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Significance of a Forest Fragment as a Bird Habitat and its Importance in Biodiversity Conservation

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Abstract: Halgolla Forest (N7o18', E80o31', 536m above sea level), located close to the historic town of Danture, Sri Lanka, consists of mixed evergreen tropical plant species spanning over an area of about 20 ha. Despite its small size, the forest reserve is home to a large number of bird species, numbering over 50. The present study was conducted from the June to August 2013. The objective of the present study was to measure the bird diversity of this forest, and compare it with the avifaunal diversity of nearby home gardens. Peak observation hours were between 0600-0900 h and 1600-1830 h. Observations were done on a weekly basis. Among the notable species were endemics such as the Sri Lanka gray hornbill (*Ocyeros gingalensis*), Sri Lanka lorikeet (*Loriculus beryllinus*), yellow-fronted barbet (*Megalaima flavifrons*), Sri Lanka scimitar babbler (*Pomatorhinus melanurus*), and brown-capped babbler (*Pellorneum fuscocapillum*). The endemic Sri Lanka gray hornbill was observed nesting inside the forest. Several proposed endemic species, such as Sri Lanka green pigeon (*Treron pompadora*), Sri Lanka small barbet (*Megalaima rubricapillus*), and Sri Lanka wood shrike (*Tephrodornis affinis*) were also observed. Given the importance of this forest as a watershed area for nearby tea and paddy cultivations, and the large number of bird species it supports, Halgolla Forest is undoubtedly an important area for biodiversity conservation.

Keywords: bird diversity, endemic species, forest fragment

1. Introduction

Many ecologists believe that birds disappear from tropical forest fragments because they are poor dispersers despite their high mobility [23]. The distributions of many species are affected by habitat fragmentation [22]. Therefore this group of animals could be an important indicator of fragmentation and extinction of species given the fact that the effects of habitat fragmentation can be seen clearly from avian species because they are conspicuous species and because they are poor dispersers. Birds are excellent biological indicators [17]. They are quickly affected by environmental changes such as loss or fragmentation of their habitat. Ecological indicators are mainly used to assess the condition of the environment or to diagnose the cause of the environmental change [19].

There is increasing evidence to support the fact that habitat fragmentation severely affects the distribution and abundance of certain species of birds. Yamaura et al. hypothesized that habitat fragmentation leads to loss of individuals and is more important than habitat loss in landscapes with a structurally similar matrix [28]. Yamaura et al. report that flycatchers and certain species of tree nesters were highly affected by habitat fragmentation. Van Houtan et al. found that bird species which disappear from fragments move extensively between (potential) plots before isolation, but not after

[23]. Van Houtan et al. also report that these birds often disperse to longer distances in continuous forest than in fragmented forest. Furthermore, these species also have a preference to emigrate from smaller to larger fragments, with no preference to continuous forest.

Species that stick to fragments are generally less mobile and often do not cross gaps, but after fragmentation, they disperse further than before. Van Houtan et al. suggest that tropical forest birds may be better dispersers than was previously assumed. Ferraz et al. found that a 10-fold decrease in the rate of species loss requires a 1000-fold increase in its area [8]. They found that fragments that are about 100 ha lose about one half of their total number of bird species in less than 15 years. This time is too short for implementing any effective conservation measures. So it is important to keep track of bird species in a forest, especially if there is increasing human activity in the habitat.

Studies done using recorded calls of certain species of songbirds reveal that birds are more likely (about twice as likely) to travel through 50 m of woodland than through 50 m in the open to reach the recording [6]. According to Desrochers and Hannon [6], woodland links significantly facilitate movements of birds across fragmented landscapes. A similar study shows similar results [5].

Watson et al. suggests that bird communities in woodlands have a varying response to habitat fragmentation in different landscapes [25]. Watson et al. report that the type of landscape matrix may have a considerable influence on how bird species are affected by woodland fragmentation in southeastern Australia. Githiru and Lens suggest that the effect of fragmentation may depend on the demographic attributes of discrete subpopulations [12]. Smaller populations inhabiting tiny habitat fragments could play an important role in increasing the long-term survival of spatially structured populations.

Some small birds such as ovenbirds and scarlet tanagers have home ranges of only a hectare or two, but are usually not found in forest fragments less than 10 ha in size. These species are called *area sensitive species*. In addition, uncommon species, even though they may not be area sensitive, are also unlikely to occur in a small patch by chance alone [14].

Avifaunal diversity is an excellent indicator of ecosystem stability because birds respond quickly to changes in their environments [18]. Studies on bird assemblages have contributed significantly to the field of community ecology [26],[27]. Species richness and the presence of rare species are two of the most frequently used criteria for the selection of conservation areas [21]. In addition, community composition and relative abundance of target species are important in selecting areas for conservation. Bird populations and associated habitats are useful tools in environmental monitoring [3].

1.1. Objectives

The objective of the present study was to measure the bird diversity in Halgolla Forest, which is a forest fragment located in Danture, Sri Lanka (N7°18', E80°31', 536m above sea level), as an indicator of its overall biodiversity, and compare it with the avifaunal diversity of nearby home gardens.

2. Materials and Methods

Halgolla Forest (N7°18', E80°31', 536m above sea level), located close to the historic town of Danture, Sri Lanka, is a forest fragment consisting of mixed evergreen tropical plant species spanning over an area of about 20 ha. There are several forest fragments located close to Halgolla, namely Dekinda, Motana, and Alagalla forest areas. The Halgolla forest is bordered by tea and paddy plantations, as well as home gardens consisting of mixed plant species. The mean annual rainfall in the areas (where all these forest fragments are located) is about 2000 mm and the mean annual temperature is about 25 °C (data from the Meteorology Department, Sri Lanka).

The data were based on point transects with unlimited distance (variable circular plot method, VCPM). We followed Sutherland [24] and Bibby et al. [1] for our point transects. Five sampling stations were selected by using a systematic random sampling procedure within the reserve, with each station separated from the next by a distance of about 500 paces (approximately 250 m). To ensure correct pacing, a GPS receiver (Garmin GPS 72H, 2009, Garmin International, Inc. Kansas, U.S.A.) was used. These distances were maintained as the minimum distances between any pair of stations as far as possible in order to eliminate bias such as double counting. For observing birds, we used Nikon 8×40 binoculars. All individual birds seen and heard were recorded. Counts were made between sunrise and sunset each day. Peak counting hours were between 0600–0900 h and 1600–1830 h, when the birds are most active. Each count lasted for about 20 minutes. Counts were made weekly from June to August 2013.

Before beginning to count at each station, at least a few seconds were spent without counting in order to reduce the effect of disturbance on counting. Since extreme weather conditions may affect bird activity [1], to avoid possible biases in extreme weather conditions, such as heavy rain, observations were not carried out. The same methods were employed to census birds in nearby home garden (for comparison).

As a measure of avifaunal diversity in Halgolla forest and nearby home gardens, Simpson's diversity index and Simpson's evenness measure were calculated. Species nomenclature followed Dickinson [7], Kaluthota and Kotagama [15], and Ripley [20].

3. Results

The present study detected 51 bird species in Halgolla. Thirty three species were observed in the nearby home gardens. Among the notable species were endemics such as the Sri Lanka gray hornbill (*Ocyeros ginalensis*), Sri Lanka lorikeet (*Loriculus beryllinus*), yellow-fronted barbet (*Megalaima flavifrons*), Sri Lanka scimitar babbler (*Pomatorhinus melanurus*), and brown-capped babbler (*Pellorneum fuscicapillum*). The endemic Sri Lanka gray hornbill was observed nesting inside the forest. Several proposed endemic species, such as Sri Lanka green pigeon (*Treron pompadora*), Sri Lanka small barbet (*Megalaima rubricapillus*), and Sri Lanka wood shrike (*Tephrodornis affinis*) were also observed. Figure 1 shows the abundance of the ten most common bird species in Halgolla and Figure 2 shows the abundance of ten most common bird species in the nearby home gardens. Tables 1 and 2 give the abundance of ten most common species of birds in Halgolla and nearby home gardens respectively. It is interesting to note that the most common species of bird in Halgolla forest was the red-vented bulbul whereas the

most common species in home gardens was the common myna. The least common species in both ecosystems was the crested hawk-eagle. Table 3 shows the abundance of bird species in Halgolla and nearby home gardens recorded during the present study.

3.1. Diversity indices

The diversity indices showed that Halgolla forest had a higher diversity of birds compared to the nearby home gardens. The avifaunal diversity as measured by Simpson’s index (D) was 0.0217 for Halgolla and 0.0311 for home gardens. Simpson’s index gives a higher value for habitats with lower diversities. The calculated value of Simpson’s measure of evenness was 0.9025 for Halgolla and 1.0058 for home gardens.

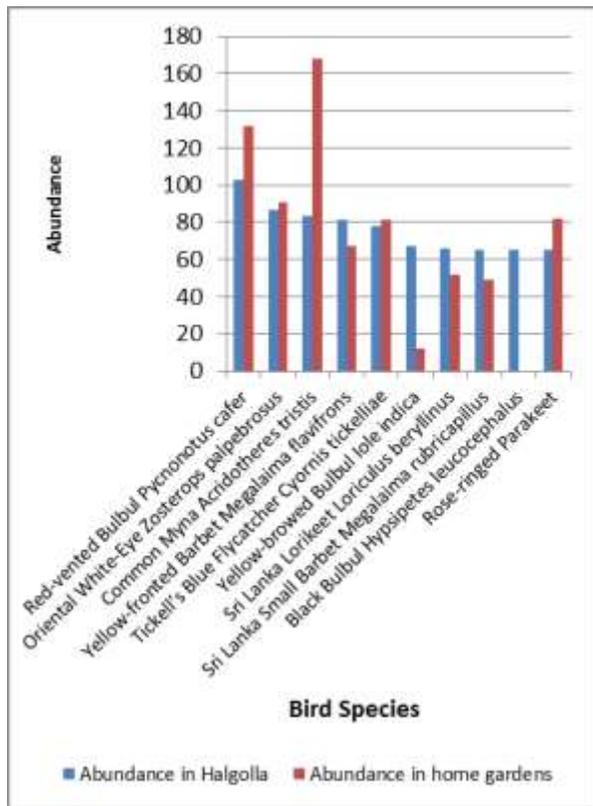


Figure 1 Abundance of the ten most common bird species in Halgolla and nearby home gardens (sorted by abundance in Halgolla)

Table 1 Abundance of the ten most common bird species in Halgolla

Species	Abundance in Halgolla
Red-vented Bulbul Pycnonotus cafer	103
Oriental White-Eye Zosterops palpebrosus	87
Common Myna Acridotheres tristis	83
Yellow-fronted Barbet Megalaima	81

Species	Abundance in home gardens
flavifrons	
Tickell’s Blue Flycatcher Cyornis tickelliae	78
Yellow-browed Bulbul Iole indica	67
Sri Lanka Lorikeet Loriculus beryllinus	66
Sri Lanka Small Barbet Megalaima rubricapillus	65
Black Bulbul Hypsipetes leucocephalus	65
Rose-ringed Parakeet	65

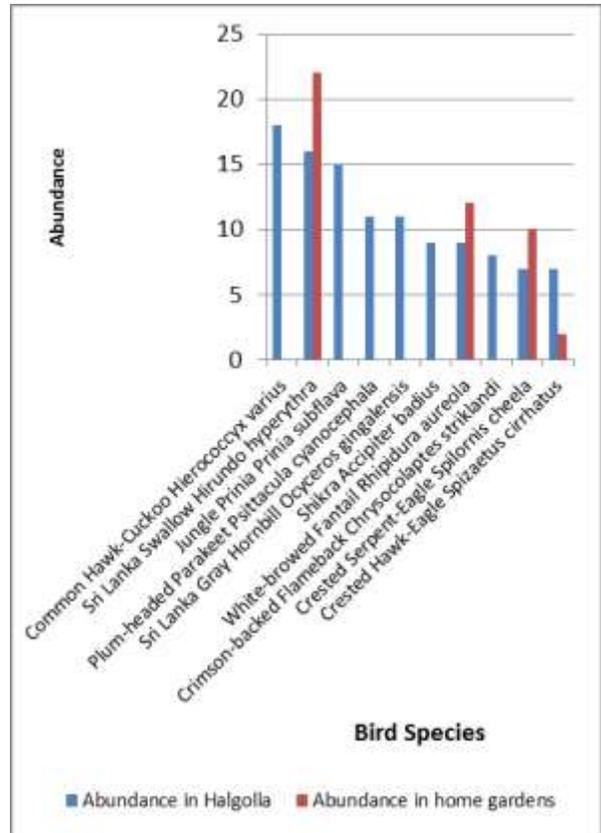


Figure 2 Abundance of the ten least common bird species in Halgolla and nearby home gardens (sorted by abundance in Halgolla)

Table 2 Abundance of the ten most common bird species in home gardens

Species	Abundance in home gardens
Common Myna Acridotheres tristis	168
Yellow-billed Babbler Turdoides affinis	162
Red-vented Bulbul Pycnonotus cafer	132
Spotted Dove Streptopelia chinensis	121
Oriental White-Eye Zosterops palpebrosus	91
Common Tailorbird Orthotomus	91

sutorius	
Brown-headed Barbet <i>Megalaima zeylanica</i>	89
Gray-necked Crow <i>Corvus splendens</i>	83
Rose-ringed Parakeet	82
Purple-rumped Sunbird <i>Nectarinia zeylonica</i>	82

Table 3 Abundance of bird species in Halgolla and nearby home gardens recorded during the present study (sorted by abundance in Halgolla)

Species	Halgolla	home gardens
Red-vented Bulbul <i>Pycnonotus cafer</i>	103	132
Oriental White-Eye <i>Zosterops palpebrosus</i>	87	91
Common Myna <i>Acridotheres tristis</i>	83	168
Yellow-fronted Barbet <i>Megalaima flavifrons</i>	81	67
Tickell's Blue Flycatcher <i>Cyornis tickelliae</i>	78	81
Yellow-browed Bulbul <i>Iole indica</i>	67	12
Sri Lanka Lorikeet <i>Loriculus beryllinus</i>	66	52
Sri Lanka Small Barbet <i>Megalaima rubricapillus</i>	65	49
Black Bulbul <i>Hypsipetes leucocephalus</i>	65	0
Rose-ringed Parakeet	65	82
Indian Hill Myna <i>Gracula indica</i>	64	12
Large-billed Crow <i>Corvus macrorhynchos</i>	63	79
Purple-rumped Sunbird <i>Nectarinia zeylonica</i>	63	82
Small Minivet <i>Pericrocotus cinnamomeus</i>	62	0
Spotted Dove <i>Streptopelia chinensis</i>	59	121
Red-backed Woodpecker <i>Dinopium benghalense</i>	58	48
Small Flowerpecker <i>Dicaeum erythrorhynchos</i>	58	61
Black-headed Oriole <i>Oriolus xanthornus</i>	56	49
Brown-headed Barbet <i>Megalaima zeylanica</i>	55	89
Asian Koel <i>Eudynamis scolopacea</i>	55	68
Gray-necked Crow <i>Corvus splendens</i>	54	83
Pied Flycatcher Shrike	52	0
Layard's Parakeet <i>Psittacula calthorpae</i>	50	0

Scarlet Minivet <i>Pericrocotus flammeus</i>	50	48
Loten's Sunbird <i>Nectarinia lotenia</i>	48	0
Sri Lanka Wood-Shrike <i>Tephrodornis affinis</i>	44	0
Common Tailorbird <i>Orthotomus sutorius</i>	40	91
Yellow-billed Babbler <i>Turdoides affinis</i>	40	162
Indian Roller <i>Coracias benghalensis</i>	38	0
Jerdon's Leafbird <i>Chloropsis jerdoni</i>	38	17
Common Coucal <i>Centropus sinensis</i>	37	45
Common Iora <i>Aegithina tiphia</i>	35	0
Sri Lanka Scimitar Babbler <i>Pomatorhinus melanurus</i>	35	36
Lesser Yellow-naped Woodpecker <i>Picus chlorolophus</i>	33	0
Brown-capped Babbler <i>Pellorneum fuscicapillum</i>	32	41
Emerald Dove <i>Chalcophaps indica</i>	30	39
Large Cuckoo Shrike <i>Coracina macei</i>	28	0
Gold-fronted Leafbird <i>Chloropsis aurifrons</i>	27	0
White-bellied Drongo <i>Dicrurus caerulescens</i>	26	49
Sri Lanka Green Pigeon <i>Treron pompadora</i>	24	0
Gray Tit <i>Parus major</i>	20	29
Common Hawk-Cuckoo <i>Hierococyx varius</i>	18	0
Sri Lanka Swallow <i>Hirundo hyperythra</i>	16	22
Jungle Prinia <i>Prinia subflava</i>	15	0
Plum-headed Parakeet <i>Psittacula cyanocephala</i>	11	0
Sri Lanka Gray Hornbill <i>Ocyrceros gingalensis</i>	11	0
Shikra <i>Accipiter badius</i>	9	0
White-browed Fantail <i>Rhipidura aureola</i>	9	12
Crimson-backed Flameback <i>Chrysocolaptes striklanti</i>	8	0
Crested Serpent-Eagle <i>Spilornis cheela</i>	7	10
Crested Hawk-Eagle <i>Spizaetus cirrhatu</i>	7	2

4. Discussion

It has been recorded previously that bird species that are most sensitive to habitat fragmentation are ground- or open-nesters nesting in shrubs or trees [16]. Lampila et

al. [16] further report that resident species are equally sensitive to fragmentation in the Nearctic and Palearctic regions, but Nearctic migrants are more sensitive than Palearctic migrants. Furthermore, Old World species were less sensitive than New World species, and this prediction was based on the history of forest fragmentation on these two areas. The most abundant species in Halgolla forest were those species that are widely distributed in many of the avifaunal zones of Sri Lanka. The same pattern has been reported previously for birds in the Neotropics and temperate zones [11], [21]. Within a taxonomic assemblage, locally abundant species tend to be widespread and locally rare species tend to be restricted in their distribution [11].

Halgolla forest is bordered by plantations and village home gardens. The edges of the reserve have already been influenced to a considerable degree by humans, resulting in the accidental or deliberate introduction of plant species that were not naturally occurring in the reserve, e.g. *Areca*. This has implications on the composition of avifauna. Human-derived environmental change is known to provide ecological opportunities in habitats for plants and animals [2], [9], [10]. In Halgolla, some of the most common bird species were those also associated with human habitations, e.g. red-vented bulbul, Oriental white-eye, and common myna. Furthermore, specialist plant feeders could be affected by tree density [13].

Several nearby patches, for example Alagalla and Dekinda, may act as reservoirs of species for Halgolla. In conservation biology, the use of corridors to reduce the effects of habitat fragmentation has become a major focus [4]. Castellón and Sieving tested the importance of corridors to birds by conducting a translocation experiment of chucaco tapaculo (*Sclerochilus rubecula*), a forest understory bird endemic to South American temperate rainforest [4]. They tested the effects on three habitat types: open habitat, shrubby secondary vegetation, and wooded corridors. Their results indicate that open habitat significantly limits chucaco dispersal, but dispersal takes place well through wooded corridors and shrubby secondary vegetation. This highlights the importance of having nearby forest fragments. These may enable the bird communities to maintain viable populations for a relatively long time. Githiru and Lens also support the idea of connection between fragments [12]. They found that the survival probability of the white-starred robin *Pogonochila stellata* in the highly fragmented Taita Hills in Kenya was similar among fragments, but turnover rates were different, indicating that different processes caused removal from the patches.

The results in general indicated that the fruit and other plant eating species (e.g. nectarivores) were more

abundant than other species. Many of the vegetarian species had higher densities compared to insectivorous and carnivorous species.

The relative abundance of target species, as well as community composition, is an important parameter when selecting potential areas for conservation [21]. Areas in which the target species are common or abundant should be given priority to ensure viable populations in the long term. The present study site had considerable numbers of some endemic species and proposed endemic species.

In the light of the present data, given the importance of this forest as a watershed area and the large number of bird species it supports, Halgolla forest is undoubtedly an important site for biodiversity conservation.

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