Understory Bird Community of An Oil Palm Plantation in Central Kalimantan

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Abstract. The implementation of High Conservation Value (HCV) area in oil palm plantation in Indonesia has caused the occurrence of remnant natural areas within oil palm landscape. Such forest remnants increase habitat heterogeneity that is important to maintain biodiversity in oil palm plantation including birds. Understory birds are the most prone to habitat degradation compared to other bird group species. This study aims at examining understory bird community in an oil palm plantation with different distance from HCV area. Mist nets were set up in June 2014 and January/February 2015 in areas adjacent to HCV area and 1 km from the HCV area. A total of 24 species from 13 families were caught in the mist nests. The highest bird diversity ($S=14$; $H'=2.14$) were recorded in location adjacent to HCV area in June 2014. Most birds captured were insectivores. However, based on the number of individuals, the understory bird community in oil palm plantation was dominated by frugivores from the family of Pycnonotidae. Brood patch was detected in birds found in both locations indicating use of the habitat for breeding.

Keywords: bird diversity, oil palm, guild, habitat use

1. Introduction

One of the growing plantation commodities in Indonesia is oil palm. The average growth of oil palm plantation in the period of 2004-2014 was predicted to reach 7.67%, with a total area of 10.9 ha in the year of 2014 [1]. Tremendous impact on ecosystem from the expansion of oil palm plantation came from forest habitat loss and fragmentation and decline of species diversity [2,3]. Many studies such as [4] had shown that biodiversity in oil palm plantation is lower than those in forested landscape. However, the implementation of high conservation value (HCV) area concept in oil palm plantation in Indonesia has provided remnants of natural habitat in oil palm landscape, which is believed to protect some of the biodiversity in the landscape. Such forest remnant increase habitat heterogeneity that is important to maintain biodiversity in oil palm plantation including birds [5,6]. According to [7,8] oil palm landscape still hold valuable bird diversity.

Understory birds are the most prone to habitat degradation compared to other bird group species [9]. This study aimed at examining understory bird diversity in oil palm plantation at different distance...
from the forest edge. A more detailed biological data on birds, such as age, breeding status, and health condition is needed to evaluate the use of oil palm plantation by bird community. Unfortunately such information is still rare in Indonesia. The use of mist nets in this study will help to collect more biological data of bird community in addition to providing more precise species identification.

2. Study sites and methods

2.1. Description of the study site
The study was conducted in an oil palm plantation (size 7400 ha) in Pangkalan Lada District, Kotawaringin Barat Regency, Central Kalimantan. The total area of remnant natural habitat was approximately 500 ha. Remnants of natural habitats consisted of lowland secondary rainforest and swamp forest. Some swampy open areas also occur at the boundary of oil palm plantation. The lowland secondary forest was dominated by pioneer trees such as Macaranga spp and Dillenia spp, although some native tree species such as Shorea spp, Syzigium sp, Ficus spp, and Eusyderoxylon zwageri were still found in the area. The sparse canopy allowed the growth of shrubs and other understory plants at the forest floor.

The plantation consisted of different ages of oil palm stands; however, the study location was focused on medium age plantation (approximately 7-9 years old), with a total height ranges between 6-7 m at the edges of natural area and 7 - 8 m at the distance of 1 km from the natural habitat. In general, the lower vegetation cover was more dense in location closer to the natural habitat but there were spots of dense lower vegetation in location 1 km from the natural habitat as a result of gaps in plantation cover. The average rainfall in the study site was 1850.22 mm/year with the average number of rainy days 97.6 days/year. The average temperature was 26.1-27.2°C [10].

2.2. Methods

2.2.1. Data collection. Birds were captured using mist nets at the edge of the forest and 1 km from the edge of the forests. Mist nets were set up and opened from 6.00 to 17.00. In June 2014 the total net-hours were 2466 net-hours at the edge of the forest and 3384 net-hours at 1 km of the forest. In February 2015 the total net hours were 4218 net-hours at the forest edge and 8706 net-hours at 1 km from the forest. The differences between net-hours were influenced by the availability of tracks and suitable weather. Nets were opened only during fine weather. Nets were closed during rain, when it was too hot or during strong wind. Nets were placed in shady areas and were checked at least once an hour to minimize risk of injury of captured birds. Any bird captured in the mist nets was removed from the net, put into bird bag, and brought to banding station to be identified, weighed, measured, and examined for brood patch and molt. Indication of breeding was determined by presence or absence of brood patch while molt was examined at primary feathers and scored from 0 (old feather) to 5 (new complete feather) following [11]. Only known species were marked with IBBS (Indonesian Bird Banding Scheme) numbered metal bands. Birds were then released back into their habitat. Bird identification was supported using field guide by [12] and [13], while the naming of species follows [14].

2.2.2. Data analysis. Total species diversity was expressed by the number of species (S) and Shannon Index of Diversity (H’) and Margalef Index (D_Mg) following [15]. Functional diversity was assessed by classifying birds according to feeding guild based on [16]. Bird abundance was derived from the capture rates (number of birds/100net-hour). Molt score for each primary feather was summed up to get a total molt score. Since only one wing was examined the total score ranges between 0-50.
3. Results

3.1. Species diversity, composition and abundance
A total of 24 species from 13 families were captured during the study. Most families were represented by only one species. The family of Pycnonotidae was dominant and was represented by five species, followed by Nectariniidae (4 species), Timaliidae (3 species), Alcedinidae (2 species) and Sylviidae (2 species). The number of species, number of individuals and diversity indices were higher in area adjacent to forest for both seasons (table 1). Insectivorous birds dominated the understory bird community in both location in oil palm plantation (table 2).

Table 1. Species diversity of understory birds using mist net method based on season dan distance from forest edge.

| Species diversity | June 0-100 m | June 1km | Jan/Feb 0-100m | Jan/Feb 1km |
|-------------------|--------------|----------|----------------|-------------|
| Number of Species | 14           | 8        | 16             | 4           |
| Number of Individuals | 46          | 17       | 59             | 4           |
| H'                | 2.14         | 1.92     | 1.86           | 1.39        |
| E                 | 0.81         | 0.92     | 0.67           | 1.00        |
| D_Mg              | 3.40         | 2.47     | 3.68           | 2.16        |

Table 2. Composition of bird community based on feeding guild.

| Feeding Guild   | Number of Species | % |
|-----------------|-------------------|---|
| Carnivores      | 1                 | 4.17 |
| Frugivores-Insectivores | 5 | 20.83 |
| Granivores      | 2                 | 8.33 |
| Insectivores    | 9                 | 37.50 |
| Nectarivores    | 4                 | 16.67 |
| Omnivores       | 1                 | 4.17 |
| Piscivores      | 2                 | 8.33 |

In general capture rates were low, with the highest was at the location adjacent to forest (table 3). The abundant species varied between locations and seasons, but Yellow-vented Bulbul was the most abundant in both locations and seasons. Several species were only found in one season, such as Olive-winged Bulbul and Blue-eared Kingfisher that were found only in June 2014 while Asian Red-eye Bulbul and Plaintive Cuckoo were only found in the January/February 2015.

3.2. Brood patch as indication of breeding, and molt characteristics
Brood patch was detected only in four individuals; those were Ashy Tailorbird (2 individuals), Rufous-Tailed Tailorbird (1 individual), and Striped Tit-Babbler (1 individual). Ashy Tailorbird showed brood patch in both seasons while Rufous-Tailed Tailorbird only showed brood patch in June 2014, and Striped Tit-Babbler showed brood patch in January 2015. The occurrence of brood patch may indicate the breeding status of birds. Therefore, Ashy Tailorbird were found breeding in both seasons.
### Table 3. Estimate of bird abundance based on capture rates in different season and distance from forest edge.

| Species                                      | Abundance (ind/100 net-hours) |
|----------------------------------------------|--------------------------------|
|                                              | June 2014  | Jan/Feb 2015 |
|                                              | 0-100m     | 1 km         | 0-100m      | 1 km         |
| Besra (*Accipiter virgatus*)                 | 0.00       | 0.00         | 0.00        | 0.02         |
| White-breasted Waterhen (*Amaurornis phoenicurus*) | 0.00       | 0.00         | 0.00        | 0.02         |
| Stork-billed Kingfisher (*Pelargopsis capensis*) | 0.00       | 0.00         | 0.00        | 0.02         |
| Common Emareld Dove (*Chalcophaps indica*)    | 0.04       | 0.03         | 0.02        | 0.00         |
| Pliantive Cuckoo (*Cacomantis merulinus*)     | 0.00       | 0.00         | 0.05        | 0.00         |
| Blue-eared Kingfisher (*Alcedo meninting*)   | 0.16       | 0.00         | 0.00        | 0.00         |
| Puff-backed Bulbul (*Pycnonotus eutilotus*)   | 0.04       | 0.00         | 0.02        | 0.00         |
| Olive-winged Bulbul (*P. plumosus*)          | 0.00       | 0.06         | 0.00        | 0.00         |
| Yellow-vented Bulbul (*P. goiavier*)         | 0.73       | 0.15         | 0.76        | 0.00         |
| Cream-vented Bulbul (*P. simplex*)           | 0.12       | 0.00         | 0.05        | 0.00         |
| Asian Red-eye Bulbul (*P. branneus*)         | 0.00       | 0.00         | 0.12        | 0.00         |
| Long-tailed Shrike (*Lanius schach*)          | 0.04       | 0.03         | 0.05        | 0.00         |
| White-rumped Shama (*Copsychus malabaricus*) | 0.04       | 0.00         | 0.00        | 0.00         |
| Fluffy-backed Tit-Babbler (*Macronous ptilosus*) | 0.00       | 0.00         | 0.02        | 0.00         |
| Striped Tit-Babbler (*M. gularis*)           | 0.08       | 0.03         | 0.00        | 0.00         |
| White-chested Babbler (*Trichastoma rostratum*) | 0.00       | 0.00         | 0.05        | 0.00         |
| Rufous-tailed Tailorbird (*Orthotomus sericeus*) | 0.00       | 0.09         | 0.05        | 0.00         |
| Ashy Tailorbird (*O. ruficeps*)              | 0.08       | 0.06         | 0.02        | 0.00         |
| Pied Fantail (*Rhipidura javanica*)          | 0.08       | 0.06         | 0.02        | 0.02         |
| Crimson Sunbird (*Aethopyga siparaja*)        | 0.00       | 0.00         | 0.02        | 0.00         |
| Brown-throated Sunbird (*Anthreptes malacensis*) | 0.00       | 0.00         | 0.02        | 0.00         |
| Ruby-cheeked Sunbird (*A. singalensis*)       | 0.08       | 0.00         | 0.05        | 0.00         |
| Little Spiderhunter (*Arachnothera longirotra*) | 0.04       | 0.00         | 0.07        | 0.00         |
| Dusky Munia (*Lonchura fuscans*)              | 0.12       | 0.00         | 0.00        | 0.00         |

In the first field session in June 2014, 58 birds were checked for molt (several birds were released or escaped before complete examination). Only one bird had complete new feathers (score 50), that was the Pied Fantail, and 22 individuals (38%) of 10 species were in active molt (score 4 - 44). In the
second field session in January/February 2015 63 birds were checked for molt. There were 15 individuals (23.8%) consisted of 7 species that showed complete new primary feathers (molt score 50). Those were Yellow-vented Bulbul, Asian Red-eye Bulbul, Ashy Tailorbird, Long-tailed Shrike, Little Spiderhunter, Ruby-cheeked Sunbird and Brown-throated Sunbird. Active molt of primary feathers (score ranged from 1-46) were detected in 19 individuals (30.2%) consisted of 10 species, and the rest were not in molting.

4. Discussion
This study confirmed other studies in oil palm landscape regarding level of species diversity. Compared to study by [5] in Selangor, Malaysian Peninsula, the species diversity in this study was even lower. However, low diversity of birds in this study may also result of using the mist netting method. According to [17] the mist net method has limited coverage and can only capture a certain size range of birds, usually those between 5-100 g. The drawback of assessing bird abundance using capture rates from mist net was also discussed by [18]. Birds that fly more often will have a greater chance to be captured compared to birds that fly less eventhough they have relatively similar abundance. Yellow-vented Bulbul used to forage in group, and prefer to forage closer to the ground compared to other bulbuls [12]. Therefore they have higher possibility to be caught in the mist nets. This might explain the high number of this species in this study.

There was a tendency that bird diversity was higher in location adjacent to forest edge compared to those farther away. The possible reason was the availability of lower vegetation in that area. Edge area received more sunshine so it stimulated the faster growth of shrubs and other lower vegetation. The positive effect of lower vegetation on the diversity of birds was reported by [19] in Eastern Guatemala and [7] in the oil palm plantation in East Kalimantan. This is in line with [20], that the presence of epiphytes and the number of plant cover has a positive impact on the diversity of birds in the plantation.

The most abundant species was Yellow-vented Bulbul, whose major diet are fruit but also consume insects. The large number and variety of individual abundance of insectivorous birds in oil palm plantations shows the potential of bird communities as pest control in oil palm plantations. The role of birds as a controlling insect pest in oil palm plantations has been proved by [21] whose exclosure experiment showed that higher leaf damage by insect found in the protected plot.

The occurrence of brood patch in a bird shows that the bird is either incubating or brooding; therefore it is an indicator of breeding stage. The information on breeding season and breeding ecology of birds in Indonesia is still very limited. The most comprehensive data so far was published in 1950 by [22]. Research by [23] showed that breeding season in Sarawak, in the northern part of Kalimantan Island, was related to the high availability of insect. Birds tend to breed when insects as the potential diet was abundant. According to [24] arthropod abundance was the key factor that determine breeding in birds. In addition to breeding, a quite high proportion of birds in the study area were undergoing molt. Molt activity consumes high energy for birds to replace and grow new feathers. The occurrence of breeding and molting in the study area may imply the availability of sufficient resources for birds, especially insectivorous birds, in the oil palm plantation.

5. Conclusion
In general, understory bird diversity in oil palm plantation was low. Bird diversity was influenced by habitat heterogeneity with higher bird diversity found at the area closer to forest edge. Most birds captured were insectivores, but the dominant birds were frugivores from the family of Pycnonotidae. Use of oil palm plantation for breeding was shown by the occurrence of brood patch. The occurrence of brood patch and molt may also indicate sufficient resources in oil palm plantation for certain groups of birds, especially insectivores.
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