

Trophobioses between ants and hemipterans in a tropical rainforest in Borneo

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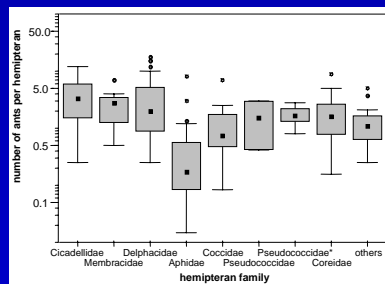


Introduction

Ants are the most dominant group of arthropods in tropical rainforests. For many ant species, honeydew (excretions from plant-sucking hemipterans) is a crucial resource that is commonly monopolised against competing ant species in trophobiotic associations. We investigated the specificity between trophobiotic partners, the degree of monopolisation and the dynamics of trophobioses. Our study was carried out in the rainforest understorey in Danum Valley (Borneo, Malaysia) between July and October 2004.



Crematogaster (Paracrema) modiglianii with a coreid on *Dinochloa trichogona*



* specific partners of herdsmen ants (Dill et al. 2002)

The number of ants per individual hemipteran is an indicator of the attractiveness of a trophobiosis (Blüthgen & Fiedler 2002). The lowest value is found for aphids (mostly *Aphis cf. gossypii* on *Eupatorium odoratum*), while cicadellids and membracids have the highest value.

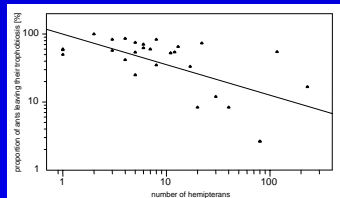
Ant-hemipteran associations (numbers show independent replicates)

	N (ants)	Membracidae	Cicadellidae	Delphacidae	Aleyrodidae	Aphidae	Coccidae	Pseudococcidae	Pseudococcidae*	Psyllidae	Coreidae
N (hemipterans)	159	18	22	28	1	34	12	6	7	9	22
<i>Dolichoderus thoracicus</i>	30	4	4	1		10	2	3		6	
<i>Dolichoderus indrapurensis</i>	7	2	2	2			1				
<i>Dolichoderus maschwitzi</i> *	9			1					7	1	
<i>Techynomymex cf. albipes</i>	7	1	1	2		1	1				1
<i>Anoplolepis gracilipes</i>	5					4	1				
<i>Camponotus cf. arrogans</i>	12		1	3							7
<i>Camponotus cf. irritabilis</i>	6					5		1			
<i>Camponotus (Colobopsis) cf. saundersi</i>	4			2							2
<i>Paratrechina sp. 1</i>	8	2	3	2							1
<i>Paratrechina sp. 3</i>	6					3		2			1
<i>Polyrhachis olybrius</i>	11	1		3							5
<i>Polyrhachis ypsilon</i>	4	1	1								2
<i>Crematogaster (Paracrema) modiglianii</i>	15	4	1	3	1	1	3			2	
<i>Crematogaster (Orthocrema) sp. 1</i>	7		1	2		1	1				2
<i>Lophomyrmex sp. 1</i>	16	1	6	7		1	1				
<i>Tetramorium sp. 1</i>	5	1				4					
40 additional ant species	56	3	22	4	0	15	11	2	3	0	5

* specific associations of herdsmen ants (Dill et al. 2002)

We found 57 ant species (18 genera) associated with 45 species of hemipterans on 39 plant species from 22 families. *Camponotus*, *Crematogaster* and *Dolichoderus* were the most common ant genera. The climbing bamboo *Dinochloa trichogona* (Poaceae) was the most frequent host plant in the forest understorey. Ant-attended Delphacidae and Coreidae were found exclusively on *D. trichogona*; both infested 26% of the individual bamboos examined.

In open secondary vegetation, the common invasive weed *Eupatorium odoratum* (Asteraceae) harboured ant-attended gall-forming aphids (infestation rate: 83%). Most commonly trophobioses were attended by a broad spectrum of ants at the local scale, although trophobioses on each plant individual were often restricted to a single ant colony per time (in 95% of all surveys). Although many ant species were opportunistic in their choices of hemipterans and plants, overall partitioning between associated ant, homopteran, and plant partners was highly significant.



Ant distraction from hemipterans by sugar baits decreases with the size of the trophobiosis ($r_s = -0.37$, $p = 0.03$)



Lophomyrmex with three stages of a Cicadellidae species on *Parashorea*



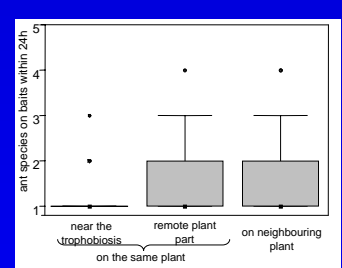
Dolichoderus maschwitzi (herdsmen ants) together with *Promymococcus* on *D. trichogona* (Dill et al. 2002). These ants monopolized trophobioses, but did not attend sugar baits

According to a hypothesis by Becerra and Venable (1989), extrafloral nectaries (EFNs) function to distract ants from their trophobioses to avoid their harmful effects. In order to test this hypothesis, we placed five sugar baits (20 vol. %) to imitate EFNs around trophobioses (note that these baits represent highly exaggerated EFNs in terms of nectar availability and quality). Numbers of ants at the trophobiosis declined significantly one hour after the start of the experiment. However, the proportion of ants leaving their trophobiosis significantly decreased with the number of hemipterans attended. This implies that costs for EFNs to sufficiently distract ants would be very large compared to their benefits (see also Katayama & Suzuki 2003).

Over a course of 35 days, larger associations were more stable (= same ant species continuously present) than smaller ones. Like the results above, this may indicate that ants consider large trophobioses as a more valuable resource than smaller associations.



Lophomyrmex with Delphacidae on *Dinochloa trichogona*



Increase of ant diversity on sugar baits away from the trophobiosis (Friedman ANOVA: $\chi^2 = 7.8$, $p = 0.02$, $N = 45$).

We placed sugar baits near trophobioses to test whether additional sugar-feeding ants occurred in the vicinity. In most cases (73%), baits next to the trophobiosis were only visited by ants from the same colony involved in the trophobiosis. Ant species richness and evenness increased significantly with distance to the trophobiosis. This indicates that the trophobiotic ant monopolises the area around its trophobiosis, but not the whole plant or neighbouring plants.

This behaviour differs between highly dominant ants (e.g. *Dolichoderus thoracicus* or *Crematogaster modiglianii*) and less dominant species (e.g. *Polyrhachis* spp.).

Conclusions

Although most ant species usually tend several species of hemipterans as trophobiotic partners, there is a clear partitioning between them. Moreover, ants often monopolise their trophobiotic site. Larger trophobioses are less commonly abandoned than smaller ones.

Acknowledgements

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References

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