Differential pollinator visitation to *Melastoma malabathricum* (Melastomataceae) under different sunlight conditions

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Abstract
We studied Differential pollinator visitation to *Melastoma malabathricum* (Melastomataceae) under different ambient conditions at the Maliau Basin Conservation Area in Sabah, Malaysian Borneo on 21-24 August 2007. This study were investigated whether pollinator visitation is differentiated under different ambient conditions, which could imply the partitioning of limited resources by *M. malabathricum* flowers or the pollinator community. From the study, a total of 142 flowers in the sun and 322 in the shade and recorded 26 insect morphospecies visiting *M. malabathricum* flowers. Comparing the average number of all insect visitors on flowers, there was no significant difference between flowers in the shade and sun and only significant were ants excluded ($p = 0.01845$). These results suggest that ants may not discriminate between shaded and sunlit plants as much as insects capable of flight. However, bees also appear to have no preference for flowers in either the sun or the shade. Thus, the difference that we detected was likely due to other insects whose abundance was less than Hymenoptera but displayed stronger preferences.We conclude that *M. malabathricum* flowers attract different insect visitors under sun and under shade, but differences in abundance are only evident at certain scales.

Keywords
Competition, shade, sun.

Hypotheses
H_0: The pollinator community does not differ among flowers of *Melastoma malabathricum*.
H_1: Pollinator abundance and species composition differ between flowers exposed to sun and those in the shade.

Introduction

Pollination benefits both flowering plants and their insect visitors: a critical phase in sexual reproduction for flowers and an important food source for nectar- and pollen-feeding insects. Flowering plants and insect pollinators have been hypothesized to have coevolved, further strengthening their mutual interdependency. However, coevolution between flowering plants and their pollinators may most frequently be “diffuse” among a set of interacting species (Howe 1980, Janzen 1980, Howe & Smallwood 1982, Herrera 1985), as not all nectar and pollen feeders are pollinators, and specialization appears relatively uncommon. The goals of pollination differ between pollinators and flowers; whereas insects are likely to feed on nectar or pollen from a variety of different flowers (pers. obs.), flowers must transfer pollen to another of the same species. Flowers thus benefit most from either a specialist pollinator, or by attracting the greatest number of insects possible to increase the chances of successful fertilization.

If flowers compete for the attention of a local pollinator community, then we expect competition for pollinators to be most intense within the same species of flowers because individuals possess the same traits and grow in similar habitats. One method by which intraspecific competition could be reduced may be to attract different subsets of the pollinator community under different environmental conditions. Members of the pollinator community may also have species-specific preferences for flowers in particular conditions that reduce competition within and among species.

We studied insects visiting *Melastoma malabathricum*, a conspicuous day-blooming plant along stream beds and forest clearings at the Maliau Basin Conservation Area. *M. malabathricum* is pollinated primarily by bees; pollen in Melastomataceae are released from poricidal anthers only when bees buzz the anthers with vibrations of around 420 Hz or higher (Renner 1989). *M.*

malabathricum often grow in areas where flowers alternate between a shaded and sunlit environment multiple times during the course of the day. By observing flowers in the sun and the shade, we investigated whether pollinator visitation is differentiated under different ambient conditions, which could imply the partitioning of limited resources by *M. malabathricum* flowers or the pollinator community.

Methods

We studied insects visiting *M. malabathricum* flowers at the Maliau Basin Conservation Area in Sabah, Malaysian Borneo. From 21-24 August 2007 between 0800 and 1000 hrs, we identified *M. malabathricum* flowers within 7 meters of the Bornean Bristlehead Road that were either in bloom or were expected to bloom the same day. For each flower, we recorded the time, stage of blossom (open/close), sunlit or shaded, and used Swarovski EL 8,5x42 binoculars to count the number of each insect morphospecies that appeared to be feeding on pollen. We identified insect morphospecies to family, subfamily, and/or species following Hill & Abang (2005). We performed *t*-tests to analyze the data using software R 2.3.1 for differences in the abundance of all insect visitors, all insects except ants, all Hymenoptera except ants, Apidae only, and the most abundant bee species.

Results

We observed 142 flowers in the sun and 322 in the shade and recorded 26 insect morphospecies visiting *M. malabathricum* flowers (Table 1). Comparing the average number of all insect visitors on each flower per unit time, there is no significant difference between flowers in the shade and sun (Figure 1; $t = 0.4677$, df = 271.63, $p = 0.6404$). When ants were excluded, significantly more insects visited flowers in the shade than in the sun ($t = -2.3808$, df = 160.088, $p = 0.01845$). However, the difference was insignificant for all Hymenoptera except ants ($t = -1.0001$, df = 192.296, $p = 0.3185$), Apidae only ($t = -0.8461$, df = 192.022, $p = 0.3985$), and the most abundant bee species (*Apis*? sp.) only ($t = 0.345$, df = 162.277, $p = 0.7305$). Species composition also differs quite dramatically between flowers under the sun and shade (Figure 2, Figure 3).

Discussion

Insect visitors on *M. malabathricum* differ only slightly between flowers in the sun and under shade. There were no significant differences for all insects nor any of the subsets of insects that we tested for *except* comparing all non-ant insects. Our results suggest that ants may not discriminate between shaded and sunlit plants as much as insects capable of flight. However, bees also appear to have no preference for flowers in either the sun or the shade. Thus, the difference that we detected was likely due to other insects whose abundance was less than Hymenoptera but displayed stronger preferences. Comparing figures 2 and 3, one prominent example is the black weevil (Curculionidae), which represented 20% of insect abundance in the sun but only 2% in the shade. Another explanation for why ants and bees do not appear to differentiate between sun and shade may be because they are central point foragers and therefore limited in the range for which they can forage (Harrison 2004). We conclude that *M. malabathricum* flowers attract different insect visitors under sun and under shade, but differences in abundance are only evident at certain scales. Further investigations may reveal whether this difference serves to reduce competition for either pollinators or the community of insect visitors.

References

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Table 1. Insect visitors to *Melastoma malabathricum* along Bornean Bristlehead Road at the Maliau Basin Conservation Area.

Order	**Family**	**Species**	**# individuals**
Coleoptera	Curculionidae	weevil black	33
Coleoptera	Curculionidae	weevil brown	1
Coleoptera	Curculionidae	weevil small	1
Coleoptera	Scarabaeidae	*Popillia* sp.	7
Coleoptera	?	beetle sp.	1
Diptera	Asilidae?	Asilidae?	1
Diptera	Tephritidae	Tephritidae large	6
Diptera	Tephritidae?	Tephritidae? small	1
Diptera	?	tiny black fly	2
Hemiptera	Reduviidae	Reduviidae yellow	1
Hemiptera	Reduviidae	Reduviidae green	2
Hemiptera	Reduviidae	Reduviidae red	1
Hymenoptera	Anthophoridae	*Anthophora* sp.	11
Hymenoptera	Apidae	*Apis*? sp.	105
Hymenoptera	Apidae	*Trigona* sp. black large	20
Hymenoptera	Apidae	*Trigona* sp. black small	6
Hymenoptera	Apidae	*Trigona* sp. brown	16
Hymenoptera	Formicidae	ant black	78
Hymenoptera	Formicidae	ant red	144
Hymenoptera	Halictidae	*Halictus*? sp.	18
Hymenoptera	Xylocopidae	*Xylocopa platynoda*	2
Hymenoptera	?	bee sp.	1
Lepidoptera	Nymphalidae	*Parthenos sylvia*	1
Orthoptera	Gryllidae	Gryllidae	2
Orthoptera	Tettigonidae	Tettigonidae b&w	1
Orthoptera	Tettigonidae	Tettigonidae red	1

Figure 1. Average number of all insect visitors did not differ between sunlit (S) and shaded (Sh) flowers of *Melastoma malabathricum* along Bornean Bristlehead Road at the Maliau Basin Conservation Area ($t = 0.4677$, df = 271.63, $p = 0.6404$).

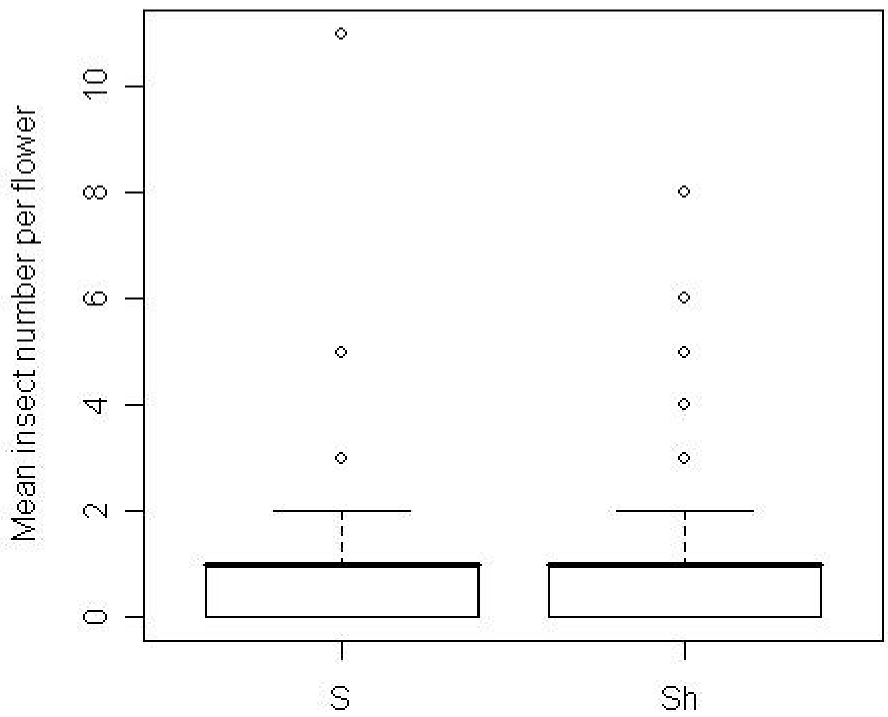


Figure 2. Insect visitors to sunlit flowers of *Melastoma malabathricum* along Bornean Bristlehead Road at the Maliau Basin Conservation Area.

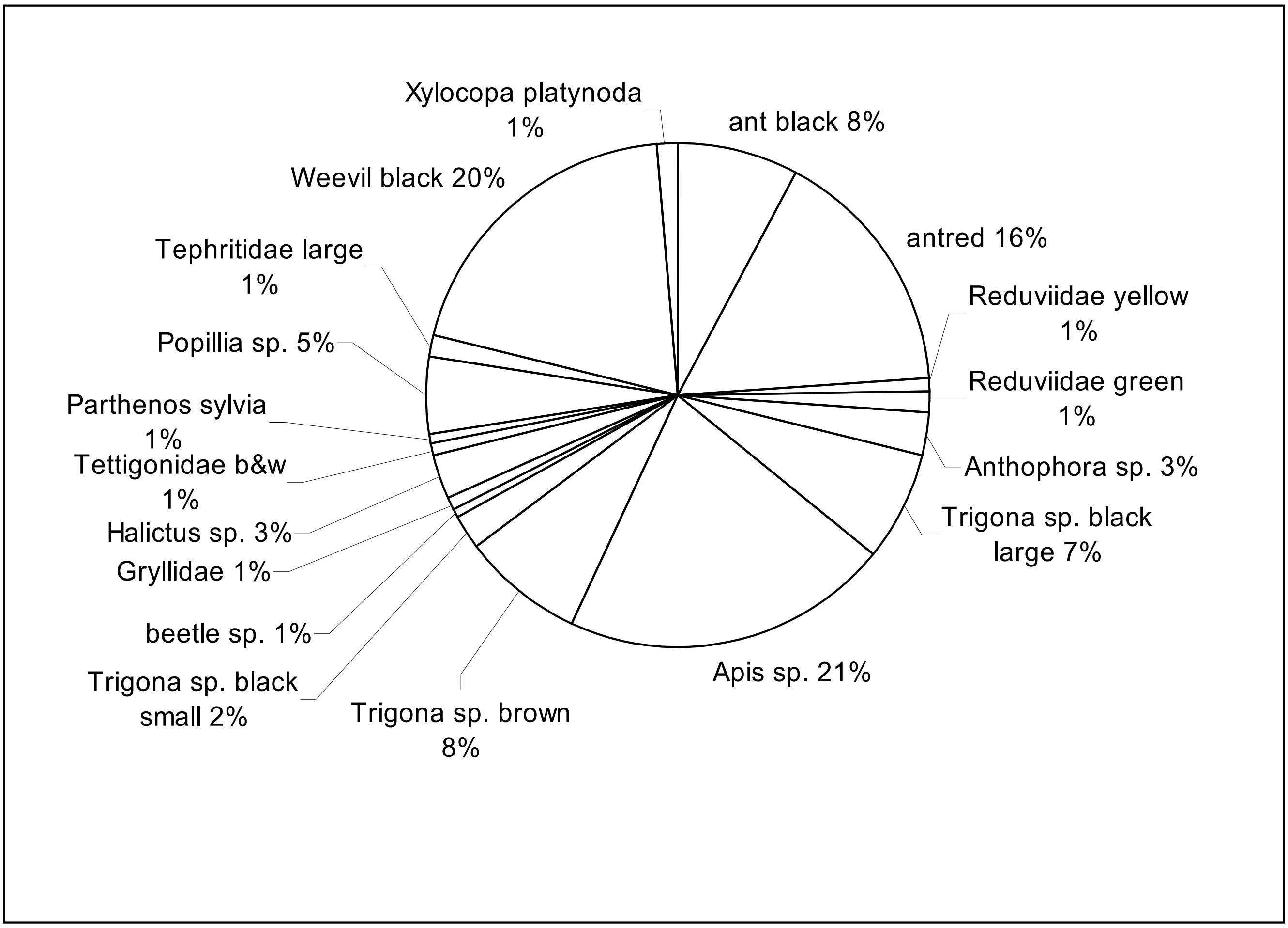
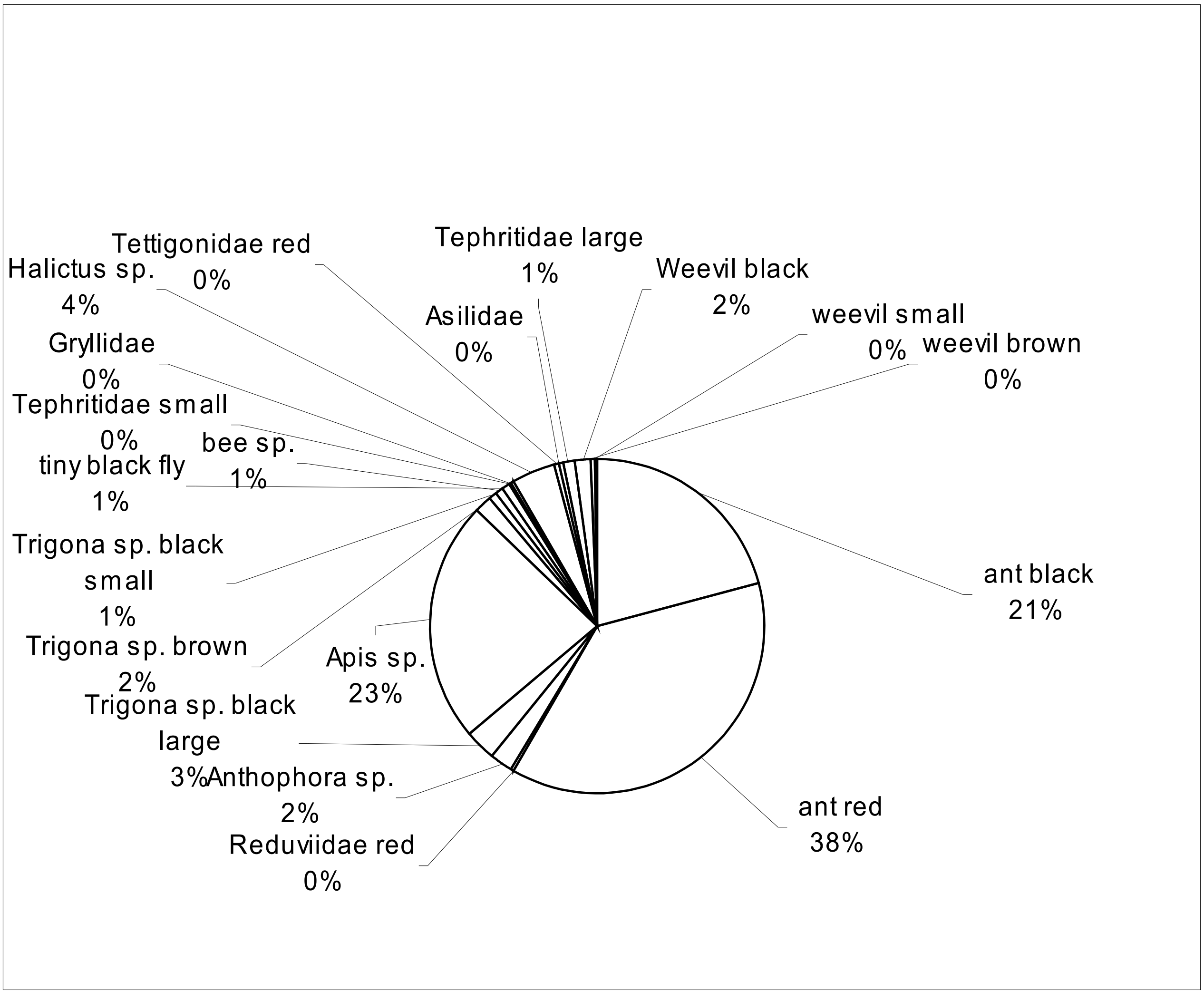


Figure 3. Insect visitors to shaded flowers of *Melastoma malabathricum* along Bornean Bristlehead Road at the Maliau Basin Conservation Area.



Tettigonidae red
0%
Halictus sp.
4%
Gryllidae
0%
Tephritidae small
0%
bee sp.
1%
tiny black fly
1%
Trigona sp. black small
1%
Trigona sp. brown
2%
Apis sp.
23%
Trigona sp. black large
3%
Anthophora sp.
2%
Reduviidae red
0%
Tephritidae large
1%
Asilidae
0%
Weevil black
2%
weevil small
0%
weevil brown
0%
ant black
21%
ant red
38%