



Universiteit
Leiden
The Netherlands

The impact of sustainable forest management on plant and bird diversity in East Kalimantan, Indonesia

Arbainsyah, A.

Citation

Arbainsyah, A. (2016, December 6). *The impact of sustainable forest management on plant and bird diversity in East Kalimantan, Indonesia*. Retrieved from <https://hdl.handle.net/1887/44704>

Version: Not Applicable (or Unknown)

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/44704>

Note: To cite this publication please use the final published version (if applicable).

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/44704> holds various files of this Leiden University dissertation.

Author: Arbainsyah

Title: The impact of sustainable forest management on plant and bird diversity in East Kalimantan, Indonesia

Issue Date: 2016-12-06

Summary

The impact of Sustainable Forest Management on plant and bird diversity in East Kalimantan, Indonesia

Keywords: Sustainable forest management, Selective logging, Species richness, Forest structure, Forest recovery, Tropical rain forest.

The increasing destruction of tropical rainforests is a result of rapid changes in land use and increased logging. Evidence suggests that logging could have a substantial impact on the biodiversity of tropical rainforests. Especially illegal logging leads to multiple processes which negatively affect populations of plants and animals. FSC certification of forest concessions aims to reduce the negative impact of logging. The question is however whether FSC certification of selectively logged forest really has a positive impact on the conservation of biodiversity in the long term. So far, no quantitative evidence is available to prove this (Van Kuijk *et al.*, 2009). I examined the impact of logging under different logging regimes in East Kalimantan, by comparing forest sites which had been selectively logged 1, 5 and 10 years ago and one disturbed forest site (Pusrehut) with a site in undisturbed primary lowland rainforest. Particular emphasis was placed on plant diversity, structure of forests and bird communities. The study area is geographically diverse, consisting of rolling hilly landscape with shallow valleys and gullies. The altitude of the lowland Dipterocarp forest and sub-montane forest, ranges from 25-140 m above sea level. This provides for diverse habitats, which are rich in plant and bird communities.

Fieldwork was carried out in three forest reserves in East Kalimantan. The sites in Berau were in the process of being FSC certified. All forest sites were studied using the same methodology: 1). All terrestrial plants were sampled and identified in primary forest (1 site) and selectively logged forest (3 sites) in 600 subplots (10 × 10 m). Trees were systematically recorded along line transects of 6 ha. Saplings were recorded in 60 subplots (5 × 5 m) of 1.5 ha and seedlings were recorded in 60 subplots (2 × 2 m) of 0.24 ha, positioned alternately to the left and right of the transect centre lines at intervals of 100 m; 2). All birds were identified during point counts in all sites, in the selective logging concession in a primary site and in selectively logged forest sites in the Berau district, a primary site in Sungai Wain and a disturbed site in Pusrehut Kutai Kartanegara between February and August 2014. In all sites we selected 30 sampling points to conduct point counts at a distance of 200 m from each other were selected.

At least 156 tree species were identified during field work; the number of tree species in the forest site selectively logged 1 year ago was higher than in the other sites. Tree densities were significantly lower in the forest sites selectively logged 1 and 5 years ago compared to the primary forest site, but tree densities in the forest site logged 10 years ago were similar to those of the primary forest site. The number of tree stems was almost as high in the primary forest site compared to the selectively logged forest sites, with a total number 612 tree stems encountered. Dipterocarpaceae was the most dominant family. Some of the plant species identified were unique to either disturbed or selectively logged forest, or to primary forest, while some were found in both selectively logged forest sites and in the primary forest site. Some of the typical palm tree species, such as *Oncosperma horidum* were very abundant in the forest sites selectively logged 1 and 10 years ago, while less abundant in the other sites.

The sapling vegetation revealed a high diversity in the selectively logged forest sites compared to the primary forest site in Berau. The sites in Berau, which were in the process of being FSC certified, were over-represented by new regenerating species such as *Madhuca malaccensis*, which were more dominant than other species in the forest site selectively logged 5 years ago as compared to the primary forest site. A total of 97 plant species have been identified, with the highest number of plant species in the primary forest site. Many seedlings comprised of new pioneer species, and newly recorded plants, such as *Macaranga hypoleuca*, which is fast growing and particularly abundant in the selectively logged forest sites. The highest number of species was found in the forest site selectively logged 1 year ago, with a total number of 95 species encountered. The species richness of Dipterocarpaceae within the selectively logged forest suggests that logging in the past have had little effect on its diversity. This was especially the case for *Shorea* spp. which occurs both in primary forest and logged forest.

Many of the plant species are important for ecosystem services, which was measured by Plant Functional Types (PFT), which is representative of certain patterns in forest structure, and through tree species composition and species diversity in relation to stem diameter. Species specific wood density was used to assign species to three classes of PFT (light, medium, heavy hardwood). My research showed large differences among the PFT classes in the selectively logged forest sites. The “heavy hardwood” class, represented by a certain abundance of stems and species richness, was significantly lower in the forest sites selectively logged 1 and 5 years ago compared to the primary forest site. Stems with a higher abundance in the selectively logged forest sites generally belonged to the “light wood” class. The most abundant species in this class was *Shorea parvifolia*, which is one of the main Dipterocarp timber trees.

The study area provides suitable habitat for most of Borneo's lowland bird families. Bird observations were done in all study sites from February to August 2014. A total of 154 species were identified, including 10 endemic Bornean species.

The structure of a bird community could provide an indicator of habitat disturbance, e.g. after selective logging. Apart from the 154 bird species which were identified in all forest sites, most species identified in the primary forest sites were also found in the disturbed and/or selectively logged forest sites. Although there were no significant differences in species composition between the six forest sites, I did find a significant higher abundance of birds per foraging layer of both the terrestrial guild and the frugivorous/insectivorous guild in primary forest sites as compared to the secondary forest sites. I also found that endemic insectivorous birds showed a significantly higher abundance in the primary forest sites compared to the secondary forest sites. This confirms earlier findings on the impact of logging on avian communities in East Kalimantan.

Diversity index data, used as an indicator for all growth stages (trees, saplings and seedlings) of the forest community, showed that all sites were floristically very diverse. This indicates that in the selectively logged forest sites the abundance of tree species was affected rather than species richness itself. This effect is even stronger in relation to diameter-related patterns of tree survival, as was confirmed by the clear pattern of tree survival related to Plant Functional Type (PFT) classes I found. In the selectively logged forest sites, this PFT related pattern might also result in selective extinction of certain tree species/genera because of differences in tree species composition among PFT classes. This means that, although large areas of the forest concession have been logged in the past, this has probably had a limited impact on the plant species richness. Bird diversity appeared to be similar in the two external sites [one primary forest site (Sungai Protected forest site) and one disturbed forest site (Pusrehut forest site)], as compared to the primary forest site and the selectively logged forest sites in Berau. However, I found a higher mean species number in the primary forest sites, which may be the result of a higher mean species abundance in the primary forest sites.

My main conclusion is that, although selectively logged forest sites were still high in tree species richness, tree densities are affected by selective logging. In the long run, selective logging will affect the presence or absence of tree species and/or genera because different tree species fulfil different functional types.

My main conclusion regarding bird communities is that selective logging affects the abundance of birds within their communities, especially in small forest sites. The risk of local species extinction is likely to increase when sites are smaller and

more isolated from undisturbed forest. Nonetheless, even the use of sufficiently large sites may not prevent certain species from becoming extinct, when logging is not selective or when selective logging continues without releasing the pressure after a certain amount of time.