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Diurnal birds in the Bungawalbin Creek catchment, northern New South Wales, with a focus on spatial and temporal changes in reporting rates of declining woodland birds

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Birds at 41 sites in grassy dry open sclerophyll (eucalypt) forests and woodlands in eight State Forests in the Bungawalbin Creek catchment, Richmond River District, northern New South Wales, were surveyed across all seasons from February 2004 to July 2006. One hundred and eight diurnal species were detected, including 11 state-listed threatened species and a further 17 temperate woodland species considered to be of conservation concern. No introduced species were found. Results suggest that the bird assemblages of the Bungawalbin Creek middle catchment dry forests have remained largely intact over the 25 years following a previous study (1977–80), and confirm the persistence of populations of a range of threatened taxa and other species identified as declining or subject to local extinction on the adjoining tablelands and slopes of northern New South Wales. The study area is a stronghold for declining temperate woodland species such as Painted Button-quail *Turnix varius,* Little Lorikeet *Glossopsitta pusilla*, Brown Treecreeper *Climacteris picumnus* and Black-chinned Honeyeater *Melithreptus gularis*. Evidence for lower recent reporting rates was found, however, in Peaceful Dove *Geopelia striata*, Buff-rumped Thornbill *Acanthiza reguloides*, Varied Sittella *Daphoenositta chrysoptera,* Rufous Whistler *Pachycephala rufiventris*, Jacky Winter *Microeca fascinans* and Double-barred Finch *Taeniopygia bichenovii*.

INTRODUCTION

Temperate eucalypt woodlands were once widespread in south-eastern Australia, occurring mainly along and inland of the Great Dividing Range from southern Queensland through to South Australia. These woodlands have been cleared and degraded to such an extent that they now comprise some of the most heavily-modified landscapes in Australia (Lindenmayer *et al.* 2005; Rayner *et al.* 2014). Many temperate woodland birds are regarded as having undergone substantial, and ongoing, population declines at regional to national scales, largely as a consequence of the extensive loss and modification of their eucalypt woodland habitat (Recher 1999; Reid 1999; Ford *et al.* 2001; Olsen *et al.* 2005; Barrett *et al.* 2007; Montague-Drake *et al.* 2009). Although the status of woodland birds has been widely discussed in the published literature, there have been relatively few robust studies measuring population changes in specific locations over time (Rayner *et al.* 2014).

Bungawalbin Creek, a tributary of the Richmond River, drains the lower rainfall south-western sector of the Richmond Valley, on the North Coast of New South Wales (NSW). Although now a mosaic of cleared and forested land, the catchment retains in its middle reaches tracts of grassy woodland and dry open eucalypt forest, mostly within some eight State Forests (SFs) ranging in size between 610 and 11 000 hectares. These vegetation formations include near-coastal outliers of the temperate woodlands of south-eastern Australia (Keith 2004).

Gosper (1992) compiled a comprehensive bird species inventory using monthly surveys at two sites in the Bungawalbin Creek catchment, one each in Myrtle and Royal Camp SFs. The sites were chosen as representative samples of the major vegetation formations in the middle catchment. That study, carried out in 1977–80, and subsequent casual surveys (Gosper and Holmes 2002), identified the presence of coastal populations of a suite of woodland species identified as declining or at risk in south-eastern Australia, including, notably, the adjacent New England Tableland and North-West Slopes regions of NSW (Barrett *et al.* 1994; Reid 1999; Watson *et al.* 2003; Courtney and Debus 2006; Debus *et al.* 2006a; Ford *et al.* 2009).

The aim of the present study (foreshadowed by Gosper and Holmes 2002), in which multiple sites across eight SFs were surveyed, was to provide more recent information on the composition of the bird communities of the Bungawalbin Creek middle catchment, and to compare this with data collected 25 years earlier. There was a focus on assessing the distribution and persistence of species of conservation concern, including, but not limited to, those species currently listed under the NSW *Threatened Species Conservation Act 1995*.

STUDY SITES

Forty-one survey sites were located in eight SFs in the Bungawalbin Creek catchment in north-east NSW (Figure 1; see Appendix 1 for a list of SFs, their areas and locations of sites). The study area lies between 15 and 55 kilometres south of Casino and between 25 and 55 kilometres from the coastline. Topography is relatively flat, with elevation 20 to 130 m asl. Watercourses flow intermittently and semi-permanent waterholes and small dams are few. The area lies in the subtropical climate zone, is characterized by a wet summer and a dry late winter-spring, with a mean annual rainfall (Casino) of 1046 mm (see Gosper 1986 for a more detailed overview).

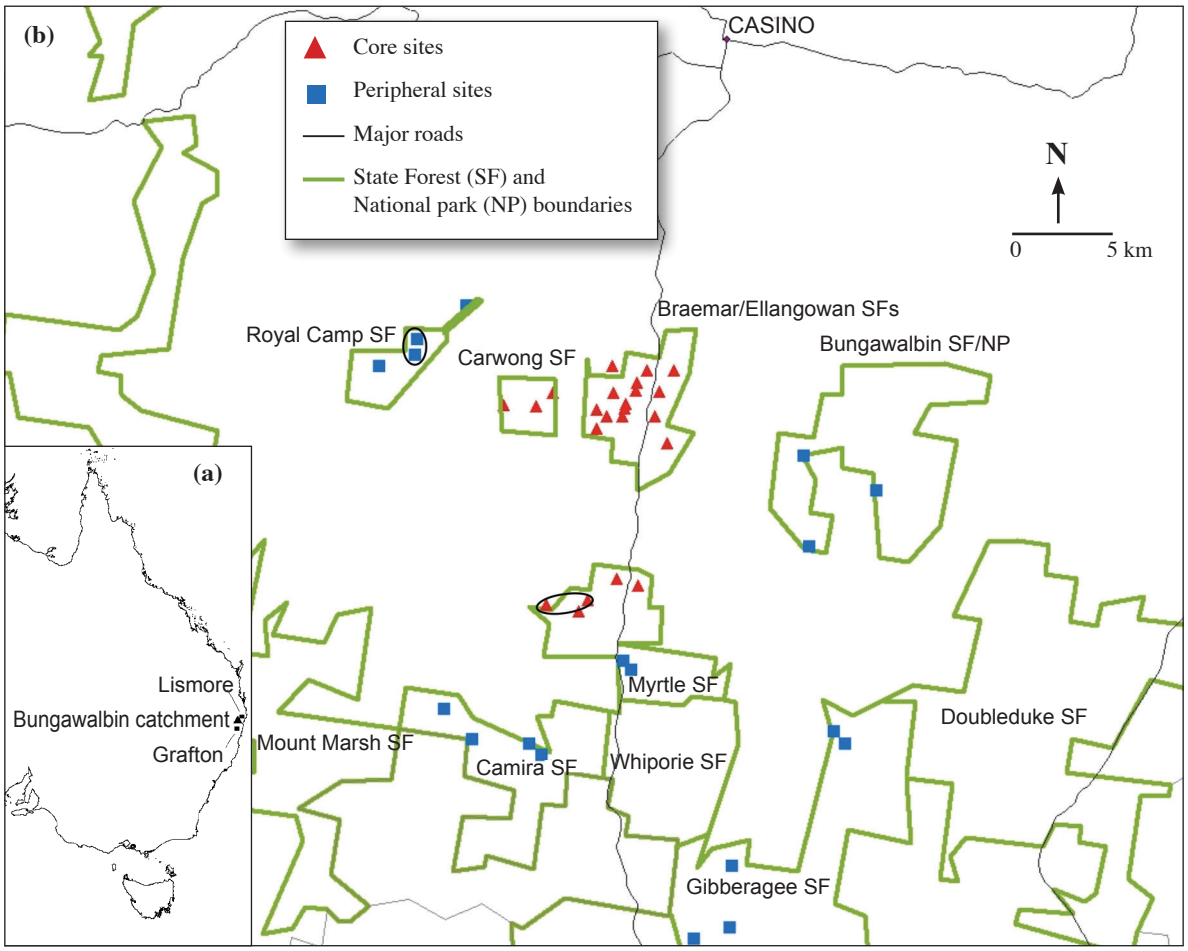

Figure 1. *Location of the: (a) Bungawalbin Creek catchment in Australia; and (b) sample sites within the catchment. The two encircled pairs of 2004–6 sites comprise those areas also surveyed in 1977–80. See Methods for the rationale underpinning the division of sites into core and peripheral.*

Vegetation formations are grassy dry open eucalypt forests and woodlands, with Clarence Valley Dry Sclerophyll Forest and Coastal Valley Grassy Woodlands the dominant classes. For floristic and structural descriptions see Binns (1995) and Keith (2004); also Gosper (1992) and Totterman (2012) for details of some specific sites. Canopy dominant trees included spotted gums (*Corymbia henryi* and *C. variegata*), ironbarks (*Eucalyptus siderophloia* and *E. crebra*), Grey Box (*Eucalyptus moluccana*), Grey Gum (*E. propinqua*), Forest Red Gum (*E. tereticornis*) and Pink Bloodwood (*C. intermedia*). The structure and biotas of these formations in the Bungawalbin and nearby Clarence catchments have stronger affinities with woodlands of the New England Tablelands and Western Slopes, and with the dry forests of subtropical south-east Queensland, than with other vegetation formations of the NSW North Coast and adjoining escarpment (Gosper 1992; Keith 2004).

Braemar, Myrtle (part), Carwong and Ellangowan SFs (25 sites in total) comprised the core study area, supplemented by a further 16 sites (termed 'peripheral') in the closest sections of surrounding SFs (Myrtle (part), Royal Camp, Camira, Bungawalbin and Gibberagee) (Figure 1). Peripheral sites tended to be moister forests with more understorey shrubbery (including invasive lantana *Lantana camara*) compared with the more open forests/woodland of the core area. This is associated with closer proximity to the catchment rim (i.e. Richmond Range; except Bungawalbin) to the south and west; and therefore slightly increasing elevation, hilliness of the terrain and precipitation, and local drainage factors, such as sites with riparian vegetation (single sites in Royal Camp and Gibberagee) or bordering swamp sclerophyll forest and associated seasonal inundation in parts (Bungawalbin SF). Sites were selected to provide a coverage of fine-scale habitat features including ridge lines, north and south facing slopes, low-lying areas, proximity to edges (access tracks, adjoining cleared areas and pine plantations, fence lines, log dump clearings, powerline corridors), watercourses, semi-permanent waterholes, and localized plant assemblages (e.g. banksia, paperbark, teatree) which occurred as isolated pockets. The two sites surveyed in 1977–80 were included in the 2004–06 study.

METHODS

Each of the 41 sites was surveyed four times, once in each season (41 x 4 = 164 surveys in total) over a 30-month period between February 2004 and July 2006. Surveys were made in

Table 1

Survey programs 1977–1980 and 2004–2006.

Period	Sites	Duration (months)	Frequency	Search time (minutes)	Surveys (total)	Survey effort (total hours)
Aug 1977-Jan 1980	2	30	monthly	150-180	58	165
Feb 2004-July 2006	41	30	1/season (4)	60	164	164

each calendar month except August 2005 and May 2006. A fixed route, determined by a 60 minute trial survey at each site, was used. Each 1977–80 site was divided and treated as two sites to fit the 2004–06 survey configuration. Actual completion times varied slightly, depending on the abundance of birds, and the need to deviate to identify birds detected from the route proper. Surveys were conducted in the mornings, by walking the route slowly, with frequent pauses. All species seen and heard were logged, although occasional records of waterbirds are not included here. On many days several sites were surveyed consecutively. All surveys in both 1977–80 and 2004–06 were conducted by DGG.

Survey programs used here, and by Gosper (1992), are summarized in Table 1. The 2004–06 survey program, which used multiple sites (i.e. 41 versus 2), was designed to provide a much broader coverage of the middle catchment forests in terms of geographical area and number of SFs sampled, and associated habitat features. Overall survey effort (time) was similar between 2004–06 and 1977–80 surveys (164 v 165 hours) but individual site survey search effort (60 minutes v 150 – 180 minutes), and as a consequence, survey patch size, was much reduced in 2004–6. Species presence only was recorded (i.e. numbers of individuals not tallied). Scientific names of bird species are shown in Table 2.

For each bird species per site, reporting rate was determined by the percentage of all visits in which that species was recorded. In statistical analyses, bird species recorded at less than five percent of total visits across all sites (1977–80 and 2004–06) were omitted, leaving 82 species. Non-metric multi-dimensional scaling ordination of sites by reporting rates of bird species was completed using PRIMER software (Version 6.1.11, PRIMER-E, Plymouth, UK), using the Bray-Curtis dissimilarity metric. Separate ordinations were conducted on all bird species and those previously identified as woodland decliners (see Table 3). PERMANOVA and PERMDISP were used to test whether there were differences in community composition of the whole bird community and woodland decliners between core and peripheral sites. SIMPER was used to identify which bird species contributed most to dissimilarity between core and peripheral sites.

RESULTS

A composite inventory encompassing all seasons and including species not detected in the current study but which were recorded in the 1977–80 study, and/or during incidental visits to some sites in the years between the two studies, produced 124 species (Table 2). One hundred and eight diurnal species were recorded in 2004–06, 12 of which were not recorded in the earlier study. Of the 104 species recorded in 1977–80, nine were not detected in the 2004–06 surveys. An additional seven species were recorded during incidental visits. No introduced species were found. Eleven state-listed threatened species (under NSW legislation) were present, together with a further 17 species (Table 3) considered to be declining or at risk in woodlands in NSW.

Across the survey area as a whole, no regularly-recorded species appears to have been lost. Most species reported in one study only had low levels of occurrence (reporting rates of <3.0 %) and/or were found at few sites (2004–06), suggesting such species are irregular visitors, although often relatively common and/or widespread in adjoining habitats. Species present in 1977–80 but not detected in 2004–06 probably continue to occur in low numbers or periodically. White-winged Chough *Corcorax melanorhamphos* was recorded in Carwong SF in 2010 (Totterman 2012). Regent Honeyeater *Anthochaera phrygia* was recorded at three locations between the studies (Gosper and Holmes 2002). Forest Kingfisher *Todiramphus macleayii*, a species whose local distribution in the southern limits of its range appears to fluctuate (Higgins 1999), was recorded from the edges of the 1977–80 sites, both of which were in close proximity to semi-permanent waterholes. It probably continues to periodically occupy such sites when conditions are suitable.

However, we have identified that a number of species may have declined between the sample periods on the basis of sharply lower reporting rates overall in 2004–06 compared to 1977–80, and also in at least one of the two re-sampled locations (Table 3). During 2004–06 Buff-rumped Thornbills *Acanthiza reguloides* were detected only twice, and were not found at either of the Myrtle and Royal Camp SF sites where they were present in 1977–80 (at reporting rates of 72% and 14% respectively; Table 3). Rufous Whistlers *Pachycephala rufiventris* had an overall reporting rate 35–40 percent lower in 2004–6 than at 1977–80 sites, and similar magnitudes of differences occurred in comparisons between the individual sites that were re-sampled. Overall 2004–6 reporting rates of Peaceful Dove *Geopelia striata*, Varied Sittella *Daphoenositta chrysoptera*, Jacky Winter *Microeca fascinans* and Double-barred Finch *Taeniopygia bichenovii* were much lower than in 1977–80, although among the two individual re-sampled sites the 2004–6 reporting rate was only substantially lower at one. Further, in the case of Varied Sittellas, they were recorded in all 10' squares covering the Bungawalbin Creek catchment between 1973 and 1983 (Gosper 1986), but only at four sites in 2004–6. Species not widely regarded as declining woodland birds but which showed similar patterns of substantially lower reporting

Table 2

Composite bird species list and reporting rates, by season, for 41 sites in State Forests of the Bungawalbin Creek middle catchment in 2004–06. ** = recorded in 2004–06 study but not 1977–80 study; (P) = recorded 1977–80 but not in 2004–06; # = additional species recorded at site(s) between the studies. Nocturnal species are listed for completeness only and were not included in statistical analyses.

Species	Summer n=41	Autumn n=41	Winter n=41	Spring n=41	Total (reporting rate %) n=164	Sites recorded n=41
Brown Quail *Coturnix ypsilophora***	0	0	2	0	2 (1.2)	2
Brown Cuckoo-Dove *Macropygia amboinensis*						(P)
Common Bronzewing *Phaps chalcoptera*	6	5	4	8	23 (14.0)	13
Peaceful Dove *Geopelia striata*	31	26	13	25	95 (57.9)	37
Bar-shouldered Dove *Geopelia humeralis***	2	7	5	6	20 (12.2)	14
Wonga Pigeon *Leucosarcia picata***	10	3	3	8	24 (14.6)	16
Tawny Frogmouth *Podargus strigoides*	0	1	0	0	–	
White-throated Nightjar *Eurostopodus mystacalis*	1	0	0	0	–	
Australian Owlet-nightjar *Aegotheles cristatus*	3	4	2	2	–	
White-throated Needletail *Hirundapus caudacutus*	3	0	0	2	5 (3.0)	5
Square-tailed Kite *Lophoictinia isura*						#
Pacific Baza *Aviceda subcristata*						(P)
White-bellied Sea-Eagle *Haliaeetus leucogaster***	0	0	1	0	1 (0.6)	1
Whistling Kite *Haliastur sphenurus*	1	0	0	1	2 (1.2)	2
Brown Goshawk *Accipiter fasciatus*	0	0	0	1	1 (0.6)	1
Collared Sparrowhawk *Accipiter cirrocephalus*	3	0	1	0	4 (2.4)	4
Wedge-tailed Eagle *Aquila audax*	0	3	0	1	4 (2.4)	4
Little Eagle *Hieraaetus morphnoides*	1	0	0	0	1 (0.6)	1
Peregrine Falcon *Falco peregrinus*						(P)
Painted Button-quail *Turnix varius*	9	14	19	16	58 (35.4)	31
Glossy Black-Cockatoo *Calyptorhynchus lathami*	1	3	0	2	6 (3.7)	3
Yellow-tailed Black-Cockatoo *Calyptorhynchus funereus*	1	5	3	1	10 (6.1)	8
Rainbow Lorikeet *Trichoglossus haematodus*	34	36	36	32	138 (84.1)	41
Scaly-breasted Lorikeet *Trichoglossus chlorolepidotus*	34	28	27	28	117 (71.3)	41
Musk Lorikeet *Glossopsitta concinna***	0	3	1	0	4 (2.4)	4
Little Lorikeet *Glossopsitta pusilla*	27	33	39	37	136 (82.9)	41
Australian King-Parrot *Alisterus scapularis*	17	6	5	12	40 (24.4)	28
Crimson Rosella *Platycercus elegans***	0	0	1	0	1 (0.6)	1
Eastern Rosella *Platycercus eximius*	7	13	8	18	46 (28.0)	26
Turquoise Parrot *Neophema pulchella***	0	1	1	0	2 (1.2)	2
Eastern Koel *Eudynamys orientalis*	7	0	0	2	9 (5.5)	9
Channel-billed Cuckoo *Scythrops novaehollandiae*	6	0	0	4	10 (6.1)	9
Shining Bronze-Cuckoo *Chalcites lucidus*	4	10	2	4	20 (13.7)	16
Little Bronze-Cuckoo *Chalcites minutillus*	0	0	1	1	2 (1.2)	1
Pallid Cuckoo *Cacomantis pallidus*						(P)
Fan-tailed Cuckoo *Cacomantis flabelliformis*	0	11	8	3	22 (13.4)	17
Brush Cuckoo *Cacomantis variolosus*	20	6	0	4	30 (18.3)	22
Barking Owl *Ninox connivens*						#
Southern Boobook *Ninox novaeseelandiae*	0	0	2	0	–	
Laughing Kookaburra *Dacelo novaeguineae*	31	17	12	20	80 (48.8)	37
Forest Kingfisher *Todiramphus macleayii*						(P)
Sacred Kingfisher *Todiramphus sanctus*	11	0	0	17	28 (17.1)	23
Rainbow Bee-eater *Merops ornatus*	21	24	22	13	80 (48.8)	35
Dollarbird *Eurystomus orientalis*	3	0	0	3	6 (3.7)	6
White-throated Treecreeper *Cormobates leucophaea*	10	7	10	10	37 (22.6)	16
Brown Treecreeper *Climacteris picumnus*	27	26	28	31	112 (68.3)	36
Superb Fairy-wren *Malurus cyaneus*	27	24	29	34	114 (69.5)	37
Red-backed Fairy-wren *Malurus melanocephalus*	18	18	18	16	70 (42.7)	25
Variegated Fairy-wren *Malurus lamberti*	19	19	18	19	75 (45.7)	29
White-browed Scrubwren *Sericornis frontalis*	5	2	1	2	10 (6.1)	8
Large-billed Scrubwren *Sericornis magnirostra*	1	0	0	1	2 (1.2)	2
Speckled Warbler *Chthonicola sagittata*	2	3	3	3	11 (6.7)	8
Weebill *Smicrornis brevirostris*	0	3	3	3	9 (5.4)	5
Brown Gerygone *Gerygone mouki*	2	2	2	2	8 (4.9)	3
White-throated Gerygone *Gerygone albogularis*	1	1	0	5	7 (4.3)	6
Striated Thornbill *Acanthiza lineata*	6	5	6	6	23 (14.0)	12
Yellow Thornbill *Acanthiza nana***	0	0	1	2	3 (1.8)	2
Buff-rumped Thornbill *Acanthiza reguloides*	0	0	1	1	2 (1.2)	1
Brown Thornbill *Acanthiza pusilla*	8	5	9	8	30 (18.3)	14
Spotted Pardalote *Pardalotus punctatus*	1	25	24	4	54 (32.9)	31
Striated Pardalote *Pardalotus striatus*	21	28	17	14	80 (48.8)	38
Eastern Spinebill *Acanthorhynchus tenuirostris*	0	1	6	0	7 (4.3)	7

Table 2 (continued)

Species (continued)	Summer n=41	Autumn n=41	Winter n=41	Spring n=41	Total (reporting rate %) n=164	Sites recorded n=41
Lewin's Honeyeater *Meliphaga lewinii*	6	7	6	6	25 (15.2)	9
Yellow-faced Honeyeater *Lichenostomus chrysops*	11	22	18	15	66 (40.2)	29
Fuscous Honeyeater *Lichenostomus fuscus*	40	41	40	41	162 (98.8)	41
Noisy Miner *Manorina melanocephala*	5	7	6	7	25 (15.2)	14
Little Wattlebird *Anthochaera chrysoptera*	6	13	7	17	43 (26.3)	21
Regent Honeyeater *Anthochaera phrygia*						(P)
Red Wattlebird *Anthochaera carunculata***	0	0	1	0	1 (0.6)	1
Scarlet Honeyeater *Myzomela sanguinolenta*	4	31	22	23	80 (48.8)	36
Brown Honeyeater *Lichmera indistincta*	2	6	1	4	13 (7.9)	8
White-cheeked Honeyeater *Phylidonyris niger*	2	3	5	4	14 (8.5)	10
Black-chinned Honeyeater *Melithreptus gularis*	23	20	25	23	91 (55.5)	40
White-throated Honeyeater *Melithreptus albogularis*	5	9	4	8	26 (15.9)	11
White-naped Honeyeater *Melithreptus lunatus*						#
Blue-faced Honeyeater *Entomyzon cyanotis*	8	9	7	13	37 (22.6)	19
Noisy Friarbird *Philemon corniculatus*	33	36	35	41	145 (88.4)	41
Little Friarbird *Philemon citreogularis*	13	12	10	17	52 (31.7)	32
Striped Honeyeater *Plectorhyncha lanceolata***	0	0	3	0	3 (1.8)	3
Grey-crowned Babbler *Pomatostomus temporalis*	5	5	10	9	29 (17.7)	14
Spotted Quail-thrush *Cinclosoma punctatum*	1	1	4	2	8 (4.9)	7
Eastern Whipbird *Psophodes olivaceus*	6	7	7	3	23 (14.0)	11
Varied Sittella *Daphoenositta chrysoptera*	2	0	2	0	4 (2.4)	4
Black-faced Cuckoo-shrike *Coracina novaehollandiae*	32	14	4	26	76 (46.3)	40
White-bellied Cuckoo-shrike *Coracina papuensis*	28	19	26	36	109 (66.5)	40
Cicadabird *Coracina tenuirostris*	17	3	0	2	22 (13.4)	19
White-winged Triller *Lalage sueurii*						(P)
Varied Triller *Lalage leucomela*	1	0	0	1	2 (1.2)	1
Crested Shrike-tit *Falcunculus frontatus*	18	9	11	20	58 (35.4)	30
Golden Whistler *Pachycephala pectoralis*	2	20	15	3	40 (24.4)	26
Rufous Whistler *Pachycephala rufiventris*	35	14	2	29	80 (48.8)	37
Little Shrike-thrush *Colluricincla megarhyncha*	0	0	0	1	1 (0.6)	1
Grey Shrike-thrush *Colluricincla harmonica*	37	37	38	39	151 (92.1)	41
Australasian Figbird *Sphecotheres vieilloti***	1	0	0	2	3 (1.8)	2
Olive-backed Oriole *Oriolus sagittatus*	30	17	10	28	85 (51.8)	40
Masked Woodswallow *Artamus personatus*						#
White-browed Woodswallow *Artamus superciliosus*						#
Dusky Woodswallow *Artamus cyanopterus*	18	20	16	21	75 (45.7)	35
Grey Butcherbird *Cracticus torquatus*	11	8	5	14	38 (23.2)	17
Pied Butcherbird *Cracticus nigrogularis*	4	5	3	3	15 (9.1)	9
Australian Magpie *Cracticus tibicen*	12	11	12	4	39 (23.8)	23
Pied Currawong *Strepera graculina*	4	6	4	4	18 (11.0)	12
Spangled Drongo *Dicrurus bracteatus*	9	3	0	1	13 (7.9)	12
Rufous Fantail *Rhipidura rufifrons*	3	2	0	0	5 (3.0)	5
Grey Fantail *Rhipidura albiscapa*	17	24	14	19	74 (45.1)	28
Willie Wagtail *Rhipidura leucophrys*	32	38	30	38	138 (84.1)	39
Australian Raven *Corvus coronoides***	0	0	2	3	5 (3.0)	5
Torresian Crow *Corvus orru*	16	21	25	34	96 (58.5)	39
Leaden Flycatcher *Myiagra rubecula*	18	6	0	14	38 (23.2)	24
Restless Flycatcher *Myiagra inquieta*	15	18	15	18	66 (40.2)	30
Black-faced Monarch *Monarcha melanopsis*	1	1	0	0	2 (1.2)	2
Spectacled Monarch *Symposiarchus trivirgatus*						(P)
Magpie-lark *Grallina cyanoleuca*	0	1	1	1	3 (1.8)	3
White-winged Chough *Corcorax melanorhamphos*						(P)
Jacky Winter *Microeca fascinans*	13	18	16	19	66 (40.2)	29
Scarlet Robin *Petroica boodang*						#
Rose Robin *Petroica rosea*	0	8	9	0	17 (10.4)	13
Hooded Robin *Melanodryas cucullata*	5	5	5	6	21 (12.8)	13
Eastern Yellow Robin *Eopsaltria australis*	29	26	19	26	100 (61.0)	39
Tawny Grassbird *Megalurus timoriensis***	0	0	0	1	1 (0.6)	1
Rufous Songlark *Cincloramphus mathewsi*						#
Silvereye *Zosterops lateralis*	8	17	16	5	46 (28.0)	24
Welcome Swallow *Hirundo neoxena*	3	3	3	2	11 (6.7)	8
Tree Martin *Petrochelidon nigricans*	5	8	3	0	16 (9.8)	15
Mistletoebird *Dicaeum hirundinaceum*	41	21	19	40	121 (73.8)	41
Double-barred Finch *Taeniopygia bichenovii*	3	2	2	1	8 (4.9)	7
Red-browed Finch *Neochmia temporalis*	20	25	30	24	99 (60.4)	37
Diamond Firetail *Stagonopleura guttata*	3	4	4	8	19 (11.6)	12
Chestnut-breasted Mannikin *Lonchura castaneothorax*						#
Species Total:	83	83	86	93	108	

Table 3

Occurrence by State Forest/survey site of diurnal land-birds considered threatened, declining or at risk in NSW woodlands (after Barrett et al. 1994; Reid 1999; Watson et al. 2003; Debus et al. 2006a), in the Bungawalbin Creek middle catchment. *Threatened species as listed under NSW legislation.

State Forest	Braemar (n=11)	Bungawalbin (n=3)	Camira (n=4)	Carwong (n=3)	Ellangowan (n=4)	Gibberagee (n=5)	Myrtle (n=7)	Royal Camp (n=4)	All	Myrtle	Royal Camp
Species									Reporting rate (%) 2004-6	1977-80	1977-80
Peaceful Dove	11	2	4	3	4	4	6	3	57.9	89.7	93.1
Whistling Kite					1			1	1.2	13.8	6.9
Little Eagle*							1		0.6	3.4	0
Painted Button-quail	9	1	2	3	4	2	6	4	35.4	44.8	10.3
Glossy Black-Cockatoo*						2		1	3.7	10.3	3.4
Musk Lorikeet				1	3				2.4	0	0
Little Lorikeet*	11	3	4	3	4	5	7	4	82.9	93.1	82.8
Turquoise Parrot*			1	1					1.2	0	0
Brown Treecreeper*	11	2	4	3	4	4	5	3	68.3	79.3	62.1
Speckled Warbler*	1			1	1		4	1	6.7	0	48.3
Weebill					1	2	1	1	5.4	44.8	6.9
Buff-rumped Thornbill								1	1.2	72.4	13.8
Brown Thornbill	1	1	1		2	2	4	3	18.3	31	100
Spotted Pardalote	5	3	4	3	3	4	5	4	32.9	37.9	48.3
Black-chinned Honeyeater*	11	3	4	3	4	5	6	4	55.5	41.4	48.3
Grey-crowned Babbler*	1	1	3	2		1	5	1	17.7	69	0
Varied Sittella*							3	1	2.4	20.7	10.3
White-bellied Cuckoo-shrike	11	3	4	3	4	5	6	4	66.5	86.2	79.3
Crested Shrike-tit	7	3	4	1	3	4	5	3	35.4	34.5	24.1
Rufous Whistler	7	3	4	3	4	5	7	4	48.8	89.7	86.2
Grey Shrike-thrush	11	3	4	3	4	5	7	4	92.1	93.1	96.6
Dusky Woodswallow	10	2	4	3	4	4	5	3	45.7	86.2	34.5
Restless Flycatcher	8	1	4	3	1	4	6	3	40.2	69	37.9
Jacky Winter	9	1	3	3	3	3	4	3	40.2	69	96.6
Hooded Robin*	7			2	1	1	2		12.8	51.7	0
Eastern Yellow Robin	10	3	4	2	4	5	7	4	61	55.2	96.6
Double-barred Finch		1		1	2		1	2	4.9	13.8	79.3
Diamond Firetail*	7		1	3	1				11.6	17.2	0

rates overall and at re-sampled sites in 2004–6 were Black-faced Cuckoo-shrike *Coracina novaehollandiae* and White-throated Gerygone *Gerygone albogularis*. Other species with markedly lower reporting rates across all sites in 2004–6 than at either of the 1977–80 sites (Table 3) had similar reporting rates in the two periods at the re-sampled sites, indicating that the overall differences may be a result of spatial variability, rather than a temporal change in reporting rate.

Wonga Pigeon *Leucosarcia picata* and Bar-shouldered Dove *Geopelia humeralis* were found at greater than 30 percent of the 2004–06 sites, and had reporting rates of greater than 12 percent, but were not recorded in the earlier study. The Wonga Pigeon in particular has become more plentiful in the Richmond River district during the last 30 years (Gosper and Holmes 2002) and may be an 'increaser', while the increase in Bar-shouldered Doves is consistent with state-wide trends (Barrett *et al*. 2007). Musk Lorikeets *Glossopsitta concinna*, also not recorded in 1977–80, irrupt into the district in autumn-winter at irregular intervals, and can be present in large numbers in the Bungawalbin Creek SFs at such times (unpub. data). Olive-backed Orioles *Oriolus sagitattus* had consistently higher reporting rates overall and at the re-sampled sites in 2004–6 compared to 1977–80. Influxes of White-browed and Masked Woodswallows (*Artamus superciliosus* and *A. personatus*), species not detected during either survey, were recorded in the study area, including at a number of survey sites, at irregular intervals outside the survey periods.

Table 4

Differences in the bird community between core and peripheral sites in the Bungawalbin Creek catchment based on reporting rates of all bird species or declining woodland bird species (see Table 3). Non-significant PERMDISP tests indicate no difference in dispersion between core and peripheral sites. *** P = 0.001; ** P < 0.01.

Birds included	df	PERMANOVA Pseudo-F	PERMDISP F
All species	1,39	6.26***	2.04
Woodland decliners	1,39	4.59**	0.03

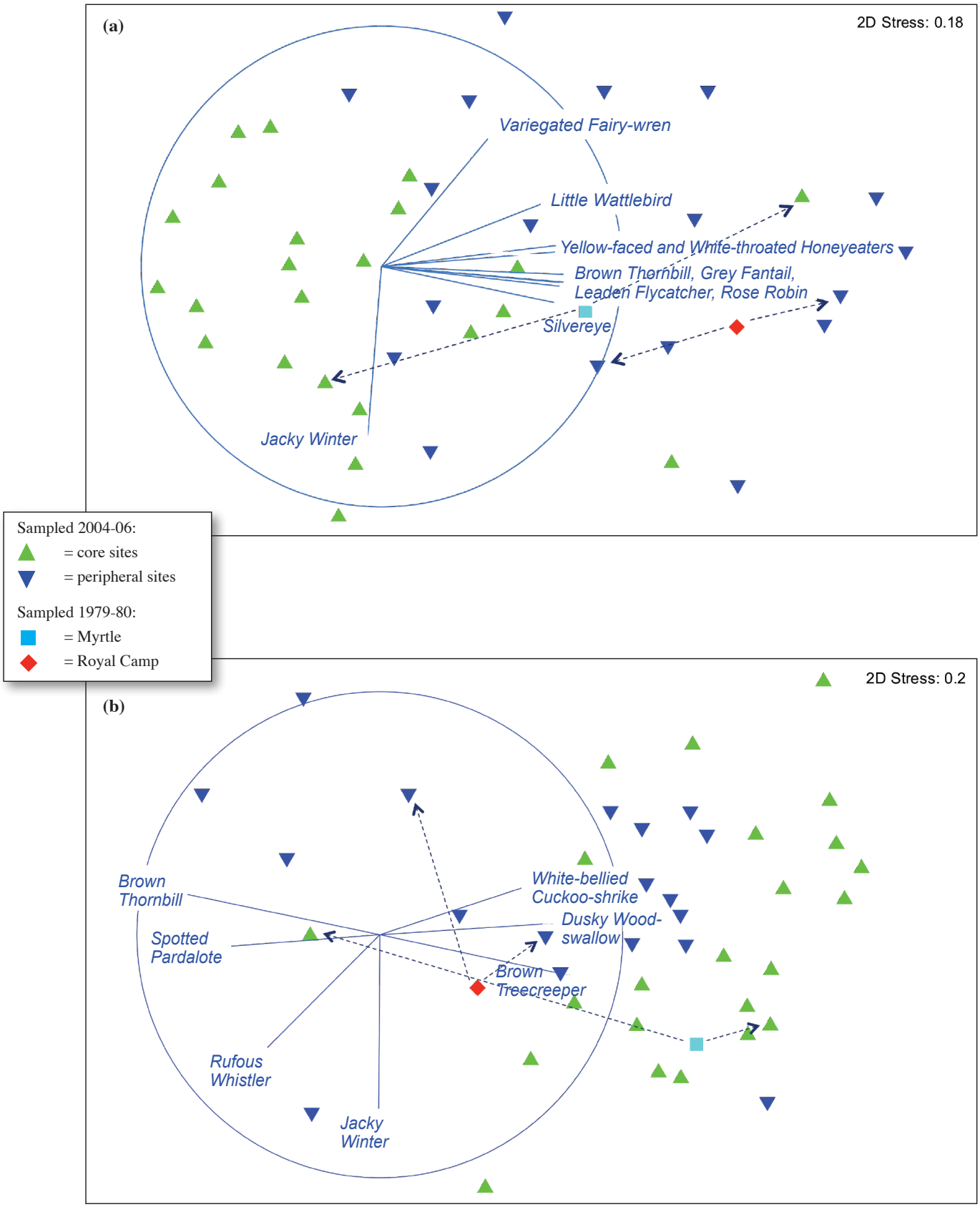

Figure 2. *Non-metric multi-dimensional scaling of survey sites in the Bungawalbin Creek catchment by reporting rates of* ***(a)*** *all bird species; and* ***(b)*** *declining woodland bird species (see Table 3). Vectors show the direction of association of bird species with Pearson's correlation coefficients* ***(a)*** *> 0.7; and* ***(b)*** *> 0.6. The dashed lines show the placement in ordination space of the two components of the sites surveyed in 1979–80 sampled again but separately in 2004–06.*

Figure 3. *Spatial patterns of reporting rates for selected threatened or declining woodland birds in the Bungawalbin Creek catchment:* ***(a)*** *Painted Button-quail;* ***(b)*** *Brown Treecreeper;* ***(c)*** *Hooded Robin; and* ***(d)*** *Diamond Firetail. See Figure 1 for the context of sample sites. Reporting rate:* + = 0; △ = 0.25; ▲ = 0.5; ▲ = 0.75; ▲ = 1.0.

Table 5

The species contributing most to differences between (dissimilarity) core and peripheral sites in the Bungawalbin Creek catchment, ordered by decreasing dissimilarity. Declining woodland bird species are indicated by bold font.

Species	Mean reporting rate		Dissimilarity (% contribution)	Cumulative dissimilarity (% contribution)
	Core	Peripheral		
Red-backed Fairy-wren	0.66	0.13	2.96	2.96
Grey Fantail	0.3	0.64	2.53	5.49
Variegated Fairy-wren	0.29	0.67	2.49	7.98
Little Wattlebird	0.07	0.51	2.33	10.31
Yellow-faced Honeyeater	0.26	0.58	2.29	12.61
Jacky Winter	0.5	0.28	2.05	14.65
White-throated Treecreeper	0.08	0.42	1.94	16.59
Eastern Yellow Robin	0.47	0.79	1.86	18.46
Red-browed Finch	0.57	0.65	1.86	20.32
Brown Treecreeper	0.72	0.64	1.77	22.09
Painted Button-quail	0.47	0.21	1.77	23.86

The ordinations indicate that there is little evidence for substantial change in the overall bird community having occurred between 1977–80 and 2004–06 based on reporting rates. In the all species ordination (Figure 2a), at the two locations surveyed in both periods the placement in ordination space of the 1977–80 sites was between that of the two corresponding 2004–06 sites, with the pairs of 2004–06 sites being separated along the mesic/shrubby-xeric/open divide characterising the overall ordination. While the ordination by declining woodland birds also shows the location of the 1977–80 sites between the corresponding 2004–06 sites on the mesic/shrubby-xeric/open axis, there is also a consistent shift in ordination space on the other axis (Figure 2b). This shift was associated with higher reporting rates of Jacky Winter and Rufous Whistler in 1977–80.

There was little overlap in ordination space between core and peripheral sites on the basis of reporting rates of all regularly-recorded bird species or solely on declining woodland birds (Figure 2). In the all-species ordination, a set of bird species typically associated with mesic and/or shrubbier habitats was strongly correlated with the distribution of sites in ordination space. These species, such as Rose Robin *Petroica rosea*, Leaden Flycatcher *Myiagra rubecula*, Silvereye *Zosterops lateralis* and Brown Thornbill *Acanthiza pusilla* were associated with peripheral sites. Among woodland decliners, reporting rates of mesic/shrubby-associated species (Brown Thornbill, Spotted Pardalote *Pardalotus punctatus*) were orientated in ordination space in the opposite direction to Brown Treecreeper *Climacteris picumnus*, White-bellied Cuckoo-shrike *Coracina papuensis* and Dusky Woodswallow *Artamus cyanopterus*. The latter set of species was associated with core sites and with open woodland.

Differences in the all-species and woodland decliner bird communities between core and peripheral sites were confirmed by the significant PERMOVA tests (Table 4). Of the species contributing greatest dissimilarity between core and peripheral sites (Table 5), those with higher reporting rates in peripheral sites were either more typically associated with mesic and/or shrubby habitats (Grey Fantail *Rhipidura albiscapa*, Variegated Fairy-wren *Malurus lamberti*, Yellow-faced Honeyeater *Lichenostomus chrysops*, White-throated Treecreeper *Cormobates leucophaea*, Eastern Yellow Robin *Eopsaltria australis*), or coastal areas (Little Wattlebird *Anthochaera chrysoptera*). Species contributing high dissimilarity with substantially higher reporting rates in core sites are mostly strongly associated with dry forests and woodlands and are also vulnerable to decline in fragmented landscapes (Jacky Winter, Brown Treecreeper, Painted Button-quail *Turnix varius*).

DISCUSSION

Our results highlight the on-going value of the Bungawalbin Creek grassy dry sclerophyll forests and woodlands for an array of species that are vulnerable to the effects of habitat fragmentation and degradation, and that have declined in south-eastern Australia. The middle catchment SFs and core sites in particular are a stronghold for Painted Button-quail (Figure 3a), Little Lorikeet *Glossopsitta pusilla*, Brown Treecreeper (Figure 3b), Black-chinned Honeyeater *Melithreptus gularis*, Hooded Robin *Melanodryas cucullata* (Figure 3c) and Diamond Firetail *Stagonopleura guttata* (Figure 3d) (Table 3). This is in stark contrast to the dramatic population reductions and local extinctions of these and/or other species, during the period discussed here, in the adjoining New England Tablelands and North-West Slopes regions of NSW (Courtney and Debus 2006; Debus *et al.* 2006a, 2006b; NSW Scientific Committee 2008, 2011a, 2011b; Ford *et al.* 2009). The strongest evidence of declines in reporting rates in the Bungawalbin catchment between 1977–80 and 2004–6 was found in the Buff-rumped Thornbill, Rufous Whistler, Peaceful Dove, Jacky Winter, Double-barred Finch and Varied Sittella. Unfortunately, the experimental design of this study does not allow the causal factors driving these results to be identified, as any shifts in reporting rates may also be influenced by different survey methods, variability in climate between survey periods (Barrett *et al.* 2007) and/or other factors.

The relatively high consistency of the bird assemblages of the Bungawalbin Creek SFs between 1977–80 and 2004–06 is further demonstrated by the absence of introduced species, and of open country birds such as Crested Pigeon *Ocyphaps lophotes* and Galah *Eolophus rosiecapillus*, which are widespread in

the district (Gosper 1986; Gosper and Homes 2002). Noisy Miners *Manorina melanocephala*, an aggressive species known to negatively impact on the diversity and abundance of small passerines in habitats where fragmentation and degradation have occurred (e.g. Maron 2008), and Pied Currawongs *Strepera graculina* and Grey Butcherbirds *Cracticus torquatus*, both known nest predators of small passerines (Higgins *et al.* 2006; Debus *et al.* 2006a; pers. obs.), have remained patchily distributed across the study area.

The SFs of the Bungawalbin Creek catchment form part of the Casino Management Area (CMA) of the Forestry Corporation of NSW. Most of the threatened species identified in this study were not listed under the NSW *Threatened Species Conservation Act 1995* at the time of preparation of the CMA Environmental Impact Statement (EIS), which considered proposed forestry management and operations for the period 1996 to 2005. As such they were not recognized in the EIS, and therefore were not considered when mitigation measures for the amelioration of proposed forestry activities were devised (State Forests of NSW 1995). The continued persistence of most species at similar reporting rates suggests that forest management practices (at least up until 2006) had not caused a substantial decline in habitat quality. It is also likely that the large size of the habitat units involved (all SFs >600 ha), and the presence of linking vegetation on adjoining private lands and their low intensity land use (mainly grazing), were also important. On the other hand, one threatened and five non-threatened but generally declining woodland bird species appear to have declined in the Bungawalbin Creek catchment, and none of the core sites which are particularly important in supporting the assemblage of declining woodland birds most strongly associated with dry forests and woodlands is in a conservation reserve.

Summary of status of Threatened Species in the Bungawalbin Creek middle catchment 1977 –2006.

Species status is shown in parentheses, with status under the NSW *Threatened Species Conservation Act 1995* listed first, followed by that in *The Action Plan for Australian Birds 2010* (Garnett *et al.* 2011).

Little Eagle *Hieraaetus morphnoides* (Vulnerable/Least Concern): scarce; singles recorded irregularly and infrequently across the catchment in 2004–06 and 1977–80, also between studies.

Glossy Black-Cockatoo (south-eastern subspecies *C. lathami lathami*) (Vulnerable/Near Threatened): widely distributed across catchment (Gosper 1986); low numbers, mostly pairs, trios; in 2004–06 recorded from three sites in two SFs, reporting rate <4%; in 1977–80 present at both Myrtle and Royal Camp SF sites with reporting rates 10% and 3% respectively; also records between studies (Table 3).

Little Lorikeet (Vulnerable/Least Concern): widespread in catchment (Gosper 1986); abundant; in 2004–06 present at all 41 sites; high reporting rate (>80%) with little seasonal variation in both 1977–80 sites and across all sites in 2004–6 (Table 3).

Turquoise Parrot *Neophema pulchella* (Vulnerable/Least Concern): irregular visitor in small numbers to the Bungawalbin Creek catchment (Gosper and Holmes 2002); in 2004–06 singles/ pairs at sites in Carwong and Camira SFs; also Carwong SF between studies; drought refugees or scarce non-breeding visitors (records were in autumn and winter)?

Brown Treecreeper (eastern subspecies *C. picumnus victoriae*) (Vulnerable/Near Threatened): widespread in catchment (Gosper 1986; Figure 3b); moderately abundant; in 2004–06 present at 34 sites (83%), reporting rate 68%; in 1977–80 reporting rates of 79% and 62% respectively at Myrtle and Royal Camp SF sites.

Speckled Warbler *Chthonicola sagittata* (Vulnerable/Least Concern): widespread in catchment (Gosper 1986) but patchily distributed; low densities; in 2004–06 found at eight (20%) sites across five SFs, reporting rate 7%; in 1977–80 found at one of two sites (Royal Camp) where reporting rate 48%; records between the studies from various locations in catchment, including survey sites.

Regent Honeyeater *Anthochaera phrygia* (Critically Endangered/Critically Endangered): recorded Myrtle SF in 1977–80 study; recorded between studies at Gibberagee, Ellangowan and Myrtle SFs (Gosper and Holmes 2002); not recorded 2004–06.

Black-chinned Honeyeater (south-eastern subspecies *M. gularis gularis*) (Vulnerable/Near Threatened): widespread in catchment (Gosper 1986); moderately abundant; in 2004–06 found at 40 sites (>97%), reporting rate 56%; in 1977–80 reporting rates of 41% and 48% respectively at Myrtle and Royal Camp SF sites.

Grey-crowned Babbler (eastern subspecies *P. temporalis temporalis*) (Vulnerable/Least Concern)*:* widespread in catchment but not evenly distributed (Gosper 1986); moderately common; in 2004–06 found at 14 sites (34%) across seven SFs, reporting rate 18%; in 1977–80 found at one of two sites (Myrtle SF) where reporting rate 69%.

Varied Sittella (Vulnerable/Least Concern): widespread in catchment (Gosper 1986); low densities; has probably declined over the last few decades in the catchment (see Results).

Hooded Robin (south-eastern subspecies *M. cucullata cucullata*) (Vulnerable/Near Threatened): fairly widespread in core sites, but rare in peripheral sites (Figure 3c); in 2004–06 recorded from 12 sites (29%) across five SFs, reporting rate 13%; in 1977–80 recorded from one of two sites (Myrtle SF) where reporting rate 52%; recorded Camira, Carwong, Braemar, Gibberagee and Myrtle SFs between the studies.

Diamond Firetail (Vulnerable/Least Concern): limited distribution in middle catchment being largely confined to core sites in Braemar, Ellangowan and Carwong SFs (Figure 3d); present at low densities; in 2004–06 recorded from 11 sites (27%) across four SFs, reporting rate 12%; in 1977–80 recorded from one of two sites (Myrtle SF) where reporting rate 17%; recorded Carwong, Braemar, Ellangowan and Myrtle SFs between studies.

Square-tailed Kite *Lophoictinia isura* (Vulnerable/Least Concern), Swift Parrot (Endangered/Endangered), Scarlet Robin (Vulnerable/Least Concern) and Flame Robin (Vulnerable/Near Threatened) were recorded from the study area between the studies (Gosper and Holmes 2002).

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REFERENCES

Barrett, G. W., Ford, H. A. and Recher, H. F. (1994). Conservation of woodland birds in a fragmented rural landscape. *Pacific Conservation Biology* **1**: 245–56.

Barrett, G. W., Silcocks, A. F., Cunningham, R. B., Oliver, D. L., Weston, M. A. and Baker, J. (2007). Comparison of atlas data to determine the conservation status of bird species in New South Wales, with an emphasis on woodland dependent species. *Australian Zoologist* **34**: 37–77.

Binns, D. (1995). 'Flora Survey Report Casino Management Area'. Supporting Document No. 7, Casino Management Area EIS. (State Forests of New South Wales: Pennant Hills.)

Courtney, J. and Debus, S. J. (2006). Breeding habits and conservation status of the Musk Lorikeet *Glossopsitta concinna* and the Little Lorikeet *G. pusilla* in Northern New South Wales. *Australian Field Ornithology* **23**: 109–124.

DECCW (New South Wales Department of Environment, Climate Change and Water) (2009). 'Northern Rivers Regional Biodiversity Management Plan'. www.environment.gov.au/.../pubs/northern-rivers-appendix-10.pdf.

Debus, S. J., Ford, H. A. and Page, D. (2006a). Bird communities in remnant woodland on the New England Tablelands, New South Wales. *Pacific Conservation Biology* **12**: 50–63.

Debus, S. J., Ford, H. A. and Tremont, S. (2006b). Bird Communities in remnant woodland on the upper North-west Slopes of New South Wales. *Australian Zoologist* **33**: 519–529.

Ford, H. A., Barrett, G. W. Saunders, D. A. and Recher, H. F. (2001). Why have birds in the woodlands of southern Australia declined? *Biological Conservation* **97**: 71–88.

Ford, H. A., Walters, J. R., Cooper, C. B., Debus, S. J. and Doerr, V. A. (2009). Extinction debt or habitat change? – Ongoing losses of woodland birds in north-eastern New South Wales, Australia. *Biological Conservation* **142**: 3182–3190.

Garnett, S. T., Szabo, J. K. and Dutson, G. (2011). 'The action plan for Australian birds 2011'. (CSIRO Publishing: Collingwood, Victoria.)

Gosper, D. G. (1986). Birds in the Richmond River District, NSW, 1973–83. 1. Distribution. *Corella* **10**: 1–16.

Gosper, D. G. (1992). Forest bird communities of the Richmond River District, New South Wales. *Corella* **16**: 78–88.

Gosper, D. and Holmes, G. (2002). Status of birds in the Richmond River district, New South Wales, 1973–2000. *Corella* **26**: 89–105.

Keith, D. A. (2004). 'Ocean shores to desert dunes: the native vegetation of New South Wales and the ACT'. (Department of Environment and Conservation: Hurstville.)

Higgins, P. J. (Ed.) (1999). 'Handbook of Australian, New Zealand and Antarctic Birds', Vol.4. (Oxford University Press: Melbourne.)

Higgins, P. J., Peter, J. M. and Cowling, S. J. (Eds) (2006). 'Handbook of Australian, New Zealand and Antarctic Birds', Vol.7. (Oxford University Press: Melbourne.)

Lindenmayer, D., Crane, M., and Michael, D. (2005). 'Woodlands: a disappearing landscape'. (CSIRO: Collingwood.)

Maron, M. (2008). Size isn't everything: the importance of small remnants to the conservation of woodland birds in Australia. *Australian Field Ornithology* **25**: 53–58.

Montague-Drake, R. M., Lindenmayer, D. B. and Cunningham R. B. (2009). Factors affecting site occupancy by woodland bird species of conservation concern. *Biological Conservation* **142**: 2896–2903.

NSW Scientific Committee. (2008). 'Hooded Robin *Melanodryas cucullata cucullata* – Populations in Eastern BioRegions. Review of current information in NSW May 2008'. Unpublished report arising from the Review of the Schedules of the Threatened Species Conservation Act 1995. (NSW Scientific Committee: Hurstville.)

NSW Scientific Committee (2011a). Brown Treecreeper (eastern subspecies) – vulnerable species listing. Last updated 28 February 2011. http://www.environment.nsw.gov.au/determinations/BrownTreecreeperVulSpListing.htm

NSW Scientific Committee (2011b). Little Lorikeet *Glossopsitta pusilla* – vulnerable species listing. Last updated 28 February 2011. http://www.environment.nsw.gov.au/determinations/littlelorikeetFD.htm

Olsen, P., Western, M., Tzaros, C. and Silcocks A. (2005). The state of Australia's birds 2005. Woodlands and birds. Supplement to *Wingspan* **15,** no 4.

Rayner, L., Lindenmayer, D. B., Gibbons, P., and Manning, A. D. (2014). Evaluating empirical evidence for decline in temperate woodland birds: A nationally threatened assemblage of species. *Biological Conservation* **171**: 145–155.

Recher, H. F. (1999). The state of Australia's avifauna: a personal opinion and prediction for the new millennium. *Australian Zoologist* **31**: 11–27.

Reid, J. R. W. (1999). 'Threatened and declining birds in the New South Wales sheep-wheat belt: 1. Diagnosis, characteristics and management.' Consulting report to NSW National Parks and Wildlife Service. (CSIRO Wildlife and Ecology: Canberra.)

State Forests of NSW. (1995). 'Casino Management Area Environmental Impact Statement'. (State Forests of NSW: Pennant Hills.)

Totterman, S. L. (2012). Evaluation of bird survey methods and estimators for species inventory in dry sclerophyll forest. *Corella* **36**: 81–89.

Watson, J., Watson, A., Paull, D., and Freudenberger, D. (2003). Woodland fragmentation is causing the decline of species and functional groups of birds in southeastern Australia. *Pacific Conservation Biology* **8**: 261–70.

Appendix 1

Survey sites in the Bungawalbin Creek middle catchment 2004 –2006.

State Forest (area) Site code	Elevation (metres asl)	Location
Braemar SF (2016 ha)		
BR1	50	29º01'57.8" S / 153º00'19.4" E
BR2	55	29º02'21.6" S / 152º59'59.2" E
BR3	65	29º02'36.3" S / 152º59'57.8" E
BR4	110	29º03'10.8" S / 152º59'36.5" E
BR5	75	29º03'02.8" S / 152º59'38.5" E
BR6	60	29º02'40.7" E / 152º59'13.8" E
BR7	85	29º03'24.6" E / 152º59'30.9" E
BR8	80	29º03'48.2" E / 152º58'43.4" E
BR9	65	29º03'24.8" E / 152º59'02.4" E
BR10	60	29º03'12.5" E / 152º58'43.0" E
BR11	45	29º01'50.3" S / 152º59'12.9" E
Bungawalbin SF / National Park (1199 ha + 3722 ha)		
BW1	25	29º07'32.5" S / 153º05'27.8" E
BW2 (now NP)	30	29º05'45.8" S / 153º07'36.1" E
BW3	50	29º04'41.3" S / 153º05'17.8" E
Camira SF (4999 ha)		
CM1	100	29º14'10.6" S / 152º56'57.6" E
CM2	80	29º13'48.2" S / 152º56'34.6" E
CM3	100	29º13'39.1" S / 152º54'47 1" E
CM4	105	29º12'43.0" S / 152º53'53.0" E
Carwong SF (610 ha)		
CW1	70	29º02'41.6" S / 152º57'18.9" E
CW2	85	29º03'06.2" S / 152º56'48.5" E
CW3	75	29º03'03.6" S / 152º55'46.1" E
Ellangowan SF (1175 ha)		
EG1	40	29º01'57.3" S / 153º01'10.1" E
EG2	60	29º02'39.3" S / 153º00'41.3" E
EG3	90	29º03'25.8" S / 153º00'32.8" E
EG4	90	29º04'17.1" S / 153º00'58.0" E
Gibberagee SF (11332 ha)		
GG1	20	29º13'26.1" S / 153º06'15.2" E
GG2	35	29º13'49.5" S / 153º06'36 6" E
GG3	50	29º17'42 0" S / 153º03'01 0" E
GG4	75	29º19'58.8" S / 153º01'48.7" E
GG5	100	29º19'37 6" S / 153º02'55.8" E
Myrtle SF (5711 ha)		
M1	60	29º08'35.6" S / 152º59'20.7" E
M2	45	29º08'48.8" S / 153º00'01.2" E
M3##	50	29º09'15.0" S / 152º58'25.7" E
M4##	50	29º09'24.5" S / 152º57'06.9" E
M5	40	29º09'36.1" S / 152º58'07.9" E
M6	40	29º11'27.8" S / 152º59'49.3" E
M7	35	29º11'10.9" S / 152º59'34.0" E
Royal Camp SF (2193 ha)		
RC1	70	28º59'54.3" S / 152º54'35.8" E
RC2##	80	29º00'57.8" S / 152º53'02.4" E
RC3##	80	29º01'28.5" S / 152º52'57.7" E
RC4	130	29º01'49.2" S / 152º51'48.4" E

Source: DECCW (2009)

##1977-80 study sites

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Breeding diets of four raptor species in the Australian tropics

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The breeding diets of four diurnal raptor species were studied, by analysis of pellets, prey remains, stomach flushes of trapped birds and feeding observations, in the Top End of the Northern Territory and in the Kimberley region (northern Western Australia) in 1988–89. These were the Black-breasted Buzzard *Hamirostra melanosternon,* Brown Goshawk *Accipiter fasciatus,* Little Eagle *Hieraaetus morphnoides* and Australian Hobby *Falco longipennis.* The Buzzard and Brown Goshawk were vertebrate generalists (mammals, birds and reptiles), the former also taking birds' eggs, and the latter also taking many invertebrates. The Little Eagle took mostly birds, with few reptiles and even fewer mammals. The Hobby took small birds and flying insects. This study complements another, concurrent study of the raptor community in the Top End, by characterising the feeding niches of an additional four diurnal species out of the ten now studied in some detail. The remaining 14 species (of the 24 that make up the diurnal raptor assemblage in northern mainland Australia) require further attention in the tropics.

INTRODUCTION

The diets of many raptor species in the Australian tropics are poorly known, although Corbett *et al*. (2014) provided comprehensive dietary samples for four diurnal species and reviewed prior studies on two others in the Top End of the Northern Territory (NT). Aumann and Baker-Gabb (1991) and Marchant and Higgins (1993) provided a summary of the diets of four additional raptor species in the Top End and the Kimberley region (northern Western Australia (WA)): the Black-breasted Buzzard *Hamirostra melanosternon*, Brown Goshawk *Accipiter fasciatus*, Little Eagle *Hieraaetus morphnoides* and Australian Hobby *Falco longipennis*. Here we provide the data supporting those summaries (which gave only percentages of each prey class), as foreshadowed by Aumann and Baker-Gabb (1991, p. 46). The context of those prey collections is given elsewhere (Aumann 1991; Aumann and Baker-Gabb 1991), i.e. an ecological study of the Red Goshawk *Erythrotriorchis radiatus*, and a survey of the other raptor species and aspects of their biology, in the Top End in 1988–89 and the Kimberley region in 1989.

The four subject species in this paper were identified as potential competitors of the Red Goshawk for avian prey. Fortuitously, these raptor species are the same four for which Corbett *et al*. (2014) obtained few dietary samples, during their study concurrent with ours. Further, we here correct an error in the previously published dietary table and summary statistics for the Little Eagle in the tropics (Table 5 of Aumann and Baker-Gabb (1991), p. 23, and text of Marchant and Higgins (1993), p. 183).

METHODS

The study locations are described elsewhere, i.e. near-coastal open eucalypt forest and subcoastal riparian gallery forest and flanking woodland in and near Kakadu National Park in the Top End, and riparian gallery forest and woodland on the middle and upper reaches of Kimberley rivers (Aumann 1991; Aumann and Baker-Gabb 1991; Debus *et al*. 2015). Collections of dietary samples were obtained as follows, with prey individuals in each sample identified, counted and quantified (by number) according to the methods of Aumann (2001). For all four raptor species, the number of vertebrate items identified only to order or family level, and the nature of their remains or pellets (e.g. size/age of larger items, whether live kill or carrion, fur or feathers only), precluded accurate estimates of prey biomass.

Black-breasted Buzzard

Pellets and orts (prey remains) were collected from beneath six active nests (four in the NT and two in WA), and there were two observations of individuals feeding, both in the Kimberley. Information for the Top End was obtained in 1988 and 1989, for the Kimberley in 1989. Pellets = 38 (85 prey items); orts = 20 (20 prey items); feeding observations = two prey items.

Brown Goshawk

Pellets and orts were collected from beneath two active nests (one in the NT and one in WA, in 1989), and stomach flushes (all from the NT in 1989; e.g. see Marti *et al*. (2007) on the method) occurred for 12 captured individuals (discounting stomach flushes of two other captured individuals that yielded only plant material). Pellets = 10 (18 prey items); orts = seven (seven prey items); stomach flushes = 21 prey items.

Little Eagle

Pellets and orts were collected from beneath three active nests (one in the NT and two in WA), and stomach flushes occurred for two captured individuals (NT). All information was collected in 1989. Pellets = one (two prey items); orts = 46 (46 prey items); stomach flushes = four prey items.

Table 1

Summary of breeding diets (% *n* of prey classes) of four raptor species in the Top End (NT) and Kimberley (WA), 1988–1989; *n* = prey items in parentheses. Note correction of percentages for Little Eagle concerning reptiles and fish (cf. Table 5 of Aumann and Baker-Gabb 1991, p. 23, and Marchant and Higgins 1993, p. 183).

Prey class	Black-breasted Buzzard (107)	Brown Goshawk (46)	Little Eagle (52)	Australian Hobby (56)
Mammals	16.8	28.3	5.8	0
Birds	38.3	19.6	76.9	53.6
Birds' eggs	11.2	0	0	0
Reptiles	27.1	19.6	11.5	0
Fish	0	0	3.8	0
Invertebrates	6.5	32.6	1.9	46.4

Australian Hobby

Pellets and orts were collected from beneath four active nests (two in the NT and two in WA), and there were two observed captures of food items (both in WA). Information for the Top End was obtained in 1988 and 1989, for the Kimberley in 1989. Pellets = 20 (38 prey items); orts = 16 (16 prey items); observed prey captures = two prey items.

RESULTS

Although taking a range of vertebrate prey classes, the Black-breasted Buzzard and Little Eagle were primarily bird-eaters, whereas the Brown Goshawk took mostly mammals, and as many reptiles as birds (Table 1; Appendices 1–3, which give scientific names of prey). Brown Goshawks also took many invertebrates (mostly beetles and orthopterans), although this result may have been biased by the number of stomach flushes for this species. Some invertebrates could also have been the stomach contents of Goshawk prey items. Vertebrates would have greatly predominated by biomass in the Goshawk's diet (mammals and birds up to >100 g in size, vs invertebrates ~1 g each).

The Black-breasted Buzzard also took many mammals and reptiles, and was the only species to take birds' eggs. Large mammals (pig, cattle and goat) were presumably obtained as carrion. Some of the other mammals (quoll, bandicoot) may have been road kill, given that they are largely nocturnal (e.g. Van Dyck and Strahan 2008), which therefore need not imply foraging in low-light conditions by Buzzards. Invertebrates (beetles and grasshoppers, ~1 g each) were trivial by number and especially by biomass in the Buzzard's dietary sample. For the Buzzard and/or Brown Goshawk, 'unidentified Gruiformes' (Appendices 1 and 2) could have included Turnicidae (button-quail *Turnix* sp.), classified in the order Gruiformes at the time of the dietary analysis.

The Little Eagle took mostly birds, and some reptiles. The freshwater turtles taken may have been on land, at the water's edge (e.g. basking) or robbed from Whistling Kites *Haliastur sphenurus* (or scavenged from the latter's prey discards), and the few fish may have been taken from the water surface or robbed from kites. From the dietary profile (Appendix 3), birds would have contributed most by biomass. Some large items (e.g. Bustard; Sulphur-crested Cockatoo, albeit the small northern subspecies), and the macropod, were possibly obtained as carrion. The Australian Hobby was primarily a bird-eater, but took almost as many invertebrates as birds. Birds (up to ~50 g in size) would have contributed the bulk of prey biomass compared with invertebrates (mainly beetles, winged hymenopterans and dragonflies, ~1 g each). The 'unidentified Galliformes' (Appendix 4) was presumably a quail (Phasianidae).

DISCUSSION

The results for the subject raptor species of our study (Appendices 1–4) complement the data set of Corbett *et al*. (2014) for four diurnal raptor species. Our data greatly extend their samples, and confirm their findings, for the Black-breasted Buzzard, Brown Goshawk, Little Eagle and Australian Hobby. Among the raptor community in the Top End, as discussed by Corbett *et al*., the Buzzard and Brown Goshawk can be categorised as generalists focussed on three or four main prey categories (mammals, birds and reptiles), with the former also robbing birds' nests for eggs, and the latter also taking many invertebrates. The Little Eagle and Hobby are more specialised, the former mostly taking birds, with a few items from the other vertebrate categories, and the latter taking many aerial insects as well as birds.

All four species overlap with the Red Goshawk in avian prey species, although the Hobby, and apparently the Brown Goshawk, take smaller birds than does the Red Goshawk (see Aumann and Baker-Gabb (1991) and Marchant and Higgins (1993) for the Red Goshawk; also Johnstone and Storr (1998)). Johnstone and Storr (1998) gave a comprehensive prey list (and other biological data) for the Red Goshawk in the Top End, summarised from a study by T. Van Der Zwan that has, regrettably, remained unpublished. Johnstone and Storr (1998) also gave anecdotal prey records for several raptor species in the Kimberley (and elsewhere in WA).

The diet of the Black-breasted Buzzard in the Top End and Kimberley is broadly similar to that in the arid zone, although a much larger dietary sample detected many more invertebrates as prey in the arid zone (see Marchant and Higgins 1993; Aumann 2001; Nunn and Pavey 2014).

The diet of the Brown Goshawk in the tropics is similar to that determined by other studies, including in the Kimberley (see Aumann 1990; Burton and Olsen 1997a,b; Johnstone and

Storr 1998; Riddell 2011a), though with regional variation in the proportions of birds and reptiles. For instance, a study in urban Darwin in 2013–14 recorded more birds (20) than mammals (four) or reptiles (14, $n = 38$; Riddell 2015). Diet is also similar to that of the Brown Goshawk in arid and southern Australia, although the small tropical subspecies *A. f. didimus* appears to take smaller prey than does the large nominate subspecies (see Marchant and Higgins 1993; Aumann 2001).

The diet of the Little Eagle in the tropics, as suspected where there are few Rabbits *Oryctolagus cuniculu*s or other suitably sized mammals (as also in the dry subtropics: Fisher 2010), consists largely of birds, whereas in the arid and southern zones it consists largely of reptiles or mammals, respectively (e.g. Aumann 2001; Olsen *et al*. 2013 and studies cited therein). Anecdotal and circumstantial evidence suggests that in tropical forests and woodlands, Little Eagles in soaring flight capture birds by a dive attack to the tree or tall shrub canopy (Garstone 1986; Debus and Searle 2014): a subject for further study.

The diet of the Australian Hobby in the tropics consists of small birds and flying insects (and micro-bats: Corbett *et al*. 2014), as elsewhere in Australia, as revealed by the surprisingly few studies conducted on this species, given its widespread distribution and abundance even in urban and rural areas (see Marchant and Higgins 1993; Aumann 2001; Olsen *et al*. 2006, 2008).

The diets of almost half of the diurnal raptors regularly occurring in the Top End (10 out of 24 species: Corbett *et al*. 2014) have now been described from substantial sample sizes of data, such that many species can now be characterised in terms of their feeding niches within the tropical raptor community. Significant knowledge gaps still exist for the remainder, notably the biology and ecology in the tropics of, for example: the Pacific Baza *Aviceda subcristata* (although a study in the subtropics is in progress by K.D. Fisher and F. Hill, in prep.); the Square-tailed Kite *Lophoictinia isura* (still unconfirmed whether it breeds in the Kimberley, Top End or Cape York Peninsula); the Brahminy Kite *Haliastur indus* (see Riddell 2013a); the Grey Goshawk *Accipiter novaehollandiae* in the monsoonal tropics (although studies by Riddell (2011b, 2013b) are a significant start); the Collared Sparrowhawk *A. cirrocephalus* in e.g. urban Darwin (though briefly studied in the subtropics by Barnes and Debus (2014)); and the Grey Falcon *Falco hypoleucos* breeding in the Kimberley (previous studies having addressed the arid zone, e.g. see Janse *et al*. (2015) for a review). Most of these are endemics or near-endemics worthy of further attention in the tropics and elsewhere.

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REFERENCES

Aumann, T. (1990). The breeding behaviour of a Brown Goshawk *Accipiter fasciatus didimus* pair. *Australian Bird Watche*r **13:** 156–163.

Aumann, T. (1991). Notes on birds of the middle and upper reaches of Kimberley rivers during the dry season, 1989. *Australian Bird Watche*r **14:** 51–67.

Aumann, T. (2001). An intraspecific and interspecific comparison of raptor diets in the south-west of the Northern Territory, Australia. *Wildlife Research* **28:** 379–393.

Aumann, T. and Baker-Gabb, D. J. (1991). The Ecology and Status of the Red Goshawk in Northern Australia. *RAOU Report* **75**. (RAOU: Melbourne.)

Barnes, C. P. and Debus, S. J. S. (2014). Observations on the post-fledging period of the Collared Sparrowhawk (*Accipiter cirrocephalus*). *Sunbird* **44:** 12–23.

Burton, A. M. and Olsen, P. (1997a). Niche partitioning by two sympatric goshawks in the Australian wet tropics. *Wildlife Research* **24:** 45–52.

Burton, A. M. and Olsen, P. (1997b). A note on inter- and intraspecific differences in the diets of sympatric Brown Goshawks and Grey Goshawks in the non-breeding season. *Australian Bird Watche*r **17:** 138–141.

Corbett, L., Hertog, T. and Estbergs, J. (2014). Diet of 25 sympatric raptors at Kapalga, Northern Territory, Australia 1979–89, with data on prey availability. *Corella* **38:** 81–94.

Debus, S. J. S. and Searle, J. B. (2014). Surveys of the Red Goshawk and other raptors on the Weipa Plateau, Cape York Peninsula. *Sunbird* **44:** 36–51.

Debus, S. J. S., Baker-Gabb, D. J. and Aumann, T. A. (2015). Parental time-budgets, breeding behaviour and affinities of the Red Goshawk *Erythrotriorchis radiatus*. *Corella* **39:** 87-92.

Fisher, K. D. (2010). Breeding and diet of the Little Eagle *Hieraaetus morphnoides* in central Queensland. *Australian Field Ornithology* **27:** 119–127.

Garstone, R. (1986). Little Eagle *Hieraaetus morphnoide*s takes Banded Fruit-Dove *Ptilinopus cinctus*. *Australian Bird Watcher* **11:** 242–243.

Janse, I., Kloecker, U., Roshier, D. and Witte, I. (2015) Breeding diet and behaviour of a pair of Grey Falcons *Falco hypoleucos* and their offspring in north-western New South Wales. *Corella* **39:** 46 – 51.

Johnstone, R. E. and Storr, G. M. (1998). 'Handbook of Western Australian Birds, Volume 1: Non-passerines'. (WA Museum: Perth.)

Marchant, S. and Higgins, P. J. (Eds) (1993). 'Handbook of Australian, New Zealand and Antarctic Birds, Volume 2: Raptors to Lapwings'. (Oxford University Press: Melbourne.)

Marti, C. D., Bechard, M. and Jacksic, F. M. (2007). Food habits. In 'Raptor Research and Management Techniques' (Eds D. Bird and K. L. Bildstein). Pp. 129–152. (Hancock House: Surrey, British Columbia.)

Nunn, P. J. and Pavey, C. R. (2014). Breeding biology and behaviour of a pair of Black-breasted Buzzards *Hamirostra melanosternon* near Alice Springs, Northern Territory, including response to nest destruction. *Australian Field Ornithology* **31:** 57–76.

Olsen, J., Debus, S. J. S., Judge, D. and Rose, A. B. (2013). Diets of Wedge-tailed Eagles *Aquila audax* and Little Eagles *Hieraaetus morphnoides* breeding near Canberra, 2008–2009. *Corella* **37:** 25–29.

Olsen, J., Fuentes, E., Bird, D.M., Rose, A.B. and Judge, D. (2008). Dietary shifts based upon prey availability in Peregrine Falcons and Australian Hobbies breeding near Canberra, Australia. *Journal of Raptor Research* **42:** 125–137.

Olsen, J., Fuentes, E., Rose, A.B. and Trost, S. (2006). Food and hunting of eight breeding raptors near Canberra, 1990–1994. *Australian Field Ornithology* **23:** 77–95.

Riddell, W. (2011a). Double-brooding by the Brown Goshawk in Darwin, Northern Territory. *Australian Field Ornithology* **28:** 92–93.

Riddell, W. (2011b). The juvenile plumage of the Grey Goshawk *Accipiter novaehollandia*e in northern Australia. *Australian Field Ornithology* **28:** 180–185.

Riddell, W. (2013a). Raptor observations in Darwin, Northern Territory. *Australian Field Ornithology* **29:** 160–163.

Riddell, W. (2013b). Double-brooding and other observations of Grey Goshawks in Darwin, Northern Territory. *Australian Field Ornithology* **29:** 152–156.

Riddell, W.E. (2015). Aspect of breeding ecology of the Brown Goshawk *Accipiter fasciatus* in an urban environment in northern Australia. *Northern Territory Naturalist*. **26:** 32-43.

Van Dyck, S. and Strahan, R. (Eds) (2008). 'The Mammals of Australia', 3rd edn. (Reed New Holland: Sydney.)

Appendix 1

Diet of the Black-breasted Buzzard in the Top End of the Northern Territory, 1988–89, and Kimberley region of WA, 1989, by number.

	Prey species	Total
Mammals:	Northern Quoll *Dasyurus hallucatus*	3
	Red-cheeked Dunnart *Sminthopsis virginiae*	2
	Northern Brown Bandicoot *Isoodon macrourus*	7
	Rat *Rattus* sp.	1
	Feral Pig *Sus scrofa*	1
	European Cattle *Bos taurus*	1
	Feral Goat *Capra hircus*	1
	Unidentified	2
	Subtotal	**18**
Birds:	Plumed Whistling-Duck *Dendrocygna eytoni*	1
	Australian Owlet-nightjar *Aegotheles cristatus*	1
	Hawk *Accipiter* sp.	1
	Unidentified Gruiformes	1
	Galah *Eolophus roseicapillus*	1
	Rainbow Lorikeet *Trichoglossus haematodus*	18
	Red-winged Parrot *Aprosmictus erythropterus*	1
	Unidentified Psittaciformes	4
	Unidentified Cuculiformes	1
	Forest Kingfisher *Todiramphus macleayii*	1
	Unidentified Passeriformes	2
	Unidentified birds	9
	Subtotal	**41**
Reptiles:	Frilled Lizard *Chlamydosaurus kingii*	1
	Unidentified dragon (Agamidae)	6
	Skink *Carlia* sp.	1
	Bluetongue *Tiliqua* sp.	1
	Unidentified skink (Scincidae)	18
	Unidentified monitor (Varanidae)	2
	Subtotal	**29**
Insects:	Unidentified Scarabaeidae	1
	Unidentified Tenebrionidae	1
	Unidentified Coleoptera	3
	Unidentified Orthoptera	2
	Subtotal	**7**
	Eggs of birds	**12**
	TOTAL	**107**

Appendix 2

Diet of the Brown Goshawk in the Top End of the Northern Territory, 1988–89, and Kimberley region of WA, 1989, by number.

	Prey species	Total
Mammals:	Sugar Glider *Petaurus breviceps*	6
	Rat *Rattus* sp.	6
	Unidentified	1
	Subtotal	**13**
Birds:	Unidentified Gruiformes	1
	Rainbow Lorikeet *Trichoglossus haematodus*	1
	Unidentified Passeriformes	2
	Unidentified birds	5
	Subtotal	**9**
Reptiles:	Unidentified dragon (Agamidae)	1
	Unidentified skink (Scincidae)	7
	Unidentified lizard (Sauria)	1
	Subtotal	**9**
Spiders:	Unidentified Araneae	1
Insects:	Unidentified Scarabaeidae	2
	Unidentified Tenebrionidae	1
	Unidentified Coleoptera	3
	Unidentified Hymenoptera	3
	Unidentified	5
	Subtotal	**14**
	TOTAL	**46**

Appendix 3

Diet of the Little Eagle in the Top End of the Northern Territory and Kimberley region of WA, 1989, by number.

	Prey species	Total
Mammals:	Unidentified Macropodidae	1
	Unidentified	2
	Subtotal	**3**
Birds:	Tawny Frogmouth *Podargus strigoides*	1
	Australian Bustard *Ardeotis australis*	2
	Sulphur-crested Cockatoo *Cacatua galerita*	1
	Rainbow Lorikeet *Trichoglossus haematodus*	2
	Northern Rosella *Platycercus venustus*	2
	Unidentified Psittaciformes	1
	Blue-winged Kookaburra *Dacelo leachii*	6
	Sacred Kingfisher *Todiramphus sanctus*	3
	Black-faced Cuckoo-shrike *Coracina novaehollandiae*	4
	White-bellied Cuckoo-shrike *Coracina papuensis*	1
	Rufous Whistler *Pachycephala rufiventris*	1
	Torresian Crow *Corvus orru*	2
	Unidentified Corvidae	3
	Magpie-lark *Grallina cyanoleuca*	1
	Unidentified birds	10
	Subtotal	**40**
Reptiles:	Skink *Ctenotus* sp.	1
	Bluetongue *Tiliqua* sp.	1
	Unidentified skink (Scincidae)	1
	Unidentified monitor (Varanidae)	1
	Red-faced Turtle *Emydura victoriae*	1
	Northern Snake-necked Turtle *Macrochelodina rugosa*	1
	Subtotal	**6**
Fish:	Unidentified	2
Insects:	Unidentified	1
	TOTAL	**52**

Appendix 4

Diet of the Australian Hobby in the Top End of the Northern Territory, 1988–89, and Kimberley region of WA, 1989, by number.

	Prey species	Total
Birds:	Unidentified Galliformes	1
	Peaceful Dove *Geopelia striata*	1
	Unidentified Columbiformes	4
	Varied Lorikeet *Psitteuteles versicolor*	3
	Horsfield's Bronze-Cuckoo *Chalcites basalis*	1
	Unidentified Cuculiformes	1
	Sacred Kingfisher *Todiramphus sanctus*	2
	Unidentified Coraciiformes	3
	Little Woodswallow *Artamus minor*	2
	Unidentified Passeriformes	6
	Unidentified birds	6
	Subtotal	**30**
Arachnids:	Scorpionidae *Urodacus* sp.?	1
Insects:	Unidentified Elateridae	1
Coleoptera	Unidentified Scarabaeidae	2
	Unidentified Tenebrionidae	7
	Unidentified Curculionidae	3
	Unidentified Coleoptera	2
Insects:	Unidentified Halictidae	1
Hymenoptera	Unidentified Colletidae	1
	Unidentified Apoidia	2
	Unidentified Sphecidae	1
	Formicidae *Polyractis* sp.	2
Insects: Hemiptera	Unidentified Cicadidae	1
Insects: Odonata	Unidentified	2
	Subtotal	**25**
	TOTAL	**56**

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SEABIRD ISLANDS No. 265

Leo's Island, Easter Group, Houtman Abrolhos, Western Australia

Location: 28°41'23"S, 113°51'37"E; 71 kilometres west of Geraldton, Western Australia. Located 7.6 kilometres ENE of Rat Island, the largest of the islands in the Easter Group of the Houtman Abrolhos.

Status: Houtman Abrolhos Islands Reserve No. A20253, vested under the Land Act 1933 (WA) with the Minister for Fisheries for conservation of flora and fauna, tourism and for purposes associated with the fishing industry.

Description: Leo's Island has an area of 23 hectares. It is 1200 metres long by 300 metres wide and two metres above MHWS. The island has a composite structure[1]. It is comprised of aeolian limestone platform reef overlain by storm cast coral shingle, with areas of concreted coral framestone along the north-western shore. There is a large, shallow tidal pool in the centre of the island.

There are several sandy beaches along the north-western shore, broken by low cemented coral limestone cliffs. Along the south and eastern (seaward) shoreline the coast is comprised wholly of coral rubble and shingle storm-cast ridges.

The island is dominated by low, salt-tolerant shrubs and succulents[2]. Sandy areas support *Atriplex* spp., *Myoporum insulare*, *Rhagodia* spp. and *Nitraria billardierei* over most of the island. Low coastal dunes contain stands of *Spinifex longifolius*. There is a large area of *Halosarcia halocnemoides* and *Carpobrotus virescens* in damper sands.

Landing: Onto the north-west point of the island by dinghy, inshore from the protected anchorage.

Ornithological History: Most visits by ornithologists have been brief, and have involved circumnavigating the island over a two-hour period. The island's seabird colonies were mapped over three years from 2006 to 2008. We also visited the island briefly in August 2001, November 1987 and 2007, December 1999, January 2000 and April and July 2014. R. E. Johnstone visited in October 1981 and August 1983 and K. Coates visited on numerous occasions between 1989 and 2006. C. Feare and J. N. Dunlop visited in December 2008. The first extensive surveys were conducted by A. Burbidge and P. Fuller during their island-wide surveys during the summer of 1981, 1991, 1995, 1996 and 1999.

Breeding Seabirds and Status

Pandion cristatus Eastern Osprey – A single pair nests at Leo's Island. In December 2006 a near-fledged nestling was observed at the north end of the island.

Haliaeetus leucogaster White-bellied Sea-Eagle – A pair uses a nest on a small islet to the NE of the fishing camps. They use a navigation marker and the roofs of the fishing huts as feeding roosts.

Larus pacificus Pacific Gull – Six pairs. Nests were scattered across the island on high ground usually atop low vegetation

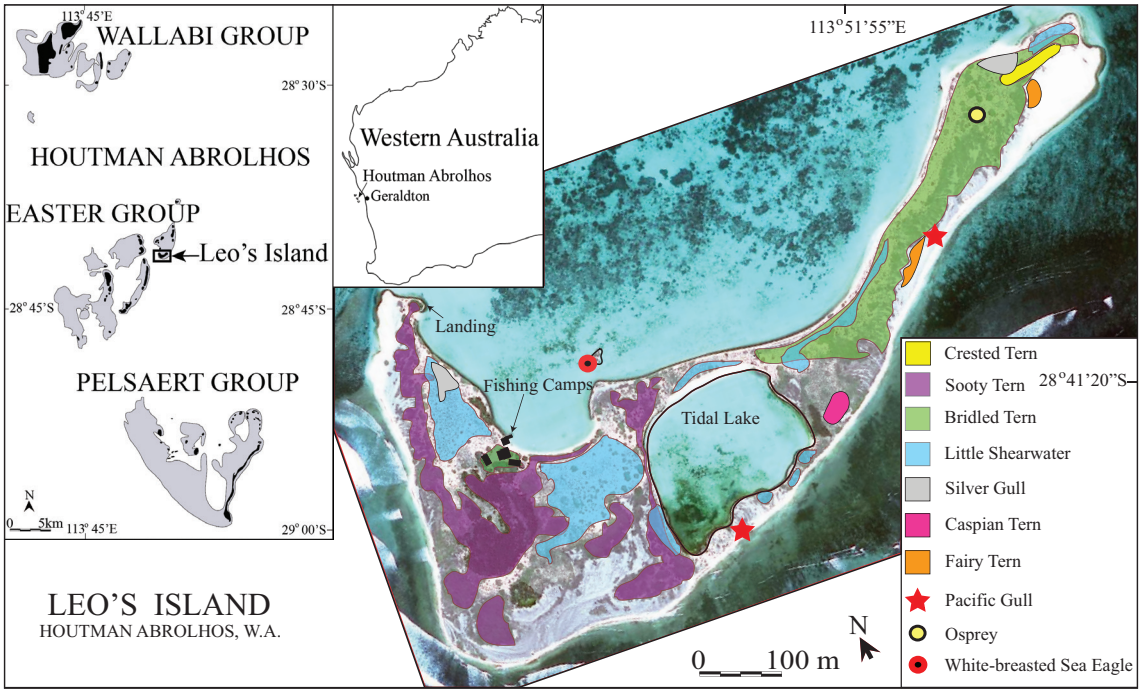

Figure 1. *Leo's Island, Houtman Abrolhos, Western Australia.*

Figure 2. *Aerial photograph of Leo's Island looking WNW.*

surrounded by coral ridges. Nests were constructed of woven brown algae, principally *Ecklonia radiata*, *Sargassum distichum* and *Cystoseira trinodis*. Eggs were laid in August and young fledged by November. By the time of our December 2006 visit adult birds were caring for fledglings/juveniles.

Chroicocephalus novaehollandiae Silver Gull – Silver Gulls nested in loose colonies across the island, mainly amongst *Spinifex longifolius* in the low dune areas of the island to the north and west of the rock-lobster fishing camps. In December 2006 we located 34 active nests, of which 13 contained one or two egg clutches and one had a large pullus[3]. A total of 35 nests were found in 2008, of which 10 were active. Previously, two nests were located in 1999[4], and Storr[5] lists them as breeding on the island. It is likely that this species breeds both in summer and autumn on this island.

Puffinus assimilis Little Shearwater – We estimated 3247 burrows in 2006 and 4656 in 2008, although the breeding population would be somewhat lower than the total burrow count. Inspection of burrows in 11 random 5m x 5m quadrats showed that the density of burrows averaged 0.2/m^2, (range 0.04-0.50/m^2). By the time of our visit in December burrows were deserted and occasional fresh bodies of dead adults or fledglings were noted. Nests occurred in sandy areas of the island, principally areas adjacent to and south of the large tidal pool.

Pelagodroma marina White-faced Storm-Petrel – A single adult was found dead near the fishing camp in December 2008. This species may nest amongst the more extensive Little Shearwater burrows across the island.

Onychoprion anaethetus Bridled Tern – In some years estimates of up to 500 pairs of this species were recorded [6]. In December 2006, we recorded only 64 pairs[3]. Bridled Terns nest throughout the island in areas away from the more densely packed Sooty Terns *Onychoprion fuscatus* at the southern half of the island. They nest at the base of *Nitraria billardierei* bushes along the shoreline, or in crevices created by slabs of coral shingle. This species has also adapted to nesting under camp floors or building materials associated with rock lobster fishing camps. In December 2006 birds had recently laid, although breeding effort throughout the Houtman Abrolhos was significantly lower than in other years due to the lateness of the season[3].

Onychoprion fuscata Sooty Tern – This species was previously the most numerous seabird on the island, where up to 22 320 pairs have bred[3]. Twenty pairs were recorded breeding in 1991, and between 500–1000 in 1995[6]. By 1996 it was estimated that about 20 000 pairs had bred but there were none breeding in late November 1999. More recent surveys estimate 20 096 pairs nesting on the island in 2006, 20 000–30 000 pairs in 2007 and 22 320 pairs in 2008[3,8]. The colony was established across all bushy areas in the southern half of the island in densities (calculated from 5m^2 quadrats) of up to 1.6 birds/m^2. On 5 January 2005 there were thousands of Sooty Terns in attendance on Leo's Island, but there were no chicks or pulli present, and only the broken remnants of a few eggs suggesting the season had been a poor one for this species. No Sooty Terns nested on Leo's Island in 2012, 2013 or 2014 as the population seemed to have dispersed to Rat Island.

Sterna dougallii Roseate Tern – Roseate Terns were not breeding in 1993[6], but bred as early as 25 November in 1999 (627 pairs[4]). We counted just one pair on the island on 12 December 2006[3].

Sternula nereis Fairy Tern – Several small colonies (totalling 47 pairs) of this species were observed scattered across the northern parts of the island in December 2006[3]. In November 2007 there were 12 nests. Two pairs were recorded on eggs in December 2008. Fairy Terns nest amongst finer coral rubble between coral ridges or at edges of vegetated areas on the northern part of the island.

Thalasseus bergii Crested Tern – In late November 1991, 600 pairs[6] were found on Leo's Island and seven pairs in 1999[4]. Colonies of more than 250 nests (1989), 500 nests (1991),

and 700 nests (1996) were also observed[7]. In December 2008 a colony of 422 Crested Terns on single eggs nested at the extreme northern end of the island on low sand dunes. Crested Terns commenced laying between October–December and were very synchronous. Autumn nesting in the Pelsaert Group has also been recorded[9].

Hydroprogne caspia Caspian Tern – Up to 70 pairs have been recorded. This usually solitary nester has nested colonially since at least 1989, when 40-50 pairs were recorded with eggs and fully fledged young[7]. The species was still nesting colonially in 1991 (70 pairs[6]), 1993 (40 pairs[4]), 1996 (10 pairs[7]), 1999 (32 pairs) and 2006 when we found 14 nests, with large pulli and fledglings in a sandy vegetated area to the NE of the tidal pool[3]. In December 2008 there were approximately 30 nests with eggs and chicks[3]. Previously, the species had nested colonially on Wooded Island 8.5 kilometres to the SW (8 pairs – Alexander 1922[10]). It nests elsewhere on West Wallabi (22 pairs), Pelsaert (10 pairs) and singly on 19 other islands throughout the Houtman Abrolhos[3].

Factors Affecting Status

European Rabbits *Oryctolagus cuniculus* were introduced to the island by fishermen but were absent by 1969. The island has several buildings and other infrastructure belonging to a single rock-lobster fisher. The remains of a previous camp are evident near the landing site. The rock-lobster fishing season is now open all year and fishermen may utilize their camp whilst fishing for lobsters. Previously the fishing season extended from March 15–June 30, outside of the main seabird breeding seasons.

Leo's Island is a popular destination for visitors due to its safe anchorage, Australian Sea-lions *Neophoca cinerea* and seabird breeding colonies. Visitors usually walk along worn tracks to the tidal lake, and when guided keep to the beach edge. However often some stray from the path and inadvertently enter the sandy rookeries of the Little Shearwater.

Australian Sea-lions have bred here and several haulouts are evident, particularly adjacent to the fishing camp and tidal lake. Some sandy areas occupied by Little Shearwaters have been damaged by basking sea-lions.

There is a navigation marker on the island that may present a collision hazard at night.

Other Seabirds Recorded

Ardenna carneipes	Flesh-footed Shearwater – A single bird was observed at sea SE of Leo's Island in July 2014.
Puffinus huttoni	Hutton's Shearwater – Up to 50 birds occurred in rafts at sea amongst Wedge-tailed Shearwaters in Eastern Passage, 200 metres S of Leo's Island.
Egretta sacra	Eastern Reef Egret – No nests of this species have been found, although it occupies the island and suitable rocky overhangs are available for nest sites.
Phalacrocorax varius	Pied Cormorant – This species roost at times on the northern spit.
Haematopus fuliginosus	Sooty Oystercatcher – No nests were located but a pair of this species was observed in 2006 and 2008 roosting on the island.
Haematopus longirostris	Australian Pied Oystercatcher – No nests were located but a pair of this species was observed defending potential sites in 2006 and 2008.

Other Vertebrates Recorded

Silvereye	*Zosterops lateralis*
Ruddy Turnstone	*Arenaria interpres*
Grey-tailed Tattler	*Tringa brevipes*
Welcome Swallow	*Hirundo neoxena*
King Skink	*Egernia kingie*

Banding

None.

Bibliography

1. Collins, L. B., Wyrwoll, K-H., and France, R. E. (1991). The Abrolhos carbonate platforms: geological evolution and Leeuwin Current activity. *Journal of the Royal Society of W.A.* **74**: 47–57.
2. Harvey, J. M., Alford, J. J., Longman, V. M. and Keighery, G. J. (2001). A flora and vegetation survey of the islands of the Houtman Abrolhos, Western Australia. *CALMScience* **3**: 521–623.
3. Surman, C. A. and Nicholson, L. W. (2009). A survey of the breeding seabirds and migratory shorebirds of the Houtman Abrolhos, Western Australia. *Corella* **33**: 81–98.
4. Burbidge, A. A. and Fuller, P. J. (2004). Numbers of non-burrowingbreeding seabirds of the Houtman Abrolhos: 1991–1993 and 1999. *Corella* **28**: 96–103.
5. Storr, G. M., Johnstone, R. E. and Griffin, P. (1986). Birds of the Houtman Abrolhos, Western Australia. *Rec. W.A. Mus.* **24**: 1–42.
6. Fuller, P. J., Burbidge, A. A. and Owens, R. (1994). Breeding Seabirds of the Houtman Abrolhos, Western Australia. *Corella* **18**: 97–113.
7. Coates, K. (2005). Houtman Abrolhos Island Bird Sightings 1987–2005. Unpublished manuscript. 12Pp.
8. Chris Feare, pers.comm.
9. Surman, C. A. (1998). Seabird breeding schedules at the Pelsaert Group of islands, Houtman Abrolhos, Western Australia between 1993 and 1998. *Rec. W.A. Museum* **19**: 209–216.
10. Alexander, W. B. (1922). The vertebrate fauna of Houtman's Abrolhos. *Journal of the Linnean Society, London* **34**: 457–486.

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Date compiled: December 2014

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Corella, 2016, 40(1): 20-22

SEABIRD ISLANDS No. 266

Newman Island, Easter Group, Houtman Abrolhos, Western Australia

Location: 28°51'49"S, 113°59'43"E; 57 kilometres west of Geraldton, Western Australia. Located 4.2 kilometres north of Pelsaert Island, the largest of the islands in the Pelsaert Group, Houtman Abrolhos.

Status: Houtman Abrolhos Islands Reserve No. A20253, vested under the Land Act 1933 (WA) with the Minister for Fisheries for conservation of flora and fauna, tourism and for purposes associated with the fishing industry.

Description: Newman Island (6.1ha) is 725 metres long and up to 230 metres wide, although it averages 60 metres in width and is three metres above MHWS.

The geology is a composite island structure[1]. It is comprised of aeolian limestone platform reef overlain by loose coral shingle storm ridges with some coarse coral sand beaches. There are areas of cemented coral shingle and framestone. There are six tidal ponds on the island.

The island is largely free of vegetation over the extensive areas of bare coral ridges. Along the southern shoreline of the main part of the island are narrow stands of the mangrove *Avicennia marina*. The northern shoreline is also lined with mangroves to the west, as well as *Halosarcia halocnemoides* and *Nitraria billardierei* dwarf shrubland, with *Suaeda australis* succulents. Areas of bare coral have very occasional Coastal Groundsel *Senecio lautus* and Austral Seablite *Sonchus oleraceus*. Areas with some sand or guano are usually interspersed with Wild Oats *Avena fatua*. Of the 19 plants recorded, five (26%) are exotic[2].

Up until 2013 there were seven buildings and a jetty associated with rock lobster fishers. The jetty and four derelict buildings and associated rubbish have since been removed. Three buildings remain, as well as surveyors' pickets from an airstrip proposed for the island in 1981.

Landing: A landing can be made onto the south-eastern end of the island near to the original jetty site. There are no deep water access points or safe anchoring sites on the island, and access is by small vessel only.

Ornithological History: Few visits by other ornithologists have been made as most visit the larger Pelsaert Island. CAS visited in late January 1989, April 1989, February 1991, April–May 1997, July 1998, April 1999, July 2003, October 2008, May 2009, April 2011, and December 2012, April and December 2013 and June, October and November 2014. In addition, we extensively mapped Newman Island seabird colonies over three years between 2006–2008. R. E. Johnstone visited in October 1981 and August 1983. Surveys were conducted by A. Burbidge and P. Fuller during their island-wide surveys during the summer of 1981, 1991, 1995, 1996 and 1999.

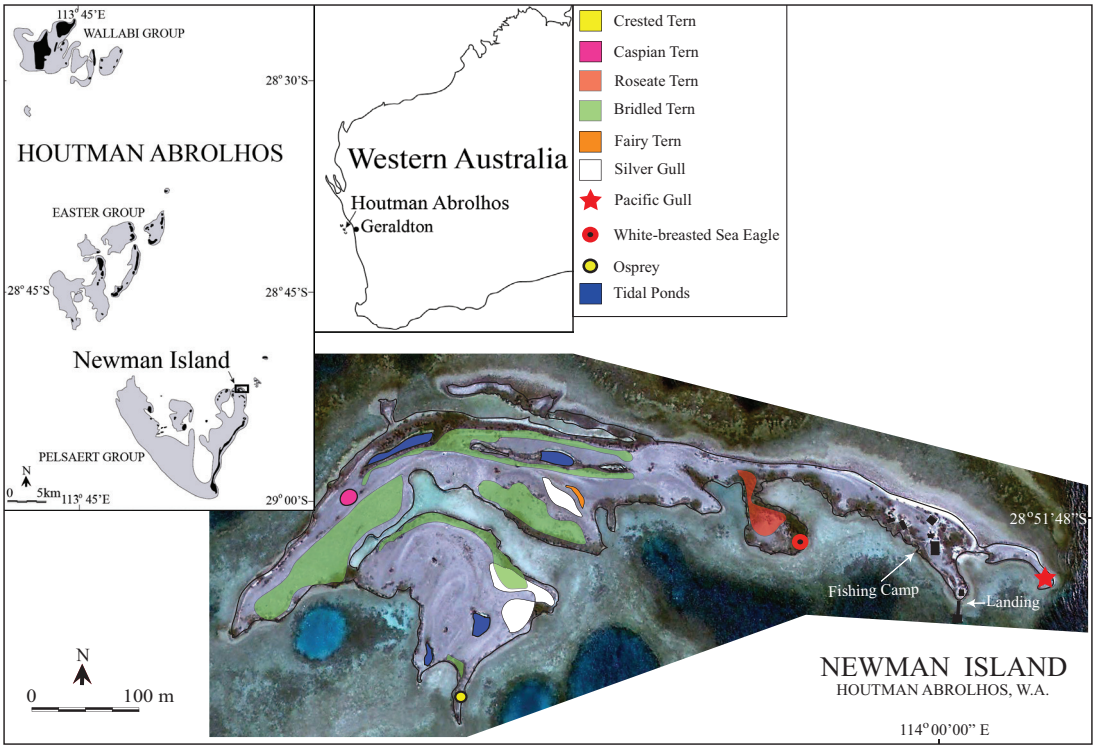

Figure 1. *Newman Island, Houtman Abrolhos, Western Australia.*

Breeding Seabirds and Status

Pandion cristatus Eastern Osprey – Two nests, one active most years.

Haliaeetus leucogaster White-bellied Sea-Eagle – One recently used nest adjacent to mangroves was empty in December 2006[3], however an adult was incubating eggs in July 2014.

Larus pacificus Pacific Gull – One pair has nested on a coral ridge at the eastern end of island above the high water mark since our visits commenced in 1989. The nest was constructed of woven brown algae and some flotsam, principally *Ecklonia radiate* and *Sargassum distichum* as well as strands of nylon rope. Eggs were laid in August and young usually fledged by November or early December. By the time of our December 2006 visit, birds were caring for fledglings/juveniles.

Chroicocephalus novaehollandiae Silver Gull – Up to 79 nests have been recorded but breeding effort was highly variable. In April 1989 there were approximately 100 adults, with many nests containing eggs. In April 2011 only seven nests were active, and of 27 nests located in June 2014, five were active. More Silver Gulls nested here during autumn than in summer. Other seabird observers have recorded 15 nests in December 1993, none in December 1999[4] and 12 in December 2006[3].

Onychoprion anaethetus Bridled Tern – Up to 55 nests have been observed. This is one of the most unusual nesting sites for this species as there are two distinct nesting populations. Johnstone[5] first observed autumn nesting of Bridled Terns here in 1981. Subsequent visits by CAS have confirmed this, with up to 130 adults overhead in late April, and on occasions 30 adults in June. Summer breeding birds had fledglings in late April at a time when the autumn-nesting population commenced laying. Adults in July 2003 had bare or refeathering brood patches, and there was one fledgling and a bird incubating an egg. On 24 April 1999, 22 nests with eggs and fresh chicks were located. At least four eggs examined were hatching. On 21 April 2011, we located at least six eggs, two nests with chicks less than three days old as well as two with fledglings. At a time when Bridled Terns on the other 89 islands that they nest on at the Houtman Abrolhos are migrating northwards to the Sula Sea[6], those on Newman Island were fledging young. Summer breeding Bridled Terns fledged young by mid-late April and autumn nesting birds by mid-late July. Bridled Terns nested in a loose colony across all areas of the island favouring broken ground and along the fringes of stands of the mangrove *Avicennia marina*.

Sterna dougallii Roseate Tern – Up to 80 nests have been recorded in autumn. In late April 1997 there were 80 nests and 350 adults attending the colony, however the colony was abandoned by May 1997. In late April 2013 we recorded 42 birds on eggs and 50 others were prospecting for nest sites. This species nests along coral ridges usually where finer coral fragments facilitate nest scrapes.

Sternula nereis Fairy Tern – Small colonies (up to 20 pairs) of this species were observed in 1993 and 1999[4,7]. CAS recorded 30 nests in February 1991; half of these contained 1–2 eggs and the other half young chicks. On 15 October 2014, six adults were defending sites, and one nest contained a single egg. On Newman Island nesting always occurred on finer coral fragments in exposed areas. Nesting locations varied from one year to the next.

Thalasseus bergii Crested Tern – In late April 1989 CAS recorded 30 nests, all with fresh eggs. Elsewhere at the Houtman Abrolhos, Crested Terns commenced laying between October–December and were very synchronous. Autumn nesting in the Pelsaert Group has also been recorded on Stick Island where in late May 1997 a colony contained pulli aged from 5–25 days.

Hydroprogne caspia Caspian Tern – One pair. In October 2014 a nest contained two nestlings <5 days old.

Factors Affecting Status

The island is visited infrequently due the difficulty of landing and the collapse of the jetty. Present and past buildings and a jetty on the island are remnants that were used by rock lobster fishermen. Bridled Terns often nest amongst stacks of timber or corrugated iron associated with some fishing camps.

Australian Sea-lions *Neophoca cinerea* used some near shore areas amongst mangroves as haulouts.

Like other islands in the Houtman Abrolhos, there are several introduced weed species, including Wild Oats *Avena fatua*, the Medic Burr *Medicago polymorpha* and Wild Radish *Raphanus sativus*. Competition from weed species may impact native vegetation and nesting sites of some species.

Other Seabirds Recorded

Haematopus longirostris	Australian Pied Oystercatcher – No nests were located but a pair of this species was observed.
Egretta sacra	Eastern Reef Egret – A pair of birds was observed in mangroves adjacent to one of the tidal ponds. Quite possibly this species nests under cover there.

Other Vertebrates Recorded

Grey Plover	*Pluvialis squatarola*
Bar-tailed Godwit	*Limosa lapponica*
Silvereye	*Zosterops lateralis*
Red-capped Plover	*Charadrius ruficapillus*
Greater Sand Plover	*Charadrius leschenaultii*
Red-necked Stint	*Calidris ruficollis*
Ruddy Turnstone	*Arenaria interpres*
Grey-tailed Tattler	*Tringa brevipes*
Welcome Swallow	*Hirundo neoxena*

Banding

Onychoprion anaethetus – five adults in 1997, 13 adults in 2003.

Bibliography

1. Collins, L. B., Wyrwoll, K-H., and France, R. E. (1991). The Abrolhos carbonate platforms: geological evolution and Leeuwin Current activity. *Journal of the Royal Society of W.A.* **74**: 47–57.
2. Harvey, J. M., Alford, J. J., Longman, V. M. and Keighery, G. J. (2001). A flora and vegetation survey of the islands of the Houtman Abrolhos, Western Australia. *CALMScience* **3**: 521–623.
3. Surman, C. A. and Nicholson, L.W. (2009). A survey of the breeding seabirds and migratory shorebirds of the Houtman Abrolhos, Western Australia. *Corella* **33**: 81–98.
4. Burbidge, A. A. and Fuller, P. J. (2004). Numbers of non-burrowing breeding seabirds of the Houtman Abrolhos: 1991–1993 and 1999. *Corella* **28**: 96–103.
5. Storr, G. M, Johnstone, R. E. and Griffin, P. (1986). Birds of the Houtman Abrolhos, Western Australia. *Rec. W.A. Mus.* **24**: 1–42.
6. Dunlop, J. N. and Johnstone, R. E. (1994). The migration of Bridled Terns *Sterna anaethetus* breeding in Western Australia. *Corella* **18**: 125–129.
7. Fuller, P. J., Burbidge, A. A. and Owens, R. (1994). Breeding Seabirds of the Houtman Abrolhos, Western Australia. *Corella* **18**: 97–113.

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Erratum.

Seabird Islands: Gun Island, Pelsaert Group, Houtman Abrolhos, Western Australia

C. A. Surman and L. W. Nicholson

Corella **39:** 102-104.

Page 103: **Other Vertebrate Recorded.** Yellow White-eye *Zosterops luteus* should read, Silvereye *Zosterops lateralis*.

RECOVERY ROUND-UP

This section is prepared with the co-operation of the Secretary, Australian Bird and Bat Banding Schemes, Australian Nature Conservation Agency. The recoveries are only a selection of the thousands received each year; they are not a complete list and should not be analysed in full or part without prior consent of the banders concerned. Longevity and distance records refer to the ABBBS unless otherwise stated. The distance is the shortest distance in kilometres along the direct line joining the place of banding and recovery; the compass direction refers to the same direct line. (There is no implication regarding the distance flown or the route followed by the bird). Where available ABBBS age codes have been included in the banding data.

Recovery or longevity items may be submitted directly to me whereupon their merits for inclusion will be considered.

Hon. Editor

The following abbreviations appear in this issue:
ABBBS – Australian Bird and Bat Banding Schemes
AWSG - Australasian Wader Study Group.
BMRC - The Bird Migration Research Centre, Japan.
NZBS – New Zealand Banding Scheme.
SABRU- South African Bird Ringing Unit.
SOSSA – Southern Oceans Seabird Study Association
SSG -BOAT – Shorebird Study Group – BOAT (Tas.)
VWSG - Victorian Wader Study Group.

Red-tailed Tropicbird *Phaethon rubricauda*

200-16854. Adult (1+) banded by G. K. Williams on Sugarloaf Rock Nature Reserve, WA on 11 Jan. 2006. Recaptured, released alive with band at Nosy Ve Islet, near Anakao, Madagascar on 20 Apr. 2015 by M. Le Corre, over 9 years 3 months after banding. 6919 km WSW.

(This is the longest movement recorded for the species.)

Tristan Albatross *Diomedea dabbenena*

J09313*. Nestling banded by SABRU, South Africa on Gough Island, South Atlantic Ocean, South Africa (40°20'00"S 09°55'00"W) on 30 Oct. 1992. Recaptured, released alive with two bands at sea East of Wollongong, NSW, (34°25'00"S 151°00'00"E) by SOSSA on 5 Oct. 1997. 11 473 km SSE.

(The bird was also banded with ABBBS band no. 140-34794)

*South African Bird Ringing Unit band.

Wedge-tailed Shearwater *Ardenna pacifica*

161-70290. Nestling banded by N. W. Swanson Muttonbird Island, Coffs Harbour, NSW on 9 Apr. 1981. Recovered dead at Bonny Hills Beach, NSW on 28 Nov. 2015, over 34 years, 7 months after banding 146 km SSE.

(This is the oldest recorded for the species.)

Short-tailed Shearwater *Ardenna tenuirostris*

162-28394. Adult (1+) banded by R. D. Wooller on Great Dog Island, Bass Strait, Tas. on 3 Dec. 1991. Recovered dead at 90 Mile Beach, Loch Sport, Vic. on 15 Nov. 2015, over 23 years, 11 months after banding. 252 km N.

Australasian Gannet *Morus serrator*

(a) M57092*. Juvenile banded by NZBS on White Island, Bay of Plenty, New Zealand (37°31'00"S 177°11'00"E) on 8 Feb. 1995. Recovered exhausted, rehabilitated and released alive with band at Lighthouse Beach, Ballina, NSW (28°52'00"S 153°35'00E) on 14 Oct. 2015, over 20 years, 8 months after banding. 2388 km WNW.

* New Zealand Banding Scheme band

(b) 131-64923. Nestling banded by F. I. Norman at Popes Eye off Queenscliff, Port Phillip, Vic. on 24 Nov. 1988. Recovered dead at Ocean Grove Beach, Vic. on 21 Dec. 2015, over 27 years after banding. 16km W.

Australasian Bittern *Botaurus poiciloptilus*

121-33441 plus Satellite Tag. . Immature (1) male banded by A. F. Silcocks at Rice Crop, Kidman Highway, 20 km SSW of Coleambally, NSW on 22 Apr. 2015. Located using radio telemetry three times:

(1) At Pick Swamp, SA on 2 May 2015, 10 days after banding, 551 km SW.

(2) At Long Swamp, Vic. on 10 May 2015, 18 days after banding, 4 km E of previous site.

(3) At Lake Wyangan, NSW on 18 Sep. 2015, 4 months, 27 days after banding. 615 km NE of previous site. (85 km N of the original banding site).

(This is the longest movement recorded for the species.)

Australian Pied Oystercatcher *Haematopus longirostris*

101-04626. Adult (3+) banded by VWSG on Swan Island, Queenscliff, Vic. on 22 Dec. 1995. Recovered dead on Mud Island, Port Phillip Bay, Vic. on 9 Dec. 2015, over 19 years, 11 months after banding. 8 km E.

Ruddy Turnstone *Arenaria interpres*

5A54180* plus Engraved Leg Flag: Orange XCK. Juvenile (J) banded by BMRC Japan at Shunkunitai, Nemuro, Hokkaido Pref. Japan (43°17'00"N 145°26'00"E) on 27 Aug. 2013. Bird recaptured, released alive with band at Pelican Point, Carpenter Rocks, SA (37°55'00"S 140°24'00"E) by AWSG on 11 Nov. 2015. 9041 km S.

* Bird Migration Research Centre, Japan band.

Bridled Tern *Onychoprion anaethetus*

061-76060. Nestling banded by J. N. Dunlop on Penguin Island, WA on 1 Jan. 1988. Recaptured, released alive with band at banding place twice, the last occasion on 26 Sep. 2015, over 27 years, 8 months after banding.

(This is the oldest recorded for the species.)

Pacific Gull *Larus pacificus*

110-96984. Nestling banded by SSG –BOAT on Visscher Island, Tas. on 31 Dec. 1983. Recovered dead at Eaglehawk Neck, Pirate Bay, Tas. on 3 Aug. 2015, over 31 years 7 months after banding. 19 km S.

(This is the oldest recorded for the species.)

Purple-crowned Fairy-wren *Malurus coronatus*

026-06164 plus colour bands LDymRDrn. Adult (2-) male banded by J. C. Z. Woinarski at the Victoria River access Boat-ramp, Gregory National Park, NT on 7 Aug. 2002. Colour marking sighted in field (band number inferred) at banding place on 7 Jun. 2015, 12 years, 10 months after banding.

(This is the oldest recorded for the species.)

Speckled Warbler *Pyrrholaemus sagittatus*

019-73349. Adult (1+) male banded by R. Jacobs at Burrendong Arboretum, near Wellington, NSW on 30 May. 2009. Recaptured, released alive with band at banding place on 21 Nov. 2015, over 6 years, 6 months after banding.

Yellow-rumped Thornbill *Acanthiza chrysorrhoa*

019-20399. Adult (1+) banded by A. & A. Leishman at Munghorn Gap Nature Reserve, NSW on 24 April 2005. Recaptured, released alive with band twice the last occasion by G. Fry on 18 April, 2014, 9 years after banding.

(The bird was also banded with band no. 019-95575.)

Buff-rumped Thornbill *Acanthiza reguloides*

018-87343. Adult (1+) banded by G. Fry at Munghorn Gap Nature Reserve, NSW on11 May 2009. Recaptured, released alive with band on 15 Aug. 2015, over 6 years, 3 months after banding.

(The bird was also banded with band no. 019-95723.)

Inland Thornbill *Acanthiza apicalis*

(a) 018-57959. Adult (2+) banded by G. Fry at Warraderry State Forest, near Grenfell, NSW on 14 Dec. 2008. Recaptured, released alive with band at banding place five times, the last occasion on 23 Sep. 2015, over 6 years, 9 months after banding.

(b) 018-57986. Immature (1) banded by G. Fry at Warraderry State Forest, near Grenfell, NSW on 14 Dec. 2008. Recaptured, released alive with band at banding place three times, the last occasion on 17 May. 2015, over 7 years, 5 months after banding.

(The bird was also banded with band no. 019-95338.)

White-plumed Honeyeater *Lichenostomus penicillatus*

(a) 026-10498. Adult (1+) banded by C. Kinross at Burrendong Arboretum, near Wellington, NSW on 5 Jun. 2005. Recaptured, released alive with band at banding place ten times the last occasion by J. Allnutt on 22 Nov. 2015, over 10 years and 5 months after banding.

(b) 026-32431. Adult (2+) male banded by D. McKay at Burrendong Arboretum, near Wellington NSW on 5 May 2007. Recaptured, released alive with band at banding place twice the last occasion by A. Hunt on 21 Nov. 2015, over 8 years, 6 months after banding.

Rufous Whistler *Pachycephala rufiventris*

(a) 035-14220. Adult (3+) male banded by G. Fry at Warraderry State Forest, near Grenfell, NSW on 7 Oct. 2007. Recaptured, released alive with band at banding place on 25 Sep. 2015, over 7 years 11 months after banding.

(b) 035-14226. Adult (3+) male banded by G. Fry at Warraderry State Forest, near Grenfell, NSW on 7 Oct. 2007. Recaptured, released alive with band at banding place on 25 Sep. 2015, over 7 years, 11 months after banding.

(The above two birds were banded on the same day and at the same banding place in 2007 recaptured together on the same day at the banding place in 2015.)

(c) 035-26466. Adult (3+) male banded by A. & A. Leishman at Warraderry State Forest near Grenfell, NSW on 5 Oct. 2006. Recaptured, released alive with band at banding place on 25 Jan. 2015, over 8 years, 4 months after banding.

Grey Shrike-thrush *Colluricincla harmonica*

051-80526. Adult (2+) male banded by A. R. Bougher at the Wandoo National Park (formerly Dobaderry Nature Reserve) near Beverley, WA on 17 May 2003. Recaptured, released alive with band at banding place on 28 Jun. 2015, over 12 years, 1 month after banding.

BANDING SNIPPET

Pink Robins

Only three Pink Robins have been banded in the Sydney Region: the first at Shaw's Creek (May 1984) below the Blue Mountains escarpment and adjacent to Hawkesbury Heights, the second at Nurragingy Reserve, Doonside (July 2013) and the third at Wianamatta Nature Reserve near Penrith (August 2014 and retrapped in June and August 2015). There have also been three observations recorded from around Sydney – Picnic Point (August 1972), Castle Hill (April 1975) and St. Ives (June 1985) and two near Wollongong – Primbee (Sept 1987) and Bulli (September 1988).

It is unlikely that the Pink Robin banded by us in 2014 and retrapped twice at the same locality in 2015 travelled from the species' northerly limit of its known breeding range in the Brindabella Ranges west of Canberra, approximately 250 kilometres south, to this locality two years running. It has been speculated that in the Canberra area the Pink Robin is a winter migrant from its high altitude breeding areas to the relatively warmer lower altitudes. The most likely scenario is that in the Sydney region the species is also an altitudinal, rather than latitudinal, migrant and probably spends most of its time (breeding season September to April) in the densely forested valleys of the Blue Mountains and moves east out of the mountains to winter on the relatively warmer Cumberland Plain.

Rose Robins, a similar species, are known to migrate from the Blue Mountains to the Cumberland Plain during winter months and are regularly sighted and captured at our study sites at Scheyville National Park, Agnes Banks Nature Reserve, Windsor Downs Nature Reserve, Nurragingy Reserve, Prospect Nature Reserve and Wianamatta Nature Reserve. Perhaps the Pink Robins are following the same altitudinal movement pattern.

Pink Robins breed in the dense understory of wet sclerophyll forests and rainforests, such as occur in the deep gullies and valleys of the eastern and central Blue Mountains. It is possible that in this region they occupy areas that are rarely visited by skilled bird observers, or they have been misidentified as the relatively common Rose Robin. The plumage features to watch for are a prominent frons white spot (lower forehead – base of upper mandible), rufous wing bars, lack of white in tail and a pink (as distinct from rose-red) breast or wash on the breast.

John Farrell and Jeff Hardy

Notice to Contributors

Manuscripts relating to any form of avian research will be considered for publication. Field studies are preferred particularly where identification of individual birds, as by banding, has formed an integral part of the study. Some broad areas of research which do not necessarily require individual identification include morphometric analyses, techniques, species diversity and density studies as well as behavioural investigations. Behavioural, plumage and breeding studies can be conducted in captivity but must provide basic ornithological knowledge rather than avicultural interest.

Manuscripts are classified as either major articles (more than 1,500 words) or minor articles (500 to 1,500 words). Minor articles need no summary. Shorter notes relating to almost any aspect of ornithology are welcomed but must adhere to the aims of the Association. Species lists or sightings which are not discussed in relation to historical evidence or scientific parameters are not suitable for publication in *Corella*. Authors proposing to prepare Seabird Island items should contact the Assistant Editor,Seabird Islands, and obtain a copy of the guidelines.

Contributors are requested to observe the following points when submitting articles and notes for publication in *Corella*.

Manuscripts:

A guide to the format required for tables, figures and manuscripts can be attained by reference to a recent edition of the journal and more specifically to the Publication Style found on the ABSA website.

Articles or notes should be sent via email to the editor as a .doc or .rtf file or typewritten and submitted in triplicate via post. Double spacing is required with typing on one side of the paper only. Margins of not less than 25 mm width at the left hand side and top, with similar or slightly smaller at the right hand side of the page are required.

All pages of the manuscript must be numbered consecutively, including those containing references, tables and captions to illustrations, the latter placed in after the text. No underlining and no abbreviations should be used within the text.

The *Style Manual for Authors,Editors and Printers* (6th edition 2002; John Wiley & Sons Australia, Ltd.) is the guide for this journal. Spelling generally follows the Macquarie Dictionary.

Nomenclature and Classifications follow:

Christidis, L. and Boles, W. E. (2008). 'Systematics and Taxonomy of Australian Birds'. (CSIRO: Collingwood, Victoria).

Proper nouns, particularly place and bird names must commence with a capital letter.

Headings are as follows: **HEADING – capitals and bold** (e.g. **RESULTS)**

Sub Heading – lower case and italics (e.g. *Ecology*)

Referencing:

References to other articles should be shown in the text – '. . . Bell and Ferrier (1985) stated that . . .'or '…. this is consistent with other studies (Jones 1983; Bell and Ferrier 1985).'– and in the Reference Section as:

Bell, H. L. and Ferrier, S. (1985). The reliability of estimates of density from transect counts. *Corella* 9: 3-13.

Jones, J. C. (1983). 'Sampling Techniques in Ornithology.'(Surrey Beatty and Sons: Chipping Norton, NSW.)

Figures (Maps and Graphs) and Tables:

The printable area of the page is 18 cm x 27 cm; double column figures/tables will be 18 cm across; single column figures/tables will be 8.5 cm across; widths between one column and double column can also be accommodated.

The captions for figures should be typed up onto a page separate from the figure.

Maps

Maps should be clear and relevant to the study and can be submitted in a variety of formats (.tif, .eps, .pcx) but the recommended one is a high resolution .jpg file (colour is acceptable). In some instances simply listing the latitude and longitude may suffice instead of a published map. Maps should only show necessary information. Excessive labelling(including names of towns, roads, rivers) will clutter the figure making it difficult to locate key place names. Photocopies of original hand drawn maps are not suitable for publication. They should be submitted only initially. When the paper is accepted for publication, the originals must be submitted so that they can be scanned into an appropriate electronic format.

Graphs

Lines should be thick and dark and any fill used should show a clear distinction between sets of data (colour fills are acceptable). Borders around the graph and the key are not necessary. The recommended format is an .xls file – this makes it very easy to adjust fills, thickness of lines etc, if necessary.

Where possible, please present the figure at final size. Figures that seem satisfactory when they are large, can present problems when they are reduced. Remember that if the figure has to be reduced for publication the figure will reduce equally in all dimensions i.e. both width and height will reduce. This can cause some problems, such as: (i) Line graphs where the lines are very close together can lose clarity. (ii) The typeface will reduce. Please ensure that the final typeface size AFTER reduction will be a minimum of 10 times Times New Roman typeface.

Tables

The recommended format is an .xls file but tables created in Word are acceptable. These should normally have a maximum size of one page but larger tables can be accommodated, if necessary.

FOR MORE DETAILED INFORMATION OR ASSISTANCE IN THE PREPARATION OF FIGURES PLEASE CONTACT THE PRODUCTION EDITOR.

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