, 1995). Like other insect groups, parasitoids are well suited to monitoring landscape changes because of they abundance, species rich and most of them are ubiquitous in occurrence (Lewis & Whitfield, 1999)

The hymenopteran parasitoid is a big group of insects that primarily parasitizing other insects or arthropods for their development and reproduction (Hassell, 1982). For this reason the parasitoid communities are very important in population regulation of other insect herbivores that indirectly or directly involve in maintaining stability of any ecosystem (Jervis & Kidd, 1996; Hawkins & Sheehan, 1994). Many of them are also being used as biological control agents of economic important insect pests worldwide (Hawkins *et al.*, 1993). For examples, *Diadegma insulare* Cresson (Ichneumonidae) and *Cotesia plutellae* Kurdjimov (Braconidae) are being used in biological control agents in integrated management of diamondback moth, *Plutella xylostella* L., a major pest of crucifer crops (Biever *et al.*, 1994; Ooi, 1992). In addition, Speight *et al.* (1999) noted that the parasitods are good biological indicator of biodiversity or habitat disturbance. With the 'parasitoids' role in maintaining ecological balance, especially in forest ecosystems and with increasing disturbance to ecosystems due to human activities such as agricultural expansion, deforestation and urbanization, this study was conducted to ascertain the effect of habitat disturbance on the parasitoid community population abundance and diversity.

Materials and Methods

The experiment was carried out in different habitats in Peninsular Malaysia from July to November 1998 and from July to November 1999. These habitats represented different ecosystems namely: undisturbed forest (Kuala Lompat Wildlife Forest Reserve, KLWFR), disturbed or secondary forest (UKM Permanent Forest Reserve, UKM-PFR) and agricultural habitats (MARDI Fruit Orchard, MFO and PORIM Oil Palm, POP). Sampling was done using four randomly installed malaise traps (100 m apart) per habitat for one whole week duration per month and was repeated for three consecutive months. Insects collected were brought to the laboratory for proper preservation and identification to subfamily and morphospecies (Goulet & Huber, 1993). Statistical analysis was made using analysis of variance (one way-ANOVA) and the Shannon-Weiner Diversity Index was determined using the GW Basic Program (Robinson, 1991).

Results and Discussion

A total of 909 braconids, 1187 chalcids and 954 ichneumonids were collected. The agricultural habitat (in MFO) had a significantly ($P < 0.05$) higher number of braconids (404 individuals) and chalcids (618 individuals) than the undisturbed (KLWFR) and disturbed habitats (UKM-PFR). On the other hand, ichneumonids (657 individuals) were found to be significantly more abundant ($P<0.05$) in the undisturbed habitat (KLWFR) compared to the disturbed (UKM-PFR) and agricultural habitats (MFO and POP) (Fig. 1). This indicates that the ichneumonids more sensitive to habitat disturbances or environmental changes as compared with that of braconids and chalcids. The biology of most ichneumonids that prefer cooler environment, highly host-specific and feeding on certain food or plants (Wahl & Sharkey, 1993; La Salle & Gauld, 1993) may contribute to its highly sensitive environmental changes.

The difference in the abundance of these parasitoids with respect to the different habitats could also have been caused by the availability of additional resources aside from insect

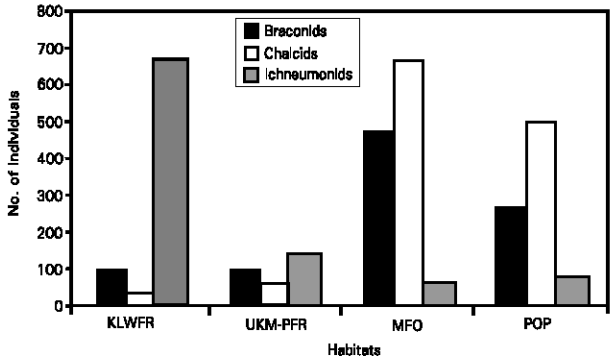

Fig. 1: Number of individuals of parasitoids in various habitats. (KLWFR, Kuala Lompat Wildlife Forest Reserve: UKM-PER, UKM permanent Forest Reserve MFO MARDI Fruit).

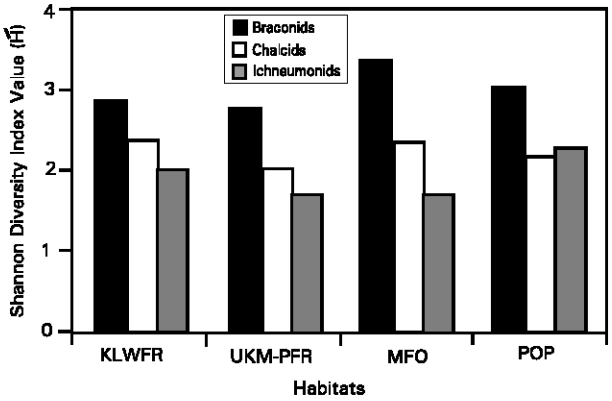

Fig. 2: Shannon Diversity Index value (H') of parasitoids in various habitats (KLWFR, Kuala Lompat Wildlife Forest Reserve; UKM-PFR, UKM Permanent Forest Reserve MFO MARDI Fruit).

hosts. Examples of these are adult food sources, shelter, mating sites and alternate hosts. Dyer and Landis (1996) found that *Eriborus terebrans* (Hymenoptera: Ichneumonidae) live longer in a habitat where there are enough sources of sugar. For *Diadegma insulare*, the presence of wild flowers and nectar-producing plants enhanced its longevity and fecundity (Idris & Grafius, 1995).

The results obtained on species diversity agree with the universal claim that diversity significantly varies ($P < 0.05$) among habitats. A high Shannon diversity index (H') was observed for braconids and ichneumonids in the agricultural habitats MFO and POP, respectively and for chalcids in the undisturbed habitat (KLWFR) (Fig. 2). Evidently, this trend does not correspond to that on species abundance. High abundance does not necessarily mean high diversity, for diversity is the number of species in a given area or habitat (Tauber *et al.*, 1986). Pielou (1975) states that species diversity (H') is very much dependent on the species evenness (E) and species richness (R). The high H' for ichneumonids in POP which was not significantly different ($P > 0.05$) with that of KLWFR suggests that palm oil plantation with abundance of flowering weeds within and around the field provide plenty of hosts and resources needed by this parasitoid. This indirectly tells the plantation management that there should be no total field free of weeds or even shrubs if they want the parasitoid to function and less pesticides be used for controlling insect pests of palm oil.

The observed difference in diversity indexes among these parasitoids could also have been due to the differential availability of their specific hosts in a given habitat. Tauber *et al.* (1986) stressed that parasitoids have high species-specificity. That is, species of parasitoids present in a particular habitat correspond to a specific host. This constitutes the parasitoid-host interaction. For braconids and ichneumonids that have high diversity index in an agricultural area (e.g. braconids in MFO and ichneumonids in POP), the parasitoid-host interaction could have had a wide spectrum. Gauld (1988) states that ichneumonid and braconid parasitoids have four major biological strategies in relation to host utilization namely: koinobiont, idiobiont, ecto- and endoparasitism. Aside from this, an agricultural area may house other insects, which serve as alternate hosts for these parasitoids.

The results concluded that disturbance to a certain degree does not negate or adversely affect neither the abundance nor the diversity of parasitoid communities. However, on species level of parasitoid, disturbance in a habitat may induce the abundance and/or increase diversity of a particular species over the other.

Acknowledgments

We thank the Wildlife Department and National Parks of Pahang, Forest Research Institute of Malaysia (FRIM), Malaysian Agriculture Research and Development Institute (MARDI), University Kebangsaan Malaysia (UKM) and Palm Oil Research Institute (PORIM) for permission to conduct the study. This study was supported by the IRPA grant no. 09-02-02-0022 & 09-02-02-0170.

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