**Bird Species**

**As Health Indicators Of Tropical Forest Ecosystem**

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**Introduction**

The increasing need for intensive forest land use has motivated efforts to develop methods of sustainable management. To do that, relevant ecosystem qualities should be defined and measured to allow for monitoring and planning (Styring *et al*. 2016, Angelston *et al*. 2013, Zakaria *et al*. 2005, Euler 1999, Furness et al. 1993). However, it is impossible to monitor all taxa in species-rich forest ecosystem. One way to monitor and identify the current status or qualities of an ecosystem is to select specific species as indicators of particular ecosystem conditions. Therefore, there is a great potential and need to identify species or groups of species that are affected, whether negatively or positively, by logging in turn to provide indication to the forest ecosystem health (Zakaria and Rajpar 2016, Styring & Zakaria 2004, Zakaria & Francis 2001, Carignan & Villard 2002, Zakaria & Nordin 1998).

**Study Sites and Methodology**

Bird survey was carried out using mist-nets at Sungai Lalang Forest Reserve, located in the Selangor State. The study site is classified as a hill dipterocarp forest in which selective timber logging had been practised since the early 1970s. Three compartments: a primary forest (Compartment 24) and two logged forests with 5-year (Compartment 18) and 10-year (Compartment 33) of recovery. All three sites chosen are similar in terms of topography, which is basically undulating and cut by several small streams that form steep gullies. Approximately 90 days of netting were set up in each compartment.

**Results and Discussion**

The results indicated that a total of 20 families were recorded, which were represented by 58 species (283 individuals), 62 species (290 individuals) and 61 species (392 individuals) in the primary, 5-year-old and 10-year-old logged forests, respectively. In general, the number of understorey species and individuals captured in primary forest were similar to that of the 5-year-old and 10-year-old logged forests. The total number of species was quite similar in all forest types based on the richness index. The results indicated that the bird communities overlapped heavily, but the logged forest site had lower species richness and fewer individuals.The family of Pycnonotidae, Nectariniidae and Timaliidae formed considerable proportion (>50%) of the total species captured in the three sites. Nonetheless, results indicated that the Pycnonotidae and Nectariniidae, which mostly comprised of secondary or colonizing species such as bulbuls and spiderhunters increased in number while the primary forest babbler species of Timaliidae decreased when condition shifted from primary to logged forests.

This study found that some changes occurred in the species composition after logging, with retention of many of the original species and reductions or losses of others. At the same time, secondary or colonizing and edge species often increased. As a result number of species was often similar. In term of feeding guilds results indicated that insectivore guild, which includes sallying insectivore, terrestrial insectivore, foliage-gleaning insectivore and bark-gleaning insectivore, represented the highest number of species captured (Table 2). More insectivorous species tend to be captured in primary forest compared to logged forest. In contrast, more frugivore/ insectivore species were captured in logged forests than in primary forest.

At species level, results indicated that Red-eyed Bulbul (*Pycnonotus brunneus*) and Grey-bellied Bulbul (*Pycnonotus cyaniventris*) had greatly increased in number when primary forests are logged (Figure 1). On the other hand, the number of Moustached Babbler (*Malacopteron magnirostre*) had considerably decreased in logged forest when compared to primary forest. Thus, these species might be suitable indicators of forest conditions due to their sensitivity to habitat disturbance.

In general, edge or secondary species, many of which are frugivore/insectivore and nectarivore/insectivore guilds, had increased in number while interior forest species, in particular insectivore decreased in logged forests. The differences in terms of species and guilds may also implies that even after 10-year interval, the logged forest conditions had yet to reach that of primary forests within which most bird community is found. Nonetheless, the slight increase in abundance of some babblers may reflect the reestablishment of a shaded understorey habitat (Styring *et al*. 2016, Zakaria *et al*. 2002).

The study suggested that the condition of a forest may be reflected by the presence or absence of certain forest-dependent bird species. This implies that the sensitivity of birds to the changes in the forest conditions that they depend on may provide direct indication to the health of the forest ecosystem. In other words, the effectiveness at conserving the birds will also indicate the success in safeguarding ecosystem functions and biodiversity as a whole. As such, it means that the maintenance of the key components of biodiversity such as avifauna with respect to their significant ecological roles may be an option that aids in the sustainable management and the long-term productivity of forests.

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**Figure 1.** Population size of selected species in different forest types

# Table 1. Feeding guilds of birds captured in primary and logged forests

|  |  |  |  |
| --- | --- | --- | --- |
| **Guild/Species** | **Number of Birds (%)** | | |
| Compt VJR | Compt 18 | Compt 33 |
| Carnivore | 23 (8.13) | 29 (10.00) | 25 (6.38) |
| Arboreal Foliage Gleaning Carnivore/Insectivore | 3 (1.06) | 9 (3.10) | 1 (0.26) |
| Terrestrial Insectivore | 9 (3.18) | 11 (3.79) | 12 (3.06) |
| Arboreal Foliage Gleaning Insectivore | 77 (27.21) | 39 (13.45) | 55 (14.02) |
| Bark Gleaning Insectivore | 13 (4.59) | 18 (6.21) | 21 (3.56) |
| Sallying Insectivore | 35 (12.37) | 27 (9.31) | 20 (5.10) |
| Arboreal Foliage Gleaning Insectivore/Frugivore | 67 (23.67) | 89 (30.69) | 121 (30.87) |
| Terrestrial Insectivore/Frugivore | 5 (1.77) | 3 (1.03) | 8 (2.04) |
| Arboreal Foliage Gleaning Frugivore | 5 (1.77) | 6 (2.07) | 7 (1.79) |
| Nectarivore/Insectivore/Frugivore | 46 (16.25) | 59 (20.35) | 122 (31.12) |
| **Total** | **283 (100)** | **290 (100)** | **392 (100)** |