Altitudinal distribution of birds at the Warra LTER Site, southern Tasmania: a preliminary study

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Abstract

Birds were surveyed in late autumn/winter and in summer at plots along an altitudinal transect ranging from 60 to 1300 metres above sea level at the Warra Long-Term Ecological Research Site. Twenty-four species were recorded during surveys, including eight endemic and one exotic species. Species richness and bird abundance both declined dramatically above the tree-line, which occurs between 1000 and 1100 m asl. Only one species, typical of lowland treeless habitats elsewhere, was recorded solely above the tree-line in the present study. Several species were restricted to mixed forest plots (700 m asl and below). Neither species richness nor bird abundance was significantly different between the two sampling periods. However, several species showed seasonal trends in frequency and abundance, as a result of movements into and out of the area or due to altitudinal movements within the area. The number of species recorded during surveys was lower than that found in other studies in similar habitats elsewhere in Tasmania. This may be due to the restricted period of sampling and the relative habitat homogeneity of the Warra altitudinal transect. Nevertheless, the study provides baseline data for future research. A list of bird species recorded at Warra in this and other studies is also provided.

Introduction

The Warra Long-Term Ecological Research (LTER) Site has been established in the Southern Forests of Tasmania in order to provide an experimental research base for an ecological approach to management and also to provide an understanding of the ecology of Tasmanian wet sclerophyll forests (Packham 1995). In addition to research into the impact of various silvicultural regimes on soil, water, flora and fauna, baseline data from undisturbed forest are being collected. The present study is part of that baseline data collection. Previous research on birds at the Warra LTER Site includes a study of the impacts of logging (Hingston 2000), and preliminary data collection in the silvicultural systems trial by Brown (1998) and the present author.

Research elsewhere has shown that there is generally an inverse relationship between altitude and bird species richness (Gall and Longmore 1978; Hawkins 1999; Lan and Dunbar 2000), due to the reduced variety of habitats at high altitude. No Australian bird species is confined to alpine habitats. In the Snowy Mountains, Osborne and Green (1992) noted that only two species, the little raven and Richard's pipit, both of which are associated with lowland treeless habitats, were more abundant in the alpine zone than in subalpine woodland. Studies in Australia have tended to concentrate on a relatively small range of altitudes in either forest (Lamm and Wilson 1966; Brereton and Taylor 2000) or alpine habitats (Thomas 1987; Schulz 1991). However, Ratkowsky and Ratkowsky (1976) recorded observations from 240 to 1270 m above sea level (asl) on Mount Wellington in spring and summer, and Hingston (1994) examined sites ranging

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from 450 to 1200 m asl in Tasmania's Great Western Tiers over a one-year period.

Climatic change has been invoked as a factor affecting the distribution of bird species and the timing of altitudinal migrations (Pounds *et al.* 1999; Inouye *et al.* 2000). The present study documents an initial sampling of the altitudinal and seasonal distribution of a depauperate island avifauna, from mixed forest at 60 m asl to alpine habitats at 1300 m asl. In the event of significant climate change or associated environmental changes, these data will provide a baseline for future comparisons.

Methods

Fixed-point distance surveys of 20 minutes duration were conducted at 100 m contour intervals along three altitudinal transects (see Brown *et al.* 2001). Each transect ran generally along a ridgeline in unlogged vegetation. The first ranged from 60 to 560 m asl and the second from 100 to 600 m asl. Both of these were in State forest. The third ranged from 600 to 1300 m asl on the slopes of Mount Weld in the Southwest National Park, part of the Tasmanian Wilderness World Heritage Area. A general description of the vegetation is given by Corbett and Balmer (2001). All birds seen or heard were recorded, as well as the distance from the central point. To avoid problems arising from differences in species' detectability, only those birds within 40 m were included for species richness and abundance analysis. Records beyond 40 m helped to inform species' altitudinal distributions. The author performed all surveys on the lower transects, while the author and one other person performed the surveys on the upper transect (a different person each season).

Surveys were undertaken in late autumn and winter (between April 26th and June 6th 2000) and in summer (between January 9th and February 4th 2001). Plots on the upper transect were surveyed from seven to nine times in both sample periods. Plots on the lower transects were surveyed three times in autumn/winter, and four times in summer. At each plot, at least one survey in each season was performed in early morning (within three hours of sunrise). Other surveys were conducted in late morning and early afternoon, with exact times dependent on practical considerations of walking between sites. However, every effort was made to ensure that sample times were generally equivalent between sites. Surveys were not performed in rain or in high winds. There was no snowfall or snow cover during either of the sampling periods.

Due to the lower number of surveys on the lower transects, it was decided to combine surveys for presentation of data. The 60 and 100 m asl survey plots were combined, the 160 and 200 m asl plots, and so on. The vegetation of the plots in the lower transects was equivalent, and ordination of plots and multi-response permutation procedures found that there was no significant difference between the bird composition of the surveys on the two lower transects. Therefore, it was considered legitimate to combine these surveys.

There was some difficulty determining the species of a member of the Accipitridae that was recorded. It may be either the collared sparrowhawk or the brown goshawk.

Seasonal differences in species richness and total abundance, as well as abundance of more common species (over all sites), were tested using the Mann-Whitney W test. Depending on these seasonal differences, species were classified as summer visitors, winter visitors and residents, while infrequently recorded species were not classified.

Results

Twenty-four species were recorded during the surveys (Table 1), including eight endemic species, and one introduced species, the superb lyrebird. Several other

Table 1. Distribution of bird species along an altitudinal gradient in autumn/winter and in summer.

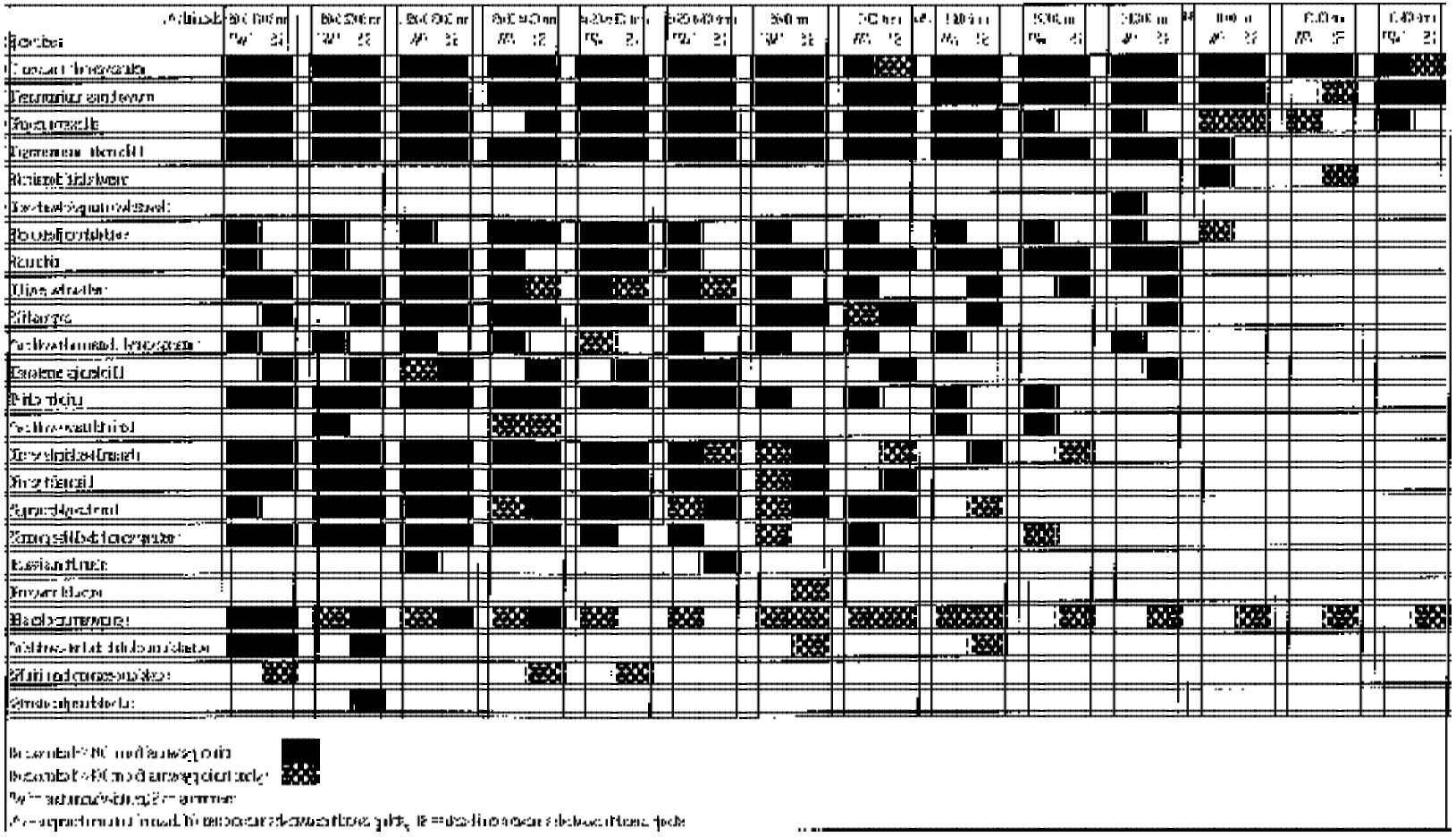

Table 2. Frequency and abundance of species, species richness, and total bird abundance by season.

Species	Per cent of surveys recorded		Mean abundance over all surveys ± SD			
	Autumn / winter (n = 97)	Summer (n = 111)	Autumn / winter (n = 97)	Summer (n = 111)	Mann-Whitney W Test	Seasonal pattern
Yellow-throated honeyeater	19.59	0	0.27 ± 0.62	0	-	winter visitor
Pink robin	28.87	7.21	0.36 ± 0.62	0.08 ± 0.31	P < 0.001	winter visitor
Scrubtit	36.08	12.61	0.44 ± 0.66	0.15 ± 0.43	P < 0.001	winter visitor
Spotted pardalote	30.93	2.71	0.37 ± 0.60	0.03 ± 0.16	P < 0.001	winter visitor
Crescent honeyeater	62.89	43.24	1.58 ± 2.00	1.02 ± 1.55	P < 0.01	winter visitor
Strong-billed honeyeater	16.49	6.31	0.24 ± 0.63	0.09 ± 0.39	P < 0.05	winter visitor
Green rosella	24.74	26.13	0.27 ± 0.49	0.36 ± 0.69	NS	resident
Tasmanian thornbill	65.98	62.16	1.41 ± 1.34	1.17 ± 1.14	NS	resident
Tasmanian scrubwren	44.33	49.55	0.59 ± 0.77	0.69 ± 0.80	NS	resident
Grey fantail	14.43	25.22	0.17 ± 0.43	0.30 ± 0.55	NS	resident
Silvereye	5.15	27.93	0.07 ± 0.33	0.56 ± 1.09	P < 0.001	summer visitor
Eastern spinebill	3.09	30.63	0.03 ± 0.17	0.48 ± 0.86	P < 0.001	summer visitor
Olive whistler	11.34	7.21	0.12 ± 0.36	0.09 ± 0.37	-	resident
Superb lyrebird	7.22	9.01	0.07 ± 0.26	0.12 ± 0.40	-	resident
Grey shrike-thrush	7.22	7.21	0.08 ± 0.31	0.10 ± 0.38	-	resident
Yellow wattlebird	3.09	0	0.03 ± 0.17	0	-	unclear
Yellow-tailed black cockatoo	1.03	1.80	0.01 ± 0.10	0.02 ± 0.13	-	unclear
Black currawong	1.03	6.31	0.02 ± 0.20	0.06 ± 0.24	-	unclear
Striated fieldwren	3.09	0	0.03 ± 0.17	0	-	unclear
Striated pardalote	0	0.90	0	0.01 ± 0.10	-	unclear
Goshawk / sparrowhawk	2.06	0	0.02 ± 0.14	0	-	unclear
Bassian thrush	2.06	0.90	0.02 ± 0.14	0.01 ± 0.10	-	unclear
			Mean ± SD			
			autumn/winter	**summer**		
Species richness			3.91 ± 2.65	3.27 ± 2.23	NS	
Total abundance			6.21 ± 4.74	5.33 ± 4.19	NS	

NS = not significant; - = not analysed

species were observed incidentally in the Warra LTER Site. A full list of common and scientific names of species observed (both in the present study and in previous studies) is included in Appendix 1. In autumn / winter, a total of 602 individuals were recorded within 40 m of a survey point from 97 surveys. In summer, 592 individuals were recorded from 111 surveys. The crescent honeyeater and Tasmanian thornbill were the only species recorded in more than 50% of surveys, while other abundant species included the pink robin, scrubtit, Tasmanian scrubwren, grey fantail, green rosella and silvereye. All of these are typical Tasmanian wet forest bird species. Ordination and *t*-tests showed no significant difference in abundance, species richness or species composition between surveys performed by the author and either of the other observers on the upper transect.

Table 1 shows the distribution of individual species along the altitudinal gradient in autumn / winter and in summer, including distributions of species where they were only recorded more than 40 m from a survey point. Species that were frequently recorded beyond 40 m were those with loud and distinctive calls, such as the grey shrike-thrush and olive whistler, or large and visible species, such as the black currawong and green rosella. Some of these records were from some considerable distance from the survey point, and they may have been significantly above or below the altitude under which they are entered. Nevertheless, the information provided supplements records within 40 m. In particular, the presence of the black currawong at high altitudes would not be apparent solely from records within 40 m of survey points. Outside of survey times, several species were observed above the tree-line, including the wedge-tailed eagle, Australian hobby and three honeyeater species.

In general, the species recorded at higher altitudes were a subset of those from the lower forests. The tree-line lies between 1000 and 1100 m asl, and very few species were recorded above this. The striated fieldwren was the only species that was not recorded below the tree-line (Table 1). This species is known from treeless lowland habitats (Watts 1999). The crescent honeyeater was common above the tree-line, while the Tasmanian scrubwren was resident in small numbers. The 1200 m plot was particularly exposed and the crescent honeyeater was the only species recorded within 40 m of this plot. Several species were present (some with seasonal variation) up to the tree-line, while another group of species were either absent or extremely rare above the extent of mixed forest.

Several species showed seasonal trends (Table 2). Species fell generally into four groups: winter visitors, such as the yellow-throated honeyeater and spotted pardalote, which disperse within Tasmania; summer visitors, such as the eastern spinebill and silvereye, which arrive from mainland Australia or from elsewhere in Tasmania; residents, such as the Tasmanian thornbill and Tasmanian scrubwren; and those with no clear pattern, either through irregular movements or small numbers of recordings, such as the bassian thrush and black currawong. Seasonal differences of some species related to the entire altitudinal transect. For example, the yellow-throated honeyeater was common in autumn / winter but absent in summer, while the eastern spinebill was very rarely present in autumn / winter, but recorded at a range of altitudes in summer (Figure 3).

Species richness and total abundance were both slightly higher in autumn / winter than in summer (Figures 1 and 2) and, although these differences were not significant (Table 2), they were consistent along the altitudinal gradient except for the montane forest from 800 to 1000 m asl. Species richness and total abundance both showed a slight negative trend with altitude, but neither value declined considerably until the tree-line was reached. Figure 3 (a–e) shows the altitudinal abundance patterns for a selection of species, which exemplify

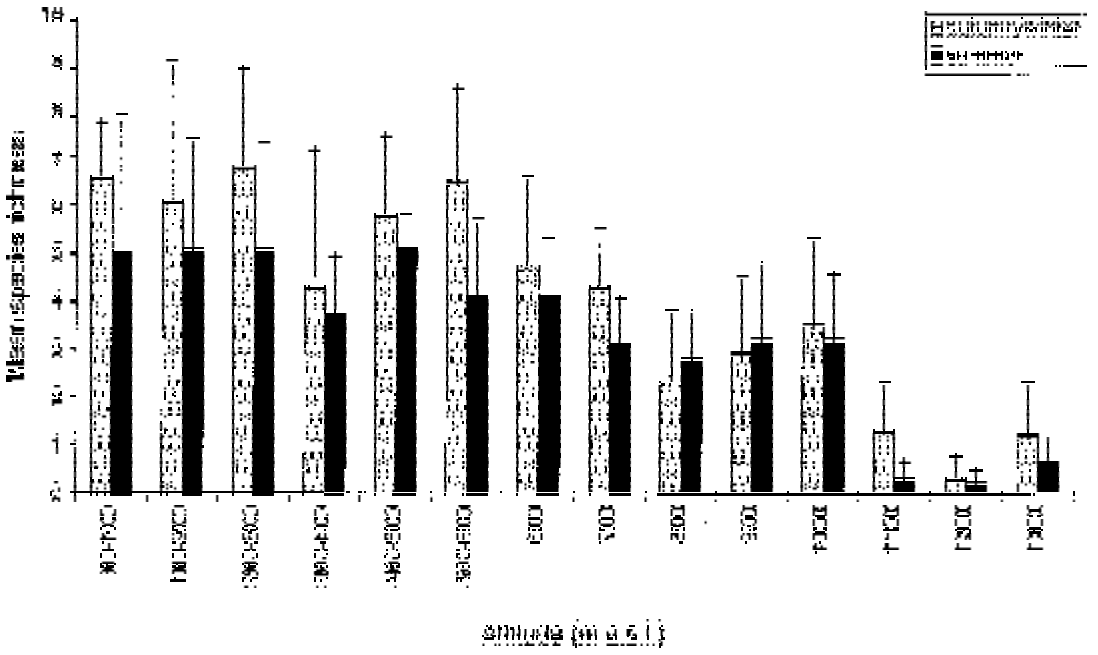

Figure 1. Mean species richness (per survey) and standard deviations by altitude. (Autumn/winter sample sizes: 60–100 to 560–600 m asl, n *= 6; 600 m asl,* n *= 8; 700 and 800 m asl,* n *= 9; 900–1300 m asl,* n *= 7. Summer sample sizes: 60–100 to 1200 m asl,* n *= 8; 1300 m asl,* n *= 7.)*

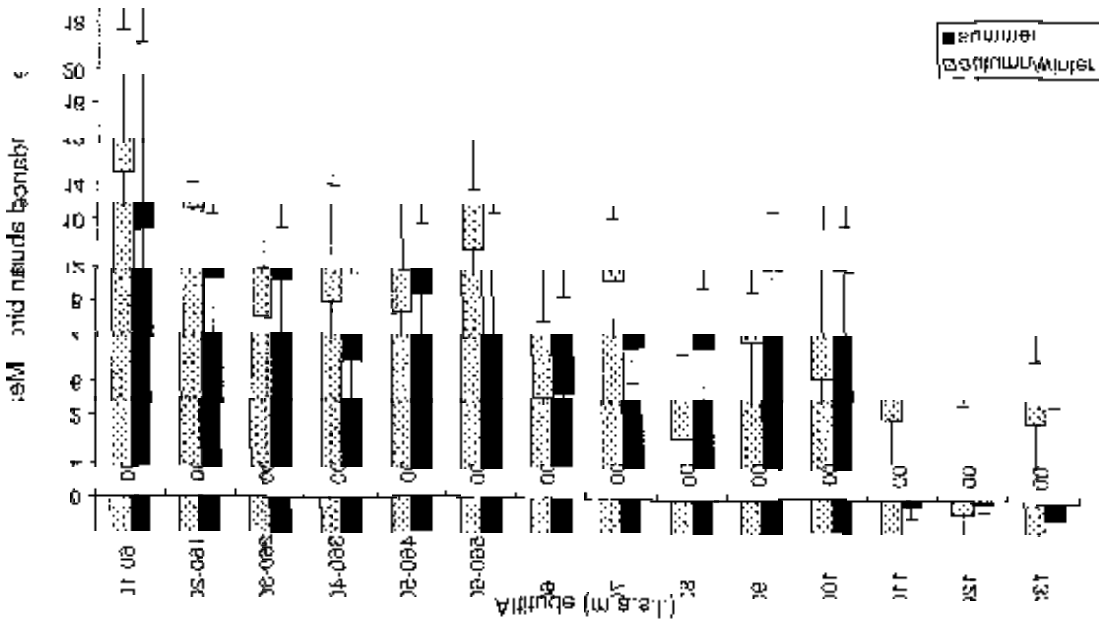

Figure 2. Mean total bird abundance (per survey) and standard deviations by altitude. (Autumn/winter sample sizes: 60–100 to 560–600 m asl, n *= 6; 600 m asl,* n *= 8; 700 and 800 m asl,* n *= 9; 900–1300 m asl,* n *= 7. Summer sample sizes: 60–100 to 1200 m asl,* n *= 8; 1300 m asl,* n *= 7.)*

distribution patterns. The grey fantail (Figure 3d) was recorded at higher altitudes in summer; similar patterns were observed in the olive whistler, grey shrike-thrush, and possibly the silvereye. The pink robin, by contrast, was recorded at higher altitudes during winter, and the strong-billed honeyeater showed a similar trend, as did the green rosella, which was more common above the tree-line in winter.

Discussion

Altitudinal distribution of birds

The small number of species recorded above the tree-line was consistent with other studies of alpine habitats in Tasmania (Ratkowsky and Ratkowsky 1976; Hingston 1994). Hingston (1994) recorded only ten species from a 1200 m asl site in the Great Western Tiers, with a maximum of five species from a single, half-hour survey. Two of those species were not recorded at all in the present study, but these were single records of the welcome swallow and peregrine falcon. The Tasmanian thornbill was also recorded from all alpine surveys in that study, whereas it was only recorded once above the tree-line in the present study. However, Hingston's (1994) site consisted of heath and shrubs up to 2 m tall, unlike the low, alpine vegetation of the survey plots above the tree-line on Mount Weld. Ratkowsky and Ratkowsky (1976) recorded only five species above the tree-line on Mount Wellington in spring and summer. The only species in common with the present study was the Tasmanian scrubwren. Other species recorded by Ratkowsky and Ratkowsky (1976) were the fantailed cuckoo, peregrine falcon, flame robin and forest raven, the last being the most common. Ratkowsky and Ratkowsky (1987) recorded 38 species from alpine habitats throughout Tasmania, but their study included montane rainforest, subalpine eucalypt forest and dwarf coniferous forest, and did not distinguish which species were recorded above the tree-line.

Compared with similar habitat on the Australian mainland, very few species were recorded above the tree-line on Mount Weld. Osborne and Green (1992) recorded 36 species (29 excluding waterbirds) above the tree-line in the Snowy Mountains, compared with seven on Mount Weld. The difference in species richness probably reflects both the depauperate nature of Tasmania's avifauna and the sampling effort of Osborne and Green's (1992) ten-year study. Species recorded by Osborne and Green (1992) included several species or congenerics of species which were recorded in forested habitat at lower altitudes on Mount Weld, such as the olive whistler, shining bronze-cuckoo, grey fantail and silvereye. The silvereye was also recorded above the tree-line on the Great Western Tiers (Hingston 1994). It is likely that some of these species venture above the tree-line on Mount Weld at times. Indeed, five species or congenerics recorded above the tree-line by Osborne and Green (1992) were observed above the tree-line outside of survey times during the present study. Several species recorded in alpine habitat in the Snowy Mountains were typical of lowland treeless habitats, particularly grassland. The absence of similar species at Mount Weld may reflect temporal variation in their use of that habitat. Alternatively, they may be absent from the Warra LTER Site because, unlike other highland areas, there is little or no low altitude grassland close by. Treeless lowlands near Mount Weld are buttongrass plains, habitat for the striated fieldwren, the one open country species recorded above the tree-line in the present study.

The species recorded from forested habitats on the altitudinal transect are also consistent with the avifauna of Tasmanian wet forests. Hingston (2000) recorded 31 species from low altitude, oldgrowth forest in the Warra LTER Site in autumn. Eleven species recorded in that study were not recorded in the present study. Eight of the 11 species were very scarce in Hingston's (2000) study, and their absence can be explained by habitat preferences. Two species, the forest

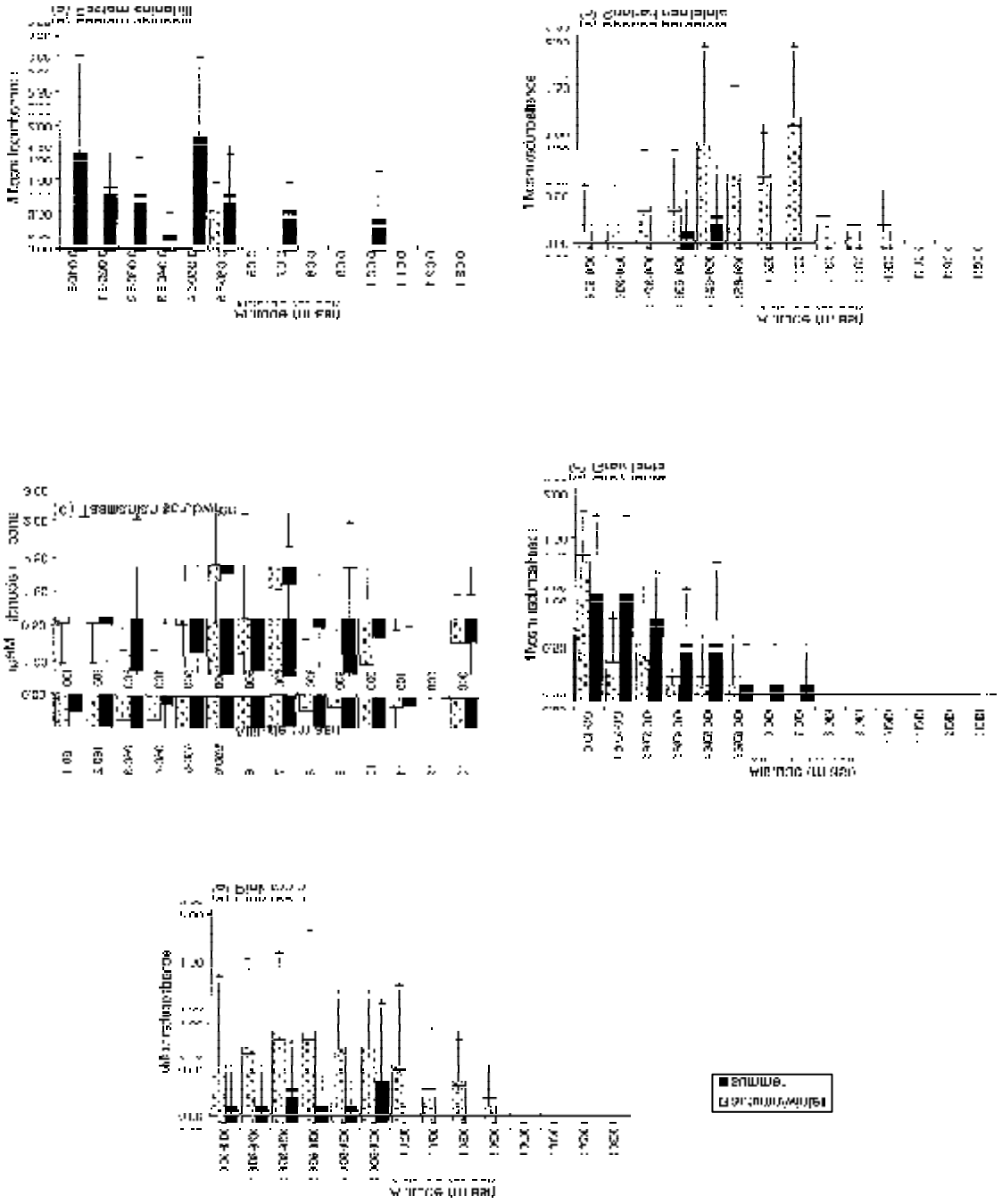

Figure 3. Altitudinal distribution according to season of: (a) summer visitor, eastern spinebill; (b) winter visitor, spotted pardalote; (c) resident, Tasmanian scrubwren; (d) higher altitude in summer, grey fantail; and (e) higher altitude in winter, pink robin. (Autumn/winter sample sizes: 60–100 to 560–600 m asl, n = *6; 600 m asl,* n = *8; 700 and 800 m asl,* n = *9; 900 to 1300 m asl,* n = *7. Summer sample sizes: 60–100 to 1200 m asl,* n = *8; 1300 m asl,* n = *7.)*

raven and superb fairy-wren were common, are visually and aurally distinctive, but are typical of more disturbed and open habitats than were surveyed in the present study. The black-headed honeyeater was also commonly recorded by Hingston (2000), and it is possible that some individuals of this species have been overlooked amongst strong-billed honeyeaters in the present study. In other wet sclerophyll forest and mixed forest areas in Tasmania, a similar species composition has been recorded (Ratkowsky and Ratkowsky 1976; Thomas 1986; Hingston 1994; Brereton and Taylor 2000). These studies have recorded more species than the present study, and reasons for this are discussed below.

The altitudinal distribution of the birds in forested habitats showed some interesting trends. While many species were generally present from the Weld River valley to the subalpine eucalypt woodland, several species did not extend, or barely extended, beyond the range of mixed forest, presumably due to lack of foraging opportunities. These species included the strong-billed honeyeater, grey shrike-thrush, grey fantail, superb lyrebird, spotted pardalote and bassian thrush. It is worth noting that the last species is almost certainly under-represented in the records due to its cryptic nature and lack of vocalisation. It was encountered fairly often while walking between sites, but point counts are probably not the best way to survey this species. None of the commonly recorded species preferred the subalpine eucalypt woodland or montane rainforest, and no species dropped out as altitude decreased. This is similar to the experience at Jackeys Marsh (Hingston 1994) and on Mount Wellington (Ratkowsky and Ratkowsky 1976).

Studies of wet sclerophyll forest elsewhere in Tasmania have tended to record more species (Thomas 1986; Brereton and Taylor 2000). The low overall species richness of the present study may be explained by the comparative sampling effort and the range of habitats sampled by other studies. The present study was restricted to *Eucalyptus obliqua*-dominated mixed forest, montane rainforest, *E. coccifera* subalpine woodland and alpine vegetation. Ratkowsky and Ratkowsky (1976) recorded 62 species from Mount Wellington, but sampled dry sclerophyll forest, gully vegetation, and land cleared for farming, in addition to habitats similar to those found in the altitudinal plots of the present study. Thomas (1986) recorded 36 species from *E. obliqua*-dominated wet sclerophyll forest on Mount Wellington, but this was from 51 four-hour visits spread throughout the year, and he noted that some species he recorded were typical of dry sclerophyll forest, which is adjacent to that site. Species recorded in the other studies in Tasmania mentioned above that were not recorded in the present study are mostly uncommon and/or cryptic (such as the grey goshawk and brush bronzewing), typical of non-wet forest habitats (such as the brown thornbill, blue-winged parrot and tree martin), or exotics (such as the common blackbird, common starling and goldfinch). Surveying for the present study was undertaken in a limited period, with relatively few repeats, and more surveys are required. Species that were not recorded or were rarely recorded and which might have been expected to be more abundant include migratory species, such as the fan-tailed cuckoo, shining bronze-cuckoo, flame robin and striated pardalote. These may have been recorded with further sampling, but it is also possible that the generally harsh climate of the Southern Forests, combined with low habitat diversity, has resulted in an avifauna depauperate in comparison with other Tasmanian forests. The importance of short-term changes in weather is difficult to quantify, but is likely to be considerable, especially at higher altitudes where extreme weather conditions are quite common.

Seasonal variation

Species richness and total bird abundance were not significantly different between autumn/winter and summer. Both measures

were slightly higher in autumn/winter, which is counter-intuitive, due to the presence of summer migrants. This probably reflects changes in behaviour and detectability. In winter, when resources are scarcer, birds may forage more actively and over a wider area. In summer, when territories have been established and nesting is occurring, birds may be less conspicuous. Sampling in the present study was performed after the spring courtship period, which would explain the fact that there was no increase in abundance or species richness. Brereton and Taylor (2000) noted a similar pattern in wet sclerophyll forest on the Central Plateau.

Species composition did show seasonal differences. Several species showed distinct trends in presence and abundance in the study area. Movement of birds, whether local or long distance, in response to changes in abundance of resources such as insects and flowers, is a common theme in forests and alpine areas in south-eastern Australia (Lamm and Wilson 1966; Osborne and Green 1992; Loyn 1993). Six species in the present study are listed as winter visitors. Differences in seasonal abundance for the pink robin and scrubtit may be due to differences in detectability rather than actual differences in abundances, although the former is described as nomadic (Watts 1999). Anecdotal evidence and examination of raw data indicate that these species were commonly recorded purely by call in autumn/winter, whereas in summer most records were from sightings. This suggests that seasonal changes in vocal behaviour may be responsible for differences in records of these two species. It may also be important for other species, but this was not evident from personal experience. Only two common species (the silvereye and eastern spinebill) were recorded significantly more often in summer, despite greater resource availability at this time. Summer migrants such as the fantailed cuckoo, dusky woodswallow and black-faced cuckoo-shrike, which have been observed by the author in the Warra LTER Site although not in the present study's surveys, also move into the area at this time. The movement of some species (e.g. the grey fantail, olive whistler and grey shrike-thrush) to higher altitudes in summer is presumably due to increased resource availability. Canopy invertebrate abundance is highest in eucalypt forests in warmer months (Recher *et al.* 1990). More benign weather may also play a role. By contrast, three common species (the pink robin, strong-billed honeyeater and green rosella) were recorded at higher altitudes in winter, indicating that some foraging opportunities increase during the colder part of the year. Loose and hanging bark is a major winter foraging substrate in Victorian *Eucalyptus regnans* forests (Loyn 1985a, b), and bark is shed by *Eucalyptus obliqua* in southern Tasmanian forests in late autumn and winter (Turnbull and Madden 1986). Bark is the major foraging substrate for strong-billed honeyeaters and their distribution may reflect its availability. Sharland (1981) notes that the pink robin moves into drier eucalypt forest during the cooler months, although the reasons for this are unclear. The green rosella is thought to be feeding on seeds above the tree-line, but food species were not identified in the present study.

Exotic species

Monitoring changes in the number and abundance of exotic species is one way of monitoring disturbance or changes in wilderness quality. The only exotic species recorded during the present study was the superb lyrebird, which was introduced to Tasmania (at Hastings and Mount Field) in the 1930s and 1940s (M. Driessen, pers. comm.). It has since spread widely through the wet forests of southern and central Tasmania. Its impacts on ground foraging species such as the bassian thrush is not known. However, a recent study suggests that the scratchings and rakings of the superb lyrebird affect the vegetation structure of wet forests (Tanner 2000). The presence of only one exotic bird species probably reflects the relatively undisturbed nature of much of the Warra LTER Site, and

its remoteness from sources of those exotic species which prefer anthropogenic landscapes. This was the experience of Brown *et al.* (1998) at Pelion Plains near Mount Ossa, and Brereton and Taylor (2000) on the Central Plateau, who each recorded only one exotic species (the laughing kookaburra and superb lyrebird respectively). By contrast, studies in areas closer to anthropogenic landscapes reported more exotic bird species, and these tended to be European species rather than introductions from mainland Australia. Hingston (1994) recorded the laughing kookaburra, common starling, European goldfinch and common blackbird, while Ratkowsky and Ratkowsky (1976) recorded the last three of these in addition to the house sparrow and European greenfinch.

Conclusion

Species appear to be limited in their altitudinal distributions by the apparent availability of foraging niches, and very few extend beyond the tree-line. Most species typical of wet forest habitats in Tasmania were recorded from lower parts of the altitudinal transect, but with significant differences in species composition between seasons. This variability presumably reflects changes in resource availability. The Tasmanian alpine and wet forest avifauna is depauperate compared with that of mainland Australia, and the avifauna of the study area appears to be depauperate compared with those in more diverse alpine and forest habitats elsewhere in Tasmania.

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Appendix 1. Species recorded from the Warra LTER Site.

A. Species recorded from surveys on the altitudinal transect: total numbers recorded within 40 m of survey point by altitude (m asl) in autumn / winter (W) and summer (S)[1]. Nomenclature follows Christidis and Boles (1994).

Scientific name	Common name	60–100		160–200		260–300		360–400		460–500		560–600		600		700		800		900		1000		1100		1200		1300		Total	
		W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S
Accipiter fasciatus	goshawk sp.[2]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0
Accipiter cirrocephalus	goshawk sp.[2]																														
Calyptorhynchus funereus	yellow-tailed black cockatoo	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Platycercus caledonicus	green rosella[3]	5	4	3	1	3	1	0	3	1	3	2	4	5	14	1	4	2	3	1	3	1	0	0	0	0	0	2	0	26	40
Menura novaehollandiae	superb lyrebird[4]	1	0	2	1	1	3	0	4	1	1	0	1	0	1	2	2	0	0	0	0	0	0	0	0	0	0	0	0	7	13
Pardalotus punctatus	spotted pardalote	1	0	1	0	2	0	2	1	6	2	4	0	5	0	11	0	2	0	1	0	1	0	0	0	0	0	0	0	36	3
Pardalotus striatus	striated pardalote	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Sericornis humilis	Tasmanian scrubwren[3]	3	2	3	4	2	9	2	1	3	7	8	10	7	9	13	11	2	4	1	9	7	5	1	1	0	0	5	5	57	77
Acanthonris magnus	scrubtit[3]	5	0	7	0	5	2	1	0	5	2	4	0	5	4	5	1	1	1	3	5	2	2	0	0	0	0	0	0	43	17
Calamanthus fuliginosus	striated fieldwren	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	3	0
Acanthiza ewingii	Tasmanian thornbill[3]	13	14	13	16	8	14	10	10	14	13	18	13	19	11	18	12	7	5	7	9	9	13	1	0	0	0	0	0	137	130
Anthochaera paradoxa	yellow wattlebird[3]	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	3	0
Lichenostomus flavicollis	yellow-throated honeyeater[3]	1	0	1	0	6	0	7	0	0	0	5	0	2	0	2	0	1	0	0	0	1	0	0	0	0	0	0	0	26	0
Melithreptus validirostris	strong-billed honeyeater[3]	2	7	6	1	4	1	4	1	3	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	23	10
Phylidonyris pyrrhoptera	crescent honeyeater	33	13	12	2	8	5	11	1	9	6	11	12	2	1	7	0	7	18	15	26	17	27	9	1	4	1	8	0	154	113
Acanthorhynchus tenuirostris	eastern spinebill	0	12	0	7	0	6	0	1	0	14	3	6	0	0	0	4	0	0	0	0	0	3	0	0	0	0	0	0	3	53
Petroica rodinogaster	pink robin	3	1	4	1	5	2	5	1	4	1	4	3	4	0	2	0	3	0	1	0	0	0	0	0	0	0	0	0	35	9
Pachycephala olivacea	olive whistler	2	1	2	1	1	2	2	0	1	0	1	0	2	0	1	0	0	3	0	1	0	2	0	0	0	0	0	0	12	10
Colluricincla harmonica	grey shrike-thrush	1	3	1	1	2	2	1	1	2	1	1	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	8	11
Rhipidura fuliginosa	grey fantail	8	8	2	8	3	6	1	4	1	4	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	16	33
Strepera fuliginosa	black currawong[3]	2	1	0	3	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	7
Zosterops lateralis	silvereye	0	17	0	9	1	3	2	11	1	8	2	2	1	9	0	1	0	1	0	0	0	1	0	0	0	0	0	0	7	62
Zoothera lunulata	bassian thrush	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1
Total		81	84	58	57	52	57	48	41	51	62	67	53	52	51	64	36	26	37	30	53	40	53	14	2	4	1	15	5	602	592

[1] Number of surveys: autumn / winter — 60–100 to 560–600 m asl, *n* = 6; 600 m asl, *n* = 8; 700 and 800 m asl, *n* = 9; 900–1300 m asl, *n* = 7. Summer — 60–100 to 1200 m asl, *n* = 8; 1300 m asl, *n* = 7.

[2] These two species were not differentiated during the present study

[3] Endemic species

[4] Exotic species

Appendix 1. Continued.

B. Species recorded more than 40 m from survey point or outside survey times in the present study, by the present author during other surveys, by Brown (1998) or by Hingston (2000).

Scientific name	Common name	Scientific name	Common name
Phalacrocorax carbo	great cormorant	*Phylidonyris novaehollandiae*	New Holland honeyeater
Aquila audax	wedge-tailed eagle	*Petroica multicolor*	scarlet robin
Falco longipennis	Australian hobby	*Petroica phoenicea*	flame robin
Falco berigora	brown falcon	*Melanodryas vittata*	dusky robin[1]
Phaps elegans	brush bronzewing	*Pachycephala pectoralis*	golden whistler
Cacatua galerita	sulphur-crested cockatoo	*Coracina novaehollandiae*	black-faced cuckoo-shrike
Cacomantis flabelliformis	fantailed cuckoo	*Cracticus torquatus*	grey butcherbird
Chrysococcyx lucidus	shining bronze-cuckoo	*Corvus tasmanicus*	forest raven
Ninox novaeseelandiae	southern boobook	*Stagonopleura bella*	beautiful firetail
Malurus cyaneus	superb fairy-wren	*Hirundo nigricans*	tree martin
Acanthiza pusilla	brown thornbill	*Hirundo neoxena*	welcome swallow
Melithreptus affinis	black-headed honeyeater[1]		

[1] Endemic species