AVIFAUNAL DIVERSITY IN A TEA PLANTATION ECOSYSTEM IN THE UP-COUNTRY OF SRI LANKA

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Abstract

A survey on birds was conducted at Mattakelle Tea Estate with the objective of assessing the significance of a given tea plantation ecosystem in maintaining avifaunal diversity. Seven different habitats were identified in the ecosystem namely home garden, seasonal stream, small scale reservoir, Eucalyptus forest, wetland, tea field and secondary forest. The monitoring was conducted from January to June 2010 using line transect method. 28 counts were made for each habitat. Besides, activities of birds, feeding habits and food recourses were observed.

61 species of birds including 9 species of endemics and 10 species of migrants were recorded. One globally threatened species Kashmir Flycatcher (*Ficedula subrubra*) and 12 nationally threatened species were observed. Among the habitats, the highest species count of 62% was recorded in home garden habitat where Shannon index (H') = 3.03 and Evenness (J) =0.46. Species diversity and the evenness of the secondary forest were comparable to tea field indicating H'= 2.86 and J=0.43; H' =2.77 and J= 0.46 respectively. The avifaunal diversity was relatively low in the rest.
The study revealed that each of the habitats provided unique niches and supported maintenance of natural diversity. Vegetation structure and the complexity of the ecosystem in tea plantations play a vital role in sustaining avifaunal diversity. Several conservation measures such as increasing plant diversity, introduction of shade trees, conduct of good agricultural practices and prevention from setting fire are recommended to protect and conserve avifaunal diversity.

1. INTRODUCTION

Sri Lanka is a tropical island (65610km^2 in extents) located in the Indian Ocean off the southern tip of Indian peninsular. Growing human population in Sri Lanka has caused clearance of natural habitats for human settlements, agricultural lands, industrial areas and related infrastructure. In centuries past, during the time of the Sinhala kings, forest and animal life were an important part of the social fabric. With the onset of the colonial era, there was a dramatic change in the cultural and socio-political climate in the country.

During this period of foreign rules there was large scale destructions of the forests, particularly for the establishment of plantations. These activities marked the beginning of environmental problems and large scale biodiversity erosion in the country (Anon, 1999). The island has lost approximately half the area of forests it had just over a half a century ago, in 1950s (Wijesinghe, 2000), and currently it retains only about 23.5% of forest cover. Even the existing protected forests in the wet zone rich in biodiversity, continue to be degraded due to illegal encroachment and suffer further fragmentation (IUCNSL, 2007).

Sri Lanka, despite its small size, has a rich avifaunal diversity. Over 471 species of birds representing 20 orders and 76 families have been recorded in Sri Lanka, (Kotagama et al. 2006). These include 225 breeding residents, 128 winter visitors, four summer visitors, 106 vagrants, and two passage migrants. Of them, 33 are endemic to the island (Kotagama et al. 2006). Owing to this high diversity and endemism, Sri Lanka has been recognized as a country with "Important Bird Areas", a "key Asian region for threatened birds" and an "Endemic Bird Area" (Kaluthota & Kotagama 2005). According to the 2007 List of Threatened Fauna and Flora of Sri Lanka (IUCNSL, 2007), 87 resident birds are grouped in

four threatened categories. These include 10 critically endangered (CR), 15 endangered (EN), 21 vulnerable (VU) and 41 species are near threatened (NT). Among the migratory birds that visit Sri Lanka, 6 species are listed as globally threatened (GT).

Studies on avifauna of agricultural lands and economically important crop plantations such as tea, rubber and coconut are very scarce. Further, the role of human-altered landscapes in conservation of birds has been greatly neglected. Extensive studies on ecology and distribution of birds of Sri Lanka have so far been conducted only in and around protected areas such as Sinhaeraja World Heritatage site (Bambaradeniya *et al.,* 2003), Lower Hantane (Gunaratne & Gunatilleke, 2003) in the wet zone, Kaduru Doova (Kapurusinghe, 2000) in mangrove forest and Gal-oya National Park (Hettige *et. al.,* 2000), Buttala (Surasinghe & Alwis, 2010) in dry intermediate zones of Sri Lanka.

Hence, the present study was conducted in Mattakelle tea estate located in Nuwara Eliya district of the Up-country wet zone of Sri Lanka, between latitude 6^0 921'N, longitude 80^0 701'E. It is situated approximately 10km from Talawakelle town, within the Agro-ecological region WU2a (Panabokke & Kannangara, 1996) falling under the Montane wet zone. Average annual rainfall of the area is about 2250mm and annual average minimum, maximum, temperatures are 14.2^0 C and 22.8^0 C respectively. Average elevation is 1371m above sea level. The estate consists of 361ha. Out of which 258ha are occupied by tea cultivation.

The agro-ecosystems in the estate are dominated by tea (*Camellia sinensis*) plantation with low shade trees such as *Erythrina lithosperma, Calliandra calothrysus* and high shade tree *Grevillea robusta* and *Eucalyptus* plantations along with a small segment under traditional agriculture managed by estate community with multi-species of vegetables. Among the tree species, Avocado (*Persea americana*), Mango (*Mangifera indica*) and Jak (*Artocarpus heterophyllous*) have been recorded. Kahakona (*Cassia spectabilis*), African tulip tree (*Spathodea campanulata*) and Fern tree (*Jacaranda mimosifolia*) were found along roadsides as ornamental trees.

Most of the hilly areas and abandoned tea lands have been converted to *Eucalyptus* plantations for timber and firewood requirements of the estate. The non-forest vegetation types were mostly grasslands and abandoned lands. A small patch of secondary forest situated in a corner of the estate was observed while, *Eupatorium inuliformes, Symbopogan confertifloru,* were abundant in the margins. Large trees were sparse and among them *Syzygium* spp. and *Calophyllum* spp. were the most conspicuous. *Symplocos cochinchinensis* and unidentified Bamboo species dominated the understory. Newly planted *Eucalyptus* trees were growing inside the secondary forest.

In the face of rapid economic development and increasing human population, the extent of conservation lands is gradually reducing. On the other hand, in the plantation sector where tea, rubber and coconut are grown, mono-cropping is the accepted practice, and this does not promote the maintenance of biodiversity. However, it is encouraging to note that some plantations have recently turned to multi-cropping.

The objectives of the study were to identify the habitats which are supported to bird life in tea plantation ecosystem, quantify the present status of avifaunal diversity, behavior patterns of birds and importance of ecosystems for threatened bird species in Mattakelle tea estate. The outcome of the exercise expects to generate a wealth of information on avifaunal diversity and ecology. The information could be of major importance in formulating effective strategies to conserve the agro-ecosystems, to develop further studies and particularly to understand the beneficial effects of the natural avifaunal diversity to the tea plantations.

2. METHODOLOGY

A thorough field survey was conducted for identify different habitats in tea plantation ecosystem. Then field observations on birds were conducted for a duration of 28 weeks commencing from January to July 2010 using line transects method. The intensity of observations was 4 days per month. Birds counting were made at 4 observation points along a 100m x 10m line transect and 20 minutes was spent at each habitat (6.30 – 6.50 am in the morning or 4.00 – 4.20 pm in the evening) and same exercise was repeated in the remaining habitats. At each observation point in the transect, birds heard or sited within 10m radius were recorded over a 5 minutes period. The time of monitoring of each of the habitat was systematically allocated so that each habitat was considered both in morning and evening sessions. Besides, activities of birds, feeding habits and food recourses were observed and recorded.

A pair of 7x35 binocular was used to observe birds. Popular field guilds Harrison (1999) and Henry (1971) were used for bird identification. For the purpose of recording and observations at each habitat type for each day, a pre design data sheet was used.

3. RESULTS AND DISCUSSION

Seven different habitats were identified in the ecosystem namely home garden[1], seasonal stream[2], small scale reservoir[3], *Eucalyptus* forest[4], wetland[5], tea field[6] and secondary forest[7] as seen in the figure 1.

Figure 1. Map of the Mattakelle tea estate

The diversity of birds and their distribution with respect to available habitat types showed the importance of Mattakelle as an ideal bird habitat, within the Up Country tea growing area of Sri Lanka. During the study period, a total of 61 species of birds including 9 species of endemics and 10 species of migrants were recorded. Among them, one globally threatened and 12 nationally threatened bird species were identified (Table 1).

Species	Common name	Residential status	IUCNSL Red List status (2007)
1. *Ficedula subrubra*	Kashmir Flycatcher	Migrants	Globally Threatened
2. *Saxicola caprata*	Pied Bush Chat	Resident	Endangered
3. *Spizaetus nipalensis*	Mountain Hawk-Eagle	Resident	Vulnerable
4. *Pycnonotus penicillatus*	Sri Lanka Yellow-Eared Bulbul	Endemic	Vulnerable
5. *Turdoides rufescens*	Sri Lanka Orange-Billed Babbler	Endemic	Vulnerable
6. *Elanus caeruleus*	Black-Winged Kite	Resident	Near Threatened
7. *Dendrocopos nanus*	Brown-Capped Pygmy Woodpecker	Resident	Near Threatened
8.*Pellorneum fuscocapillum*	Sri Lanka Brown-Capped Babbler	Endemic	Near Threatened
9. *Pomatorhinus melanurus*	Sri Lanka Scimitar Babbler	Endemic	Near Threatened
10. *Dumetia hyperythra*	Tawny-Bellied Babbler	Resident	Near Threatened
11.*Culicicapa ceylonensis*	Grey-Headed Canary Flycatcher	Resident	Near Threatened
12. *Stta frontalis*	Velvet-Fronted Blue Nuthatch	Resident	Near Threatened
13. *Zosterops ceylonensis*	Sri Lanka White-Eye	Endemic	Near Threatened

Table 1: IUCN 2007 status of threatened birds recorded in Mattakelle estate

Present study indicated that home garden as a preferred habitat that maintain the highest bird diversity recording 38 species that represent 62% of the all the birds species recorded in the survey (Figure 2) where Shannon index (H') = 3.03 and Jaccard index (J) =0.46. This can be explained, as the home garden habitat was well-structured with more plant species, including woody lianas and twiners that provide more niches and food sources for birds.
On the other hand, secondary forest was not well-structured with less number of plant species. Among the birds recorded in the survey, Black-Headed Oriole, Scarlet Minivet, Asian Brown Flycatcher, Asian paradise Flycatcher, Pied Thrush, Indian Blue Robin and Velvet-Fronted Blue Nuthatch were restricted to home garden. Sri Lanka Yellow-Eared Bulbul and Green Tree Warbler were only recorded from the secondary forests. The Oriental Honey-Buzzard, Black-Winged Kite and Brown-Capped Pygmy Woodpecker were recorded only in tea field. Species diversity and the evenness of the secondary forest were comparable to tea field indicating H'= 2.86 and J=0.43; H' =2.77 and J= 0.46 respectively (Table 2).

Table 2: Similarity and diversity index at different habitats

Study site	Shannon index (H')	Jaccard index (J)
Home garden	3.03	0.46
Secondary Forest	2.86	0.43
Tea Field	2.77	0.46
Wetland	2.64	0.49
Eucalyptus Forest	2.57	0.43
small scale reservoir	2.55	0.38
Seasonal stream	2.53	0.38

Although the wetland habitat had the lowest bird diversity with 18 species accounting only for 29% of the total avifaunal diversity of the study area, Intermediate Egret, Oriental Skylark and White-Browed Prinia were restricted to such aquatic habitats. Very few birds were observed inside the *Eucalyptus* forest, where they were sighted either perched on marginal *Eucalyptus* trees or perched on tree species such as *Erythrina lithosperma, Calliandra calothrysus* and *Grevillea robusta*.

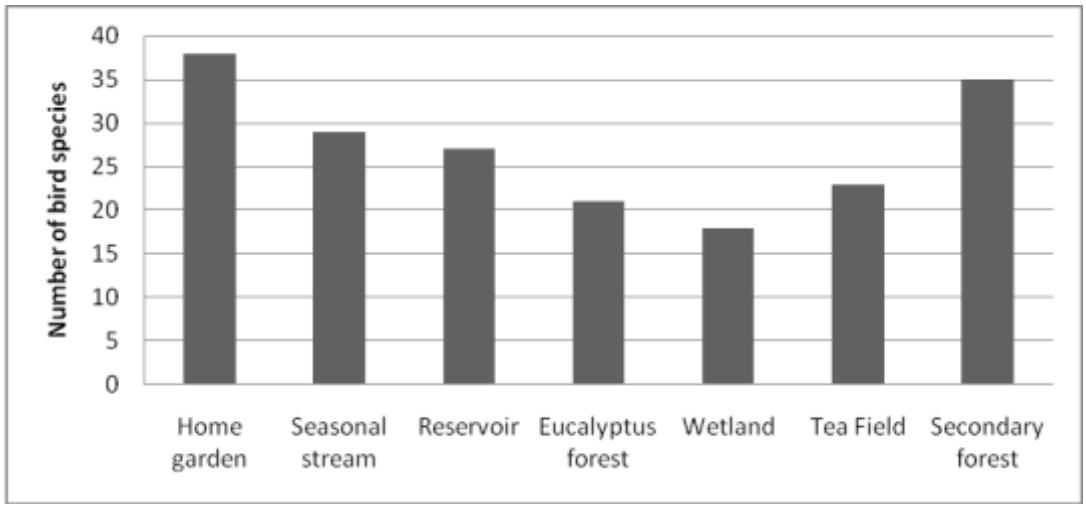

Figure 2: Number of bird species recorded from each habitat type in Mattakelle Estate

Seven bird species (Spotted Dove, Blue-Tailed Bee-Eater, Brown Shrike, Common Myna, Red-Vented Bulbul, Yellow-Billed Babbler and Sri Lanka White-Eye) were recorded in all seven habitats. During the period of survey, Orange-Billed Babbler which is very rare in this area was recorded only once in Eucalyptus forest with a flock of Yellow-Billed Babbler. Two adults of White-Browed Prinia with two juveniles were recorded during the month of March in the wetland habitat. The most encountered bird species was the Sri Lanka White-Eye and observed to flock in large numbers.

Thirty seven out of 61 of the birds observed were insectivores. (Figure 3). The study revealed that most of insectivores such as Sri Lanka Scimitar Babblers, Tawny-Bellied Babblers, Yellow-Billed Babblers, White eyes and Great Tits fed on insects that live on or within tea and shade plants whereas others such as Grey-Headed Canary Flycatchers, Tickell's Blue Flycatchers, White-Browed Fantails, White bellied Drongos, Blue-Tailed Bee-Eaters fed on flying insects.

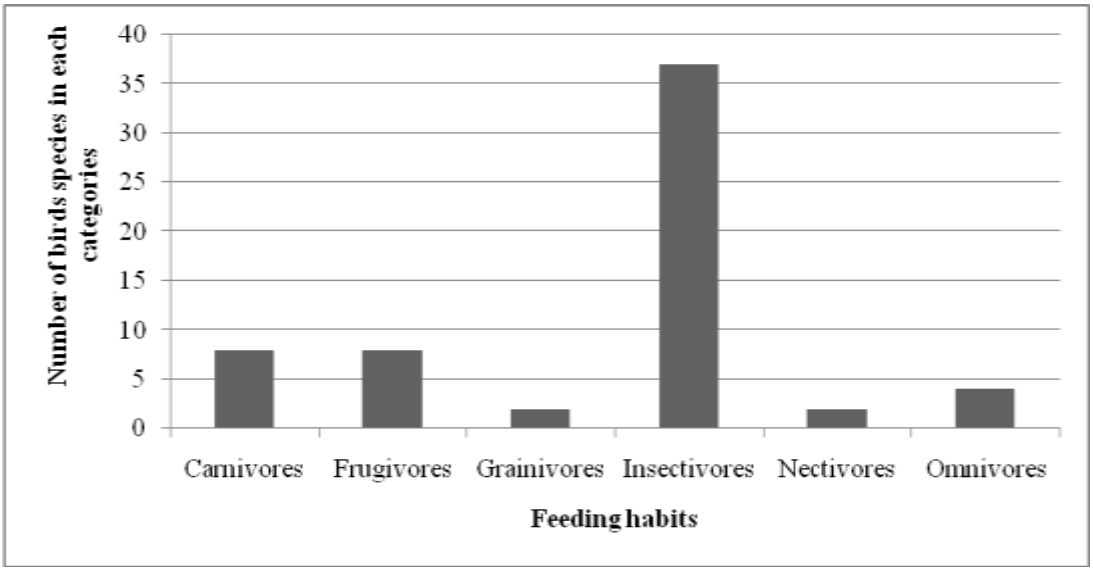

Figure 3: Proportion of primary (frugivores, grainivores and nectivore) and secondary consumers (carnivores, insectivores and omnivores)

The representation of grainivores and nectivores was very few. Both endemic species, Yellow Fronted Barbets and Crimson Fronted Barbets as well as Black Headed Orioles fed on ripened fruits and important species for dispersing seeds.

The high number of avifaunal observations on the shade tree species of *Calliandra calothrysus* and *Grevillea robusta* may be due to the fact that they are wide spread throughout the plantation and provide micro habitats for the various needs of the avifauna. A large *Ficus* tree was used by White-Bellied Drongo and Pied Bush Chat for their nesting in tea field habitat.

During the survey, considerable extents of habitat destruction and modification were observed. Most of wetlands and seasonal streams of the site, which were used by waterfowls, grassland birds and egrets, were converted to agricultural lands. Setting fire on grasslands in dry season, illegal felling of forest trees in secondary forest and some catchment areas of water sources were some frequent and destructive human activities in the area. It could directly affect the nesting sites and food resources. Regular human movements through tea fields and noises from land vehicles could have affected the behavior of forest birds. Therefore, such may have been the reasons for less species observed in tea ecosystem than natural forests. On the other hand, population of Jungle crows was drastically increased with garbage. During the study period, groups of crows were noted to extensively predate on birds including eggs and juveniles and destroyed nests.

Uncontrolled and excessive usage of agro-chemicals was observed in the agricultural lands. Introducing good agricultural practices and enhancing awareness of harmful effects of excessive agro-chemical usage among the estate community would bring about beneficial changes as well as proper function of ecosystems. Further, increasing plant diversity with native nectarine species and fruit-bearing plants in home gardens and road sides may supportive to increasing avifaunal diversity. Further studies should be targeted on ecology, behavior studies of birds, population dynamics and interaction with human activities of Mattakelle estate and in other plantation ecosystems as well.

4. CONCLUSION

Out of the seven habitats in Mattakelle estate, home garden is the best site for birds followed by secondary forest. The study revealed that each of the habitats provided unique niches and supported maintenance of natural diversity. Vegetation structure and the complexity of the ecosystem in tea plantations play a vital role in sustaining avifaunal diversity. Several conservation measures such as increasing plant diversity, introduction of shade trees, conduct of good agricultural practices and prevention from setting fire are recommended to protect and conserve avifaunal diversity.

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List of bird species recorded from Mattakelle Estate

Family Species	**Common name**
Ardeidae	
1. *Mesophoyx intermedia*	Intermediate Egret
2. *Ardeola grayii*	Indian Pond Heron
Accipitridae	
3. *Pernis ptilorhynchus*	Oriental Honey-Buzzard
4. *Elanus caeruleus*	Black-Winged Kite
5. *Spilornis cheela*	Crested Serpent-Eagle
6. *Spizaetus nipalensis*	Mountain Hawk-Eagle
Phasianidae	
7. *Gallus lafayetii*	Sri Lanka Jungle Fowl
Rallidae	
8. *Amaurornis phoenicurus*	White-Breasted Water Hen
Columbidae	
9. *Streptopelia chinensis*	Spotted Dove
Psittacidae	
10. *Loriculus beryllinus*	Sri Lanka Hanging Parrot
11. *Psittacula kramerii*	Rose-Ringed Parakeet
Cuculidae	
12. *Cacomantis sonneratii*	Banded-Bay Cuckoo
13. *Centropus sinensis*	Greater Coucal
Alcedinidae	
14. *Halcyon smyrnensis*	White-Breasted Kingfisher
Meropidae	
15. *Merops philippinus*	Blue-Tailed Bee-Eater
Capitonidae	
16. *Megalaima flavifrons*	Sri Lanka Yellow-Fronted Barbet
17. *Megalaima rubricapilla*	Crimson-Fronted Barbet
18. *Dinopium benghalense*	Red-Backed Woodpecker
19. *Dendrocopos nanus*	Brown-Capped Pygmy Woodpecker
Pittidae	
20. *Pitta brachyuran*	Indian Pitta
Alaudidae	
21. Alauda gulgula	Oriental Skylark
Laniidae	
22. *Lanius cristatus*	Brown Shrike

Oriolidae

23. *Oriolus xanthornus*	Black-Headed Oriole

Dicruridae

24. *Dicrurus caerulescens*	White-Bellied Drongo

Sturnidae

25. *Acridotheres tristis*	Common Myna

Campephagidae

26. *Coracina melanoptera*	Black-Headed Cuckoo-Shrike
27. *Pericrocotus flammeus*	Scarlet Minivet

Pycnonotidae

28. *Pycnonotus cafer*	Red-Vented Bulbul
29. *Pycnonotus penicillatus*	Sri Lanka Yellow-Eared Bulbul

Muscicapidae

30. *Pellorneum fuscocapillum*	Sri Lanka Brown-Capped Babbler
31. *Pomatorhinus melanurus*	Sri Lanka Scimitar Babbler
32. *Dumetia hyperythra*	Tawny-Bellied Babbler
33. *Chrysomma sinense*	Yellow-Eyed Babbler
34. *Turdoides rufescens*	Sri Lanka Orange-Billed Babbler
35. *Turdoides affinis*	Yellow-Billed Babbler

Muscicapinae

36. *Muscicapa dauurica*	Asian Brown Flycatcher
37. *Ficedula subrubra*	Kashmir Flycatcher
38. *Cyornis tickelliae*	Tickell's Blue Flycatcher
39. *Culicicapa ceylonensis*	Grey-Headed Canary Flycatcher
40. *Rhipidura aureola*	White-Browed Fantail

Monarchini

41. *Terpsiphone paradisi ceylonensis*	Asian paradise Flycatcher

Sylviinae

42. *Prinia socialis*	Ashy Prinia
43. *Prinia socialis*	White-Browed Prinia
44. *Acrocephalus dumetorum*	Blyth's Reed-Warbler
45. *Orthotomus sutorius*	Common Tailorbird
46. *Phylloscopus nitidus*	Green Tree Warbler

Turdinae

47. *Zoothera wardii*	Pied Thrush
48. *Luscinia brunnea*	Indian Blue Robin
49. *Copsychus saularis*	Oriental Magpie Robin
50. *Saxicoloides fulicata*	Black Robin
51. *Saxicola caprata*	Pied Bush Chat

Paridae

52. *Parus major*	Great Tit
53. *Stta frontalis*	Velvet-Fronted Blue Nuthatch

Motacillidae

54. *Dendronanthus indicus*	Forest Wagtail
55. *Montacilla cinerea*	Grey Wagtail

Dicaeidae

56. *Dicaeum erythrorhynchos*	Pale-Billed Flowerpecker

Nectarinidae

57. *Nectarinia asiatica*	Purple Sunbird
58. *Nectarinia lotenia*	Long-Billed Sunbird

Zosteropidae

59. *Zosterops ceylonensis*	Sri Lanka White-Eye

Ploceidae

60. *Passer domesticus*	House Sparrow
61. *Lonchura punctulata*	Scaly-Breasted Munia