

A STUDY ON MIXED SPECIES BIRD FLOCKS OF SUB - MONTANE WET EVERGREEN FOREST IN THE NORTHERN FLANK OF THE KNUCKLES REGION IN SRI LANKA.

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Abstract

Flocks of mixed species birds were studied in the sub-montane wet evergreen forest habitats of Knuckles in the Central Province of Sri Lanka. Monthly transects and opportunistic observations were made between April and October 1998. The results revealed that percentage of bird species contributing to the flock forming behaviour at Riverstone was 36.5%. A total of 30 mixed species bird flocks were encountered during the study period. Seventeen (17) species from 13 families were recorded as participants of the mixed species flocks and these included three endemic species. The flock size varied between 3-15 species (mean \pm SD 7.41 ± 1.49) and 5-55 individuals. The smallest flock contained 5 individuals with 3 species. The flock size in Riverstone was not positively correlated to the number of species. The Grey-headed Canary Flycatcher and Sri Lanka Hill White-eye act as nuclear species while the Yellow-eared Bulbul, Velvet fronted Nuthatch, Oriental White-eye and Great Tit were regular species. The Yellow eared Bulbul was one of the lead species. The Sri Lanka Bush Warbler and Dark-fronted Babbler were occasional species in flocks. The foraging behavior of species varied within a flock. Cluster analysis revealed that four main associations were present in flocks. Migrant species comprised only a minor component of mixed species.

Introduction

The association of birds mixed-species foraging groups is a widespread phenomenon in the tropics and neo-tropics (Moynihan, 1962, McClure, 1967, Munn & Terborgh 1979, Mclean *et al*, 1987 and Partridge & Ashcroft, 1976). Flocks in the tropics are generally the largest and most diverse (Bell, 1981a).

A flock is generally considered as a collection of two or more species whose formation depends upon positive responses by individuals to other flock members of their own or other species (Gill, 1994). Reasons for such flocking mechanisms are mainly related to feeding or predation (Bell, 1981b). Mixed species flocking is thought to increase foraging efficiency without increasing intraspecific competition (Macdonald & Henderson, 1977). Birds in groups can learn from their own species or other species of the flock where to locate food resources and predators. This may help an individual to locate food in a habitat and avoid predators. This allows a more efficient way of foraging and reduces time wasted foraging, in an area that may have already been cleaned by a flock. Furthermore, the presence of a large number of birds may also reduce the vulnerability of predation.

Mixed species flocking behavior has been observed in various parts of Sri Lanka; Horton Plains (Partridge & Ashcroft, 1976), Sinharaja rain forest (Kotagama *et al*, 1986),

Thangamalai Sanctuary (Perera & Kotagama, 1995), montane and highland forests (Bambaradeniya & Ranawana, 1999), submontane dry evergreen forest at Knuckles (Sriyani *et al.*, 2000) and at two altitudes on northern flank of the Knuckles Region, in the Central Province of Sri Lanka (Sriyani *et al.*, 2001). However, there is a lack of information on mixed-species foraging flocks in the intermediate and mid elevations of Sri Lanka. Thus, this study has concentrated on the mixed species flocks in the sub montane wet evergreen forest habitat on the northern flank of the Knuckles Region in the Central Province of Sri Lanka.

Study Area

The Knuckles range is situated within the districts of Matale and Kandy in the Central Province of Sri Lanka.

This massif extends northeast and southeast and has an average height of 1500m. It has an undulating crest with several peaks (Cooray, 1998). The geographical position of this range is very important as it acts as a wind barrier for monsoon winds and receives heavy rain during the monsoon period. The combined effect of topography, temperature, soil and rainfall results in a broad range of vegetation types. Habitat in the Knuckles ranges from montane forest to lowland dry evergreen forest and represent a unique ecosystem supporting having high biodiversity (Ekanayake, 1994 and IUCN, 1994).

This study was carried out in different habitats on the northern flank of the Knuckles region. The range extended from Riverstone (1000m) to Illukkumbura (520m), having an average elevation of around 585m and lying between 7° 31' and 7° 33' N and 80° 44' and 80° 43' E. The study site was confined to Riverstone where the average elevation is 1000m. The Riverstone habitats have been identified as sub montane wet evergreen forest, Patana grasslands, scrub forest habitats and streamside forest.

Methodology

A transect method was adopted (Bibby *et al.*, 1993). Transect counts were made twice a day between 0600 h to 0900 h and 1600 h to 1800 h from April to October 1998. No counts were made during the rain in this study. The transect route was a 1 km line which covered all of the habitats within the study area. Twelve (12) transects were carried out per month. When feeding flocks were encountered, information was collected on species composition of the flocks, number of individuals and foraging activities.

Gradient Transect Method (GRADSECT) and plot sampling methods were used for the vegetation analysis (Green & Gunawardena, 1993). The data were analyzed using Statistica version 6.

Results

A total of 30 bird flocks and 17 flock forming bird species (Table 1) were encountered in Riverstone. Of these, only 25 flocks were observed in totality, and were used in the analysis. The number of species that contributed to the flocks at Riverstone range from 3 to 15 species. (Table 2). However, not all of the 17 species were found in one flock. The majority of flocks consisted of 15 species. Among these species, the Sri Lanka Hill White-eye (*Zosterops ceylonensis*)(21/25), the Sri Lanka Yellow - eared Bulbul (*Pycnonotus cafer*)(20/25), the Grey - headed Canary Flycatcher (*Culicicapa ceylonensis*)(17/25), the Velvet-fronted Nuthatch (*Sitta frontalis*)(16/25) and the Oriental White-eye (*Zosterops palpebrosa*)(14/25) were the most common species and were represented in more than 14 flocks in this area. The Sri Lanka Bush Warbler (*Bradypterus palliseri*)(4/25), the Common Iora (*Aegithina tiphia*) Greenish Warbler (*Phylloscopus trochiloides*)(2/25) and the Bar-winged Flycatcher Shrike (*Hemipus pictatus*)(4/25) were occasional species within the flocks.

Table 1
The composition of 25 flocks (n = 25) encountered in transects at Riverstone Forest in the Knuckles Region.

Name of the Species	Individual of a species in a flock (Mean \pm SD)	% of flocks a species in (Frequency in flocks)	Abbreviation
1. Sri Lanka Hill White-eye <i>Zosterops ceylonensis</i>	13.13 \pm 2.69	0.95	HWE
2. Sri Lanka Yellow-eared Bulbul <i>Pycnonotus cafer</i>	4.27 \pm 0.23	0.91	YEBB
3. Grey – headed Canary Flycatcher <i>Culicicapa ceylonensis</i>	6.93 \pm 1.65	0.77	GHCFC
4. Velvet-fronted Nuthatch <i>Sitta frontalis</i>	4.31 \pm 1.07	0.72	VFBNH
5. Great Tit <i>Parus major</i>	2.36 \pm 0.66	0.55	GT
6. Oriental White-eye <i>Zosterops palpebrosa</i>	5.13 \pm 1.62	0.50	OWE
7. Dull-blue Flycatcher <i>Eumyias sordida</i>	2.20 \pm 0.87	0.50	DUBFC
8. Scimitar Babbler <i>Pomatorhinus horsfieldii</i>	2.18 \pm 0.57	0.50	SCBB
9. Yellow-fronted Barbet <i>Megalaima flavifrons</i>	1.25 \pm 0.43	0.45	YFBT
10. Scarlet Minivet <i>Pericrocotus flammeus</i>	2.83 \pm 0.57	0.27	SMVT
11. Black Bulbul <i>Hypsipetes leucocephalus</i>	2.00 \pm 0.63	0.23	BBB
12. Sri Lanka Bush Warbler <i>Bradypterus palliseri</i>	2.00 \pm 0.74	0.14	SLWA
13. Dark - fronted Babbler <i>Rhopocichla atriceps</i>	4.00 \pm 0.83	0.09	DFBB
Common lora <i>Aegithina tiphia</i>	2.00 \pm 0.57	0.14	CI
15. Bar Winged Flycatcher Shrike <i>Hemipus pictatus</i>	2.00 \pm 0.03	0.23	BWFS
16. Greenish Warbler <i>Phylloscopus nitidus</i>	2.00 \pm 0.00	0.05	GTWA
17. Pale – billed Flowerpecker <i>Dicaeum erythrorhynchos</i>	2.00 \pm 0.21	0.05	PBFP

Table 2 gives the number of bird species flock at Riverstone. The largest flock at per flock at Riverstone which ranged Riverstone contained more than 50 from 3 to 15 species (mean \pm SD 7.41 \pm individuals and the smallest flock 1.49). Table 3 shows the individuals per contained less than 20 individuals.

Table 2. Percentage number of flocks containing 'flock species' at Riverstone during the study.

No of species per flock	3	4	5	6	7	8	9	10	11	12	15
Percentage of flocks	11.42	8.57	11.42	14.31	28.57	8.57	8.57	-	-	-	8.57

Table 3. Percentage numbers of flocks containing "flock individual" at Riverstone during the study.

No of individuals per flock	< 20	20 - 29	30 - 39	40- 49	> 50
% of flock	4.6	13.6	22.6	31.8	27.4

Flock Organization

Table 4 shows the composition of flocks in the study area. The Grey-headed Canary Flycatcher, the Sri Lanka Hill White-eye and the Scimitar Babbler were the nuclear species at Riverstone. These birds were usually resident. The majority of flocks were formed by the three nuclear species. However, more than 50% of flocks were lead by the Yellow-eared Bulbul. The Yellow-eared Bulbul, the Velvet-fronted Nuthatch, the Oriental White-eye and the Great Tit were the regular species at Riverstone.

Two species of territorial birds, the Sri Lanka Bush Warbler and the Dark-fronted Babbler were also occasionally seen with the flocks within their territory. They

joined flocks for a short period of time while flocks were passing through their territories. A migrant, the Greenish Tree Warbler was also occasionally observed with flocks during the migratory season, when the flock was passing through its territory.

Other common birds that were encountered in the forest did not contribute to the flocks. These species included the Common Grackle (*Gracula religiosa*), the Wood Pigeon (*Columba torringtoni*), and the Sri Lanka Lorikeet (*Loriculus beryllinus*). The Jungle Squirrel (*Funambulus sublineatus obscurus*) also followed the flocks frequently gave alarm calls.

Table 4. Categories of flock species

Category *	Name of the Species
Nuclear Species	Grey-headed Canary Flycatcher
	Sri Lanka Hill White-eye
	Scimitar Babbler
Lead Species	Sri Lanka Yellow-eared Bulbul
Regular Species	Sri Lanka Yellow-eared Bulbul
	Velvet-fronted Nuthatch
	Oriental White-eye
	Great Tit
Occasional Species	Sri Lanka Bush warbler
	Dark-fronted Babbler
	Greenish Warbler

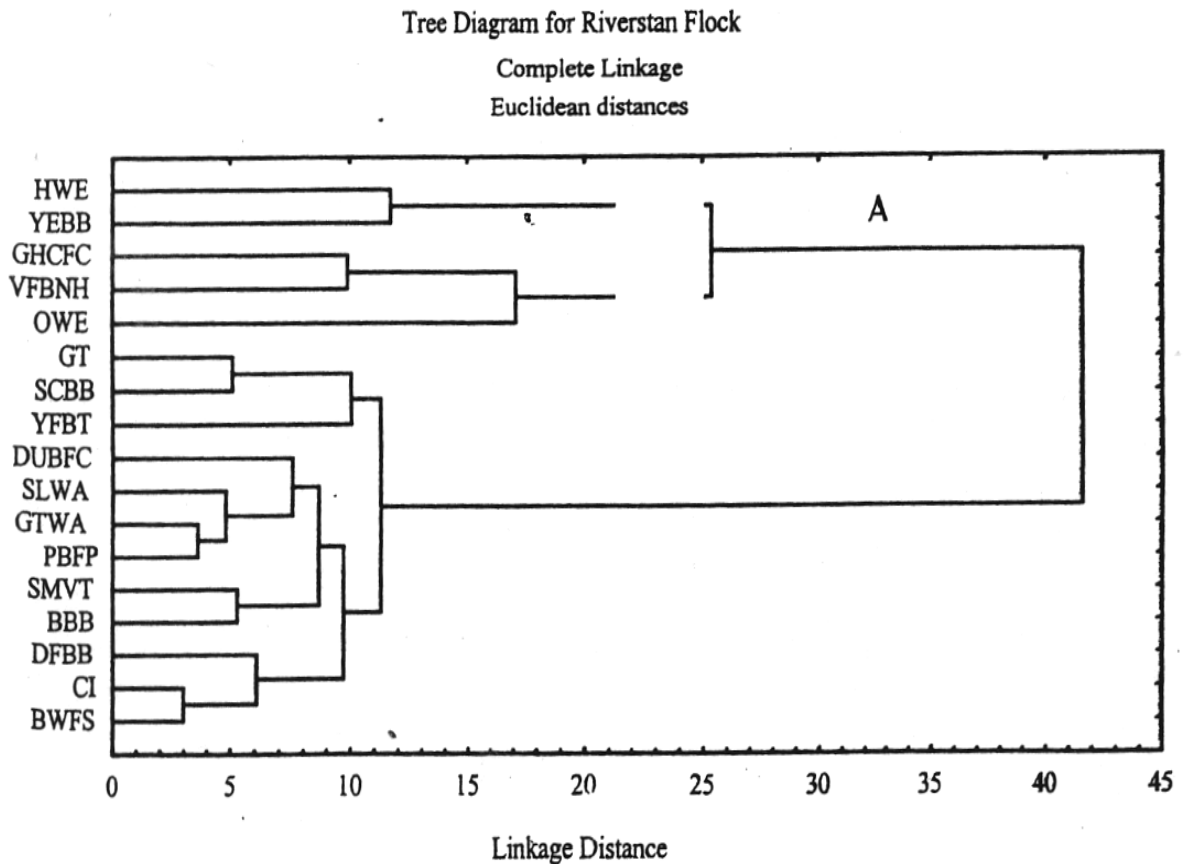
(* Based on Bell, 1981a)

Degree of Association

The tree cluster graph (Fig.2) shows the degree of association between the flock species of the flocks at each site. At Riverstone, there were two main associations (A and B), and this showed 26% linkage distance from the rest of the

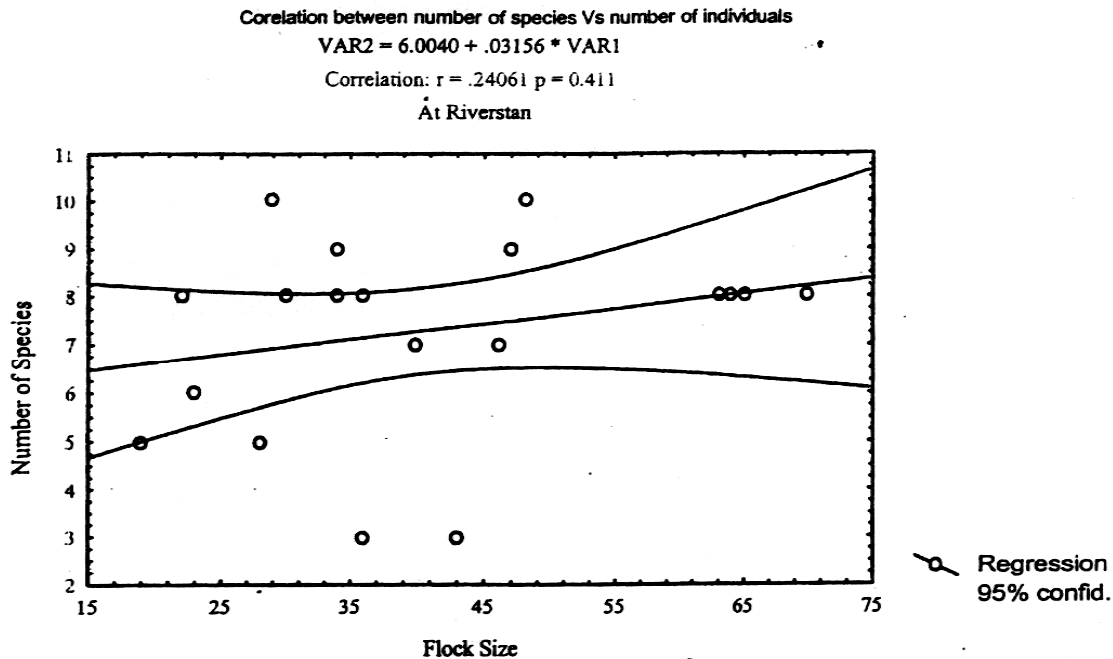
species. In-group 'A' the highest association was shown by the Grey-headed canary Flycatcher and the Velvet-fronted Nuthatch. These birds foraged mostly in the canopy and sub canopy levels. Group 'B' showed four sub groups.

Fig. 2 Dendrogram showing degree of association within mixed species flocks of birds in Riverstone (Abbreviations for the bird species are given in Table 1).



Flock size at Riverstone was not positively correlated ($r = 0.241$) with the number of species (Fig.3). The mean number of individuals participating from each species, however was y low (1.32 ± 1.23).

Fig. 3 Association between number of species and number of individuals (size of flocks) at Riverstone.



Discussion

Mixed species flocking was found to be a common behavioral pattern in the Knuckles Range. The percentage of flocking species contributing to the flocks was 36.5%. (in comparison Sinharaja was 38% (Kotagama et al, 1986) and Tangamalai Sanctuary was 36.11 % (Perera & Kotagama, 1995) However, the Knuckles value is only 2% lower than Sinharaja and equal to Tangamalai Sanctuary. The percentage of flocking species contributing to the flocks, however, may vary because this study was confined to a small area of the northern flank of the Knuckles Range. The present findings support Tramer and Kemp's (1980) arguments that mixed species flocks are characteristic of all forest and forest edge habitats and that their composition varies with elevation and habitats. Tramer and Kemp (1980) also argued that the highly diverse and most tightly organised flocks occurred in the wet forest of higher elevations. More than 50% of birds species (regular resident species) present in Knuckles were found in flocks showing flock forming behaviour.

In general, there is an advantage in communal foraging to individuals when

they participate in flock forming. This grouping behavior gives protection from predators and also enhances the efficiency of foraging (McClellan et al, 1987). According to Gill (1994), maximum predator detection benefit is derived from a large group size of around 25 individuals. The flock formation reflects trade off between costs and benefits.

The Riverstone data showed a negative correlation between flock size and the number of individuals in each species. This may be due to the low species diversity at the Riverstone study site. Different authors have shown that flocking is an adaptation to reduce predation as well as to avoid interspecies competition (Gill, 1994 and Dean,1990). Flocking behavior in this study could be due to the same mechanism. The majority of species occur singly or as mated pairs. Increased flock size appears to reflect an increase in species rather than that an increase of individuals of species already present (Paulsen, 1996). This is in accordance with the results at Pitawalapatana site (Sriyani 2000), where flock size increased due to the addition of migratory birds during the migratory season.

Different species in flocks have different optimum speeds of movement through the forest. The observation of horizontal distribution and speed of flocks revealed that the leading species were far-ahead of the followers in horizontal distribution (Sriyani 2000). The foraging speed also varied and the distance between the leaders and the followers was approximately 75m. Partridge & Ashcroft (1976) have shown that bird flocks in Sri Lanka have different optimum speed of movement through the forest, and it must be a strong positive advantage in flocking to collect other species that represent the maximum composition of the flock in the habitat. McClure (1967) has observed that in Malayan forests canopy birds were left behind due to their slower foraging speed and frequently stopped feeding to catch up with the rest of the flock.

Many researchers have shown that the staggering of species could possibly result in a cascade from insects at the bottom to the birds feeding at the top. However, in this study it was observed that the different species in the flocks took very different routes. The slow moving birds appear to benefit from the flushing of insects by other species in the flock. During the study period, babblers were occasionally recorded trailing behind the main flocks.

On several occasions researchers in Sri Lanka have considered the Sri Lankan Yellow-eared Bulbul to be a nuclear species (Partridge and Ashcroft, 1976, Kotagama *et al*, 1986). However, according

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to Greig - Smith's (1978) classification, the present study indicates that the Sri Lankan Yellow-eared Bulbul could be considered as a leading species due to its presence in leading more than 80% of the flocks while the Grey-headed Canary Flycatcher and the Sri Lankan Hill White-eye contributed to form the flocks.

In the present study frugivores and mixed feeders (such as the Yellow-eared Bulbul, the Sri Lanka Hill White-eye and the Oriental White-eye) foraged in the canopy or just below the canopy. The insectivores (such as the Grey-headed Canary flycatcher, the Velvet-fronted Blue Nuthatch, the Great Tit, and the Sri Lanka Dull-blue flycatcher and the Tickles Blue flycatcher) foraged in sub canopy and under growth.

In this study the majority of herbivorous birds foraged among the canopy fruits as mixed feeders. The insectivorous birds utilized a much broader range of habitat. Firth's (1984) observations suggest that more mixed feeders forage in higher strata than insectivores due to a higher biomass of insects in sub canopies and lower strata than in the canopy.

Therefore these results indicate that the difference in utilization of vertical strata may be the most important factor contributing to niche differentiation within the study area. Foraging assemblies of mixed feeders and insectivores may reflect the availability of food resources in different strata.