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DIURNAL AND SEASONAL CHANGES IN AGGRESSION IN A HONEYEATER COMMUNITY

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Aggression within a honeyeater community was examined on both diurnal and seasonal scales over a period of one year. Aggression was more common in the morning and afternoon than at midday. Honeyeaters were most abundant during the flowering of two banksias. Most aggressive interactions were recorded during these months. It is suggested that the level of aggression may be influenced seasonally, by honeyeater abundance, and diurnally, by changes in nectar availability.

The aim of this paper is to report and discuss the diurnal and seasonal trends in aggressive behaviour in a community of Australian honeyeaters (Meliphagidae). Studies that have recorded aggression within assemblies of nectarivorous birds have dealt primarily with hummingbirds (e.g. Feinsinger 1976, des Granges 1979). To date quantitative work on honeyeater aggression is minimal, which is unusual since multispecies communities are common in Australia (e.g. Ford and Paton 1977, Thomas 1980) and most species exhibit inter- and intraspecific aggression (Immelmann 1961).

In those papers that do comment on aggression within honeyeater communities (Ford 1979, Ford and Paton 1982) there has been little information given on what changes in aggression may occur during the day and in the course of the year. Such information is restricted to a few individual species (Paton 1979, Rooke 1979). This paper examines changes in aggression for a honeyeater community, as well as documenting the levels of inter- and intraspecific interaction among member species.

STUDY SITES AND METHODS

The study was carried out over one year (August 1981 to July 1982) in the New England National Park (30°30'S., 152°27'E.) which lies on the eastern escarpment of the Great Dividing Range in northern NSW. The vegetation is predominately dry sclerophyll forest comprising *Eucalyptus obliqua*, *E. radiata* and *E. viminalis*, with a dense understorey of proteaceous shrubs particularly *Banksia integrifolia* and *B. collina*. These two banksias were the main nectar sources during the study period.

Eleven species of honeyeater have been recorded in New England National Park (Kikkawa *et al.* 1965, pers. obs.). Of these, the New Holland Honeyeater *Phylidonyris novaehollandiae* (NHH), Eastern Spinebill *Acanthorhynchus tenuirostris* (ES), Red Wattlebird *Anthochaera carunculata* (RW) and Lewin's Honeyeater *Meliphaga lewinii* (LH) were regularly encountered for most of the year. Yellow-faced Honeyeaters *Lichenostomus chrysops* and White-naped Honeyeaters *Melithreptus lunatus* were only temporarily abundant migrants while

others such as Noisy Friarbirds *Philemon corniculatus* were rare visitors.

Each month a 1.2 km transect was walked twice at 0700, 1200 and 1600 hours. At points 75 m apart, five minutes was spent recording the numbers of all honeyeaters (of all species) in the vicinity and the number of aggressive interactions. Interactions were divided into two types: 'chases' where the fleeing bird was pursued beyond its point of departure, and 'displacements' where the attacker supplanted but did not follow the fleeing bird.

Diurnal changes in nectar availability were determined by sampling six inflorescences using capillary tubes at three times during the day. Sampling was done on one day during the flowering of each *Banksia* species.

RESULTS

During the course of the day the incidence of chasings and displacements changed in similar ways. The frequencies of each were highest in the morning and afternoon and lowest at midday (Table 1). This pattern was consistent in all months of the year (Figure 1). The diurnal trend in nectar standing crops is shown in Table 2. In both nectar samples there was no correlation mean nectar volume and the amount of aggression recorded on the transect made at the same time (*B. integrifolia* sample $r = 0.41$, *B. collina* sample $r = -0.19$, $n = 3$, $p > 0.05$ in both cases).

Seasonally, the levels of aggression were greatest during the times of peak honeyeater abundance, which coincided with the flowering of the banksias (Figure 1). At each time of day, as the number of honeyeaters in the area increased so too did the frequency of aggressive

TABLE 1

Total counts of all aggressive interactions at different times of day (all months combined).

Type of interaction	Time of day (hours)		
	0700	1200	1600
Chase	102	48	114
Displacement	120	65	104
Totals	222	113	218

TABLE 2

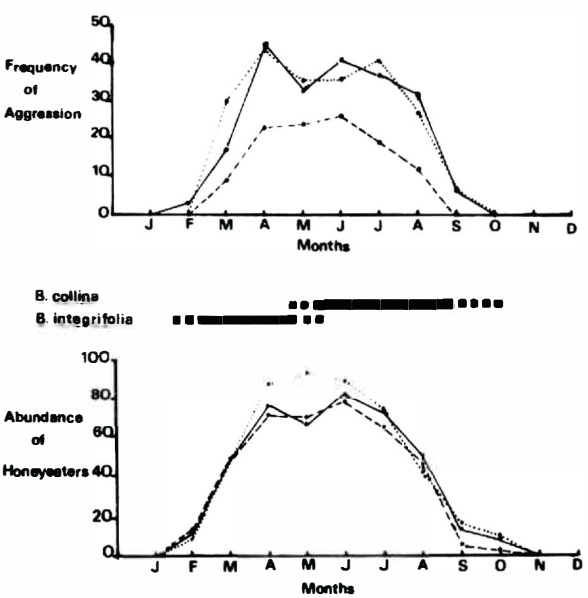
Mean standing crops of nectar (μl/inflorescence) at different times of the day.

Banksia species	Time of day (hours)		
	0700	1200	1600
B. integrifolia	685	150	0
B. collina	1 353	410	70

TABLE 3

Inter- and intraspecific aggression among the common honeyeater species (chases and displacements combined).

Species attacking	Mean weight	Species attacked			
		RW	LH	NHH	ES
RW	(126 g)	32	2	30	7
LH	(34 g)		5	—	11
NHH	(21 g)		9	284	157
ES	(12 g)				239



● Figure 1. *Frequency of honeyeater aggression (total per transect); flowering periods of the two* Banksia *species, and the abundance of honeyeaters in the area (mean total number of birds per transect). In both the aggression and abundance figures the following apply — dotted line: 0700 hours transect; dashed line: 1200 hours transect, and solid line: 1600 hours transect.*

acts (0700 hours, $r = 0.96$; 1200 hours, $r = 0.98$; 1600 hours, $r = 0.98$, $n = 12$ and $p<0.01$ in all cases).

Inter- and intraspecific aggression was noted among the four main honeyeater species present in the study area. In general, each species attacked only conspecifics and/or species smaller than themselves (Table 3). The only exception was the New Holland — Lewin's Honeyeater interaction, where the smaller New Hollands attacked the larger species on several occasions. Lewin's were never seen chasing or displacing New Hollands.

The New Holland Honeyeaters were the only species to consistently exhibit territoriality during the year (unpublished data). They were also the only species to breed in the area when banksias were in flower. Active nests were found in autumn (February to April) and in spring (July to September).

DISCUSSION

As there were no significant changes in either the number of honeyeaters seen during the day (Figure 1) or their activity (unpublished data), some other factor must be sought to explain the diurnal fluctuation in aggression. Although there was no significant relationship between the amount of aggression noted and nectar availability this does not preclude nectar availability from having an indirect effect on aggression. For example, during the course of the day changes in a bird's rate of energy intake, which will be influenced by the size of nectar standing crops, may ultimately affect the levels of certain hormones related to the expression of aggressive behaviour. Such an interactive pathway has been proposed in relation to the determination of the frequency and duration of foraging bouts by humingbirds (Hainsworth and Wolf 1979). More information is needed before an adequate explanation of the diurnal trend in honeyeater aggression could be attempted.

Studies of hummingbirds have revealed diurnal patterns in aggression that are similar (Gass 1978) to those found in the New England honeyeaters, or else the complete opposite (Stiles and Wolf 1970) with aggression most frequent at midday. Sunbirds appear to be most aggressive in the morning and least in the afternoon (Frost and Frost 1980), while Paton (1979) recorded little diurnal change in the aggression of New Hollands defending *B. marginata* inflorescences. Explanations, when given, were based on diurnal changes in nectar availability, bird numbers or the ability of the birds to detect each other.

Seasonal changes in the level of aggression follow the same pattern as that exhibited by honeyeater numbers. Although there is a correlation between the two factors, this does not necessarily mean that there is a cause and effect relationship. The increase in aggression may be a result of an increased frequency of encounter between birds, but alternatively it may be due to increased competition for food among the birds and has little to do with abundance *per se*.

In interspecific encounters, larger species tend to attack smaller species .Size-related dominance hierarchies have been recorded in communities of both captive (Tullis and Wooller 1981) and wild honeyeaters (Ford and Paton 1982). The attacks by New Hollands on the Lewin's Honeyeaters may be a case where differences in dominance between species is related to differences in dependency on nectar and not just size (Tullis and Wooller 1981). New Hollands appear to be more nectarivorous than the Lewin's (Pyke 1980).

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A SURVEY OF PELAGIC BIRDS IN THE WESTERN CORAL SEA AND GREAT BARRIER REEF

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Little is known of the distribution of seabirds in the Western Coral Sea, i.e. the area west of 155°E longitude and north of 25°S latitude nominated by Pickard *et al.* (1977). Most of the area is within the Coral Sea Islands Territory of Australia which extends west to 157°10′ longitude, north to 12° and south to 24° latitude.

Although Serventy (1959) summarised what is known of the birds of Willis Island, where there is a manned lighthouse, many of the small cays and islands have only been visited once by ornithologists, in 1961/1962 (Hindwood *et al.* 1963). In the winters of the same years Norris (1967) made the most comprehensive observations yet available on pelagic birds in the area.

The cays and islands in Figure 1 have automatic weather stations or lighthouse installations and have been surveyed at least once and usually twice per year since 1979 by the Australian National Parks and Wildlife Service (ANPWS) which is developing a nature conservation programme for the Coral Sea Islands Territory. The results discussed in this paper were obtained during the course of one survey.

THE SURVEY

We surveyed a section of the Coral Sea and Great Barrier Reef between 15 to 26 May 1981 (Figure 1). A total of 50 hours 45 minutes was spent on watch from the M.V. *Cape Pillar*.