Diversity and Distribution of Avifauna at the Tropical Montane Cloud Forests of Horton Plains National Park

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Abstract

Diversity and distribution of avifauna was studied at the tropical montane cloud forests of Horton Plains National Park, situated in the highland plateau of the Nuwara Eliya district from September 2015 to May 2016. Three main habitats were identified; cloud forest habitat, cloud forest die-back habitat and grassland habitat. Nine, 300 m line transects were marked in each of the habitats. Avifauna was recorded on three consecutive days of each month while travelling along these transects. Seventy eight species of birds were recorded during the study period. This included 66 resident species (with 13 endemic species) and 12 migratory species. The maximum value of the Shannon Wiener Index H' of 2.56 was recorded from the cloud forest habitat. In the cloud forest die-back habitat the H' was 2.49 and in the grassland habitat the H' was 2.31.The Jaccard similarity index, between cloud forest and cloud forest die-back was 0.58, and these two habitats had more common species. Cloud forest is the major habitat to be protected, with other habitats, in HPNP. Hence management of the HPNP should plan more actions to improve long term monitoring plans to warrant the protection of threatened species.

Keywords: bird diversity and distribution, endemic birds, Horton Plains, tropical montane cloud forest

1. Introduction

Sri Lanka is a tropical island in the Indian Ocean, at the southern point of the Indian sub-continent, with a main island and several small islands. Sri Lanka is one of the eight 'Hottest Hotspots' out of the 36 Biodiversity Hotspots in the world (Myers et al., 2000). Therefore, Sri Lanka is ranked among the highest in Asia, in terms of 'biodiversity per unit area' (MOE, 2012).

Sri Lanka is rich with 453 avifaunal species recorded at present, including 240 species of breeding residents, of which 27 are endemics and six proposed endemics (Gunawardena and Weerakoon, 2012). The country is divided into six avifaunal zones, according to the distribution patterns of the resident bird species (Kotagama, 1993). These zones are northern or Indian zone, low country wet zone, mid-country wet zone, hill country wet zone, dry zone and uva zone. Hill country wet zone is one of them, which is rich and abundant with most of the endemic and threatened species (Kotagama, 1993: Harrison and Worfolk, 1999).

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Furthermore, there are some threats to the avifauna in Sri Lanka. Because the forest area coverage in Sri Lanka in 2015 was 33.0%, and despite the value being recorded to be, so it is fast declining (World Bank, 2016).

There is a difference in the vegetation of highland forests in Sri Lanka, above 1,500 m (Ashton et al., 1997). These forests have been classified as tropical montane cloud forests (WCMC, 1997). In Sri Lanka, Horton Plains, Hakgala Nature Reserve, Peak Wilderness Sanctuary and Knuckles are the main forests of this particular type. The Horton Plains National Park (HPNP) is a well-known place in Sri Lanka, as a saddle shaped highland plateau (Pethiyagoda, 2012) surrounded by tea and *Eucalyptus* plantations.

There were previous studies carried out in the HPNP, as floral and faunal inventory (MfC, 1994), National Conservation Review (Green and Gunawardena, 1997) and Management Plan (DWC, 2005). Moreover, they have studied the avifaunal diversity on that studies. However, there were no recorded study after the Biodiversity Baseline Survey at HPNP which was conducted in 2007 by Department of Wildlife Conservation. The aim of this research to fill the research gaps of avifaunal studies in the HPNP. Therefore, this study was conducted to record the avifaunal diversity and to determine the population distribution of birds in different habitats in the HPNP.

2. Materials and Methods

2.1 Study area

The study was conducted at the Horton Plains National Park (6°47′- 6°50′N, 80°46′-80°50′E) in Nuwara Eliya District at the eastern extremity of the central highlands (Figure 1). The HPNP is a protected area under the Department of Wildlife Conservation. The elevation of HPNP is about 2,000 m from mean sea level. The area of the national park is 31.6 km². HPNP was divided into three main habitat types, according to different characteristics of vegetation by using the methods of Biodiversity Baseline Survey at Horton Plains National Park (DWC, 2007).

These three habitats were cloud forest, cloud forest die-back and grasslands. The cloud forest was distributed within 1,236 ha (39.7% of total area) with an undisturbed old-growth forest which is low in height (15-20 m) and the canopy trees were characteristically gnarled and twisted, due to the lower temperatures and high winds. The cloud forest die-back was distributed within 956 ha (30.7% of total area). Larger area of the canopies in the cloud forest were dead, and therefore it was known as the cloud forest die-back. There were three types of habitats which were totally considered as grasslands. These habitats were dwarf bamboo, tussock grass and carpet grass (DWC, 2007). Grassland habitat was distributed in 806 ha (25.8% of the total area) of the national park.

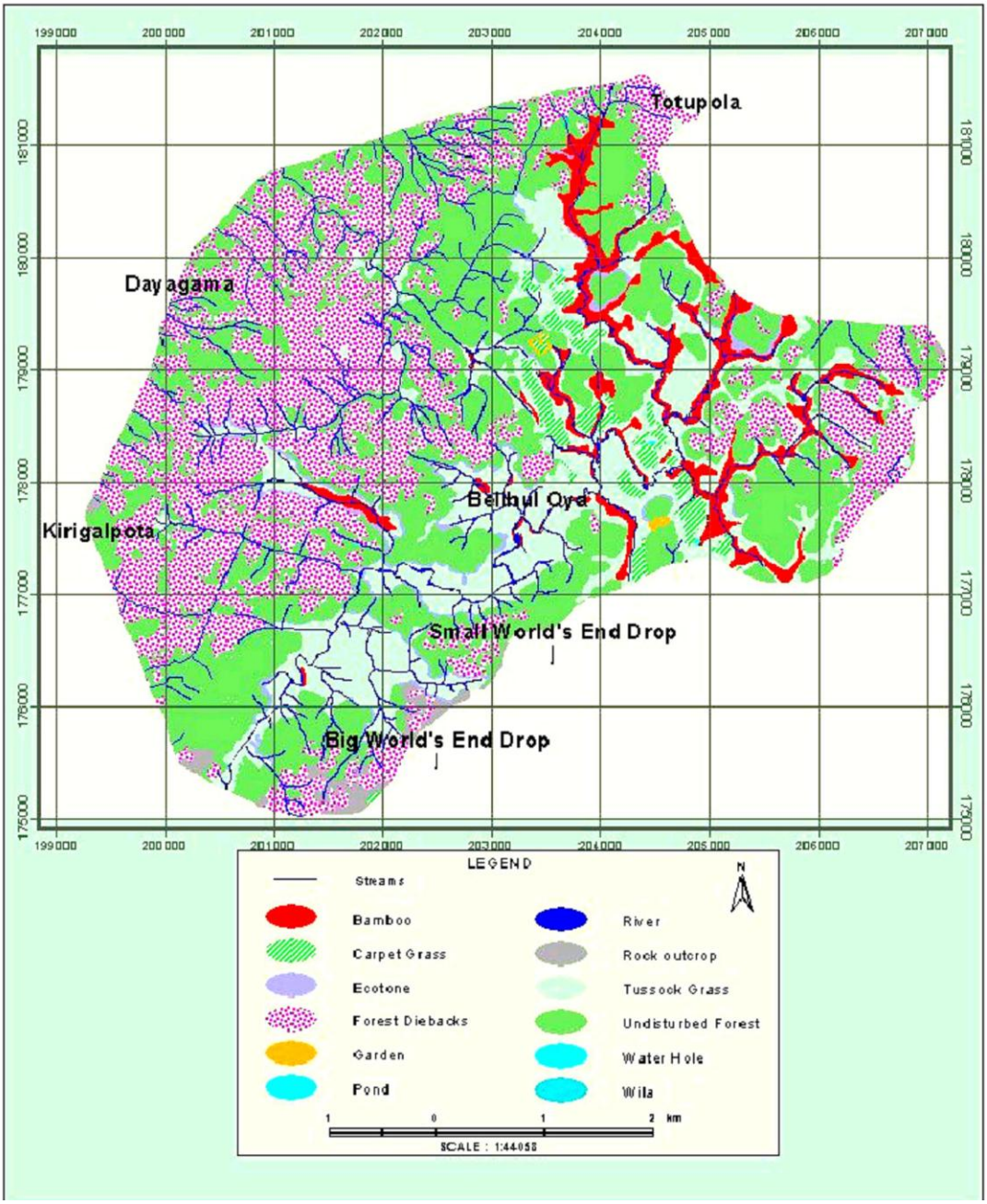

Figure 1: Vegetation map of Horton Plains National Park (Source: DWC, 2007).

2.2 Site selection

Sampling areas were located by using 1:50 000 analogue maps and 1:10 000 digital topographical maps, of the Department of Survey. A global positioning system device (Garmin- eTrex® 10) was used to mark transects within habitats. Nine, 300 m line transacts with 20 m swath, were marked in the cloud forest, cloud forest die-back and grassland habitats.

2.3 Data collection

All the species of birds seen or heard within transect, were identified by using a 10 × 50 binocular (Nikon, Monarch) and recorded by using field guides of Harrison and Worfolk (1999). Identified bird

species were classified according to the National Red List of 2012 (MOE, 2012) and the Revised Avifaunal List of Sri Lanka (Kaluthota and Kotagama, 2009) Population of the birds was recorded on three consecutive days of each month, from September 2015 to May 2016 by traveling along transacts, from 05.30 a.m. to 09.30 a.m. Finally, opportunistic data and incidental observations were used to supplement information (Sutherland et al., 2004).

2.4 Data analysis

Relative abundance [(number of individuals per species/total number of individuals) × 100%], Shannon Weiner Diversity Index H' was calculated using the equation $H' = -\sum (P_i \ln P_i)$ where P_i=the proportion of the total sample belonging to the i^{th} species to measure the avifaunal diversity. Significant differences between the monthly diversity indices were calculated using the t test. [$t = (H' - H)/ (varH_1 + var H_2)1/2$] (Magurran, 1988). Jaccard Similarity Index {SJ} was calculated between the habitat by using the equation SJ=Sa / (Sa + Sb + Sc) {Sa=number of species unique to the first habitat, Sb=number of the species unique to the second habitat and Sc=number of species common in both habitats. Microsoft Excel™ was used to store data and further more calculations and illustrations of the figures. Minitab 17™ was used for statistical analysis of variance and t - test.

3. Results

Although there were 31 species recorded in the first month, this value was increased to seventy eight by the ninth month. Furthermore, the cumulative number of the species was recorded as a plateau in the last five months (Figure 2). Therefore, it was determined that the sampling effort was adequate for final calculations and analysis. Seventy eight species within 33 families of birds were recorded during the study period (Table 1). This included 66 resident species (with 13 endemic species) and 12 migratory species. A total of 4,537 individuals belonging to 60 species were recorded in the cloud forest habitat. 1,870 individuals belonging to 45 species were recorded in the Cloud forest die-back habitat. Moreover 2,897 individuals that belong to 41 species were recorded in the grassland habitat.

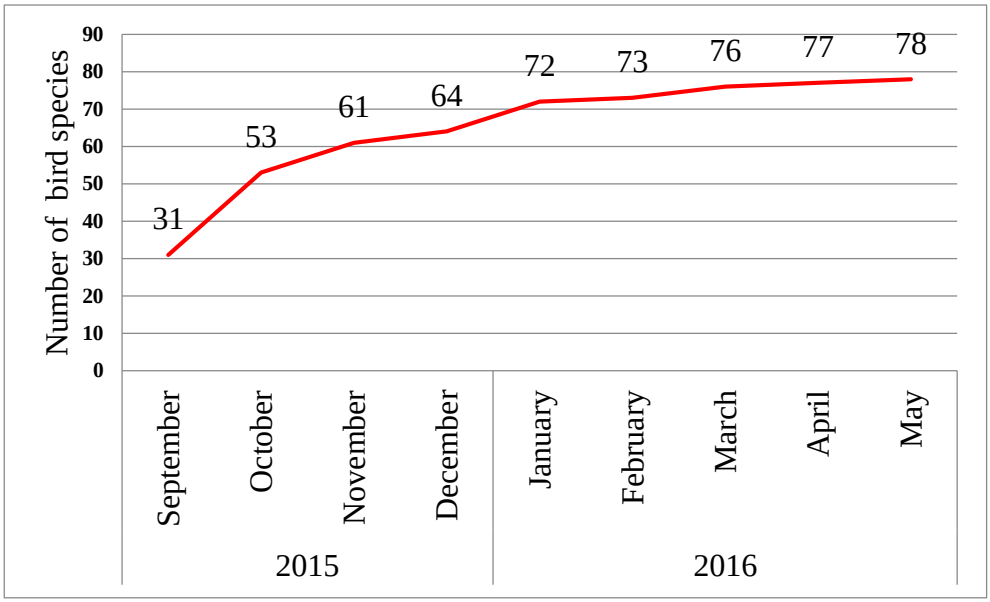

Figure 2: Cumulative number of bird species.

Table 1: Resident bird species and total number of species recorded during the study period.

Scientific Name	Common Name	NCS	GCS	C	D	G	Prior records
Family: Phasianidae							
Coturnix chinensis Linnaeus,1766	Blue Quail	EN	LC	2	2	0	√
Gallus lafayetii Lesson, 1831 E	Sri Lanka JungleFowl	LC	LC	144	49	87	√
Family: Picidae							
Dendrocopos nanus (Vigors,1832)	Brown-Capped Woodpecker	LC	LC	1	0	0	√
Picus xanthopygaeus (Gray & Gray, 1846)	Streak-Throated Woodpecker	EN	LC	3	0	0	-
Chrysocolaptes lucidus (Scopoli, 1786) PE	Greater Flameback	LC		8	0	0	√
Family: Alcedinidae							
Alcedo atthis (Linnaeus,1758)	Common Kingfisher	LC	LC	1	0	0	√
Family: Meropidae							
Merops philippinus Linnaeus,1766*	Blue-Tailed Bee-Eater	CR	LC	0	0	16	√
Family: Cuculidae							
Cuculus varius Vahl, 1797	Common Hawk-Cuckoo	EN	LC	2	0	0	√
Centropus sinensis(Stephens, 1815)	Greater Coucal	LC	LC	4	0	0	√
Cuculus micropterus Gould,1838 *	Indian Cuckoo	LC	LC	2	0	0	√
Family: Apodidae							
Collocalia unicolor (Jerdon,1840)	Indian Swiftlet	LC	LC	12	17	35	√
Hirundapus giganteus(Temminck, 1825)	Brown-Backed Needletail	NT		0	0	2	√
Cypsiurus balasiensis (Gray,1829)	Asian Palm-Swift	LC	LC	951	189	782	√
Tachymarptis melba(Linnaeus, 1758)	Alpine Swift	EN	LC	42	13	67	√
Family: Hemiprocnidae							
Hemiprocne coronata (Tickell,1833)	Crested Treeswift	LC		1	0	0	-
Family: Columbidae							
Columba livia Gmelin, 1789	Rock Pigeon	CR	LC	0	2	17	√
Columba torringtoniae(Blyth & Kelaart, 1853)E	Sri Lanka Wood- Pigeon	VU	VU	14	3	0	√
Stigmatopelia chinensis(Scopoli, 1786)	Spotted Dove	LC	LC	0	0	1	-
Chalcophaps indica(Linnaeus, 1758)	Emerald Dove	LC	LC	1	0	0	√
Ducula aenea (Linnaeus,1766)	Green Imperial-Pigeon	LC	LC	5	8	0	√
Family: Rallidae							
Rallina eurizonoides Lafresnaye, 1845*	Slaty-Legged Crake	CR	LC	0	0	2	-
Family: Charadriidae							
Vanellus indicus (Boddaert,1783)	Red-Wattled Lapwing	LC	LC	0	0	24	√
Family: Accipitridae							
Pernis ptilorhyncus(Temminck, 1821)	Oriental Honey- Buzzard	NT	LC	3	1	1	√
Haliastur indus (Boddaert,1783)	Brahminy Kite	LC	LC	6	2	7	-
Spilornis cheela (Latham,1790)	Crested Serpent-Eagle	LC	LC	0	0	12	√
Accipiter badius (Gmelin,1788)	Shikra	LC	LC	2	0	1	√
Ictinaetus malayensis (Temminck, 1822)	Black Eagle	NT	LC	5	5	4	√
*Spizaetus nipalensis*Hodgson, 1836	Mountain Hawk-Eagle	VU		2	1	0	√
Family: Corvidae							
Corvus levaillantii Lesson,1831	Jungle Crow	LC	LC	142	48	144	√
Family: Campephagidae							
Pericrocotus flammeus(Forster, 1781)	Scarlet Minivet	LC	LC	46	0	0	√
Hemipus picatus (Sykes,1832)	Bar Winged Flycatcher Shrike	LC	LC	48	19	0	√
Family: Rhipiduridae							
Rhipidura aureola Lesson,1830	White-Browed Fantail	LC	LC	0	1	0	-
Family: Turdidae							
Myophonus blighi(Holdsworth, 1872) E	Sri Lanka Whistling Thrush	EN	EN	8	0	1	√

Turdus merula Linnaeus,1758	Eurasian Blackbird	EN		46	4	31	√
Family: Muscicapidae							
Eumyias sordidus (Walden,1870) E	Sri Lanka Dull Blue Flycatcher	VU	NT	104	60	2	√
Copsychus saularis(Linnaeus, 1758)	Oriental Magpie Robin	LC	LC	0	0	4	√
Saxicola caprata (Linnaeus,1766)	Pied Bush Chat	EN	LC	3	25	188	√
Culicicapa ceylonensis Swainson, 1820	Grey- Headed Canary- Flycatcher	LC	LC	37	0	0	√
Family: Sturnidae							
Acridotheres tristis (Linnaeus,1766)	Common Myna	LC	LC	5	2	34	√
Gracula ptilogenys Blyth, 1846E	Sri Lanka Myna	VU	NT	2	0	0	√
Family: Sittidae							
Sitta frontalis Swainson, 1820	Velvet Fronted Nuthatch	LC	LC	120	10	0	√
Family: Paridae							
Pavus major Linnaeus, 1758	Great Tit	LC		68	51	0	√
Family: Hirundinidae							
Hirundo domicola Jerdon,1844	Hill Swallow	VU	LC	564	173	819	√
Family: Pycnonotidae							
Pycnonotus cafer (Linnaeus,1766)	Red-Vented Bulbul	LC	LC	0	9	4	√
Pycnonotus penicillatus Blyth, 1851E	Sri Lanka Yellow-Eared Bulbul	VU	NT	602	445	0	√
Family: Cisticolidae							
Cisticola juncidis (Rafinesque,1810)	Zitting Cisticola	LC	LC	13	2	84	√
Prinia socialis Sykes, 1832	Ashy Prinia	LC	LC	3	11	0	-
Family: Zosteropidae							
*Zosterops ceylonensis Holdsworth, 1872*E	Sri Lanka White Eye	NT	LC	797	447	16	√
Family: Sylviidae							
Bradypterus palliseri (Blyth,1851) E	Sri Lanka Bush Warbler	EN	NT	25	23	0	√
Orthotomus sutorius(Pennant, 1769)	Common Tailorbird	LC	LC	41	7	0	√
Family: Timaliidae							
Garrulax cinereifrons Blyth, 1851E	Sri Lanka Ashy-Headed Laughingthrush	EN	VU	5	4	0	√
Pellorneum fuscocapillus(Blyth, 1849) E	Sri Lanka Brown Capped Babbler	LC	LC	3	0	0	√
Pomatorhinus melanurus Blyth, 1847E	Sri Lanka Scimitar Babbler	LC	LC	50	19	0	√
Dumetia hyperythra (Franklin,1831)	Tawny-Bellied Babbler	LC	LC	1	1	0	-
Rhopocichla atriceps (Jerdon,1839)	Dark Fronted Babbler	LC	LC	86	51	0	√
Chrysomma sinense (Gmelin,1789)	Yellow Eyed Babbler	LC	LC	1	0	0	-
Turdoides rufescens (Blyth,1847) E	Sri Lanka Orange Billed Babbler	VU	NT	17	0	0	√
Turdoides affinis (Jerdon, 1845)	Yellow Billed Babbler;	LC	LC	2	9	2	√
Family: Dicaeidae							
Dicaeum erythrorhynchos(Latham, 1790)	Pale Billed Flowerpecker	LC	LC	414	108	23	√
Family: Nectariniidae							
Nectarinia asiatica (Latham,1790)	Purple Sunbird	LC	LC	4	4	0	√
Nectarinia lotenia (Linnaeus,1766)	Long Billed Sunbird	LC	LC	24	8	11	√
Nectarinia zeylonica (Linnaeus, 1766)	Purple Rumped Sunbird	LC	LC	4	3	0	√
Family: Motacillidae							
Anthus rufulus Vieillot, 1818	Paddyfield Pipit	LC	LC	0	7	105	√
Family: Estrildidae							
Lonchura striata (Linnaus,1766)	White Rumped Munia	LC	LC	0	0	22	√
Lonchura punctulata(Linnaeus, 1758)	Scaly Breasted Munia	LC	LC	0	2	55	√
Lonchura malacca (Linnaeus,1766)	Tricoloured Munia	LC	LC	5	13	242	√

Maximum number of individuals was the hills wallow followed by the Asian palm swift. The highest number of species was recorded from the Family Timaliidae (babblers). The most significant about these findings was that all the species of that family whereas present at Horton Plains National Park.

Table 2: Migratory birds and vagrants species recorded during the study period. (* Only the breeding population has been considered in this assessment)

Scientific Name	Common Name	NCS	GCS	C	D	G	Prior Records
Family: Muscicapidae							
Ficedula subrubra(Hartert & Steinbacher, 1934)	Kashmir Flycatcher		VU	4	0	0	√
Muscicapa dauurica Pallas, 1811	Asian Brown Flycatcher		LC	0	4	0	√
Muscicapa muttui (Layard, 1854)	Brown-Breasted Flycatcher		LC	1	0	0	-
Luscinia brunnea (Hodgson, 1837)	Indian Blue Robin		LC	1	0	0	√
Family: Laniidae							
Lanius cristatus Linnaeus, 1758	Brown Shrike		LC	3	3	8	√
Family: Motacillidae							
Dendronanthus indicu s (Gmelin, 1789)	Forest Wagtail		LC	9	2	7	√
Motacilla flava Linnaeus, 1758	Yellow Wagtail		LC	7	0	1	-
Motacilla cinerea Tunstall, 1771	Grey Wagtail		LC	12	8	25	√
Family: Hirundinidae							
Hirundo rustica Linnaeus, 1758	Barn Swallow		LC	3	8	11	√
Riparia riparia (Linnaeus, 1758)	Sand Martin		LC	0	0	7	-
Family: Laridae							
Chlidonias hybrida (Pallas, 1811)	Whiskered Tern		LC	0	0	1	-
Family Scolopacidae							
Gallinago stenura (Bonaparte, 1830)	Pintail Snipe		LC	0	0	2	√

Abbreviations: E = Endemic species, PE = Possibly Endemic, C= Cloud Forest, D = Cloud Forest Die-back, G = Grassland, NCS = National Conservation Status, GCS = Global Conservation Status
Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC)

Out of the 12 species from the recorded migratory birds at HPNP, the highest number of species were recorded from Family Muscicapidae (Table 2). Moreover three species of wagtails were recorded. In addition aquatic birds; whiskered tern and pintail snipe were recorded. Of the 78 species that were included for this research there were ten species, which only one individual was recorded (Table 1 and 2). Lowland common species such as the Common Kingfisher and the Spotted Dove were recorded in the least numbers.

A total of 19 species of birds that were believed to be nationally endangered, were recorded within the study period. Of them Blue-Tailed Bee-Eater, Rock Pigeon (taking into consideration only the wild population for this purpose) and Slaty-Legged Crake were in the CR (Critically Endangered) category. Besides Blue Quail, Streak-Throated Woodpecker, Common Hawk-Cuckoo, Alpine Swift, Sri Lanka Whistling Thrush, Eurasian Blackbird, Pied Bush Chat, Sri Lanka Bush Warbler and Sri Lanka Ashy-Headed Laughing thrush were in the EN (Endangered) category. Additionally, Sri Lanka Wood Pigeon, Mountain Hawk-Eagle, Sri Lanka Dull Blue Flycatcher, Sri Lanka Myna, Hill Swallow, Sri Lanka Yellow-Eared Bulbul and Sri Lanka Orange Billed Babbler were in the VU (Vulnerable) category.

There were globally threatened species were recorded: Sri Lanka Whistling Thrush (EN), Sri Lanka Wood Pigeon (VU), Sri Lanka Ashy-headed Laughing thrush (VU) and the Kashmir Flycatcher (VU). There were eight new breeding resident species (Streak-throated Woodpecker, Crested Treeswift, Spotted Dove, Slaty-Legged Crake, Brahminy Kite, White-Browed Fantail, Ashy Prinia, Tawny-Bellied Babbler and Yellow-Eyed Babbler) and four migratory species (Brown-breasted Flycatcher, Yellow Wagtail, Sand Martin and Whiskered Tern) recorded for the first time in HPNP. Of the species of birds which were recorded from the fixed line transects, only 35 species were recorded from the cloud forest while 26 species were recorded from the cloud forest die-back and 23 species from the grassland. Therefore these species were only subjected to statistical analysis, while the other recorded species were treated as opportunistic observations.

Table 3: Relative Abundance of cloud forest.

Rank	Species	Relative Abundance %
1	Asian Palm Swift	20.96
2	Sri Lanka White-Eye	17.56
3	Sri Lanka Yellow-Eared Bulbul	13.26
4	Hill Swallow	12.43
5	Pale Billed Flowerpecker	9.12
6	Sri Lanka Junglefowl	3.17
7	Jungle Crow	3.12
8	Velvet-Fronted Nuthatch	2.64
9	Sri Lanka Dull-Blue Flycatcher	2.29
10	Dark-Fronted Babbler	1.89
11	Great Tit	1.49
12	Sri Lanka Scimitar Babbler	1.10
13	Bar-Winged Flycatcher-Shrike	1.05
14	Scarlet Minivet	1.02
15	Eurasian Blackbird	1.01
16	Alpine Swift	0.92
17	Common Tailorbird	0.90
18	Grey-Headed Canary Flycatcher	0.81
19	Sri Lanka Bush Warbler	0.55
20	Long-Billed Sunbird	0.52
21	Sri Lanka Orange-Billed Babbler	0.37
22	Sri Lanka Woodpigeon	0.30
23	Zitting Cisticola	0.28
24	Indian Swiftlet	0.26
25	Grey Wagtail	0.26
26	Forest Wagtail	0.19
27	Sri Lanka Whistling-Thrush	0.17
28	Greater Flameback	0.17
29	Yellow Wagtail	0.15
30	Brahminy Kite	0.13
31	Black Eagle	0.11
32	Sri Lanka Ashy-Headed Laughing Thrush	0.11
33	Common Myna	0.11
34	Black-Headed Munia	0.11
35	Green Imperial Pigeon	0.11

Table 4: Relative abundance of the cloud forest die-back.

Rank	Common Name	Relative Abundance %
1	Sri Lanka White-Eye	23.90
2	Sri Lanka Yellow-Eared Bulbul	23.79
3	Asian Palm Swift	10.10
4	Hill Swallow	9.25
5	Pale-Billed Flower-Pecker	5.77
6	Sri Lanka Dull-Blue Flycatcher	3.20
7	Dark-Fronted Babbler	2.72
8	Great Tit	2.72
9	Sri Lanka Junglefowl	2.62
10	Jungle Crow	2.56
11	Pied Bushchat	1.33
12	Sri Lanka Bush Warbler	1.22
13	Bar-Winged Flycatcher-Shrike	1.01
14	Sri Lanka Scimitar Babbler	1.01
15	Indian Swiftlet	0.90
16	Black-Headed Munia	0.69
17	Alpine Swift	0.69
18	Velvet-Fronted Nuthatch	0.53
19	Yellow-Billed Babbler	0.48
20	Red-Vented Bulbul	0.48
21	Barn Swallow	0.42
22	Long-Billed Sunbird	0.42
23	Grey Wagtail	0.42
24	Green Imperial Pigeon	0.42
25	Paddyfield Pipit	0.37
26	Common Tailorbird	0.37

Table 5: Relative abundance of grassland.

Rank	Common Name	Relative Abundance %
1	Hill Swallow	28.27
2	Asian Palm Swift	26.99
3	Black-Headed Munia	8.35
4	Pied Bushchat	6.48
5	Jungle Crow	4.97
6	Paddyfield Pipit	3.62
7	Sri Lanka Junglefowl	3.01
8	Zitting Cisticola	2.89
9	Alpine Swift	2.31
10	Scaly-Breasted Munia	1.89
11	Indian Swiftlet	1.20
12	Common Myna	1.17
13	Eurasian Blackbird	1.07
14	Grey Wagtail	0.86
15	Red-Wattled Lapwing	0.82
16	Pale-Billed Flowerpecker	0.79
17	White-Rumped Munia	0.75
18	Rock Pigeon	0.58
19	Sri Lanka White-Eye	0.55
20	Blue Tailed Bee-Eater	0.55
21	Crested Serpent Eagle	0.41
22	Barn Swallow	0.37

23	Brown Shrike	0.27

According to the relative abundance values in the cloud forest habitat (Table 3) the Asian Palm Swift was the most common bird (relative abundance=20.96%) followed by the Sri Lanka White-Eye, the Sri Lanka Yellow-Eared Bulbul, the Hill Swallow and the Pale-Billed Flowerpecker. In the cloud forest die-back habitat (Table 4) the most common species was the Sri Lanka White-Eye (relative abundance=23.90%) followed by the Asian Palm Swift, the Black-Headed Munia, the Pied Bush Chat and the Jungle Crow.

In the cloud forest die-back habitat (Table 5), the most common species was the Hill Swallow (relative abundance=28.2706) followed by the Asian Palm Swift, the Black-Headed Munia, the Pied Bush Chat and the Jungle Crow.

Table 6: Opportunistic data recorded at three habitats.

Number	Common Name	Cloud forest	Cloud forest die-back	Grassland	Total
1.	Kashmir Flycatcher	4	-	-	4
2.	Greater Coucal	4	-	-	4
3.	Purple Sunbird	4	4	-	8
4.	Purple Rumped Sunbird	4	3	-	7
5.	Pied Bushchat	3	-	-	3
6.	Brown-capped Babbler	3	-	-	3
7.	Oriental Honey-buzzard	3	1	1	5
8.	Barn Swallow	3	-	-	3
9.	Ashy Prinia	3	1	-	4
10.	Streaked-throated Woodpecker	3	-	-	3
11.	Brown Shrike	3	3	-	6
12.	Yellow-billed Babbler	2	-	2	4
13.	Sri Lanka Hill Myna	2	-	-	2
14.	Shikra	2	-	1	3
15.	Indian Cucoo	2	-	-	2
16.	Mountain Hawk Eagle	2	1	-	3
17.	Common Hawk Cucoo	2	-	-	2
18.	Blue-breasted quail	2	-	2	4
19.	Yellow-eyed Babbler	1	-	-	1
20.	Indian Blue Robin	1	-	-	1
21.	Emerald Dove	1	-	-	1
22.	Brown-breasted Flycatcher	1	-	-	1
23.	Crested Treeswift	1	-	-	1
24.	Tawny Bellied Babbler	1	1	0	4
25.	Common Kingfisher	1	-	-	1
26.	Brown-capped Pygmy Woodpecker	1	-	-	1
27.	Black eagle	-	5	4	9
28.	Eurasian Blackbird	-	4	-	4
29.	Sri Lanka Ashyheaded Laughing Thrush	-	4	-	4
30.	Asian Brown Flycatcher	-	4	-	4
31.	Sri Lanka Woodpigeon	-	3	-	3
32.	Scaly-breasted Munia	-	2	-	2
33.	Forest Wagtail	-	2	7	9
34.	Rock Pigeon	-	2	-	2
35.	Common Myna	-	2	-	2

36.	Brahminy Kite	-	2	7	9
37.	Zitting Cisticola	-	2	-	2
38.	White-browed Fantail Flycatcher	-	1	-	1
39.	Sand Martin	-	-	7	7
40.	Oriental Magpie Robbin	-	-	4	4
41.	Red-vented Bulbul	-	-	4	4
42.	Sri Lanka Dull-blue Flycatcher	-	-	2	2
43.	Slaty-legged Crake	-	-	2	2
44.	Brown-breasted Needle-tail	-	-	2	2
45.	Pintail Snipe	-	-	2	2
46.	Yellow Wagtail	-	-	1	1
47.	Sri Lanka Whistling thrush	-	-	1	1
48.	Spotted Dove	-	-	1	1
49.	Long-billed Sunbird	-	-	1	1
50.	Whiskered Tern	-	-	1	1

From the total species taken into account in this study, 50 species of birds (Table 06) were observed opportunistically, while some rare species were also recorded in least numbers and a special feature being, the record of the Oriental Honey-Buzzard in all three habitats.

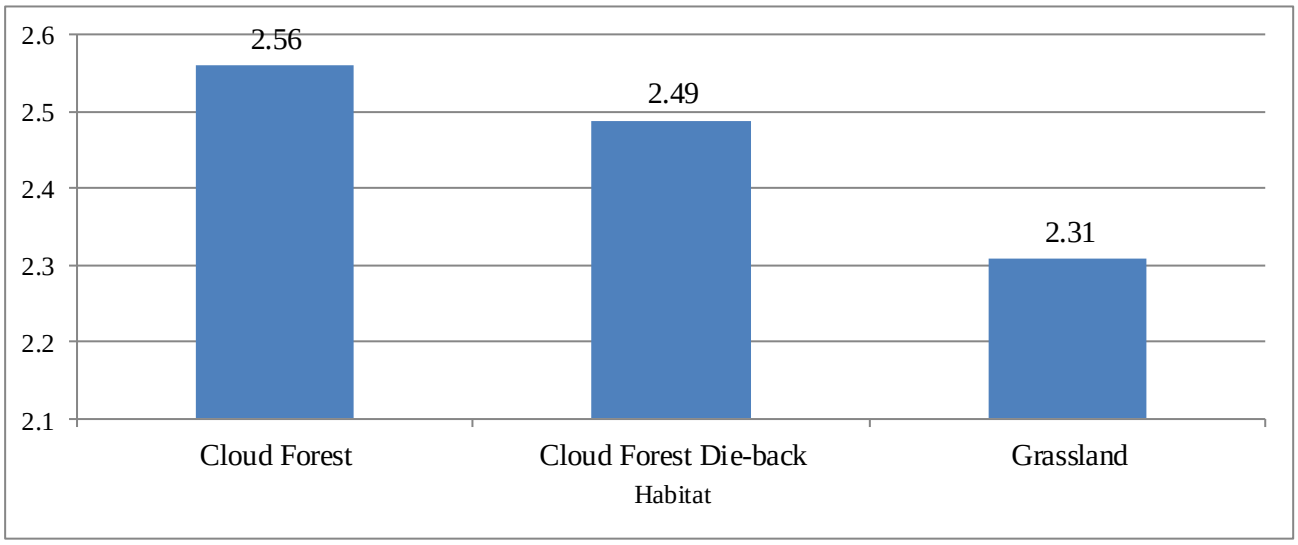

Figure 3: Shannon Wiener Index of the main three Habitats of Horton Plains.

Maximum Shannon Wiener Index (H') was recorded from cloud forest habitat (H'=2.56) while a minimum H' was recorded from grassland habitat (H'=2.31). Moreover after applying the t-test, in the cloud forest die-back habitat, the H' is 2.4 (Figure 03). Bird diversity differed significantly between the cloud forest die-back habitat and the grassland habitat (t= 2.2587, df= 3826) as well as between the cloud forest and grassland habitats (t=3.9484, df= 6484).Bird diversity of the cloud forest did not differ significantly from the cloud forest die-back bird diversity (t=0.9325, df=3529).

Table 7: Jaccard Similarity Index.

Habitat	Sa	Sb	Sc	Sum	Jaccard Index
Cloud Forest; Cloud Forest Die-back	22	6	38	66	0.58
Cloud Forest Die-back; Grassland	17	14	27	58	0.47

Cloud Forest ;Grassland	24	15	26	65	0.40

Jaccard Similarity Index (Table 07) between the cloud forest and cloud forest die-back was at 0.58 and these habitats had more similar species. Moreover between the cloud forest die-back and the grasslands, the value was at 0.47 and minimum value, 0.40 was recorded between the cloud forest and the grasslands which had less similar species.

4. **Discussion**

Though the Horton Plains National Park is relatively smaller than other National parks (DWC, 2007), this area is rich in avifaunal diversity with a large number of bird species (Total number of species=78). There are endemic bird species with high population, present within the HPNP. Within the study there were some bird species that were not recorded in any of the previous surveys. They consisted of resident breeders such as, the Streak-Throated Woodpecker, the Crested Tree Swift, the Spotted Dove, the Slaty-Legged Crake, the Brahminy Kite, the White-Browed Fantail, the Ashy Prinia, the Tawny-Bellied Babbler and the Yellow-Eyed Babbler. Moreover there were migratory species such as the Brown-Breasted Flycatcher, Yellow Wagtail, Sand Martin and the Whiskered Tern.

In this study, percentage of the Sri Lankan breeding residents, 30.19% were recorded. Furthermore out of the endemic birds (27 considered endemic birds according to the National Red List: MOE, 2012) there were 48.15% were from Horton Plains National Park. Although the Rock Pigeon (Threatened category:CR) had recoded within the study, however, they were recorded near habitats which were disturbed by humans. Therefore, this pigeons should be feral pigeons (*Columba livia intermedia*) which were in LC category.

In previous diversity studies done by floral and faunal inventory (MfC, 1994) they have mentioned 87 bird species with 14 endemic species. In addition National Conservation Review (Green and Gunawardena, 1997) has recorded 26 species with 5 endemic birds. Furthermore Management Plan (DWC, 2005) has mentioned 87 species with 14 endemics. Final study about the bird diversity done by the Department of Wildlife Conservation has recorded 64 species with 13 endemic birds (DWC, 2007).

Out of the newly recorded species, though the Slaty-Legged Crake was previously not recorded from Horton Plains National Park. However they were appeared in Victoria Park of Nuwara Eliya (Pethiyagoda, 2012). On the contrary, common bird species within lowlands such as Spotted Dove and Brahminy Kite were also observed by present study. Sand Martin was an irregular visitor (Vagrant) and a migratory species, recorded for the first time.

There is a significant difference of diversity and distribution of birds, among three habitats. There were more common bird species recorded from the cloud forest and cloud forest die-back habitats. This may be because of there was only little distinction between these two habitats in terms of floristic characteristics (DWC, 2007).

Habitat preference is highest in the cloud forest, according to the species richness (60) and species diversity (Shannon Wiener index = 2.56). Cloud forest is the major habitat to be protected, with other habitats, in HPNP.

Furthermore, in this study some previously recorded (MfC, 1994) bird species were not observed. Night birds such as, Spot-Bellied Eagle Owl (*Bubo nipalensis*, Hodgson, 1836), was not observed because this study was carried out only in the morning period. Moreover, some species such as the Black-Winged Kite (*Elanus caeruleus*, Desfontaines, 1789), Montagu's Harrier (*Circus pygargus*, Linnaeus, 1758), Crested Goshawk (*Accipiter trivirgatus*, Temminck, 1824), Booted Eagle (*Hieraaetus pennatus*, Gmelin, 1788) and Common Kestrel (*Falco tinnunculus*, Linnaeus, 1758) were not recorded because of the time limitation. In addition, endemic birds such as Sri Lanka Spurfowl (*Galloperdix bicalcarata*, Forster, 1781) and Sri Lanka Grey Hornbill (*Ocyceros gingalensis*, Shaw, 1811) was not recorded in this study. However, the study is ongoing and the authors will publish their new findings in near future.

5. Conclusion

Present study reveals about the diversity and population distribution of the bird species at the Horton Plains National Park. Hence management of the HPNP should plan more actions to improve further long term monitoring plans of avifauna to warrant the protection by minimizing threats. The HPNP is a protected area, however there are other plantations around this area. Therefore, it is important to encourage the surrounding plantations to improve resources by practicing environmental friendly performances, such as to develop mixed plantings of *Eucalyptus* with other native fast-growing species (Williams, 2015).

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