Supporting Information Table S1 – A qualitative review comparing invertebrate availability in natural forests and non-oil palm, exotic tree plantations in Southeast Asia. Exotic status of plants follows Agroforestree database (http://old.worldagroforestry.org/treedb/index.php), or as reported by the author if not available. If primary and secondary forests are available in the study, we always selected secondary forests. If both abundance and biomass are available, we reported both results. We reported results by different sampling strategies if possible, otherwise aggregated metrics were used. Studies that surveyed invertebrates using baits or traps (e.g. pitfall traps) were excluded, as the results might reflect differences in activity levels rather than availability (Leather 2005; Yi, Feng, Xue, Sang & Axmacher 2012). Results are based on comparing observed values between plantations and forests. F: Forests P: Plantations.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Plantation | Forest | Location | Taxa | Metric | Method | Results | Study |
| *Acacia dealbata* | Natural forests (did not specify primary or secondary) | Nilgiri | Micro-arthropods | Abundance | Berlese-Tullgren funnel | F > P | Jayaraman, Chinappan & Vallavan (2017) |
| *Acacia mangium* | Primary | Sabah | Beetles | Abundance | Mist-blowing | F > P | Chung, Eggleton, Speight, Hammond & Chey (1998) |
| *Acacia mangium* | Primary | Sabah | Beetles | Abundance | Winkler sampling | F > P | Chung, Eggleton, Speight, Hammond & Chey (1998) |
| *Acacia mangium* | Primary | Sabah | Lepidopteran larvae | Abundance | Mist-blowing | P > F | Chung, Chey, Speight, Eggleton & Hammond (2002) |
| *Acacia mangium* | Primary | Sabah | Orthoptera | Abundance | Mist-blowing | F > P | Chung, Chey, Speight, Eggleton & Hammond (2002) |
| *Acacia mangium* | Primary | Sabah | Phytophagous Coleoptera | Abundance | Mist-blowing | F > P | Chung, Chey, Speight, Eggleton & Hammond (2002) |
| *Acacia mangium* | Primary | Sarawak | Macroinvertebrates | Abundance | Soil sampling | F > P | Tsukamoto & Sabang (2005) |
| *Acacia mangium* | Primary | Sarawak | Macroinvertebrates | Biomass | Soil sampling | P > F | Tsukamoto & Sabang (2005) |
| *Acacia mangium* | Secondary | Sabah | Canopy arthropods | Abundance | Mist-blowing | F > P | Chey, Holloway, Hambler & Speight (1998) |
| *Eucalyptus deglupta* | Secondary | Sabah | Canopy arthropods | Abundance | Mist-blowing | F > P | Chey, Holloway, Hambler & Speight (1998) |
| *Eucalyptus globules* | Natural forests (did not specify primary or secondary) | Nilgiri | Micro-arthropods | Abundance | Berlese-Tullgren funnel | F > P | Jayaraman, Chinappan & Vallavan (2017) |
| *Gmelina* *arborea* | Old logged dipterocarp forest | South Kalimantan | Termites | Abundance | Standardized search along transects | F > P | Jones & Prasetyo (2002) |
| *Gmelina arborea* | Secondary | Sabah | Canopy arthropods | Abundance | Mist-blowing | F > P | Chey, Holloway, Hambler & Speight (1998) |
| *Gmelina* *arborea* | Secondary | South Kalimantan | Termites | Abundance | Standardized search along transects | F > P | Gathorne-Hardy, Jones, Syaukani (2002) |
| *Lophostemon confertus* | Secondary | Hong Kong | Invertebrates | Abundance | Beating | F > P | Kwok (1996) |
| *Lophostemon confertus* | Secondary | Hong Kong | Invertebrates | Biomass | Beating | F > P | Kwok (1996) |
| *Lophostemon confertus* | Secondary | Hong Kong | Invertebrates | Abundance | Searching litter samples | F > P | Kwok (1996) |
| *Lophostemon confertus* | Secondary | Hong Kong | Invertebrates | Biomass | Searching litter samples | F > P | Kwok (1996) |
| Mahogany | Natural forests (did not specify primary or secondary) | South Central Luzon | Soil arthropods | Abundance | Berlese-Tullgren funnel | F > P | Sopsop & Lit (2015) |
| Mahogany | Natural forests (did not specify primary or secondary) | South Central Luzon | Leaf-litter arthropods | Abundance | Berlese-Tullgren funnel | P > F | Sopsop & Lit (2015) |
| *Paraserianthes falcataria* | Secondary | Sabah | Canopy arthropods | Abundance | Mist-blowing | F > P | Chey, Holloway, Hambler & Speight (1998) |
| *Pinus caribaea* | Secondary | Sabah | Canopy arthropods | Abundance | Mist-blowing | F > P | Chey, Holloway, Hambler & Speight (1998) |
| Rubber | Disturbed secondary | Xishuangbanna | Soil macroinvertebrates | Abundance | Berlese-Tullgren funnel & searching soil samples | F > P | Yang & Zhang (1997) |
| Rubber | Natural forests (did not specify primary or secondary) | Xishuangbanna | Canopy spiders | Abundance | Canopy fogging | F > P | Zheng, Li & Yang (2015) |
| Rubber | Natural forests (did not specify primary or secondary) | Xishuangbanna | Nematodes | Abundance | Cotton-wood filter method | F > P | Xiao, Tian, Zhou, Ai, Yang & Schaefer (2014) |
| Rubber | Natural forests (did not specify primary or secondary) | Xishuangbanna | Termites | Abundance | Standardized search along transects | F > P | Lin, Liu, Xiao, Xia & Yang (2017) |
| Rubber | Primary | West Kalimantan | Termites | Abundance | Standardized search along transects | F > P | Hidayat, Endris & Dwiyanti (2018) |
| Rubber | Primary | Xishuangbanna | Ground-dwelling spiders | Abundance | Searching litter samples | F > P | Zheng, Yang & Li (2009) |
| Rubber | Secondary | Dak Lak | Termites | Abundance | Standardized search along transects | P > F | Neoh, Itoh & Bong (2015) |
| Rubber | Secondary | South Kalimantan | Termites | Abundance | Standardized search along transects | F > P | Gathorne-Hardy, Jones, Syaukani (2002) |
| Rubber | Secondary | Sumatra | Beetles | Abundance | Winkler sampling | F > P | Susilo, Indriyati & Hardiwinoto (2009) |
| Rubber | Secondary | Sumatra | Macroinvertebrates | Abundance | Searching sieved litter samples | F > P | Barnes et al. (2014) |
| Rubber | Secondary | Sumatra | Macroinvertebrates | Biomass | Searching sieved litter samples | F > P | Barnes et al. (2014) |

Barnes, A. D., Jochum, M., Mumme, S., Haneda, N. F., Farajallah, A., Widarto, T. H. & Brose, U. (2014). Consequences of tropical land use for multitrophic biodiversity and ecosystem functioning. Nature Communications, 5**,** 5351. doi: 10.1038/ncomms6351

Chey, V. K., Holloway, J. D., Hambler, C., Speight, M. R. (1998). Canopy knockdown of arthropods in exotic plantations and natural forest in Sabah, north-east Borneo, using insecticide mist-blowing. Bulletin of Entomological Research, 88, 15-24. doi: 10.1017/S0007485300041511.

Chung, A. Y. C., Eggleton, P., Speight, M. R., Hammond, P. M., Chey, V. K. (2000). The diversity of beetle assemblages in different habitat types in Sabah, Malaysia. Bulletin of Entomological Research, 90, 475-496. doi: 10.1017/S0007485300000602.

Chung A. Y. C., Chey, V. K., Speight, M. R., Eggleton, P. & Hammond, P. M. (2002). A survey on defoliation and phytophagous insects in four habitat types in Sabah, Malaysia. Journal of Tropical Forest Science, 14, 116-130.

Gathorne-Hardy, F. J., Jones, D. T., Syaukani (2002). A regional perspective on the effects of human disturbanec on the termites of Sundaland. Biodiversity and Conservation, 11, 1991-2006. doi: 10.1023/A:1020890627168

Hidayat, M. R., Endris, W. H. & Dwiyanti Y. (2018). Effect of a rubber plantation on termite diversity in Melawi, West Kalimantan, Indonesia. Agriculture and Natural Resources, 52, 439-444. doi: 10.1016/j.anres.2018.10.016.

Jayaranman, D., Chinaappan, G. & Vallavan, R. (2017). Soil micro arthropods assemblages in selected plantation in The Nilgiris, Tamilnadu, India. International Journal of Advanced Research in Biological Scienes. 4, 90-97. doi: 10.22192/ijarbs.2017.04.11.011.

Jones, D. T. & Prasetyo, A. H. (2002). A survey of the termites (Insecta: Isoptera) of Tabalong district, South Kalimantan, Indonesia. The Raffles Bulletin of Zoology, 50, 117-128.

Kwok, H. K. (1996). Seasonality of forest birds in Hong Kong. PhD thesis, The University of Hong Kong.

Leather, S. R. (2005). Insect Sampling in Forest Ecosystems. Malden, MA: Blackwell Pub.

Lin, X. -B., Liu, S. -J., Xiao, H. -F., Xia, S. -W., Yang, X. -D. (2017). Effects of rubber plantation on structure and diversity of termite community. Chinese Journal of Zoology, 36, 2847-2854. doi: 10.13292/j.1000-4890.201710.007

Neoh, K. -B., Bong, L. -J., Nguyen, M. T., Nguyen, V. T., Nguyen, H. Q., Itoh, M., . . . Yoshimura, T. (2015). Termite diversity and complexity in Vietnamese agroecosystems along a gradient of increasing disturbance. Journal of Insect Conservation, 19, 1129-1139. doi: 10.1007/s10841-015-9828-8

Sopsop, G. & Lit, I. Jr. (2015). Soil-litter arthropod assemblage in dipterocarp forest, agroforestry area and mahogany plantation in Makiling Forest Reserve, Laguna. Journal of Nature Studies. 14, 47-65

Tsukamoto, J. & Sabang, J. (2005). Soil macro-fauna in an *Acacia mangium* plantation in comparison to that in a primary mixed dipterocarp forest in the lowlands of Sarawak, Malaysia. Pedobiologia, 49, 69-80. doi: 10.1016/j.pedobi.2004.08.007

Xiao, H. F., Tian, Y. H., Zhou, H. P., Ai, X. S., Yang, X. D., Schafer, D. A. (2014). Intensive rubber cultivation degrades soil nematode communities in Xishuangbanna, southwest China. Soil Biology and Biochemistry, 76, 161-169. doi: 10.1016/j.soilbio.2014.05.012

Yi, Z., Feng, J., Xue, D., Sang, W., Axmacher, J. C. (2012). A comparison of terrestrial arthropod sampling methods. 3, 174-182. doi: 10.5814/j.issn.1674-764x.2012.02.010

Yang, X. -D. & Zhang, J. -H. (1997). Community strucutre of soil animals in man-made plant communities in dry season in Xishuangbanna. Zoological research, 18, 403-409

Zheng, G., Li, S. -Q., Yang, X. -D. (2015). Spider diversity in canopies of Xishuangbanna rainforest (China) indicates an alarming juggernaut effect of rubber plantations. Forest Ecology and Management, 338, 200-207. doi: 10.1016/j.foreco.2014.11.031

Zheng, G., Yang, X. -D., Li, S. -Q. (2009). Biodiversity of ground-dwelling spider in six forest types in Xishuangbanna, S. W. China. Acta Entomological Sinica, 52, 875-884. doi: 10.16380/j.kcxb.2009.08.016

Supporting Information Table S2 – A species list showing the frequency of occurrences of different ant species at station levels in secondary forests and *L. confertus* plantations.

|  |  |  |
| --- | --- | --- |
| Species | Secondary forests (n=195) | Plantations (n=199) |
| *Anoplolepis gracilipes* | 0 | 12 |
| *Aphaenogaster exasperata* | 25 | 1 |
| *Brachyponera obscurans* | 2 | 9 |
| *Camponotus nicobarensis* | 2 | 1 |
| *Carebara rectidorsa* | 1 | 1 |
| *Carebara* sp.1 | 5 | 10 |
| *Crematogaster egidyi* | 6 | 3 |
| *Crematogaster quadriruga* | 0 | 1 |
| *Crematogaster* sp. cf. *zoceensis* | 0 | 1 |
| *Diacamma* sp.1 | 5 | 9 |
| *Ectomomyrmex leeuwenhoki* | 0 | 1 |
| *Ectomomyrmex* sp.1 | 25 | 14 |
| *Gnamptogenys bicolor* | 25 | 7 |
| *Leptogenys kraepelini* | 1 | 0 |
| *Monomorium chinensis* | 0 | 1 |
| *Monomorium impexum* | 3 | 2 |
| *Monomorium* sp. psw-01 | 13 | 14 |
| *Nylanderia emmae* | 13 | 0 |
| *Nylanderia* sp.5 | 72 | 59 |
| *Odontoponera denticulata* | 71 | 45 |
| *Oecophylla smaragdina* | 4 | 0 |
| *Paraparatrechina sauteri* | 0 | 2 |
| *Pheidole hongkongensis* | 0 | 1 |
| *Pheidole nodus/tumida* | 12 | 30 |
| *Pheidole pieli* | 43 | 51 |
| *Pheidole rabo* | 11 | 3 |
| *Pheidole taipoana* | 11 | 4 |
| *Pheidole ochracea* | 4 | 3 |
| *Polyrhachis tyrannica* | 1 | 0 |
| *Prenolepis naoroji* | 1 | 0 |
| *Pseudoneoponera rufipes* | 1 | 0 |
| *Technomyrmex* sp.A | 1 | 0 |
| *Technomyrmex horni* | 9 | 14 |
| *Technomyrmex obscurior* | 1 | 0 |
| *Technomyrmex pratensis* | 0 | 6 |
| **Total** | 27 | 27 |

Supporting Information Figure S1 – A map showing the distribution of study sites in Hong Kong. 

Supporting Information Figure S2 – A photo of representative bait containers with a sugar (left) and protein (right) bait inside. Baits are of a similar shape and size to minimize any effect by these factors. In total, pictured here, there are 35 *Gnamptogenys bicolor* workers with 6 of them occupying protein baits. Thus, the preference of protein baits in this station is 0.17.

Appendix S1 Compositional differences between habitats

**Compositional analyses**

As sampling efforts were unequal between sites due to loss of baiting stations, we quantified abundance of ants in each site using the percentage of baiting stations (regardless of the type of baits) within which they were detected. We conducted non-metric multidimensional scaling (NMDS) based on Bray-Curtis dissimilarity to visualize ant compositional differences between secondary forests and *L. confertus* plantations. To examine if compositional differences were significant, we conducted multivariate generalized linear models using binomial distributions, with habitat as the sole predictor. Multivariate generalized linear models have been shown to perform better than traditional analyses (e.g. PERMANOVA), as it better addresses the mean-variance relationship in assemblage data (Warton, Wright & Wang 2012). We also conducted logistic regressions for each species to examine how their occurrence varied between habitats. To control for multiple comparisons, we adjusted the p-values using false-discovery rate, as recommended in Pike (2011). For all logistic regressions, weight was specified as the number of sampling stations in each site. NMDS was conducted using R-package *vegan* (Oksanen et al. 2019), while the multivariate generalized linear model was conducted using *mvabund* (Wang, Naumann, Wright & Warton 2012).

**Results**

The multivariate generalized linear model revealed significant compositional differences between *L. confertus* plantations and secondary forests (p = 0.018, Appendix S1 Figure S3). Only four species showed significant changes in occurrence between habitats. *Odontoponera denticulata* was frequently observed in both habitats, although its occurrence was reduced from 36.41 % in secondary forests to 22.61 % in *L. confertus* plantations (adjusted p-value = 0.032). *Gnamptogenys bicolor* and *Aphaenogaster exasperata* were also less frequently observed in *L. confertus* plantations (adjusted p-value = 0.026 for both species), with their occurrence decreased from 12.82% (both species) in secondary forests to 3.52 % (*G. bicolor*) and 0.50 % (*A. exasperata*) in *L. confertus* plantations. The only species to exhibit a positive response in *L. confertus* plantations was *P. nodus/tumida* (adjusted p-value = 0.046), as its occurrence increased from 6.15 % in secondary forests to 15.08 % in *L. confertus* plantations.

一張含有 文字, 地圖 的圖片

自動產生的描述

Fig. S3 NMDS ordination visualizing compositional differences between secondary forests and *L. confertus* plantations. The dotted line represents 95% confidence intervals of each habitat based on standard errors.

**References**

Oksanen, J., Blanchet, F. G., Friendly, M., Kindt, R., Legendre, P., McGlinn, D., . . . Wagner, H. (2019). Community ecology package.

Pike, N. (2011). Using false discovery rates for multiple comparisons in ecology & evolution. Methods in Ecology and Evolution, 2, 278-282. doi: 10.1111/j.2041-210X.2010.00061.x

Wang, Y., Naumann, U., Wright, S. T., Warton, D. I. (2012). mvabund- an R package for model-based analysis of multivariate abundance data. Methods in Ecology and Evolution, 3, 471-474. doi: 10.1111/j.2041-210X.2012.00190.x

Warton, D. I., Wright, S. T., Wang, Y. (2012). Distance-based multivariate analyses confound location and dispersion effects. Methods in Ecology and Evolution, 3, 89-101. doi: 10.1111/j.2041-210X.2011.00127.x