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The Mixed-species Flocks of Birds in a Deciduous Dry Forest of Madagascar

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Madagascar has many unique and peculiar birds in a wide variety of habitats. Since M. J. Delacour's zoological expedition (reported by RAND (1936)), however, there have been few ornithological studies carried out. From 1989 to 1991, we carried out several surveys of mixed-species flocking of forest birds in Madagascar. EGUCHI *et al.* (1993) reported the composition of mixed-species flocks and the foraging behaviour of flock members observed in a tropical moist forest (the Andasibe Reserve) in the eastern domain. This paper describes the structure of mixed-species flocks of birds in a deciduous dry forest in the western domain.

The investigation was carried out in a deciduous dry forest at the Ankarafantsika Reserve (16°15'S, 46°45'E, 80 m above sea level; called "Ampijoroa" hereafter) from 28 September to 15 October, 1990, when several species started breeding. Average canopy height was around 12 m and the undergrowth was sparse. Most tall trees (8 m <) lacked leaves but ever-green broad-leaved trees covered from middle to lower layers. More detailed description for vegetation of this forest has been given by JENKINS (1987) and RAZAFY (1987).

Mixed-species flocks have been classified a number of ways; e.g. small or large, long-sustained or ephemeral, or tightly organized or not (cf. MOYNIHAN 1962). Following HUTTO (1987), we defined a mixed-species flock as a group of two or more species occurring within 20–30 m, in which flock members moved in concert. Two or three observers walked separately in early morning and mid-afternoon along the paths cut in the forest. Once encountered, a flock was followed for as long as possible or until contact was lost. We recorded the composition of the flock, number of individuals, foraging height, height of the vegetation, location in vegetation (leaf/twig, branch, trunk, undergrowth/ground, and air) and foraging technique (gleaning, hovering, probing, snatching, and hawking). See EGUCHI *et al.* (1993) for a detailed explanation of methods. Scientific and common names follow LANGRAND (1990).

Table 1 shows a list of species joining mixed-species flocks whose composition was ascertained. In all, 18 species were observed joining mixed-species flocks. The mean number of species was 4.4 per flock (ranges 2–8); smaller than in Andasibe, 6.9 (ranges 2–12) in October (EGUCHI *et al.* 1993). The difference between two areas may be due to a difference in species richness; i.e. 24 species of passerines living in Ampijoroa and 33 species in Andasibe (NAGATA *et al.* unpubl.). The Blue Vanga, Madagascar Paradise Flycatcher, Crested Drongo, and Common Newtonia were observed in more than 50% of 25 flocks (Table 1). In most cases, one or two individuals of any given species joined mixed-species flocks. For the Crested Drongo, Common Newtonia, Common Jery and Blue Vanga, however, four or five conspecific individuals were observed in mixed-species flocks.

Mixed-species flocks comprise two different types of participants, nuclear species and attendant species, according to the regularity of participation and their roles in maintaining flock cohesion, e.g. uttering a contact call (MOYNIHAN 1962). In Andasibe, the Madagascar White-eye and Common Newtonia were nuclear species; 79% of the mixed-species flocks observed in-

Table 1. Species joining mixed-species flocks in Ampijoroa, Madagascar

Species ¹	No. of observations ²			Mean number of individuals
	Joining	Away	Total	
Blue Vanga	15	1	16	2.1
<i>Cyanolanius madagascariensis</i>				
Madagascar Paradise Flycatcher	15	1	16	1.6
<i>Terpsiphone mutata</i>				
Crested Drongo	14	1	15	1.9
<i>Dicrurus forficatus</i>				
Common Newtonia	14	1	15	3.3
<i>Newtonia brunneicauda</i>				
Long-billed Greenbul	12	4	16	2.3
<i>Phyllastrephus madagascariensis</i>				
Rufous Vanga	8	9	17	2.7
<i>Schetba rufa</i>				
Ashy Cuckoo Shrike	7	2	9	1.8
<i>Coracina cinerea</i>				
Common Jery	6	3	9	2.3
<i>Neomixis tenella</i>				
Spectacled Greenbul	5	1	6	1.5
<i>Phyllastrephus zosterops</i>				
Crested Coua	4	1	5	—
<i>Coua cristata</i>				
Total number of flocks	25	—	—	—

¹ Madagascar Bulbul *Hypsipetes madagascariensis*, Sickie-billed Vanga *Falculea palliata*, Souimanga Sunbirds *Nectarinia souimanga*, Van Dam's Vanga *Xenopirostris damii*, Madagascar Magpie Robin *Copsychus albospectularis*, Madagascar White-eye *Zosterops maderaspatana*, Cuckoo-roller *Leptosomus discolor*, and Hoopoe *Upupa epops* were observed joining in mixed-species flocks once or twice.

² "joining"=observed in mixed-species flocks, "away"=observed as solitary or in single-species flocks.

cluded one or both of them (EGUCHI *et al.* 1993). In Ampijoroa, however, white-eyes were seldom observed joining mixed-species flocks. Instead, Blue Vanga seemed to play the role of nuclear species with Common Newtonia.

Among five species regularly occurred in the mixed-species flocks, Blue Vanga and Common Newtonia were foliage gleaners, Long-billed Greenbul was a trunk gleaner and Madagascar Paradise Flycatcher and Crested Drongo were hawkers (EGUCHI *et al.* 1993). For the Long-billed Greenbul, Blue Vanga and Ashy Cuckoo Shrike, foraging data were enough to compare between Ampijoroa and Andasibe. Although there were no significant differences in either foraging technique or foraging location between these two areas, foraging height was significantly lower for all species in Ampijoroa than in Andasibe ($P < 0.01$ in each species, χ^2 -test).

Most flock members foraged within 5 m above ground in Ampijoroa. In particular, the Madagascar Paradise Flycatcher and Crested Drongo often foraged in the undergrowth, though they were higher layer foragers in Andasibe (EGUCHI *et al.* 1993). It is likely that significant differences in foraging height were due to the difference between these areas in the average tree height.

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マダガスカル落葉広葉樹林に生息する鳥類の混群. マダガスカル西部地域、アンカラファンチカ自然保護区(アンピジュルア)の落葉広葉樹林に生息する鳥類の、非繁殖期の混群構成と採餌ニッチに関する調査を行った。生息する鳴禽類 24 種のうち、18 種が少なくとも 1 度は混群内で観察された。混群の平均構成種数は 4.4 種であった。ルリイロマダガスカルモズ、ニュートンヒタキ、マダガスカルサンコウチョウ、マダガスカルオウチュウ、テトラカヒヨドリの 5 種は混群で 頻度高く観察され、樹冠部つまみ捕り採餌、幹部つまみ捕り採餌、空中採餌のいずれかの採餌ニッチに属していた。ルリイロマダガスカルモズとニュートンヒタキは混群の中核種と考えられる。生息種数と混群構成種数ともに東部地域の降雨林より少なく、東部降雨林で中核種となっているマダガスカルメジロが少なかった。ルリイロマダガスカルモズ、テトラカヒヨドリ、マダガスカルオオサンショウクイの採餌ニッチを地域間で比較すると、植生内の採餌部位や採餌方法に違いはなかったが、採餌の高さはアンピジュルアの方が東部降雨林より有意に低かった。混群構成や採餌高さの違いは、両地域の森林構造の違いによると考えられる。——江口和洋・永田尚志・山岸哲

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