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DENSITY OF BIRDS IN EUCALYPT WOODLAND NEAR ARMIDALE, NORTH-EASTERN NEW SOUTH WALES

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Birds were counted along four 8-9 ha transects 50 m wide throughout 1981. Densities averaged 8.3-11.1 birds/ha, with numbers tending to be highest in winter and lowest in spring. About 50% of individuals belonged to species that are insectivorous, 35% were honeyeaters (eating nectar and insects) and about 13% were of graminivorous species. Frugivores and vertebrate-feeders were scarce. A total of 67 species were seen of which 40 were resident in one or more sites and 11 were breeding summer visitors. Numbers of several species, especially pardalotes and honeyeaters, increased in early autumn and declined in late winter. Home ranges of seven species were mapped and these more accurate estimates of density were compared with those from the transect censuses. On average, density was underestimated by the transect censuses by 15%, and by up to 50% for individual species. Estimates of density at one site were about 50% of those made nearby in 1978 and 1979. A severe drought had probably contributed to this decline.

Results are compared with those from three other locations in south-eastern Australia. Although they span nearly 8° of latitude the composition of the avifauna and its seasonality are very similar in all four locations.

INTRODUCTION

Recently several workers have estimated the density of birds in eucalypt woodlands and forests in south-eastern Australia (Bell 1980, Loyn 1980, Ford and Bell 1981, Friend 1982, Kavanagh and Recher 1983, Recher *et al.* 1983a, b, summarised in Recher 1984). We estimated the density of birds in eucalypt woodland near Armidale (30° 30'S., 151° 40'E.) between January 1981 and February 1982, as part of a study on birds in relation to eucalypt dieback. We also compared densities of some species of birds estimated from territory mapping with those from transect counts to gain an idea of the accuracy of the latter. Shields and Recher (1984) and Bell and Ferrier (1985) have recently done the same.

STUDY SITES

Eastwood State Forest (10 km SE of Armidale) was chosen as the major study area. It is one of the few areas within 20 km of Armidale that carries a reasonable area (100 ha) of natural woodland, similar to that covering the Northern Tablelands at the time of European settlement. Some trees had been cut down before and in the early stages of the study, but tree-felling had virtually ceased in 1981. There was dense regrowth of eucalypts in a few places, perhaps where most trees had been removed previously. The forest was lightly grazed by cattle, horses, Wallaroos *Macropus robustus*, Swamp Wallabies *Wallabia bicolor* and Hares *Lepus capensis*.

Two sites at Eastwood were chosen, 200 m apart, for censusing birds. Site 1 was 8 ha, site 2 was 9 ha. Site 1 overlaps with Site 1 described in Ford and Bell (1981). We censused birds at two other sites (both 9 ha); Hillgrove Creek State Forest (12 km E of Armidale) and the campus of the University of New England (4 km W of Armidale). Hillgrove (site 3) has woodland similar to that at Eastwood, but it was perhaps more heavily grazed and it has less understorey. Trees had been felled extensively at the University of New England (site 4) and many of those remaining are dead. The ground is rockier there than at the other sites and the grass is denser. This site has not been grazed for at least 15 years except by the occasional macropod, and now suffers little disturbance. Site 4 overlaps with site 2 in Ford and Bell (1981).

The density of trees and mistletoes at each site was estimated by counting them in twenty 10 m x 10 m quadrats placed at 50 m intervals along four lines 75 m apart. Shrubs were counted in twenty 5 m x 5 m quadrats at the same sites. An estimate of density of plant cover at 0-1 m, 1-5 m and > 5 m was made in 1 m^2 in each of these quadrats. Site 4 has far fewer trees than the other three sites, which have similar tree densities (Table 1). Shrubs, mostly sapling eucalypts, were most dense at site 1, and at similar densities in the other three sites. Site 4 had the most ground vegetation (mostly grasses). Mistletoes were more common at the two Eastwood sites (1 and 2).

One hundred trees were chosen randomly at each site and identified. The Ribbon-gum

TABLE 1

Details of vegetation at each site.

Site	1	2	3	4
Trees/ha	345	415	365	60
Shrubs/ha	400	240	160	220
Ground cover	41%	52%	22%	83%
1-5 m cover	5%	1%	1%	5%
> 5 m cover	16%	32%	24%	7%
Mistletoes/ha	35	75	10	10

Eucalyptus viminalis clearly dominates at the University of New England whereas the stringybark *E. caliginosa* dominates the other sites (Table 2). *E. blakelyi* (Blakely's Red Gum), *E. viminalis* and *E. melliodora* (Yellow Box) occur at all sites. The study was started in the latter stages of a severe drought. Rainfall for Armidale is shown in Table 3. Although good rain fell in the winter in 1981, plants barely started growing until September. By the end of 1981 growth of grasses, shrubs and trees was far more prolific than it had been in the previous two summers, when grass seeds were virtually absent and shrub growth minimal. Although no measurements were made of the growth of vegetation the differences in growth rate over different years probably affected populations of both insects and birds. Insects were sampled on eucalypt foliage throughout 1981 at sites 1 and 4 (S. Harrington, C. Donovan and M. Lowman unpublished). On the whole insects were scarce, with no period when they were abundant. Bell (1985) also found foliage insects scarce in 1981 at Wollomombi (30 km E of Eastwood).

TABLE 2

Numbers of each species of tree at each site, 100 trees counted.

Site	1	2	3	4
Eucalyptus caliginosa	44	56	63	
E. blakelyi	32	20	13	19
E. viminalis	10	7	2	81
E. melliodora	7	11	22	
E. bridgesiana		1		
Acacia filicifolia	6	5		
A. irrorata	1			

TABLE 3

Rainfall (mm) at Armidale in 1980 and 1981 and mean for last 50 years (source Armidale Express, 6 January, 1982)

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1980	67	72	18	3	111	31	20	7	5	65	10	103	516
1981	13	84	5	28	83	49	63	19	53	87	76	92	653
Mean 50 years	112	92	66	36	44	48	46	51	52	74	83	88	792

CENSUS METHODS

A wide variety of methods is available for estimating densities of terrestrial birds (Pyke and Recher 1984). These include transects of fixed or variable width (Bell 1980, Recher *et al.* 1983b, Bell and Ferrier 1985), circular plots (Recher *et al.* 1983b) and mapping of territorial birds Loyn 1980). Shields and Recher (1984) used four methods: transect census, territory mapping, nest searches and mist-netting. The main method used in this study was the fixed width transect.

Trees were marked with surveyors' coloured tape at 50 m intervals to make a grid in each site. The censuser walked along the centre line (marked with white tape), of each 50 m square and recorded onto a map all birds identified (seen or heard) within 25 m of this line. Censuses were 1 600 m (site 1) and 1 800 m (other sites) in length and took about one hour. When the area is gridded there are few problems with determining whether a bird is within 25 m or not. Observers walked slowly, stopping at about 25 m intervals or when birds were seen or heard. The major inaccuracies in this method are underestimation of density either because birds move away from the observer before being located or because birds are overlooked. Franzreb (1981) and Hilden (1981) found that by using the fixed-width line transect they underestimated density by some 50%, i.e. the estimate obtained is about half of the true density. Eucalypt woodland is more open than the habitats in which these workers censused and a 50 m wide strip is more conservative than the 120 m strips used by Recher *et al.* (1983b) and 80 m strips used by Friend (1982). Bell and Ferrier (1985) found that transect censuses underestimated densities of many species but that those of variable width (Emlen's 1971 method) are more reliable than fixed-width transects. Shields and Recher (1984) found that the reliability of results of fixed-width transects varied greatly between species, and that territory mapping was unreliable for some Australian species.

A better estimate of the density of several species was obtained by plotting the home ranges of colour-banded birds at site 1. A grid of 12 ha was used, which included the 8 ha grid. Ranges were plotted for the following species: Superb Fairy-wren, Speckled Warbler, Rufous Whistler, Eastern Yellow Robin, Crested Shrike-tit, White-throated and Brown Treecreepers (scientific names in Table 4). Densities calculated by the two methods were compared for the breeding season only (August, 1981 - February, 1982), when home ranges varied less than when the birds were not breeding.

Censuses were carried out twice each month from January, 1981 to January, 1982, at sites 1 and 2, and from February, 1981 to February, 1982, at site 4 and once a month from March, 1981 to February, 1982, at site 3. SN censused up to July, 1981 and LB from August, 1981, onwards. All three authors noted locations of colour-banded birds.

RESULTS

The mean densities of each species at each site for the entire period of censusing are given in Table 4. The number of species at each site ranged from 41 to 48. The bird communities were similar at the two Eastwood sites (1 and 2), which differed from those at Hillgrove Creek State Forest (site 3) and the University of New England (site 4) (Table 5). Sites 3 and 4 differed markedly from each other. Site 4 differed most in its vegetation from the other

TABLE 4

Density (birds/ha) of each species at each site, calculated by dividing total number seen by area of transect and number of counts. Feeding groups are those given in Ford and Bell (1982).

	Site 1	Site 2	Site 3	Site 4
Number of counts	26	26	12	24
Pacific Black Duck *Anas superciliosa*		.01		
Maned Duck *Chenonetta jubata*	.01		.02	.11
Australian Kestrel *Falco cenchroides*				.01
Painted Button-quail *Turnix varia*	.02	.01		
Crested Pigeon *Ocyphaps lophotes*				.01
Galah *Cacatua roseicapilla*			.02	.18
lorikeet sp?		.01		
Crimson Rosella *Platycercus elegans*			.01	.06
Eastern Rosella *P. eximius*	.66	.53	.50	1.15
Red-rumped Parrot *Psephotus haematonotus*				.22
Fan-tailed Cuckoo *Cuculus pyrrhophanus*			.01	
Shining Bronze-Cuckoo *Chrysococcyx lucidus*			.02	
Tawny Frogmouth *Podargus strigoides*	.01			
Australian Owlet-Nightjar *Aegotheles cristatus*	.01			
Laughing Kookaburra *Dacelo novaeguineae*	.04	.02	.02	.08
Sacred Kingfisher *Halcyon sancta*	.04	.04		.01
Rainbow Bee-eater *Merops ornatus*	.01			
Dollarbird *Eurystomus orientalis*		.01		.01
Welcome Swallow *Hirundo neoxena*		.05		
Tree Martin *Cecropis nigricans*	.01			.03
Black-faced Cuckoo-shrike *Coracina novaehollandiae*	.07	.12	.06	.20
White-winged Triller *Lalage sueurii*	.01			.18
Scarlet Robin *Petroica multicolor*	.02	.03	.12	.02
Red-capped Robin *P. goodenovii*	.01			
Eastern Yellow Robin *Eopsaltria australis*	.39	.12	.14	
Crested Shrike-tit *Falcunculus frontatus*	.20	.20	.06	.01
Golden Whistler *Pachycephala pectoralis*	.04	.06	.09	.01
Rufous Whistler *P. rufiventris*	.36	.10	.30	.05
Grey Shrike-thrush *Colluricincla harmonica*	.13	.25	.14	.13
Black-faced Monarch *Monarcha melanopsis*		.01		
Leaden Flycatcher *Myiagra rubecula*	.01		.03	.01
Restless Flycatcher *M. inquieta*	.04	.04	.03	.01
Grey Fantail *Rhipidura fuliginosa*	.15	.03	.09	.01
Willie Wagtail *R. leucophrys*	.09	.15	.06	.13
Rufous Songlark *Cincloramphus mathewsi*				.03
Superb Fairy-wren *Malurus cyaneus*	1.18	.25	.16	.46
Speckled Warbler *Sericornis sagittatus*	.41	.10	.31	
White-throated Gerygone *Gerygone olivacea*	.01		.05	
Brown Thornbill *Acanthiza pusilla*	.01			.01
Buff-rumped Thornbill *A. reguloides*	.21	.07	.70	
Striated Thornbill *A. lineata*	.06	.06	.14	.01
Varied Sittella *Daphoenositta chrysoptera*	.30	.20	.46	.06
White-throated Treecreeper *Climacteris leucophaea*	.65	.32	.54	.10
Brown Treecreeper *Climacteris picumnus*	.16	.12	.30	.01
Red Wattlebird *Anthochaera carunculata*	.10	.18	.02	.20
Noisy Friarbird *Philemon corniculatus*	.06	.15	.05	.16
Noisy Miner *Manorina melanocephala*				.02
Yellow-faced Honeyeater *Lichenostomus chrysops*	.01	.02	.10	
White-eared Honeyeater *L. leucotis*			.06	
Fuscous Honeyeater *L. fusca*	3.23	3.63	.71	1.71
Brown-headed Honeyeater *Melithreptus brevirostris*	.04	.12	.19	
White-naped Honeyeater *M. lunatus*	.55	.18	.81	.19
Eastern Spinebill *Acanthorhynchus tenuirostris*	.01	.01	.10	
Scarlet Honeyeater *Myzomela sanguinolenta*			.02	
Mistletoebird *Dicaeum hirundinaceum*	.17	.15	.13	
Spotted Pardalote *Pardalotus punctatus*	.18	.05	.33	
Striated Pardalote *P. striatus*	.67	.39	.98	.64
Silvereye *Zosterops lateralis*	.01	.01	.12	
Diamond Firetail *Emblema guttata*	.05	.01	.06	.01
Olive-backed Oriole *Oriolus sagittatus*		.01		

Table 4 continued

Common Starling *Sturnus vulgaris*				1.63
White-winged Chough *Corcorax melanorhamphos*	.16	.11	.12	
Dusky Woodswallow *Artamus cyanopterus*	.19	.12		.18
Grey Butcherbird *Cracticus torquatus*				.01
Australian Magpie *Gymnorhina tibicen*	.21	.17	.17	.35
Pied Currawong *Strepera graculina*	.11	.08	.05	
Australian Raven *Corvus coronoides*	.02	.01	.05	.02
Insectivores	5.92	3.21	5.41	4.32
Honeyeaters	4.00	4.29	2.06	2.28
Herbivores	1.12	0.77	0.95	1.74
Vertebrate-feeders	0.05	0.04	0.03	0.07
All Species	11.09	8.31	8.45	8.41

sites; it had fewer live trees but more dead trees. Hole-nesters like the Common Starling, parrots and pardalotes were more common there. Rosellas and Common Starlings may also have been more common there because it was surrounded by open country, where they feed. Overall about half of the birds at each site were primarily insectivorous and 25-50% were honeyeaters (Table 4). The latter were predominantly *Melithreptus* or *Lichenostomus*, two genera that mostly eat insects, honeydew or manna rather than nectar (Ford and Paton 1976, 1977, Paton 1980, Wykes, in press). The only frequently used source of nectar was that of the mistletoe *Amyema*, which flowered from February to April. (Foraging data have been collected for all species between 1981 and 1985). About 10% of birds were herbivores, chiefly the seed-eating Eastern Rosella, which was particularly abundant in site 4. The only native succulent fruits eaten by birds were those of mistletoes, eaten by the Mistletoebird, and the small shrub *Chenopodium trigonum*, eaten by Speckled Warblers and Silvereyes. Birds that include a significant amount of vertebrates in their diet were generally scarce.

TABLE 5

Similarity in proportions of species between each pair of sites (Similarity $= 1 - \frac{1}{2}\Sigma|P_{ij} - P_{ik}|$, where P_{ij} and P_{ik} are the proportions of bird species i of all species at sites j and k).

	Site 1	Site 2	Site 3
Site 2	0.747		
Site 3	0.630	0.509	
Site 4	0.522	0.526	0.364

The densities of birds in sites 1 to 3 fell markedly between June and October (Figure 1). Part of the reason for this decline may have been the changeover from SN to LB at the end of July (LB was initially less experienced than

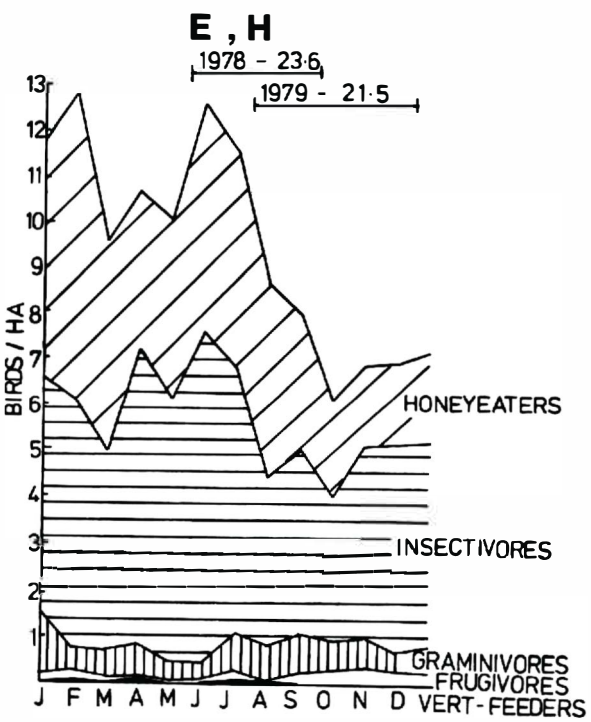

Figure 1. *Mean estimated densities of birds of five groups from sites 1 to 3. Densities and periods of censuses are also given for 1978 and 1979.*

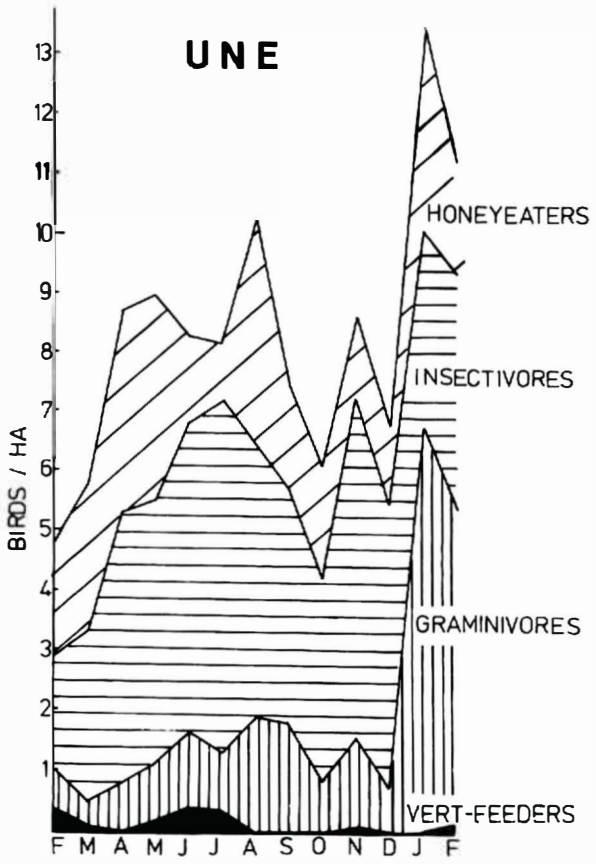

Figure 2. *Estimated densities of birds of four groups at site 4.*

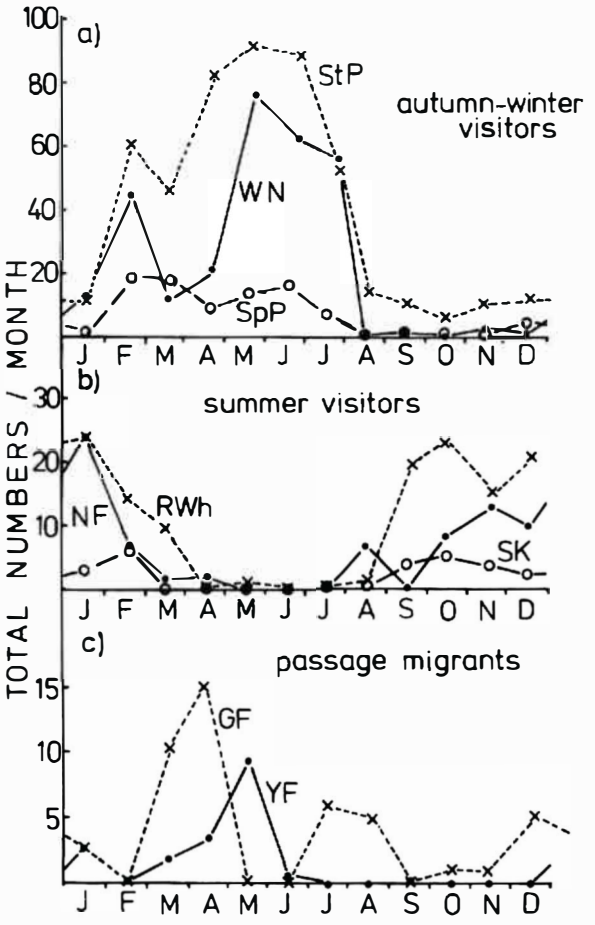

Figure 3. *Numbers of (a) Striated Pardalote (St P), White-naped Honeyeater (WN), Spotted Pardalote (Sp P), (b) Rufous Whistler (R Wh), Noisy Friarbird (NF), Sacred Kingfisher (SK), (c) Grey Fantail (GF) Yellow-faced Honeyeater (YF) in each month. All sites combined.*

SN) though densities at site 4 did not change through the winter (Figure 2). Honeyeaters showed the most marked decline from about 5 birds per ha in June to about 2 birds per ha in the last three months of the year. Most White-naped Honeyeaters left in late winter. The local breeding season is from August to January for most species and breeding was generally unsuccessful before November, 1981 (H. Ford, H. Bell, R. Noske unpublished). Hence the decline from June to October can be partly attributed to mortality with lack of recruitment. A further reason is that birds may be harder to see in the breeding season as most flocks have broken up and some individuals will be incubating or behaving secretively. The increase late in January, 1982, in site 4 is mostly through an influx (or successful breeding) of starlings and Eastern Rosellas.

Several species showed marked seasonal changes in abundance. The cuckoos, Sacred Kingfisher, Rufous Whistler, Rufous Songlark, White-winged Triller, Leaden Flycatcher and White-throated Gerygone are summer visitors though only the whistler is common. The Noisy Friarbird, Red Wattlebird and Black-faced Cuckoo-Shrike also tended to be least common in winter (Figure 3). White-naped Honeyeaters,

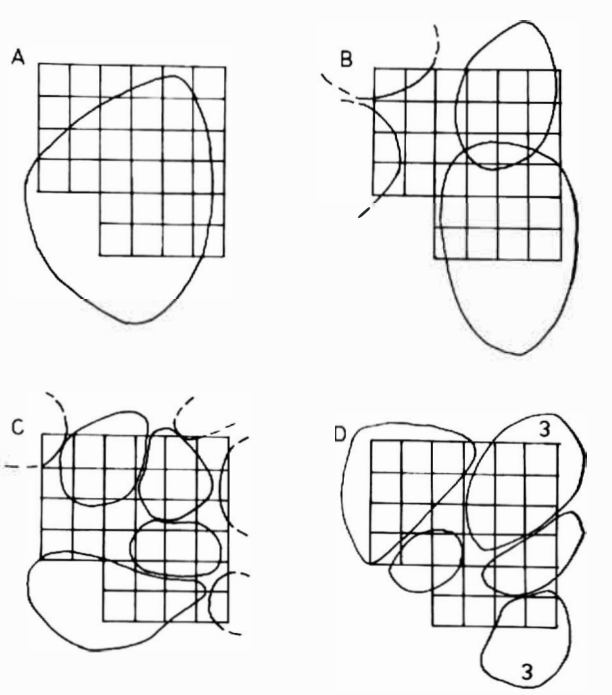

Figure 4. *Home-ranges of (a) Crested Shrike-tit, (b) Speckled Warbler, (c) Rufous Whistler and (d) Superb Fairy-wren at site 1. Grid is in 50 m squares. (3 indicates presence of a helper).*

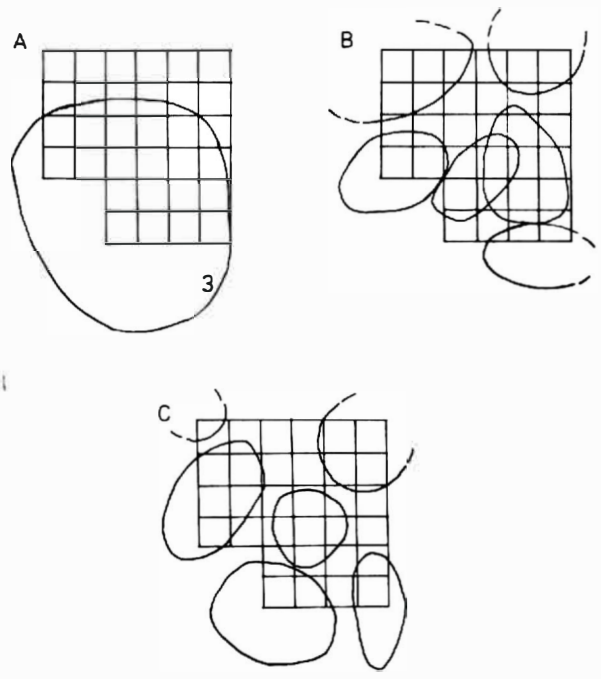

Figure 5. *Home-ranges of (a) Brown Treecreeper, (b) White-throated Treecreeper and (c) Eastern Yellow Robin at site 1. Grid is in 50 m squares.*

and both species of pardalotes were scarce in spring (although all breed locally). The Yellow-faced Honeyeater, a well-known migrant (Hindwood 1956), appeared to be mostly a passage migrant as did the Grey Fantail (Figure 3).

The home ranges of seven species at site 1 are shown on Figures 4 and 5, with the grid where the censuses were carried out. These are based on sightings of colour-banded birds between August, 1981, and February, 1982. Densities were calculated for each species by adding the proportions of each home range that falls within the 8 ha grid and the number of birds occupying this range. When young had fledged they were added to the number in the home range. For instance for group 1 (top right corner) of Superb Fairy-wrens there were three birds (2♂♂, 1♀) from August to December (5 months) and seven birds (4 young reared) in January and February (2 months). Sixty percent of this home-range was deemed to fall within the 8 ha grid, thus there was an average of (3 x 5/7) + (7 x 2/7) x .60 = 2.48 birds from this group. Other wren groups add 1.83, 1.03, 1.37, 1.66 birds, total-

TABLE 6

Estimates of density (birds/ha) for seven species at Eastwood 1 comparing two methods: transect data from August to February inclusive; and plotting home-ranges.

	Transect	Home-Range	Transect x 100/ home-range
Crested Shrike-tit	.12	.15	80%
Speckled Warbler	.51	.77	66%
Rufous Whistler	.54	.88	61%
Superb Fairy-wren	1.34	1.05	128%
Brown Treecreeper	.23	.32	72%
White-throated Treecreeper	.60	.54	111%
Eastern Yellow Robin	.41	.78	53%
ALL SPECIES	3.75	4.49	85%

ilng 8.37 birds in 8 ha or 1.05 birds/ha. Similar calculations were made for the other species.

Densities were also calculated for each species from the transect data for the same period. The results are compared in Table 6. The density from plotting home-ranges is assumed to be more accurate although a degree of subjectiveness is involved in drawing boundaries of home-ranges, especially when these fall partly outside the grid. Also transient birds were not counted, so if anything the density estimates from mapping are still underestimates. Bearing these sources of error in mind, transect censuses appear to be accurate for some species — Superb Fairy-wren and White-throated Treecreeper, but to underestimate densities by up to 50% for others, e.g. Eastern Yellow Robin.

The degree of accuracy accords with the conspicuousness of the species. Fairy-wrens are ground-dwelling and often call and Treecreepers call frequently and are easily seen. Eastern Yellow Robins on the other hand are often inconspicuous and although male Rufous Whistlers are noisy and obvious in the breeding season, females are harder to locate. If the species whose home ranges were plotted in site 1 are representative of all species, this would give a density of about 14 birds per ha (instead of c.11) for this site.

DISCUSSION

The average density at sites 1 to 3 was estimated to be 9.3 birds/ha, compared with 23.6 and 21.5 birds/ha in 1978 and 1979 respectively at sites overlapping with site 1 (Ford and Bell 1982). These earlier censuses were carried out over only part of the year; June to September, 1978 and August to December, 1979. In 1981 these periods had slightly higher and slightly lower densities respectively than the average for the whole year. One reason for this decline is the drought. 1980 was very dry and few young birds fledged. There may also have been declines through emigration and mortality during the 1981 winter. There was virtually no grass or herb seed set in 1980 and this is reflected by a decline in Diamond Firetails (Table 7). Several insectivorous birds seem to have declined during the drought, especially the thornbills. Apparent declines of several species, the pardalotes and White-naped Honeyeater, are partly because these species are most abundant in winter when the 1978 census was carried out. On the other hand several insectivores have maintained reasonably constant numbers over the three years (Table 7).

TABLE 7

Estimates of density (birds/ha) of several species at Site 1 in 1978, 1979 and 1981.

Species that apparently declined during drought.	1978	1979	1981
Golden Whistler	.43	.79	.04
Buff-rumped Thornbill	1.54	.92	.21
Striated Thornbill	1.58	.25	.06
Brown-headed Honeyeater	.65	.38	.04
Silvereye	.36	.88	.01
Diamond Firetail	1.18	.25	.05
Species apparently not affected by drought.			
Eastern Yellow Robin	.68	.67	.39
Superb Fairy-wren	1.03	1.41	1.18
Speckled Warbler	.49	.54	.41
Varied Sittella	.20	.20	.30
Fuscous Honeyeater	3.07	5.46	3.23

A site partly overlapping with site 4 was censused in 1979. Density in that year was estimated at 10.5 birds/ha, not much more than the 8.4/ha estimated in 1981, though the latter is inflated by an increase in starlings and Eastern Rosellas in summer 1981-1982. The vegetation at site 4 is less dense than at other sites and has suffered from moderate eucalypt dieback. In 1979 it had about half the density of birds of site 1, whereas in 1981 density at site 4 was 75% of that at site 1. There had been recovery of the trees over the previous few years. Possibly the main reason why density has not declined as much in site 4 is that the common species there; Eastern Rosella, Superb Fairy-wren, Fuscous Honeyeater and starling may have been less affected by the drought.

Most other places in south-eastern Australia where bird density has been estimated are in sclerophyll forest rather than woodland. Bell's (1980) site near Canberra and Shields and Recher's (1984) sites near Bombala are most similar to the Armidale sites and these observers used similar methods. Densities of ground vegeta-

tion of 10-47%, of shrubs 2-4% and trees 27-50% at Canberra compared with 22-52%, 1-5%, and 16-32% in our sites 1 to 3. Comparable figures were not given by Shields and Recher (1984), but their two sites were woodland or open forest, mostly with little understorey. Bell estimated that there were 4.7 birds/ha in forest and 6.05/ha in regrowth along a power line. Shields and Recher's transect censuses averaged 17.5-25 birds per ha, closer to our 1978 and 1979 figures for Eastwood. Many species were found in all three areas although their abundances were often different.

Loyn (1980) mapped territories in eucalypt forest in eastern Victoria. He found from 7.8 to 18.1 territories per ha in mature forest and 0.6 to 8.5 territories per ha in regrowth areas. Assuming a minimum of two birds per territory, densities in the former are thus considerably above those near Canberra and Armidale (in 1981). Shields and Recher (1984) calculated density of territories for individual species rather than for the whole community; these will be discussed later. A feature of both Bell's and Loyn's forest sites is the low frequency of honeyeaters, 9% and 13% compared with 35% near Armidale. Pardalotes (17% Canberra) and thornbills (25% Victoria) were major groups in the other places.

Recher *et al.* (1983b) rightly pointed out that many species in south-eastern Australia are regular migrants. On the whole densities of birds are lower in winter than in the other seasons near Bombala and to a less marked extent at Canberra (Bell 1980). In contrast near Armidale numbers in winter tend to be higher than those in spring. Loyn's (1980) study did not cover a whole year (only August to February) though he does comment on the status of many species. Many species are breeding migrants to most or all of the study areas. They are virtually or entirely absent between May and August. These include: Sacred Kingfisher, White-winged Triller, Rufous Whistler, Leaden and Satin Flycatchers, White-throated Gerygone, Olive-backed Oriole and Rufous Songlark. Most or all of the cuckoos probably belong to this group too. Several other species, although seen during winter appear to be more common in spring and summer. These include Black-faced Cuckoo-shrike (absent in winter from Bombala), Red Wattlebird (Armidale and Canberra), Noisy Friarbird (Armidale and Canberra), Dusky Woodswallow (all areas but absent from winter in southern ones).

A few species differ in status between the four areas (Table 8). Overall there is a tendency for status to change from summer to winter visitor

TABLE 8

Status of various species at each of four sites.

	Armidale 30°30'S This study	Canberra 35°30'S Bell 1980	Bombala 37°S Recher *et al.* 1983b	Gippsland 38°S Loyn 1980
Golden Whistler	Chiefly winter visitor	Winter visitor	Non-breeding visitor	Chiefly summer visitor
Grey Fantail	Autumn peak	Chiefly summer visitor	Summer visitor	Chiefly summer visitor
Yellow-faced Honeyeater	Chiefly winter visitor	Autumn and spring peaks	Summer visitor	Chiefly summer visitor
White-naped Honeyeater	Chiefly winter visitor	Spring peak	Summer visitor	Concentrate in winter
Spotted Pardalote	Scarce in spring	Chiefly autumn and winter	Summer visitor	?
Striated Pardalote	Scarce in spring	Complex	Summer visitor	Chiefly summer visitor
Silvereye	Chiefly winter visitor	Passage migrant	Summer visitor	Chiefly summer visitor
Altitude	1 000 m	650 m	850 m	200-400 m

as one goes north, e.g. in Golden Whistler, Yellow-faced Honeyeater and Striated Pardalote. Regular patterns are complicated by differences in altitude and the frequent presence of two or more populations. For instance, near Armidale a few Silvereyes breed, but many more pale-flanked (mainland?) birds arrive in autumn as do many dark-flanked (Tasmanian?) birds.

Perhaps only the White-browed Woodswallow *Artamus superciliosus* can be regarded as a nomadic visitor. It was common in Armidale in spring 1980 and spring 1982 with many breeding, but virtually absent in 1981 and 1983. It was also abundant at Bombala in 1980 (Recher and Schulz 1983), though not recorded previously, and reached Nadgee, far south coast of NSW, in 1981 (Recher, pers. comm.).

Several species for which we plotted home-ranges were also censused by two or more methods by Bell and Ferrier (1985) or Shields and Recher (1984), though their methods differed from ours. Shields and Recher also suggested the best census methods for each of their species. Eastern Yellow Robins were under-estimated by Shields and Recher and by us from transects. Plotting of territories or home-ranges is probably the best method for this species, though communal breeding, which we did not observe, may complicate matters. Unlike us Shields and Recher (1984) found female Rufous Whistlers conspicuous on transect censuses, possibly because they covered their transects more slowly than we did.

Fairy-wrens and White-throated Treecreepers were easy to locate at both sites, and Bell and Ferrier (1985) found that their transect counts of treecreepers were reliable. Speckled Warblers sing well, so their territories can easily be mapped, but their complex social organization (Bell 1984) means that mapping should be combined with colour-banding if absolute densities are required. Shrike-tits are probably reliably counted on transects, indeed mapping may be unreliable as they have large territories and may breed communally (Howe and Noske 1980). We considered mapping, colour-banding and nest-searches for our common honeyeater, the Fuscous, but experienced the same difficulties that Shields and Recher did with the White-naped Honeyeater (high density, complex social behaviour). Transect censuses are probably the best way to count honeyeaters, unless a lot of time is committed to banding and nest-searching. Finally it should be pointed out that transect censusing is virtually the only method that can be used in the non-breeding season.

Bell and Ferrier (1985) compared the densities from mapped ranges of colour-banded birds with estimates from transects. They also found that transect censuses underestimate density but that those of variable width (Emlen's (1971) method) are more reliable than fixed-width transects.

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