Low species richness and high impact of invasive species in arboreal ant communities in oil palm plantations – a threat to natural biodiversity in Malaysia

Martin Pfeiffer[1] & Carsten Brühl[2]

1 University of Ulm, Institute of Experimental Ecology, Albert-Einstein Allee 11, 89069 Ulm, Germany

2 University Koblenz-Landau, Institute of Environmental Sciences, Fortstraße 7, D-76829 Landau, Germany

Introduction

The strong global demand for oils and fats has caused a rapid growth of the oil palm industry in the ASEAN region, leading to the conversion of large areas of land to oil palm production. Malaysia and Indonesia produce over 83% of the total world output of palm oil. Oil palm plantations have been increasingly perceived as environmentally damaging. Negative impacts include pesticide usage, declining soil health, loss of biodiversity and proliferation of exotic animal species. The industry itself as well as non-governmental organisations (NGOs) like the WWF have identified and are addressing these serious and urgent problems.

Establishment of plantations leads to a complete change of the ecosystem and only little is known about animal life in theses huge areas (3,376,664 ha in Malaysia in 2000). Ants are the dominant insect group inside the plantations and play a role in ecological control of pest insects. Our ongoing project compares the diversity of the ant communities in canopies of oil palm plantations in Sabah and Peninsula Malaysia and investigates the influence of non-native ant species. As *Elaeis guineensis* originates from Africa we supposed that oil palm plantations could propagate invasive ant species to South East Asia.

Hypotheses

We expected:

- **A low species richness of ants in oil palm plantations compared with natural rain forest habitats**
- **The dominance of certain ant species leading to the formation of "ant mosaics"**
- **A high influence of exotic ant species**
- **A high similarity of plots in both parts of Malaysia**

METHODS

Ants were studied in two oil palm plantations, each much larger than 1000 ha and farmed with integrated pest management (less use of insecticides) on Borneo (28 Sept. to 19 Oct. 2004) and Peninsular Malaysia (10 to 29 Aug. 2005)(Fig. 1).

Fig. 1 The sample sites in Borneo (Tawau, Golden Hope Plantation, N 04.23' E 117° 51') and Peninsula Malaysia (Banting, Golden Hope Research Centre N 02° 48' E 101° 28').

Ants were sampled during the harvest from 2-4 freshly cut palm fronds of each palm and stored in alcohol. We sampled 675 palms from 13 fields on Borneo and 553 palms from 6 fields in the Peninsula Malaysia. Ants were identified with a reference collection in our lab at the University of Ulm, Germany (http://www.antbase.net).

Results

The rarefaction plots showed that our sampling was almost complete (Fig. 2). Altogether we sampled 49 species of canopy ants, 35 species in Borneo, 36 species in Peninsular Malaysia. 23 species were shared between both plots, resulting in a moderate beta-diversity (quantitative Sørensen Index: 0.47). A total of 37 ant species was predicted by the ICE-species estimator for each plot. Only 17 (Borneo) and 23 (Peninsula Malaysia) species made 95% of all species occurrences (SO). We found a massive impact of exotic ant species: 9 species with altogether 46 % of all SO were non-native (Fig. 3). *Technomyrmex albipes*, *Oecophylla smaragdina* and *Anoplolepis gracilipes* were the most abundant ant species in the palm canopy.

Literature

Floren, A, Linsenmair, K E (2005). The importance of primary tropical rain forest for species diversity: An investigation using arboreal ants as an example. - Ecosystems 8: 559-567.

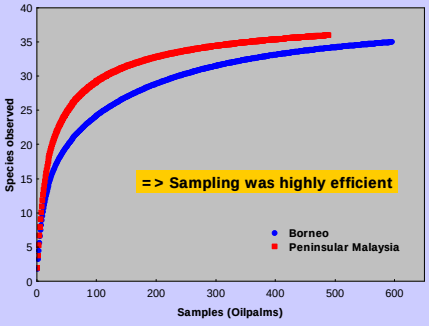


Fig. 2 Rarefaction plot of our study, confirming the low species richness of the oil palm plantations. 36 species in Peninsular Malaysia and 35 in Borneo, respectively.

Summary

We found:

- **a low species richness of arboreal ants in plantations: 36 and 35 species in PM and Borneo, respectively; 49 species altogether**
- **a set of typical "oil palm ant species" forming clearly defined ant communities**
- **46 % of all species occurrences belonged to nine invasive "tramp" ant species**
- **Plots in both parts of Malaysia differed only in subdominant native species**

Take Home Message:

- **Oil palm plantations house only few native arboreal ant species and act as a pool for invasive ant species that may endanger Malaysia's biodiversity.**

Discussion

The Malaysian oil palm plantations house only 40 species of native ants, while in primary rainforests 280 native arboreal species have been collected (Floren & Linsenmair 2005). The complete eradication of the native fauna and flora during the establishment of plantations and the large scale planting of an exotic crop are main drivers for the abundance of invasive alien ant species that dominate the plantations. To optimise the resilience of native insect communities new methods have to be established inside the plantations to conserve native (ant) species and to provide stepping stones habitats for the dispersal of forest species between forest fragments that become typical for the landscape.

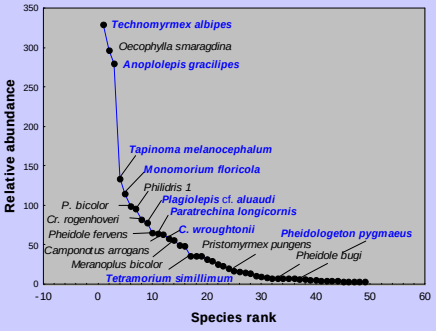
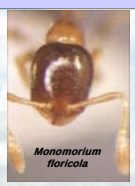
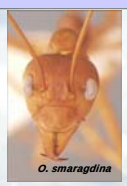


Fig. 3 Combined species abundance plot for both study sites. Blue colour indicates invasive ant species, black are native species. Given are only identified species.





www.antbase.net

Acknowledgements

We thank the Golden Hope Management and the EPU Malaysia for research permission (EPU Permit N0. 1557). We are indebt to the staff of Golden Hope, especially **Dr. Ho Cheng Tuck** and **Mr. Teh Chong Lay**, for their friendly support during our study, to M. Verhaagh, Karlsruhe, B. Seifert, Görlitz, K. Eguchi, Kagoshima and B. Bolton, London for help during the identification of ants and to K.E. Linsenmair, Würzburg for the provision of his car. **Contact:** martin.pfeiffer@uni-ulm.de