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The Abundance of Scuttle Fly (Diptera:Phoridae) in Five Selected Forests and the Potential of its Genera, *Megaselia* and *Woodiphora*, as Biological Indicators of Forest Disturbance

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Abstract: The abundance of scuttle fly (phorid flies) was studied in the selected forest habitats of Peninsular Malaysia in 1996 and 2000, respectively. The scuttle flies were more abundant in the undisturbed than in the disturbed forests. A total of 26-phorid genera were collected and this was estimated to be 11.4% of the total phorid genera worldwide. This study also successfully collected 21.7% (12 genera) of the total genera recorded from Oriental and Australasian region (55 genera) and 33.3% (5) of the total genera recorded from Malaysia (15). The individuals of genera *Megaselia* and *Woodiphora* were the most abundant as compared to other 24 genera recorded. The ratio for the total *Megaselia* to *Woodiphora* (M:W) individuals indicated that the less disturbed forests had higher M:W ratio than the more disturbed forests. The potential of *Megaselia* and *Woodiphora* to be used as biological indicator of forest disturbance are discussed.

Key words: Scuttle fly, forest disturbance, biological indicator, *Megaselia, Woodiphora*

Introduction

Ecologically, insects are occupying diverse niches (found in every conceivable habitat) and play different functional roles important in sustaining the dynamics of ecosystem process (Walker, 1992). They could be herbivores (some of them are pests), predators and parasites/parasitoid (maintaining the population dynamics of herbivore insects), pollinators (such as bees), decomposers (such as termites) and scavengers (some beetles and flies) – each group or species within groups have distinct feeding habits (Miller, 1993; Kim, 1993). As such, they are closely associated with the habitat and factors within it. Any change within habitat they are occupying would certainly affect their presence.

Having specific ecological and biological needs, together with high species population abundance and diversity, made insect as one of the most important biological indicators used to monitor environmental changes. This is true as 22% of the 69 papers presented during the 9th International Symposium on Bioindicators' held in 1997 in Kuala Lumpur, Malaysia were related to the use of insects for monitoring environmental changes and pollutants. Other organisms used or studied were plants (18%), bacteria (10%), arthropod other than insects (10%), fungus (5%), snail (5%), and other (birds, rodents, crustaceans, fishes etc. (30%).

This study was conducted to determine the abundance of phorid (scuttle flies) in the selected forests of Peninsular Malaysia and also to determine its potential to be used as a biological indicator of forest disturbances. Results of this study are expected to be useful for the forest manager and policy makers that normally have great influences as far as the land use decision is concerned.

Materials and Methods

The study was conducted at four forest reserves namely the Ayer Hitam Forest Reserve (AHFR), Sg. Lalang Forest Reserve (SgLFR), Sungkai Forest Reserve (SFR) and Kuala Lompat Forest Reserve (KLWFR). The AHFR is an undulating lowland dipterocarp forest ranging from 15 to 157 m above sea level, about 1,000 ha and located 20 km from the University Putra Malaysia (UPM) main campus. The SgLFR is situated within the Semenyih of Sepang District, Selangor, with gazette area of about 790 ha, 50 – 800 m above sea level, undulating lowland and highland dipterocarp forest dominated by *Shorea* spp. Both AHFR and SgLFR were selected logged between 1936 and 1965 and could be classified as fragmented forests (Faridah Hanum, 1999). The SFR is considered as highland diperocarp forest with the gazette area of about 1784ha, at 400 – 700 m above sea level, situated within the district of Tapah, Perak, Malaysia. It was minimally logged at the fringes of the Reserve during the Japanese occupation of Malaya, but restored since then. For the KLWFR please see above. The KLWFR is in the state of Pahang, Malaysia and part of Krau Wildlife Forest Reserve. It is a lowland dipterocarp forests with 50 – 300 m and 50 – 60 m above sea level respectively, covering about 4,000 ha. The majority of plants presence is of virgin dipterocarp even though there is some disturbances at the forest fringe.

Seventy-five pitfall traps were randomly placed along three transacts at the SgLFR. The transacts were 1,000m long each started from forest fringes towards the forest interior, parallel to each other and separated by a 300m distance. The sampling was done for a week per month for three consecutive months (July to September 1999). Insects trapped were collected daily and brought to laboratory for sorting and identification. The Malaise trap (MT) was used for sampling at AHFR. Two transacts were established within the AHFR, both were parallel to each other and 200 m apart. There were three sampling points (treatments) chosen along each transect. The distance between the points per transect was 500 and 300 m, and 30 - 50 m from forest edge for innermost, middle and forest fringe respectively. A total of six malaise traps were used with one trap placed at each sampling point beginning on 4th until 11th September 2000. Traps were left in the forest for eight days before insects were collected, and brought to the laboratory for sorting and identification.

At the SFR, MT and yellow pan trap (YPT) were used concurrently. Four MT were placed horizontally (HT) starting at the fringes of SFR towards the inner side at 200 m apart. All MT were installed and left for a week per month before insects were collected and brought back to the laboratory. A total of 20 YPT were also placed within the forest at 100m distance between traps. Insects were collected daily and brought to laboratory for sorting and identification. The collections of both MT and YPT were made for four consecutive months (July – October 2000). We could not do this to other forests due to the limited manpower, time and funding. The collection at KLWFR was made using MT for one year period starting from November 1999 – April 2000. Six MT (400 m apart) were set up along the transect line starting at 100 m from the forest fringes towards the forest interior. Insect traps were collected weekly and brought to laboratory for sorting and identification.

The specimens were identified (up to genera) based on the Disney (1996 & 1994), Disney and Kistner (1994 a & b) and Disney (1989). Data for the total individuals collected per genus per

forest was relatively compared as some of genera had less than five individuals collected per forest which did not allow us to analyze it using a χ^2 (Ott, 1988).

Results and Discussion

Abundance: A total of 26 phorid genera were recorded from the four forests studied (Table 1). The SgLFR (18) and SFR (17) had relatively the highest while AHFR (8) and KLFR (8) had the lowest number genera. The 26 genera are 11.4% of the total genera of phorid recorded worldwide (228 genera) (Disney, 1994). This study successfully collected 21.7% (12 genera) of the total genera recorded from Oriental and Australasian Region (55 genera) and 33.3% (5) of the total genera recorded from Malaysia (15) (Disney 1994,). Although SgLFR is relatively more disturbed than the SFR or KLFR, the number of phorid genera collected from SgLFR and SFR were comparable. Although the period of sampling was much longer in KLFR (one year) than that of SFR (five months), the number of phorid genera collected from SgLFR was much higher than that of KLFR (Table 1). This indicates that YPT that was used in SFR collected the most phorid as compared with MT.

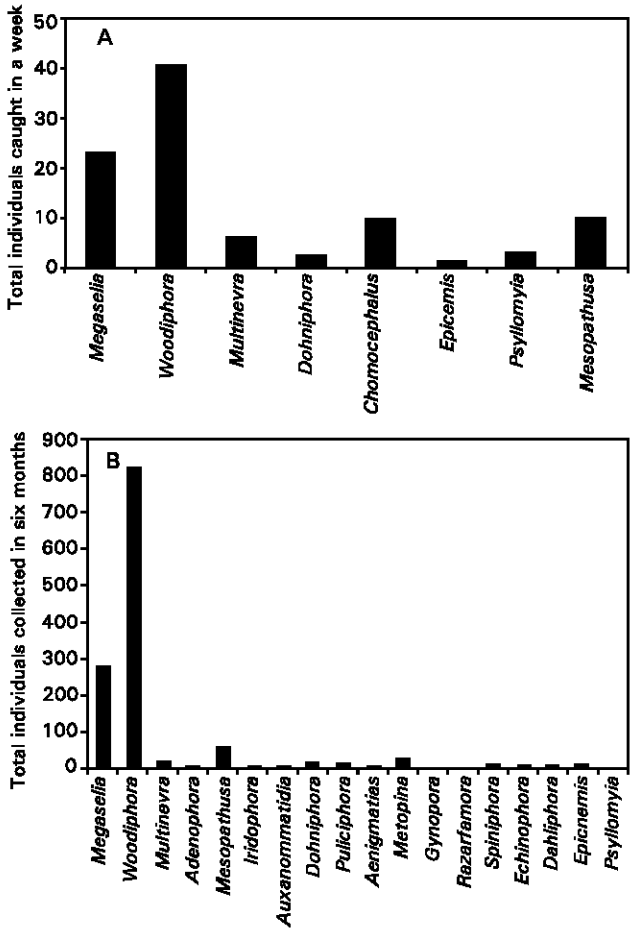

Fig. 1: Total individuals phorid collected from two forests reserved within the langat Basin (A, Air Hitam Forest Reserve; B, Sg Lalang Forest Reserve)

The genera *Megaselia* and *Woodiphora* were collected from all forest reserves probably because they are cosmopolitan phorids (Disney, 1994). *Megaselia* and *Woodiphora* members are highly abundant in Malaysia and other Oriental regions. However,

Table 1: Genera of Phorid recorded in four different forest reserves[1]

Genera	Sg.LFR	AHFR	SFR	KLWFR
Megaselia	+	+	+	+
Woodiphora	+	+	+	+
Multinevra	+	+	+	+
Apocephalus	-	-	+	+
Mesopathusa	+	+	+	+
Iridophora	+	-	+	+
Gymnophora	+	-	-	+
Auxanommatidia	+	-	+	+
Dohniphora	+	+	+	-
Puliciphora	+	-	+	-
Aenigmatias	+	-	+	-
Metopina	+	-	+	-
Microselia	-	-	+	-
Stichillus	-	-	+	-
Conicera	-	-	+	-
Aenictacantha	-	-	+	-
Ecitoptera	-	-	+	-
Necperissa	-	-	+	-
Chonocephalus	-	+	-	-
Epicnemis	+	+	-	-
Psyllomyia	+	+	-	-
Spiniphora	+	-	-	-
Echidnophora	+	-	-	-
Adenophora	+	-	-	-
Dahliphora	+	-	-	-
Razorfemora	+	-	-	-

[1]AHFR, Ayer Hitam Forest Reserve; SFR, Sungkai Forest Reserve; KWFR, Kuala Lompat Wild Life Forest Reserve; SgLFR, Sg. Lalang Forest Reserve

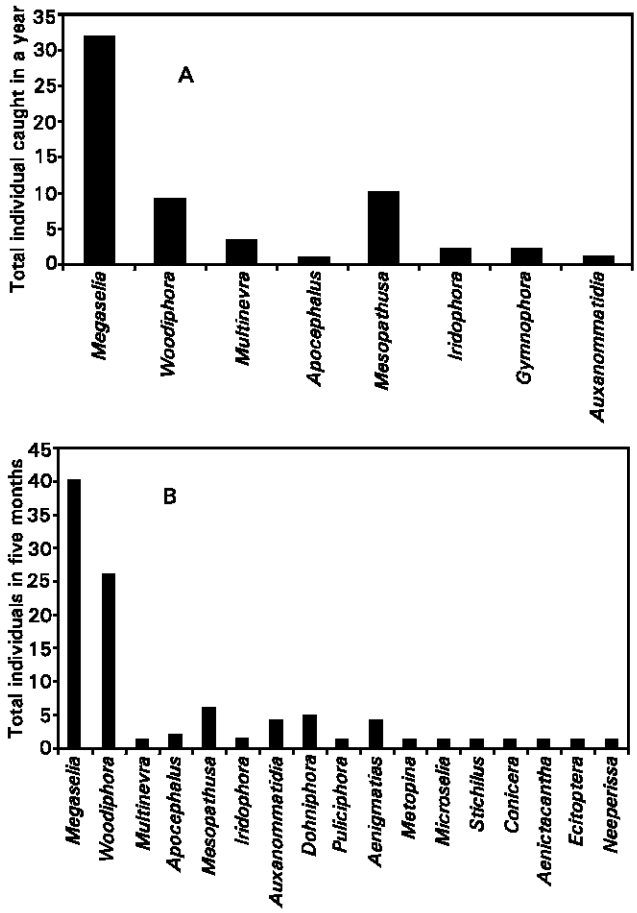

Fig. 2: Total individuals phorid collected from two forests reserved outside the Langat basin (A, Kuala Lompat Forest Reserve; B, Sungkai Forest Reserve).

genus *Apocephalus* was only collected from less disturbed forests such as SFR and KLFR. This suggests that they prefer cooler environment in the KLFR and SFR as compared to warmer environment in the more isolated and fragmented AHFR and SgLFR. The presence of *Apocephalus* in a particular habitat may indicate that the habitat is less disturbed.

***Megaselia* and *Woodiphora* as biological indicator of forests disturbance:** A total of 91 and 1,322 phorid individuals were collected from AHFR and SgLFR, while the SFR and KLFR had 94 and 54 phorid individuals. The total number of *Woodiphora* individuals collected at the SgLFR and AHFR were relatively greater than number of individuals collected from other genera (Fig. 1A and B). In contrast, individuals of *Megaselia* were caught at greater numbers from less disturbed or primary forests (SFR or KLFR) than the more disturbed and fragmented forests (SgLFR and AHFR) (Fig. 2A and B). The greater numbers of *Woodiphora* and *Megaselia* in four forests indicated that members of these genera are cosmopolitans and have adapted to wide range of environmental conditions (Disney, 1994). It may also be attributed to the abundance of food or hosts within the forests.

Most phorid in particular members of the genus *Megaselia* have wide range of food for their larval stages (Disney, 1994). Their food may range from live to dead plants and animal materials, and sometimes causing myasis on injured host (Disney, 1994; Meinhardt & Disney, 1989; Johal *et al.*, 1994). Santini (1998) found that *M. scalaris* is a new potential pest of stored foodstuffs in the Mediterranean countries while Idris and Abdullah (1997 & 1999) reported that it has the potential to be used as a biological agent of round snail, *Bradybaena similaris*. Members of the *Woodiphora* and *Megaselia* were also reported to feed on the dead termites and ants worldwide (Disney, 1989). The *Megaselia* and *Woodiphora* individuals were more abundant in most habitats (Disney, 1994) as compared with individuals of other genera (Fig. 1, 2A and B). As explained above the SFR and KLFR are the least disturbed forests than that of AHFR and SgLFR. Based on the current information we ranked the four forests as (highly disturbed first mentioned) AHFR > SgLFR > SFR > KLFR (Shhuko, Md. Nor, UKM – personal communication). The *Megaselia* to *Woodiphora* ratio were 0.73 : 1, 0.34 : 1, 3.33 : 1 and 1.55 : 1 for AHFR, SgLFR, KLFR and SFR respectively. This indicates that the low ratio of *Megaselia* to *Woodiphora* somewhat related to the high degree of habitat disturbances at AHFR (0.73 : 1) and SgLFR (0.34 : 1). AHFR is considered a fragmented forest as it is being isolated from the other forests within the Langat Basin by the land development activities. Although SgLFR is less fragmented than AHFR and still connected to the primary forest of Gunung Nuang, the ratio of *Megaselia* to *Woodiphora* at SgLFR was relatively lower than that of AHFR. This is probably due to AHFR has been acting as a refuge for many animals including insect like *Megaselia* that are adversely affected by the loss of habitat as the result of forest destruction and fragmentation. The negative impact of on-going development activities around the AHFR on the phorid populations as indicated in this study should be used by any party involved in the land development projects as an example as to why their selfish action could destroy the existing biological diversity.

Unlike certain insect groups, phorid is highly abundant in the tropics. Our results suggest that certain phorid genera could be used as biological indicators for differences in forest disturbances as indicated by the ratio between total *Megaselia* and *Woodipgora* individuals. However, further studies with more replicates (frequent sampling) and longer sampling time would confirm this sort of preliminary investigation before it could be recommend to the land development managers and policy makers.

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