Mixed flock of insectivorous birds in Gunung Gede-Pangrango National Park, West Java, Indonesia

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Abstract. Although mixed flock has been widely studied in various locations elsewhere, very little information was reported from Indonesia. This study was aimed at re-discovering the mixed-flocks that were reported existed in Gunung Gede-Pangrango National Park three decades ago. Transects between 1,600m and 2,400m with 200 m interval were surveyed for 50h in Gunung Putri Resort. Flock size, composition, dominance and sighting probability were calculated. Five mixed flocks were re-discovered in the study site (probability 0.10), decreased in number compared to previous research (probability 0.57). The flocks were found between 2,000m and 2,300m asl, consisted of 9 species, averaging 39.6 individual birds (ranged 9-11 birds) and. Blue Nuthatch, Mountain White-eye and Little Pied Flycatcher were dominant and always part of every flock member. Ashy Drongo and Lesser Racquet-tailed Drongo could play role as flock leaders.

Keywords: Bird community, Blue Nuthatch, high altitude, Little Pied Flycatcher Mountain White-eye

1. Introduction
The mixed flocks of insectivorous birds are groups of birds from different species, which travel and forage together and considered as the most common and complex interactions in forest environments [1, 2]. The main benefits of mixed-species flocking are reduced predation risk and increased foraging efficiency [3].

In general, members of mixed flock of bird species are classified into ‘leader’ (sometimes refer to as ‘nuclear’) and ‘followers’ (or ‘satellite’) [4-6]. Leaders normally show conspicuous behaviors, including distinctive alarm and/or other vocalizations and active movements, to enhance flock cohesion and may also stimulate flock formation, while followers are species that are thought to get the benefits of flock participation [7].

Many studies of mixed flocks have been conducted elsewhere (see reviews of [1, 6, 8]). However, mixed flock of Indonesian insectivorous birds has been very scarcely reported in the scientific publication. The only available publication was a report published in 1987 [9], based on field observation on mix flocks in 12 areas in Java, including in Gunung Gede-Pangrango National Park (GGPNP). This research aimed to re-discover the mixed flock in GGPNP, and analyze the mixed-flock characteristics, mainly flock size and composition.
2. Materials and methods
The field research was conducted in Gunung Putri Resort (5°45′0″–5°46′30″S; 106°58′30″–107°0′0″E), part of GGPNP. As the mixed flocks previously were found by [9] in a higher altitude, the observation sites were purposively selected between 1,600m and 2,400m asl. Our pre-survey indicated that there was only a few bird (and other wildlife) found above 2,400m and thus we assumed that the probability to find a mixed flock would be very low at above that altitude.

A group of birds was considered a mixed flock if it travelling in the same direction. To find the mixed flock, three field observers followed existing trails as the primary transects. From the primary transects, several secondary transects of altitudes 1600m, 1800m, 2000m, 2200m, and 2400m were established, perpendicular to the left and right sides of the primary transects. When necessary, areas in between the secondary transects were surveyed as well.

Field visits were conducted during daylight, from 6:00 to 5:00 pm. The effective survey duration (excluded pre-survey and travel time from the camp to the primary transect) was 50h, which was conducted in November 2015, coincided with rainy season. In addition to the data of the bird species and their number, dominance and sighting probability were also calculated.

3. Results
Five mixed flocks of insectivorous birds were found in the study area, observed at the altitude between 2,000m and 2,300m asl. The average size of mixed flocks was 39.6 birds, although the flock can be as big as 51 individuals, totaling 9 member species (or less in some flocks) (table 1). All of the member species are insectivorous occupy various guilds. The encounter time of the mixed-flock varies from 6 to 10 minutes, averaging 7.8 minutes.

Of the 9 member species of the mixed flocks, three species - namely Blue Nuthatch (29.3% of the total population of mixed flock), Mountain White-eye (24.7%), and Little Pied Flycatcher (12.6%) - were always part of the member in all mixed flocks and also dominated their flocks. Drongos (Ashy and Lesser Racquet-tailed), on the contrary, were always present as single individual in their flocks (table 2 and table 3).

Apparent there was a relation between number of individuals within the flocks and the number of species. Flock with high individual members (Flock 2 and 4) had the highest species number (9 species). In contrast, the smallest flock (Flock 3) had the smallest species number (only 6 species).

Table 1. Summary of the insectivorous mixed flock encountered along Gunung Putri transect, Gunung Gede-Pangrango National Park.

| Parameter                                      | Value                                      |
|------------------------------------------------|--------------------------------------------|
| Number of mixed flock found                    | 5                                          |
| Sighting probability                          | 1 flock/10 effective observation hour      |
| Altitude of mixed flock found                  | 2,000–2,300m asl                           |
| Range of mixed flock sizes                     | 31–51 individuals                          |
| Average number of individuals in the mixed flock±SD | 39.6±7.6 individuals/mixed flock           |
| Total number of species in the mixed flocks    | 9 species                                  |
| Average number of species in the mixed flock±SD | 7.4±1.3 species/mixed flock                |

4. Discussion
In the study area, the mixed-flock in Gunung Putri Resort was re-discovered, although the encounter number (5 flocks in 50 observation hours; probability 0.10) was significantly lower than mixed-flocks previously found by [9], i.e. 27 flocks in 47 observation hours (probability 0.57). Study [9] in 12 sites in West Java Province was conducted between July and December 1986. However, the exact timing for his observation in GGPNP was not specifically mentioned. Most likely [9] was conducted during the rainy season, the same season as this study.
Table 2. Species composition of mixed flocks (n=5) and probability of species occurrence in the study area.

| No | Common name                        | Species (Latin Name)          | Range of number of individuals in mixed flocks | Range of dominance (%) | Sighting probability in mixed flocks |
|----|-----------------------------------|-------------------------------|-----------------------------------------------|------------------------|-------------------------------------|
| 1  | Blue Nuthatch                      | *Sitta azurea*                | 8-12                                          | 19.5-30.7              | 1.0                                 |
| 2  | Mountain White-eye                 | *Zosterops montanus*          | 7-12                                          | 15.7-26.6              | 1.0                                 |
| 3  | Little Pied Flycatcher             | *Ficedula westermanni*        | 5-10                                          | 12.8-19.6              | 1.0                                 |
| 4  | Grey-headed Canary-Flycatcher      | *Pteruthius aenobarbus*       | 1-5                                           | 9.8-16.1               | 0.8                                 |
| 5  | Chestnut-fronted Shrike-Babbler    | *Pteruthius aenobarbus*       | 4-6                                           | 8.9-12.8               | 0.8                                 |
| 6  | White-browed Shrike-Babbler        | *Pteruthius flaviscapis*      | 3-6                                           | 5.9-18.8               | 0.8                                 |
| 7  | Mountain Leaf Warbler              | *Phylloscopus trivirgatus*    | 2-4                                           | 4.4-12.9               | 0.6                                 |
| 8  | Ashy Drongo                        | *Dicrurus leucophaeus*        | 1                                             | 2.2-3.1                | 0.6                                 |
| 9  | Lesser Racquet-tailed Drongo       | *Dicrurus remifer*            | 1                                             | 2.22                   | 0.2                                 |

Some possible reasons that might contribute to the decrease of the mixed flock compare to the study of [9] are (1) the decrease population of insectivorous birds due to the decrease habitat quality in the nearby area, or (2) the weak reason to form a mixed flock due to the abundance of insect food or lack of predation. Further comparison of flock size and species composition with previous study at the same location was unable to be performed because data and analyses [9] were combined and aggregated from all his 12 sites.

As for the flock size, in the lowland to mid-elevation rainforest in Sri Lanka [10] reported that the flock size averaged 41.3 individuals, very similar to this study. Previous studies in Brazil suggested that flock size have been known to be varied between seasons (rainy and dry) due to food availability and breeding activities [11]. Other factors that might influence the flock size were the density of avian predators and openness of the vegetation [3], as well as the size of forest fragments [12].

According to Hutto [13], a ‘leader’ (or ‘nuclear’) species have several distinct characteristics, including showing active behaviour and calls, tend to lead the flocks, rarely found outside mixed species flocks, and found in a high percentage of flocks. Goodale et al. [8] reviewed the ‘leader’ of the mixed-flock of East Asian birds and found out that fulvettas, bushtits and tits were the most common ‘leaders’.

In the previous study, Erftemeijer [9] discovered that the Greater Racket-tailed Drongo (Dicrurus paradiseus) was identified as the ‘leader’ in the mixed-flock of lowland areas, while the Lesser Racquet-tailed Drongo replaced the role in the highland areas. In this study, the Greater Racket-tailed Drongo was not found, and its role was substituted by the Ashy Drongo.

The drongos in this study, either Ashy Drongo or Lesser Racquet-tailed Drongo, played role as the ‘leaders’ and they showed a clear behavior of leading and protecting the flock. However, the absence of a drongo species in one flock (Flock 3; no other species was seen to play role as a ‘leader’) and the presence of two drongo species in another flock (Flock 4) suggests that the roles of ‘leaders’ and ‘followers’ in this study were quite loose or only temporary.
In Southeast Asia, comparison of the ‘leader’ was difficult due to lack of other similar studies. The closest comparison with this study was from Sri Lanka in South Asia. In Sri Lanka’s rainforest, Drongo – represented by Greater Racket-tailed Drongo Dicrurus paradiseus – was identified [10] as a possible ‘leader’ in the mixed-flocks and had been known to be more successful when they joined mixed-species bird flocks [14].

Table 3. Size and composition of each mixed flock found in the study area

| Flock Number | Total Individuals [Species] | Common Name                                      | Number of Individuals |
|--------------|-----------------------------|--------------------------------------------------|-----------------------|
| 1            | 39                          | Blue Nuthatch                                    | 12                    |
| [2.000-2,100]| 7                          | Mountain White-eye                               | 8                     |
|              |                             | Chestnut-fronted Shrike-Babbler                   | 5                     |
|              |                             | Little Pied Flycatcher                           | 5                     |
|              |                             | White-browed Shrike-Babbler                      | 4                     |
|              |                             | Grey-headed Canary-Flycatcher                     | 5                     |
|              |                             | Ashy Drongo                                      | 1                     |
| 2            | 51                          | Blue Nuthatch                                    | 10                    |
| [2.100-2,200]| 9                          | Little Pied Flycatcher                           | 10                    |
|              |                             | Mountain White-eye                               | 8                     |
|              |                             | Chestnut-fronted Shrike-Babbler                   | 6                     |
|              |                             | Grey-headed Canary-Flycatcher                     | 5                     |
|              |                             | Mountain Leaf Warbler                            | 4                     |
|              |                             | White-browed Shrike-Babbler                      | 3                     |
|              |                             | Sunda Warbler                                    | 3                     |
|              |                             | Ashy Drongo                                      | 1                     |
| 3            | 31                          | Blue Nuthatch                                    | 8                     |
| [2,200-2,300]| 6                          | Mountain White-eye                               | 7                     |
|              |                             | Little Pied Flycatcher                           | 5                     |
|              |                             | Grey-headed Canary-Flycatcher                     | 5                     |
|              |                             | Mountain Leaf Warbler                            | 4                     |
|              |                             | Sunda Warbler                                    | 2                     |
| 4            | 45                          | Mountain White-eye                               | 12                    |
| [2,300-2,400]| 9                          | Blue Nuthatch                                    | 11                    |
|              |                             | Little Pied Flycatcher                           | 6                     |
|              |                             | Grey-headed Canary-Flycatcher                     | 5                     |
|              |                             | Chestnut-fronted Shrike-Babbler                   | 4                     |
|              |                             | Mountain Leaf Warbler                            | 2                     |
|              |                             | Ashy Drongo                                      | 1                     |
|              |                             | Lesser Racquet-tailed Drongo                     | 1                     |
| 5            | 32                          | Blue Nuthatch                                    | 8                     |
| [2,300-2,400]| 6                          | Mountain White-eye                               | 8                     |
|              |                             | White-browed Shrike-Babbler                      | 6                     |
|              |                             | Grey-headed Canary-Flycatcher                     | 5                     |
|              |                             | Mountain Leaf Warbler                            | 4                     |
|              |                             | Ashy Drongo                                      | 1                     |

References
[1] Harrison N M and Whitehouse M J 2011 Animal Behavior 81 1-14
[2] Greenberg R 2000 Birds of Many Feathers: The Formation and Structure of Mixed-Species Flocks of Forest Birds On the Move: How and Why Animal Travel in Groups ed S Boinski
and P A Garber (Chicago: University of Chicago) pp 521-58

[3] Thiollay J 2003 *Ornitologia Neotropical* **14** 47-65
[4] Moynihan M 1962 *Smithsonian Miscellaneous Collectioin* **143** 1-140
[5] Morse D H 1970 *Ecological Monographs* **40** 119-68
[6] Sridhar H, Beauchamp G and Shanker K 2009 *Animal Behavior* **78** 337-47
[7] Contreras T A and Sieving K E 2011 *International Journal of Zoology* **2011** 1-11
[8] Goodale E, Ding P, Liu X, Martinez A, Si X, Walters M and Robinson S K 2015 *Avian Research* **6** 1-14
[9] Erftemeijer P 1987 Forest Avifauna on West Java: An analysis of Mixed Flocks of Insectivorous Birds in Lowland and Mountain Forest on West Java, Indonesia (Wageningen: Wageningen Agricultural University – World Wildlife Fund Netherlands – Institut Pertanian Bogor)

[10] Kotagama S W and Goodale E 2004 *Forktail* **20** 63-70
[11] Develey P F and Peres C A 2000 *Journal of Tropical Ecology* **16** 35-53
[12] Maldonado-Coelho M and Marini M A 2004 *Biological Conservation* **116** 19-26
[13] Hutto R L 1994 *The Condor* **96** 105-118
[14] Satischandra S H K, Kudavidanage E P, Kotagama S W and Goodale E 2007 *Forktail* **23** 145-148