Name	Counterpart	Title
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Background and Methods

The large-scale transformation of natural rainforest into the simplified habitats of production systems such as oil palm has resulted in the loss of important habitats for many forest plants and animals. Habitat loss due to transformation also reduces insect diversity and this reduction is likely to affect ecosystem services. The ecosystem services greatly affected by habitat transformation are pollination, biological pest control and carbon-nitrogen retention. Deforestation rates in Southeast Asia are among the highest of any tropical region, with expansion of oil palm being one important factor. Conversion to oil palm has been shown to have a negative impact on overall biodiversity. Designing plantation landscapes with agroforestry is proposed as one strategy to satisfy livelihood needs while increasing biodiversity and ecological functions.

Figure 1. Condition of enrichment plot (40x40m) in 2018 and how to set up a pitfall trap (inset)

The EFForTS Project established a large-scale, long term biodiversity enrichment experiment in an oil palm plantation in PT Humusindo Makmur Sejati, Jambi, Indonesia. Six native tree species were planted at the site, including fruit tree species (*Parkisa speciosa, Archidendron pauciflorum* and *Durio zibethinus*), timber species (*Peronema canescens* and *Shorea leprosula*) and a species producing natural latex (*Dyera polyphylla*). Planting native tree species is considered a restoration measure for increasing biodiversity. Understanding the interaction between land use, biodiversity, and ecosystem functioning requires long-term observational, comparative and experimental study. Long term monitoring for beneficial insects in enrichment oil palm plantation is very important for the better understanding of the ecosystem services related to the changes of plant structures over time.

The research consisted of field work on insect diversity using plots set up by EFForTS. Pitfall traps were used to trap ground living insects (mainly ants) and yellow pan traps to trap low-flying insects (mainly parasitoid wasps). The enrichment experimental plots were the plots with different levels of plant species diversity (1, 2, 3 and 6 spp.) and only focus on the 40x40m plots (Figure 1). As many as four pitfall traps and four yellow pan traps were installed at the same time on the designated plots for three days. Insects were sampled over a month period in July 2018, and will be replicated each year. The tree species in the plots were identified and counted. The insects, ants and parasitoid wasps were identified to morphospecies to determine their functional role.

In total, we collected 5504 individual ants in 47 species and 531 individual parasitoid wasps in 176 species from 12 plots with different plant species richness (Table 1). The species richness and abundance of ants were significantly different between plots (Figure 2a, b). In contrast, species richness and abundance of parasitoid wasps did not differ between plots (Figure 2c, d).This indicated that ants are more affected by different plot characteristics than parasitoid wasps. There was no significant effect (by linear mixed effects model) of the number of oil palm and other trees (as fixed effects) on the species richness and abundance of ants were not affected by number of oil palm and other

trees. However, the species richness and abundance of parasitoid wasps was significantly less in sites where the number of oil palm trees was high.

The conclusion of the first year monitoring is increasing plant diversity in oil palm plantation have different effects on the different taxa of insects. Ant diversity was more affected by plant diversity in oil palm plantations, while the diversity of parasitoid wasps was influenced by the density of oil palm trees.

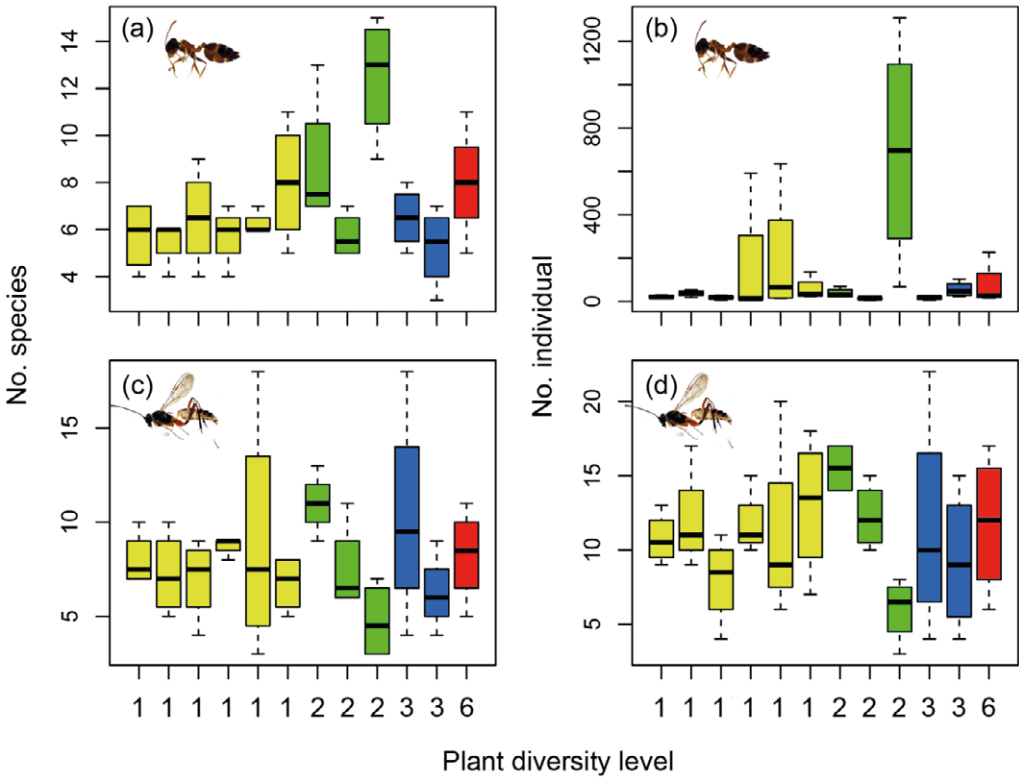

Figure 2. Species richness and abundance of ants (a and b) and parasitoid wasps (c and d) between plots (plant diversity level)