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ABSTRACT

Birds play pivotal roles in many ecosystems and the benefits humans derive from them. Birds and their functional roles are affected by habitat change and disturbance to variable degrees. We examined bird composition in three habitats in North Sumatra: natural forests, rubber agroforests (RAF) and rubber monoculture plantations (RMP). The birds were observed using a quick biodiversity survey protocol. Changes in structure and composition of vegetation in agriculture and cleared land influenced bird species composition across feeding guilds; we discuss impacts this may have on ecosystem services.

Keywords: Agroforest, guild type, plantation, rubber, quick biodiversity survey

1. INTRODUCTION

Forest ecosystems in various stages of transformation and conversion provide goods and services that benefit humankind. Bird, as one of ecosystem components, contributes ecosystem services, usually discussed as provisioning, regulating, supporting and cultural services. Birds play many roles, including as pollinators, seed dispersers, predators, and providers of pest control. However, human activities alter the natural ecosystems, such as forest, into agricultural lands, plantations and development of infrastructure for industrial activities. Intensification of land management, like in monoculture plantation, increases yield and productivity. On the other hand, it affects habitats and diversity of flora and fauna. In a disturbed area, roles of birds may be limited due to changes of their habitat.

Since the nineteenth century, forest cover in Sumatra has declined drastically, mainly owing to human activities, with early conversion focused on North Sumatra province. The natural vegetation in forested areas has changed to man-made ecosystems, such as agroforest, tree plantation and agriculture. For centuries, Sumatran smallholder farmers practiced traditional systems of mixed agriculture involving annual crops and perennial trees—such as food, fruit trees and resin—to form a typical forest-like structure; hence its designation as an agroforestry system.

Agroforestry offered such alternative that could balance needs of generate income and ecology-friendly. Different composition of flora species and structure of vegetation in different habitat affected birds composition (Styring *et al.*, 2011). However, little is known about ecosystem services provided by birds on different land use types in North Sumatra. This paper focused on roles of birds, which are based on foraging behavior, occurred at different habitats in North Sumatra.

2. METHODS

The study was conducted in three habitats, viz. rubber monoculture plantations (RMP), rubber agroforests (RAF) and forest areas, in two districts of Simalungun and Aek Tarum, North

Sumatra. The birds were observed by using a descriptive survey methods by implementing a quick biodiversity survey protocol for birds, where data were collected along a line transect of 1 km and the list of 20 MacKinnon's (MacKinnon *et al.*, 1993). The list of 20 MacKinnon's bird species is a recording method to verify the species of birds and to calculate the density of bird species. Data were tabulated and identified referred to the nomenclature (Sukmantoro *et al.*, 2007). Birds were then grouped into foraging behaviors or guild types (Lambert and Collar, 2002). Data were analysed using descriptive analysis.

3. RESULT AND DISCUSSION

3.1 Foraging Types

A total of 17 foraging types was identified in the survey: arboreal frugivore (AF), arboreal foliage gleaning insectivore (AFGI), arboreal foliage gleaning insectivore-frugivore (AFGIF), arboreal frugivore-predator (AFP), aerial insectivore (AI), bark gleaning insectivore (BGI), miscellaneous insectivore-piscivore (MIP), nectivore (N), nocturnal predator (NP), nectivore-insectivore-frugivore (NIF), piscivore (P), raptor (R), sallying insectivore (SI), sallying substrate gleaning insectivore (SSGI), terrestrial frugivore (TF), terrestrial insectivore (TI) and terrestrial insectivore-frugivore (TIF).

All feeding groups were present in forests, while in RAF and RMP the piscivore (P) and terrestrial insectivore-frugivore (TIF) feeding groups were absent. In the RMP, further losses occurred in that the frugivore-predator (AFP), nectivore (N), terrestrial frugivore (TF) were also lacking, but it included nocturnal predators (NP), not observed in RAF (Figure 1).

Forest habitat had the highest species richness (122 species) compared with species richness in RAF (46 species) and RMP (30 species) (Ayat, 2010). Forests provide suitable conditions for many bird species for foraging, nesting, resting and breeding. Forest degradation and habitat loss influence bird population and composition. Within this data set bird species diversity is non-linearly associated with tree diversity. Similar evidence reported in comparison between forest and *Acacia mangium* plantation (Styring *et al.*, 2011).

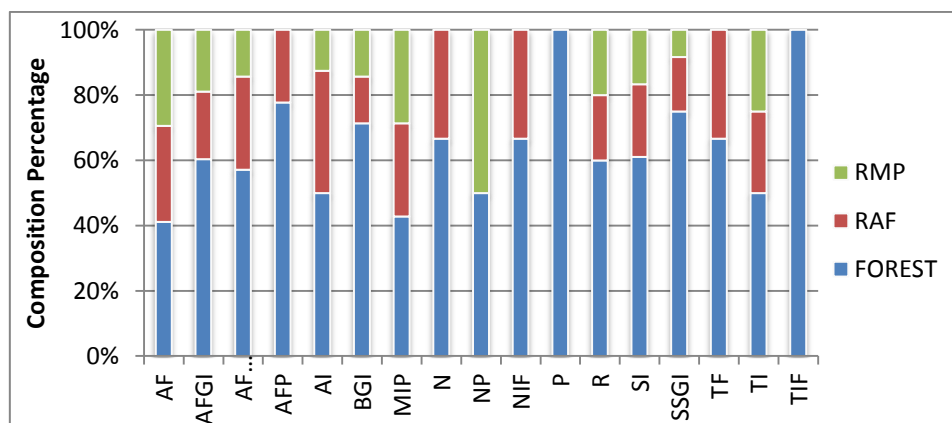


Figure 1: Composition of bird guild types in different habitats in North Sumatra (Ayat, 2011)

Remarks: RMP=Rubber monoculture, RAF=Rubber Agroforest. AF=arboreal frugivore, AFGI=arboreal foliage gleaning insectivore, AFGIF=arboreal foliage gleaning insectivore-frugivore, AFP=arboreal frugivore-predator, AI=aerial insectivore, BGI=bark gleaning insectivore, MIP=miscellaneous insectivore-piscivore, N=nectivore, NP=nocturnal predator, NIF=nectivore-insectivore-frugivore, P=piscivore, R=raptor, SI=sallying insectivore, SSGI=sallying substrate gleaning insectivore, TF=terrestrial frugivore, TI=terrestrial insectivore and TIF=terrestrial insectivore-frugivore.

3.2 Mutualism Association of Bird and Plant

Birds through their mobility connect habitats in a landscape, involving energy transfer among ecosystems, and contribute to ecosystem functions and resilience through their foraging and seed dispersal. Bird-plant interaction of pollination and seed dispersers have large impacts on ecosystems (Lunberg and Moberg, 2003). Pollination process of some trees species is assisted by birds. Nectivorous birds (family: Nectariniidae) that only consume nectar and pollinate some trees species, were encountered in both forests and RAF, but not found in RMP. RMP was dominated by rubber trees (at all stages). Rubber trees are insect pollinated (Warmke, 1952). Four species of nectivores encountered in both forest and RAF were *Anthreptes singalensis*, *Cinnyris jugularis*, *Arachnothera affinis* and *Anthreptes malacensis* (Ayat, 2011).

Birds disperse seeds through fruit consumptions. Frugivorous birds (family: Columbidae and Sturnidae) that only consume fruits as their diet, were encountered in the three habitats. Birds disperse seeds of many woody plant species with direct value to humans for timbers, medicine, food and other uses. Numbers of frugivory birds and combination of frugivory and other feedings were encountered in forests. In RAF and RMP, on the other hand, were found less frugivory birds.

Large frugivorous birds, such as Bucerotidae, were not found in either RAF or RMP. They have high susceptibility to anthropogenic and environment change. Large-bodied fruits require large frugivorous birds to carry and disperse fruits to larger distances from mother trees. Lower density and smaller size of frugivorous birds may result in seedlings being concentrated under the mother trees and less seedling dispersal (Wenny *et al.*, 2011). In consequence, tree diversity of ecosystems is expected to decline over the longer term. Agroforests provide food for frugivorous species, but hunting pressure on the larger birds may reduce effectiveness of seed dispersal.

3.3 Pest Control

Insectivorous birds provide regulating services in pest control. One species of the Apodidae family belonging to the aerial insectivore (AI) guild, *Collocalia esculenta* (glossy swiftlet), was encountered in the three habitats. Consumption of flying arthropods and reducing the population of herbivorous insects potentially benefits humans in improving growth and yield of agriculture commodities.

Some bird species (predator and raptor guild types) benefit agriculture. Raptors (e.g. eagles, family: Accipitridae) and predators (e.g. owls, family: Strigidae) consume rats (rodents), which are considered as pest of crops and tree crops (such as oil palm). Very few study on the potential relation of birds in the natural ecosystems and agricultural ecosystems.

3.4 Nutrient Cycling

Birds contribute in nutrient cycling of ecosystems. Aquatic and marine birds produce guano, which is beneficial as phosphor fertilizer (Wenny *et al.*, 2011) Aquatic birds belongs to piscivore type consume fish. *Ardea* spp. and *Egretta garzetta* (Ardeidae) were encountered in forest only. Landscape of the study area consisted of hilly mountains, valleys, lowlands laid along rivershed of Aek Tarum and Sigura-gura. Although Piscivores are considered as a predator, they contribute to nutrient cycling in the habitats. All birds contribute in maintaining the equilibrium of food chain in the ecosystems.

4. CONCLUSION

Birds provide many ecosystem services, especially regulating and supporting services, that are directly and indirectly benefit for human life. Shifting in natural ecosystems to man-made ecosystems affected bird species composition and population. Habitat loss reduces bird

composition and birds with specialist role have the highest risk of extinction. Rubber monoculture plantation did not provide suitable condition for all bird species. Enrichment planting of bird's food-tree species may attract more bird species in the plantation area for foraging and resting. Efforts to conserve habitats and bird population maintain diverse services provided by ecosystem, thus contributing to human well-being.

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