THE TERRESTRIAL BIRDS OF THE ROXBY DOWNS AREA: A TEN YEAR HISTORY

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ABSTRACT

Patterns of bird records, excluding waterbirds, in the Roxby Downs area derived from opportunistic observations from 1988 to 1997 are presented. A total of 106 native and four introduced species was recorded. Less than half (47) of the bird species were considered to be residents, five were regular seasonal visitors, 16 were frequently recorded opportunistic visitors and 42 species were locally uncommon or vagrants. We describe their residency status, seasonality and recording frequency and compare these data with count data from quantitative surveys. An annotated list includes observations on breeding, behaviour, predators and diet of birds in the region.

INTRODUCTION

Several Australian arid-zone birds have declined considerably in range or abundance since European settlement (Garnett 1992; Reid and Fleming 1992). However, quantitative data on the abundance and distribution of birds in the sparsely-settled areas of Australia are limited, which hampers detection and monitoring of historical and contemporary changes in the status of bird populations. Furthermore, long-term studies are typically required to assess the status of bird communities in arid regions because many Australian arid-zone birds are nomadic (Davies 1976; Schodde 1982) and the populations of some resident species fluctuate considerably with prevailing environmental conditions (Read, Reid and Venables 2000).

The avifauna of northern South Australia is characterised by a relatively impoverished assemblage of birds which inhabit the stony or sandy deserts, a higher diversity in riparian or other woodland areas and a rich assemblage of nomadic and migratory waterfowl which take advantage of temporary wetlands (Reid, Badman and Parker 1990; Read and Badman 1999). Despite numerous publications concerning short-term surveys of large regions and more detailed studies on particular species which were summarised by Reid, Badman and Parker (1990), and Read and Badman (1999), there have been no published long-term studies of the dynamics of dryland bird assemblages in arid South Australia. Prior to the preparation of the Olympic Dam Project Environmental Impact Statement (EIS) (Kinhill-Stearns Roger 1982), the ornithological history of the Roxby Downs area was poorly known (Reid 1982). A thorough inventory of local species has subsequently been accumulated (Read 1994) through the baseline study conducted for the EIS, and subsequent avifauna surveys since the early 1980s. The affects of mining and pastoralism on the local bird assemblage were established through repeated quantitative transects over a four year period (Read, Reid and Venables 2000). The colonisation of several bird species at amenity plantings and domestic waterbodies was described by Read (1999). Population sizes, habitat preferences and occupancy periods of over 150,000 waterfowl of 56 species in the Roxby Downs–Woomera area has been documented by Read and Ebdon (1998).

With the exception of the aforementioned detailed studies, most of the information on the bird assemblages in the Roxby Downs area is derived from opportunistic sightings or observations which are recorded monthly. The aim of this paper was to integrate this opportunistic information from the last 10 years in order to document the recording frequency and residency status of local terrestrial bird species. This process provides a baseline upon which future changes in the status of species may be assessed and enables us to identify gaps in the data which would benefit from future targeted observations. This study also permits comparison of the relative values of long-term opportunistic versus short-term quantitative datasets, in establishing the local status of avifauna.

METHODS

Study area

Roxby Downs is located approximately 510 km north of Adelaide in the South Australian arid zone (Figure 1). The study area incorporates a 30 km radius around Roxby Downs town,

although most observations were made immediately north of Roxby Downs, within the Olympic Dam Mine Lease and the Roxby Downs Municipal Lease. Summers are hot, winters are mild and the rainfall is highly erratic and aseasonal with a long-term annual mean of 168 mm (Read 1995a) and a median, which is a more meaningful figure, of 136 mm at Roxby Downs Station (F. Badman pers. comm.). White cypress-pine *Callitris glaucophylla*, narrow-leaved hop-bush *Dodonaea viscosa* ssp. *angustissima*, and *Acacia* spp. are characteristic vegetation of the parallel orange sand dunes in the region, whereas chenopods including bladder saltbush *Atriplex vesicaria*, bluebushes *Maireana* spp., bassias *Sclerolaena* spp. and grasses are the principal vegetation of the interdunal swales.

The study area has historically been used for sheep and cattle pastoralism, although stock were excluded from the 175 km² Olympic Dam Mine Lease and 100 km² Roxby Downs Municipal Lease in 1986 (Read 1992). Cattle are still grazed on Andamooka and Roxby Downs pastoral stations. The residential and mining centres of Roxby Downs, Olympic Dam and Andamooka also lie within the study area.

Sampling methods and analysis

Birds were observed opportunistically by several experienced birdwatchers and marked off on a checklist every month from January 1988 to December 1997. Yearly totals of species recorded were calculated from March to February, which corresponds with the reporting period for the Olympic Dam Corporation Environmental Monitoring and Management Programme. Whilst search effort varied, at least four hours were spent observing birds in all months. Noteworthy breeding, dietary and habitat affinity observations were also recorded.

Birds were allocated to one of five categories based on the number of months in which they were recorded and the patterns of their occurrence. 'Frequently Recorded Residents' were recorded in more than 75 of the 120 months. 'Infrequently Recorded Residents' were considered to permanently inhabit the region and were recorded from 15 to 74 months. 'Frequently

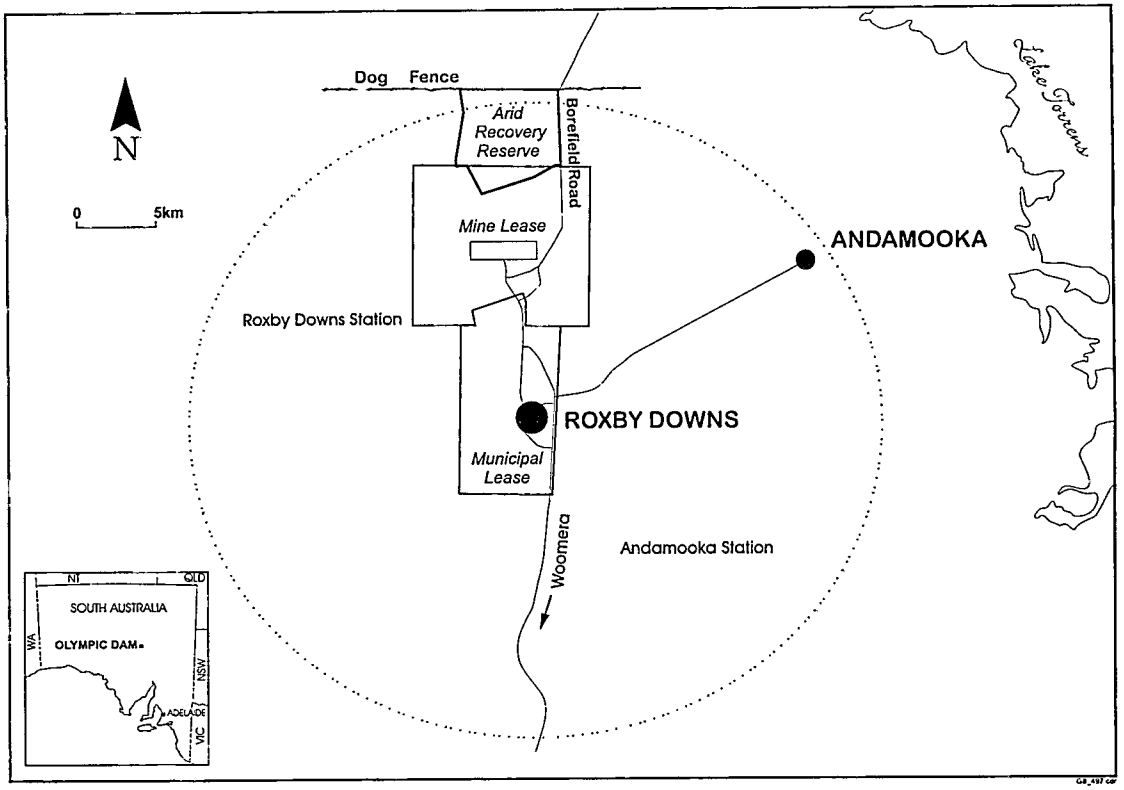

Figure 1. Location of Roxby Downs and extent of the study area.

Recorded Seasonal Visitors' were recorded from at least 40 months and showed a regular pattern in the time of year that they were recorded. 'Frequently Recorded Opportunists' were not residents but were recorded in more than 18 months, typically in good seasons following rains. The final category was 'Nomadic or Uncommon Species', which were recorded in less than 15 months. Some of the birds in this latter category may inhabit the region more frequently than our data suggest but due to their cryptic nature were overlooked during opportunistic surveys.

RESULTS

A total of 110 species was recorded over the 10 year period (Table 1), of which 36 were considered to be frequently recorded residents. Eleven species were infrequently recorded residents, 16 frequently recorded opportunists, five regular seasonal visitors and 42 were nomadic or uncommon. Species richness did not vary a great deal between seasons with the maximum number (97) of species being recorded over the autumn months and the minimum (93) over the summer months. Yearly totals ranged from 80 species in 1996-97 up to 93 species in both 1991-92 and 1992-93 (Table 2).

A total of 63 species was recorded breeding in the region. Most breeding records (162; 58%) were in the spring months and the least (21; 8%) from the autumn months (Figure 2). Zebra Finches *Taeniopygia guttata,* which nested locally in every month of the year, were recorded breeding in 18% of months, which was more often than any other species. We have local breeding records of all common resident birds, with the exception of three species. The Crested Bellbird *Oreoica gutturalis* almost definitely breeds locally and its omission from the breeding list should be rectified by targeted searches. Local populations of House Sparrows *Passer domesticus* have also increased in abundance dramatically over the study period (Read 1999) and their exclusion from the breeding list represents an oversight in the data collection. Little Corellas *Cacatua sanguinea* were the only common species recorded that we cannot be confident bred locally.

The Roxby Downs bird inventory contains one endangered species, the Plains-wanderer *Pedionomus torquatus* and several species, namely Major Mitchell's Cockatoo *Cacatua leadbeateri,* Blue-winged Parrot *Neophema chrysostoma,* Australian Bustard *Ardeotis australis* and Peregrine Falcon *Falco peregrinus,* which are considered to be vulnerable within South Australia (Stanger *et al.* 1998).

The local bird inventory included many rarely recorded species. Seven species were only recorded on one occasion: Swamp Harrier *Circus approximans;* Peregrine Falcon; Oriental Pratincole *Glareola maldivarum;* Oriental Cuckoo *Cuculus saturatus;* Red-browed Pardalote *Pardalotus rubricatus;* Gibberbird *Ashbyia lovensis;* and Barn Swallow *Hirundo rustica.* A further 10 species were recorded in less than five months throughout the study period: Black Falcon *Falco subniger;* Plains-wanderer; Australian Pratincole *Stiltia isabella;* Blue-winged Parrot; Black-eared Cuckoo *Chrysococcyx osculans;* Barn Owl *Tyto alba;* Fork-tailed Swift *Apus pacificus;* White-throated Gerygone *Gerygone olivacea;* White-fronted Chat *Epthianura albifrons;* and Restless Flycatcher *Myiagra inquieta.*

There was not a direct relationship between rainfall and birds recorded in a year, although general trends were evident. Bird species numbers generally declined from 1992-93 which was a wet year through to 1996-97 which ended a run of three drier years. Even though the rainfall for 1996-97 appears high, conditions were generally dry since 143 mm out of the 275 mm fell in the last month of the recording period (Table 2).

Quantitative bird transects throughout a range of habitats in four successive years yielded only 62 (including three waterbirds) species (Read, Reid and Venables 2000), or only 54% of the bird species recorded in this opportunistic study over a longer period. The opportunistically collected data set conformed with quantitative transect counts in as much as several species including the Zebra Finch, Crested Pigeon *Ocyphaps lophotes,* Black-faced Woodswallow *Artamus cinereus* and Singing Honeyeater *Lichenostomus virescens* were all recorded frequently and in high abundance in these surveys (Table 3). However, our data suggest that the relative abundance of species which have benefited from, and are adapted to, human

Table 1. The percentage of months within each season (30 months) that each species was recorded and recorded breeding, and the percentage of total months (120 months) that each species was recorded from January 1988 to December 1997 at Roxby Downs.

Species	Months Recorded (%)					Mths Recorded Breeding (%)				
	DJF	MAM	JJA	SON	*Total*	DJF	MAM	JJA	SON	*Total*
Frequently Recorded Residents										
Emu *Dromaius novaehollandiae*	67	60	63	77	67	3	0	7	17	7
Whistling Kite *Haliastur sphenurus*	67	70	80	67	71	0	0	7	13	5
Black Kite *Milvus migrans*	93	87	87	93	90	0	0	3	13	4
Wedge-tailed Eagle *Aquila audax*	87	90	90	90	89	0	0	20	17	9
Brown Falcon *Falco berigora*	83	77	63	83	77	0	0	10	7	4
Nankeen Kestrel *Falco cenchroides*	83	77	80	93	83	10	0	10	30	13
Crested Pigeon *Ocyphaps lophotes*	97	90	93	93	93	0	0	0	17	4
Galah *Cacatua roseicapilla*	80	87	87	87	85	0	0	7	23	8
Little Corella *Cacatua sanguinea*	87	80	77	83	82	0	0	0	0	0
Blue Bonnet *Northiella haematogaster*	93	83	87	93	89	0	3	7	17	7
Mulga Parrot *Psephotus varius*	77	87	83	63	78	0	0	3	10	3
Bourke's Parrot *Neopsephotus bourkii*	57	53	67	77	63	0	0	23	13	9
Variegated Fairy-wren *Malurus lamberti*	73	63	57	77	68	0	0	0	7	2
White-winged Fairy-wren *Malurus leucopterus*	87	53	83	77	75	0	7	0	7	4
Chestnut-rumped Thornbill *Acanthiza uropygialis*	60	67	67	80	68	0	0	10	13	6
Southern Whiteface *Aphelocephala leucopsis*	70	80	73	77	75	0	0	10	7	5
Spiny-cheeked Honeyeater *Acanthagenys rufogularis*	80	87	87	83	84	0	3	3	0	2
Yellow-throated Miner *Manorina flavigula*	73	90	87	77	82	3	0	7	7	4
Singing Honeyeater *Lichenostomus virescens*	83	83	90	87	86	0	0	3	3	2
White-plumed Honeyeater *Lichenostomus penicillatus*	77	63	67	83	73	0	0	3	0	1
White-browed Babbler *Pomatostomus superciliosus*	77	77	90	83	82	0	0	3	3	2
Cinnamon Quail-thrush *Cinclosoma cinnamomeum*	77	67	100	83	83	0	0	0	3	1
Crested Bellbird *Oreoica gutturalis*	83	70	80	77	78	0	0	0	0	0
Magpie-lark *Grallina cyanoleuca*	90	97	83	87	89	10	13	17	30	18
Willie Wagtail *Rhipidura leucophrys*	87	90	87	93	89	10	3	3	36	13
White-breasted Woodswallow *Artamus leucorynchus*	67	60	47	80	63	7	0	3	13	6
Black-faced Woodswallow *Artamus cinereus*	87	87	90	90	88	3	0	0	10	4
Grey Butcherbird *Cracticus torquatus*	77	90	87	77	83	0	0	0	6	2
Australian Magpie *Gymnorhina tibicen*	87	90	83	80	85	0	0	3	3	2
Australian Raven *Corvus coronoides*	80	90	83	90	86	0	3	0	7	3
Little Crow *Corvus bennetti*	70	67	70	83	73	0	0	7	7	3
Richard's Pipit *Anthus novaeseelandiae*	77	67	80	80	76	0	0	3	7	3
House Sparrow* *Passer domesticus*	83	87	87	83	85	0	0	0	0	0
Zebra Finch *Taeniopygia guttata*	97	100	87	90	93	7	20	23	23	19
White-backed Swallow *Cheramoeca leucosternus*	67	67	60	83	69	0	0	0	7	2
Welcome Swallow *Hirundo neoxena*	87	93	87	90	89	0	7	0	17	6
Infrequently Recorded Residents										
Little Eagle *Hieraaetus morphnoides*	60	33	60	70	56	0	0	7	20	7
Common Bronzewing *Phaps chalcoptera*	47	43	10	47	37	0	3	0	0	1
Tawny Frogmouth *Podargus strigoides*	57	50	40	47	48	0	0	0	3	1
Splendid Fairy-wren *Malurus splendens*	13	23	20	7	16	0	0	0	0	0
Inland Thornbill *Acanthiza apicalis*	10	7	13	23	13	0	0	0	0	0
Yellow-rumped Thornbill *Acanthiza chrysorrhoa*	27	57	43	43	43	0	0	3	7	3
Hooded Robin *Melanodryas cucullata*	0	13	17	20	13	0	0	3	3	2
Chirruping Wedgebill *Psophodes cristatus*	53	33	57	43	47	0	0	0	0	0
Grey Shrike-thrush *Colluricincla harmonica*	50	50	70	70	60	3	0	0	0	1
Black-faced Cuckoo-shrike *Coracina novaehollandiae*	43	73	57	60	58	0	3	0	7	3
Ground Cuckoo-shrike *Coracina maxima*	10	7	20	30	17	0	0	3	0	1
Frequently Recorded Seasonal Visitors										
Pallid Cuckoo *Cuculus pallidus*	0	33	53	50	34	0	0	0	0	0
Red-backed Kingfisher *Todiramphus pyrrhopygia*	63	17	37	90	52	3	0	0	13	4
Rainbow Bee-eater *Merops ornatus*	93	20	0	50	41	0	0	0	0	0
Red-capped Robin *Petroica goodenovii*	20	67	70	43	50	0	0	3	0	1
Mistletoebird *Dicaeum hirundinaceum*	30	70	80	37	54	0	3	0	0	1
Frequently Recorded Opportunists										
Black-shouldered Kite *Elanus axillaris*	30	20	13	27	23	0	0	0	0	0
Little Button-quail *Turnix velox*	20	7	17	43	22	0	0	0	3	1

Table 1 *continued*.

Species	Months Recorded (%) DJF	MAM	JJA	SON	*Total*	Mths Recorded Breeding (%) DJF	MAM	JJA	SON	*Total*
Diamond Dove *Geopelia cuneata*	17	20	10	33	20	7	0	0	7	4
Peaceful Dove *Geopelia striata*	23	37	57	40	39	0	0	3	0	1
Cockatiel *Nymphicus hollandicus*	40	20	20	43	31	3	0	0	7	3
Budgerigar *Melopsittacus undulatus*	57	33	33	63	47	7	3	7	13	8
Horsfield's Bronze-Cuckoo *Chrysococcyx basalis*	10	23	33	33	25	0	0	0	0	0
Crimson Chat *Epthianura tricolor*	23	10	20	40	23	0	0	7	3	3
Orange Chat *Epthianura aurifrons*	47	27	27	60	40	0	0	0	0	0
White-winged Triller *Lalage sueurii*	10	3	20	50	21	3	0	0	7	3
Masked Woodswallow *Artamus personatus*	13	0	0	47	15	0	0	0	3	1
Tree Martin *Hirundo nigricans*	17	17	17	10	15	0	0	0	7	2
Fairy Martin *Hirundo ariel*	23	13	23	50	28	3	0	7	17	7
Clamorous Reed-Warbler *Acrocephalus stentoreus*	17	10	7	27	15	0	0	0	3	1
Rufous Songlark *Cincloramphus mathewsi*	10	0	27	27	16	0	0	0	0	0
Brown Songlark *Cincloramphus cruralis*	20	13	27	47	27	0	0	0	0	0
Nomadic or Uncommon Species										
Stubble Quail *Coturnix pectoralis*	0	10	7	7	6	0	0	0	0	0
Spotted Harrier *Circus assimilis*	10	10	3	20	11	0	0	0	0	0
Swamp Harrier *Circus approximans*	0	0	3	0	1	0	0	0	0	0
Brown Goshawk *Accipiter fasciatus*	13	10	10	13	12	0	0	0	0	0
Collared Sparrowhawk *Accipiter cirrhocephalus*	17	7	7	17	12	0	0	0	0	0
Australian Hobby *Falco longipennis*	17	13	10	20	15	0	0	0	0	0
Black Falcon *Falco subniger*	7	7	0	0	3	0	0	0	0	0
Peregrine Falcon *Falco peregrinus*	0	3	0	0	1	0	0	0	0	0
Australian Bustard *Ardeotis australis*	7	7	0	10	6	0	0	0	0	0
Plains-wanderer *Pedionomus torquatus*	0	0	3	3	2	0	0	0	0	0
Inland Dotterel *Charadrius australis*	7	3	3	10	6	0	0	0	0	0
Banded Lapwing *Vanellus tricolor*	13	13	17	13	14	0	0	0	3	1
Oriental Pratincole *Glareola maldivarum*	0	0	0	3	1	0	0	0	0	0
Australian Pratincole *Stiltia isabella*	7	0	0	3	3	0	0	0	7	2
Rock Dove* *Columbia livia*	10	7	10	7	8	0	0	0	0	0
Spotted Turtle-Dove* *Streptopelia chinensis*	3	7	13	3	7	0	0	0	3	1
Major Mitchell's Cockatoo *Cacatua leadbeateri*	3	10	3	0	4	0	0	0	0	0
Blue-winged Parrot *Neophema chrysostoma*	0	7	0	3	3	0	0	0	0	0
Oriental Cuckoo *Cuculus saturatus*	0	0	0	3	1	0	0	0	0	0
Black-eared Cuckoo *Chrysococcyx osculans*	0	3	3	0	2	0	0	0	0	0
Southern Boobook *Ninox novaeseelandiae*	3	7	33	7	13	0	0	0	0	0
Barn Owl *Tyto alba*	0	7	0	7	3	0	0	0	0	0
Spotted Nightjar *Eurostopodus argus*	20	7	7	3	9	0	0	0	0	0
Australian Owlet-nightjar *Aegotheles cristatus*	3	0	13	10	7	0	0	3	3	2
Fork-tailed Swift *Apus pacificus*	7	3	0	0	3	0	0	0	0	0
Red-browed Pardalote *Pardalotus rubricatus*	3	0	0	0	1	0	0	0	0	0
Striated Pardalote *Pardalotus striatus*	7	13	43	10	18	0	0	0	3	1
Rufous Fieldwren *Calamanthus campestris*	13	3	3	7	7	0	0	0	0	0
White-throated Gerygone *Gerygone olivacea*	0	3	3	0	2	0	0	0	0	0
Grey-fronted Honeyeater *Lichenostomus plumulus*	0	7	17	0	6	0	0	0	0	0
White-fronted Honeyeater *Phylidonyris albifrons*	20	3	10	13	12	0	0	3	0	1
Pied Honeyeater *Certhionyx pectoralis*	13	0	13	10	9	0	0	0	0	0
White-fronted Chat *Epthianura albifrons*	3	7	3	0	3	0	0	0	0	0
Gibberbird *Ashbyia lovensis*	0	0	0	3	1	0	0	0	0	0
Varied Sitella *Daphoenositta chrysoptera*	13	13	17	13	14	0	0	0	0	0
Rufous Whistler *Pachycephala rufogularis*	7	23	10	17	14	0	0	0	0	0
Restless Flycatcher *Myiagra inquieta*	0	7	3	0	3	0	0	0	0	0
Grey Fantail *Rhipidura fuliginosa*	0	10	20	0	8	0	0	0	0	0
White-browed Woodswallow *Artamus superciliosus*	3	0	0	20	6	0	0	0	3	1
Barn Swallow *Hirundo rustica*	0	3	0	0	1	0	0	0	0	0
Little Grassbird *Megalurus gramineus*	13	3	3	10	8	0	0	0	0	0
Common Starling* *Sturnus vulgaris*	27	33	23	47	33	0	0	0	7	2

* = introduced species

Table 2. Rainfall (mm) and the total number of bird species recorded for March–February 12 month periods.

Year	Rainfall	No. of bird species
1989-90	484	87
1990-91	103	83
1991-92	225	93
1992-93	343	93
1993-94	205	87
1994-95	133	84
1995-96	132	85
1996-97	275	80
1997-98	136	87

habitation, such as Black Kites *Milvus migrans*, Welcome Swallows *Hirundo neoxena*, Willie Wagtails *Rhipidura leucophrys* and Magpie-larks *Grallina cyanoleuca* are over-represented by our opportunistic survey techniques compared to transect counts. By contrast, fairy-wrens *Malurus* spp. and Richard's Pipit *Anthus novaeseelandiae* are more widespread or abundant than our opportunistic data suggest (Table 3). In addition, some species with limited distributions are poorly represented in these opportunistic records although they are clearly residents. A noteworthy example was the 1995 recapture of a banded male Splendid Fairy-wren *Malurus splendens* at the site of its original capture near Olympic Dam Village eight years earlier. Due to their patchy distribution, Splendid Fairy-wrens were only recorded from 16% of the survey months because they were not detected unless specifically targeted by searches.

Seasonal visitors

Bird species which displayed distinct seasonality were either spring and summer visitors, or autumn and winter visitors. Rainbow Bee-eaters *Merops ornatus* and Red-backed Kingfishers *Todiramphus pyrrhopygia* were recorded in most spring and summer months, but rarely in autumn or winter at Roxby Downs (Table 1). Several other species also tended to conform with this pattern although they were not recorded often enough to confirm this seasonality. Masked Woodswallows *Artamus personatus* and White-browed Woodswallows *Artamus superciliosus*, along with Crimson Chats *Epthianura tricolor*, with which they often form mixed-species feeding flocks, were most often recorded in spring and summer (Table 1). Likewise Orange Chats *Epthianura aurifrons* and Australian Pratincoles were also typically only recorded in the warmer months. Although recorded throughout the year, White-breasted Woodswallows *Artamus leucorynchus* were also noticeably more abundant in spring and summer than in the cooler months.

Pallid Cuckoos *Cuculus pallidus*, Mistletoebirds *Dicaeum hirundinaceum* and Red-capped Robins *Petroica goodenovii* were most often recorded in autumn and winter (Table 1). Likewise, although their low recording frequency precludes confident interpretation, Grey-fronted Honeyeaters *Lichenostomus plumulus*, Grey Fantails *Rhipidura fuliginosa*, Restless Flycatchers *Myiagra inquieta*, White-throated Gerygones and Black-eared Cuckoos were also most commonly recorded in autumn and winter at Roxby Downs.

DISCUSSION

A total of 166 bird species, including 56 waterbird species (Read and Ebdon 1998) has been recorded in the Roxby Downs area, which compares favourably with inventories of 187 and 177 for the Lake Eyre South district (Read and Badman 1999) and Innamincka Station (Land Assessment Branch 1986), respectively. The Roxby Downs total is markedly buoyed by nomadic and transient species, since less than half of the non-waterfowl are considered to be residents. Nomadism is an important trait for many Australian birds because it enables them to take advantage of the erratic climate by

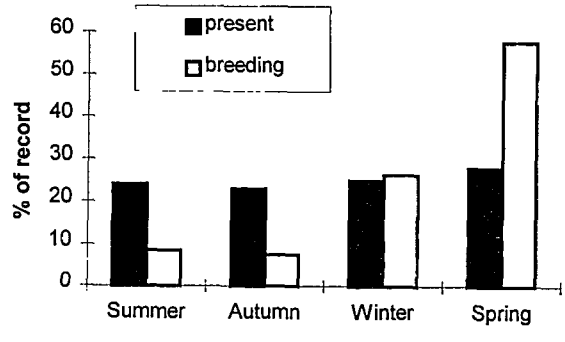

Figure 2. Percentage of total monthly observations and breeding records from each season. A total of 281 breeding records, excluding multiple records of individual species in the same month, were made over the 10 year study period.

Table 3. Status ranking of the 10 most frequently recorded species in the monthly records from this study compared with the 10 species most frequently recorded at transects and the 10 most abundant species in the four year quantitative study (Read, Reid and Venables 2000).

Species	Ranking: Monthly Observations	Transects	Abundance
Zebra Finch	1	6	1
Crested Pigeon	1	9	9
Black Kite	3	(15)	(14)
Wedge-tailed Eagle	4	(14)	(20)
Blue Bonnet	4	(27)	(26)
Welcome Swallow	4	(30)	(30)
Willie Wagtail	4	(12)	(19)
Magpie-lark	4	(21)	(24)
Black-faced Woodswallow	9	8	10
Australian Raven	10	(15)	(22)
Singing Honeyeater	10	1	5
Galah	(12)	(20)	6
Cinnamon Quail-thrush	(16)	10	(12)
White-browed Babbler	(19)	7	7
Richard's Pipit	(25)	4	8
White-winged Fairy-wren	(26)	2	3
Little Crow	(28)	5	(11)
Variegated Fairy-wren	(30)	3	4
Budgerigar	(>30)	(18)	2

congregating wherever large quantities of rain fall (Davies 1976).

Bird inventories compiled opportunistically over many years have proven to be valuable for monitoring changes in species status (Ashton 1996), particularly when sufficient resources for detailed distributional data collection are not available (Blakers, Davies and Reilly 1984; Paton, Carpenter and Sinclair 1994). Despite repeated sampling over a 3.5 year period, only 117 species from the inventory of 178 bird species for Uluru National Park were recorded (Reid, Kerle and Morton 1993), which suggests that longer surveys are required to establish the status of many species in arid Australia. Our study, and that of Read and Badman (1999), have confirmed that long-term opportunistic data sets are very valuable in compiling inventories of transient, nomadic or seasonal visitors which are often overlooked in shorter, quantitative studies. However, some regular bird surveys should be incorporated into these opportunistic databases to minimise biases towards conspicuous, human-tolerant species and against cryptic or shy species.

Despite the long-term nature of our records, we have not recorded Elegant Parrots *Neophema elegans*, which were recorded nearby on Lake Torrens in 1989 (Bellchambers and Carpenter 1990). Two other species of conservation significance, the Flock Bronzewing *Phaps histrionica* (Read, Bird and Greenfield 1996) and Thick-billed Grasswren *Amytornis textilis* (R. Ebdon and J. Read unpubl. data) have also been recorded immediately adjacent to, but not within, the study area. The Thick-billed Grasswren, along with some other species that were uncommon at Roxby Downs such as Rufous Fieldwren *Calamanthus campestris*, Inland Dotterel *Charadrius australis*, Australian Pratincole and Gibberbird are more commonly recorded on the gibber plains north of Roxby Downs (Read and Badman 1999).

More work is required to confirm the residency status of some of the species that we considered to be uncommon residents. This status may be affected by the development of Roxby Downs (Read 1999). The Black-faced Cuckoo-shrike *Coracina novaehollandiae* is one species which may now reside at Roxby Downs due largely to the planted eucalypts there. Likewise, the Common Bronzewing *Phaps chalcoptera*, which is dependent upon free water for drinking may now be able to permanently inhabit the region

due to the provision of water sources. Splendid Fairy-wrens are residents that were infrequently recorded due to the imprecise nature of opportunistic records. The residency displayed by Splendid Fairy-wrens conforms with the strict site fidelity reported in more mesic environments for this species (Russell and Rowley 1993).

We have also identified the following species which we presume are residents but have no local nesting records and should be targeted during the breeding season: Crested Bellbird, Little Corella, Splendid Fairy-wren, Inland Thornbill *Acanthiza apicalis*, Chirruping Wedgebill *Psophodes cristatus* and Rufous Fieldwren. Other species that probably breed locally despite our lack of records include the Brown Goshawk *Accipiter fasciatus*, Collared Sparrowhawk *Accipiter cirrhocephalus*, Major Mitchell's Cockatoo and the owl and cuckoo species, excluding the vagrant Oriental Cuckoo.

Quantitative counts, or particular attention to the arrival and departure dates, may be required to confirm the seasonality of Masked Woodswallows, White-browed Woodswallows, White-breasted Woodswallows, Crimson Chats, Orange Chats, Pallid Cuckoos, Mistletoebirds, Red-capped Robins, Grey-fronted Honeyeaters, Grey Fantails, Restless Flycatchers, White-throated Gerygones and Black-eared Cuckoos, which our data suggest may be seasonal visitors to the area. The interaction or relative importance of season and environmental conditions caused by wet years as determinants of visitation by these species requires confirmation through long-term studies (Read and Badman 1999).

Continuation of this long-term data set should also add nomadic species to the local inventory and more importantly, allow any change to the status of species to be monitored. Of particular interest is how species respond to increased vegetation cover as a result of decreased rabbit numbers and continued destocking of the mine lease, although this vegetation response has been restricted by kangaroo grazing (F. Badman pers. comm.). Any response should be particularly apparent in the 50 km^2 Arid Recovery Reserve that has been constructed 20 km north of Roxby Downs, where domestic stock have been removed and rabbits, cats and foxes are being progressively removed from fenced regions. The inevitable decline in raptor numbers, if rabbit numbers remain low and breeding remains negligible, is another important change which can be monitored with this long-term dataset.

ANNOTATED LIST

This annotated list of avifauna (excluding waterfowl) from the Roxby Downs area includes breeding, behavioural and diet observations. Any interesting results from bird banding data that were collected at irregular times over the ten-year period that this report covers are also included. Taxonomic order follows Christidis and Boles (1994). Scientific names are presented in Table 1.

CASUARIIDAE: The Emu was a common resident in the area. Nesting was typically recorded in winter, with flocks of chicks frequently recorded throughout spring and summer. We have observed predation by eagles gradually reducing brood sizes. However, flocks of over 20 chicks tended by single males have been observed in late summer, which probably suggests that several females laid at one nest.

PHASIANIDAE: The Stubble Quail was recorded in only seven months over the survey period and was not recorded breeding.

ACCIPITRIDAE: Of the nine locally-recorded species from this family, the Black Kite, Whistling Kite, and Wedge-tailed Eagle are common residents of the Roxby Downs area. All three have bred in the area. However, the Wedge-tailed Eagle has not nested successfully since July 1995, which is attributed to the reduction in rabbit numbers in 1996 as a result of the calicivirus disease (Bowen and Read 1998). Prior to 1996, flocks of over 30 Wedge-tailed Eagles were observed locally, with up to 14 on a single kangaroo carcass. Wedge-tailed Eagles were frequently recorded after 1996 but not in such high numbers. Black Kites were often seen soaring above the rubbish dump, or roosting in white cypress-pines around Roxby Downs town in flocks of 40–50 birds and occasionally up to 200 birds. The Little Eagle was an uncommon resident in the area and was recorded breeding in several years. Fledgling raptors appear to be particularly sensitive to heat stress and several young Wedge-tailed Eagles (and Nankeen Kestrels, Falconidae) were found in a stressed state on days of extreme temperatures (>44°C).

The Black-shouldered Kite, Spotted Harrier and Swamp Harrier were largely nomadic in the

area and were also more often recorded in good seasons in the Lake Eyre South district (Read and Badman 1999). Brown Goshawks and Collared Sparrowhawks were uncommon at Roxby Downs, although both species visited the town to hunt birds attracted to water or gardens.

FALCONIDAE: Five species from this family were recorded in the area. Of special note, the Peregrine Falcon was recorded only once during the study period but was observed on several occasions in early 1998 at the Roxby Downs effluent ponds. The Peregrine Falcon's preferred habitat lies north of the study area in hilly country (Read and Badman 1999). The Nankeen Kestrel, which made extensive use of mining infrastructure for nesting (Read, Reid and Venables 2000), and Brown Falcon were common residents in the area. The Australian Hobby and Black Falcon were nomadic or uncommon in the area.

OTIDIDAE: The Australian Bustard, a declining species in South Australia and considered rare and threatened nationally (Reid and Fleming 1992) and vulnerable in South Australia (Stanger *et al.* 1998), was recorded seven times, always in good years. Bustards were surprisingly tolerant of vehicles and displayed little aversion to cars and trucks, even on heavily trafficked roads. Bustards were more regularly observed north of Roxby Downs in the Lake Eyre South district (Read and Badman 1999).

TURNICIDAE: The Little Button-quail was a common opportunist in the area, particularly in the spring months following good rainfall. There was one local breeding record when a clutch of four eggs was recorded.

PEDIONOMIDAE: There were two sightings of the Plains-wanderer, in August 1990 and October 1996, both in the town of Roxby Downs. Due to the destruction of its grassland habitat by domestic stock, feral herbivores and agriculture, Plains-wanderers are considered rare and threatened in South Australia (Reid and Fleming 1992) and vulnerable nationally (Baker-Gabb 1998). Continued regeneration of local grasslands following reduction in total grazing pressure through destocking, rabbit population declines and kangaroo population management should improve the local habitats for this species, particularly where rabbits, cats and foxes are eradicated.

CHARADRIIDAE: Although Inland Dotterels were only recorded in seven months locally, they were more frequently recorded on the open gibber plains to the north of the study area. Inland Dotterels were often active at night when they were typically seen in small flocks on outback roads to the north of Roxby Downs.

GLAREOLIDAE: The Australian Pratincole was comparatively scarce in the Roxby Downs area compared with the gibber plains of the Lake Eyre South district (Read and Badman 1999). Oriental Pratincoles were only recorded on one occasion in December 1996. Neither species was recorded breeding in the area.

COLUMBIDAE: The Crested Pigeon was a frequently recorded breeding resident throughout the area and probably increased considerably following development of permanent pastoral and mining water bodies (Read, Reid and Venables 2000). The Common Bronzewing was an infrequently recorded resident in the study area but was regularly seen in low numbers in neighbouring pastoral areas, particularly near dams in western myall *Acacia papyrocarpa* or mulga *Acacia aneura* woodlands. Peaceful Doves were frequently recorded opportunists and breeding residents in the township. In contrast, Diamond Doves were most frequently recorded near water in good seasons (Read 1999). The colonisation and subsequent extermination of Spotted Turtle-Doves at Olympic Dam is described by Read (1999). The small flock of Rock Doves in Roxby Downs township are ex-racing pigeons.

CACTUIDAE: The Galah and Little Corella were frequently recorded residents in the area. Little Corellas were often observed in large flocks of 600 or more around the town in stands of white cypress-pine. Major Mitchell's Cockatoo, which is rare and threatened in South Australia (Reid and Fleming 1992), was rarely recorded by us although they are apparently more frequently recorded in cypress-pine woodlands on Roxby Downs Station (Leo McCormack pers. comm.). A flock of over 50 Major Mitchell's Cockatoos frequented cypress-pine trees in Roxby Downs township when regional conditions were dry in March and April 1991.

PSITTACIDAE: Six parrot species were recorded in the area. The Blue Bonnet, Mulga Parrot and Bourke's Parrot were frequently

recorded breeding residents in the area. Bourke's Parrots were often associated with stands of dead mulga trees, in which they nested, whereas Blue Bonnets typically nested in cypress-pine woodland. The Mulga Parrot was recorded feeding on ruby saltbush *Enchylaena tomentosa* and bladder saltbush fruits. Budgerigars and Cockatiel were usually recorded in the Roxby Downs area in spring and summer, as is typical of other regions in southern Australia (Blakers, Davies and Reilly 1984). Breeding by budgerigars was recorded in eight months, always in good seasons when favoured food grasses, including button grass *Dactyloctenium radulans*, were seeding prolifically. The Blue-winged Parrot was uncommon in the Roxby Downs area and may be a winter visitor, as it is further north in the State (Read and Badman 1999).

CUCULIDAE: The Pallid Cuckoo and Horsfield's Bronze-Cuckoo were most frequently seen in the winter and spring months. The Oriental Cuckoo, recorded once in November 1993 (Read 1995b), was the first record from South Australia. Although the Black-eared Cuckoo was also an uncommon nomad in the area it is more common to the north of Roxby Downs (Read and Badman 1999).

STRIGIDAE: The Southern Boobook was uncommonly recorded, most often in winter.

TYTONIDAE: Barn Owls were also relatively uncommon in the area, but were recorded more frequently in abandoned buildings on the Woomera Rocket Range or at nearby stations. We only recorded Barn Owls locally in autumn and spring.

PODARGIDAE: The Tawny Frogmouth was observed and heard more frequently than the two owls and was recorded breeding once.

CAPRIMULGIDAE: The Spotted Nightjar was uncommonly recorded in open stony plains in the area but was recorded in all seasons.

AEGOTHELIDAE: Australian Owlet-nightjars were nomadic or uncommon in the area and were recorded breeding in a hollow of a borree *Melaleuca pauperiflora*.

APODIDAE: Fork-tailed Swifts were most commonly recorded during the passage of storms and more than 100 were seen flying over the Roxby Downs township in April 1992.

HALCYONIDAE: The Red-backed Kingfisher was a breeding spring/summer visitor which we have observed feeding extensively on grasshoppers and small lizards. Red-backed Kingfishers made extensive use of quarries and sand banks for nesting and apparently increased in abundance due to provision of nesting sites at Roxby Downs (Read, Reid and Venables 2000).

MEROPIDAE: The Rainbow Bee-eater, which overwinters in New Guinea and northern Australia (Blakers, Davies and Reilly 1984), was frequently seen around Roxby Downs in the summer months. A flock of over 50 bee-eaters was seen in February 1991.

MALURIDAE: The Variegated and White-winged Fairy-wren were common residents in dunes and swales respectively. Two flocks of Splendid Fairy-wren were confined to densely-vegetated dunes.

PARDALOTIDAE: Striated Pardalotes were attracted to lerps on planted eucalypts (Read 1999). They were most frequently seen locally in winter. Red-browed Pardalotes were only recorded on one occasion from the township. The White-throated Gerygone, which was first observed in May 1997, also may have also been attracted to the area since the establishment of eucalypts in the township (Read 1999). The Chestnut-rumped Thornbill and Southern Whiteface were both common residents in the area and were recorded nesting in the hollows of dead trees. By contrast the Inland Thornbill was recorded less frequently, usually as a minor component of mixed-species flocks in mulga woodland, where they mimic other thornbills, Variegated Fairy-wrens, Budgerigars, and Rufous Songlarks. Yellow-rumped Thornbills were also often found in mixed-species flocks but typically foraged more on the ground than the other thornbills. The Rufous Fieldwren was an uncommon resident, which was typically heard calling from open gibber plains.

MELIPHAGIDAE: Seven honeyeaters were recorded in the area. The Spiny-cheeked Honeyeater, Yellow-throated Miner, White-plumed Honeyeater and Singing Honeyeater were common residents. Flocks of Yellow-throated Miners were observed feeding on Sturt's desert pea *Swainsona formosa* flowers and caterpillars from lush annual growth, and along with Singing Honeyeaters, they often collected moths which were attracted to lights. The Grey-fronted, White-fronted, and Pied Honeyeaters were all either nomadic or

uncommon seasonal visitors. White-fronted Honeyeaters bred locally and were commonly seen on mistletoe in 1993. Grey-fronted Honeyeaters were probably dependent upon the eucalypt plantings around the town (Read 1999).

The Orange Chat and Crimson Chat were both common opportunists in the area, generally inhabiting open chenopod plains and sparse woodlands respectively. In contrast, the White-fronted Chat was a rare nomad in the area and was typically only recorded after heavy rains (Bellchambers and Carpenter 1990) around the margins of samphire or swamp cane-grass *Eragrostis australasica* lakes or swamps. We have only a single record of a Gibberbird from the Roxby Downs area, although this species is more commonly recorded in the Lake Eyre South district (Read and Badman 1999). A Crimson Chat nest with two eggs was recorded in a bladder saltbush.

PETROICIDAE: The Red-capped Robin was a seasonal visitor recorded in most autumn and winter months. Hooded Robins were considerably less common, but were probably resident. A Hooded Robin nest of spider web-bound grass, with two eggs, was recorded in a dead mulga tree.

POMATOSTOMIDAE: The White-browed Babbler was a common resident in the area. Nests were characteristically recorded on dunes in narrow-leafed hopbush and sandhill wattle *Acacia ligulata*.

CINCLOSOMATIDAE: The Cinnamon Quail-thrush was a frequently recorded resident in the area. Although most often recorded on open gibber plains, they were also sometimes observed on sand dunes. Chirruping Wedgebills were infrequently recorded residents in the northern part of the area where they typically called from small patches of low trees on open plains.

NEOSITTIDAE: The black-capped form of the Varied Sittella was either nomadic or uncommon in the Roxby Downs area.

PACHYCEPHALIDAE: Crested Bellbirds were frequently recorded residents in sand dunes in the area. Crested Bellbirds appeared to be easily disturbed from the mining area (Read, Reid and Venables 2000) and as such were used as bio-indicators of the extent of the impact of the mine. The Grey Shrike-thrush was an infrequently recorded resident in the area, more likely seen and heard in the winter and spring months. Rufous Whistlers were nomadic or uncommon in the area.

DICRURIDAE: There were four species from this family recorded in the area. The Magpie-lark and Willie Wagtail were common residents in the area, particularly around the town. Both were recorded breeding at all times of the year, but most breeding records were from the spring months. Magpie-larks were recorded nest-building within two days of rain and frequently built nests in trees emerging from local freshwater lakes. All seven Willie Wagtail nests found had clutches of three eggs. Grey Fantails and Restless Flycatchers were both nomadic or uncommon in the area.

CAMPEPHAGIDAE: The Black-faced Cuckoo-shrike was infrequently recorded, yet is probably a resident in the area because it was seen at all times of the year. Ground Cuckoo-shrikes were most often seen in open western myall woodlands and a group of at least four birds cooperatively built a nest on a horizontal fork of a western myall. White-winged Trillers were opportunists which were most frequently observed in the spring feeding on insects in lush annual herbage.

ARTAMIDAE: Six species from this family occurred in the area. Four of these: the White-breasted Woodswallow; Black-faced Woodswallow; Grey Butcherbird; and Australian Magpie were common residents. White-breasted Woodswallows typically nested in abandoned Magpie-lark nests, and were recorded in white cypress-pine, western myalls and planted gum trees. They were more commonly seen in summer than winter months. The Black-faced Woodswallow was one of the most ubiquitous birds throughout the area and nested in mulga trees, needlewood *Hakea leucoptera* and hop-bush. White-browed Woodswallows were invariably seen amongst flocks of the more common Masked Woodswallow. Both species were nomadic and most frequently observed in spring. Grey Butcherbirds were recorded preying on birds up to the size of Spiny-cheeked Honeyeaters and they were often found associated with mixed species flocks of small insectivorous birds in densely-vegetated areas.

CORVIDAE: The Australian Raven and Little Crow were both common residents in the area. They were recorded preying on cormorant *Phalacrocorax* sp. eggs (Dorfman and Read

1996) and scavenging in town, at dumps and at carcasses. Ravens were more common around towns and areas of permanent water whereas Little Crows were more often recorded in more remote locations, which supports observations form the Lake Eyre South district (Read and Badman 1999).

MOTACILLIDAE: Richard's Pipit was a common resident of open plains in the area. A nest with three eggs was observed set into the ground beneath a small low saltbush.

PASSERIDAE: Although few banded Zebra Finches were recaptured over a one year period, one local bird was recaptured four years after its initial capture. The Zebra Finch often built nests in dead finish *Acacia tetragonophylla* trees, but also used buildings and stationary machinery. It was recorded breeding all year round with the fewest records in the summer months. Recorded clutch sizes varied from five to 15 eggs. The House Sparrow was a common resident in residential and industrial areas and around homesteads.

DICAEIDAE: Mistletoebirds were most commonly recorded in the autumn and winter months, which appears to coincide with the peak fruiting seasons for common mistletoes, harlequin mistletoe *Lysiana exocarpi,* wire-leaf mistletoe *Amyema preissii* and pale-leaf mistletoe *A. maidenii.*

HIRUNDINIDAE: Five species from this family occurred in the area, two of which, the White-backed and Welcome Swallow, were common residents. A flock of 190 Welcome Swallows was observed in July 1990. These birds build mud nests on steel structures around the town. The Fairy Martin and Tree Martin were both frequently recorded opportunists. The Fairy Martin was recorded breeding on seven occasions with four of these records being in the spring months. The Barn Swallow was seen once at the Roxby Sewage Ponds in March 1996.

SYLVIIDAE: Brown and Rufous Songlarks were most commonly seen in spring in years when favourable autumn/winter rains provided vegetation for the insects which were their principle prey. Whereas Brown Songlarks were found most often on open plains, Rufous Songlarks usually called from wooded areas. Clamorous Reed-Warblers and Little Grassbirds were recorded in the reeds at the sewage ponds and a pond at the Roxby Downs golf course.

STURNIDAE: The Common Starling was generally uncommon in the area although large flocks inhabited tea-trees around Coorlay Lagoon when it held water in the early 1990s (Read and Ebdon 1998). Starlings were most commonly recorded on transmission line towers which they may use as a corridor to new areas (Read 1999).

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