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Yellow Wattlebirds *Anthochaera paradoxa* may conserve energy through targeted aggression

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Aggression in honeyeaters is thought to be important in both their own social organisation and the homogenization/composition of avian assemblages. Honeyeater agonistic behaviour is considered complex, but imperfectly understood. This study explored interspecific aggression by Yellow Wattlebirds, *Anthochaera paradoxa* at a flowering Coral Tree, *Erythrina variegata* which provided them with a rich nectar source. Yellow Wattlebirds responded to the presence of other birds in a targeted way. Their aggression was structured such that it resulted in effective defence of a rich nectar source while avoiding wasting energy by attacking only the largest groups of Silvereyes, *Zosterops lateralis* in the tree rather than many individuals independently; this nearly always resulted in clearing the tree of all the Silvereyes present. Yellow Wattlebirds did not attack non-nectarivorous species in the Coral Tree or nectarivorous species outside it.

Keywords: honeyeaters, agonistic behaviour, interspecific aggression, nectarivorous, flock flight initiation.

INTRODUCTION

Honeyeaters (Meliphagidae) are frequently and somewhat uncritically described as being aggressive. Thus, they have been described as 'pugnacious' (Longmore 1991; Higgins *et al*. 2001) or 'boisterous', with aggressive behaviour being very common (Higgins *et al*. 2008). The more prominent, well-known and frequent examples of aggression pointed out are those performed by the Miners, *Manorina* spp. (Fulton 2008; Kutt *et al*. 2012). The Noisy Miner, *M. melanocephala,* particularly, is frequently referred to by the anthropomorphic and emotional term 'despotic' (e.g. Mac Nally *et al*. 2012; Maron *et al*. 2013), a label that has now also been extended to the Bell Miner, *M. melanophrys* (Lambert and Leishman 2020). However, the use of such colourful and emotional terms does not accurately reflect the complex array of agonistic behaviours exhibited by various honeyeater species.

Honeyeater aggression ranges from simple supplanting to aggressive chasing away of rivals from food sources (McFarland 1985, 1986). It occurs mainly in two contexts. Firstly, many honeyeaters aggressively defend resources territorially against con- and heterospecifics (Higgins *et al*. 2008). This territorial aggression can differ between seasons, with possibly more interspecific aggression occurring during breeding, particularly in species with semi-colonial breeding dispersions (McFarland 1986; Higgins *et al*. 2008). Whether territorial defence of a nectar resource is an optimal strategy probably depends on the resource's abundance and spatial dispersion, and on the level of interspecific and intraspecific competition it generates (Carpenter and MacMillen 1976). Secondly, many different honeyeater species aggregate at profuse flowering events where intra- and interspecific aggressive interactions commonly occur (Beehler 1980; Higgins *et al*. 2008). Larger species sometimes dominate smaller ones in such aggregations (Terborgh and Diamond 1970; Ford 1979; Beehler 1980), but this may depend on flowering intensity (Mac Nally and Timewell 2005). Further agonistic complexity is evident in miners, which have formed beneficial associations in aggressively defending territories with at least two butcherbird species, the Grey Butcherbird, *Cracticus torquatus* and the Pied Butcherbird, *C. nigrogularis* (Loyn 2002; Fulton 2008; Maron 2009). Honeyeater aggression is also evident in the mobbing of predators (Smith and Roberson 1978; Loyn *et* al. 1983; Fulton 2010) and conceivably is also manifested sometimes in acts of nest predation (Fulton 2019). From this overview, it is apparent that aggression occurs in several contexts and for many reasons among honeyeaters.

Against the backdrop of these varied findings on honeyeater aggression, I undertook a study on an interesting instance of aggression in the Yellow Wattlebird, *Anthochaera paradoxa*. Yellow Wattlebirds were observed taking nectar and aggressively interacting with the somewhat nectarivorous and much smaller Silvereye, *Zosterops lateralis* in a flowering Coral Tree, *Erythrina variegata*. Yellow Wattlebirds are large honeyeaters endemic to Tasmania. Coral Trees are deciduous and belong to the pea family (Fabaceae); they are native to tropical parts of Australia, Asia and East Africa, but often planted in gardens in temperate areas, including Tasmania. While observing the aggressive attacks by the wattlebirds, I detected a pattern in which all the Silvereyes in the tree usually departed *en masse* when a wattlebird initiated an attack. On further observation, I surmised that the Yellow Wattlebirds might be selectively attacking the largest group of Silvereyes in the tree, initiating a flight response by that group which in turn stimulated all the Silvereyes in the tree to leave. Therefore, I hypothesized that the Yellow Wattlebirds' attacks were non-random and entailed the least effort needed to clear the tree of Silvereyes. To test this hypothesis, I visually divided the tree into five equal sections. If the Yellow Wattlebirds entered the sections equally, then each section should be visited 20% of the time. I established the null hypothesis that Yellow Wattlebirds would attack Silvereyes in each section of the tree equally and randomly, the alternative hypothesis being that their attacks would be non-random and not equally distributed throughout the tree. I considered from observation that Silvereyes were equally present in the various sections of the tree over time. If the null hypothesis was rejected because the wattlebirds always attacked the largest Silvereye group, it could indicate a 'deliberate choice' on their part (perhaps having learned that all Silvereyes in the tree would be dispersed) or alternatively simply be an inherent response to the largest Silvereye group.

METHODS

Study site and species

The study was conducted in the Royal Tasmanian Botanical Gardens, Hobart, over 13 hours, on the 27th and 28th November 2019. The Gardens cover an area of 14 ha (RTBG 2016). However, native forest and woodland of approximately twice that area, known as the Queens Domain, adjoins the Gardens, increasing the overall area of forested habitat. The site was chosen because Yellow Wattlebirds were observed defending a single flowering Coral Tree at 42°51'54.0"S 147°19'46.8"E. The tree was observed from a vantage-point that provided an unobstructed view of the whole tree and the entire tree was in flower. In this species flowering occurs before leaf emergence (Kumari and Kumari 2017) and the lack of leaves enabled unobstructed observations of bird interactions throughout the tree's crown. Bird species' masse, length and scientific name are given in Table 1.

Observations

Observations were made with the naked eye and binoculars when required, with the observer positioned approximately 20m from the centre of the Coral Tree. All birds attending the tree were noted. The Coral Tree crown was visually divided into five approximately equal sections: north, south, east, west and top. Five sections were chosen because they were easy to visualise and delineate, given the form of the tree. Additionally, the inflorescences appeared to be approximately evenly spread through each section of the tree, notionally making the expected chance of birds being in any one section approximately even. As the Silvereyes gradually entered the tree crown from the surrounding vegetation, all tree sections were observed simultaneously to track the relative abundances of the birds.

Data analysis

Visual division of the tree into five sections meant that the locations of Yellow Wattlebird attacks could be compared with the locations of the greatest abundances of Silvereyes. This method created a simple 20% expectation that the wattlebirds might attack the section where the greatest abundance of Silvereyes occurred on each occasion. A simple likelihood measure was used to determine if the Yellow Wattlebirds attacked randomly or non-randomly.

RESULTS

A total of 36 attacks by Yellow Wattlebirds on Silvereyes was recorded; of these, 35 were directed toward the largest group of Silvereyes in the tree (Table 2). The likelihood of this occurring at random was $(0.2)^{35} = 3.4 \times 10^{-25}$, a number closely approaching zero. Thus, the attacks were not made at random.

Table 1

Species of birds observed in a flowering Coral Tree and the number of times each was attacked by Yellow Wattlebirds. Presence is given as the number of one hourly periods in which a species was present in the 13-hour survey; it is not a measurement of the total time a species spent in the study tree. Mass (g) is after Dunning (2008) and length (cm) is after Slater *et al.* (1991). Note: Eastern Rosellas are primarily granivorous and the House Sparrow may consume nectar on occasions.

Species	Mass	Length	Presence	Attacks	Nectarivorous
Yellow Wattlebird	168	48	13	N/A	yes
Silvereye	11.8	12	13	36	yes
Little Wattlebird	71.2	28	1	2	yes
Eastern Rosella	104	30	1	1	yes, partly
Grey Fantail	8	16	13	0	no
Spotted Dove	159	25.2	1	0	no
House Sparrow	28	15	1	0	no

Yellow Wattlebirds did not attack Silvereyes outside the Coral Tree, although Silvereyes were present in the immediately surrounding vegetation. A mean of 12.4 Silvereyes (range 3 – 40) was recorded in the tree per hour in hourly estimates. Other bird species visited the study tree, but not all were attacked (Table 1). The attacks against the Little Wattlebird, *Anthochaera chrysoptera* and Eastern Rosella, *Platycercus eximius* were more aggressive than those against Silvereyes and made directly toward the target, with contact being made with the Little Wattlebird. Yellow Wattlebirds attended the tree another 22 times to consume nectar when no Silvereyes or other nectarivorous bird species were present. Intraspecific aggression between the two individually recognizable Yellow Wattlebirds that visited the tree was also recorded five times.

Only two Yellow Wattlebirds were responsible for all observed attacks on Silvereyes. As a Yellow Wattlebird arrived in the tree, the Silvereyes present would leave that section, and this in turn was rapidly followed by a mass exodus of all Silvereyes from the tree. Silvereyes would re-enter the study tree in ones and twos, gradually building in numbers until they were chased away again. Aggressive approaches by Yellow Wattlebirds were made by gliding into the tree from a higher point in the surrounding canopy.

DISCUSSION

The null hypothesis that Yellow Wattlebirds attacked Silvereyes randomly and in doing so flew to all sections of the Coral Tree equally was rejected. Yellow Wattlebirds overwhelmingly flew to the location where the largest group of Silvereyes was present, which caused most or all Silvereyes to leave the tree. Roberts (1997) reported that the more Sanderlings, *Calidris alba* that were initially disturbed (by unknown causes or people and dogs) and took flight, the more complete the departure by the flock; conversely, fewer birds taking flight initially resulted in fewer birds departing

Table 2

Position of Silvereyes in the Coral Tree and Yellow Wattlebird attack summary. Asterisks (*) indicate that more Silvereyes were in this section(s) of the tree when attacked. The tree section that the Yellow Wattlebirds attacked is given in the 'attack to' column. If this matched with the section with the most nectarivorous birds at the time, a 'yes' is shown in the 'max y/n' column. The double entry in the 'attack to' column is given because two Yellow Wattlebirds arrived simultaneously in different sections of the tree.The two-species entry, '2ER+SE', represents an occasion when two Eastern Rosellas and one Silvereye were attacked simultaneously in the same section. The 1LWB entry in the 'South' column is a single Little Wattlebird. On one occasion (17:45, 28/11/2019) the greatest number of Silvereyes were in two sections; in this case, the two Yellow Wattlebirds attacked both sections simultaneously. On another occasion, the Silvereyes were distributed equally throughout all five tree sections and thus all sections are marked with the greatest abundance; this attack was excluded from the analysis.

	Position and numbers of Silvereyes					Yellow Wattlebird	
Time	North	South	East	West	Top	attack to	max y/n
27/11/19							
15:20					*	top	yes
15:40	*					north	yes
16:10					*	top	yes
16:31				*		west	yes
16:50					*	top	yes
17:08		*				south	yes
17:10	*					north	yes
18:09		*LWB				south	yes
28/11/19							
8:43			*			east	yes
8:48				*		west	yes
8:59					*	top	yes
9:05		*				south	yes
9:13				*		west	yes
9:38	*	*	*	*	*	top	excluded
9:45					*	top	yes
10:25			*			west	no
10:40			*ER+SE			east	yes
10:57	*					north	yes
10:59					*	top	yes
11:12				*		west	yes
12:40				*		west	yes
12:55				*		west	yes
13:14				*		west	yes
14:05					*	top	yes
14:35					*	top	yes
15:04				*		west	yes
15:51				*		west	yes
16:01				*		west	yes
16:15		*				south	yes
16:24	*					north	yes
16:27			*			east	yes
17:12					*	top	yes
17:15				*		west	yes
17:30				*		west	yes
17:45				*	*	west & top	yes
17:53				*		west	yes
17:57				*		west	yes
18:15		*				south	yes
Totals	5	6	5	16	11		36y &1n

from the flock overall. Thus, Yellow Wattlebirds may have learned that attacks targeting larger groups were more likely to empty the tree of Silvereyes by initiating a greater flock flight-response. Alternatively, Yellow Wattlebirds may have simply responded to the stronger visual cue of the greater Silvereye density presented by the largest flock. Nonetheless, whether they were consciously aware of the likely outcome or not, the result was the same in that energy was presumably saved by not unnecessarily chasing individual birds or small groups.

The Yellow Wattlebirds' attacks were of low intensity or were simply spatial displacements through supplanting Silvereyes on branches. Only once or twice did a Yellow Wattlebird apparently lunge at a Silvereye and nearly catch it. In these instances, the Silvereye flock had not completely evacuated the tree, two or three individuals remained. In such cases, a Yellow Wattlebird flew to that particular section or branch and the remaining Silvereyes departed. This follow-up response was much more energetic, although the Yellow Wattlebirds made no attempt to chase the Silvereyes once they left the tree.

Yellow Wattlebirds' attacks on other nectarivorous bird species on two occasions were more direct than those on Silvereyes and clearly more aggressive. On the first occasion the attack was toward two Eastern Rosellas and on the second toward a Little Wattlebird. The latter was attacked immediately it arrived in the tree. The Yellow Wattlebird appeared to contact the Little Wattlebird, with both birds 'squawking' during the event, and the Little Wattlebird departed immediately. The Eastern Rosella and Little Wattlebird are both much larger than Silvereyes and presumably less easily intimidated. Eastern Rosellas are mainly seed-eaters, but sometimes consume nectar. The Grey Fantail, *Rhipidura albascapa* and the introduced Spotted Dove, *Streptopelia chinensis* and House Sparrow, *Passer domesticus* also entered the tree, the Grey Fantail frequently, but these species were not attacked. These species are not normally nectarivorous and the lack of aggression towards them possibly indicated that the Yellow Wattlebirds had learned that they posed no competitive threat. Alternatively, the wattlebirds might have been responding innately to subtle cues that indicate that these birds represent no competitive challenge.

Little has been reported on aggression by Yellow Wattlebirds. Published comments include that: they have the same restless disposition common to all honeyeaters (Gould 1865) and are noisy, active, conspicuous and aggressive (Higgins *et al*. 2001). They have been reported chasing a Black-headed Honeyeater, *Melithreptus affinis* (Higgins *et al*. 2001). In this study, Yellow Wattlebirds attacked Silvereyes by gliding down from the higher adjacent forest canopy to the Coral Tree. This flight mode probably conserved energy for the Yellow Wattlebird; this was especially important, as the Silvereyes continually returned to the tree after being evicted. The landing made at the end of the glide probably added to the Yellow Wattlebird's conspicuousness, as it opened its wings widely possibly making it appear larger to the Silvereyes. This action could have increased the Silvereye's fear, stimulating them to rapidly flee. All the above observations suggest that a complex array of decisions is involved in the Yellow Wattlebirds' responses to various bird species. Given that energy saving is important to fitness, it is unsurprising that non-nectarivorous birds were ignored by the Yellow Wattlebird. In contrast, the notoriously aggressive honeyeater, the Noisy Miner, aggressively targets bird species whose diet does not significantly overlap its own (Grey *et al*. 1998).

Conclusion

Although based on limited observations, the Yellow Wattlebirds' observed interspecific aggression was predictable in targeting those species whose diet overlapped with their own and not targeting introduced or native birds that represented no competitive foraging threat. Conceivably the wattlebirds made decisions about the targeting of aggression based on learning about the behaviour and competitive threat posed by other species, but this supposition requires further exploration. The Yellow Wattlebirds appeared to have adopted a resource-guarding strategy that used less energy to eliminate the smaller, more mobile and more numerous Silvereyes than one which relied on numerous individual confrontations. The null hypothesis that the defence of the nectar-rich Coral Tree was undertaken in an unordered manner was rejected in favour of the alternative that non-random, targeted defence of a resource was evident.

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