Mixed-Species Foraging Flocks of birds in rainforest at Kuranda, Queensland

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Abstract

Thirty Mixed-Species Foraging Flocks (MSFFs) of birds were observed in rainforest at Kuranda, Queensland in the period January 2013 through June 2015. The flocks comprised Nuclear, Regular and Occasional Attendants comprising four, eleven and five species respectively. The Nuclear species, Spectacled Monarch *Symposiachrus trivirgatus* and Pied Monarch *Arses kaupi* (Monarchidae), Fairy Gerygone *Gerygone palpebrosa* and Large-billed Scrubwren *Sericornis magnirostris* (Acanthizidae), were insectivores less than 20 g in weight; one or more of these was present in every MSFF observed. The mean number of species in flocks was 6.93±2.24 SD (range 2–11). More flocks were observed in the Dry Season (n=24) than the Wet Season (n=6). Equal numbers of flocks were observed in the morning and afternoon but none after 1700 hours. The findings are compared with those from other studies in the region and opportunities for further studies of MSFFs in the Australian tropics are discussed.

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Introduction

Mixed-Species Flocks (MSF) are 'a group of two or more birds of different species whose formation depended on positive responses towards each other' (Earle 1983). Mixed-Species Foraging Flocks (MSFFs) are distinguished from mixed-species assemblages by presence at stationary food sources, e.g. fruiting trees, or moving ones such as army ant attendant flocks (*sensu* Powell 1985). MSFFs have been documented from habitats worldwide (see Farley *et al*. 2008; Sridhar *et al*. 2009, Goodale & Beauchamp 2010, and references there-in) with preponderance from the Neotropics (e.g. Moynihan 1962; Munn & Terborgh 1979; Powell 1979; Terborgh 1990; Terborgh *et al.* 1990; Marín-Gómez & Arbeláez-Cortés 2015). Bird-watchers, particularly in the tropics, know the passage of MSFFs as 'bird waves' and the number and diversity of species in them contrasts with otherwise quiet periods of avian activity. The value of a bird joining MSFFs is posited to increase the likelihood of fully utilizing an available food source for all species and additional opportunities for feeding by the associated gleaning and predator species (Terborgh 1990, 1992; Greenberg 2000; Sridhar *et al.* 2009). In addition, members of the flock profit from the presence of sentinels from one or more species and thus can attend more intently to feeding activities (Moynihan 1962; Morse 1977; Thiollay 1999; Sridhar *et al.* 2009).

A review of the literature reveals few studies of mixed-species foraging flocks in Australia (e.g. Gannon 1934; Sedgewick 1949; Bell 1980; Davis & Recher 2002) and even fewer in rainforests in the Wet Tropics bioregion (e.g. Crome 1978; Vanderduys *et al*. 2012). In their study of 335 mixed-species bird flocks in northern Australian savannas Vanderduys *et al*. (2012) included 11 reports from the Wet Tropics; the species lists in

Appendix A of their paper suggest they were in the drier western margins of the bioregion. Here we report on a case study of MSFF in rainforest in north Queensland intended to stimulate further inquiry into this topic.

The questions we asked were (1) what is the composition of MSFFs in Wet Tropics of Queensland rainforest? (2) what are the feeding strategies of species in flocks? (3) are there distinct groupings of species in flocks? and (4) how do the flocks compare with those in similar habitat in the South East Asian-Australasian tropics?

Methods

Details were recorded of MSFFs of birds passing through Regional Ecosystem 7.11.1 *Notophyll vine forest on metamorphics of moderate fertility of moist and wet lowlands and foothills* (REDD 2015) at 375 m in the McAlister Range at 16°48'50"S 145°38'45"E near Kuranda, Queensland. The forest is degraded with senescing emergent *Acacia* species and canopy thinning due to local clearing and the effects of wind throw during cyclones. The site has a monsoon climate with a Wet Season (mean ≥150 mm per month) in December through April, an Austral Winter Dry Season, and a mean±1 SD Annual Rainfall of 2120±730 mm (100 years) (BOM 2015). Thirty observations were made, using 10x40 binoculars from a 3 m high verandah, of flocks passing through a 50 x 20 m section of rainforest in the period January 2013 through June 2015. The time of day, and composition and duration of transit of the flocks, was recorded. The number of birds of a species and total number of birds in a flock was not recorded. On the basis of these observations, species in flocks were assigned to groups i.e. Nuclear ('those whose behaviour appears to influence the formation and cohesion of MSFF'), Regular Attendants ('any species that associates with a flock on a frequency basis of >10% birds seen'), and Occasional Attendants, *sensu* Bell (1983) modified from Moynihan (1962) (see also Farley *et al*. 2008, for a summary). Due to difficulties in distinguishing between Yellow-spotted Honeyeater *Meliphaga notata* and Graceful Honeyeater *M. gracilis* in flocks, and as a result of numerous observations by us indicating that most birds at the study site were the former, for purpose of analysis we ascribed both to Yellow-spotted Honeyeater. A Cluster Analysis using Ward's Method was conducted using R (R Core Team 2015) to map associations of species in flocks. This method minimizes variation within a cluster; birds that occur most frequently together cluster together and those less frequently occurring together form different clusters. Clusters merge to achieve minimum variability within each new cluster in an iterative process until all species are united. The results of the study were compared with those of others in rainforest in the South East Asian-Australasian tropics.

Results

Twenty species were recorded in 30 MSFFs (Table 1). Four species were Nuclear, eleven were Regular Attendants, and five were Occasional Attendants. The mean (±1 SD) number of species in flocks was 6.93±2.24 (range 2–11) (Table 2). The Cluster Analysis shows four distinct clusters in MSFFs (Fig. 1); it demonstrates the presence of two Nuclear species, the Spectacled Monarch *Symposiachrus trivirgatus* and the Pied Monarch *Arses kaupi* (Monarchidae) in the highest hierarchical cluster (Group 1, Fig. 1), and the flocking insectivorous Fairy Gerygone *Gerygone palpebrosa* and Large-billed Scrubwren *Sericornis magnirostris*, both Acanthizidae, in Group 2 and Group 3 clusters respectively (Fig. 1). Group 4 contains those species that are Occasional Attendants in MSFFs. The average (±1 SD) time for passage of an MSFF through the survey area was 15±2.12 (range 12–21) minutes. More flocks were observed in the Dry Season (24, 80%) than the Wet Season (6, 20%). There was no difference in the number of species in flocks in Wet and Dry Seasons but the number of observations is too low for statistical analysis. Equal numbers of flocks were observed in the morning and afternoon but none after 1700 hours.

Nuclear species

These were all small (<20 g) insectivores. Spectacled Monarch occurred in 80% of flocks, and Pied Monarch in 66.7% of flocks; these two species co-occurred in 60% of flocks. The distinctive call of the Pied Monarch attracted other species to flock with it. Fairy Gerygone and Large-billed Scrubwren were present in 21 (63%) of flocks; they co-occurred in just one. One or more Nuclear species was present in every MSFF observed (Table 3). All four Nuclear species co-occurred in just one of the 30 flocks observed.

Table 1. Species in Mixed-Species Foraging Flocks of birds at Kuranda, Queensland.

Species	Family	% of flocks	Length* (cm)	Weight* (gm)	Habit	Social Organisation
Nuclear						
Spectacled Monarch *Symposiachrus trivirgatus*	Monarchidae	80.0	15–16.5	11.5	Insectivore	Small groups
Pied Monarch *Arses kaupi*	Monarchidae	66.7	14–15	13.5	Insectivore	Single, small groups
Fairy Gerygone *Gerygone palpebrosa*	Acanthizidae	40.0	10–11	8.0	Insectivore	Flocks
Large-billed Scrubwren *Sericornis magnirostris*	Acanthizidae	33.3	12–13	10.0	Insectivore	Flocks
Regular						
Little Shrike-thrush *Colluricincla megarhyncha*	Pachycephalidae	66.7	17–19	34.5	Omnivore	Single, pairs
Yellow-spotted Honeyeater *Meliphaga notata*	Meliphagidae	50.0	17–19	26.0	Omnivore	Single, small groups
Rufous Fantail *Rhipidura rufifrons*	Monarchidae	46.7	15–16	10.0	Insectivore	Single, pairs
Grey Whistler *Pachycephala simplex*	Pachycephalidae	40.0	14–15	17.5	Omnivore	Single
Grey Fantail *Rhipidura fuliginosa*	Monarchidae	36.7	14–17	8.0	Insectivore	Single, pairs
Macleay's Honeyeater *Xanthotis macleayana*	Meliphagidae	36.7	19–21	32.0	Omnivore	Single, small groups
Yellow-breasted Boatbill *Machaerirhynchus flaviventer*	Monarchidae	33.0	11–12	10.0	Insectivore	Single, pairs
Silvereye *Zosterops lateralis*	Zosteropidae	30.0	11–13	11.0	Omnivore	Flocks
Pale-yellow Robin *Tregellasia capito*	Petroicidae	30.0	12–13.5	14.0	Insectivore	Single, pairs
Dusky Honeyeater *Myzomela obscura*	Meliphagidae	23.3	12–15	13.0	Omnivore	Pairs, small groups
Victoria's Riflebird *Ptiloris victoriae*	Paradisaeidae	23.3	23–25	♀ 86 ♂105	Omnivore	Single
Occasional						
Leaden Flycatcher *Myiagra rubecula*	Monarchidae	10.0	15–16	12.0	Insectivore	Single, pairs
Black-faced Monarch *Monarcha melanopsis*	Monarchidae	10.0	16–20	23.0	Insectivore	Single
Spotted Catbird *Ailuroedus melanotis*	Ptilonorhynchidae	10.0	28–32	♀169 ♂180	Omnivore	Single, pairs
Mistletoebird *Dicaeum hirundinaceum*	Dicaeidae	6.7	10–11	9.0	Frugivore	Single
Varied Triller *Lalage leucomela*	Campephagidae	3.3	18–20	33.0	Omnivore	Single, pairs

***** Length and Weight data from HANZAB (Higgins *et al*. 2001, 2002, 2006a,b).

Table 2. Number of species in 30 Mixed-Species Foraging Flocks of birds at Kuranda, Queensland.

No of species	2	3	4	5	6	7	8	9	10	11
No of flocks	2	-	3	2	3	8	4	5	2	1
% of flocks	6.7	-	10	6.7	10	26.7	13.3	16.7	6.7	3.3

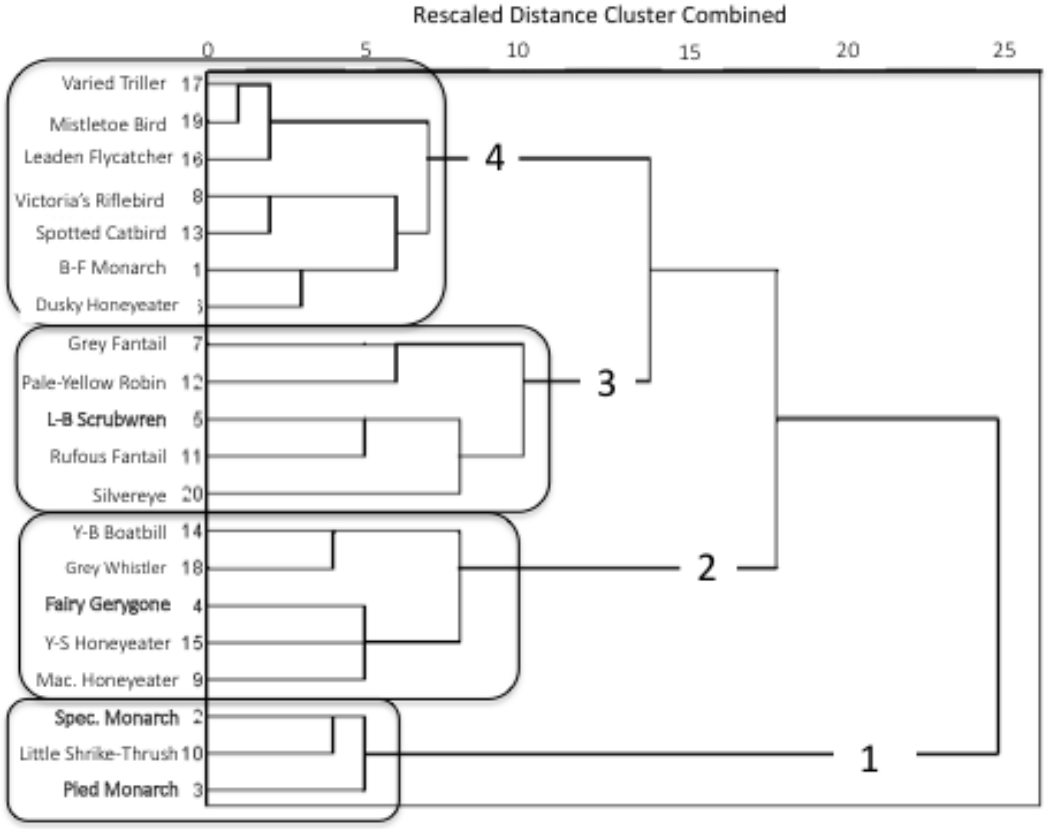

Figure 1. Dendrogram using Ward's Cluster Analysis showing hierarchical clusters of species of birds in Mixed-Species Foraging Flocks in rainforest at Kuranda, Queensland. Nuclear species names in bold.

Table 3. The number of Nuclear species of birds in 30 Mixed-Species Foraging Flocks in rainforest at Kuranda, Queensland.

No of species	1	2	3	4
No of flocks	6	13	10	1
% of flocks	20	43.3	33.3	3.3

Regular Attendant species

These comprised seven omnivore and four insectivore species, with the Silvereye *Zosterops lateralis* the only regularly flocking species in this category. This species was frequently present in the canopy but did not often join MSFFs at the study site. The honeyeater species were from three genera and despite all being omnivores to varying degrees differ markedly in weight (Table 1) and feeding strategy. The Dusky Honeyeater *Myzomela obscura* often feeds in the upper storey and takes nectar from flowers and insects, often hovering or darting out to take them. The Macleay's

Honeyeater *Xanthotis macleayana* most often works in the mid-storey and gleans insects and spiders from the foliage and epiphytes and particularly from clumps of dead leaves, it is a methodical worker and its activities can often be heard before the bird is sighted. The Yellow-spotted Honeyeater is more of a generalist, working in mid- and lower-storey, feeding on nectar, fruit, and frequently sallies forth to take insects on the wing. The Little Shrike-thrush *Colluricincla megarhyncha* and Pale-Yellow Robin *Tregellasia capito* are breeding residents in the survey area and participated in MSFFs only while present in their home range. Victoria's Riflebird *Ptiloris victoriae* observed in MSFFs gleaned insects from tree trunks and branches and leaf bases of Scrub Breadfruit *Benstonea monticola* (Pandanaceae) and were often heard before they were seen. Adult male Victoria's Riflebirds were not observed in MSFFs, despite being frequently seen at the site.

Occasional Attendant species

The five species comprised two insectivores, two omnivores and one specialist frugivore, the Mistletoebird *Dicaeum hirundinaceum*; all occurred in MSFFs as singletons or pairs. The Mistletoe Bird and Spotted Catbird *Ailuroedus melanotis* are breeding residents in the survey area and participated in the MSFF only while the flock was in their home range.

Interspecies aggression

Three incidents of interspecies aggression were observed between Little Shrike-thrush, Pale-yellow Robin, and Large-billed Scrubwren when they came into close proximity, usually on the ground. The incidents came to an end when the MSFF, including the Scrubwren, moved on and the Shrike-thrush and Robin remained in their respective territories.

Predation of flock members

No predation by raptors or other predatory species, e.g. the Black Butcherbird *Cracticus quoyi*, of MSFF members was observed during the study.

Discussion

The results in this study parallel those of studies in similar rainforest habitat in the South East Asian-Australasian tropics, e.g. Bell (1983) in Papua New Guinea, McClure (1967) in Peninsular Malaysia, Croxall (1976) in Sarawak (Table 4). This is based on the average number of species, the dominant feeding regime, i.e. insectivory, and average size and weight of nuclear species in a flock; flocks dissipating in the late afternoon was also a common feature.

On the basis of constituent species, habitat and climate, MSFFs at the study site are similar to the Small Insectivore Alliance (SIA), one of two mixed-species alliances in lowland rainforest at Brown River, Papua New Guinea described by Bell (1983). Sixteen species in the SIA also occur at the Kuranda study site and 10 of them were in MSFFs at both. The Nuclear species at both sites are similar sized small insectivores <20 g in weight. Species in the Acanthizidae are the dominant Nuclear species in MSFFs in temperate Australia (Gannon 1934; Bell 1980) and in tropical rainforest at Brown River (Bell 1983), but Monarch species were dominant more often in this study. Bell (1983) observed that 'the changes in vertical distribution of species when they joined MSF were to be expected as these have been well documented in other studies (e.g. Morse 1970; Pearson 1971; Wiley 1980)'. In this study Leaden Flycatcher *Myiagra rubecula*, Varied Triller *Lalage leucomela,* and sometimes Silvereye, came down from higher levels in response to presence of a MSFF. Bell (1980) did not observe the Leaden Flycatcher in mixed-species feeding flocks in his study at Black Mountain in the Australian Capital Territory, whereas Vanderduys *et al*. (2012) found it in MSFFs and significantly so in the presence of White–bellied Cuckoo-shrike *Coracina papuensis*, a species resident in Kuranda but not observed by us in MSFFs there.

The presence of Grey Fantail *Rhipidura fuliginosa* and Rufous Fantail *R. rufifrons* in MSFFs at the study site varied by season. Ninety three percent of MSFFs in the Dry Season contained fantails; at this time Grey Fantail migrate from cooler conditions in the south and Rufous Fantail from cooler conditions at higher altitude; both species were present only rarely in MSSFs in the Wet Season. Rufous Fantail were particularly obvious when they took insects disturbed by Pied Monarch working on tree trunks and branches, in contrast to Grey Fantail, which sallied out further and higher in pursuit of insects. This behaviour parallels that observed by Crome (1978) for those species in his study of bird assemblages in lowland mesophyll vine forest at Lacey's Creek, North Queensland.

Table 4. Comparative data for Mixed-Species Foraging Flocks in rainforest in South East Asia and Australasia.

Author	Date	Location	Elevation (m)	Habitat*	Mean no (±SD) of species in a flock
Bell HL	1983	Brown River, Papua New Guinea	*c.* 40	RF	3.42±1.19
McClure HE	1967	Subang, Selangor, Peninsular Malaysia	40	RF	11.0
		Mile 13, Selangor, Peninsular Malaysia	15-300	RF	7.6
		Sumego, Selangor, Peninsular Malaysia	120	2°RF	8.3±1.0
Croxall JP	1976	Bako, Sarawak	*c.* 150	RF	11.2±2.1
		Semengo Forest Reserve, Sarawak	*c.* 50	1°RF	11.3±1.2
		Semengo Regrowth	*c.* 50	2°RF	8.3±1
Wilson GW & Wilson RF	2018 (this study)	Kuranda	375	Disturbed RF	6.93±2.24

* RF = rainforest; 1°RF = primary rainforest; 2°RF = secondary rainforest

Our observations show Victoria's Riflebird, even when foraging, are initially independent of MSFFs and join them as the flock aggregates. On several occasions an uncoloured Victoria's Riflebird was seen to join a flock as it aggregated around a Spectacled Monarch or Pied Monarch. Forshaw (in Cooper & Forshaw 1977) notes female Victoria's Riflebird don't maintain territories and thus are free to move with flocks. In contrast, male birds are territorial and spend time and effort maintaining and defending their territory. These behaviours accord with our findings.

The Black-faced Monarch *Monarcha melanopsis* was observed in three MSFF, each time as a singleton adult in the Wet Season, and always in company with Spectacled Monarch. The Black-faced Monarch is almost twice the weight of the Spectacled Monarch and its sedate gleaning behaviour contrasts with that of the smaller and lighter Spectacled Monarch, which is more active and tends to sally after prey more often. An interesting parallel is the presence of the Black-faced Monarch in MSFFs in the Wet Tropics and at Brown River, in PNG. With few exceptions, the Black-faced Monarch is present when the Pied Monarch (Wet Tropics) and the Frilled Monarch *Arses telescopthalmus* (Brown River) are absent. The Pied Monarch and the Frilled Monarch are similar in colour, weight, size and habit, and occupy a similar niche in the two locations. Bell (1983) found the Black-faced Monarch a winter migrant Nuclear species in MSFFs at Brown River. The data in this study are too few to determine if the Black-faced Monarch is a Nuclear component of MSFFs at Kuranda; however, 16 additional observations of this species at the study site (Wilson & Wilson, unpub. data) do not support this hypothesis.

The Spotted Catbird, an Occasional Attendant in MSFF, is a breeding resident at the study site. Forshaw (in Cooper & Forshaw 1977, p219) noted that it takes eggs and nestlings to eat or to feed to their young; Frith and Frith (2004, p241) note they 'never saw them eating prey nestlings'. Menkhorst *et al*. (2017) note that Spotted Catbird take bird nestlings. Bell (1983) observed White-eared Catbird *Ailuroedus buccoides* taking nestlings at Brown River, PNG but did not record this species or the co-occurring Spotted Catbird in either of the two MSFF alliances there. However, Eastwood (1996), cited in Frith & Frith (2008), presents a second-hand report of a Spotted Catbird (sic) with Western Parotia *Parotia sefilata* in a feeding flock in Irian Jaya. In February 2013, we observed a Spotted Catbird attempt to predate a male Olive-

backed Sunbird *Nectorinia jugularis* at the study site. We suggest the Spotted Catbird is involved in MSFF in Kuranda as a generalist omnivore and opportunistic predator.

Two species not recorded in MSFFs but present at the study site warrant discussion here. The Black Butcherbird *Cracticus quoyi* (38–44 cm, 180 g) is a predator and breeding resident. Observations by us (Wilson & Wilson, unpublished data) suggest it trails flocks through the understorey, presumably in order to predate members of it. Bell (1983) observed it taking nestlings at Brown River, PNG but did not record it in MSFF there. When in the vicinity of MSFFs the Black Butcherbird appears to elicit less mobbing behaviour or alarm calling from other species than at other times. This supports the suggestion, e.g. by Sridhar *et al*. (2009), that being in a MSFF profits members by the presence of sentinels from one or more species and thus allows them to attend more intently to feeding activities. The Spangled Drongo *Dicrurus bracteatus* (28–32 cm, 82 g) is a seasonal breeding resident and was observed to alert flocks to the presence of Pacific Baza *Aviceda subcristata,* Accipitridae. Bell (1983) found it a Regular Attendant species and main 'sentinel' of the Babbler/Pitohui Alliance at Brown River, PNG, and McClure (1967) found a species of Drongo, usually as a Nuclear component, in every MSSF observed in Sarawak. In each case one or more species of Drongo was resident in each location. This contrasts with the seasonal presence of a single species, the Spangled Drongo, in North Queensland rainforests and we suggest more careful study of the association and possible involvement of them with MSFFs there is warranted.

Our results suggest there is much to learn about and opportunities for further studies of MSFFs in Australian tropical rainforests. For example, do one or two alliances occur on Cape York and if so, what are their components? Is the Spangled Drongo involved in any MSFFs on Cape York? If two alliances do occur, do they sort by weight, as Bell (1983) found at Brown River.

The findings reported here should be considered in the knowledge that composition of MSFFs change with location and altitude. For example, Bell (1983) noted differences in the Babbler/Pitohui Alliance at Brown River (*c.* 30 m) and the nearby Sogeri Plateau (*c.* 500 m) in PNG. It is likely further studies in the Australian Wet Tropics, particularly across altitude, will reveal similar variation. The results of those studies should enhance our understanding of the attributes of flocks and the characteristics that lead to their formation.

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