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Bird Community Patterns in Fragmented Vegetation Zones Around Streambeds of the Northern Tablelands, New South Wales

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Summary

Bird counts were made at 39 plots from four open woodland sites, all within 200 m from a stream, near Armidale on the Northern Tablelands of New South Wales. Of three distinct vegetation zones, the riverine contained more bird individuals than the ecotone, which in turn contained more birds than the eucalypt woodland. More bird species were generally also found in the riverine zone. Three ecological guilds were identified according to the birds' foraging patterns. The two most abundant birds in the study area, the Fuscous Honeyeater *Lichenostomus fuscus* and the White-plumed Honeyeater *L. penicillatus*, attacked members of the foliage-gleaning guild more often than they did birds outside this guild. It is suggested that further fragmentation of the already narrow belts of the riverine and ecotone zones will increase interspecific competition for resources, resulting in the reduction of bird numbers and threatening the local survival of some species.

Introduction

The reduction of many bird populations has often been attributed to habitat degradation (Myers et al. 1987, Ford 1989, Terborgh 1989, Bibby 1992). Selective removal of vegetation causes habitat fragmentation, the implications of which have considerable worldwide interest (Diamond 1975, Simberloff & Abele 1982, Terborgh 1989). In Australia, the use of fragmented habitats by birds is an important conservation topic which has attracted interest in recent years (Keast et al. 1985, Saunders et al. 1987, Ford 1989).

Inland Australia is often affected by drought. A permanent stream is therefore an important source of fresh water to woodland birds. Furthermore, the lush riverine vegetation surrounding streambeds offers a greater diversity of food than that of woodland alone. Not surprisingly, large numbers of birds are commonly observed to frequent gully forests of woodland compared with adjacent ridges (Loyn 1985, P. Smith 1985). A localised edge community or ecotone may also be rich in species because it contains representatives from both parent (riverine and woodland) communities, and it may contain species unique to this ecotone itself (e.g. the rare Noisy Scrub-bird *Atrichornis clamosus*, G. T. Smith 1985).

The Northern Tablelands of New South Wales have been subjected to widespread grazing and cropping since the arrival of Europeans. Much of the region has been cleared, and only isolated fragments of the original woodland remain. Riverine belts have also been affected by clearing, and the once continuous riverine vegetation is now interrupted by grazed grasslands. The ecotone is even more fragmented, often being completely indistinguishable from the adjoining eucalypt woodland or grasslands. The resultant loss of habitats may directly affect bird communities. In the present study, I report the bird species and their abundance found in the riverine, the ecotone and the adjacent eucalypt woodland zones. The birds are then organised into foraging guilds and their interactive behaviour examined. The work was undertaken simultaneously with a study on the habitat selection of two honeyeater species, previously reported by Chan (1990).

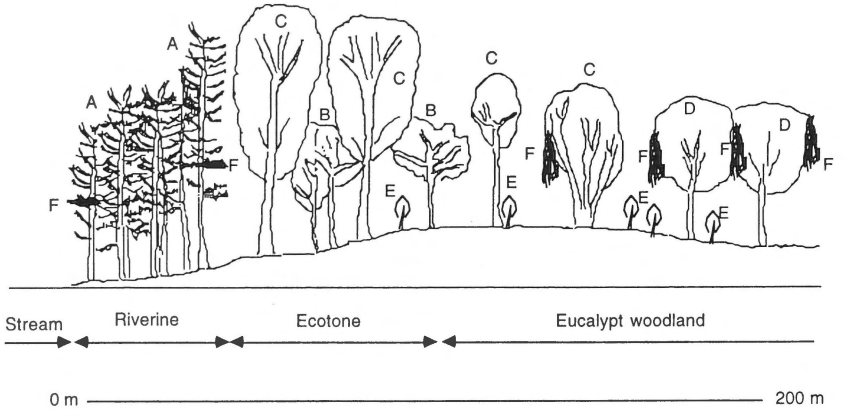

Figure 1. Profile sketch of a typical study site showing vegetation changes with respect to distance from a Northern Tablelands stream, 1987-1988. A = River She-Oak *Casuarina cunninghamiana,* **B = Rough-barked Apple** *Angophora floribunda,* **C = Blakely's Red Gum** *Eucalyptus blakelyi,* **D = Yellow Box** *Eucalyptus melliodora,* **E = *Eucalyptus* or *Angophora* saplings, F = Mistletoe** *(Amyema* **spp.).**

Study area and methods

General

Field work was conducted over a seven-month period (July 1987-January 1988) during the main bird-breeding season at four sites located in the western portion of the New England Tablelands, New South Wales. The sites were selected for their readily identifiable vegetation belts or zones: riverine, ecotone and eucalypt woodland. Each zone supports a relatively distinct plant community, the elements of which grade into one another (details in Chan 1990). A vegetation profile of a typical site is illustrated in Figure 1, and the different habitat features of the three vegetation zones are shown in Table 1. Both the riverine and ecotone belts, when present, are usually less than 40 m in width. The region can best be described as 'open woodland'.

All methods used were described in a previous paper by Chan (1990). Basically, circular plots with a radius of 20 m were established in each vegetation zone within 300 m from a stream. A total of 39 plots was established in the four sites: 12 each in the riverine and ecotone zones and 15 in the eucalypt woodland. The time spent at each sampling plot was 10 minutes, with observations beginning at a randomly chosen plot. Observations were made during the morning, and care was taken to record only single counts for each individual during an observation session. For each observation session, I recorded the plot location in the study site, time of day, identity of individuals, foraging patterns and bird interactions. Birds were observed using 10 × 50 binoculars. Only birds observed to have perched or foraged inside a sampling plot were censused; those which flew overhead were ignored. All sites were censused at least twice each month, and plot visits totalled 518.

Foraging patterns

For foraging behaviour, an upper limit of five consecutive foraging acts (see also Recher et al. 1985, Wykes 1985) was selected for each bird individual to reduce biases in favour of the more conspicuous behaviour. Upon seeing a bird, I recorded its manoeuvre when capturing a food item: (a) glean — food is gathered by a perched or moving (but not flying) bird from a substrate without interrupting the movement pattern of the bird; (b) probe — a stationary bird extracts food from a flower, wood crevice or soil by inserting its beak into the substrate; (c) pounce — from a perch a bird makes a sudden swoop to the ground or lower vegetation substrate and seizes the prey item upon landing; (d) hawk — a bird flies or makes a long hop from a perch to catch airborne prey; (e) snatch — a bird leaves its perch hastily to snap up a prey item from a substrate before landing on another perch; and (f) hover — a stationary food item is taken from a substrate while the bird is momentarily

Table 1

A summary of the vegetation structure in three vegetation zones of the Northern Tablelands, New South Wales, 1987-1988. Values are means derived from habitat measurements obtained from four study sites. dbh = diameter of tree at breast height, SD = standard deviation.

Habitat parameter	*Riverine*		*Ecotone*		*Eucalypt woodland*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Trees/ha	161.5	114.4	311.6	260.8	155.9	146.9
Shrubs/ha	155.4	175.3	28.6	26.5	113.6	338.2
Canopy height (m)	26.3	5.1	21.1	4.9	18.7	3.3
No. ground species	5.3	1.4	9.0	1.8	10.4	2.4
Diameter of large trees (>20 cm dbh)	41.8	12.7	46.7	21.0	38.0	12.9
Diameter of small trees (2-20 cm dbh)	14.0	2.7	12.9	2.7	13.3	2.7
% River She-oak *Casuarina cunninghamiana*	95.8		1.3		0.0	
% Rough-barked Apple *Angophora floribunda*	3.0		58.5		26.3	
% gum *Eucalyptus*	1.2		38.5		63.3	
% box *Eucalyptus*	0.0		1.7		10.5	

suspended in the air rapidly beating its wings. The foraging substrate was categorised according to: (i) foliage (leaves, petioles, twigs); (ii) branch; (iii) trunk; (iv) air; (v) ground; and (vi) flower. The range of heights at which a bird was seen to take a prey item was estimated at: 0-1 m (ground to base of trees and including grasses and fallen trunks); 1-4 m (small shrubs and lower trunks of trees); 4-8 m (tall shrubs and lower foliage of trees); 8-13 m (subcanopy); 13-20 m (canopy of most trees); and >20 m (canopy of taller trees).

Of the 2348 recorded foraging attempts, 96% came from 20 bird species. These 20 woodland species were the most common birds visiting the plots. The foraging data containing the 18 foraging variables (percent utilisation of the foraging categories) for the 20 bird species were placed into a data matrix to be examined by cluster analysis using the computer program BMDP2M. Common species that are not predominantly insectivorous (e.g. parrots and finches) were automatically excluded from the cluster analysis, because they do not employ the foraging methods described when feeding.

Interspecific interactions

Data on interspecific chases or displacements that involved the highly aggressive Fuscous Honeyeater *Lichenostomus fuscus* or the White-plumed Honeyeater *L. penicillatus* were given in Chan (1990). Additional data on interactions involving either of these two honeyeaters and other species are provided.

Results

A total of 70 bird species was recorded in the study area. Site 1 was visited most often, and may have in part accounted for the greater number of species observed there. More species were found in the riverine zones for three of the four sites (Table 2).

Honeyeaters

Honeyeaters accounted for 15.7% (11/70) of the species recorded in the study and 25% (5/20) of the most commonly sighted species. Fuscous and White-plumed Honeyeaters were the most abundant bird species in the open woodland community (Table 3). An average of 38% of all bird individuals recorded per point visit belonged to either one of these two honeyeater species.

The Yellow-faced Honeyeater *Lichenostomus chrysops* and the White-eared Honeyeater *L. leucotis* were the only species congeneric with White-plumed and

Table 2

Number of bird species in each vegetation zone at four study sites on the Northern Tablelands, New South Wales, 1987-1988.

Study site	*Vegetation zone*	*Number of observation sessions*	*Number of species*	*% of all species in study site*
	Riverine	46	35	59.3
1	Ecotone	45	33	55.9
	Eucalypt woodland	72	34	57.6
	Total	163	59	
	Riverine	41	30	73.2
2	Ecotone	41	17	41.5
	Eucalypt woodland	42	26	53.7
	Total	123	41	
	Riverine	41	32	72.7
3	Ecotone	44	25	56.8
	Eucalypt woodland	60	26	59.1
	Total	145	44	
	Riverine	29	25	58.1
4	Ecotone	31	30	69.8
	Eucalypt woodland	27	20	46.5
	Total	87	43	

Fuscous Honeyeaters, and their numbers were low. Four of the honeyeater species were seen on fewer than three occasions: Red *Anthochaera carunculata* and Little Wattlebird *A. chrysoptera* (during August only), Brown-headed Honeyeater *Melithreptus brevirostris* (in October), and Painted Honeyeater *Grantiella picta* (in July). The Noisy Friarbird *Philemon corniculatus* and the Eastern Spinebill *Acanthorhynchus tenuirostris* were migrants which arrived in the region around September and November respectively. Only the White-naped Honeyeater *Melithreptus lunatus* and the Yellow-faced Honeyeater were present all through the research period; the former was often seen foraging in the canopy of tall trees of the ecotone, whereas the latter was most often observed in the riverine vegetation zone. Together with the Noisy Friarbird, these two were also the only honeyeaters other than Fuscous and White-plumed Honeyeaters in the most common species list (Table 3). Fuscous and White-plumed Honeyeaters have virtually mutually exclusive horizontal distributions, occupying primarily eucalypt woodland and riverine zones, respectively (Chan 1990). When the abundance of the Fuscous Honeyeater was high, the abundance of other (non-White-plumed) honeyeaters was also low ($r_s = -0.316$, $n=39$, $P<0.05$, Spearman's rank correlation). The number of White-plumed Honeyeater individuals was not negatively correlated with the number of non-Fuscous honeyeaters ($r_s = 0.27$, $n=39$, $P>0.05$).

Other species

The top five species in the list of Table 3 (excluding Fuscous and White-plumed Honeyeaters) reached their highest abundance in the riverine vegetation zone. Superb Fairy-wren *Malurus cyaneus*, White-throated Treecreeper *Cormobates leucophaeus* and Rufous Whistler *Pachycephala rufiventris* were all insectivorous birds particularly abundant in riverine areas. The Crimson Rosella *Platycercus elegans* does not appear to preferentially select the different vegetation zones. The overall abundance ranks

Table 3

Twenty most common species counted in three vegetation zones of the Northern Tablelands, New South Wales, 1987-1988. Values are the mean number of individuals per 10 observation sessions.

Species	*Riverine plots*	*Ecotone plots*	*Eucalypt woodland plots*	*All plots*
Fuscous Honeyeater *Lichenostomus fuscus*	0.6	5.8	20.2	10.2
White-plumed Honeyeater *Lichenostomus penicillatus*	9.2	11.7	3.5	7.7
Superb Fairy-wren *Malurus cyaneus*	11.7	3.4	0.5	4.6
Crimson Rosella *Platycercus elegans*	3.2	2.9	1.1	2.2
White-throated Treecreeper *Cormobates leucophaeus*	4.4	1.3	0.3	1.8
Rufous Whistler *Pachycephala rufiventris*	2.9	1.2	0.6	1.5
Red-browed Finch *Neochmia temporalis*	2.2	0.7	1.1	1.3
Spotted Pardalote *Pardalotus punctatus*	0.8	1.9	1.0	1.2
Eastern Rosella *Platycercus eximius*	0.3	1.9	1.0	1.1
Grey Shrike-thrush *Colluricincla harmonica*	1.5	0.5	0.9	0.9
Noisy Friarbird *Philemon corniculatus*	1.3	0.4	1.0	0.9
Striated Pardalote *Pardalotus striatus*	0.4	1.4	0.7	0.8
Willie Wagtail *Rhipidura leucophrys*	0.6	0.5	1.1	0.8
Eastern Yellow Robin *Eopsaltria australis*	1.7	0.4	0.4	0.7
White-naped Honeyeater *Melithreptus lunatus*	0.7	1.1	0.4	0.7
Grey Fantail *Rhipidura fuliginosa*	1.0	0.3	0.7	0.7
Brown Treecreeper *Climacteris picumnus*	0.1	0.8	0.9	0.6
Yellow-faced Honeyeater *Lichenostomus chrysops*	1.3	0.3	0.2	0.6
Dollarbird *Eurystomus orientalis*	0.8	0.6	0.3	0.5
Golden Whistler *Pachycephala pectoralis*	1.4	0.1	0.1	0.4

of non-honeyeater species were highly negatively correlated with the number of Fuscous Honeyeater individuals ($r_s = -0.659$, $n=39$, $P<0.001$, Spearman's rank correlation). The abundance ranks of non-honeyeater species were positively correlated with the number of White-plumed Honeyeater individuals ($r_s=0.32$, $n=39$, $P<0.05$, Spearman's rank correlation).

Crimson Rosella *Platycercus elegans*, **a bird which does not appear to preferentially select different vegetation zones here.**

Plate 5 Photo: Neville Male

Guild organisation

The degree of similarity in the foraging patterns of bird species in the study area is shown diagrammatically in Figure 2. Three major groupings, or guilds, are apparent, with 'foliage gleaners' relatively distinct from the rest. In this foliage-gleaning guild, the White-plumed and Fuscous Honeyeaters, the White-naped Honeyeater, the pardalotes, the thornbills and the Golden Whistler *Pachycephala pectoralis* are very similar in their use of vegetation heights and in obtaining insects gleaned from leaves.

The second guild, 'gleaners of other substrates', is composed of birds that glean for arthropods from tree trunks (treecreepers) to gleaners that obtain most of their food from the ground (wrens and scrubwrens). Silvereyes *Zosterops lateralis* in the study sites often fed on the ground, though they were also found among small bushes as well as among foliage of trees; they are thus considered as part of this guild. The remaining bird species form a third 'non-gleaners' guild. These included species with disparate foraging methods, from birds that pounce on to the ground for insects (Eastern Yellow Robin *Eopsaltria australis*) to those which hawk for insects from the air (Grey Fantail *Rhipidura fuliginosa* and Willie Wagtail *R. leucophrys*). The Yellow-faced

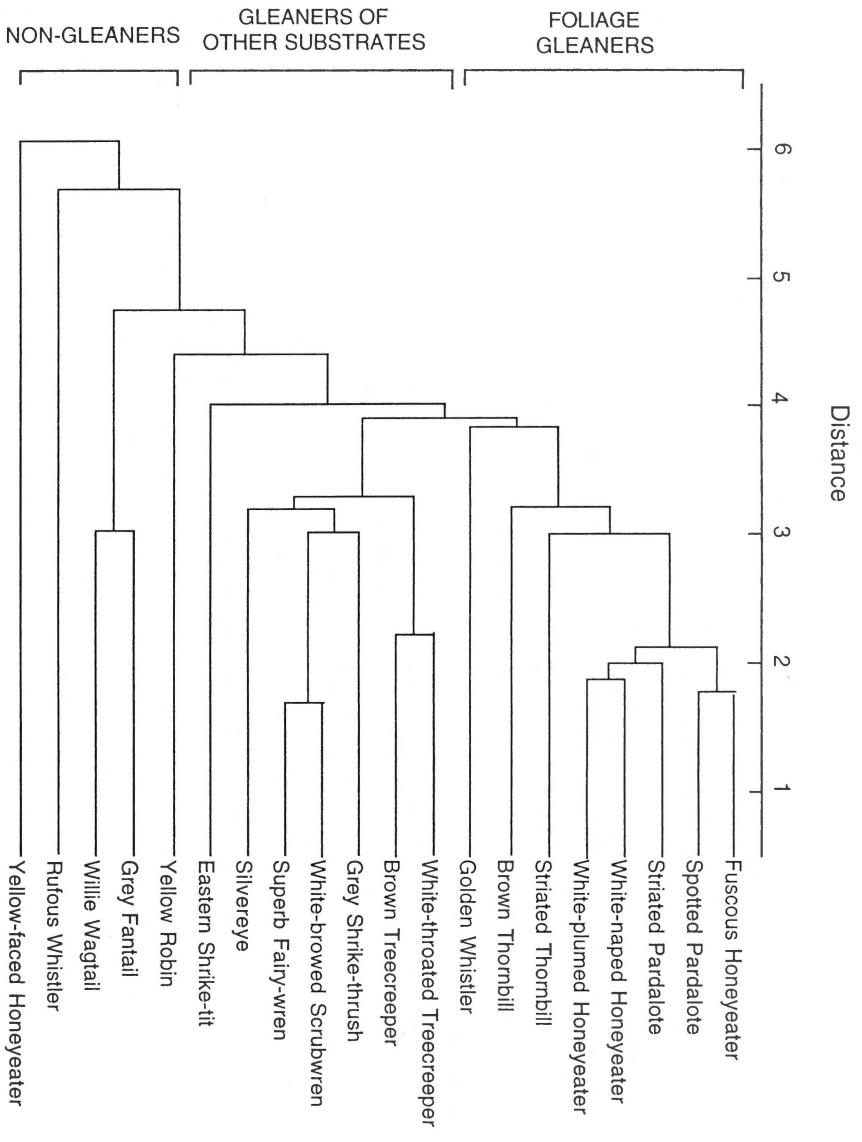

Figure 2. Dendrogram for cluster analysis of common insectivorous bird species of the open woodland on the Northern Tablelands, New South Wales, 1987-1988.

Honeyeater actually gleaned more for insects (46.5%) than it probed into flowers or wood crevices (39.5%) (see also Ford & Paton 1977), but because it is the only common species in the study area to exploit a resource base (nectar) largely ignored by other insectivorous species, it is ecologically isolated from other members of the bird community and stands out alone as a 'specialist'.

Table 4

Order of birds attacked most often by Fuscous and White-plumed Honeyeaters. Values are the percentages of total number of encounters observed. Total number of encounters was 208.

Birds attacked	*Attacker*	
	Fuscous Honeyeater	*White-plumed Honeyeater*
Fuscous Honeyeater	51.4	14.8
White-plumed Honeyeater	8.7	35.2
Pardalotes	2.9	4.9
Yellow-faced Honeyeater	2.2	4.9
White-naped Honeyeater	2.2	4.2
Thornbills	3.6	2.1
Others	29.0	33.9

Fuscous and White-plumed Honeyeaters in the area were dominant behaviourally as well as in numbers. They attacked almost all species in the area, including butcherbirds and an owl, but birds attacked most often by these two honeyeaters were those which belonged to the foliage-gleaning guild (both conspecifics and interspecifics) or the congener, Yellow-faced Honeyeater (Table 4).

Discussion

Differences in preference for various vegetation zones were exhibited by a number of bird species. Generally, a greater number of species was found in the riverine zone than in the ecotone or eucalypt woodland. Accessibility to permanent water and greater diversity/abundance of food may have been the main factors. In addition, the dense cover of the riverine zone may offer better protection from predators and provide a refuge area for birds seeking climatic relief. The predominant bird species was the White-plumed Honeyeater, though, with the exception of the Fuscous Honeyeater, its abundance did not appear to have a strong effect on that of other species. The Fuscous Honeyeater was the most abundant bird in the entire study region, but it only occasionally foraged in the riverine zone perhaps to avoid direct confrontation with the White-plumed Honeyeater (Chan 1990).

The ecotone, being an area of integrating and overlapping bird communities, also contained large numbers of birds. The finding that many birds occurred in the riverine and the ecotone plots compared with the eucalypt woodland plots, suggests that larger patches of the former belts would support larger bird populations. However, no species were unique to these vegetation belts; all species found there were also found in the adjoining eucalypt woodland.

Although the eucalypt woodland contained fewer birds on average, it accommodated several species that were absent in the riverine vegetation. These were generally birds of the open country (e.g. Jacky Winter *Microeca fascinans* and Restless Flycatcher *Myiagra inquieta*) where trees are sparse. The Fuscous Honeyeater was the predominant bird here, and in plots where it occurred in large numbers, the numbers of other birds were reduced. This was particularly so with the White-plumed Honeyeater. The negative correlation between these two abundant, ecologically similar and aggressive congeners is consistent with the theory that the abundance of a species may be reduced if competitors are present (Rosenzweig 1985).

In Figure 2, tight clusters contain species that exploit food in similar ways, and within these clusters competition is likely to be more intense than between members

Striated Pardalote *Pardalotus striatus* **(black-headed race), a foliage-gleaner**
Plate 6 Photo: G.A. Cumming

of distant foraging groups. Indeed, potential competitors with foraging patterns that overlap extensively with White-plumed and Fuscous Honeyeaters (i.e. guild members) were generally attacked more often than non-guild members. White-plumed and Fuscous Honeyeaters are able to behaviourally dominate members of the foliage-gleaning guild because they are much larger birds. The two species are relatively similar in body size (18-23 g); they are able to coexist because they occupy different vegetation zones with limited overlap (Chan 1990). The higher proportion of attacks between Fuscous and White-plumed Honeyeaters was probably related to these species' high abundance in the region, and the interactions mostly took place in areas where they overlapped. Aggressive attacks on the Yellow-faced Honeyeater by either of these species were fewer, probably because of the difference in foraging behaviour, the Yellow-faced Honeyeater being more of a nectarivore than an insectivore. Here is a situation where it is likely that niche separation helps to reduce congeneric interactions. Differences in patterns of resource utilisation are also found in other congeneric honeyeater species (Keast 1968; Recher 1971; Ford & Paton 1976, 1977; Wykes 1985; Ford 1989).

Riparian forests are often overlooked in studies of habitat fragmentation. Increased isolation of small patches of riverine vegetation would threaten the livelihood of birds utilising its resources. The ecotone may also be vital to many birds, but its significance is difficult to assess because it is so fragmented and narrow in its present state. Further fragmentation of these already narrow belts could alter the present avifauna, and interspecific competition for resources would probably be increased, leading to the displacement of some species by others that favour the more open vegetation. Any conservation management strategies in the region should therefore consider the importance to bird communities of riverine and ecotone belts, and ensure that these vegetation belts are protected from further destruction.

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