Myrmecochory in Malaysian rain forest herbs (*Globba*, Zingiberaceae)

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Introduction

The Old-World tropics encompass one of the richest floral zones of the world and some of the hot spots of ant diversity. This results in a large variety of ecological interactions between both groups. One of them is the phenomenon of "myrmecochory", the seed dispersal of plants by ants which is also well known from temperate forests, where the pro-portion of ant dispersed species comprise up to 30 percent[1]. At least 67 plant families on earth contain myrmecochorous species[1]. Beattie[1], who reviewed the distribution of ant dispersed plants proposed that species richness and abundance of myrmecochores and diaspore-dispersing ants increase with decreasing latitude and predicted a greater variety of ant-dispersal systems in the tropics. However, up to now, only few tropical myrmecochores have been described[2], especially few in the paleotropics[3]. Here we will report on myrmecochory in a Malaysian forest-floor herb[4].

Fig. 1 *Globba franciscii*, a plant of the shady rain forests of Borneo.

Fig. 2 A worker of *Polyrhachis* sp. is harvesting a seed of *Globba propinqua* directly from the plant.

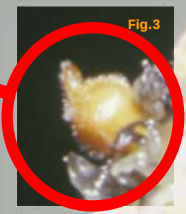

Fig. 3 A single seed of *Globba franciscii*. The fleshy elaiosome is clearly to be seen. The arrow points towards the same structure on the seed of *G. propinqua*. In the background the open fruit capsule.

Fig. 4 Workers of *Colobopsis* sp. 1 feeding on arils of seeds of *G. pendula*.

Fig. 5 Workers of *Oecophylla smaragdina* are carry-ing a seed of *G. franciscii*.

Material and Methods

***Globba* species are plants of the shady primary forest that grow at moist places along streams and waterfalls. The slender herbs are up to 0.5 –1 m high, with the delicate small, yellow, white or violet inflorescence on the top of the leafy shoots (Fig. 1).**

We studied three species: *Globba franciscii*, *G. propinqua* and *G. pendula*. Seeds (< 12 in *G. propinqua*, < 20 in *G. francisci*) are inside a seed capsule. Several such capsules may hang at one shoot while the plant is still flowering, so fruiting is more or less continuous. When fruits are ripe the capsule will burst open and present the fruits (Fig. 2,3). As common in the Zingiberaceae the examined seeds of the Globbeae have an aril, a fleshy appendage that encloses the seed partially. Aril cells are usually rich in lipids and also contain proteins, starch grains and polysaccharides[5]. In the case of the Globbeae the fleshy aril forms a large, lacerate elaiosome (ant fruit) that serves for ants as food and allows them to handle the seed easily (Fig. 4,5,6).

Field work took place in Kinabalu National Park and in Tawau Hills Park, both in Sabah, Malaysia. During the experiments always 10 seeds of the examined Globbae were presented on a small wooden tray (10 x 10 cm) that was placed randomly on the forest floor. To test arboreal ant species the tray was placed near the trunk roads of these ants. We recorded behaviour of ants towards the seeds, dispersal distances of seeds, and the number of seeds removed within one hour.

Results

In our preliminary study we found 22 species of ants of 13 genera and 4 subfamilies that fed on the seed arils of the examined Globbeae (Table 1). Ant species included Formicinae, Dolichoderinae, and Myrmicinae, many of them granivorous species, but also carnivore groups such as Ponerinae. Seed removal of the myrmecochores occurred by single ant foragers as well as by joint transport of several workers and by terrestrial and arboreal ant species. Dispersal distances of *Globba*-seeds ranged from 5 cm to more than 800 cm depending on ant species. Mean dispersal distances of diaspores were significantly correlated with mean tibia lengths of transporting ant species (Fig. 7).

Discussion

Here we show for the first time that myrmecochory is one of the mechanisms of seed dispersal in the Zingiberaceae. These results are confirmed by numerous observations of dispersal of other ginger species (Pfeiffer, unpublished data). Thus we confirm the hypo-thesis that ant-dispersal is a potential mechanism of seed distribution in the Old-World tropics. However, many of the ant species that we observed feeding on arils are also granivorous and will possibly also feed on the seeds. Thus the strong impact of seed-harvester ants may work against myrmecochory as a dispersal mechanism in tropical forests.

Fig. 6 A burst open fruit capsule of *G. propinqua*. Note the large elaio-somes.

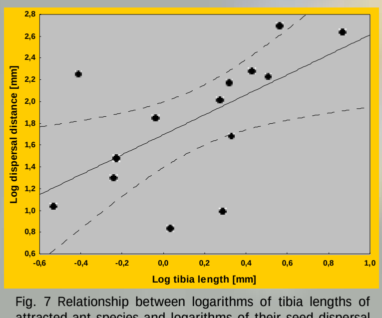

Fig. 7 Relationship between logarithms of tibia lengths of attracted ant species and logarithms of their seed dispersal distances ($Y = 1.70 + 0.92 X$, adjusted $r^2 = 0.34$, $p < 0.05$; 95 % confidence interval).

Table 1 Ant species that removed seeds of several *Globba* - species during our experiments (pooled). As we checked in other experiments, when we baited with crushed rice (Pfeiffer, unpublished data), a large part of these ant species seems to be granivorous and will possibly feed not only on the aril, but also on the seed itself. These harvester ants will possibly not contribute to a successful seed dispersal. In the table we give the number of seeds removed during the experiments, and mean distance, S.D., and number of observed seed transports.

Species	Subfamily	No. of removed seeds	Mean distance of seed transport [cm]	S.D.	N	Feeding on aril	Granivorous species
Odontoponera sp.	Pon.	66	105	15,1	11	-	x
Polyrhachis sp. 1	For.	44	184	174	27	X	-
Oecophylla smaragdina	For.	27	> 500	-	5	-	-
Diacamma c. f. rugosum	Pon.	18	193	144	6	-	-
Lophomyrmex c. f. bedoti	Myr.	18	11	1,7	9	X	x
Pheidole sp. 1	Myr.	15	30	15	6	X	x
Paratrechina sp.	For.	15	72	5,35	15	-	x
Camponotus (Colobopsis) sp. 1	For.	14	48,8	2,5	10	X	-
Leptogenys sp. 2	Pon.	10	150	70,7	2	-	-
Pheidole sp. 3	Myr.	10	10	0	4	X	x
Pheidologeton sp. 2	Myr.	10	50	0	10	X	x
Crematogaster inflata	Myr.	10	6,8	2,3	6	X	-
Dolichoderus sp.	Dol.	10	10	0	9	X	-
Pheidole aristotelis	Myr.	8	183	7,8	8	-	x
Polyrhachis sp. 2	For.	10	7	4,2	4	X	-
Turneria sp.	Dol.	9	-	-	0	X	-
Pheidole sp. 2	Myr.	9	20	10	4	-	x
Camponotus sp.	For.	9	170	0	3	-	-
Camponotus gigas	For.	5	>437	346	5	-	-
Pheidologeton sp. 1	Myr.	5	35	21	4	-	x
Camponotus (Colobopsis) sp. 2	For.	4	6	0	4	X	-
Leptogenys sp. 1	Pon.	1	-	-	0	-	x

Literature

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