The Whistler

Wirrumbirra, Laguna
Early Hunter records
Worimi Conservation Lands
Fairy Martin decline
Birds of Black Rock
Book review
Black-necked Stork display
White-bellied Sea-Eagle prey
Regent Honeyeater mimicry
Cattle Egret breeding
Channel-billed Cuckoo courtship

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- ***To encourage and further the study and conservation of Australian birds and their habitat***
- ***To encourage bird observing as a leisure-time activity***

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Authors wishing to contribute articles of general bird and birdwatching news to the club newsletter, which has 6 issues per year, should submit to the Newsletter Editor: Dan Williams scythrops@yahoo.com.au

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Front cover: Black-necked Stork *Ephippiorhynchus asiaticus* - Photo: Rod Warnock

Back cover: White-bellied Sea-Eagle *Haliaeetus leucogaster* - Photo: Trevor Murray

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The *Whistler* - Editorial

Our latest volume of *The Whistler* is a tribute to the value of keeping consistent records of birds. What is common on your patch today may change rapidly. Thanks to people like Dorothy Raine we can make factual statements about how bird populations have changed over time. Dorothy's 33-year study of the birds of her property *Wirrumbirra* show many instances of decline and only one increasing species, the Bell Miner. *Wirrumbirra* is now covenanted for wildlife and continues to support a number of species that are threatened or restricted in range.

Systematic study of the shorebird populations of the Hunter Region is a cornerstone activity of the Hunter Bird Observers Club. Alan Stuart draws together information contained in historical publications on these species. His review unearthed unpublished archival material, providing the catalyst for placing this valuable material on record. Sadly comparison of past and contemporary shorebird populations indicates a dramatic decline in the migratory species, a trend being recognised throughout Australia and a matter of global concern. In contrast some Australian resident species, primarily the Red-necked Avocet, occur more frequently and in much greater numbers.

Recent surveys of the Worimi Conservation Lands, an extensive area of coastal dune system immediately north of Newcastle, provide an impressive inventory of coastal birds, but in small numbers. The area is both home to several threatened bird species and a popular recreational and tourism asset. This study provides a baseline against which the success of balancing the sometimes conflicting demands of recreation, protecting the cultural values of the Worimi, who are the traditional land owners, and wildlife conservation can be measured.

An article focussing on the status of an individual species in the Hunter Region has been a feature of recent issues of *The Whistler*. This time the spotlight is on the Fairy Martin. The paper questions whether the species is in decline. The answer is probably yes, but why and whether it will recover are challenges for future research and conservation respectively.

The final paper provides a catalogue of the birds of the Black Rock area of Martins Creek near Paterson. This study has similarities to Dorothy Raine's long-term study at *Wirrumbirra*, but in this case the records were compiled during walks along roads in an area of lightly vegetated farmland. Again a number of declining species were identified; again the Bell Miner increased. The positive message is that a very diverse population of birds continues to exist in a highly fragmented countryside.

At last *The Whistler* has a Book Review thanks to Neil Fraser. 'An Atlas of the Birds of New South Wales and the ACT' is an important addition to the library of any HBOC member with a serious interest in the birds of the Hunter Region. Congratulations to the authors. One, Dick Cooper, is an HBOC member and former Hunter resident.

As usual we have an eclectic range of short notes. Four are concerned with bird behaviour, in three instances photographs provided evidence. Many readers will already have seen Rod Warnock's spectacular images of Black-necked Storks. Steve Merritt captured fascinating insights into the courtship style of the Channel-billed Cuckoo. HBOC pelagic trip regulars have been thrilled when White-bellied Sea-Eagles have taken shearwaters following the boat into harbour. Mick Roderick captured the moment on camera. Mick also provides insights into the use of mimicry by Regent Honeyeaters to enhance its foraging success in competition with other honeyeater species. Penny Drake-Brockman provides another update on the remarkable Cattle Egret colony at Gloucester. The Editors would urge readers to be on the lookout for surprising or little-known bird behaviours that can be reported, and perhaps be written up for these pages.

Mike Newman and **Harold Tarrant**
Joint Editors

The birds of *Wirrumbirra*, Laguna

Dorothy Raine

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Wirrumbirra is a 75 ha property located near Yango Creek Road, Laguna, 8 km south-west of Wollombi, NSW. It is situated in the Yango Creek catchment, 2 km east of Yengo National Park. The property supports Hawkesbury Sandstone open forest associations largely unmodified by clearance, grazing or frequent fires. A small number of cattle grazed the area prior to 1979, but since their removal some areas have regenerated. The property, which has been regularly monitored over a period of more than 33 years, has supported a diverse range of birds, including 12 species listed as threatened in New South Wales. A Voluntary Conservation Agreement with NSW National Parks and Wildlife Service has been in place over the property since 2002.

INTRODUCTION

Wirrumbirra is a 75 ha property located in an isolated valley accessible by a private road from Yango Creek Road near Laguna, 8 km south-west of Wollombi (32°59'04"S 151°06'06"E). Elevation ranges from 200 to 300 m above sea level. Average rainfall for the area is 744 mm.

A few non-perennial streams traverse the property. These support isolated pools, which are used by birds for drinking, however they may dry for extended periods during drought. Permanent water is therefore very scarce and is provided by the author at one location on the property, allowing observation of birds, particularly during drought.

Since cattle were removed from the property, and previously cleared areas have been allowed to regenerate, there has been a change in the vegetation, and hence the species of birds recorded. The study highlights trends that have resulted due to this change.

Observations were collected as a personal record of the natural history of the property. Their publication gives an historical indication of the various bird species present, changes that have occurred in the bird population of the property and a baseline for comparing changes that may occur in the future.

The area is preserved in perpetuity under a Voluntary Conservation Agreement with the NSW National Parks and Wildlife Service.

METHODS

Records were gathered on visits to the property between 1979 and 2012. During the first five years records were made weekly, but less consistently in subsequent years. In total, visits were made in 296 months, which for analysis purposes were split into three periods of approximately 11 years duration (116 months 1979-1989, 107 months 1990-2000 and 73 months 2001-2012). A summary was compiled for each month based on the highest number of each species recorded during a single visit.

Birds were sighted opportunistically around the property and the area covered was variable, sometimes only along the four-wheel-drive access tracks. The less frequently surveyed sandstone escarpments are quite steep in places, and difficult for walking, but provide different habitat and bird species.

HABITAT

Open forest occupies the majority of the property with dominant species: Narrow-leaved Ironbark *Eucalyptus crebra*, Narrow-leaved Stringybark *E. sparsifolia*, Grey Gum *E. punctata*, Rough-barked Apple *Angophora floribunda*, Forest Oak *Allocasuarina torulosa*, Blunt Beard-heath *Leucopogon muticus*, Narrow-leaved Geebung *Persoonia linearis* and Silver-stemmed Wattle *Acacia parvipinnula*; and a native herb and grass understorey. *Angophora euryphylla* occurs in the open forest below the ridge crests and is considered locally endemic between Putty and the Wollombi area. There is a well-developed shrub understorey.

The rocky ridge line consists of open forest dominated by Narrow-leaved Ironbark, Yellow Bloodwood *E. eximia*, Narrow-leaved Stringybark, Grey Gum, Flannel Flower *Actinotus helianthi*, Woody Pear *Xylomelum pyriforme*, Green Grevillea *Grevillea mucronulata*, Grey Spider Flower *Grevillea buxifolia*, Grass Tree *Xanthorrhoea spp.*, Blunt Beard-heath, Egg and Bacon Pea *Dillwynia floribunda var. teretifolia* and native grasses (**Figure 1**). Scaly Bark *E. squamosa* is also found on the ridge tops in their southern and northern limits. The western slopes feature *Banksia spinulosa*, Grass Tree and Slender Tea-tree *Leptospermum trinervium.* The ridge line understorey layer contains a diversity of pea flowers, boronias, grevilleas and native grasses.

Moist slopes and gullies are dominated by Ironwood *Backhousia myrtifolia* and also include Round-leaf Gum *Eucalyptus deanei,* Turpentine *Syncarpia glomulifera,* Scrub Turpentine *Rhodamnia rubescens*, Hairy Doughwood *Melicope micrococca* and various fern species. The moist slopes and gullies also support dry rainforest species, including Bird's Nest Ferns *Asplenium australasicum*, Elkhorns *Platycerium bifurcatum* and Hare's Foot Fern *Davallia pyxidata*.

A diverse range of native terrestrial, lithophytic and epiphytic orchids also occurs.

RESULTS

A total of 124 bird species is recorded for the property.

Tables 1, 2 and **3** summarise observations for the most frequently observed bird species (reporting rate >20%; i.e. a species recorded during over 20% of the months in which the property was visited) over three approximately 11-year periods. The tables also show the maximum and median numbers of individuals of each species.

Species recorded less frequently (i.e. reporting rate < 20%**)** are shown in **Table 4.**

Figure 1. Flannel flowers on rocky ridge in open forest dominated by Narrow-leaved Ironbark, Yellow Bloodwood, Narrow-leaved Stringybark and Grey Gum.

Table 1. Species recorded regularly 1979-1989

Common Name	Scientific Name	Reporting Rate (%)	Number months recorded	Maxi-mum Count	Median Count
Glossy Black-Cockatoo *	*Calyptorhynchus lathami*	39.7	46	8	4
Yellow-tailed Black-Cockatoo*	*Calyptorhynchus funereus*	36.2	42	30	5
Gang-gang Cockatoo *	*Callocephalon fimbriatum*	37.9	44	50	7
Australian King-Parrot *	*Alisterus scapularis*	38.8	45	30	4
Crimson Rosella	*Platycercus elegans*	25.0	29	15	4
Eastern Rosella *	*Platycercus eximius*	23.3	27	9	4
Superb Lyrebird *	*Menura novaehollandiae*	54.3	63	6	2
White-throated Treecreeper	*Cormobates leucophaea*	53.4	62	4	1
Satin Bowerbird *	*Ptilonorhynchus violaceus*	47.4	55	7	3
Noisy Miner *	*Manorina melanocephala*	26.7	31	12	4
Blue-faced Honeyeater *	*Entomyzon cyanotis*	37.9	44	8	4

Note: *Indicates breeding

Table 2. Species recorded regularly 1990-2000

Common Name	Scientific Name	Reporting Rate (%)	Number months recorded	Maxi-mum Count	Median Count
Wonga Pigeon *	*Leucosarcia melanoleuca*	27.1	29	5	2
Glossy Black-Cockatoo *	*Calyptorhynchus lathami*	26.2	28	9	3
Yellow-tailed Black-Cockatoo*	*Calyptorhynchus funereus*	29.9	32	24	5
Gang-gang Cockatoo *	*Callocephalon fimbriatum*	29.9	32	50	4
Australian King-Parrot	*Alisterus scapularis*	29.0	31	15	2
Crimson Rosella	*Platycercus elegans*	20.6	22	10	4
Laughing Kookaburra *	*Dacelo novaeguineae*	27.1	29	6	5
Superb Lyrebird *	*Menura novaehollandiae*	62.6	67	5	1
White-throated Treecreeper	*Cormobates leucophaea*	34.6	37	5	2
Satin Bowerbird *	*Ptilonorhynchus violaceus*	37.4	40	6	2
Superb Fairy-wren	*Malurus cyaneus*	24.3	26	8	4
Variegated Fairy-wren *	*Malurus lamberti*	29.0	31	8	5
Rockwarbler *	*Origma solitaria*	32.7	35	4	2
White-browed Scrubwren *	*Sericornis frontalis*	20.6	22	4	3
Striated Thornbill	*Acanthiza lineata*	27.1	29	20	4
Brown Thornbill	*Acanthiza pusilla*	35.5	38	10	5
Spotted Pardalote *	*Pardalotus punctatus*	22.4	24	6	2
Eastern Spinebill	*Acanthorhynchus tenuirostris*	21.5	23	4	2
Lewin's Honeyeater *	*Meliphaga lewinii*	34.6	37	6	2
Yellow-faced Honeyeater *	*Lichenostomus chrysops*	36.4	39	60	5
White-eared Honeyeater *	*Lichenostomus leucotis*	28.0	30	10	3
Yellow-tufted Honeyeater *	*Lichenostomus melanops*	22.4	24	14	5
White-naped Honeyeater	*Melithreptus lunatus*	36.4	39	30	5
Noisy Friarbird *	*Philemon corniculatus*	29.0	31	12	4
Eastern Whipbird	*Psophodes olivaceus*	22.4	24	5	2
Golden Whistler *	*Pachycephala pectoralis*	21.5	23	8	1
Rufous Whistler	*Pachycephala rufiventris*	20.6	22	5	2
Grey Shrike-thrush *	*Colluricincla harmonica*	31.8	34	5	2
Grey Butcherbird *	*Cracticus torquatus*	25.2	27	3	2
Australian Magpie *	*Cracticus tibicen*	22.4	24	4	2
Pied Currawong *	*Strepera graculina*	31.8	34	4	2
Grey Fantail *	*Rhipidura fuliginosa*	31.8	34	5	2
Australian Raven	*Corvus coronoides*	24.3	26	4	2
Leaden Flycatcher	*Myiagra rubecula*	22.4	24	4	2
Eastern Yellow Robin	*Eopsaltria australis*	33.6	36	6	2
Red-browed Finch	*Neochmia temporalis*	22.4	24	20	5

Note: *Indicates breeding

Table 3. Species recorded regularly 2001-2012

Common Name	Scientific Name	Reporting Rate %	Number months recorded	Maxi-mum Count	Median Count
Wonga Pigeon	*Leucosarcia melanoleuca*	79.5	58	5	2
Glossy Black-Cockatoo *	*Calyptorhynchus lathami*	30.1	22	6	3
Yellow-tailed Black-Cockatoo*	*Calyptorhynchus funereus*	31.5	23	23	2
Gang-gang Cockatoo *	*Callocephalon fimbriatum*	45.2	33	9	2
Australian King-Parrot	*Alisterus scapularis*	27.4	20	6	2
Crimson Rosella	*Platycercus elegans*	47.9	35	8	3
Eastern Rosella	*Platycercus eximius*	23.3	17	5	2
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	47.9	35	2	1
Southern Boobook	*Ninox novaeseelandiae*	23.3	17	2	1
Laughing Kookaburra	*Dacelo novaeguineae*	72.6	53	6	4
Superb Lyrebird *	*Menura novaehollandiae*	82.2	60	4	2
White-throated Treecreeper	*Cormobates leucophaea*	82.2	60	4	2
Satin Bowerbird	*Ptilonorhynchus violaceus*	67.1	49	6	1
Superb Fairy-wren	*Malurus cyaneus*	38.4	28	5	4
Variegated Fairy-wren	*Malurus lamberti*	47.9	35	5	4
Rockwarbler	*Origma solitaria*	50.7	37	7	2
White-browed Scrubwren *	*Sericornis frontalis*	37.0	27	10	2
Striated Thornbill *	*Acanthiza lineata*	57.5	42	10	4
Brown Thornbill	*Acanthiza pusilla*	54.8	40	12	4
Spotted Pardalote *	*Pardalotus punctatus*	54.8	40	6	2
Eastern Spinebill	*Acanthorhynchus tenuirostris*	42.5	31	3	1
Lewin's Honeyeater	*Meliphaga lewinii*	72.6	53	5	2
Yellow-faced Honeyeater	*Lichenostomus chrysops*	80.8	59	110	5
White-eared Honeyeater	*Lichenostomus leucotis*	34.2	25	5	1
Yellow-tufted Honeyeater *	*Lichenostomus melanops*	74.0	54	15	4
Bell Miner	*Manorina melanophrys*	28.8	21	16	12
White-naped Honeyeater	*Melithreptus lunatus*	61.6	45	50	5
Noisy Friarbird *	*Philemon corniculatus*	57.5	42	16	4
Spotted Quail-thrush	*Cinclosoma punctatum*	32.9	24	3	1
Eastern Whipbird	*Psophodes olivaceus*	50.7	37	4	2
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	39.7	29	2	2
Cicadabird	*Coracina tenuirostris*	21.9	16	3	2
Golden Whistler	*Pachycephala pectoralis*	64.4	47	8	1
Rufous Whistler	*Pachycephala rufiventris*	34.2	25	3	2
Grey Shrike-thrush	*Colluricincla harmonica*	84.9	62	4	2
Olive-backed Oriole *	*Oriolus sagittatus*	32.9	24	4	2
Grey Butcherbird	*Cracticus torquatus*	60.3	44	2	1
Australian Magpie	*Cracticus tibicen*	43.8	32	2	2
Pied Currawong	*Strepera graculina*	64.4	47	4	2
Grey Fantail	*Rhipidura albiscapa*	57.5	42	4	1
Australian Raven	*Corvus coronoides*	35.6	26	2	2
Leaden Flycatcher	*Myiagra rubecula*	21.9	16	3	2
Eastern Yellow Robin	*Eopsaltria australis*	65.8	48	6	2
Silvereye	*Zosterops lateralis*	24.7	18	40	5
Red-browed Finch	*Neochmia temporalis*	52.1	38	20	4

Note: *Indicates breeding

Table 4. Species seen infrequently between 1979 and 2012 (Reporting Rate < 20%).

Common Name	Scientific Name	Reporting Rate %	Number months recorded	Maximum Count
Australian Brush-turkey *	*Alectura lathami*	1.1	3	1
Stubble Quail	*Coturnix pectoralis*	0.4	2	5
Brown Quail	*Coturnix ypsilophora*	1.1	4	3
Australian Wood Duck	*Chenonetta jubata*	0.7	2	4
Pacific Black Duck	*Anas superciliosa*	1.1	3	3
Brown Cuckoo-Dove	*Macropygia amboinensis*	9.8	28	2
Common Bronzewing *	*Phaps chalcoptera*	9.1	26	5
Crested Pigeon	*Ocyphaps lophotes*	1.1	2	2
Tawny Frogmouth *	*Podargus strigoides*	3.5	10	2
White-throated Nightjar	*Eurostopodus mystacalis*	6.3	18	2
Australian Owlet-nightjar	*Aegotheles cristatus*	9.8	28	4
White-throated Needletail	*Hirundapus caudacutus*	4.9	14	40
White-necked Heron	*Ardea pacifica*	0.7	2	1
White-faced Heron	*Egretta novaehollandiae*	0.4	1	1
Pacific Baza	*Aviceda subcristata*	3.9	11	2
Brown Goshawk	*Accipiter fasciatus*	3.2	9	2
Collared Sparrowhawk *	*Accipiter cirrocephalus*	7.4	21	2
Grey Goshawk	*Accipiter novaehollandiae*	2.5	7	2
Wedge-tailed Eagle	*Aquila audax*	10.2	29	3
Little Eagle *	*Hieraaetus morphnoides*	5.6	16	3
Nankeen Kestrel	*Falco cenchroides*	0.4	1	1
Brown Falcon	*Falco berigora*	1.4	4	3
Australian Hobby	*Falco longipennis*	1.4	4	1
Peregrine Falcon	*Falco peregrinus*	1.8	5	1
Masked Lapwing	*Vanellus miles*	1.4	4	3
Painted Button-quail *	*Turnix varius*	2.8	8	4
Galah	*Eolophus roseicapillus*	1.4	4	8
Sulphur-crested Cockatoo	*Cacatua galerita*	11.2	32	30
Scaly-breasted Lorikeet	*Trichoglossus chlorolepidotus*	0.4	1	5
Musk Lorikeet	*Glossopsitta concinna*	0.7	2	5
Little Lorikeet	*Glossopsitta pusilla*	7.0	20	14
Eastern Koel	*Eudynamys orientalis*	2.1	6	1
Channel-billed Cuckoo	*Scythrops novaehollandiae*	9.5	27	4
Horsfield's Bronze-Cuckoo	*Chalcites basalis*	6.3	18	3
Shining Bronze-Cuckoo	*Chalcites lucidus*	4.2	12	2
Pallid Cuckoo	*Cacomantis pallidus*	1.4	4	1
Brush Cuckoo	*Cacomantis variolosus*	7.4	21	3
Powerful Owl	*Ninox strenua*	9.1	26	2
Azure Kingfisher *	*Ceyx azureus*	1.8	5	1
Sacred Kingfisher *	*Todiramphus sanctus*	11.9	34	4
Rainbow Bee-eater	*Merops ornatus*	10.9	31	20
Dollarbird *	*Eurystomus orientalis*	6.3	18	2
Red-browed Treecreeper	*Climacteris erythrops*	0.7	2	1
Brown Treecreeper	*Climacteris picumnus*	0.7	2	1
Chestnut-rumped Heathwren *	*Hylacola pyrrhopygia*	1.4	4	1
Speckled Warbler *	*Chthonicola sagittata*	2.1	6	3
Brown Gerygone	*Gerygone mouki*	1.4	4	4
White-throated Gerygone *	*Gerygone olivacea*	1.4	14	6
Yellow Thornbill	*Acanthiza nana*	0.7	2	6
Buff-rumped Thornbill *	*Acanthiza reguloides*	6.3	18	8
Fuscous Honeyeater	*Lichenostomus fuscus*	0.7	2	6
Little Wattlebird	*Anthochaera chrysoptera*	1.4	4	2
Regent Honeyeater	*Anthochaera phrygia*	1.4	4	20
Scarlet Honeyeater	*Myzomela sanguinolenta*	4.6	13	4
Crescent Honeyeater	*Phylidonyris pyrrhopterus*	0.4	1	1

Table 4. Species seen infrequently between 1979 and 2012 (Reporting Rate < 20%) (cont.).

Common Name	Scientific Name	Reporting Rate %	Number months recorded	Maximum Count
White-cheeked Honeyeater *	*Phylidonyris niger*	5.6	16	20
Brown-headed Honeyeater	*Melithreptus brevirostris*	0.7	2	5
Grey-crowned Babbler *	*Pomatostomus temporalis*	2.8	8	5
Varied Sittella *	*Daphoenositta chrysoptera*	8.1	23	12
White-bellied Cuckoo-shrike	*Coracina papuensis*	2.8	8	2
Crested Shrike-tit	*Falcunculus frontatus*	6.0	17	2
Pied Butcherbird	*Cracticus nigrogularis*	4.9	14	2
Spangled Drongo	*Dicrurus bracteatus*	0.4	1	1
Rufous Fantail *	*Rhipidura rufifrons*	3.9	11	4
Willie Wagtail *	*Rhipidura leucophrys*	1.1	3	1
Black-faced Monarch	*Monarcha melanopsis*	1.4	4	3
Magpie-lark	*Grallina cyanoleuca*	0.4	1	1
White-winged Chough *	*Corcorax melanorhamphos*	13.3	38	30
Jacky Winter *	*Microeca fascinans*	1.4	4	1
Scarlet Robin	*Petroica multicolor*	4.2	12	2
Flame Robin	*Petroica phoenicea*	0.4	1	1
Rose Robin	*Petroica rosea*	11.6	33	4
Welcome Swallow	*Hirundo neoxena*	4.2	12	5
Bassian Thrush *	*Zoothera lunulata*	10.2	29	5
Mistletoebird	*Dicaeum hirundinaceum*	3.5	10	4
Double-barred Finch	*Taeniopygia bichenovii*	1.8	5	10
Chestnut-breasted Mannikin	*Lonchura castaneothorax*	0.4	1	2

Note: *Indicates breeding

Table 5. Reporting rates (%) of bird species which showed large changes in status during the 33-year study.

Common Name	1979-1989 (Table 1)	1990-2000 (Table 2)	2001-2012 (Table 3)
Wonga Pigeon	12.1	27.3	79.5
Crimson Rosella	25	20.6	47.9
Eastern Rosella	23.3	8.4	23.3
White-throated Treecreeper	53.4	34.6	82.2
Satin Bowerbird	47.4	37.4	67.1
Laughing Kookaburra	13.8	27.1	72.6
Spotted Pardalote	10.3	22.4	54.8
Eastern Spinebill	1.7	21.5	42.5
Lewin's Honeyeater	2.6	34.6	72.6
Yellow-faced Honeyeater	15.5	36.4	80.8
Yellow-tufted Honeyeater	12.1	22.4	74
Bell Miner			28.8
Noisy Miner	26.7	1.9	
Eastern Whipbird	5.2	22.4	50.7
Golden Whistler	2.6	21.5	64.4
Grey Butcherbird	15.5	25.2	60.3
Australian Magpie	11.2	22.4	43.8
Pied Currawong	3.4	31.8	64.4
Eastern Yellow Robin	5.2	33.6	65.8
Red-browed Finch	9.5	22.4	52.1

Large changes in the occurrence of the regularly recorded species (RR > 20%) are shown in **Table 5**. For inclusion in this table the frequency of occurrence must have either at least doubled or halved between successive 11-year periods. Only one species, Noisy Miner *Manorina melanocephala*, declined to this extent, whereas 19 species increased.

A number of bird species now listed as threatened under the *Threatened Species Conservation Act 1995* (NSW) have been recorded on *Wirrumbirra*, some of which even now remain as breeding

species (**Table 6**). It is not surprising that two of these, the Little Eagle *Hieraaetus morphnoides* and the Brown Treecreeper *Climacteris picumnus* have not been recorded in recent years, since a noticeable state-wide decline has resulted in these species being listed. To judge from recent research, Speckled Warbler *Chthonicola sagittata* may be among the few species which suffer from the cessation of grazing, which is consistent with their sparse occurrence at *Wirrumbirra* in the later years of this study (Newman 2010, Roderick & Stuart 2010).

Table 6. Threatened species recorded at *Wirrumbirra* from 1979 to 2012

Common Name	1979	1980-1989	1990-1999	2000-2012
Little Eagle *		1982-84, 1986	1993	
Glossy Black-Cockatoo *	1979	1980-1986, 1988-89	1990-1999	2000-03, 05, 06, 2008-12
Gang-gang Cockatoo *	1979	1980-1987	1990-1999	2000-2012
Little Lorikeet		1980, 82, 83, 85, 86	1997, 1998	2003, 09, 11, 12
Powerful Owl	1979	1981-1986	1990, 92, 94, 99	2000, 01, 12
Brown Treecreeper	April 1979	May 1980		
Speckled Warbler *	1979	1980-1983		2001
Regent Honeyeater (Critically Endangered)		1983, 1984		
Grey-crowned Babbler *	1979	1982, 1983		2010
Varied Sittella	1979	1980-1982	1991, 1999	2000, 01, 04-5, 2008-10, 2012
Scarlet Robin	1979	1980, 1983-1986	1992	2009
Flame Robin			1991	

Note: * Indicates the existence of breeding records

DISCUSSION

Wirrumbirra with a bird list of 124 species, including 51 which have bred, supports a diverse population of woodland and open-country birds. Eleven of these species (**Table 6**), of which five have bred on the property, are listed as Vulnerable under the *Threatened Species Conservation Act 1995* (NSW). Of these the Glossy Black-Cockatoo and Gang-gang Cockatoo breed on the *Wirrumbirra* property, and have limited distribution in the Hunter Region (Newman *et al*. 2010). Glossy Black-Cockatoos are usually encountered feeding on *Allocasuarina* fruits and the Wollombi/Laguna area is one of the strongholds of the species in the Hunter Region (Roderick & Stuart 2010). They may commonly be seen and heard, sometimes perched all day in these trees, as they delicately extract the seeds.

The Regent Honeyeater *Anthochaera phrygia,* which is listed as Critically Endangered under the *Threatened Species Conservation Act 1995* (NSW) was recorded in August and September 1983 and again in August 1984. At this time *Eucalyptus sparsifolia* was flowering profusely. It is possible they have been present at other times, but did not coincide with our visits.

The Grey-crowned Babbler *Pomatostomus temporalis* was often present in the first few years, when the vegetation was more open. It nested in April 1982, but has been absent since, possibly due to vegetation changes. Within the Hunter Region it occurs widely, including areas where the habitat has been substantially modified (Roderick & Stuart 2010). Its decline as vegetation increased had similarities to that of the Noisy Miner (see below), but no clear connection can be established, since it was always less frequently observed than that species.

Changes in Bird Population

The most striking feature of the 33-year period results was the progressive increase in the richness and diversity of the bird population over the years, with 10 (**Table 1**), 34 (**Table 2**) and 40 (**Table 3**) species being recorded regularly (RR> 20%) in the successive 11-year periods between 1979 and 2012. In the second and third periods of the study 19 species had reporting rates at least double those in the first 11 years, whereas only one species, the Noisy Miner declined (**Table 5**). These increases, (**Table 3**), indicate that removing cattle and allowing the cleared areas to revegetate have had an overall improvement on the quality of bird habitat. At *Wirrumbirra* features of the vegetation regrowth included development of stands of *Allocasuarina littoralis* a species favoured by Glossy Black-Cockatoos. Also, in one former open area, a group of *Sannantha pluriflora* (syn. *Baeckea*) closed the canopy. However, the restoration of vegetation and the dynamic of the change in bird population was a long-term process, requiring over 20 years to approach full effect. The increased recording for some species, such as the Wonga Pigeon, during this period might also be because of vegetation regrowth.

A further factor impacting on the rate of recovery of bird populations is the presence of the Noisy Miner. Under grazed conditions degraded open woodland lacks the variety of vegetation type and structure to support diverse bird populations. This situation is exacerbated by the presence of Noisy Miners, which were frequently observed only during the initial years of this study (**Table 1**). Noisy Miners are a despotic species, which drives out smaller species from open woodland in the absence of understorey vegetation (Maron *et al.* 2013). Newman (2013) found it took about ten years after cattle were removed before the habitat became unsuitable for Noisy Miners, similar to the duration of their persistence after grazing ceased in this study (**Table 5**).

The Bell Miner *Manorina melanophrys,* another despotic, colonial species, first appeared in February 2008 but was not seen after the end of 2011. On a subsequent visit we found this species further along the creek in a neighbouring property, presumably an instance of the periodic relocations of colonies, for which this species is known (M. Newman pers. comm.).

Other Species

Some highlights of the other species recorded at *Wirrumbirra* follow.

The Superb Lyrebird was the most recorded species (66.7 %). Nests (**Figure 2**) were found each year and the young birds were observed most years.

Figure 2. Superb Lyrebird nest at *Wirrumbirra* 1994

The Rockwarbler *Origma solitaria,* the only bird species endemic to NSW, was regularly recorded. The Rockwarbler is a supporting species in the nomination of the Greater Blue Mountains Important Bird Area based on its restricted range and specialised habitat requirements, namely forested sandstone gorges with caves. *Wirrumbirra*, which is immediately adjacent, also provides this specialised habitat.

In August 2006 the fresh mound of an Australian Brush-turkey *Alectura lathami* was discovered in our rainforest, which we planted in a small gully. We did not record the bird at this time, but in September 2011 and October 2012 it was sighted.

Parrots and cockatoos are particularly well represented at *Wirrumbirra*. Among species regularly recorded, Glossy Black-Cockatoos have already been discussed. Gang-gang Cockatoos have been observed feeding on the fruits of the *Eucalyptus* spp. that dominate the open forest. They also feed on the fruits of *Persoonia linearis,* another dominant species. Yellow-tailed Black-Cockatoos have been noted extracting the wood-boring larvae of insects from the stems of *Acacia parvipinnula,* another common tree. Australian King-Parrot *Alisterus scapularis,* Crimson Rosella *Platycercus elegans* and Eastern Rosella *P. eximius* are also attracted to the property.

A Crescent Honeyeater *Phylidonyris pyrrhopterus* observed feeding in a grevillea species in July 1999 was notable in that most Hunter Region records are restricted to high altitude alpine habitat. This record suggests it may come to lower altitudes in winter.

CONCLUSIONS

The vegetation is important habitat for the Glossy Black-, Yellow-tailed, and Gang-gang Cockatoos, as well as Australian King-Parrot, Crimson and Eastern Rosellas that have all been recorded regularly at *Wirrumbirra*. For example, large stands of *Allocasuarina torulosa* occur frequently across the property, and provide a regular food supply.

Although the observer effort involved in compiling the monthly lists was variable, nevertheless a pattern emerges of consistent sightings and changes in *Wirrumbirra's* bird population. Of particular note is that the net increase in bird species is correlated with the extensive regrowth of eucalypts following the removal of cattle, with very few cleared areas now remaining. Other patterns are the regular arrival of some species, coinciding with the mass flowering of *Eucalyptus sparsifolia.*

It is gratifying to know this area is preserved in perpetuity under a Voluntary Conservation Agreement with the NSW National Parks and Wildlife Service.

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Early Hunter Region avian records

Part 3. A review of historical data about shorebirds in the Hunter Estuary

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A review of records for shorebirds in the Hunter Estuary of New South Wales has shown that 12,000-15,000 shorebirds utilised the estuary, either as resident, non-breeding visitors or passage birds most years during the period 1970-1999, with 17,000-19,000 birds present some years. The limited data available for earlier years suggests this was a long-standing situation. 33 migratory species were recorded in the estuary (20 species regularly) and nine Australian resident species (one as a vagrant).

The most abundant of the migratory species were Bar-tailed Godwits *Limosa lapponica* and Curlew Sandpipers *Calidris ferruginea*, both in many thousands each year. Red Knots *Calidris canutus* and Sharp-tailed Sandpipers *Calidris acuminata* were sometimes present in similar counts. 500-1,000 each of Pacific Golden Plovers *Pluvialis fulva*, Black-tailed Godwits *Limosa limosa* and Eastern Curlews *Numenius madagascariensis* visited. Seven other migratory species were typically present in counts of hundreds of birds. Of the non-migratory species, most were present in modest numbers (less than 100 birds). However, about 1,000 Black-winged Stilts *Himantopus leucocephalus* were often in the estuary, and many thousands of Red-necked Avocets *Recurvirostra novaehollandiae* from the 1980s onwards.

Over the 30-year main review period, the numbers of migratory shorebirds visiting in the austral summer declined by around 20%. This was matched by an increase in the numbers of non-migratory shorebirds. The numbers of visiting Curlew Sandpipers decreased by 25-30% (1,000-1,500 birds), with the most change occurring in the 1990s. Lesser Sand Plover *Charadrius mongolus* numbers plummeted, decreasing by about 90% from their initial counts of around 500 birds. The decline was even more marked for Broad-billed Sandpipers *Limicola falcinellus*, with their numbers by the mid 1970s less than 5% of their peak. The numbers of Black-tailed Godwits, Common Greenshanks *Tringa nebularia* and Marsh Sandpipers *Tringa stagnatilis* also decreased, by 30-50% in each case.

During the austral winter, immature Bar-tailed Godwits, Eastern Curlews and Curlew Sandpipers were present in high numbers. Their numbers began to decline in the 1980s. For Double-banded Plovers *Charadrius bicinctus* and some other small to medium shorebirds, the decline was already underway in 1982 if not earlier.

INTRODUCTION

The Hunter Estuary near Newcastle in New South Wales (**Figure 1**) has long been known for its importance for shorebirds (Holmes 1970, van Gessel & Kendall 1972a, Gosper 1981, Lane 1987, Smith 1991, Herbert 2007, Stuart *et al.* 2013). Most accounts have focussed on shorebird numbers but both Lane and Smith also placed the Estuary into its national/state context. In his book *Shorebirds of Australia*, Lane (1987) summarised the status Australia-wide of every shorebird species. He also prioritised sites, based on the average numbers of birds present during 1981-86. From this analysis, he named the Hunter Estuary as a top 20 site Australia-wide for 14 species (**Table 1**). The estuary narrowly missed inclusion into Lane's overall top 20 sites list which was based on average total shorebird numbers. Smith (1991) nominated the Hunter Estuary (including Kooragang Island, Fullerton Cove and Hexham Swamp) as by far the most important shorebird site in New South Wales. Smith based his nomination on maximum counts recorded at the main NSW shorebird sites.

Shorebirds utilising the Hunter Estuary include residents, non-breeding visitors, passage birds and the occasional vagrant. The majority of species (and by far the majority of birds) are non-breeding visitors, these being birds which spend a substantial part of their annual cycle in the Hunter Estuary. The estuary therefore is very important to them. This category includes northern hemisphere

breeders present for the austral summer, resident Australian shorebirds congregating near the coast under drought conditions and the Double-banded Plover which breeds in New Zealand.

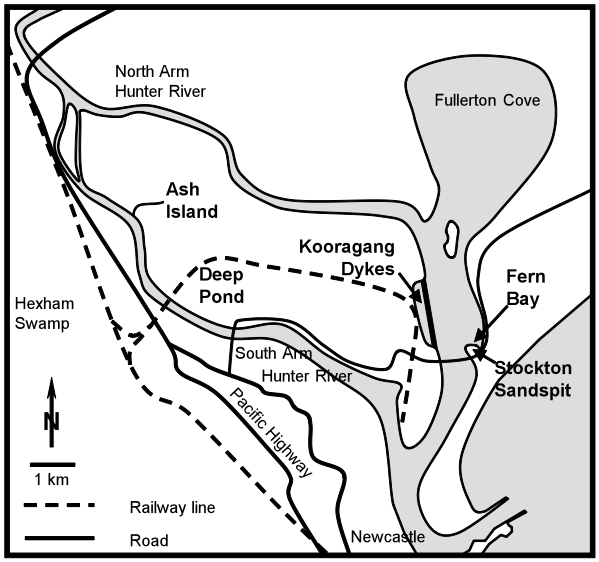

Figure 1. The Hunter Estuary (reproduced from Stuart *et al*. 2013)

Table 1. Shorebird species for which the Hunter Estuary was a 'Top 20 Site' in the 1980s (from Lane 1987)

Species	Average count 1981-85
Black-winged Stilt	550
Pacific Golden Plover	410
Double-banded Plover	90
Lesser Sand Plover	130
Red-kneed Dotterel	20
Black-tailed Godwit	470
Bar-tailed Godwit	1,300
Whimbrel	30
Eastern Curlew	490
Terek Sandpiper	30
Grey-tailed Tattler	100
Common Greenshank	560
Marsh Sandpiper	280
Curlew Sandpiper	1,570

In 1999, members of Hunter Bird Observers Club (HBOC) commenced regular monthly counts of shorebirds at the known roosting sites within the Hunter Estuary. The data from those surveys are published in the Hunter Region Annual Bird Report series (Stuart 2000-2014). The results from the 1999-2007 surveys have been discussed (Herbert 2007) and the 1999-2010 summer and winter counts were recently reported (Stuart *et al.* 2013). In time, more publications involving in-depth analysis of the results may be expected. One important limitation to carrying out such analyses is the ability to compare with pre-1999 shorebird numbers. The available data are scattered (and incomplete). The purpose of this paper is to present a holistic picture of what is known about shorebird numbers in the Hunter Estuary prior to commencement of modern surveys. For space reasons, only summary information is presented here. Full details are available in a Special Report prepared for HBOC (Stuart in preparation). An early draft of that report was made available for three other reviews (Herbert 2007, Spencer 2010, Cooper *et al.* 2014).

METHODS

Many sources of information were consulted while conducting the review. They are summarised below:

- *The Emu* (journal of BirdLife Australia, published since 1901; until the mid-1970s a good source of local and regional information);
- *Stilt* (journal of Australasian Wader Studies Group (AWSG), published since 1981; until 1998 most summer and winter wader count summaries were published);
- NSW Bird Reports (produced by Birding NSW, published since 1971; source of opportunistic records about wader numbers);
- Hunter Region Annual Bird Reports (produced by HBOC, published annually since 1993; source of opportunistic records about wader numbers in 1993-1999);
- *Hunter Natural History* (journal of the now defunct Newcastle Flora and Fauna Society; published in the 1970s);
- Miscellaneous articles, reports and books (see References for details);
- Reports to participants in the national wader counts in summer and winter 1983 and summer 1985;
- HBOC archives (which contain copies of record sheets from some of the 1982-1984 AWSG summer and winter counts);
- Personal archives of the late Wilma Barden;
- Personal recollections of various 1970s/1980s Hunter Estuary wader surveyors (Wilma Barden, Sue Hamonet, Fred van Gessel, Dick Cooper, Ann Lindsey, Tom Kendall, Phil Straw).

When reviewing these information sources, every record about shorebird numbers was noted – these are presented in a supporting detailed report (Stuart in preparation). Analysis of those individual records allowed development of a perspective of shorebird numbers in the Hunter Estuary during various time periods. The preliminary perspectives were reviewed by several of the key surveyors from the 1970s/1980s and their comments taken into account.

LITERATURE AND DATA REVIEW

Very few data were found about shorebirds in the Hunter Estuary prior to the 1960s. On the occasions that shorebirds were mentioned in the early literature, there were no firm numbers cited (and few indicative numbers) Gwynne (1932) reported that both Lesser Sand Plover *Charadrius mongolus* and Red-capped Plover *Charadrius ruficapillus* were present "in large numbers", as were "godwits, stints and sandpipers". D'Ombrain (1945) referred to the presence of large flocks of godwits in the Hunter Estuary but did not indicate which species or how many birds.

Keast (1949) reported up to 34 Grey-tailed Tattlers *Tringa brevipes* roosting in Throsby Creek during the 1943-44 seasons. He had been advised of their presence by a local birdwatcher, A.J. Gwynne, who reported that he had found them "on certain Hunter River mudflats … over a number of years" (Keast 1949).

Over 1967-1970, Holmes surveyed in the Hunter Estuary frequently (Holmes 1970). He reported 21 migratory shorebirds as occurring regularly, giving typical counts for them. Holmes also generalised about *some* of the non-migratory shorebirds which with present-day experience we might have expected to be present, and he briefly mentioned four vagrant migratory birds (Holmes 1970).

From the late 1960s, van Gessel and Kendall were monitoring shorebird numbers in the Hunter Estuary. They presented summaries in a series of *Hunter Natural History* articles (Kendall & van Gessel 1972, van Gessel & Kendall 1972a, 1972b, 1974). At the peak, their surveys were comprehensive and conducted on a weekly basis – fortunately much of the raw data were recently relocated (T. Kendall pers. comm.).

Gosper (1981) also provided data for the period 1970-73 based on monthly surveys. There was then a six-year hiatus, until AWSG commenced national summer and winter wader counts. Some members of the Newcastle Flora and Fauna Society (from which HBOC later fledged) participated in those surveys. Hunter Estuary data do not appear in the national database until 1984, but some of the earlier data were in Wilma Barden's archives.

Although the AWSG-coordinated summer and winter surveys continued into the 1990s (and beyond), results were not reported in *Stilt* after 1997. Also, in several years prior to 1997, surveys of the Hunter Estuary either were not done or not reported (for example, there were no summer survey data reports for 1990-91 and 1993-95). Fortunately over 1994-1997 Kingsford and colleagues were conducting regular surveys (Kingsford *et al.* 1998).

There are many opportunistic records of shorebird numbers in the Hunter Estuary in the 1971-1999 NSW Bird Reports and the 1993-1999 Hunter Region Annual Bird Reports. It would be only rarely that such records reflected the total numbers of shorebirds present in the estuary at the time. Rather, they reflect the numbers present at the locations which the observer visited. It would be even less likely that such records reflected the peak numbers present in any given season. Nevertheless, the records give useful insights especially for times when there is a paucity of other data available.

Anomalous Records

In a later section, some exceptional counts are discussed i.e. instances where shorebirds were present in much larger numbers than normal. However, some anomalous records were identified, where the reported numbers could be shown to be incorrect. Those records were disregarded when preparing the **Appendix**, which summarises the status of shorebirds in the Hunter Estuary from the 1960s to 1990s, and in the discussion which follows in this article. For completeness, the discounted records are:

- Reports of 4,000 Black-tailed Godwits *Limosa limosa* in 1985 and several other reports of 2,000-3,000 birds over 1984-85 (in the NSW Bird Reports). The reported high counts of 2,000-3,000 birds in January-February 1984 do not match with the AWSG count of 520 birds in February 1984. Bar-tailed Godwits *Limosa lapponica* were present in large numbers in the estuary at the time and some data entry errors (or mis-identification errors) seem likely to have occurred.
- A report in *Stilt* of 520 Ruddy Turnstones *Arenaria interpres* in February 1986. This is about an order of magnitude more than most other records. The next row in the table in *Stilt* reports just 40 Eastern Curlews *Numenius madagascariensis* in the same survey – an unusually low count for this species. Lane (1987) clearly did not use the record of 520 birds in his analysis of the Ruddy Turnstone. There seems no doubt that the two records were accidentally transposed in the *Stilt* table

(and that the error then propagated into Smith's 1991 review).

- A report of 401 Ruddy Turnstones in 1996 (Kingsford *et al.* 1998). This was a typographical error; only 40 birds were present (D. Geering pers. comm.)
- A report of 678 Marsh Sandpiper *Tringa stagnatilis* in 1996 (Kingsford *et al.* 1998). This was a typographical error; only 68 birds were present (D. Geering pers. comm.)
- A report of 633 Terek Sandpiper *Xenus cinereus* in 1997 (Kingsford *et al.* 1998). This was a typographical error; only 63 birds were present (D. Geering pers. comm.)
- Reports of 31 Greater Sand Plover *Charadrius leschenaultia* in 1976 and 23 birds in 1997 (in the NSW Bird Reports). These are very high counts for what then (as now) was considered a rare visitor to the estuary. There are no other records of >5 birds. It seems probable that some mis-identifications occurred.
- Records of Cox's Sandpiper in 1988 and Little Stint *Calidris minuta* in 1991. The former is now considered a hybrid i.e. not a full species. The latter does not appear in the current Hunter Region checklist (Stuart 2014); i.e. its presence in the Hunter Region has not been confirmed.

Summary

42 shorebird species have been reported from the Hunter Estuary (**Table 2**, **Appendix**), comprising 28 species either resident or visiting in most years and 14 rare or vagrant species.

Table 2. Shorebird species recorded in the Hunter Estuary 1960-1999

	Migratory birds	Australian resident birds	Total species
Regular visitors	20	8	28
Vagrant/accidental	13	1	14
Total shorebirds	33	9	42

The inferred status of all 42 species for each of the four decades from the 1960s to the 1990s is described in the **Appendix** (with supporting material available in Stuart in preparation). The summaries take into account all of the data available in the sources described earlier, with interpolations made for cases where gaps in data exist. It was not feasible to develop perspectives for decades earlier than the 1960s because of the very large gaps in available data.

DISCUSSION

Much of the discussion that follows in this section is based around the maximum counts for individual species. Some shorebird species are only present in their maximum numbers for a relatively short period, for example during migration passage or if conditions elsewhere have become unfavourable. That is, the maximum count does not necessarily reflect the typical situation. Examples for the Hunter Estuary are Red Knots *Calidris canutus*, which are mostly only present in September-November during their migration passage, and Sharp-tailed Sandpipers *Calidris acuminata,* which often move to/from inland wetlands in response to local rainfall patterns.

For all species, however, the maximum count at any particular wetland site indicates the relative importance of that site for survival of the species. For at least some time in their life cycle, those birds have relied on that site for food and shelter. Hence it is valid to analyse the Hunter Estuary based on maximum counts of shorebirds.

A great many of the available records have been from occasional and usually short duration visits to the estuary by observers. In most cases therefore, it is not possible to know with certainty how long a particular species remained present in its maximum numbers. Indeed, it cannot even be concluded for sure that the maximum numbers were counted. However, the fact that many species often were counted in similar numbers in repeat visits during a season, and over different seasons, does suggest that they frequently remained in their maximum numbers for extended times.

Typical Ranges for Maximum Shorebird Numbers

Table 3 summarises typical maximum numbers expected for each of the main shorebird species that occurred in the Hunter Estuary (rare and vagrant species have not been included). For each of the three decades for which sufficient data were available, a range is given. The ranges represent interpolated estimates of the maximum counts that could be expected for the species in any given season from that decade. The estimates are based upon actual count data for individual species, whenever available, with the underlying assumption that the numbers for that species will have been similar in the adjoining years for which data were not available.

Table 3. Typical shorebird maximum counts for the Hunter Estuary

	Typical maximum counts*		
Species	**1970s**	**1980s**	**1990s**
Aust. Pied Oystercatcher	5-20	5-20	5-20
Sooty Oystercatcher	1-10	1-10	1-10
Black-winged Stilt	500-1,500	500-1,500	500-1,500
Red-necked Avocet	0-100	1,000-2,000	2,000-4,000
Pacific Golden Plover	500-800	500-800	100-200
Red-capped Plover	50-100	50-100	50-100
Double-banded Plover	200-300	10-50	10-50
Lesser Sand Plover	100-500	100-200	50-100
Black-fronted Dotterel	20-50	20-50	20-50
Red-kneed Dotterel	10-50	10-50	10-50
Banded Lapwing	0-20	0-20	0-20
Masked Lapwing	50-80	50-80	50-80
Black-tailed Godwit	700-800	400-600	300-400
Bar-tailed Godwit	1,000-3,000	3,000-4,000	2,000-3,000
Whimbrel	100-200	100-200	100-200
Eastern Curlew	600-1,000	600-800	600-1,000
Terek Sandpiper	100-150	100-150	50-100
Common Sandpiper	1-5	1-5	1-5
Grey-tailed Tattler	40-50	40-50	20-40
Common Greenshank	200-300	100-200	100-200
Marsh Sandpiper	200-400	200-300	100-300
Ruddy Turnstone	30-50	20-50	20-50
Great Knot	0-10	0-8	10-50
Red Knot	1,000-2,000	1,000-2,000	1,000-2,000
Red-necked Stint	100-200	100-200	100-200
Pectoral Sandpiper	1-5	1-5	1-5
Sharp-tailed Sandpiper	1,000-1,500	1,000-1,500	1,000-1,500
Curlew Sandpiper	1,000-3,500	1,000-4,000	1,000-2,500

** Estimated total numbers of birds visiting the Hunter Estuary annually. Maximum counts for species often occurred on different days. Rarer species are not included in the Table.*

For example, for Bar-tailed Godwit in the 1970s, the maximum counts in any season would always have been of at least 1,000 birds and maximum counts of up to 3,000 birds would not have been unexpected. Taking another example, for the Curlew Sandpiper *Calidris ferruginea* in the 1970s maximum counts of 3,500 birds could be expected at times but by the 1990s any counts of more than 2,500 birds would have been considered exceptional.

For some species, there would occasionally have been greater maximum counts than indicated by the ranges given in **Table 3**. Those exceptional counts will be considered in a later section. In this section, the focus is on the typical utilisation of the estuary by shorebirds.

Table 3 provides an interpolation for all species in all years from the limited Hunter Estuary data that are available. It should not be interpreted that birds were present *all the time* in the numbers indicated. The ranges indicate the *maximum* numbers that would have been expected each year if there were regular systematic surveys.

It should be noted that analysing on the basis of the maximum numbers present is different to analysing on the basis of the numbers of birds utilising the estuary for a substantial part of the year. The latter counts (which exclude the birds that were on passage migration through the estuary) potentially relate more closely to the long-term holding capacity of the estuary for the species than do the maximum counts. However the relationship is indirect as the numbers are also affected by many external influences – these may occur at the breeding grounds or within the East Asian-Australasian Flyway. Also, in periods of no systematic surveying, it is often difficult to discern what the typical counts were for some species whereas the maximum counts are more likely to be available.

Importance of the Hunter Estuary to Shorebirds Collectively

Extending the theme that the maximum numbers of a shorebird species present at a wetland site indicate the importance of the site for the survival of that particular species, it is instructive to consider the total of all of the maximum counts. This total, being the number of different individual birds, is a useful indicator of the importance of the Hunter Estuary to shorebirds generally. Not all the birds are necessarily present simultaneously, but all have relied on the site for some part of their life cycle.

It must be noted that this analysis will under-estimate the number of individual birds that relied on the Hunter Estuary in any season, as it neglects the estuary's importance to birds that are in transit. For example, Red Knots regularly spend some time in the estuary during September-November, before continuing their migration passage. For some 4-8 weeks, the numbers present on any given day can be many hundreds and potentially in excess of 1,000 birds. Are these the same birds all the time? Most probably not – the post-breeding migration is relatively fast for most species compared with the movement north to the breeding grounds (where birds stage at several sites to feed and regain weight, thus ensuring that they arrive in prime condition for breeding). Recent studies based on flagged Red Knots show that most birds stay in the estuary for only a few days, although occasionally longer, before continuing their migration (L. Crawford pers. comm.). Thus, many thousands of Red Knots probably rely temporarily on the Hunter Estuary. For all the other migratory birds a similar situation potentially applies; birds recorded at the beginning of the migration period are not

necessarily the same as those that are present later in the season. A recent study of Bar-tailed Godwits in the Hunter Estuary confirms this (Crawford & Herbert 2013).

Despite this difficulty, by using the ranges for individual species from **Table 3** the total numbers of shorebirds utilising the estuary in each decade can be estimated. The results are presented in **Table 4**. In the 1970s at least 7,000 individual migratory shorebirds visited the Hunter Estuary each year and perhaps as many as 15,000 birds (i.e. 11,000 ± 4,000 birds). The total numbers held up fairly well in the 1980s (range 8,000-14,000 birds) but by the 1990s the total number of migrant species had declined to 9,200 ± 2,700 birds (i.e. ranging from 6,500 birds to around 12,000 birds).

Table 4. Typical numbers of shorebirds utilising the Hunter Estuary each year

	Typical numbers present*		
	1970s	**1980s**	**1990s**
Migratory shorebirds	11,000 ± 4,000	11,500 ± 3,500	9,200 ± 2,700
Australian resident birds	1,200 ± 650	2,700 ± 1,100	4,200 ± 1,600
Total shorebirds	12,000 ± 4,500	14,500 ± 4,500	13,500 ± 4,300

** Estimated total numbers of birds visiting the Estuary each year. Usually, not all species were present simultaneously in their maximum count numbers.*

Over the three decades, the numbers of Australian resident birds utilising the estuary progressively increased. This change largely reflects the growing numbers of Red-necked Avocet *Recurvirostra novaehollandiae*. These were an infrequent visitor in the 1960s and 1970s (first recorded as five birds in December 1965) but by the 1990s they often were present in counts of many thousands of birds.

Table 4 indicates the great importance of the Hunter Estuary to shorebirds. In some years during the 1980s around 19,000 individual birds potentially relied at least some of the time on the estuary for their food and shelter. This number agrees well with Smith's estimate of around 24,000 birds visiting regularly over the 20-year period 1970-1990 (Smith 1991).

Tables 3 and **4** are based upon estimates that have been developed for population ranges. Any errors in the initial estimates will distort the conclusions. It is therefore important to compare the suggested numbers with the counts for some years for which there was more intensive survey effort and more comprehensive coverage of the Hunter Estuary. The periods 1985-86 and 1994-96 offer opportunities for such comparisons, as there are data available for many species. Data for 1985-86 are mainly from Australasian Wader Study Group surveys. Data for 1994-96 are from the study by Kingsford *et al*. (1998). The shorebird counts for those five years are presented in **Table 5**. For species where no count data were available the maximum number of birds has been estimated.

Table 5. Shorebird maximum counts for some particular years

	Maximum counts*				
Species	**1985**	**1986**	**1994**	**1995**	**1996**
Aust. Pied Oystercatcher	***10***	***10***	***10***	***10***	5
Sooty Oystercatcher	***5***	***5***	***5***	***5***	8
Black-winged Stilt	1,205	943	100	500	1,659
Red-necked Avocet	1,200	1,600	2,000	3,000	4,500
Pacific Golden Plover	220	630	100	145	60
Red-capped Plover	6	106	34	50	50
Double-banded Plover	6	***20***	***20***	3	2
Lesser Sand Plover	25	83	40	35	35
Black-fronted Dotterel	***30***	***30***	20	***30***	***30***
Red-kneed Dotterel	63	***20***	20	***20***	22
Masked Lapwing	***60***	***60***	***60***	***60***	***60***
Black-tailed Godwit	***500***	550	400	300	379
Bar-tailed Godwit	4,000	1,440	5,000	2,000	3,100
Whimbrel	60	***100***	250	500	75
Eastern Curlew	650	220	303	1,000	917
Terek Sandpiper	40	5	55	154	94
Common Sandpiper	***2***	***2***	***2***	***2***	***2***
Grey-tailed Tattler	***40***	55	20	38	10
Common Greenshank	561	150	100	208	350
Marsh Sandpiper	277	12	300	433	131
Ruddy Turnstone	***20***	***20***[1]	50	6	50
Great Knot	***5***	***5***	1	20	50
Red Knot	400	50	***1,000***	305	2,000
Red-necked Stint	***100***	145	20	400	100
Pectoral Sandpiper	***1***	***1***	***1***	***1***	***1***
Sharp-tailed Sandpiper	***1,000***	940	1,000	600	228
Curlew Sandpiper	4,000	2,200	800	1,520	2,737
Total of migratory birds	11,907	6,628	9,462	7,670	10,321
Total of Aust. resident birds	2,579	2,774	2,249	3,675	6,334
TOTAL	14,486	9,402	11,711	11,345	16,655

Numbers in **Bold Italics are estimated. All others are counts.*
[1]Reported in Stilt as 520 birds

The numbers in **Table 5** agree well with the predictions of **Table 4**. In 1985 there were 14,486 total shorebirds including 11,907 migratory birds – both figures lie very near the mid-point of predicted ranges for the 1980s. Similarly for 1994-96, the actual numbers generally lie comfortably within the predicted ranges; the exception being the 1996 total of 6,314 individuals for Australian breeding resident birds. This reflects the exceptionally high count of Red-necked Avocet in that year (4,500 birds). The 1986 counts for migratory shorebirds (**Table 5**) are below the predicted maximums. This is mainly associated with very low counts for Bar-tailed Godwit,

Eastern Curlew *Numenius madagascariensis*, Marsh Sandpiper *Tringa stagnatilis* and Red Knot. Perhaps exceptionally low numbers of each of these species visited that year, but the more probable explanation is that the peak numbers were not recorded.

Over-wintering Migratory Shorebirds

Immature migratory shorebirds do not return to their breeding grounds, choosing instead to over-winter in Australia although some birds undertake a partial migration towards northern Australia (Geering *et al.* 2007). The number of birds in the Hunter Estuary in winter therefore provides another opportunity for trend analysis (however, short-term fluctuations can occur due to differences in breeding success each year: Minton *et al.* 2003). Unfortunately, there are far less winter records available as these tended not to be reported as highlights in the NSW and Hunter Region annual bird reports. The main sources of winter count data are from the 1971-77 surveys by Kendall & van Gessel (in preparation), AWSG surveys in two periods of the 1980s (records from other times are incomplete) and the work by Kingsford and colleagues in 1994-97 (Kingsford *et al.* 1998).

The maximum winter counts of the main shorebird species during 3-4 year time frames within the above periods are in **Table 6** (rare and vagrant species have not been included). Only June-July records were used, to eliminate late-departing or early-returning birds. For many species, the counts year-on-year had considerable variation. This perhaps in part reflects the natural variation. However, it is sometimes unclear whether the entire estuary was surveyed i.e. some birds that were present may have been overlooked.

From **Table 6**, some trends are apparent. In the 1970s and 1980s, Bar-tailed Godwits, Eastern Curlews and Curlew Sandpipers were present in high numbers. By the 1990s a clear decline was underway for them and for smaller shorebirds such as Red-capped Plover *Charadrius ruficapillus* and Black-fronted Dotterel *Elseyornis melanops*. The counts for Double-banded Plovers *Charadrius bicinctus* were already decreasing by the 1980s, with Red Knot also declining as an over-wintering species around that time. Conversely, Red-necked Avocets were only in low numbers until the late 1980s after which it became common for several thousand to be present in winter (and in summer).

Appearances by most other shorebirds in winter were less common events and trends are less easily discerned. Black-winged Stilt *Himantopus leucocephalus* numbers generally were stable; the peak counts for them in 1982-84 are presumed to be associated with the severe drought Australia was then experiencing (Botterill & Fisher 2003).

Table 6. Maximum shorebird winter counts for the Hunter Estuary in five survey periods

	Survey Periods				
Species	**1971-1973**	**1974-1977**	**1982-1984**	**1987-1990**	**1994-1997**
Aust. Pied Oystercatcher	11		8	1	4
Black-winged Stilt	220+	600+	1,053	302	377
Red-necked Avocet	1	11	85	2,000	3,000
Pacific Golden Plover*	13	9		4	
Red-capped Plover	80	20+	55	55	1
Double-banded Plover#	255	400+	60		3
Lesser Sand Plover*	20	3			
Black-fronted Dotterel	50+	13	4	7	
Red-kneed Dotterel	25+	2	29		
Masked Lapwing	21		34	10	12
Black-tailed Godwit*	50	30	53	110	30
Bar-tailed Godwit*	450	800+	411	620	363
Whimbrel*	22	25	30	10	8
Eastern Curlew*	160	226	290	162	85
Terek Sandpiper*	1	12			1
Common Sandpiper*					3
Grey-tailed Tattler*	17	13	15	4	
Common Greenshank*	35	6	51	9	39
Marsh Sandpiper*		1	6		1
Ruddy Turnstone*	2	5	5	7	
Great Knot*	3				13
Red Knot*	60	55	8	2	30
Red-necked Stint*	100	40+	190	4	4
Sharp-tailed Sandpiper*		1			
Curlew Sandpiper*	350	500+	580	84	91

*Birds which breed in the Northern Hemisphere.
#Non-breeding population from NZ, includes adult birds

Breeding Records of Shorebirds in the Hunter Estuary

An early record was from Gwynne (1932) who reported that dredging operations in the Hunter River had created many sandflats which had become favoured nesting sites for Red-capped Plovers.

Kendall & van Gessel (unpublished) summarised the birds found breeding on Kooragang Island during 1969-1976. They reported the numbers of breeding pairs recorded each year; **Table 7** shows their data for shorebirds. Black-winged Stilt, Red-capped Plover, Black-fronted Dotterel and Masked Lapwing *Vanellus miles* bred regularly in the estuary. Red-kneed Dotterels *Erythrogonys cinctus* also bred, but not in every year.

Table 7 Shorebird breeding records 1969-1976 (from Kendall & van Gessel unpublished)

	Number of breeding pairs						
	1969/70	**1970/71**	**1971/72**	**1972/73**	**1973/74**	**1974/75**	**1975/76**
Black-winged Stilt	6	0	1	10	9	5	2
Red-capped Plover	6	1	4	15	7	9	5
Black-fronted Dotterel	1	2	0	3	0	0	0
Red-kneed Dotterel	2	0	0	5	0	2	0
Masked Lapwing	?	1	1	2	1	3	2

Gosper (1981) confirmed the breeding status of those five species; however he reported a higher count of 25 Black-winged Stilt nests present in October-December 1972.

Neither Kendall & van Gessel (unpublished) nor Gosper (1981) described Australian Pied Oystercatchers *Haematopus longirostris* as breeding in the Hunter Estuary. However, Holmes (1970) reported that they bred behind the foredunes along Newcastle Bight.

There were occasional breeding records reported for Black-winged Stilts in the 1980s and 1990s and Red-capped Plovers in the 1990s (Stuart in preparation). The general absence of breeding records probably reflects that they were not considered to be "highlights" for inclusion in an annual bird report, rather than an absence *per se*.

Banding Studies

Banding studies do not directly indicate how many birds of a given species are present. However, it is appropriate to note that there was an extensive banding program for migratory shorebirds in the Hunter Estuary in the 1970s (van Gessel & Kendall unpublished) with the program continuing (at varying levels of activity) until 2005 – for example, see Richardson (2004) and Foate (2005).

Between July 1972 and April 1973, 728 migratory shorebirds were banded in the Newcastle and Sydney districts (Lane 1973). Between May 1973 and July 1974, an additional 845 migratory shorebirds were banded on Kooragang Island and Stockton Sandspit (van Gessel & Kendall unpublished). These numbers are indirect indicators of the types of shorebirds that were present in large numbers in the estuary in the 1970s.

Key Sites for Shorebirds

In general the sites where shorebirds roosted and foraged are not well described in the available literature. Stockton Sandspit and Fullerton Cove are specifically mentioned as important areas, but many other records are simply described as being from "Kooragang Island". The main ponds of Ash Island often hosted many birds (T. Kendall pers. comm.) and the former sewage treatment works at Stockton was an important roost for shorebirds such as Curlew Sandpiper (S. Hamonet pers. comm.).

Exceptional Counts

In the discussion below, some counts which were very much higher than the norm have been identified. The counts are considered likely to be correct but as they appear to be exceptional records compared to the norm they were not taken into account when preparing summary statements for the **Appendix**.

Most of the maximum counts of Terek Sandpiper *Tringa cinereus* in the 1970s were 100-200 birds (Kendall & van Gessel 1972) with occasional reports of 300 or so birds. However, a flock of 600 birds was at Stockton in January 1970 (Holmes 1970, van Gessel & Kendall 1972a, 1972b) and 500 birds were reported present in March 1972 (Stuart in preparation).

Most maximum counts of Common Greenshanks *Tringa nebularia* and Marsh Sandpiper *Tringa stagnatilis* were usually of 100-300 birds. In 1985, 561 Common Greenshanks were reported in the "Hunter Wetlands"; perhaps this related to an area larger than just the Hunter Estuary. Gosper (1981) reported Marsh Sandpiper to be a rare visitor and Holmes (1970) did not even list it as present in 1967-70. Conversely 433 birds were present in 1995 (Stuart in preparation) and Smith (1991) reported a maximum count of 500 birds over 1970-1990 – he noted the Hunter Estuary as one of the most important sites for the species in NSW. It seems there was considerable variation in the numbers of visiting Marsh Sandpipers.

CONCLUSIONS

Analysis of available data confirms the long-term importance of the Hunter Estuary for shorebirds. Throughout the 1970s, 1980s and 1990s, 12,000-15,000 shorebirds regularly visited the estuary, with peak counts of 17,000-19,000 birds.

Over the time period reviewed, the numbers of visiting migratory shorebirds declined by around 20-30% (2,000-3,000 fewer birds). This was approximately matched by an increase in numbers of non-migratory (Australian resident) shorebirds.

The most abundant of the migratory species were Bar-tailed Godwits and Curlew Sandpipers, both present in counts of many thousands of birds each year. Red Knots and Sharp-tailed Sandpipers were sometimes present in similar counts – the former during their migration passage and the latter when conditions were unfavourable inland. 500-1,000 each of Pacific Golden Plovers *Pluvialis fulva*, Black-tailed Godwits and Eastern Curlews visited and many hundreds each of Double-banded Plover, Lesser Sand Plover, Whimbrel *Numenius phaeopus*, Terek Sandpiper, Common Greenshank, Marsh Sandpiper and Red-necked Stint.

Of the non-migratory species, most were present in modest numbers (less than 100 birds). However, about 1,000 Black-winged Stilts were often in the estuary, and many thousands of Red-necked Avocets from the 1980s onwards.

Several of the migratory shorebirds declined notably in abundance during the review period. The numbers of visiting Curlew Sandpipers decreased by 25-30% (1,000-1,500 birds), with the most change occurring in the 1990s. Lesser Sand Plover numbers plummeted, decreasing by about 90% from their initial counts of around 500 birds. The decline was even more marked for Broad-billed Sandpipers, with their numbers by the mid 1970s less than 5% of their peak. The numbers of Black-tailed Godwits, Common Greenshanks and Marsh Sandpipers also decreased, by 30-50% in each case (~100 fewer birds of each species visiting).

Bar-tailed Godwit numbers appear to have increased in the 1980s then decreased in the 1990s but they were in greater numbers than in the 1970s. The counts of Red-necked Avocets rose dramatically from the mid 1980s, when 1,000 birds began to be recorded regularly and many thousands of birds were often present in the 1990s.

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Appendix. Status of shorebirds in the Hunter Estuary 1960s to 1990s

Species	Summary of status 1960s to 1999	Maximum counts			
		1960s	1970s	1980s	1990s
Australian Pied Oystercatcher *Haematopus longirostris*	Small numbers of birds were regularly present.	nd*	24	8	8
Sooty Oystercatcher *Haematopus fuliginosus*	Birds were rarely recorded to have utilised the Estuary.	nd	nd	nd	8
Black-winged Stilt *Himantopus leucocephalus*	Some birds were present every year and there were regular influxes of 500-1500+ birds when conditions were unfavourable inland.	nd	1,200	1,209	1,659
Red-necked Avocet *Recurvirostra novaehollandiae*	An irregular but frequent visitor. Fewer than 100 birds visited occasionally in the 1970s and early 1980s. There were two substantial influxes of many thousands of birds, over 1985-87 and 1992-97, with a trend of progressively more birds present.	5	19	1,600+	4,500
Banded Stilt *Cladorhynchus leucocephalus*	The Banded Stilt was an accidental visitor.	nd	1	1	2
Pacific Golden Plover *Pluvialis fulva*	500-800 birds regularly visited in the 1980s and the total numbers probably were similar in the 1970s. Numbers declined in the 1990s, with 100-200 birds typically being present and the peak count being of 300 birds. Birds usually did not over-winter.	100	350	800	219
Grey Plover *Pluvialis squatarola*	The Grey Plover was a rare summer visitor.	nd	1	2	1
Ringed Plover *Charadrius hiaticula*	The Ringed Plover was an accidental visitor in 1967, present over February-December.	1	0	0	0
Red-capped Plover *Charadrius ruficapillus*	100+ birds were present when conditions were favourable, and probably at least 50 birds were regularly present and some pairs breeding.	nd	90	55	50+
Double-banded Plover *Charadrius bicinctus*	Birds occasionally utilised the Estuary in winter. In the 1970s several hundred birds were sometimes present. There was subsequently a substantial decline in numbers.	50	400+	60	3
Lesser Sand Plover *Charadrius mongolus*	Many hundreds of birds came to the Estuary each year in the early 1970s. The numbers of birds visiting then declined steadily, down to just a few tens of birds by the late 1990s.	500	800	200	68
Greater Sand Plover *Charadrius leschenaultii*	The Greater Sand Plover was a rare visitor.	10	5	2	nd
Oriental Plover *Charadrius veredus*	The Oriental Plover was a rare visitor.	nd	nd	16	nd
Black-fronted Dotterel *Elseyornis melanops*	Between 20 and 50 birds were frequently present when conditions were favourable, and some birds were resident.	nd	18	24	50
Red-kneed Dotterel *Erythrogonys cinctus*	Up to 50-60 birds were sometimes present when the conditions inland were unfavourable.	nd	50	63	30
Banded Lapwing *Vanellus tricolor*	The Banded Lapwing was an infrequent visitor.	nd	1	16	9

*nd: No count data were found

Appendix Status of shorebirds in the Hunter Estuary 1960s to 1990s (cont.)

Species	Summary of status 1960s to 1999	Maximum counts			
		1960s	1970s	1980s	1990s
Masked Lapwing *Vanellus miles*	At least 50 birds were regularly present.	nd*	60	34	20+
Black-tailed Godwit *Limosa limosa*	700-800 birds migrated each summer in the 1970s, declining to 400-600 birds in the 1980s and then further declining to 300-400 birds in the 1990s. 30-50 birds often over-wintered in the 1970s and 1980s.	100	700	800	400
Hudsonian Godwit *Limosa haemastica*	A single bird was present from late 1982 and recorded intermittently until 1988.	nd	0	1	0
Bar-tailed Godwit *Limosa lapponica*	Numbers rose steadily from less than 1,000 birds in the 1960s to around 4,000 birds in the mid-1980s. Subsequently the numbers declined again and by the late 1990s the typical counts were around 2,000 birds but with records in 2 years of ~5,000 birds. There was considerable variability in the numbers present each summer. Around 400 immature birds over-wintered in the 1980s, declining to ~250 birds in the 1990s.	nd	3,500	4,000	5,000
Little Curlew *Numenius minutus*	It was a rare visitor, present in small numbers at intervals typically of 5-10 years.	3	2	32	7
Whimbrel *Numenius phaeopus*	At least 200 birds were frequently present over 1993-95 and the peak count was of around 500 birds. In most other years, the maximum counts were of less than 100 birds. Whimbrel is a difficult species to count accurately and it seems quite possible that numbers were reasonably stable from the 1970s to the late 1990s or even that they increased somewhat.	nd	105	60+	220
Eastern Curlew *Numenius madagascariensis*	At least 600 birds regularly visited from at least the 1960s onwards and in many years some 800-1,000 birds were present. A minimum of 300-400 birds were present every summer. Typically, 150-250 birds over-wintered. In excess of 1% of the total world population were present almost every year and in some years the numbers were nearly 2.5% of the population (Delany & Scott 2002). The Estuary was consistently a very important site for Eastern Curlew over the review period.	600	1,000+	900+	917
Terek Sandpiper *Tringa cinereus*	100-150 birds regularly visited and at times it supported up to 600 birds. Over-wintering was uncommon.	400	600	100	350+
Common Sandpiper *Actitis hypoleucos*	Small numbers regularly visited.	10	11	2	2
Grey-tailed Tattler *Tringa brevipes*	40-50 birds regularly visited from the early 1980s, and probably prior to then also. Occasionally, 60-100 birds were present. 10-15 birds regularly over-wintered until around the mid-1980s with the winter numbers subsequently declining to around 5 birds.	100	13	96	80
Wandering Tattler *Tringa incana*	The Wandering Tattler was a rare visitor, with occasional records of single birds.	nd	1	1	nd
Common Greenshank *Tringa nebularia*	150-200 birds regularly visited and greater numbers were present occasionally. Most years 1-10 birds over-wintered.	50	300	561	250
Marsh Sandpiper *Tringa stagnatilis*	100-200 birds regularly visited and greater numbers were present in several years. The Estuary at times supported 400-500+ birds. Occasionally, a few birds over-wintered.	nd	500+	277	433

*nd: No count data were found

Appendix Status of shorebirds in the Hunter Estuary 1960s to 1990s (cont.)

Species	Summary of status 1960s to 1999	Maximum counts			
		1960s	1970s	1980s	1990s
Wood Sandpiper *Tringa glareola)*	It was an uncommon visitor in the early 1970s and became increasingly rare in the subsequent years. It was not recorded after 1992.	nd*	6	1	1
Ruddy Turnstone *Arenaria interpres*	30-50 birds regularly visited each summer and a few birds occasionally over-wintered.	10	30	50	50+
Asian Dowitcher *Limnodromus semipalmatus*	It was an accidental visitor, with records of single birds in two years only (1985 and 1988).	nd	0	1	0
Great Knot *Calidris tenuirostris*	Birds regularly migrated each year, initially in counts of up to 12 birds but with the numbers increasing in the 1990s to 20+ birds. Over-wintering was uncommon.	40	12	8	40
Red Knot *Calidris canutus*	The peak counts each spring during the migration passage were of 1,000-2,000 birds. Outside of this period, small numbers of birds were present – typically there were less than 20 birds but occasionally the numbers rose to above 50 birds. It was uncommon for birds to over-winter.	100	600+	~400	1,567
Sanderling *Calidris alba*	Single birds were recorded in 1973 and 1995.	nd	1	nd	1
Red-necked Stint *Calidris ruficollis*	100-200 birds were regularly present and at times the Estuary supported up to 500 birds. Over-wintering was uncommon but it was an important refuge for over-wintering birds when conditions were unfavourable elsewhere.	"numerous"	500	136	278
Pectoral Sandpiper *Calidris melanotos*	1-2 birds were often present during the migration period, and less frequently there were 5-10 birds present.	nd	25	10+	<10
Sharp-tailed Sandpiper *Calidris acuminata*	Birds visited most summers, sometimes only in small to moderate numbers, but when conditions were unfavourable elsewhere, the Estuary became an important refuge, with more than 1,000 birds present at such times. It is likely that numbers were under-recorded due to infrequent visits by observers to the more preferred habitats of this species.	400	400	1,065	1,200
Curlew Sandpiper *Calidris ferruginea*	1,500-2,500 birds regularly visited each summer and the numbers rose to >3,500 birds when conditions were unfavourable elsewhere. Up to 100 immature birds regularly over-wintered and occasionally the winter counts were substantially greater. The Estuary was an important site for Curlew Sandpiper.	"numerous"	3,500	4,000	2,600
Buff-breasted Sandpiper *Tryngites subruficollis*	A single bird was caught and banded in March 1979.	nd	1	0	0
Broad-billed Sandpiper *Limicola falcinellus*	Birds often visited in counts of 100 or more in the 1960s and early 1970s, but then there was a major decline, with birds only intermittently present and in counts of less than 10 birds.	100	180	9	3
Ruff *Philomachus pugnax*	The Ruff was a rare summer visitor.	1	2	nd	1

*nd: No count data were found

Worimi Conservation Lands bird surveys (2009-2013)

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During 28 surveys over a five-year period in the Worimi Conservation Lands (WCL), a coastal area immediately north of Newcastle, 71 species of birds were recorded. The primary focus was to determine the status of shorebirds; 12 migratory and an additional seven Australian breeding species were recorded. The only shorebirds regularly recorded were Australian Pied Oystercatcher *Haematopus longirostris*, Red-capped Plover *Charadrius ruficapillus* and Double-banded Plover *Charadrius bicinctus*. The first two species breed at WCL, but in the case of the Australian Pied Oystercatcher, with minimal success, which is attributed to the large volume of vehicular traffic along the beach. The Double-banded Plover, a winter visitor from New Zealand, occurred in sufficient numbers to suggest WCL is one of the most important locations for this species in the Hunter Region and NSW.

Seven of the 71 species are listed under the *Threatened Species Conservation Act 1995* (NSW). The Australian Pied Oystercatcher and Little Tern *Sternula albifrons*, both classified as Endangered, attempt to breed in WCL, but with minimal success. Great Knot *Calidris tenuirostris*, Curlew Sandpiper *Calidris ferruginea*, Sanderling *Calidris alba* and Osprey *Pandion haliaetus* are occasional visitors. The White-fronted Chat *Epthianura albifrons*, listed as Vulnerable, is regularly present and presumed breeding.

Flocks of Australian Ravens *Corvus coronoides* and Gull-billed Terns *Gelochelidon nilotica* occurred regularly. Both species are known predators of eggs and may have an adverse impact on ground-nesting species like oystercatchers and terns.

INTRODUCTION

The Worimi Conservation Lands (WCL) 32°48′S 151°56′E are located between Fern Bay and Anna Bay immediately north of the mouth of the Hunter River. The Lands are owned by the Worimi Aboriginal Community and leased to the NSW Government to be jointly managed with the Board of Management on behalf of the traditional owners. National Parks and Wildlife Service (NPWS) carry out the day to day management. WCL are gazetted as National Park, Regional Park and State Conservation Area and include 25.5 km of beach (Draft Plan of Management - WCL Board of Management 2014). The management strategy of WCL seeks to balance several sometimes conflicting objectives. It is imperative to respect and protect the heritage values of the traditional owners, the vegetation and wildlife of the area, which include a number of restricted-distribution and threatened species. It is also important to support public access for recreational and commercial purposes. It is noted in the Draft Plan of Management that current vehicle access is not sustainable. In 2010/11 12,585 three-day beach vehicle permits in addition to the 10,347 annual beach vehicle permits were issued. During holiday time at one entrance, as many as 600 vehicles per day entered WCL. Vehicles have access to the entire length of the beach south of the northern entrance. Access to most of the dune system is now restricted and vehicles are excluded from the vicinity of Aboriginal midden sites and vegetated areas (WCL Board of Management 2014). The Sygna shipwreck and Tin City, a small collection of huts used by recreational fishermen, are the two main man-made landmarks within WCL.

Prior to this study knowledge of the bird populations of WCL was mainly based on incidental observations and there was no overview documentation. Our surveys were initiated by Warren Mayers of NSW NPWS with the dual objectives of establishing an inventory of the birds of WCL and increasing the skills of NPWS field staff in bird identification. Emphasis was placed on understanding the status of threatened species, such as the Australian Pied Oystercatcher *Haematopus longirostris,* Little Tern *Sternula albifrons* and White-fronted Chat *Epthianura albifrons*. Beach-nesting species like the Australian Pied Oystercatcher and Little Tern are often

severely affected by high vehicular usage (Weston *et al.* 2014). Disturbance may force them to use unsuitable nest sites and interfere with incubation of their eggs; and if chicks are hatched, these tiny flightless animals leave the nest and may be run over and killed, as one of their threat defense strategies is to freeze. The irony is that they frequently take shelter in wheel tracks.

SURVEY METHOD AND ANALYSIS

Two members (usually authors AL and MN) of the Hunter Bird Observers Club Inc. (HBOC) undertook semi-regular monthly bird surveys from July 2009 to December 2013, with support from NPWS. Initially a ranger and, in later years, two visitor service assistants, usually Nadine Russell (NR) and Robyn George (RG) participated in the surveys.

Surveys were carried out by four-wheel-drive vehicle usually commencing at the Lavis Lane entrance to WCL. Surveys were split into three segments (**Figure 1**) to facilitate analysis: "southern sector" from Lavis Lane entrance to southern boundary including the Sygna wreck; "central sector" from Lavis Lane entrance to Tin City; and "northern sector" from Tin City to Anna Bay (**Figure 1**). The route taken was usually the same at each survey and involved driving south to the WCL boundary behind the frontal dune, crossing the dune to the beach front and driving north along the beach front to the exit south of Anna Bay. Where the frontal dune had been breached, inspections of the swale system behind were made. Stops were made to count any birds present. The extent to which the dune system behind could be surveyed in the northern section of WCL varied; the dunes are constantly restructuring, necessitating restricted access following storm conditions. However, as the surveys were predominantly concerned with quantifying the use of WCL by species which frequent the beach, restrictions to access were of limited concern. Surveys commenced at 8.30am and lasted approximately three hours. The state of the tide was variable. All species and their numbers (other than off-shore species) were recorded

Twenty-eight surveys were completed from July 2009 to December 2013: four in 2009, seven in 2010, two in 2011, seven in 2012 and eight in 2013. Unfortunately it was not possible to conduct surveys every month as a consequence of limited NPWS staff availability and severe weather conditions causing beach closures.

Consequently, there were differences in annual and monthly survey effort which compromised trend analysis. The trends presented are limited to species which occurred sufficiently frequently for indicative variations in annual occurrence to be discerned. Even these instances are not statistically robust. Small sample sizes, sometimes compounded by large fluctuations in numbers, complicate the provision of summary statistics. We have chosen to present mean numbers even though standard deviations are often high, because they provide the reader with an indication of whether a species is typically scarce or relatively numerous at WCL. Mean numbers were calculated based on surveys when species were present and surveys when species were not recorded were excluded.

To establish the first comprehensive inventory of WCL's bird populations, which this paper provides, we drew on the incidental records of NPWS staff. Many important observations involving breeding behaviour and seabird wrecks cannot be effectively recorded by periodic surveys, even at regular monthly intervals. The role of AL and MN was to foster the recording of such additional information by providing verification of identification and explaining the conservation requirements and behaviour of breeding species.

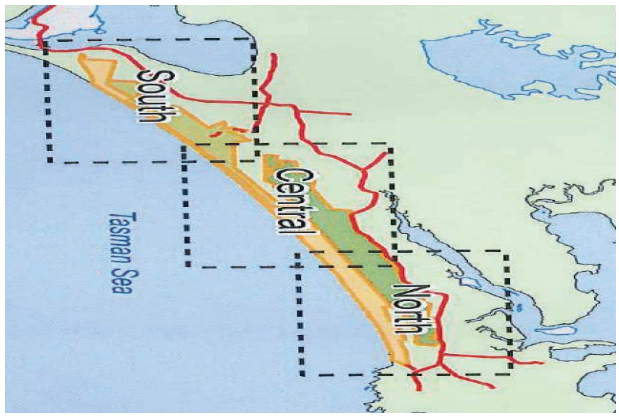

Figure 1. Schematic showing the three segments of beach surveyed in the Worimi Conservation Lands.

RESULTS AND DISCUSSION

Seventy-one species, including sea birds which are incidental in this study, were recorded (see **Appendix**). Summary statistics involving reporting rates (RR), which indicate the frequency with which a species occurred, mean and maximum numbers per survey are provided as an indication of the status of each species.

In the following discussion of the results emphasis is placed on those species for which WCL is considered to provide important habitat (i.e. WCL is arguably the stronghold of the Double-banded Plover *Charadrius bicinctus* in the Hunter Region). Other species like Australian Raven *Corvus coronoides* receive detailed consideration because their presence may be detrimental to breeding species like Little Terns. Only eight of these species (**Table 1**) were observed frequently (RR >40%) during surveys.

Table 1. Summary statistics for eight frequently recorded species during all 28 surveys.

	Reporting Rate (%)	Mean No.*	Max. No.
Whistling Kite	43	3	10
White-bellied Sea-Eagle	86	4	12
Australian Pied Oystercatcher	100	13	27
Double-banded Plover	68	65	137
Red-capped Plover	84	17	37
Gull-billed Tern	64	44	119
White-fronted Chat	68	5	16
Australian Raven	100	23	53

*Mean numbers/survey were calculated using the number of surveys each species was present.

Australian Pied Oystercatcher

Australian Pied Oystercatcher, a beach-nesting species, listed as Endangered under the *Threatened Species Conservation Act 1995* (NSW) *(TSC Act)* was observed on all 28 surveys, the highest number being 27 in July 2013. Whilst the size of WCL suggests considerable potential for supporting oystercatchers, the observed carrying capacity (number of foraging birds including both non-breeding birds and breeding pairs) is well below that which would be expected for an ocean beach of this type. Further, breeding success at WCL is abysmally low with persistent failure often directly or indirectly due to the number of vehicles travelling along the beach front (Russell & George 2013). Ideally oystercatchers nest near the high tide mark (Fletcher & Newman 2010) and from an early age onwards chicks follow their parents out to the foraging areas as the tide falls and are fed prey as soon as it is captured (Ens *et al*. 1992). This optimal strategy is not tenable at the WCL.

Oystercatcher activity, particularly breeding, is primarily restricted to an area of approximately seven kilometres in length near and north of Tin City. The restricted distribution of oystercatchers along the beach is attributed to the intensity of disturbance in the vicinity of entrances to the beach alienating the birds from these areas. There may also be issues of limited and unevenly distributed food availability. Pipis *Donax (Plebidonax) deltoides,* which are a key prey for oystercatchers on high-energy beaches, are harvested at WCL. Compression of sand by vehicles can also have an adverse impact on pipi abundance. WCL is periodically closed to harvesting allowing pipi populations to recover from declines related to these activities.

Key breeding events of the Australian Pied Oystercatcher in the study area between 2009 and 2013 are summarized below:

2009 Three pairs nested and all apparently failed (Stuart 2010);
2010 Two pairs, each with two young in October and one pair with an advanced young in November (Stuart 2011);
2011 Successful breeding and outcomes are documented (Russell & George 2012);
2012 Two nests with eggs found in September, but both failed (RG pers. obs.);
2013 One nest with two tiny chicks on 9 December. (Media Release, WCL Board of Management, December 2013);
2013 One very young juvenile with two adults on 10 December (AL pers. obs.);
2013 One nest with two recently hatched chicks on 30 December, this being a separate breeding attempt from that reported earlier in the month and thought to involve the pair which successfully fledged a chick in 2011 (Russell & George 2012).

Between 2009 and 2011 only small numbers of oystercatchers were recorded with the mean number of birds per survey less than 10 (**Figure 2**). However, during 2012 numbers increased, a trend which continued in 2013 when the mean number counted (21.8) was nearly three times that for the total period 2009 to 2011. It is suggested that, until 2011, the oystercatchers recorded were mainly resident breeding adults. Increased numbers in 2012 and 2013 are attributed to the formation of non-breeding flocks. Inspection of the plumage of these birds during surveys indicated that they contained a number of immature birds, one to three years old, which is less than the known age of first breeding (Ens & Underhill 2014). This conclusion was confirmed by the presence of the following flagged birds of known age. Three Australian Pied Oystercatchers, flagged as runners in northern NSW (two in Bundjalong National Park and one at Broadwater National Park), were identified during the surveys. WCL is over 440 km south of these locations. One bird was first seen in July 2009 approximately eight months after fledging. This bird, at age 15 months, returned to the Hunter Estuary eight months later (ABBBS 2010). The second bird was almost two years old (ABBBS 2010) when first seen and was regularly recorded over a 13-month period. The third bird was almost three years old when first seen in 2009 during the first year of this study. It returned 10 months later in May 2010. Prior to the first sighting at WCL, this bird was seen at Botany Bay, at that time two years old (ABBBS 2010). In contrast, another oystercatcher was banded as a three year old at Corner Inlet in Victoria in May 2011, over 800 km south of WCL where it was seen in February and

March 2012. This bird was also present in the Hunter Estuary over three months, September, October and November 2011, before moving to WCL (ABBBS 2011).

Collectively these records illustrate the extensive movement of Australian Pied Oystercatchers along the eastern coast of Australia and confirm that the non-breeding flocks at WCL contain immature birds including some in their first year.

Injured Australian Pied Oystercatchers, involving at least 11 different individuals, were observed on 17 (61%) surveys. Injuries affected mainly the legs and feet, which were sometimes missing, or had fishing line wrapped around them. In addition to these, in 2014, a male bird, entangled in fishing line with a lure attached was observed for several weeks by NPWS staff. When it became too weak to fly, it was caught and put into care at Taronga Zoo. It survived its ordeal and was released on 14 March 2014 (Newcastle Herald: 15 March 2014).

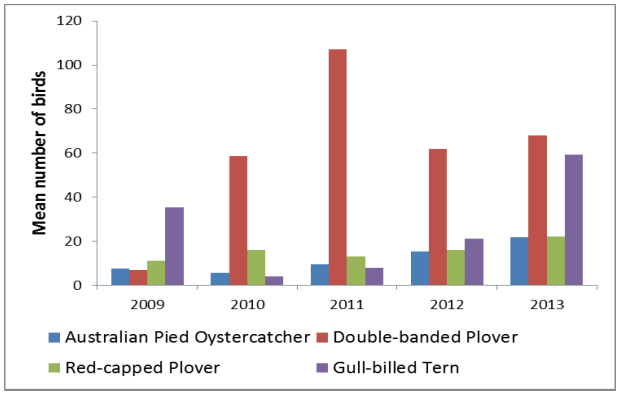

Figure 2. Annual variations in the mean number of birds present during surveys.

Pacific Golden Plover

This migratory species arrives in the Hunter Estuary in September and during diurnal high tides roosts principally on Kooragang Dykes. Pacific Golden Plover *Pluvialis fulva* are known to use WCL as a diurnal roost on occasions. It is probable that WCL is also a nocturnal roost site (Crawford & Herbert 2009). There are few records for WCL, probably because this species is easily missed during surveys if sheltering behind the frontal dune system or in the dunes south of WCL. The highest record involved approximately 220 birds in January 2006 (Stuart 2007). Pacific Golden Plover was seen on only two surveys in this study, the highest number being 67 in November 2009. On this occasion they were roosting near a swale behind the frontal dune. The other observation involved two birds in December 2013.

Double-banded Plover

In the Hunter Region WCL is one of three main destinations for this species which migrates from its breeding grounds in New Zealand. The other two are Port Stephens and the Manning Estuary. At WCL Double-banded Plovers were seen on 19 (68%) surveys. They normally arrive in February/March (Stuart 1994-2013), consistent with the monthly variation of our records (**Figure 3**), although one bird arrived abnormally early in January. Peak numbers were observed in May involving a mean of 106 (**Figure 3**) and a maximum count of 137 in 2011. Never very numerous, Double-banded Plover remain over the winter period until August/September (Stuart 1994-2013). Our records suggest the majority of birds have departed WCL by the end of August. Most observations were made of birds roosting above the high-tide mark, particularly in the vicinity of the Sygna. At times they were spread along the entire length of the beach or in small numbers on the edges of flooded swales. On one occasion they were actively feeding over an extensive area of the dunes immediately south of the Sygna.

Double-banded Plover were most numerous in 2011 as indicted by the variation of annual mean numbers (**Figure 2**). Annual variations may be impacted by the timing of the surveys as evidenced by the abnormally low mean number for 2009, the first year of the study, in which the initial survey was made in July after plovers have started to leave WCL.

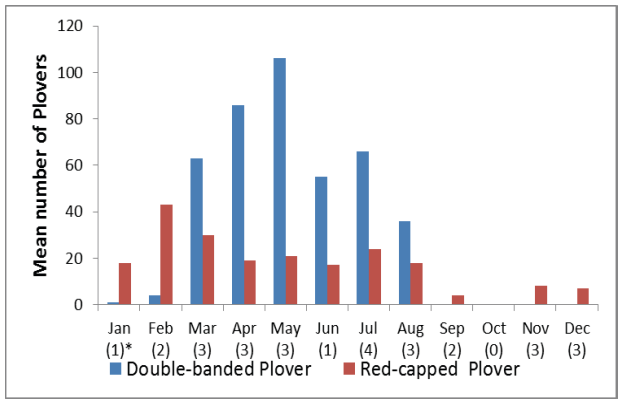

Figure 3. Monthly variation of mean numbers of Double-banded and Red-capped Plovers during 28 surveys at Worimi Conservation Lands from 2009 to 2013. *Numbers in parenthesis indicate the number of surveys conducted each month.

Red-capped Plover

Red-capped Plover *Charadrius ruficapillus* was observed on 25 (89%) surveys with the highest count of 37 on two occasions (March 2010 and May 2013). There was only one confirmed breeding record, a nest with eggs, in March 2013. Mean numbers were relatively stable between 2009 and 2012, but there was a 43% increase in 2013 compared with the previous four-year average (**Figure 2**). The monthly variation of numbers (**Figure 3**) indicates that Red-capped Plovers were more numerous between January and August than from September to December. Like the Double-banded Plover, Red-capped Plovers use a range of habitats – foraging at the edge of the waves or around the swales, when water is present, and roosting on upper areas of the beach front and in breaches in the frontal dune. They are difficult to see among the debris littering the beach and move only when a vehicle is within a few metres. Although Red-capped Plovers are regularly found at a number of coastal locations in the Hunter Region, they do not occur in large numbers and WCL is one of their strongholds.

Little Tern

Little Tern, listed as Endangered under the *TSC Act,* is a summer migrant arriving in the Hunter Region in August/September and departing by March. It was observed on six surveys which included visits to active breeding colonies. Below we draw on additional information obtained from the staff on the breeding events. Apart from a failed attempt at Lake Macquarie in November 2009 (Stuart 2010), WCL is the only known site south of the Manning Estuary where this species has attempted to breed in the past 10 years. Unfortunately the site chosen at WCL lies within the Recreational Vehicle Area which is most popular over the summer months at the height of the breeding season. Lack of staff and the relative remoteness of the site mean that observations are limited and breeding outcomes are not always known or documented. Eggs were laid in 2009/10 but the colony was abandoned, presumably due to disturbance, likely caused by vehicles. The 2010/2011 season saw nine chicks fledge. One nest with eggs was seen on 21 November 2012 (Stuart 2011-2013). On 21 January 2013 there were 15 nests and 2 chicks (R. George pers. obs.). During the next season there were 11 nests with 20 eggs on 9 December 2013 (Media Release WCL Board of Management December 2013).

Gull-billed Tern

Gull-billed Terns *Gelochelidon nilotica* roosted in compact flocks around water-filled swales and at the edge of the ocean with, but separate from, flocks of Silver Gulls *Larus novaehollandiae* and Crested Terns *Thalasseus bergii*. They were also seen foraging over dunes and using the water's edge as a flyway. Numbers of Gull-billed Terns recorded at WCL were high for the Hunter Region (Stuart 1994 to 2014), particularly in 2013 (**Figure 2**). There were complex variations in their annual (**Figure 2**) and seasonal (**Figure 4**) abundance. Between February 2010 and April 2012 Gull-billed Terns were only recorded once (8 birds in May 2011) during 11 surveys (RR 9%, n=11). In contrast Gull-billed Terns were recorded during all surveys outside this period (RR 100%, n=17) with a mean abundance of 47 terns/survey. This difference in frequency of occurrence was statistically significant when tested using the χ^2 test with Yates' correction for one degree of freedom ($\chi^2 = 62$, $P < 0.001$). The period of decreased occurrence corresponded to abnormally high rainfall in inland eastern Australia (Bureau of Meteorology Website, accessed 9 November 2014). We suggest this created conditions sufficiently favourable to Gull-billed Terns to temporarily negate the need for seasonal movements to the Hunter coast.

Gull-billed Terns were recorded in all months, except October when there were no surveys, but numbers were very low in January and February (**Figure 4**). Unpublished NSW Bird Atlas data shows numbers of Gull-billed Terns are present in NSW throughout the year with regular movement within the state (R. Cooper pers. comm. October 2014). Mapping of NSW Bird Atlas data confirms a strong seasonal movement into the inland during November-February, in particular to the Arid Bioregion and the far south-west and that increasing numbers of birds frequent the North Coast during May-August (with a corresponding substantial fall in inland numbers at this time). While some of the summer population could leave NSW during autumn and winter, the overall pattern suggests that there is a regular and strong seasonal movement of Gull-billed Terns within NSW. The movement is largely to and from the northern coastal parts of NSW (extending south to the Hunter Region) as few overwintering birds remain in southern coastal NSW (from the Central Coast southwards) and few or none are reported from the western plains to the tablelands. Small numbers may be present in the Arid and Riverine Plains Bioregions at this time (see Cooper *et al*. 2014 for description of bioregions). Breeding records of Gull-billed Terns in NSW (in the NSW

Bird Atlas dataset) show most breeding is in the far south-west (west and south from Lake Bancannia-Booligal-Barham). Breeding has been reported from September to April but the main season is November to February. Then they move. Higgins & Davies (1996) suggest that while some terns exhibit migratory patterns, as described above, others are nomadic. Monthly variations at WCL (**Figure 4**) which show low numbers in the summer months and maximum numbers between March and May are consistent with the monthly variations in the NSW Bird Atlas data set for the period 1971- 2006 (R. Cooper pers. comm. 2014).

Of considerable concern is the observed presence of Gull-billed Terns around the breeding colony of Little Terns at WCL as they have been observed predating Little Tern nests at the Manning Estuary colony (Fawcett & Thomas 2011). It is not suggested that the presence of breeding shorebirds and Little Terns attracts Gull-billed Terns to WCL. More probably their fluctuating abundance at WCL reflects broader-scale movements in NSW as discussed above.

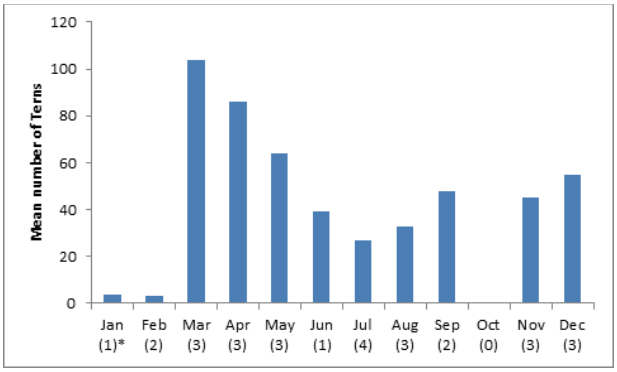

Figure 4. Monthly variation of mean numbers of Gull-billed Terns during 28 surveys at Worimi Conservation Lands from 2009 to 2013.
*Numbers in parenthesis indicate the number of surveys conducted each month.

Australian Raven

The Australian Raven has been identified as a major threat to beach-nesting birds taking both eggs and chicks (Maguire 2008). It was seen on every survey, usually in large numbers, with a mean of 23 and maximum count of 53 in July 2013. Anecdotal evidence suggested that they contributed to the failure of the 2009/2010 Little Tern nesting event. However, nesting shorebirds and terns are opportunistically exploited rather than a primary factor attracting ravens to WCL.

Other Shorebird Species

Fifteen additional species of shorebirds, including ten migratory and five Australian breeding species occurred occasionally as listed in the **Appendix**. One species, Bar-tailed Godwit *Limosa lapponica*, was not seen on the surveys, but four were present on 21 and 30 September 2011 (N. Russell pers. obs.). WCL habitat has limited suitability for most of these species, offering little by way of food resources. Black-fronted Dotterel *Elseyornis melanops* and Masked Lapwing *Vanellus miles* were found after rain had filled the swales, but they disappeared when the swales dried out. Sanderling *Calidris alba* was recorded on two surveys with a maximum count of three. It has been recorded on six other occasions. One was flagged in South Australia about 1200 km south from WCL on an unknown date (Stuart 2000 – 2014). In the Hunter Region it occurs more frequently in the Manning Estuary (Stuart 2000-2014). It is surprising that the Sanderling, which favours open sandy beaches exposed to surf (Geering *et al*. 2007), is not more common as WCL appear to provide suitable habitat. Its scarcity may be the result of disturbance from the high volume of traffic along the beach front. Red-necked Stint *Calidris ruficollis* occurred on six surveys, the highest number, 19, was seen in December 2013. It feeds around the freshwater swales, as well as at the edge of the sea and has been seen roosting with Double-banded Plovers.

White-fronted Chat

The White-fronted Chat *Epthianura albifrons,* a small passerine, is listed as Vulnerable under the *TSC Act.* It inhabits dune and swale areas where vegetation is present and was observed on 19 (68%) surveys. Observations were widespread, the highest number of 16 in March 2012. WCL is one of three areas in the lower Hunter Region where this species regularly occurs (Roderick & Stuart 2010). Although not proven, breeding almost certainly occurs.

Pelagic Species

Pelagic species, which were regularly observed offshore, were neither systematically nor quantitatively monitored and our records are incidental, primarily because the birds were usually too distant to allow identification at the species level. However, periodically beach-cast carcasses were found allowing identification. Any beach the length of WCL will be the scene of seabird tragedies as occurred in November 2009

when approximately 8000 Short-tailed Shearwaters *Ardenna tenuirostris* were found dead or dying. Similarly, in November 2010 approximately 5000 dead shearwaters lined the beach front. The scene was even worse in October 2013 when as many as 30,000 were found (Peter & Dooley 2014). Other birds found dead or dying at various times were Australasian Gannet *Morus serrator*, White-faced Storm-Petrel *Pelagodroma marina*, Shy/White-capped Albatross *Thalassarche*, Light-mantled Sooty Albatross *Phoebetria palpebrata*, Gould's Petrel *Pterodroma leucoptera*, unidentified prion species *Pachyptila*, Arctic Jaeger *Stercorarius parasiticus* and Northern Giant-Petrel *Macronectes halli*, the latter banded on South Georgia as a first-year bird (ABBBS 2012). In June 2012 a Cape Petrel *Daption capense*, a true pelagic species, was seen foraging in the surf only a few metres from the water's edge. This in-shore sighting was most unusual and may have been connected with the ongoing storm events experienced at that time.

Raptors

Eight species of raptors were recorded; by far the most common was the White-bellied Sea-Eagle *Haliaeetus leucogaster* which was observed on 24 (86%) of the surveys, with 2 to 12 individuals present. As well as adults, a number of these birds were either juvenile or sub-adult. On 16 November 2009 a young sea-eagle was found on the beach unable to fly, hooked and entangled in fishing line. It was caught and released by the ranger. Whistling Kites *Haliastur sphenurus* were recorded on 12 (43%) surveys in numbers of up to ten.

CONCLUDING REMARKS

WCL are a cultural, recreational and environmental asset to the Port Stephens/ Newcastle area and in the broader sense to NSW. From a regional and state perspective they are important to a small number of bird species which have specialised habitat requirements. These include shorebirds which feed on ocean beaches such as the Double-banded and Red-capped Plovers and the Australian Pied Oystercatcher, the latter two species breeding. The extensive dune system also provides breeding habitat for Little Terns and White-fronted Chats, both listed as threatened species in NSW and having limited distribution in the Hunter Region. Little Terns have attempted to breed every season between 2009 and 2013, but success has been limited. These ground-nesting species are vulnerable to hazards such as disturbance from vehicles, unleashed domestic dogs, horses, predation by Australian Raven and Gull-billed Tern. These anthropogenic causes of breeding failure are incremental to losses associated with natural causes such as the destruction of nests as a result of very high tides. Vulnerability extends through the period of egg incubation and continues after hatching until the chicks can fly. Flightless young are fed on the ground in a beach and dune system with limited vegetative cover to hide chicks. In the case of the Australian Pied Oystercatcher this total period of vulnerability is almost three months, which is exceptionally long compared with most other shorebird species because of their diet of bivalves which requires feeding techniques beyond the capability of chicks. Oystercatchers are the only shorebirds which feed their hatchlings.

The Little Tern, apparently a recent colonist, tends to breed in colonies in one area which simplifies the task of providing protection. Park staff respond rapidly to breeding events constructing temporary perimeter barriers and signage to prevent access and disturbance. Management is required to improve breeding success. Fortunately the terns have bred on higher ground well above the tidal zone. If current strategies for site selection continue they are unlikely to suffer inundation by high tides. In contrast the oystercatchers are highly territorial and their nest sites are both dispersed and difficult to find and hence to protect.

Intuitively a large length of undeveloped coastline like WCL would be expected to support a much larger population of breeding shorebirds like Australian Pied Oystercatchers. In north-eastern Tasmania Woehler & Ruoppolo (2014) located 460 Australian Pied Oystercatcher nests and territories during surveys in 2012/13 on just over 300 km involving 65 beaches (i.e. 1.5 breeding pairs/km compared with a maximum of five territorial pairs on 25.5km of beach at WCL). In the absence of baseline data it is impossible to determine the extent to which disturbance from recreational and commercial use is limiting WCL from reaching its full potential to support these species.

Continued good management is essential to preventing further damage to the WCL landscape such as around the swales behind the frontal dune where bird species are often found and in protecting nest sites. However unless vehicular usage during peak holidays is redirected impacts to the breeding success of beach-nesting species will likely continue. Provision of artificial chick shelters would have the dual advantage of decreasing the risk of loss to avian predators like

Australian Ravens and Gull-billed Terns and of attracting chicks to areas which could be fenced off and protected. Their beneficial use by Pied Oystercatchers has been demonstrated on beaches in northern NSW (Bob Moffat pers. comm. to MN). Elsewhere it has been concluded that it may be necessary to make permanent or temporary closures of the beach front or parts of it to successfully address this issue (Weston *et al.* 2014).

NPWS have allocated increased resources to continue the surveys on a monthly basis.

ACKNOWLEDGEMENTS

We wish to thank Warren Mayers of the NSW NPWS for his enthusiastic facilitation of the initial stages of this project. Those present will always remember his heroic rescue of the White-bellied Sea-Eagle entwined in fishing line. In the latter stages AL and MN were privileged to be accompanied by Nadine Russell and Robyn George. Nadine is a member of the Worimi people and through this interaction we obtained a better understanding of their culture. They are proud custodians of WCL with a deep concern for the sustainability of its wildlife values. We thank the Worimi for allowing us to undertake this study and NSW NPWS for logistic support and encouragement. We are indebted to Dick Cooper for his release of information on the distribution and movements of the Gull-billed Tern in advance of the publication of volume 2 of the NSW Bird Atlas. Harold Tarrant and Steven Cox are thanked for helpful comments.

The views expressed are those of the authors and not necessarily those of the NSW NPWS.

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APPENDIX

Summary of Worimi Conservation Lands Survey Results

Species	Scientific Name	No. of Counts	RR (%)	Mean	Maximum
Australian Wood Duck	*Chenonetta jubata*	1	4	4	4
Pacific Black Duck	*Anas superciliosa*	1	4	3	3
Hardhead	*Aythya australis*	1	4	25	25
Great Crested Grebe	*Podiceps cristatus*	1	4	1	1
White-throated Needletail	*Hirundaps caudacutus*	1	4	50	50
Black-browed Albatross*	*Thalassarche melanophris*				
Cape Petrel*	*Daption capense*				
Wedge-tailed Shearwater*	*Ardenna pacificus*				
Short-tailed Shearwater*	*Ardenna tenuirostris*				
Fluttering Shearwater*	*Puffinus gavia*				
Australasian Gannet*	*Morus serrator*				
Great Cormorant	*Phalacrocorax carbo*	2	7	5	9
Little Black Cormorant	*Phalacrocorax sulcirostris*	1	4	7	7
Pied Cormorant	*Phalacrocorax varius*	7	25	3	10
Australian Pelican	*Pelecanus conspicillatus*	1	4	1	1
White-necked Heron	*Ardea pacifica*	1	4	1	1
Great Egret	*Ardea alba*	1	4	2	2
White-faced Heron	*Egretta novaehollandiae*	5	18	2	2
Straw-necked Ibis	*Threskiornis spinicollis*	1	4	1	1
Osprey	*Pandion haliaetus*	1	4	1	1
Black-shouldered Kite	*Elanus axillaris*	2	7	1	1
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	24	86	4	12
Whistling Kite	*Haliastur sphenurus*	12	43	3	10
Swamp Harrier	*Circus approximans*	1	4	2	2
Nankeen Kestrel	*Falco cenchroides*	10	36	1	2
Brown Falcon	*Falco berigora*	1	4	1	1
Australian Hobby	*Falco longipennis*	1	4	1	1
Australian Pied Oystercatcher	*Haematopus fuliginosus*	28	100	13	27
Black-winged Stilt	*Himantopus leucocephalus*	2	7	1	1
Red-necked Avocet	*Recurvirostra novaehollandiae*	1	4	30	30
Pacific Golden Plover	*Pluvialis fulva*	2	7	35	67
Grey Plover	*Pluvialis squatarola*	1	4	1	1
Red-capped Plover	*Charadrius ruficapillus*	25	89	17	37
Double-banded Plover	*Charadrius bicinctus*	19	68	65	137
Greater Sand Plover	*Charadrius leschenaultii*	1	4	1	1
Black-fronted Dotterel	*Elseyornis melanops*	6	21	4	12
Banded Lapwing	*Vanellus tricolor*	2	7	2	2
Masked Lapwing	*Vanellus miles*	6	21	2	3
Ruddy Turnstone	*Arenaria interpres*	3	11	2	4
Great Knot	*Calidris tenuirostris*	1	4	1	1
Red Knot	*Calidris canutus*	1	4	1	1
Sanderling	*Calidris alba*	2	7	2	3
Red-necked Stint	*Calidris ruficollis*	6	21	7	19
Sharp-tailed Sandpiper	*Calidris acuminata*	1	4	47	47
Curlew Sandpiper	*Calidris ferruginea*	2	7	2	2

Species	Scientific Name	No. of Counts	RR (%)	Mean	Maximum
Little Tern	*Sternula albifrons*	5	18	15	33
Gull-billed Tern	*Gelochelidon nilotica*	18	64	40	126
Caspian Tern	*Hydroprogne caspia*	1	4	1	1
Common Tern	*Sterna hirundo*	1	4	6	6
Crested Tern	*Thalasseus bergii*	26	93	37	234
Silver Gull	*Larus novaehollandiae*	27	96	127	500
Superb Fairy-wren	*Malurus cyaneus*	11	39	3	8
Little Wattlebird	*Anthochaera chrysoptera*	1	4	1	1
White-fronted Chat	*Epthianura albifrons*	19	68	5	16
Eastern Whipbird	*Psophodes olivaceus*	1	4	1	1
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	1	4	2	2
Grey Butcherbird	*Cracticus torquatus*	1	4	1	1
Australian Magpie	*Cracticus tibicen*	19	68	7	20
Willie Wagtail	*Rhipidura leucophrys*	5	18	4	13
Australian Raven	*Corvus coronoides*	28	100	23	53
Golden-headed Cisticola	*Cisticola exilis*	1	4	1	1
Australian Reed-Warbler	*Acrocephalus australis*	1	4	1	1
Welcome Swallow	*Hirundo neoxena*	14	50	18	74
Common Starling	*Sturnus vulgaris*	7	25	22	52
Australian Pipit	*Anthus novaeseelandiae*	25	89	4	16

* Incidental observations; not sufficiently systematic for quantitative analysis.

In addition to sightings during the surveys, the following observations were made by NPWS staff:

Species	Scientific name	Observations
White-faced Storm-Petrel	*Pelagodroma marina*	
Light-mantled Sooty Albatross	*Phoebetria palpebrata*	
Northern Giant-Petrel	*Macronectes halli*	
Arctic Jaeger	*Stercorarius parasiticus*	
Kelp Gull	*Larus dominicanus*	
Red-necked Avocet	*Recurvirostra novaehollandiae*	6 in August 2011
Pacific Golden Plover	*Pluvialis fulva*	2 in October 2010
Bar-tailed Godwit	*Limosa lapponica*	4 in September 2011

Fairy Martin – is it declining in the Hunter?

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Anecdotal, qualitative and quantitative information all point to a possible decline of the Fairy Martin *Petrochelidon ariel* in the Hunter Region. This decline involved abandoned breeding colonies as well as a decline in frequency and range of occurrence between 1998 and 2008, with only partial subsequent recovery. The species is now primarily found breeding colonially near large expanses of open water. Possible causes of decline within the Hunter Region included the adverse impact of dry conditions on insect prey populations, increased predation at some nest sites and changes in habitat quality.

INTRODUCTION

The appearance of a new species either nationally, regionally, or just in backyards, is greeted with excitement by birdwatchers. In contrast, common species in decline often go unnoticed. Other than for regularly monitored species, like shore- and water-birds, initial realisation that a species may be "in trouble" is often subjective, unquantified and reliant on anecdotal evidence. In the Hunter Region Fairy Martin *Petrochelidon ariel* is an example; the authors realised during monthly surveys at the Morpeth Wastewater Treatment Works (MWTW) that they were seeing it less often and in much smaller numbers than formerly. In addition it had deserted several historical breeding colonies. Fortunately, some quantitative evidence was available to test our perceptions as discussed in this note.

The Fairy Martin is widely distributed in eastern Australia, but is vagrant to Tasmania. Birds are found in all seasons, but occurrence is less frequent in winter in south-eastern Australia, indicating a partial migration north after the breeding season (Barrett *et al.* 2003). In the Hunter Region the Fairy Martin's status is that of a breeding summer migrant regularly recorded as flocks of up to 20 birds from early August to mid-March with small numbers of birds remaining over winter (Stuart 1994 - 2013).

METHODS

Hunter Region records of the Fairy Martin were extracted from BirdLife Australia's Birdata archive involving records submitted by bird watchers carrying out Atlas and bird monitoring surveys. The following analysis is based on all records submitted to Birdata at May 2014. Annual Reporting Rates of Fairy Martins were calculated using all surveys in 10-minute grids for which a Fairy Martin had been recorded at least once between 1998 and 2014. Records were also obtained from the Hunter Bird Observers Club (HBOC) Annual Bird Report Series (Stuart 1994 - 2013). Incidental and anecdotal information was sought by direct approaches to people known to regularly frequent key Fairy Martin habitat.

RESULTS

BirdLife Australia's Atlas project archive Birdata contains a comprehensive inventory of Fairy Martin records in the Hunter Region for the period 1998 - 2013. During that period there were 786 Fairy Martin survey records, 711 from area surveys, and 75 from 2ha-20 minute surveys, and 15 incidental records.

Distribution

Fairy Martin Birdata records were widely distributed from across the Hunter Region, with records from 48% of the 151 ten-minute grids which comprise the area. The distribution of the records is shown in **Figure 1** which indicates a considerably decreased range for the period 2010 - 2013 compared with 1998 - 2009. The contraction of range mostly occurred in the north of the Region and in coastal areas north of Newcastle. For the period 2010 - 2013 Fairy Martins were recorded in 2013 in a disproportionate number of grids, particularly in the north, suggesting a partial recovery in Hunter Region range in that year.

The apparent decline in range should be treated with caution because the behaviour of observers contributing to the Atlas and bird monitoring projects changed (e.g. different survey site locations and number of surveys) over the 16-year period of data collection. For instance between 1998 and 2002, during the active phase of the New Atlas (Barrett *et al.* 2003), there was a high level of survey effort aimed at mapping bird distributions throughout the Region. With the subsequent focus on monitoring changes in the status of bird populations, there has been an increased emphasis on repeat surveys at the same site and less broad coverage of the region.

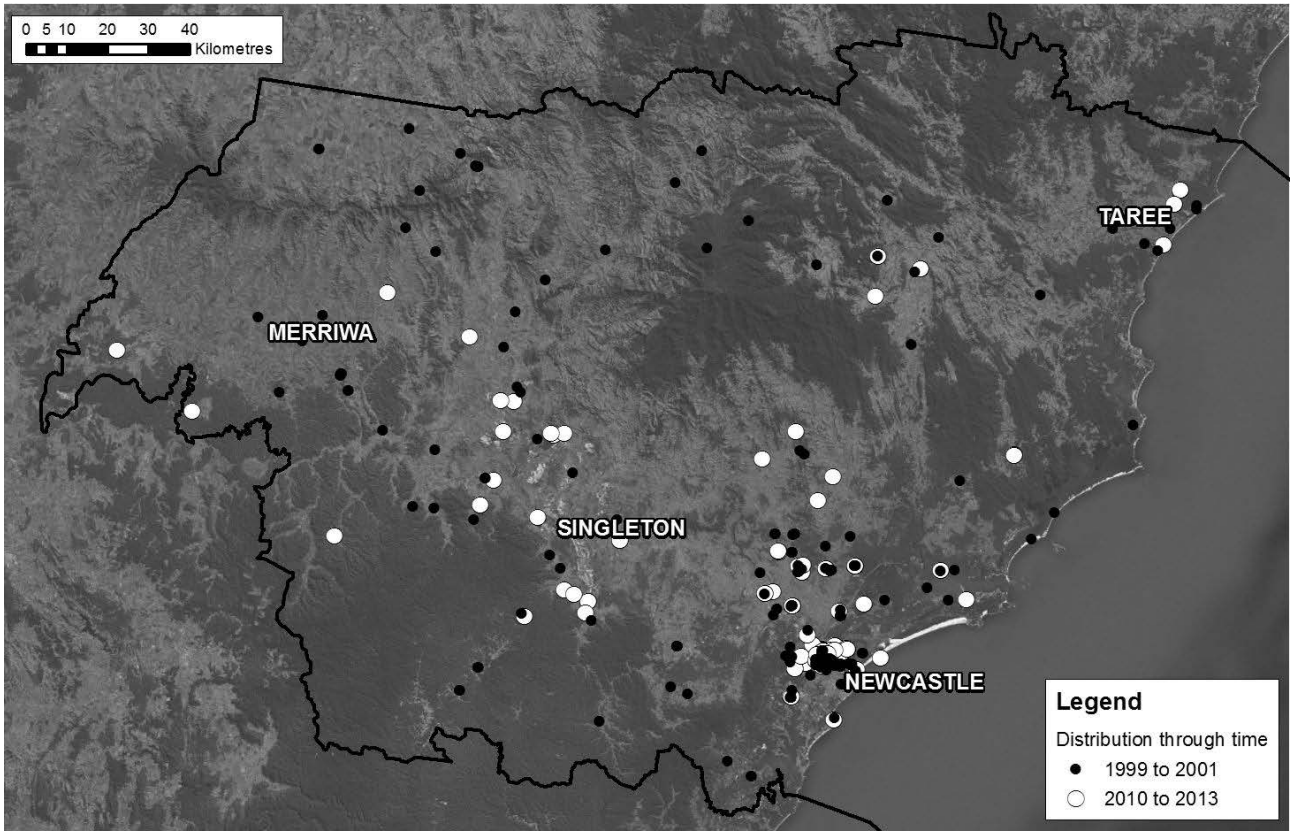

Figure 1. Distribution of Fairy Martins in Hunter Region of NSW based on all survey and incidental records submitted to BirdLife Australia's Birdata archive for the period 1998 – 2013 showing a contraction in range during the study.

Reporting Rates Trends

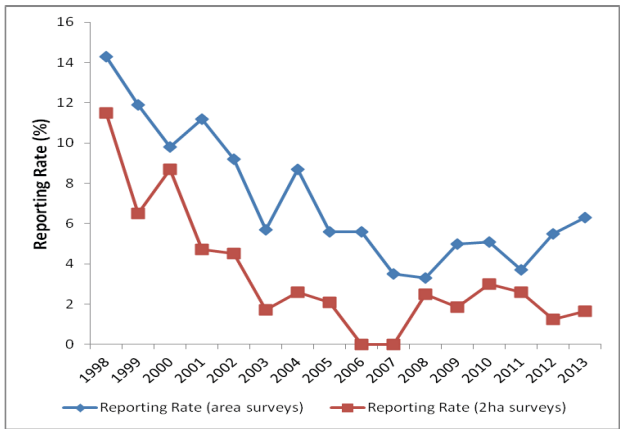

Figure 2. Variation in Reporting Rate of Fairy Martins in the Hunter Region (1998 - 2013) based on records submitted to the BirdLife Australia Birdata (n=711 for area surveys; n=75 for 2ha-20 minute surveys).

The trends in annual reporting rates (the frequency martins were recorded) are shown in **Figure 2**. For both survey types trends were similar, with an extended period of decline during the first ten years, followed by a modest recovery during the last five years of the period. Calculation of annual reporting rates corrects for variations in survey effort, but not for variations in the spread of survey sites. We place greater reliance on the area survey data because it involves more Fairy Martin records (n=711), gathered from a wider area of the Hunter Region than the 2ha-20-minute surveys (n=75) (44% as opposed to 17% of the 151 grids comprising the Hunter Region). The higher reporting rate for the area surveys reflects the increased survey effort (i.e. areas surveyed are typically larger than 2ha and survey duration longer than 20 minutes). The mean annual

reporting rate for area surveys for the period 2010 - 2013 was 50% lower than for the 1998 - 2009 period while the mean annual reporting rate for 2ha-20-minute surveys was 59% lower than the 1998 - 2009 period. The correspondence between the trends for the two types of survey adds confidence to the validity of the decline. However, as the comparisons do not involve replicated surveys (e.g. comparisons involving the same survey sites in identical seasons during the two periods) we looked for supporting evidence. Our monthly surveys at the MWTW between 2001 and 2013, where we estimated the number of martins present (**Figure 3**), provided evidence supporting the **Figure 2** trends. In the first two years of that study (2001 and 2002) large numbers of Fairy Martins were seen, often lining the wires of fence lines in association with Tree Martins *Petrochelidon nigricans* and Welcome Swallows *Hirundo neoxena*. These flocks mostly occurred in late summer and autumn, involving northward migration at the end of the breeding season. During the subsequent 11 years similar numbers were seen only in 2010, supporting our subjective conclusion that the species had become less common at MWTW and other areas like Pambalong Nature Reserve where we used to see similar accumulations of the species.

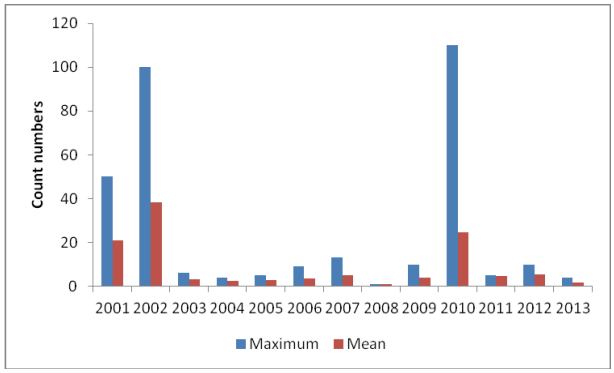

Figure 3. Variations in the maximum and mean numbers of Fairy Martins recorded during monthly counts at the Morpeth Wastewater Treatment Works near Maitland, NSW.

Breeding

It is more difficult to ascertain the extent to which breeding has declined. However, the following instances provide a basis for concern. Fairy Martins breed communally, attaching their clusters of bottle-shaped nests to an overhanging surface, often using the concrete culverts under roads and the eaves of buildings as sites. Perhaps the example best known to Hunter Bird Observers Club members is the colony which nested at the Hunter Wetlands Centre (HWC) under the eaves of the building used to hold club meetings. This colony was deserted in 2001, when the nests were destroyed during building maintenance. Nest destruction does not necessarily cause desertion of a breeding location as evidenced by the Singleton experience described below.

Fairy Martins attempted to breed on the east side of Hexham Swamp each year between 2008/09 and 2012/13. Typically the peak numbers of martins present ranged from 50 to 150, with between 12 and 90 nests recorded annually. Interest in old nests commenced as early as August with peak breeding activity in October 2011 when a total of 90 nests were spread across four locations. However, following heavy rain all breeding activity had ceased by late November. In other years nesting activity continued into January. The two most frequently used nest sites were a railway signal box and under the eaves of an unoccupied house on the edge of the swamp.

During the 1990s there were two breeding colonies, approximately 1km apart, in the Woodville-Butterwick area near Paterson, both in culverts under Butterwick Road and Glenurie Close. For two years the latter colony deserted the culvert and nested under the eaves of an adjacent house. It was suspected that predation by feral cats may have driven the shift from nesting in the culvert to the eaves. Subsequently, both colonies were deserted and Fairy Martins have been scarce in the area with no evidence of breeding during the last decade. The precise date the colonies were deserted was not recorded. No colonies are currently known in the broader Paterson area, including the Tocal Homestead (Cameron Archer pers. comm.), where the combination of extensive ponds and old buildings might be expected to provide ideal breeding opportunities.

Grant Brosie's "big year" focus on the Maitland Local Government Area (LGA) in 2013 involved sampling bird habitat throughout the area in order to obtain a comprehensive inventory of the local bird population. He found only one active colony at Oakhampton and one apparently abandoned Fairy Martin colony at Dagworth Road, Louth Park. In addition about 15-20 birds were flying into a culvert at Brush Road, Raworth; unfortunately the culvert was on private land and could not be inspected. Clearly the extent to which Fairy Martins currently breed in the Maitland LGA is limited.

In the Singleton area two colonies were visited on 4 February 2014. At the colony in John Street comprising 75 – 80 nests, around 25 martins were present, including activity at two nests. This colony, on an old brick building, has been used persistently in recent years, despite the nests being removed on at least two occasions. It is approximately 400m from the nearest permanent water, the Hunter River. The other colony at the Singleton Wastewater Treatment Works (WTW) involved approximately 50 nests, many in good condition. Despite many martins being present at the site and nearby locations, no activity at the nests was observed. However, these observations relate to the end of the season and no conclusions can be drawn about the extent of breeding activity and success at either site earlier in the 2013/14 season.

In 2002 substantial numbers of Fairy Martins were nesting under the culvert on the East Bucketts Way at Gloucester, where it crosses the Avon River and its drainage channels. In October 2004 floods washed out the nests and the martins deserted the colony. In 2013/14 searches for breeding colonies were unsuccessful, although a small number of Fairy Martins was recorded entering the culvert where Avon Valley Road crosses Oakey Creek, but there was no evidence of breeding.

Incidental Records and Anecdotal Information

We also examined the Fairy Martin species accounts in the Hunter Bird Observers Club Annual Bird Report series for the period 1993 – 2012. There was a general decrease in the number and size of Fairy Martin flocks reported, with the exception of regularly watched areas with sizable expanses of open water like Hexham Swamp, Ash Island, Morpeth and Singleton WTW. Similarly, there was a decrease in the number of locations for which breeding was recorded. These qualitative indications are consistent with the trends shown in **Figures 1** and **2**.

Long-term resident Peter Alexander's subjective opinion is that the Fairy Martin has become less numerous in the Singleton area over the past decade, despite the continued occupancy of colonies.

DISCUSSION

The primary purpose of this short note is to highlight the possibility that the Fairy Martin has declined in the Hunter Region. The evidence presented above comprises five categories:

1. Abandonment of a number of breeding colonies.

2. Decreased occurrence of large flocks at Morpeth WTW between 2003 and 2013 (**Figure 3**).

3. A decline in the reporting of Fairy Martins during bird surveys between 2000 and 2006, followed by a partial recovery between 2009 and 2013 (**Figure 2**).

4. Decreased range of occurrence in the Hunter Region (**Figure 1**).

5. Anecdotal evidence based on opinions of experienced bird watchers.

The five categories, listed above in order of decreasing strength of evidence, all suggest that the status of the Fairy Martin has declined in the Hunter Region. While it may be argued that the trends shown in **Figures 1** to **3** may all be influenced by sampling factors, it is an indisputable fact that a number of breeding colonies have been abandoned. The strength of the evidence for reporting rate trends and Morpeth WTW numbers is considered relatively strong, although possibly exaggerated by changes in observer behaviour in the former case. For instance, reporting rates are corrected for variations in number of surveys conducted annually, but not for variations in the locations and habitat surveyed. At Morpeth WTW there is the risk that monthly surveys missed the peak build-up of martins on migration in some years, but it is unlikely this occurred in 10 years out of 11. Of greater concern is the possibility that the spread of survey effort across the Hunter Region decreased after 1998 - 2002 when the New Atlas project finished, biasing the observed change in distribution (**Figure 1**) and conclusions on the extent of decreased range should be treated with caution.

Causes of decline may involve ecological factors both within and external to the Hunter Region. However, we suggest the selective abandonment of breeding colonies in the Hunter is probably associated with local environmental conditions, although the possibility of extensive mortality during winter months, when most martins have

departed to areas north of the Hunter, cannot be discounted. The decline in the size of flocks at the end of the season may involve birds moving north from areas to the south of the Hunter Region.
It is difficult and beyond the scope of this paper to attribute specific causes to the proposed decline. Within the Hunter Region candidate factors include the influence of climatic conditions on food availability, changes in the habitat of areas supporting martins and predation at breeding colonies.

Fairy Martins are insectivorous aerial feeders for which hot dry conditions may limit food availability (Mike Tarburton pers. comm.). In this respect it may be significant that the declining Reporting Rate (RR) values (**Figure 2**) coincided with the period 2000 - 2006 during which climatic conditions persistently involved below long-term mean rainfall in the Paterson area (central Hunter Valley) with 2003 and 2006 exceedingly dry years in much of the Hunter Region. The partial recovery in RR values did not occur until 2009 after wetter conditions returned in 2007. For the Grey Fantail *Rhipidura fuliginosa,* another insectivorous species, similar trends in Hunter Region observation rates correlated with annual rainfall lagged by two years (Newman 2012). This suggests the size of bird populations follows the decline and build-up of the abundance of prey and explains the delayed recovery of martin populations until 2009. We tentatively suggest the impact of dry conditions will be most marked away from large areas of permanent water leading to the abandonment of colonies in drier areas; particularly culverts over dry creeks in open country.

Many nest sites used by Fairy Martins have anthropogenic origins, indeed artificial structures including the eaves of buildings, bridges and culverts under roads are more commonly reported than natural sites like cliff overhangs and caves (see breeding section above). It is possible that changes in the design and maintenance of man-made structures have decreased the availability of elevated nest sites like the eaves of buildings, forcing the use of sites near ground level like culverts, where the risk of predation is higher. Ongoing increases in rural development will have exacerbated the situation in terms of increased densities of predators, such as feral cats, possibly leading to the widespread demise of colonies nesting close to the ground in culverts.
Wastewater treatment works like Morpeth have been upgraded to tertiary treatment during the past two decades. This may have decreased nutrient levels in holding ponds and outflows into ephemeral wetlands, with a potential negative impact on insect populations.

Colonial breeding species like Fairy Martin tend to be less uniformly distributed across the landscape than species which breed as isolated pairs. Hence decline involving the loss of a breeding colony may cause a local extinction as opposed to a decrease in abundance of a species. On this basis the range of colonial breeding species might be a very sensitive indicator of the regional status of a species and the trends shown in **Figures 1** and **2** may be valid. If so, this poses the intriguing question as to what factors trigger recolonisation or the formation of new colonies. As food availability and breeding success at existing colonies improves, does the population increase to a level where there is excess capacity causing sub-groups to split off and seek new breeding opportunities, possibly at sub-optimal locations which are only suitable for limited periods of time?

CONCLUSIONS

In this paper we have presented anecdotal, qualitative and quantitative evidence pointing to a possible decline of Fairy Martin in the Hunter Region. Changes in the status of bird populations are dynamic and the trend hopefully will be reversed. Indeed, there was some evidence of recovery between 2009 and 2013, particularly in 2013. The question is how do we measure future change? The publication of this paper may increase observer awareness of Fairy Martins resulting in an increased number of incidental reports and compounding the difficulty of drawing conclusions about changes in status from the "highlight" information recorded in the Hunter Region Annual Bird Report series, where the material submitted is highly selective (e.g. only observations involving >20 birds recorded). We suggest the best approach is for a small number of regional observers to provide an annual inventory of breeding colonies within areas immediately surrounding their homes, as occurred in Grant Brosie's study of the Maitland LGA during 2013. This will allow testing of one of our tentative explanations of the cause of decline, namely that under drier conditions the distribution of colonies contracts to areas near large expanses of permanent water, hopefully expanding back and recolonising drier locations when favourable conditions return. The fact that Fairy Martins nest colonially is highly

advantageous to monitoring in that the flocks of birds around breeding colonies are obvious and breeding activity is limited to a few locations. There is also the question of whether the size of pre-migratory flocks has changed. Just posing this question illustrates how little we know about this phenomenon; how stable are these flocks and for how long do they congregate in areas like Morpeth WTW? Again this is an opportunity for further bird study.

Tarburton (2014) has described evidence for a marked decline in the status of the White-throated Needletail *Hirundapus caudacutus* in Australia. This species is a non-breeding migrant to Australia. The most probable single cause of decline was considered to be the destruction of the Siberian forests, where a large portion of the Australian population of needletails needs old trees with hollows in which to breed. Tarburton considers there is an urgent need for further research into the population and conservation status of this species. The findings of this paper may highlight the need for similar broad-scale analysis of the status of the Fairy Martin in Australia, assuming trends in the Hunter are widespread.

ACKNOWLEDGEMENTS

The authors thank numerous members of the Hunter Bird Observers Club for providing their records and recollections of Fairy Martins in the Hunter Region, particularly Peter Alexander (Singleton), Grant Brosie (Maitland) and Penny Drake-Brockman (Gloucester) who made specific searches for active breeding colonies in their local areas. Mike Tarburton is thanked for insights into his specialty; the behaviour of insectivorous birds of the sky. Alan Stuart and Harold Tarrant are thanked for comments on the interpretation of the decline. As always in articles of this type access to the wealth of knowledge contained in BirdLife Australia's Birdata archive is invaluable; we thank Andrew Silcocks, Alan Stuart, Ian Martin, Peter Struik and Dan Williams for their contributions to presenting the data in a manner which allows critical analysis and publication.

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Birds of the Black Rock area near Martins Creek in the Hunter Valley (1999-2013)

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This paper demonstrates how keeping bird lists during loosely structured walks in the foothills near Paterson in the Hunter Valley over a 15-year period provided a valuable record of the local bird population. 124 species were recorded, primarily woodland and open country species. Seasonal and long-term annual trends in occurrence are discussed. The area contains pockets of habitat suitable for species like the Double-barred Finch and Speckled Warbler which are becoming scarce in the Paterson area. Swift Parrots occurred occasionally and Rainbow Bee-eaters in late summer.

INTRODUCTION

The Black Rock area near Martins Creek supports many of the open country and woodland birds found in the Paterson area of the Hunter Valley in NSW. Over a 15-year period I made regular visits to the area and accumulated an inventory of the bird population. This paper discusses the composition of the diverse bird population of the area.

Sightings of Swift Parrots, a threatened species, were the motivation for initiating long-term monitoring involving periodic visits to the area, particularly during winter months.

METHODS

I walked up Black Rock Road from the junction with Barford Lane to the junction with Fitness's Road, a distance of 1.5km. During the first km the road passes through cleared farmland with a few dwellings and three small dams. In this stretch roadside vegetation, including mature trees, provided important bird habitat. Over the next 0.5km the road climbed through an unfenced area, where there was a variety of woodland, grassland and wet gully habitats. I then walked approximately 0.5km to the crest of Fitness's Road (~100m ASL), before descending through privately owned open woodland to the continuation of Black Rock Road approximately 0.5km beyond the Fitness's Road junction. The return journey to Barford Lane initially passes through a stand of mature eucalypt woodland. Two dams in this area and leakage from a reservoir tank (now repaired) provided permanent water in this segment. The total distance walked was approximately 5km. The area is shown in **Figure 1**.

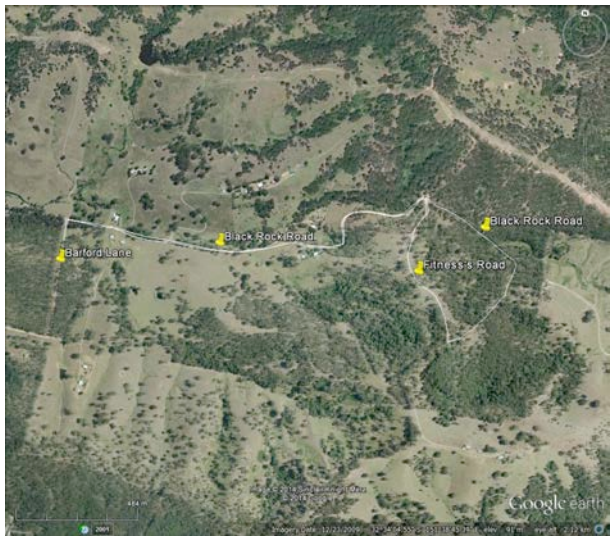

Figure 1. Survey route in Black Rock area.

Visits were made in the morning and typically involved 2 to 3 hours. A bird list, based on species seen and heard during each visit, was submitted to the BirdLife Australia (BLA) Birdata archive as a 5km survey (site ID 97476) centred on 32.568S 151.649E. While rigid survey protocols were not used the visits were conducted following the same route enabling meaningful comparisons of the frequency of occurrence of different species.

Reporting rates (RR), the frequency a species occurred during the visits, were used to indicate the relative abundance of bird species. For instance, an experienced bird observer would have a 90% chance of seeing or hearing a species with a 90% RR during a visit to the Black Rock area.

However, the seasonal timing of visits was not structured, complicating the interpretation of trends in seasonal and long-term annual occurrence.

To assist the interpretation of results, RRs in this study were compared with those for the Hunter Region extracted from Birdata for the almost identical period 1998-2012. The results in this study, submitted as 5km radius surveys, were compared with the combined 500m and 5km radius survey data submitted to Birdata.

RESULTS

Between 1999 and 2013, 104 visits were made to the study area. The number of surveys, mean list lengths, mean number of species recorded for each of the three-year periods of the study (five in total), and the ratio of summer/winter surveys are shown in **Table 1**. The highest intensity of observation was during the first three years (1999-2000). Species diversity was greatest at the beginning (49.3 and 48.6 species/visit) and during the last three years (46.5 species/visit).

One hundred and twenty four species were recorded, some regularly and others on just a few or even a single occasion. The full species list in taxonomic order is contained in **Appendix 1**, with a break-down of RRs for successive three-year periods. The results presented below and the ensuing discussion are primarily concerned with birds which occurred regularly.

Very Common Species (RR >80%)

Approximately one fifth of the species were in this category (**Table 2**), including 23 with a RR > 80%. Two summer migrants, White-throated Gerygone *Gerygone albogularis* RR 48.1% and Rufous Whistler *Pachycephala rufiventris* RR 44.2% were accorded very common status for the summer period, although there were several interesting records of the former species involving late departures and early arrival. The mean ratio of RR (%) in this study compared to the whole Hunter Region was 3.3, with two species Yellow-tufted Honeyeater *Lichenostomus melanops* and Jacky Winter *Microeca fascinans* at least double the mean ratio.

Table 1. Summary of visits, mean list length and number of bird species recorded during visits to the Black Rock area near Martins Creek between 1999 and 2013.

	1999/2001	2002/2004	2005/2007	2008/2010	2011/2013	1999/2013
Number of surveys	35	19	13	15	22	104
Mean list length	49.3	48.6	46.0	41.6	46.5	47.1
Number of species recorded	122	119	96	87	100	124
Summer/winter survey ratio*	1.3	1.4	0.9	0.7	1.0	1.1

*Summer defined as September to February, the main period when summer migrants are present.

Table 2. Very commonly recorded species (RR>80%)

Common Name	Scientific Name	RR (%) This study	RR (%) Hunter Region	RR Ratio Black Rock/Hunter
Superb Fairy-wren	*Malurus cyaneus*	100	49.4	2.0
Yellow-faced Honeyeater	*Lichenostomus chrysops*	99.0	38.1	2.6
Lewin's Honeyeater	*Meliphaga lewinii*	98.1	30.1	3.3
Australian Magpie	*Cracticus tibicen*	98.1	58.4	1.7
Grey Fantail	*Rhipidura albiscapa*	97.1	45.5	2.1
Eastern Rosella	*Platycercus eximius*	96.2	42.7	2.3
Spotted Pardalote	*Pardalotus punctatus*	95.2	26	3.7
Eastern Whipbird	*Psophodes olivaceus*	95.2	29.7	3.2
Noisy Miner	*Manorina melanocephala*	94.2	35.4	2.7
Australian Raven	*Corvus coronoides*	93.3	45	2.1
Laughing Kookaburra	*Dacelo novaeguineae*	92.3	44.1	2.1

Table 2. Very commonly recorded species (RR>80%) continued

Common Name	Scientific Name	RR (%) This study	RR (%) Hunter Region	RR Ratio Black Rock/Hunter
Grey Shrike-thrush	*Colluricincla harmonica*	92.3	29.4	3.1
Jacky Winter	*Microeca fascinans*	90.4	12.5	7.2
Masked Lapwing	*Vanellus miles*	89.4	47.2	1.9
Willie Wagtail	*Rhipidura leucophrys*	89.4	46.1	1.9
White-browed Scrubwren	*Sericornis frontalis*	88.5	26.9	3.3
Striated Pardalote	*Pardalotus striatus*	86.5	17.1	5.1
Australian Wood Duck	*Chenonetta jubata*	85.6	30.7	2.8
Red Wattlebird	*Anthochaera carunculata*	85.6	20.1	4.3
Pied Butcherbird	*Cracticus nigrogularis*	85.6	29.4	2.9
Welcome Swallow	*Hirundo neoxena*	85.6	43.9	1.9
Yellow-tufted Honeyeater	*Lichenostomus melanops*	81.7	7.3	11.2
Eastern Spinebill	*Acanthorhynchus tenuirostris*	80.8	25.7	3.1
White-throated Gerygone*	*Gerygone albogularis*	48.1	12.5	3.8
Rufous Whistler*	*Pachycephala rufiventris*	44.2	20	2.2

*Summer Visitor

Commonly recorded species (RR 40 to 79%)

Just over 25% of all the species recorded fell in this category, with 29 having a RR in the range 40 to 79%. If their RR values are doubled, three summer migrants also merit inclusion; Sacred Kingfisher *Todiramphus sanctus* 22.1%, Channel-billed Cuckoo *Scythrops novaehollandiae* 21.2% and Dollarbird *Eurystomus orientalis* 20.2%. Variations in the RR ratio indicated several species with disproportionately high values (e.g. Wonga Pigeon *Leucosarcia picata* 6.4 and Double-barred Finch *Taeniopygia bichenovii* 5.6) as well as species with abnormally low values (e.g. Brown Thornbill *Acanthiza apicalis* 1.8) compared with the average of 3.1 for this group of species (**Table 3**).

Table 3. Commonly recorded species (RR 40 to 79%)

Common Name	Scientific Name	RR (%) This study	RR (%) Hunter Region	RR Ratio Black Rock/Hunter
Eastern Yellow Robin	*Eopsaltria australis*	79.8	28	2.9
Magpie-lark	*Grallina cyanoleuca*	78.8	47	1.7
Red-browed Finch	*Neochmia temporalis*	78.8	32.5	2.4
Crested Pigeon	*Ocyphaps lophotes*	77.9	30.4	2.6
Golden Whistler	*Pachycephala pectoralis*	76.9	28.4	2.7
Dusky Moorhen	*Gallinula tenebrosa*	75	17.7	4.2
Grey Butcherbird	*Cracticus torquatus*	74	31.3	2.4
Bar-shouldered Dove	*Geopelia humeralis*	71.2	20.7	3.4
Yellow Thornbill	*Acanthiza nana*	70.2	26.7	2.6
Striated Thornbill	*Acanthiza lineata*	68.3	13.8	4.9
Pied Currawong	*Strepera graculina*	67.3	15.5	4.3
Wonga Pigeon	*Leucosarcia picata*	66.3	10.3	6.4
Satin Bowerbird	*Ptilonorhynchus violaceus*	66.3	19	3.5
Silvereye	*Zosterops lateralis*	66.3	29.3	2.3
Variegated Fairy-wren	*Malurus lamberti*	63.5	16.7	3.8
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	63.5	36.1	1.8
Australian King-Parrot	*Alisterus scapularis*	59.6	17.9	3.3

Table 3. Commonly recorded species (RR 40 to 79%) continued.

Common Name	Scientific Name	RR (%) This study	RR (%) Hunter Region	RR Ratio Black Rock/Hunter
Brown Thornbill	*Acanthiza apicalis*	53.8	30.6	1.8
White-naped Honeyeater	*Melithreptus lunatus*	53.8	10.9	4.9
Mistletoebird	*Dicaeum hirundinaceum*	52.9	11.8	4.5
Noisy Friarbird	*Philemon corniculatus*	49	23.4	2.1
Double-barred Finch	*Taeniopygia bichenovii*	49	8.7	5.6
Galah	*Eolophus roseicapillus*	48.1	32.5	1.5
Speckled Warbler	*Chthonicola sagittata*	46.2	14.4	3.2
Little Lorikeet	*Glossopsitta pusilla*	43.3	8.5	5.1
Crimson Rosella	*Platycercus elegans*	43.3	14	3.1
White-throated Treecreeper	*Cormobates leucophaea*	42.3	22.3	1.9
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	40.4	17.9	2.3
Olive-backed Oriole	*Oriolus sagittatus*	40.4	15.5	2.6
Sacred Kingfisher*	*Todiramphus sanctus*	22.1	15.6	1.4
Channel-billed Cuckoo*	*Scythrops novaehollandiae*	21.2	10.3	2.1
Dollarbird*	*Eurystomus orientalis*	20.2	13.7	1.5

*Summer visitor

Moderately common species (RR 20 to 39%)

Just over 15% of the species recorded fall into this category; with 12 species having a RR in the range 20 to 39%, and a further 6 summer migrants; Cicadabird *Coracina tenuirostris* 19.2%, Eastern Koel 19.2%, Black-faced Monarch 17.3%, Leaden Flycatcher *Myiagra rubecula* 16.3%, Rainbow Bee-eater *Merops ornatus* 13.5% and Rufous Fantail *Rhipidura rufifrons* 11.5% added. In this category there was one obvious change in status of a species, Bell Miners *Manorina melanophrys* colonising the gully at the junction of Black Rock and Fitness's Road during the last six years of the study. The White-bellied Cuckoo-shrike *Coracina papuensis* had a high RR ratio of 8.0 compared with an average of 2.6 for this group (**Table 4**). In contrast waterbirds had low values; White-faced Heron *Egretta novaehollandiae* 0.5 and Purple Swamphen *Porphyrio porphyrio* 0.9.

Table 4. Moderately commonly recorded species (RR 20 to 39%)

Common Name	Scientific Name	RR (%) This study	RR (%) Hunter Region	RR Ratio Black Rock/Hunter
Pacific Black Duck	*Anas superciliosa*	37.5	37.0	1.0
Cattle Egret	*Ardea intermedia*	36.5	20.1	1.8
Bell Miner	*Manorina melanophrys*	34.6	12.5	2.8
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	30.8	13.4	2.3
Scarlet Honeyeater	*Myzomela sanguinolenta*	27.9	11.4	2.4
Rainbow Lorikeet	*Trichoglossus haematodus*	26.9	22.1	1.2
Pheasant Coucal	*Centropus phasianinus*	25.0	9.1	2.7
White-bellied Cuckoo-shrike	*Coracina papuensis*	24.0	3.0	8.0
Buff-rumped Thornbill	*Acanthiza reguloides*	23.1	5.6	4.1
White-faced Heron	*Egretta novaehollandiae*	21.2	43.4	0.5
Varied Sittella	*Daphoenositta chrysoptera*	21.2	8.2	2.6
Purple Swamphen	*Porphyrio porphyrio*	20.2	23.3	0.9
Cicadabird*	*Coracina tenuirostris*	19.2	4.5	4.3
Eastern Koel*	*Eudynamys orientalis*	19.2	12.0	1.6
Black-faced Monarch*	*Monarcha melanopsis*	17.3	7.2	2.4
Leaden Flycatcher*	*Myiagra rubecula*	16.3	6.6	2.5
Rainbow Bee-eater*	*Merops ornatus*	13.5	3.9	3.5
Rufous Fantail*	*Rhipidura rufifrons*	11.5	7.3	1.6

*Summer visitor

Uncommon and occasional species (RR <20%)

The remaining 50 species fall into this category, and for 12 species there was only a single occurrence (see **Appendix**, where species are listed in descending order of reporting rate; i.e. uncommon and occasional species are last).

DISCUSSION

List length/survey was typically in the range 40 to 50 species throughout the 15 years' duration of the project (**Table 1**). In the following sections the more commonly observed species (RR>20%) are discussed in comparison with RR found throughout the Hunter Region. This approach allows species, for which the Black Rock area is a "hot spot", to be highlighted. Similarly, it identifies species which are under-represented at Black Rock. The ratio of RR values in this study compared to Birdata for the Hunter Region is typically 3 (**Tables 2** to **4**). This is a consequence of the greater survey effort in these surveys (i.e. a large area and diversity of habitat sampled over a longer period of time than in a typical Birdata survey).

Two factors contribute to very high RR values for resident species; species which are abundant and well distributed throughout the area and secondly the extent to which they advertise their presence. Consequently, variations in RR magnitudes between species may reflect differences in species detectability as well as absence. Large and highly vocal species are more easily detected than small skulking birds. Seasonal variations in vocal activity must also be taken into account as well as the unstructured timing of the surveys (see variations in summer to winter survey activity in **Table 1**).

Very common species (RR>80%)

Species in this category are mostly residents, seasonal in the case of migrants. For this group of birds (**Table 2**) variations in RR are mainly associated with differences in species abundance and detectability rather than their intermittent occurrence in the study area.

The Superb Fairy-wren *Malurus cyaneus* was the only species observed on every visit, closely followed by Yellow-faced Honeyeater *Lichenostomus chrysops*, Lewin's Honeyeater *Meliphaga lewinii*, Australian Magpie *Cracticus tibicen*, Grey Fantail *Rhipidura albiscapa*, Eastern Rosella *Platycercus eximius*, Spotted Pardalote *Pardalotus punctatus* and Eastern Whipbird *Psophodes olivaceus*. The mix of these species, individually favouring different habitats including open country, grassland, open forest and wet gullies, illustrates the variety of habitat in the Black Rock area. All had RRs >95% and are recognised to be common and widely distributed residents of the Hunter Region (Stuart 2013). All, except two, of the 23 resident species with RRs >80% fit this mould. Jacky Winter, although widespread in the Hunter Region, is considered a usual rather than a common resident and the Yellow-tufted Honeyeater is described as occasionally, but widely recorded in the Hunter Region (Stuart 2013). Both had abnormally high RR ratios (**Table 2**) compared with the mean ratio of 3.3 for this group of birds, suggesting that Black Rock provides specialised habitat for these species. Throughout the study a colony of Yellow-tufted Honeyeaters was located on Black Rock Road just beyond the junction with Fitness's Road. Towards the end of the study a colony of Bell Miners formed in an adjacent gully and this seemed to force the Yellow-tufted Honeyeaters to shift their foraging range into more open woodland.

Commonly recorded species (RR 40 to 79%)

All 29 non-migratory species in this category were recorded a number of times in each three-year period and in most cases RR varied little between years. Many of these species, particularly those with the higher RRs, are resident and just less abundant and more difficult to detect. However, there were indications that some species declined in the third period (2005-2007), only partially recovering subsequently (see variations in RR values for three-year periods in the **Appendix**). Examples include the Variegated Fairy-wren *Malurus lamberti* and Fan-tailed Cuckoo *Cacomantis flabelliformis*.

Species well represented at Black Rock compared with the rest of the Hunter Region, with a higher than mean RR ratio of 3.1 (**Table 3**), included Wonga Pigeon *Leucosarcia picata* 6.4, Double-barred Finch *Taeniopygia bichenovii* 5.6 and Little Lorikeet *Glossopsitta pusilla* 5.1. The Wonga Pigeon is frequently heard calling, but seldom seen. Black Rock is one of the areas near Paterson where the Double-barred Finch can be regularly located. It is usually found at the sides of Black Rock Road in the last km before the junction with Fitness's Road, in groups of up to 20 and was nest building there in November 2013. It has become

increasingly scarce in the Paterson area and has disappeared from the woodland at Green Wattle Creek during the last five years (Newman 2009 and unpublished information). The RR ratio comparison probably understates the importance of the occurrence of this species at Black Rock, which is near the eastern edge of its range in the Hunter Region. The Double-barred Finch is less abundant in the Paterson area than in core habitat to the west (Newman unpublished analysis of Birdata observations). Similar comment can be made concerning the Speckled Warbler *Chthonicola sagittata* (ratio 3.2), a threatened species discussed in a subsequent section. The Little Lorikeet is an example of a species which occurs intermittently in the area (Newman 2009), and is discussed in the section on threatened species.

A number of species in this group appear under-represented in the area based on the RR ratio. These include Sacred Kingfisher 1.4, Dollarbird 1.5, and Galah *Eolophus roseicapillus* 1.5, Magpie-lark *Grallina cyanoleuca* 1.7 and Brown Thornbill 1.8. Lack of nest sites may contribute to the scarcity of the Sacred Kingfisher, Dollarbird and Galah, a situation exacerbated by the ongoing clearing of trees in an area with limited nest hollows. The Magpie-lark and Brown Thornbill are more difficult to explain as both are easily detected, the former frequenting open areas and both having frequently used characteristic calls. There appears to be habitat suitable for both species.

The seasonal variation of RR for the Olive-backed Oriole *Oriolus sagittatus* (**Figure 2**) suggests it occurs less frequently between February and August. While this could indicate the partial movement of birds from the Black Rock area, an alternative explanation is that the species calls less frequently outside the breeding season and consequently is detected less. Some credence for the latter explanation is provided by increased detection during the May-June period, possibly associated with a late autumnal increase in song activity. However, the most plausible interpretation may involve a combination of both explanations. In Victoria Emison *et al.* (1987) found that Orioles were summer migrants with a few remaining in winter. However, although most birds did not leave until March or April reporting rates declined sharply after December, probably because after nesting the Orioles cease calling. The view that the Olive-backed Oriole is a partial migrant in the Hunter Region is supported by the results of the NSW Bird Atlas which indicate movements away from coastal areas during the winter months (Dick Cooper pers. comm.).

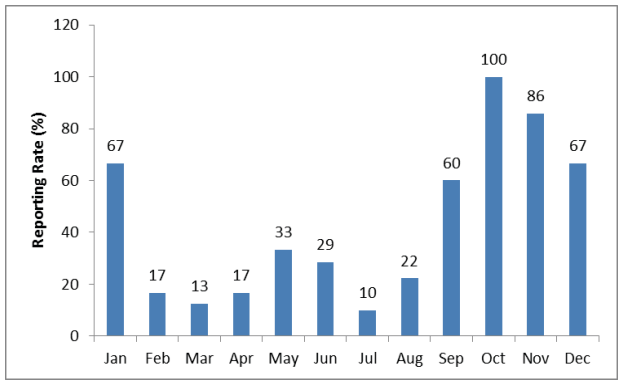

Figure 2. Seasonal variation in reporting rate of Olive-backed Orioles in the Black Rock area 1999-2012.

Moderately common species (RR 20 to 39%)

Species in this category are probably intermittently present. Exceptions include the Bell Miner, which since colonising the area, has been recorded on every survey and is currently a very common species (RR>80%). The Pheasant Coucal *Centropus phasianinus* is also probably permanently present, being primarily detected when calling during the breeding season and seldom seen. Like the Olive-backed Oriole it is almost certainly under-recorded outside the breeding season.

The White-bellied Cuckoo-shrike *Coracina papuensis*, with a RR ratio of 8 compared to a mean value of 2.6 for the other species in this category (**Table 4**), favours the woodland area on Black Rock Road beyond the Fitness's Road junction. The Buff-rumped Thornbill *Acanthiza reguloides* with a RR ratio of 4.2, while relatively frequently present at Black Rock, is generally scarce in the Paterson area. Like the Speckled Warbler and Double-barred Finch, it is near the eastern edge of its local distribution. The Cicadabird, ratio 4.3, is another species apparently suited to the area, however this may be a consequence of under-recording by observers not familiar with its call.

The occurrence of the Rainbow Bee-eater is fascinating; 13 of the 14 records occurred between 30 December and mid-March, when the species was usually seen hawking insects along Fitness's Road at the highest point in the study area (~100 m ASL). These records suggest a post-breeding dispersal to higher ground before the northern migration occurs. Bee-eaters breed along the banks

of the Paterson and Allyn Rivers. The single September record probably involved birds on southern passage.

Waterbirds are disadvantaged by the lack of suitable habitat; Purple Swamphens *Porphyrio porphyrio* (RR ratio 0.9) occurred intermittently on a small pond permanently occupied by Dusky Moorhens *Gallinula tenebrosa*. White-faced Herons (RR ratio 0.5) also occurred intermittently, often foraging in paddocks. A Buff-banded Rail *Gallirallus philippensis* was recorded on three occasions between February 2002 and April 2006 in creek-side vegetation immediately above Barford Lane and at the dam occupied by the Dusky Moorhens. It was probably resident during this period.

Changes in Species Status

The mean list length for the period 2008-2010 (41.6 species/visit) was 15% lower than for the first six years of the study 1999-2004. During the next three years the list length increased, but remained 4.2% below the 49.1 species/visit during 1999-2001. These variations suggest that the species diversity of the bird population in the Black Rock area may have undergone a decline followed by a partial recovery. However, the differences were not statistically significant at the p=0.05 level and were subject to seasonal bias because there was a lower proportion of summer surveys in the 2008-2010 period (**Table 1**) which generate longer lists. The number of species recorded in the first two three-year periods (**Table 1**) again suggests a decline in species diversity followed by partial recovery. However, this trend is biased by an increased number of summer surveys, which generate long bird lists, being conducted in the initial years of the project.

Trends in the temporal variation of RR for individual species included species which declined and partially recovered (**Figures 3** and **4**), species which peaked mid-study (**Figure 5**), species which declined without recovery and species which colonised the area (**Figure 6**).

The trends shown by the Speckled Warbler, Buff-rumped Thornbill and Varied Sittella *Daphoenositta chrysoptera* (**Figure 3**) all involve a marked decline in RR during the period 2008-2010, followed by a partial recovery during the subsequent three years.

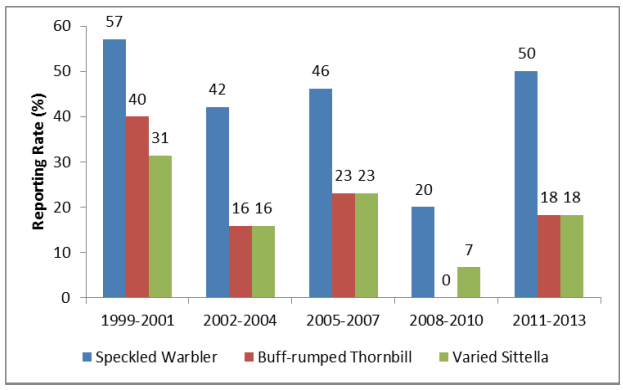

Figure 3. Variations in the reporting rates of three species, which declined during 2008-2010, followed by a partial recovery in 2011-2013.

The Fan-tailed Cuckoo showed a similar decline and partial recovery (**Figure 4**). This effect was even more pronounced in the case of the Shining Bronze-cuckoo *Chalcites lucidus* and Pallid Cuckoo *Cacomantis pallidus*, which were primarily recorded in the first three-year period, with a possible partial recovery in the last six years. However, the evidence for these species is tenuous because of the small number of records.

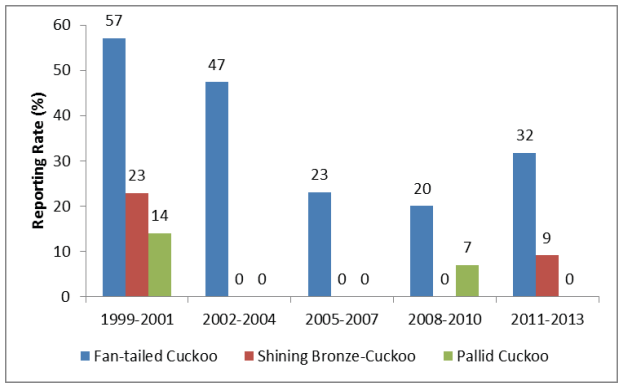

Figure 4. Decline in reporting rates of three cuckoo species during the middle of the study, followed by indications of a partial recovery.

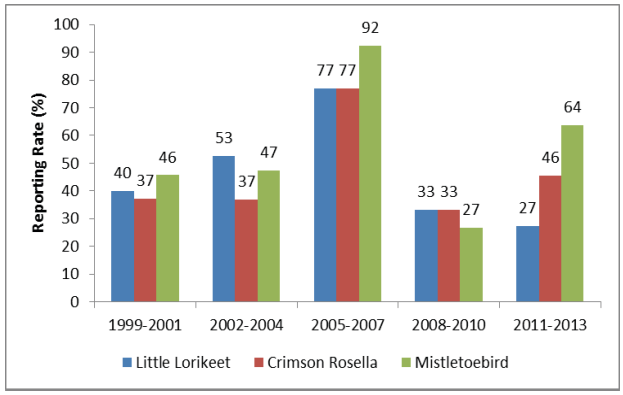

Figure 5. Three species, Little Lorikeet, Crimson Rosella and Mistletoebird, with reporting rates peaking during 2005-2007.

In contrast the trends for the Little Lorikeet, Crimson Rosella and Mistletoebird peaked in 2005-2007, the middle of the study (**Figure 5**).

The Bell Miner was rarely recorded before it colonised a gully near the junction of Black Rock and Fitness's Roads in 2008-2010 (**Figure 6)**. In contrast the White-winged Chough *Corcorax melanorhamphos* and Brown-headed Honeyeater *Melithreptus brevirostris* declined after being moderately common during the first nine years; neither species was recorded in the last three years of the study.

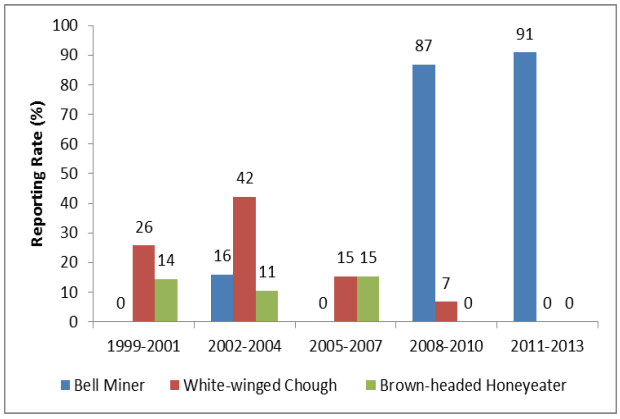

Figure 6. Comparison of reporting rate trends of Bell Miners, an increasing species and the White-winged Chough and Brown-headed Honeyeater, declining species.

With the exception of the increase in the Bell Miner, there were insufficient results to demonstrate statistically robust changes in status at the p=0.05 level. However, in some cases trends suggest changes with viable biological explanations, as discussed below.

The Hunter Region and the Paterson district experience highly variable rainfall patterns. Both seasonal and annual variations in rainfall are potential drivers of changes in the status of bird populations. In a local study I discussed how these influenced Grey Fantail numbers (Newman 2012b). In that analysis it was shown that an extended period of drought both in and external to the Paterson area with its climax in 2006, adversely affected the local fantail population with a subsequent recovery from 2008 onwards. Thus drought conditions provide a plausible explanation of the trends reported in this section. However, there will be subtle differences in the mechanism by which each species is impacted. For instance, sparse resident species (e.g. Speckled Warbler) may die out and unless there is good connectivity to core populations, local extinction may become permanent, particularly for sedentary species. For more mobile species, there may be a temporary population shift to other regions where superior conditions exist. The cuckoos may fit this pattern.

Threatened Species

Seven species listed under the NSW Threatened Species Act 1995 were recorded during the study. An additional species is known to have occurred historically.

The Little Lorikeet, a vulnerable species, was regularly recorded (RR 43.3%), but most frequently during the 2005-2007 period (RR 76.9%). It mainly occurred in mature eucalypts on Black Rock Road about 200m past the Fitness's Road junction, which was the area favoured by the Swift Parrots *Lathamus discolor* in the winter of 2000.

Swift Parrots (RR 5.6 %), an endangered species, were recorded during six successive visits between 23/7/2000 and 27/8/2000, when up to 20 were present, feeding in flowering gums on Black Rock Road 200m beyond the Fitness's Road junction. There was only one subsequent record on 24/8/2007, which was in open woodland approximately 200m from the previous sightings. These records are consistent with a view that Swift Parrots return to favoured areas after periods of prolonged absence (M. Roderick pers. comm.). Unfortunately clearing, involving the removal of mature trees, has occurred recently in both these areas, although some suitable habitat remains.

Speckled Warblers *Chthonicola sagittata* (RR 46.2%), listed as vulnerable, were recorded regularly, except between 2008 and 2010 when the RR (20%) fell to less than half its normal level before recovering in 2011-2013 (**Figure 2**). The Speckled Warbler has specialised habitat requirements, favouring wooded areas with some shrubs and limited ground cover (Newman 2010a & 2012a). At Black Rock, in the absence of grazing, grass cover probably becomes too dense for this species, limiting its foraging opportunities.

Black-chinned Honeyeaters *Melithreptus gularis* (RR 1.9%), listed as vulnerable, were only recorded in August 2000 and September 2001. This is consistent with the species' status as an occasional visitor to the Paterson area as opposed to a resident species elsewhere in the Hunter Region (Newman 2007 & 2009).

Grey-crowned Babblers *Pomatostomus temporalis* (RR 1.0%), another vulnerable species, were first recorded on the 104th visit on Black Rock Road at a location just after the Barford Lane junction. Four babblers were foraging in an area where the roadside vegetation had been modified by removing the entire understorey. The resulting park-like habitat with tall eucalypts was ideal for Noisy Miners *Manorina melanocephala*, which were harassing the babblers. Babblers are resident on Black Rock Road below Barford Lane in acreage gardens; so the above observation demonstrates the opportunistic response of the species to annex habitat favourable to them when it becomes available.

Varied Sittellas *Daphoenositta chrysoptera* (RR 21.2%), listed as vulnerable, were recorded sporadically (**Appendix 1**), consistent with other studies in the Paterson area (Newman 2010a). In these studies, the impression gained was of a species, which was locally nomadic, rather than holding a fixed territory indefinitely. It was also suggested that the species was declining in the Hunter Region (Newman 2010b). Although temporal variations in RR in this study suggest a possible decline, with a lower RR (6.7%) in 2008-2010 (**Figure 2**), the observed differences were not statistically conclusive.

There is a historical record of the critically endangered Regent Honeyeater *Anthochaera phrygia* for the area (Lyn Walsh pers. comm.).

CONCLUSIONS

This study demonstrates the value of recording birds over a sustained period while bird watching during an extended walk. Even though the surveys were conducted in a consistent, rather than rigidly structured manner, they have provided valuable insights into the status of the bird populations of the area. Not only has a comprehensive inventory of the birds of Black Rock been documented, but it has been possible to quantify how often the 124 species were recorded; over half occurred relatively frequently (RR>20%) throughout the study.

High effort surveys generating long species lists, as used in this study, capture locally sparse species at low reporting rates (e.g. Varied Sittella, Buff-rumped Thornbill and Double-barred Finch), which are often missed in less comprehensive surveys (e.g. BLA's standard 2ha-20 minute survey). Although the trends for such species (**Figures 3, 4, 5** and **6**) may lack statistical robustness because of small sample sizes they may still provide a valid indication of changes in species' status. The Black Rock study area, as has been pointed out, is on the eastern edge of the local range of several species, which are more abundant further inland. For these species Black Rock is a marginal area and local populations may be particularly sensitive to change at the regional level, providing a valuable litmus test for the health of these species (i.e. local extinctions at the edge of the range may indicate a widespread regional contraction in range). The database generated in this study provides a basis for the future testing of present indications. Will Double-barred Finches and Speckled Warblers become locally extinct or fully recover and even exceed 1991-2001 levels?

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APPENDIX 1

Bird Species recorded in Black Rock, Martins Creek area between 1999 and 2013, sorted in descending order of overall frequency of occurrence (reporting rate).

Species	1999/2001	2002/2004	2005/2007	2008/2010	2011/2013	1999/2013
Superb Fairy-wren	100.0	100.0	100.0	100.0	100.0	100.0
Yellow-faced Honeyeater	100.0	94.7	100.0	100.0	100.0	99.0
Lewin's Honeyeater	100.0	100.0	92.3	100.0	95.5	98.1
Australian Magpie	100.0	89.5	100.0	100.0	100.0	98.1
Grey Fantail	97.1	100.0	92.3	93.3	100.0	97.1
Eastern Rosella	100.0	100.0	92.3	80.0	100.0	96.2
Spotted Pardalote	100.0	100.0	100.0	86.7	86.4	95.2
Eastern Whipbird	100.0	94.7	100.0	80.0	95.5	95.2
Noisy Miner	97.1	89.5	92.3	100.0	90.9	94.2
Australian Raven	100.0	89.5	92.3	86.7	90.9	93.3
Laughing Kookaburra	97.1	89.5	76.9	86.7	100.0	92.3
Grey Shrike-thrush	97.1	89.5	100.0	80.0	90.9	92.3
Jacky Winter	100.0	100.0	84.6	60.0	90.9	90.4
Masked Lapwing	91.4	89.5	84.6	80.0	95.5	89.4
Willie Wagtail	91.4	94.7	84.6	73.3	95.5	89.4
White-browed Scrubwren	91.4	94.7	92.3	86.7	77.3	88.5
Striated Pardalote	94.3	94.7	76.9	80.0	77.3	86.5
Australian Wood Duck	94.3	89.5	76.9	53.3	95.5	85.6
Red Wattlebird	94.3	89.5	100.0	66.7	72.7	85.6
Pied Butcherbird	80.0	84.2	76.9	93.3	95.5	85.6
Welcome Swallow	88.6	89.5	92.3	66.7	86.4	85.6
Yellow-tufted Honeyeater	85.7	73.7	84.6	80.0	81.8	81.7
Eastern Spinebill	82.9	78.9	84.6	73.3	81.8	80.8
Eastern Yellow Robin	85.7	84.2	69.2	66.7	81.8	79.8
Magpie-lark	97.1	84.2	76.9	53.3	63.6	78.8
Red-browed Finch	80.0	89.5	84.6	53.3	81.8	78.8
Crested Pigeon	77.1	94.7	84.6	66.7	68.2	77.9
Golden Whistler	74.3	73.7	76.9	80.0	81.8	76.9
Dusky Moorhen	91.4	78.9	61.5	33.3	81.8	75.0
Grey Butcherbird	68.6	89.5	61.5	60.0	86.4	74.0
Bar-shouldered Dove	68.6	73.7	84.6	73.3	63.6	71.2
Yellow Thornbill	80.0	78.9	46.2	66.7	63.6	70.2
Striated Thornbill	74.3	63.2	53.8	86.7	59.1	68.3
Pied Currawong	88.6	68.4	61.5	46.7	50.0	67.3
Wonga Pigeon	71.4	73.7	69.2	60.0	54.5	66.3
Satin Bowerbird	82.9	52.6	61.5	60.0	59.1	66.3
Silvereye	62.9	68.4	69.2	60.0	72.7	66.3
Variegated Fairy-wren	74.3	78.9	46.2	53.3	50.0	63.5

Appendix 1: Bird Species recorded in Black Rock, Martins Creek area between 1999 and 2013, sorted in descending order of overall frequency of occurrence (reporting rate) (continued).

Species	**1999/2001**	**2002/2004**	**2005/2007**	**2008/2010**	**2011/2013**	**1999/2013**
Black-faced Cuckoo-shrike	68.6	63.2	69.2	53.3	59.1	63.5
Australian King-Parrot	74.3	47.4	61.5	60.0	45.5	59.6
Brown Thornbill	42.9	52.6	61.5	53.3	68.2	53.8
White-naped Honeyeater	65.7	47.4	69.2	46.7	36.4	53.8
Mistletoebird	45.7	47.4	92.3	26.7	63.6	52.9
Noisy Friarbird	40.0	63.2	61.5	40.0	50.0	49.0
Double-barred Finch	31.4	68.4	69.2	33.3	59.1	49.0
Galah	54.3	42.1	53.8	26.7	54.5	48.1
White-throated Gerygone	48.6	52.6	46.2	60.0	36.4	48.1
Speckled Warbler	57.1	42.1	46.2	20.0	50.0	46.2
Rufous Whistler	51.4	63.2	30.8	33.3	31.8	44.2
Little Lorikeet	40.0	52.6	76.9	33.3	27.3	43.3
Crimson Rosella	37.1	36.8	76.9	33.3	45.5	43.3
White-throated Treecreeper	51.4	31.6	15.4	26.7	63.6	42.3
Fan-tailed Cuckoo	57.1	47.4	23.1	20.0	31.8	40.4
Olive-backed Oriole	31.4	36.8	61.5	40.0	45.5	40.4
Pacific Black Duck	54.3	42.1	7.7	13.3	40.9	37.5
Cattle Egret	54.3	52.6	15.4	13.3	22.7	36.5
Bell Miner	0.0	15.8	0.0	86.7	90.9	34.6
Yellow-rumped Thornbill	34.3	52.6	23.1	26.7	13.6	30.8
Scarlet Honeyeater	22.9	36.8	23.1	20.0	36.4	27.9
Rainbow Lorikeet	2.9	5.3	23.1	53.3	68.2	26.9
Pheasant Coucal	22.9	26.3	23.1	33.3	22.7	25.0
White-bellied Cuckoo-shrike	20.0	10.5	15.4	53.3	27.3	24.0
Buff-rumped Thornbill	40.0	15.8	23.1	0.0	18.2	23.1
Sacred Kingfisher	25.7	15.8	15.4	33.3	18.2	22.1
White-faced Heron	20.0	31.6	23.1	6.7	22.7	21.2
Channel-billed Cuckoo	17.1	21.1	23.1	26.7	22.7	21.2
Varied Sittella	31.4	15.8	23.1	6.7	18.2	21.2
Purple Swamphen	5.7	0.0	7.7	53.3	45.5	20.2
Dollarbird	20.0	15.8	0.0	40.0	22.7	20.2
Brown Gerygone	14.3	36.8	0.0	13.3	27.3	19.2
White-winged Chough	25.7	42.1	15.4	6.7	0.0	19.2
Wedge-tailed Eagle	25.7	15.8	15.4	0.0	4.5	14.4
Yellow-tailed Black-Cockatoo	5.7	36.8	23.1	0.0	4.5	12.5
Musk Lorikeet	0.0	10.5	30.8	33.3	4.5	11.5
Crested Shrike-tit	14.3	5.3	15.4	13.3	9.1	11.5
Common Myna	2.9	26.3	7.7	13.3	13.6	11.5
Little Pied Cormorant	14.3	5.3	15.4	0.0	9.1	9.6
Shining Bronze-Cuckoo	22.9	0.0	0.0	0.0	9.1	9.6
Brown Cuckoo-Dove	2.9	10.5	7.7	13.3	13.6	8.7
Brush Cuckoo	8.6	15.8	7.7	6.7	4.5	8.7
Brown-headed Honeyeater	14.3	10.5	15.4	0.0	0.0	8.7
Dusky Woodswallow	5.7	5.3	15.4	6.7	9.1	7.7
Grey Teal	14.3	5.3	7.7	0.0	0.0	6.7

Appendix 1: Bird Species recorded in Black Rock, Martins Creek area between 1999 and 2013, sorted in descending order of overall frequency of occurrence (reporting rate) (continued).

Species	1999/2001	2002/2004	2005/2007	2008/2010	2011/2013	1999/2013
Straw-necked Ibis	5.7	5.3	23.1	0.0	4.5	6.7
Fuscous Honeyeater	11.4	5.3	7.7	6.7	0.0	6.7
Brown Falcon	11.4	10.5	0.0	0.0	0.0	5.8
Swift Parrot	17.1	0.0	0.0	0.0	0.0	5.8
Pallid Cuckoo	14.3	0.0	0.0	6.7	0.0	5.8
Topknot Pigeon	8.6	0.0	15.4	0.0	0.0	4.8
White-throated Needletail	8.6	5.3	0.0	0.0	4.5	4.8
Painted Button-quail	2.9	0.0	7.7	13.3	4.5	4.8
Grey Goshawk	5.7	10.5	0.0	0.0	0.0	3.8
Nankeen Kestrel	5.7	0.0	0.0	0.0	9.1	3.8
Sulphur-crested Cockatoo	2.9	5.3	7.7	0.0	4.5	3.8
Green Catbird	5.7	0.0	7.7	0.0	4.5	3.8
Regent Bowerbird	5.7	0.0	0.0	0.0	9.1	3.8
White-necked Heron	2.9	5.3	0.0	0.0	4.5	2.9
Brown Goshawk	0.0	10.5	0.0	0.0	4.5	2.9
Buff-banded Rail	0.0	10.5	7.7	0.0	0.0	2.9
Australasian Figbird	0.0	0.0	7.7	0.0	9.1	2.9
Brown Quail	0.0	5.3	0.0	0.0	4.5	1.9
White-headed Pigeon	2.9	0.0	0.0	6.7	0.0	1.9
Scaly-breasted Lorikeet	0.0	0.0	0.0	6.7	4.5	1.9
Black-chinned Honeyeater	5.7	0.0	0.0	0.0	0.0	1.9
Torresian Crow	0.0	5.3	0.0	6.7	0.0	1.9
Restless Flycatcher	0.0	0.0	15.4	0.0	0.0	1.9
Spotted Dove	0.0	5.3	0.0	0.0	0.0	1.0
Great Cormorant	0.0	5.3	0.0	0.0	0.0	1.0
Australian Pelican	2.9	0.0	0.0	0.0	0.0	1.0
Eastern Great Egret	0.0	0.0	7.7	0.0	0.0	1.0
Royal Spoonbill	2.9	0.0	0.0	0.0	0.0	1.0
Black-shouldered Kite	0.0	0.0	0.0	0.0	4.5	1.0
Pacific Baza	2.9	0.0	0.0	0.0	0.0	1.0
Australian Hobby	0.0	0.0	0.0	0.0	4.5	1.0
Little Corella	0.0	0.0	7.7	0.0	0.0	1.0
White-winged Triller	0.0	0.0	0.0	6.7	0.0	1.0
Rose Robin	2.9	0.0	0.0	0.0	0.0	1.0
Tree Martin	0.0	0.0	0.0	0.0	4.5	1.0

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Book Review

An Atlas of the Birds of NSW and the ACT, Volume 1. Emu to Plains-wanderer

By Richard M. Cooper, Ian A.W. McAllan and Brian R. Curtis, 2014.
New South Wales Bird Atlassers Inc, 720 pp., numerous tables, graphs and maps.
Hardback, A4 format, $135.00, ISBN 978-0-957704-73-2

Have you ever wondered how the hundreds of hours you have spent being bitten by mosquitoes, shivering in freezing winter winds, wading through ankle-deep mud or getting tired and sunburnt while conducting bird surveys contributes to the understanding and conservation of our avifauna? The recently published Atlas of the Birds of NSW and the ACT, Volume 1, (Atlas) answers this question with a comprehensive display of the power of the work of 'citizen scientists'. The Atlas is a milestone in the literature of the distribution, breeding, migration, historical change and current status of NSW & ACT avifauna. It also covers adjacent waters of the western Tasman Sea and is the first of three volumes to be published by the New South Wales Bird Atlassers (NSWBA). Volume 1 covers 183 species from Emu to Plains-wanderer and represents the contribution of tens of thousands of hours of input from more than 1500 volunteers including field observers, researchers, data analysts, writers, reviewers and cartographers.

The Atlas has a simple and well written introduction that explains the Atlas objectives, how to interpret the contents and summarises the methodology used, data sources, data vetting and processing. The Atlas draws on 5.6 million records obtained from April 1770 to 31 December 2006. About one half of the data used was from NSWBA field work, literature, historical records and reports from the general public. The remaining data was obtained from Ornithological Groups, Tertiary Institutions, The Australian Museum, private records and BirdLife Australia. In the process of assembling the data set, NSWBA digitised a number of historical and private collections of records.

All data was vetted to ensure correct identification and location of species, and to remove duplicated records and bias. The number of species recorded in each 10-minute block is greatest in near-coastal regions, and around major population centres, and decreases progressively to the west. Surprisingly, there are a number of 10-minute land blocks in Central NSW with no observations. Records for pelagic species are much fewer and restricted mainly to near-inshore waters, except where pelagic surveying has been conducted.

Bird watchers will not be surprised to learn that the ten most frequently reported species in NSW & ACT are Australian Magpie, Magpie-lark, Willie Wagtail, Galah, Welcome Swallow, Laughing Kookaburra, Crested Pigeon, Black-faced Cuckoo-shrike, Australian Raven and Superb Fairy-wren.

Factors that affect avian distribution and the impact of key threatening processes for birds are summarised. The proportion of remnant native vegetation in woodland districts in NSW is recorded as varying from 9 to 25%.

The text for each species covers breeding, seasonal movements, historical records and changes in distribution, current status, and is supported by maps, tables and graphs. The text is enhanced by the inclusion of a limited number of excellent photographs. There is a summary of the number of records, reporting blocks and breeding blocks used for each species. Data is presented as maps of Reported Distribution 1971-2006, Reporting Rate (frequency of occurrence during Atlas surveys) and Reported Breeding Distribution. Where sufficient data is available, Historical Distribution Maps for the periods 1770-1970, 1971-1980, 1981-1990 and 1991-2000, or more limited time periods, are presented. The maps are constructed with 30-minute grids showing Reported Distribution and Breeding data points for each of the 10-minute blocks with records. The Reporting Rate maps present data for 30-minute blocks and display four levels of reporting differentiated by symbols.

Seasonal Reporting Rates for nine Bioregions are presented for land birds in tables where sufficient data is available. Monthly Breeding, Monthly Reporting Rate and Annual Reporting Rate (1986-2006) data is presented as histograms. The Reporting Rate data is summarised in a table with the number of records used, the reporting rate trend and the statistical significance of the trend reported

as a "p-value". Analysis is limited to breeding season and changes in reporting rate over time.

The nine Bioregions used in the Atlas were identified by a biogeographic analysis of the NSW Bird Atlas dataset by Julian R.W. Reid, Fenner School of Environment & Society, ANU. This analysis is included in Appendix 2. Bioregions are North Coast, Northern Tablelands and Escarpment, Central & South Coast, Tablelands, Western Slopes, Riverine Plain, Central Peneplain, Mallee & Acacia Woodland, and Arid. The diagnostic species of each region are presented in tables. The Hunter Region occupies the most complex biogeographic area in NSW, located at the convergence of four bioregions: North Coast; Central and South Coast; Northern Tablelands and Escarpment; and Tablelands. This is one reason the Hunter Region supports the largest number of species of any geographic region in NSW & ACT.

I found the text to be clear and concise and the maps, tables and graphs are simple, easy to read and well labelled. The text is fully referenced. Appendix 1 includes a comprehensive list of the historical literature. The manuscript sources used, involving over 1,000 publications and other sources, are listed in References.

Data presented in monthly reporting rates combined with seasonal distribution maps illustrates species migration and is supported by a concise summary of relevant reference sources. At the finest scale, altitudinal migration is documented for some species including White-necked Heron, White-faced Heron, Australian Wood Duck, Australian Hobby, Brown Falcon and Nankeen Kestrel. On a broader scale, seasonal movements between coastal and inland areas in response to annual weather patterns and breeding cycles is well illustrated for many species. For other species that migrate beyond state borders as part of their annual cycle, the lack of distribution maps for adjoining states can be somewhat frustrating, but is well outside the scope of this publication.

The maps showing changes in distribution and graphs showing reporting rate trends over time document the decline of many species, but also significant expansion for others. Species that have extended their distribution include many members of the Family Columbidae, Pacific Baza, Square-tailed Kite, Eastern Osprey, Cattle Egret, Black-necked Stork and Australian Brush-turkey.

For the Hunter Region, the declines of Emu and Bush Stone-curlew are illustrated as are increases for species such as the Wompoo Fruit-Dove, Wandering Whistling-Duck and the Plumed Whistling-Duck. The seasonal reporting rate changes for pelagic species including petrel, shearwater, booby, prion and albatross are well illustrated and documented.

The Atlas data indicate that the annual reporting rate for 45 species is increasing, including 12 species determined as threatened by the NSW Scientific Committee. Most concerning however, is that reporting rates for 67 species are declining at significant levels, including 10 species listed as threatened in NSW. The results also indicate that further monitoring is required to be able to report conclusively on the status of another 33 species. The plight of the Endangered Plains-wanderer is highlighted with distribution now limited to the western Riverina, a rapidly declining annual reporting rate and very few reports since 1994. Some species exhibit U-shaped annual reporting trends. These include the Blue-billed Duck, Great Crested Grebe and the Australasian Shoveler. The reasons for these changes are unclear.

The Atlas is a stand-alone document and does not duplicate information recorded in the Handbook of Australian, New Zealand and Antarctic Birds (HANZAB). While avian distribution and population, movements and breeding dispersion are discussed from referenced sources in HANZAB, there is no quantitative data in these volumes which were published in the early 1990s and which are becoming increasingly out of date. The Atlas also provides further support for the conclusions and recommendations published in the State of Australian Birds Series by Birds Australia in the mid-2000s.

The Atlas presents data in a quantitative format that allows a better understanding of the status and needs of each species, and identifies where conservation management efforts are best concentrated. It also provides a baseline against which future studies, trends and the effectiveness of conservation programmes can be measured.

One of the great strengths of the Atlas is the information provided regarding the patterns of annual movements of species and their change in distribution over time. The establishment of detailed data sets for periods of up to 35 years for most species covers multi-generational time frames and allows assessment of population trends using IUCN listing criteria.

The Atlas will be a great source of data for researchers of the effects of Climate Change. There are a number of species that exhibit changed distribution/range and are now reported more frequently in coastal areas than in the west, and some species that have increasing reports in the south of the state. The Pacific Baza is one species that is cited in the text as an example.

The Atlas is probably not a reference source for the less curious bird enthusiast. It will appeal mainly to more technically minded ornithologists, conservation organisations, wildlife managers, environmental consultants, scientists and government agencies. The data will be invaluable in developing policy, minimising future impact and planning more cost-effective research and conservation programmes. It also provides an early warning system for non-flagship species that will require closer monitoring. It will help identify new Important Bird Areas (IBAs) and provide support for existing IBAs.

The detailed compilation of historical records and other private data sources completed by NSWBA as part of the research for this publication will be a valuable resource for future researchers.

Volume 2 is planned to be published in 2015 and will cover species from the Comb-crested Jacana to the Striated Pardalote. Volume 3 will cover the Eastern Spinebill to the Common Greenfinch, as well as vagrant species, and the birds of the Lord Howe Island group.

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Up-down display of Black-necked Stork at Hexham Swamp, Hunter Wetlands National Park NSW

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INTRODUCTION

Birds offer a great range of behavioural displays which as in the following case may serve to reinforce pair bonds, assert territorial rights and can also indicate aggressive intent. This note concerns spectacular displays made by a pair of Black-necked Stork *Ephippiorhynchus asiaticus*, a large species which is uncommon in the Hunter Region of NSW.

OBSERVATIONS

On 21 May 2014 at Hexham Swamp (32°51'11"S 15°40'59"E; elevation 1m) three Black-necked Storks were present including a pair distinguished by eye colour, dark in the male and yellow in the female, that had been there regularly since mid-January. The third bird appeared to be a younger female based on yellow eye and duller leg colour. The changes of plumage and their timing for immature birds is not well known (Marchant & Higgins 1990). Soon after I arrived the older female chased the third bird away. The regular pair then spent a period either preening or stationary. The older female began foraging away from the male and was subsequently joined by the male. **Figures 1** and **2**, selected from a 29-image sequence which finished at 9:00am show key features of a display between the adult pair triggered by the close approach of the immature female. They faced each other and the male bowed over with wings extended. The female responded by also raising her wings. The birds had raised wings as depicted in **Figure 2** with the wing tips quivering quickly. The third bird was in the foreground throughout but moved away a few metres. Finally the older female flew at the younger female at 9:07am and chased it away, later to be joined by the male. The third bird was approximately 50m away. The third bird stayed there for 40 minutes then flew some hundreds of metres south to the edge of Ironbark Creek. Later in the morning the pair flew towards the Ironbark Creek end of the swamp to be approached by the third bird which was quickly chased away, resulting in a vigorous aerial display. I was in a moving vehicle so no images were obtained.

Figure 1. The start of the up-down display with the female commencing to elevate her wings and the male bowing before her. The immature female bird is in the foreground.

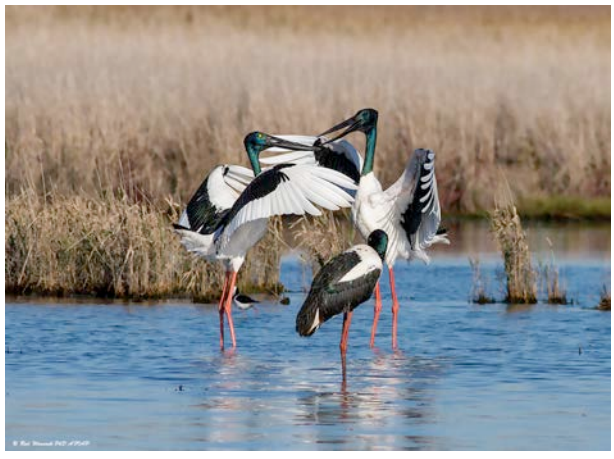

Figure 2. Image taken midway through the up-down display sequence. The yellow eye of the intruding female bird is visible in enlarged images.

DISCUSSION

The above behaviour was new to me so I immediately sent an image and a description of the display to Greg Clancy who has conducted a long-term study of this species. Greg replied as follows:

'The behaviour is what I have observed a few times during my studies. I have described this behaviour in my paper on nesting (Clancy & Ford 2011). What is happening is that a mated pair is occupying their territory and a third bird, an interloper, arrives. The interloper attempts to usurp the territorial bird but the pair usually display to each other with what is known as the "up-down display". This seems to send a signal to the interloper that this pair is a mated pair and the respective bird is not interested in "divorcing and remarrying". This is usually enough for the interloper to get the message and move on but sometimes a chase is needed. I have recorded this mostly when a female interloper arrives but I suspect that an interloper male would be treated similarly.'

Clancy & Ford (2011) recorded the 'up-down display' 15 times at or near nests; on 10 occasions immediately after an adult male had landed on the nest. Four displays occurred during the pre-egg-laying stage, six during incubation and five while nestlings were on the nest. Two displays occurred while a third adult was present. The 'up-down display' was also observed away from the nest eight times. Six of these displays occurred while a third adult was present, once while an additional adult pair of storks was present, once when an adult female landed in a wetland near an adult male, once while a juvenile stork was nearby, and once as a White-bellied Sea-Eagle *Haliaeetus leucogaster* flew low overhead.

Marchant & Higgins (1990) suggest the 'up-down display' is a greeting display and emphasised the solitary nature of the Black-necked Storks; consequently interactions and agonistic behaviour were virtually unknown within Australia prior to Clancy & Ford's studies.

At Hexham Swamp the adult pair often fly to distant Casuarina trees and land in them near the Maryland side of the swamp which raises the possibility of nesting in Hexham Swamp. However, in NSW only 10% of the 70 nests observed were in trees less than five metres in height (Clancy & Ford 2011). In Hexham Swamp, the number of large trees is limited and the most suitable are near human habitation. While most nesting occurs in or adjacent to fresh water swamps Black-necked Storks have nested in mangroves with trees as small as four metres used (Marchant & Higgins 1990). Consequently, future breeding at Hexham Swamp, which is at the southern limit of the species' breeding range in eastern Australia, would seem a distinct possibility following the recent opening of the floodgates to restore tidal inundation (Chapman & Hyde 2012). The main breeding season is between August and January, although there are records for all months except February (Cooper *et al.* 2014).

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Observation of a White-bellied Sea-Eagle taking submerged seabird prey

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A White-bellied Sea-Eagle *Haliaeetus leucogaster* was observed taking a live Wedge-tailed Shearwater *Ardenna pacifica* that was completely submerged as the sea-eagle approached. Although sea-eagles are known to hunt seabirds, there appears to be no published evidence of them taking a seabird that is submerged in Australia. A sequence of images illustrates the scenario.

The White-bellied Sea-Eagle *Haliaeetus leucogaster* is a large raptor species distributed around the perimeter of the Australian coastline (including Tasmania) as well as from the Bismarck Archipelago west to the Indian subcontinent. It also extends inland in Australia along major rivers and around large inland water bodies.

White-bellied Sea-Eagles are opportunistic hunters and feed on a variety of prey such as fish, birds, reptiles, mammals, crustaceans and carrion (Marchant & Higgins 1993). Amongst some of the many prey items known to be taken are seabirds such as shearwaters and seabirds as large as Australasian Gannets *Morus serrator* (Debus 2012; Marchant & Higgins 1993).

Pelagic birdwatching trips have been run out of Port Stephens on a semi-regular basis since January 2010 and upon return to port in the late afternoon it is common for one, or sometimes two, White-bellied Sea-Eagles to fly out and soar above the feeding seabirds attending the food scraps in the wake of the boat. On two occasions (10 October 2010 and 28 April 2013) a sea-eagle has successfully taken a shearwater from behind the boat. The latter of these two successful hunting pursuits was noteworthy because the shearwater was almost completely submerged at the time of the capture.

At around 4:15pm on 28 April 2013 an adult White-bellied Sea-Eagle approached the boat approximately 3 nautical miles from the heads of Port Stephens (32º 43' 37" S, 152º 13' 31" E). The bird circled for a short period over the wake of the boat where a number of shearwaters (Wedge-tailed, Short-tailed and Flesh-footed) as well as Silver Gulls were feeding on food scraps. The sea-eagle approached from the east and after circling high for a minute or so, made an initial swoop that ended several metres above the birds. It then made another swoop, dropping altitude at a sudden rate. The sea-eagle stooped at high speed such that the momentum enabled it to rapidly approach the wake of the vessel at a shallow angle. Moments later, the sea-eagle emerged from the stoop with a Wedge-tailed Shearwater *Ardenna pacifica* in its talons.

The hunt and kill took place very quickly and it was not until later when digital photographs were scrutinised that it was realised that the shearwater was completely submerged as the sea-eagle made the final part of the approach (**Photo 1**). The images also reveal that the shearwater was mostly submerged as the sea-eagle made the capture (**Photos 2** & **3**).

Photo 1 shows the sea-eagle making the final part of the approach to the wake of the boat. One Wedge-tailed Shearwater is visible, with its back to the sea-eagle, presumably feeding on scraps on the water surface. The prey is not visible in this image.

Photo 2 shows the outstretched talons of the sea-eagle, only seconds before making the capture. Some feathers of the prey can be seen protruding from the water about a metre in front of the sea-eagle. The other shearwater remains seemingly oblivious to the sea-eagle's approach.

Photo 3 shows the sea-eagle immediately after taking the shearwater. The water draining off the shearwater indicates that the bird was still submerged as the capture was made. The second shearwater again appears unaware of the sea-eagle's presence.

To the author's knowledge, a sea-eagle taking a submerged seabird (apart from Little Penguins *Eudyptula minor*) has not been documented and is considered noteworthy behaviour (S. Debus pers. comm.).

Whilst shearwaters commonly feed on submerged food by diving, what is not known is if the shearwater was aware that the sea-eagle was approaching and was attempting to conceal itself from the raptor, or if it was oblivious to the presence of the sea-eagle. Considering that the second shearwater, which was feeding by floating on the water surface, appears to have been completely unaware of the threat posed by the sea-eagle, it is probable that the bird taken was not aware of the sea-eagle either. It is also probable that a shearwater alerted to an approaching raptor would take flight, rather than dive.

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The Whistler **8 (2014)**: 58-59

Observations of a Regent Honeyeater performing mimicry of a Little Wattlebird

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The Regent Honeyeater *Anthochaera phrygia* is a medium-sized species of honeyeater that occurs in open forests and woodlands from south-east Queensland to Central Victoria. It has suffered significant declines in recent decades and is listed nationally as 'Endangered' and as 'Critically Endangered' within New South Wales (NSW).

On 3 August 2014, a male Regent Honeyeater was located by Jenny Powers and Chris and David Eastham at the end of a causeway track on the eastern side of Belmont Swamp, Lake Macquarie NSW (33º 2' 36" S, 151º 39' 52" E). The bird was seen feeding on the blossom of a small number of Swamp Mahogany *Eucalyptus robusta* trees and was in the presence of White-cheeked Honeyeaters *Phylidonyris niger*, Brown Honeyeaters *Lichmera indistincta* and Noisy Friarbirds *Philemon corniculatus*. At the time of writing, 29 October 2014, this was one of only two Regent Honeyeaters recorded in the Lake Macquarie catchment in 2014.

The following morning I confirmed that the bird was an adult male, predominantly determined by the extent and structure of the warty face. The bird was also very vocal, but interestingly the vocalisations almost exclusively involved precise mimicry of a Little Wattlebird *Anthochaera chrysoptera*. Typical Regent Honeyeater calls (or parts thereof) were intermittently used, usually at the end of a burst of Little Wattlebird mimicry. Regent Honeyeaters and Little Wattlebirds both use bill-clapping widely when calling (Prendergast 1987); although in this case the clapping calls were exaggerated to enhance the mimicry effect. This was also the case when I revisited the site on 8 August 2014.

Regent Honeyeaters are known to mimic larger honeyeater species and the 'quality' of the mimicry is said to be high (e.g. Veerman 1992, 1994; Ley 1992), particularly when in the presence of those larger species in mixed foraging flocks. Veerman (1992, 1994) suggested mimicry in Regent Honeyeaters only occurs in the non-breeding season (usually winter), typically in the direct presence of the mimicked species and usually whilst associating with them, but in the absence of any other Regent Honeyeaters. Since then, many more cases have been observed, including several filmed (by Veerman and others, pers. comms.). The context of the behaviour in these recent observations has remained, with few exceptions, remarkably consistent with the statements made there. Mimicry has rarely been heard near Regent Honeyeater nest sites during the breeding season (Ley & Williams 1998).

Veerman concluded that the mimicry is used in the sense of "deception" to either attempt to achieve cohesion with a foraging flock of larger birds (e.g. friarbirds *Philemon* spp. and wattlebirds *Anthochaera* spp.) or as a territorial defence against smaller honeyeaters. On one occasion he observed a Regent Honeyeater approach a Red Wattlebird until almost touching and perform a call of a wattlebird, after which the Red Wattlebird departed and the Regent Honeyeater did more mimicry. Veerman also concluded that such use of mimicry is behaviour unique among Australian honeyeaters.

For this observation, it is thought that the mimicry was used to assert an impression of a larger honeyeater being present to other smaller honeyeaters nearby. The Regent Honeyeater was aggressive to White-cheeked and Brown Honeyeaters, in defending the clearly-favoured Swamp Mahogany tree where it was predominantly observed. The use of mimicry could have been employed to minimise the need to chase birds away and hence expend energy. On the day of the first observation there was much aggression shown towards the Regent Honeyeater by up to four Noisy Friarbirds, though no mimicry was heard that day (J. Powers pers. comm.). It is possible that the bird engaged in the use of

mimicry in the absence of the Noisy Friarbirds to attempt to maintain governance of the favoured tree.

The typical pattern from prior observations is that the species being mimicked has been present in the immediate vicinity; however this was not the case here. The closest point where I found Little Wattlebirds was approximately 300m to the east. Little Wattlebirds are relatively common in other parts of Belmont Swamp (J. Powers pers. comm.) and are the common large honeyeater in the areas dominated by coastal scrub vegetation (*Banksia* spp. and *Leptospermum* spp.). Whether or not the Regent Honeyeater chose to mimic the call of a locally-dominant honeyeater (as opposed to one that is less common or transitory) is a matter for speculation, though it would seem likely that it was a deliberate choice given the location and circumstances.

ACKNOWLEDGEMENTS

The author wishes to acknowledge Philip Veerman, who reviewed a draft of the manuscript and suggested a number of improvements.

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Cattle Egret – a brief note on the fourth consecutive breeding event at Gloucester, NSW

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Figure 1. Cattle Egret colony on a small dam at Gloucester near the end of the 2013/14 breeding season (photo by Terry Hardwick).

In the 2010/11 season Cattle Egrets *Ardea ibis* established a new breeding colony at Gloucester (Drake-Brockman 2011). Breeding continued at the same site in 2011/12, but this caused the willow trees to die, in addition to the dam drying up, forcing the birds to move to an alternative site nearby (Drake-Brockman 2012 & 2013). This note provides an update on the continued use of the displaced colony site in 2013/14, despite its small size and few trees suitable for nests (**Figure 1**).

An almost total lack of rain from July 2013 and very hot daytime temperatures delayed breeding in 2013/14 although Cattle Egrets continued to use the previous season's site for roosting. Its dam had retained some water, being fed from the sales yard overflow, but the surrounding paddocks were as dry as a bone. However, several heavy rain storms starting from 9th November 2013 stimulated the egrets to commence nest building and a rough count of 75 nests was made on 17th November with a few birds already sitting. Conditions remained dry through most of December, but by the end of that month there were half-grown chicks grouped away from nests and many newly-hatched chicks attended by parents. Most nests that contained chicks had two or three per nest, giving an approximate estimate of chick numbers at 140.

The site was not checked again until 3rd February 2014 when about ten chicks with punk rocker hair styles remained in their nests, looking skinny and underfed as almost no rain had fallen in the meantime and the paddocks were drying out. However, I did not observe any evidence of chicks dying from lack of food. No adults were incubating or working on new nests. A count of chicks sufficiently mature to leave the site was not possible as adults and chicks scattered on my arrival.

By mid-March on approach to the dam nearly all chicks flew to nearby tall trees or joined others in the paddocks, leaving five that were still too

immature to fly. Of these, three retained black bills and two were showing some yellow in their bills. By the end of March no chicks remained on the site during the day, but it continued to be used for roosting.

By mid-April Cattle Egrets were widely scattered throughout the Gloucester, Avon and Karuah valleys, from Booral to Barrington. Light rain was keeping the paddocks green so this season's chicks have an excellent chance of surviving. Assuming they return with their parents to breed at this natal site in Gloucester next season, a potential expansion of the colony is unlikely. For Cattle Egret it is obligate that nest and roost sites are located over water although much of their foraging takes place away from water. The present site is abnormally small for an egret breeding colony and the vegetation has suffered severely with the trees now dead or highly stressed. To my knowledge there is only one other site in the immediate area that is suitable; a larger dam with an island containing a group of willow trees approximately 2km east of the present site, but in the Avon River valley. Cattle Egrets forage in this valley and have roosted there in the past. This dam has also retained water during the recent droughts.

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Channel-billed Cuckoos performing a previously undescribed courtship display

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On 21 October 2013 at 5:17pm the alarm calls of many Noisy Miners *Manorina melanocephala* were heard at my home in Budgewoi (33°14'10"S 151°33'56"E) followed by calls of a Channel-billed Cuckoo *Scythrops novaehollandiae*.

I took my camera outside to see two Channel-billed Cuckoos pursued by around a dozen Noisy Miners, at least two Pied Currawongs *Strepera graculina* and three or more Australian Magpies *Cracticus tibicen*.

The Channel-billed Cuckoos landed in a tall tree, while the other birds made alarm calls and dive-bombed them.

An initial view through my 400mm lens suggested the top bird was feeding the bottom bird, which I interpreted as courtship display between an adult pair, since juvenile cuckoos are normally fed by a host parent. In any case Channel-billed Cuckoos are summer visitors and it was too early in the breeding season for fledged juveniles. Later examination of my photographs confirmed that both birds were in adult plumage.

When I got closer I took 220 photos of this behaviour in an eight-minute period.

Meanwhile the attack and alarm calls of the other birds were relentless, until they put the cuckoos back into the air, calling as they flew into the distance at 5:25pm followed by some of the other birds.

When I reviewed the images on my computer I noticed that the cuckoos were not feeding, instead they were holding each other's upper mandible and lower mandible between their upper mandible and lower mandible. Mostly the cuckoos were observed to be taking each other's lower mandible between their upper and lower mandible and tugging on it. In many images they are almost touching bills, but in subsequent images they were

holding each other's bill or throat and I believe this was a "playful Mexican stand-off" to try and grab their mate's bill.

They were also captured in many later photos tugging at each other's throats with their bills individually or in some cases at the same time (**Figure 1**).

While conducting these displays the cuckoos were very vocal, accompanied by fanning their tails and flapping their wings while they tried to ignore the attempts by the local birdlife to move them on.

I attribute my observations to courtship behaviour but they differ from previous accounts of courtship feeding by Channel-billed Cuckoos, which involve the male offering a stick insect to a female as a prelude to copulation (Higgins 1999). Johnson (1983) provided a detailed description of this behaviour in which the female was apparently attracted by the offer of the stick insect, and took and swallowed it immediately after copulation. In the case of the behaviour documented in the present note no copulation was observed. Possibly my observations involve rituals associated with pair formation, whereas the courtship feeding involving food transfer is a precursor to copulation.

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Figure 1. Pair of adult Channel-billed Cuckoos tugging at each other's neck in a courtship display.

The *Whistler* – Instructions to Authors

The *Whistler* is an occasional publication of the Hunter Bird Observers Club Inc. (HBOC), which is based in Newcastle. HBOC members are active in observing birds and monitoring bird populations in the Hunter Region. This journal-style publication is a venue for publishing these regionally significant observations and findings. The journal publishes three types of articles:

1. **Contributed Papers**
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Authors should consider the appropriateness of their study to this publication. The publication is suitable for studies either geographically limited to the Hunter Region or with obvious relevance to it. Papers attempting to address data and issues of a broader nature should be directed to other journals, such as *Corella, Australian Field Ornithology* and *Emu*. Contributed papers should include analyses of the results of detailed ecological or behavioural studies, or syntheses of the results of bird monitoring studies. These may include comprehensive annotated species lists of important bird areas and habitats. Such data would then be available for reference or further analysis in the many important issues of bird conservation facing the Hunter Region.

Communication of short notes on significant bird behaviour is also encouraged as a contribution to extending knowledge of bird habits and habitat requirements generally. Reviews of bird books are also solicited, with the intention of providing a guide for other readers on their usefulness regionally and more broadly.

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- Manuscripts should be up to 12 pages in length (longer in exceptional circumstances) and of factual style.
- They should include a summary of approximately 250 words.
- An 'Introduction' or 'Background' section introduces the aims of and rationale for the study and cites any other work considered essential for comparison with the study.
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- A section on 'Results' includes description and/or analysis of data highlighting trends in the results; this may be divided into subsections if more than one body of data is presented; use of photos, drawings, graphs and tables to illustrate these is encouraged.
- A section headed 'Discussion' should attempt to set the results in a wider context, indicating their significance locally and/or regionally; comparison with national and international work is optional, as is the discussion of possible alternative conclusions and caveats; suggestions for future extension of the work are encouraged.
- A final section headed 'Conclusion[s]' gives a concise summary of findings, usually without introducing any new data or arguments.
- Appendices of raw data and annotated lists of bird species and habitats can be included in tabular form at the end of the article.
- References should be cited in brief within the text of the article, and full references should be listed at the end of the text after any Acknowledgements and before Appendices and Annotated Lists. References should be formatted as per the formatting instructions below.
- The preferred layout described above can be modified at the Editors' discretion.

Short Notes

- Should be no more than 4 pages of descriptive or prosaic style.
- Should provide an adequate description of the location of observations, a brief rationale for documenting the observations, and a cogent description of observations; similar relevant observations should be cited with references if appropriate.
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- Should be approximately 2 pages of critical assessment and/or appreciation.
- Should introduce the topics and aims of the book as the reviewer understands them, comment on the thoroughness and rigour of content, and conclude with comments on the effectiveness and originality of the book in meeting its aims, particularly for birdwatchers in the Hunter Region area if appropriate.
- References should be cited and listed as for contributed papers.

Formatting Instructions

Although not necessary, it may assist if authors format their manuscripts as follows:

1. A4 size page, portrait layout except for large tables or figures;
2. Margins 2 cm top, bottom, left and right;
3. Title in bold 16pt Arial font, centred;
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6. Section headings capitalized in bold Arial font, 12 pt size, left justified;
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9. Typescript should be Times New Roman, 11 pt, except methods, acknowledgements and references which are 10 pt;
10. Figures and Tables to be included at the end of the document in Times New Roman font, 10 pt minimum size, title left justified, below figures and above tables with "**Figure x.**" or "**Table y.**" heading the title;
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