Is forest remnants able to support bird community? Case in tropical lowland forest of West Java, Indonesia

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Abstract. Lowland tropical forests have undergone intensive fragmentation, resulting in the creating of many forest remnants. The aim of the research was to reveal how much tropical lowland forest remnant in West Java is able to support bird communities. The research was conducted during rainy and dry season in Dramaga and Haurbentes Experiment Forest (each covered 60 ha), by employing a standard point count method, for 5 days in each land use, using a 1.2 km transects of 5 points each (300 m distance) in April to October 2016. Shannon-Wiener (H’) and Jaccard’s similarity indices (SIJ) were calculated. The variation of species composition for both seasons was also compared. Bird richness was 30 species for Dramaga (H’ 2.72) and 39 species for Haurbentes (H’ 2.91), both seasons combined. SIJ was 0.39 (both seasons combined). Season had a significant impact on bird diversity and composition, where rainy season supported more birds in Haurbentes, but the opposite in Dramaga. Forest remnants were able to support the bird community, mostly small-sized insectivores, frugivores, granivores, and nectarivores. Small remnants were not able to support raptors (e.g., kite), medium to large-sized frugivores (hornbills, pigeon), medium-sized woodpeckers, as well as species preferred thick bushes and shrubs (e.g. babblers, starlings, crows, magpies).

Keywords: avian community, dry season, rainy season, urban forest

1. Introduction

Fragmentation of forest ecosystems leads to a decrease in species richness and causes changes in the structure and composition of bird communities [1,2]. When forest fragmentation continues due to the fulfillment of human development, the result would be small remnants, most probably surrounded by matrix unsuitable for birds and hamper the bird dispersal.

Forest remnants, especially in urban tropics, might still important as habitat for various bird species, small mammals, and insects. Unfortunately, data regarding this topic in the tropical country of Southeast Asia is very limited. The aim of this research was to reveal the bird species found in the remnant forests of West Java and how much tropical lowland forest remnant in West Java is able to support bird communities. Based on the results, a recommendation will be formulated in order to sustain bird diversity in remnant forests.

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2. Methods
The research was conducted in two tropical lowland forest remnants, namely Haurbentes and Dramaga (figure 1), both are experimental forest managed by the Center for Research and Innovation, Ministry of Environment and Forestry, Republic of Indonesia (table 1). The two sites are surrounded by settlement, mixed with annual/perennial crops and rice fields owned by local communities, creating a distinct forest patch for the habitat of birds and other small-sized wildlife species.

Haurbentes forest consisted of mixed species of Dipterocarpaceae family, dominated by Shorea and Hopea. The forest was systematically planted since 1940 and created a forest resembled a natural forest with a closed dense canopy consisted of 3-4 layers. There are some small creeks running along the borders of the forest. Dramaga forest consists of more diverse tree species compare to Haurbentes, although still dominated by Dipterocarp trees. Adjacent to the study area, to the south, there is a small lake. A river also runs along the northern side of the site.

The study was conducted in May-June 2016 (represent rainy season) and September-October 2016 (represent dry season). In 2016, the rainfall pattern was completely different compared to previous years. Rainy season lasted until mid-July. The season was considered to be dry starting in September. Data collection in all sites was conducted through a point count method [3], with a duration of 5 days in each site. Transect length was 1.2 km, divided into 5 points each, with 300 m distance. The duration of observation in each point count was 10 min. Observations were conducted in the morning (06.00-09.00 am) and in the afternoon (03.00-06.00 pm). Field observation in each point was repeated five times on different days, to get more reliable data. Data collected were bird species (through visual and audio, if necessary) and their respective numbers. Sequence and nomenclature of bird species followed [4]. Data analysis was done by employing Chao’s species estimation [5], diversity indices (Shanon-Wiener; $H'$) [6], and Jaccard’s similarity index ($S_j$) [7].

Figure 1. Map of study sites: Haurbentes forest (left) and Dramaga forest (right).
Table 1. Characteristics of study sites in Dramaga and Haurbentes, West Java, Indonesia.

| Parameter                  | Dramaga          | Haurbentes        |
|----------------------------|------------------|-------------------|
| Size of area (ha)          | 57.75            | 78.50             |
| Geographic location        | 6°00'33"-6°33'38"S; 106°10'5"-106°10'5"E | 1°00'16"-1°05'33"S; 112°20'45"-112°22'10"E |
| Dominant tree genera       | Mixed species of Pinus, Khaya, Terminalia, Agathis, Shorea, Eugenia, Hopea | Dipterocarp trees, mostly Anisoptera, Dipterocarpus, Dryobalanops, Shorea, Hopea, Vatica |
| Habitat types              | Tropical lowland forest | Tropical lowland forest |
| Habitat surrounding        | Housing, offices, small lake, river | Small village, dryland seasonal crop, rice field |
| Elevation (m asl)          | 244              | 250               |
| Topography                 | Flat (0-6%)      | Hilly (26-45%)    |

3. Results

3.1. Species diversity and composition

Remnant forests of Dramaga and Haurbentes were inhabited by 50 bird species in total (table 2; locations and seasons combined). Haurbentes had slightly more bird species (39 species) than Dramaga (30 species). Chao estimation suggested that the total bird species in Haurbentes was 41 species, while in Dramaga was 34 species. Species diversity indices (H’) for both areas were also similar (H’ 2.91 for Haurbentes, 2.72 for Dramaga).

In terms of species present, there was a slight difference in bird composition, showed by a relatively low similarity coefficient (SI = 0.39). Bird associated with water could be easily found in Dramaga, as this site is adjacent to the river in the northern side and small lake on the southern side. Haurbentes was more forest-like, as shown by drongos and flycatcher, which can be found in Haurbentes, but not in Dramaga. It is rather surprising, however, that barbets – which usually prefer a mature forest - were present in Dramaga, but not in Haurbentes.

Table 2. Bird species found in Dramaga and Haurbentes tropical forest remnants during rainy season (1) and dry season (2) (● present, □ absent).

| Nr. | Scientific Name                  | Common Name           | Dramaga | Haurbentes |
|-----|----------------------------------|-----------------------|---------|------------|
| 1   | Isobrychussininensis             | Yellow Bittern        | ●       | □          |
| 2   | Isobrychuscinamomeus             | Cinnamon Bittern      | □       | ●          |
| 3   | Turnixusscator                   | Barred Buttonquail    | ●       | □          |
| 4   | Anaurornisphoenicus              | White-breasted Waterhen | □     | ●          |
| 5   | Treronvernans                    | Pink-necked Green Pigeon | □   | ●          |
| 6   | Streptopeliachinensis            | Spotted Dove          | ●       | ●          |
| 7   | Macropygiaemiliana               | Ruddy Cuckoo Dove    | □       | ●          |
| 8   | Proboscigeraterrimus*            | Palm cockato*         | ●       |            |
| 9   | Cacomantissonneratii             | Banded Bay Cuckoo     | □       | ●          |
| 10  | Cacomantismerulinus              | Plaintive Cuckoo      | □       |            |
| 11  | Cacomantissepulcralis            | Rusty-breasted Cuckoo | ●       | ●          |
| 12  | Surniculuslugubris               | Asian Drongo-Cuckoo   | □       | ●          |
| 13  | Rhamphococcuscurruvostris        | Chestnut-breasted Malkoha | □   |            |
| 14  | Centropushimalensis              | Lesser Coucal         | □       | ●          |
| 15  | Collocalialinchi                 | Cave Swiftlet         | ●       |            |
| 16  | Alcedomeningting                 | Blue-eared Kingfisher | □       | ●          |
| 17  | Halcyon cyanoventris             | Javan Kingfisher      | □       | ●          |
| 18  | Halcyon chloris                  | Collared Kingfisher   | ●       | ●          |
3.2. Dominant species

Although both areas overall had a low similarity in bird composition, assessment of the dominant species indicated that the dominant species were very similar (table 3). Of the five most dominant species identified in each site, four species were the same, although the order was slightly different. Collared Kingfisher was the most dominant species in Dramaga and second dominant in Haurbentes. In Haurbentes, it was Sooty-headed Bulbuls that were identified as the most dominant species. Other dominant species of both areas were Spotted Dove and Common Tailorbird.

Table 3. Five dominant bird species identified in the study areas, listed from the highest number of species encounter.

| No. | Haurbentes | Dramaga |
|-----|------------|---------|
| 1   | Sooty-headed Bulbul | 1 Collared Kingfisher |
| 2   | Collared Kingfisher | 2 Sooty-headed Bulbul |
| 3   | Spotted Dove | 3 Spotted Dove |
| 4   | Common Tailorbird | 4 Common Tailorbird |
| 5   | Small Minivet | 5 Olive-backed Tailorbird |

*natural distribution is not in West Java; most likely released by local people or escaped from its cage
3.3. Influence of season on bird species
Spotted Dove, Collared Kingfisher, Common Tailorbird, Oriental White-eye, and Cave Swiftlet were always present in both study areas during rainy and dry seasons. In Dramaga, 47% (14 of 30 species) of the bird species can be found in both seasons, while in Haurbentes, the percentage was slightly lower at 36% (14 of 39 species). The rest of the species can only be found in one season. Comparing seasons, clearly season played a significant role in bird occurrence. In Dramaga, the number of birds found in the dry season was higher than in the rainy season. In Haurbentes, the situation was contradictory, as the number of birds in the dry season was lower compared to the rainy season.

4. Discussion
4.1. Remnant forest as bird habitat
Despite their small sizes, tropical remnant forests were still able to support various bird species, mostly insectivores and frugivores. Small remnant forests provide clearly all birds’ habitat components, especially food and shelter, although the core area was small.

In terms of light penetration, small remnants received more light than a large contiguous areas, especially on the forest floor. This is mainly because of the light penetration from the periphery of the remnant forest. The light intensity is very important for birds’ habitat because it may affect food production (i.e. fruit, nectar and insects) [8]. The diversity and richness of food also may increase habitat suitability, and thus it will reduce the time required by birds for food searching and decrease energy expenditure, as also concluded by [9]. Another reason why the small remnant forest able to support various birds is that birds often prefer to utilize multiple habitats for food, shelter, and breeding sites to maintain viable populations [9,10,11]. For granivorous birds, that the prevalence of seed-eating birds is positively linked with seed availability [12].

4.2. Bird species persist and absent in remnant forests
Within a specific habitat, vegetation diversity can provide various microhabitats, and thus attracting a greater number of bird species due to the availability of more diverse food, suitable breeding sites and cover from bad weather [13,9]. However, not all birds were able to survive in small remnants.

Tailorbirds, flycatchers, and drongos were closely related to gaps, edges, and other open area due to the abundance of insect larvae. Open areas with sparse vegetation were preferred by these birds to forage on insects through sallying and gleaning for insect larvae in tree foliage that had been attracted by fruits and flowers. Woodpeckers, barbets, and nuthatch seemed to have a positive association with large-diameter trees due their thick bark that contains insects. Ioras, bulbuls, and minivets were associated with medium-sized trees, because these birds foraged on insects and caterpillars in the canopy. Meanwhile, bird distribution in the shrub habitat was affected by the diversity and richness of food resources and vegetation (i.e., grasses, shrubs, trees), as reported by [14].

In other non-remnant habitat, some factors have been known to influence bird species composition, relative abundance, distribution, and richness, namely food availability, tree size and height, as well as the percentage of cover [15]. In remnant forests, these factors also found to be important. In addition, the characteristics of the adjacent landscape of urban forest remnants such as community forest, food crops and water bodies (e.g. rivers, rice field, lake) might also promote high species diversity and abundance due to their diverse habitat and abundant prey, mainly insects [16].

Although remnant forests are able to support a good number of birds, the small areas also lose some birds. Comparison with areas with similar forest types revealed that the bird species unable to cope with the small areas are raptors (e.g., Brahminy Kite), medium to large-sized frugivores (hornbills, pigeon), medium-sized woodpeckers, species preferred thick bushes and shrubs (e.g. babblers, starlings, crows, magpies).
4.3. Bird diversity and season
The effect of the season on bird diversity has been studied in many areas. In most cases [17], bird diversity in the rainy season was higher than in the dry season, as it also happened in Haurbentes in this study. In Dramaga, on the contrary, the number of bird species was higher during the dry season.

There was a possibility that the Dramaga forest was served as a refuge of many bird species that normally live in the surrounding areas, considering that most surrounding areas (i.e. rice field or cropland) were drier or more open during the dry season. Cinnamon Bittern and White-breasted Waterhen, for example, were found in the Dramaga forest during the dry season, and not during the rainy season. During the rainy season, these two species were able to inhabit rice fields and cropland surrounding the forest.

Another possibility of the higher bird species number in the dry season was a better visibility of the observer due to a more open tree canopy. In the dry season, many tree species shed their leaves, thus canopy-preferred birds such as Pink-necked Green Pigeon and bark-prober such as Velvet-fronted Nuthatch could be easily spotted.

4.4. Management implication
Although small in size, this study showed that the remnant forests were able to support a relatively high number of bird species. As many natural forests have been gone a fragmentation process and only leave small fractions of it, these small remnants are still worth to be conserved and managed.

Small forest remnants in this study were located near human settlements. Therefore, the management of these small remnants is crucial to prevent the birds from illegal hunting. With the increasing intensity and diversity of bird hunting, species such as bulbuls, minivets, ioras, and white-eyes have been subjected to heavy hunting for cage birds. Protection and regular patrol are needed, as well as an awareness program to the local community.

5. Conclusion
In conclusion, although small in size, remnant forests play important roles in the tropics as habitat for various bird species. Many bird species – mostly feed on insects, grains, nectars, and fruits – still can be found in remnant forests. Although the composition of bird species seemed to change through different seasons and sites, some bird species might dominate the remnants. Besides as habitat for birds and other wildlife species, remnants also important for other environmental benefits as well and, thus, their existence should be maintained.

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**Acknowledgments**
We are grateful to the Center for Research, Development and Innovation, Ministry of Environment and Forestry for their permission to use Dramaga and Haurbentes forests as our study areas. Funding of this research was provided by the Government of Indonesia through BOPTN (*Bantuan Operasional Perguruan Tinggi Negeri*) of IPB University, grant number 40/IT3.11/LT/2014.