The Whistler

Channel-billed Cuckoo Courtship
Great Frigatebird in the Hunter
Pied Oystercatcher
White-fronted Chat
Habitat change at Swan Bay
Martindale Surveys
Australian Pelican movement

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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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Front cover: Channel-billed Cuckoo *Scythrops novaehollandiae* - Photo: Rob Palazzi
Back cover: Red-chested Button-quail *Turnix pyrrhothorax* - Photo: Mick Roderick
Spine: Sharp-tailed Sandpipers *Calidris acuminata* - Photo: Rob Palazzi

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Editorial

Welcome to the 18th edition of *The Whistler*, presented here for your reading pleasure. This edition brings you 13 articles covering a wide variety of topics from across the Hunter Region. Four of the articles present the results of long-term studies with extensive data sets. The remaining nine are shorter articles which document various aspects of avian behaviour, population studies, unusual observations, and some 'firsts' for the Hunter Region.

Results are presented for a study by HBOC members of five different habitat types in the Martindale Valley, that were surveyed quarterly across seven years. This study is only the second ever to deal with southwestern parts of the Hunter Region and it considerably expands our knowledge of the avian populations in that part of the region. Eighteen threatened species were amongst the 190 species recorded. The seasonal change in population is documented as are the impacts of El Niño and La Niña climate events. The study demonstrated that the avian population responded to increased rainfall in a similar manner to that associated with inland wetland systems, rather than a near-coastal refuge.

A long-term study reported by Mike Newman and Eric Woehler documents how a Red-browed Finch population in the Paterson area responded opportunistically to higher rainfall. The study demonstrates an increase in the number of birds per survey and an increase in group size that lagged the increased rainfall by two years. The quarterly sampling technique used for the study was shown to be sufficient to generate statistically significant trends for the finches and three additional woodland species.

A paper by Ann Lindsey and Neil Fraser reviews the status of the White-fronted Chat in the Hunter Region. The known local distribution of the species is mainly limited to six estuarine wetland sites all of which are targets for regular shorebird monitoring by HBOC members. The study demonstrated a 64.5% decline in reporting rate over the period 2010-2023, which was similar to state-wide studies for the species. The authors also highlighted that the species' true distribution across the region could be much wider than is currently understood.

The fourth reported long-term study is about the Swan Bay area of Port Stephens. The article relates local changes in the behaviour and population of wader species to habitat changes at the site over a 48-year period. An important coastal wetland on the site previously hosted 25-50% of the shorebirds in Port Stephens. The numbers of shorebirds have declined by 30% and many species are no longer recorded. The site is subject to encroachment by mangroves due to rising sea level and changed weather patterns, exacerbated by human intervention. The article suggests measures to support wader populations in the face of rising sea levels.

There are nine shorter articles in this edition of *The Whistler*, which collectively comprise around 50% of the total content. We are delighted to be able to present the diverse range of topics which these articles cover.

One of the articles is about Snapper Island, near Swan Bay, Port Stephens. This small rocky island, supporting littoral rainforest habitat, is infrequently visited by birders. The rainforest habitat supports a range of fruit-eating birds including Rose-crowned Fruit-Dove. Five other threatened species including Glossy Black- Cockatoos have been recorded. Another Port Stephens article demonstrates the decline in the local Whistling Kite population. Increased competition from other raptor species is postulated as the probable cause.

Two articles are based on observations from within the port of Newcastle. Judy Little has used local bird banding observations and recapture records for Australian Pelicans to assess their longevity and movements within our region. The other article, supported by excellent photography, describes the sighting of a Great Frigatebird in Newcastle Harbour in 2015, the first confirmed record for the Hunter Region.

First time author Mandy McDonald has analysed Australian Pied Oystercatcher records from around Lake Macquarie, another area with limited previous documentation. Her study showed that the species had increased breeding success in 2021 and 2022, which she attributes to reduced human interference of nesting sites during the COVID-19 lockdown.

Two articles by Kim Pryor describe previously unreported aspects of Channel-billed Cuckoo and Galah behaviour, respectively. The cuckoos were observed exchanging food items as part of their courtship behaviour. Galah chicks, from a back-yard nest box brood, were observed to fledge on the same day. Both articles are wonderful illustrations of how little has been documented about many Australian birds as well as excellent examples of the important role that all of us potentially can fill by careful observation and then follow-up reporting.

Broughton Island, the site of a number of exceptional reports and avian firsts for the region, was the site of another first-time record. A trail camera revealed a Peregrine Falcon displaying previously undocumented behaviour when capturing a Wedge-tailed Shearwater on the ground, just prior to dawn. The final short article, by Dick Jenkin, also documents another first for the Hunter Region. While birding along the Cattle Lane hot-spot in the north-west of the region, Dick made the first breeding record of Red-chested Button-quail for the Hunter Region.

It is pleasing to note that, once again, this latest edition includes articles from several first-time authors or co-authors. Over the 18 years of annual publication, there have been 85 individuals who have appeared at least once as an author or co-author. To us, that serves to demonstrate the important role that *The Whistler* fills in documenting Australian birdlife at a regional level – it would not have occurred to many of those local authors to put pen to paper were it not for their awareness of *The Whistler*'s existence and their knowledge that some of their peers had previously "given it a go".

Preparation of *The Whistler* involves a large team and we extend our thanks to all the contributors, referees and production staff. We also thank the Newcastle Coal Infrastructure Group for their continuing financial support.

Neil Fraser and Alan Stuart
Joint Editors

The birds of Snapper Island, Port Stephens, NSW

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Avian records from Snapper Island in the western end of Port Stephens were reviewed. The island covers 13 ha and supports a littoral rainforest community with numerous figs and other fruit-bearing plants and vines. Forty-seven avian species have been recorded. The most common species were White-bellied Sea-Eagle *Haliaeetus leucogaster*, Little Pied Cormorant *Microcarbo melanoleucos*, Brown Gerygone *Gerygone mouki*, Golden Whistler *Pachycephala pectoralis*, Grey Fantail *Rhipidura albiscapa* and Eastern Yellow Robin *Eopsaltria australis*. The island provides suitable habitat for seven frugivorous avian species, including Rose-crowned Fruit-Dove *Ptilinopus regina* and Topknot Pigeon *Lopholaimus antarcticus.* Nankeen Night-heron *Nycticorax caledonicus*, which were once the main drawcard to the island, are now present in small numbers only.

INTRODUCTION

Snapper Island (32º42'09"S, 152º00'04"E) is a small isolated, heavily vegetated, rocky island located in the western end of Port Stephens, 2 km east of the settlement of Swan Bay (**Figure 1**). It was first set apart for the "preservation of birds" in 1912 under the provisions of the *Bird Protection Act 1901* (NSW Government Gazette, 3 April 1912). The island was listed as a Nature Reserve by the NSW Government in 1982, and now is managed by NSW National Parks and Wildlife Service, Hunter Coast Branch.

The island was originally protected due to the presence of a large colony of Nankeen Night-Heron *Nycticorax caledonicus.* A trip to the island during the breeding season was a highlight for ornithologists visiting the Port Stephens area in the 1920s and 1930s. Reports from that period described hundreds of nesting pairs (Chisholm & Cayley 1928; Hordern & Hordern 1931) and thousands of breeding herons (Dungog Chronicle: Durham and Gloucester Advertiser 1931). Unfortunately, the island's herons were regularly targeted by shooters for their breeding plumes which were highly prized by the millinery industry (The World News 1936; The World News 1939).

This report summarises the bird species recorded in recent times and describes the island's habitat. The island is also known to provide habitat for the vulnerable Grey-headed Flying-fox *Pteropus poliocephalus* (Office of Environment & Heritage 2014).

Site description

Snapper Island is 800 m long and 250 m at its widest point, and covers 13 ha. It has a central ridge, aligned northwest-southeast, that rises steeply to 17 m at its highest point. Access is largely limited to the shoreline due to steep nearshore slopes and dense vegetation. The shoreline is rocky apart from a short section of sandy beach on the western side of the island that is used for access. The surrounding waters are shallow, 1-2 m in depth. The island's vegetation is classified as Myall-Wallis Lakes Littoral Rainforest and is the only example of this community in Port Stephens (Trees Near Me NSW 2023). Littoral rainforest in NSW is classified as an endangered ecological community under the *Biodiversity Conservation Act 2016* (NSW) (Office of Environment and Heritage 2022).

The canopy through the central spine of the island consists of several rainforest species, the more common ones being Yellow Tulipwood *Drypetes deplanchei*, Red Olive-berry *Elaeodendron australe*, Whalebone Tree *Streblus brunonianus*, and Red Ash *Alphitonia excelsia*. There are also many pockets of Cabbage Palm *Livistonia australis* throughout the centre and Swamp Oak *Casuarina glauca* is common around the perimeter. Eucalypts are rare with only a small number of Forest Red Gum *Eucalyptus tereticornis*. The eastern side of the island is dominated by figs, right down to the shoreline: Sandpaper Fig species *Ficus coronata* and *Ficus fraseri*, Port Jackson Fig *Ficus rubiginosa*, Deciduous Fig *Ficus superba var. henneana* and Strangler Fig *Ficus watkinsiana*. Due to the density of the canopy, the mid-storey is almost

non-existent. However, on the western side where light is plentiful, the weed Lantana *Lantana camara* is now prevalent. The ground layer is predominantly vines, mainly Whip Vine *Flagellaria indica*, Water Vine *Cissus antarctica* and Common Silkpod *Parsonsia straminea*.

Feral goats *Capra aegagrus hircus*, which foraged on low-growing plants, were removed from the island in 1998. Between 2010 and 2013, bush regeneration crews from Trees in Newcastle worked on the island and removed most of the Lantana and White Passion Flower *Passiflora subpeltata* (T. Clarke pers. comm.). A Statement of Management Intent produced by the National Parks and Wildlife Service in 2014 stated that "priorities include an ongoing program of rainforest regeneration on Snapper Island which is targeting Lantana and Climbing Asparagus *Asparagus plumosus* to protect the littoral rainforest vegetation community" (Office of Environment & Heritage 2014). Since then, parts of the island have become heavily overgrown with Lantana and, together with the density of the rainforest, limit access mainly to the shoreline. (N. Karlson pers. obs.; M. Kearns, pers. comm.).

The island is occasionally used by the local community for boat-based recreational purposes.

Figure 1. Location map, Snapper Island, Port Stephens NSW.

METHODS

Records from surveys on Snapper Island were extracted from three sources: the BirdLife Australia Birdata portal (https://birdata.birdlife.org.au/home), the Cornell Lab of Ornithology eBird Australia portal (https://ebird.org/australia/home) and the BioNet portal of the NSW Department of Planning and Environment (https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/nsw-bionet). The maximum and mean counts were derived.

RESULTS

Only 29 records were located from Snapper Island and surrounding waters: Birdata had seven surveys; eBird seven surveys; and BioNet had two surveys plus another 13 incidental records, all of which were single species records of White-bellied Sea-Eagle *Haliaeetus leucogaster*.

The 16 full surveys were from 1972 onwards, with a total of 47 species recorded. The number of records and maximum and mean counts for the 47 species are summarised in **Table 1** together with their breeding status and their NSW conservation status. There were breeding records for six species: White-bellied Sea-Eagle, Sacred Kingfisher *Todiramphus sanctus*, Brown Gerygone *Gerygone mouki*, Grey Fantail *Rhipidura albiscapa*, Australian Raven *Corvus coronoides* and Eastern Yellow Robin *Eopsaltria australis*.

In addition, a breeding record for Australian Pied Oystercatcher *Haematopus longirostris* was identified - they were nesting on a small area of sand on the rocky shoreline at the northern tip of the island in September 2014 (T. Clarke pers. comm.).

DISCUSSION

Snapper Island is unique in Port Stephens. It is the only island covered by rainforest and its isolated location, relatively limited recreational use and protected status, creates an ideal habitat for some bird species. The most frequently recorded species were White-bellied Sea-Eagle (17 records), Grey Fantail and Eastern Yellow Robin (eight records each), and Little Pied Cormorant *Microcarbo melanoleucos*, Brown Gerygone and Golden Whistler *Pachycephala pectoralis* (seven records each).

The rainforest, with its numerous figs and other fruiting trees, shrubs and vines, provides foraging habitat for frugivorous species including White-headed Pigeon *Columba leucomela*, Rose-crowned Fruit-Dove *Ptilinopus regina*, Topknot Pigeon *Lopholaimus antarcticus*, Channel-billed Cuckoo *Scythrops novaehollandiae*, Australasian Figbird *Sphecotheres vieilloti*, Silvereye *Zosterops lateralis* and Mistletoebird *Dicaeum hirundinaceum*. This is reflected in the high maximum counts for some of these species. The rainforest vegetation also appears to attract a significant insect population that provides foraging for Oriental Dollarbird *Eurystomus orientalis,* Brown Gerygone and Grey Fantail.

Nankeen Night-Heron are still recorded on the island, but in greatly reduced numbers when compared to records from earlier last century, and apparently, they no longer breed there. These changes may be partly due to unlawful shooting in the past, but the extensive overgrowth of Lantana is probably limiting access to suitable nesting sites.

Four raptor species have been recorded: Grey Goshawk *Accipiter novaehollandiae*, White-bellied Sea-Eagle, Whistling Kite *Haliastur sphenurus* and Southern Boobook *Ninox novaeseelandiae*.

The absence of migratory wader records from the island is noteworthy, since large numbers are recorded regularly from the nearby shorelines of Port Stephens (Stuart 2020). Their absence probably reflects the lack of suitable tidal foraging and roosting habitat around the rocky island. However, the relatively secluded foreshore has provided a suitable nesting site for Australian Pied Oystercatcher and may also be suitable for Sooty Oystercatcher *Haematopus fuliginosus*. The waterbirds around the island, gulls, terns, pelicans, herons and cormorants, are common throughout Port Stephens (Stuart 2007; Stuart 2020; Fraser 2023).

Threatened Species

Six of the species recorded are listed as threatened under the NSW *Biodiversity Conservation Act 2016*. Australian Pied Oystercatcher is listed as endangered, and Rose-crowned Fruit Dove, Sooty Oystercatcher, White-bellied Sea-Eagle, Glossy Black-Cockatoo *Calyptorhynchus lathami* and Varied Sittella *Daphoenositta chrysoptera* are all listed as vulnerable. The Glossy Black-Cockatoo was foraging in Swamp Oak in January 2023.

CONCLUSION

Snapper Island is a unique rainforest habitat in Port Stephens that attracts woodland and frugivorous species including Topknot Pigeon and the vulnerable Rose-crowned Fruit-Dove. Because of its isolation and limited human disturbance, the shores of the island have been used for nesting by a pair of Australian Pied Oystercatcher. The rocky shores might also provide potential nesting sites for Sooty Oystercatcher. The island has had only limited avian monitoring and is worthy of further study from the birdwatching community. More effective control of weeds is required, in order to help restore the rainforest habitat.

Table 1. Species counts, Reporting Rates, conservation status and breeding records, Snapper Island.

Common Name	Scientific Name	Mean Count	Max. Count	Records	Breeding Records	Conservation Status NSW
White-headed Pigeon	*Columba leucomela*	2	4	2		
Rose-crowned Fruit-Dove	*Ptilinopus regina*	2	3	3		Vulnerable
Topknot Pigeon	*Lopholaimus antarcticus*	14	20	5		
Australasian Darter	*Anhinga novaehollandiae*	-	1	1		
Little Pied Cormorant	*Microcarbo melanoleucos*	1	1	7		
Great Pied Cormorant	*Phalacrocorax varius*	1	2	2		
Australian Pelican	*Pelecanus conspicillatus*	1	2	2		
Striated Heron	*Butorides striata*	-	1	1		
White-faced Heron	*Egretta novaehollandiae*	1	1	5		
Nankeen Night-Heron	*Nycticorax caledonicus*	12	24	3		
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	1	4	17	✓	Vulnerable
Whistling Kite	*Haliastur sphenurus*	1	2	4		
Grey Goshawk	*Accipiter novaehollandiae*	-	1	3		
Australian Pied Oystercatcher	*Haematopus longirostris*	2	2	3	✓	Endangered
Sooty Oystercatcher	*Haematopus fuliginosus*	1	2	3		Vulnerable
Greater Crested Tern	*Thalasseus bergii*	1	1	2		
Silver Gull	*Chroicocephalus novaehollandiae*	-	2	1		
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	-	6	1		Vulnerable
Little Corella	*Cacatua sanguinea*	-	3	1		
Channel-billed Cuckoo	*Scythrops novaehollandiae*	-	1	3		
Southern Boobook	*Ninox novaeseelandiae*	-	1	1		
Azure Kingfisher	*Ceyx azureus*	-	1	1		
Laughing Kookaburra	*Dacelo novaeguineae*	1	2	2		
Sacred Kingfisher	*Todiramphus sanctus*	1	2	3	✓	
Dollarbird	*Eurystomus orientalis*	-	2	1		
Brown Gerygone	*Gerygone mouki*	10	20	7	✓	
Brown Thornbill	*Acanthiza pusilla*	1	1	2		
Eastern Spinebill	*Acanthorhynchus tenuirostris*	-	4	1		
Scarlet Honeyeater	*Myzomela sanguinolenta*	-	1	1		
Brown Honeyeater	*Lichmera indistincta*	-	1	1		
Blue-faced Honeyeater	*Entomyzon cyanotis*	-	2	1		
Varied Sittella	*Daphoenositta chrysoptera*	-	2	1		Vulnerable
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	-	1	1		
Eastern Shrike-tit	*Falcunculus frontatus*	-	1	1		
Golden Whistler	*Pachycephala pectoralis*	1	3	7		
Australasian Figbird	*Sphecotheres vieilloti*	-	2	1		
Australian Magpie	*Cracticus tibicen*	1	3	2		
Pied Currawong	*Strepera graculina*	1	1	2		
Rufous Fantail	*Rhipidura rufifrons*	-	1	1		
Grey Fantail	*Rhipidura albiscapa*	3	8	8	✓	
Australian Raven	*Corvus coronoides*	1	1	3	✓	
Forest Raven	*Corvus tasmanicus*	-	1	1		
Black-faced Monarch	*Monarcha melanopsis*	-	1	1		
Eastern Yellow Robin	*Eopsaltria australis*	2	4	8	✓	
Silvereye	*Zosterops lateralis*	13	30	6		
Welcome Swallow	*Hirundo neoxena*	3	5	3		
Mistletoebird	*Dicaeum hirundinaceum*	3	10	7		

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Courtship feeding in the Channel-billed Cuckoo in the Hunter Region, New South Wales

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INTRODUCTION

The Channel-billed Cuckoo *Scythrops novaehollandiae novaehollandiae* is a large, grey cuckoo with a long, barred tail and heavy decurved bill. It has a distinctive cruciform flight silhouette and a raucous call. It is found in forests, woodlands and grasslands, and eats mostly fruits, especially figs *Ficus* spp., as well as some insects, eggs and young birds (BirdLife Australia 2024; Higgins 1999).

The Australian Channel-billed Cuckoo (subspecies *novaehollandiae*) arrives in northern and eastern Australia to breed between August and September and leaves for New Guinea and Indonesia between January and April (BirdLife Australia 2024; Higgins 1999). During the breeding season, it appears to form pair bonds (Higgins 1999) and participate in courtship behaviour (Merrett 2014). The Channel-billed Cuckoo is an obligate brood parasite which lays eggs in the nests of species such as the Australian Magpie *Gymnorhina tibicen*, Pied Currawong *Strepera graculina* and corvid spp. (BirdLife Australia 2024). Its young are raised by the host-parents.

Courtship feeding occurs when a male animal feeds a female animal during courtship and/or incubation (Ehrlich *et al*. 1988). It is more common in birds than other animals (Galván & Sanz 2011; Lack 1940). In birds, a male usually presents solid or regurgitated food to a soliciting female (Ehrlich *et al*. 1988). The provision of food depends on the male's health, the female's nutritional needs and the female's signals such as vocalisations (Cantarero *et al*. 2014; McCallum & Shaw 2023). Interestingly, courtship feeding is mostly found in bird species in which only the female builds the nest and incubates, and the male and female eat plant foods, face low predation risk (Galván & Sanz 2011) and care for the young (Lack 1940).

Many Australian parasitic cuckoos, including the Pallid Cuckoo *Cacomantis pallidus,* Brush Cuckoo *Cacomantis variolosus,* Fan-tailed Cuckoo *Cacomantis flabelliformis,* Horsfield's Bronze-Cuckoo *Chrysococcyx basalis* and Shining Bronze-Cuckoo *Chrysococcyx lucidus* carry out courtship feeding (reviewed by Noske 1981). However, since the early 1950s, the Channel-billed Cuckoo has been documented carrying out courtship feeding only three times, with chewed leaves (Hindwood & McGill 1951), stick insects (Johnson 1983) and large insects (Goddard & Marchant 1983).

To photograph foraging Channel-billed Cuckoos, I visited a park that contains mature fig trees. This note describes one opportunistic observation of a male Channel-billed Cuckoo offering a female a mulberry during copulation at Morpeth in the Hunter Region.

METHODS

On 8 October 2023, a search was made for Channel-billed Cuckoos at Morpeth (32°43'42"S, 151°38'15"E), New South Wales. The habitat was cultivated grassland with trees, including fruiting mature figs *Ficus* spp., understorey plants and ponds. The birds were photographed from a concealed location with a Canon 5D Mark IV camera with a Sigma 150-600 mm f/5-6.3 DG OS contemporary lens.

RESULTS

A Channel-billed Cuckoo was observed feeding from a fruiting shrub, most likely Black Mulberry *Morus nigra*. It plucked a mulberry and flew ~80 m to a eucalypt that was ~30 m in height. It mounted a second Channel-billed Cuckoo (presumed female) that was perched on a branch. I assumed that copulation occurred because the male was on the female's back for 18 s (**Figure 1**; **Table 1**). The mulberry was passed to the female then taken back and eaten by the male (**Figure 2**; **Table 1**). The female was not heard vocalising before or during copulation.

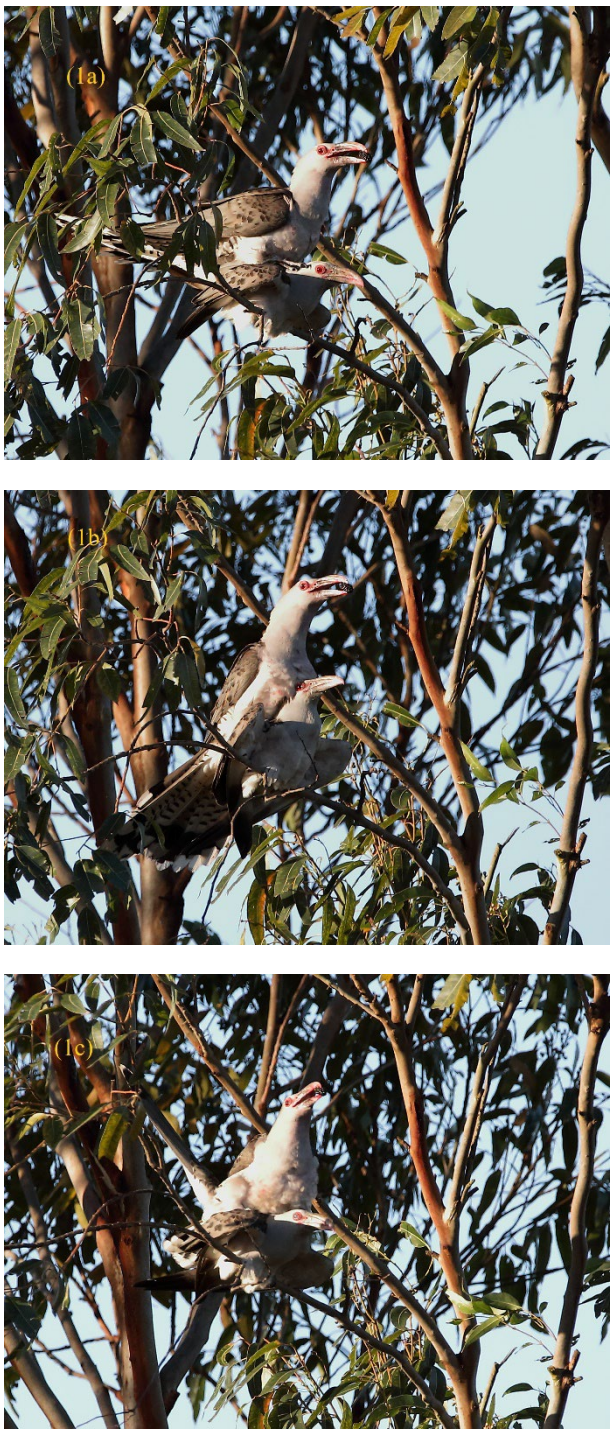

Figure 1. Copulation evidenced by the: (a) male mounting the female; (b) male gripping the female; and (c) male lifting his tail and female crouching and lifting her wings.

DISCUSSION

I observed Channel-billed Cuckoos using a previously unreported food type, a fruit, for courtship feeding during copulation in the Hunter Valley, New South Wales. This observation is contrary to previous comments that courtship feeding has evolved more often (but not only) in bird species in which solely the female builds the nest and incubates, and both male and female care for the young (Lack 1940). The function of courtship feeding in parasitic cuckoos is yet to be elucidated.

Relationships between courtship feeding and reproductive success are complex and difficult to unravel. Courtship feeding may relate to a higher probability of egg laying, shorter courtship (Green & Krebs 1995) and incubation (Lyon & Montgomerie 1985; Nilsson & Smith 1988) periods, and greater egg mass, clutch size and hatching success (Helfenstein *et al*. 2003; Lyon & Montgomerie 1985; Nilsson & Smith 1988; Nisbet 1973). Thus, it may improve the reproductive success of both parents. Reproductive success largely depends on access to enough nutritious food (Martin 1987), and in parasitic cuckoos, the cuckoo pair forages during egg production and the host-species pair forages during incubation. Therefore, it is difficult to work out what proportion of overall reproductive success is due to food collection by each pair or individual.

It is also not known whether all male Channel-billed Cuckoos feed females during courtship or how often they do. Johnson (1983: 44) proposed that **'…** the capture and presentation of a large food item by the male is a prerequisite for mating in Channel-billed Cuckoos', however, the paucity of documented reports on courtship feeding does not support this view. A male may choose whether to feed and how much to feed in response to a female's nutritional needs, which may be communicated through begging signals (Cantarero *et al*. 2014). He may be more likely to feed a female that demands more food because she is experiencing disability or injury (Cantarero *et al*. 2014), foraging unsuccessfully or producing large eggs (McCallum & Shaw 2023).

CONCLUSIONS

This observation of the Channel-billed Cuckoo has identified a new courtship food, a mulberry, and provided further evidence of courtship feeding. Additional investigations are needed to determine how common courtship feeding is for the Channel-billed Cuckoo, if it is closely associated with copulation, which foods are involved, and if they are usually eaten by the female.

Figure 2 Courtship feeding showing the: (a) male on the female's back with a mulberry in his bill; (b) female reaching for the mulberry; (c) female taking the mulberry from the male; (d) male taking the mulberry back from the female; (e) male holding the mulberry; and (f) male swallowing the mulberry.

Table 1. Courtship feeding in a Channel-billed Cuckoo pair in the Hunter Valley in 2023

Time (pm) (h:min:s)	Observation	Figure
5:17:57	Male flew with a mulberry in his bill from a mulberry tree to a eucalypt in which the female was perched.	
5:18:13	Male mounted the female with flat feet on her neck	**1a**
5:18:16	Male gripped the female at the juncture of her body and wings	**1b**
5:18:18	Male raised and turned his tail; female crouched and lifted her wings	**1c**
5:18:20	Male remained in mating position with the mulberry in the tip of his bill	**2a**
5:18:23	Female stretched her bill towards the mulberry; both were in mating position	**2b**
5:18:24	Female took the mulberry from the male; the tips of their bills were together; both were in mating position	**2c**
5:18:31	Male took the mulberry back from the female; the tips of their bills were together; both were side by side on the branch	**2d**
5:18:32	Male held the mulberry in the tip of his bill; the tips of their bills were apart; female appeared to have a fragment of mulberry in the tip of her bill	**2e**
5:18:35	Male swallowed the mulberry	**2f**

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First confirmed sighting of a Great Frigatebird within the Hunter Region, NSW

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An adult female Great Frigatebird *Fregata minor* was observed in Newcastle Harbour, New South Wales, on 7 January 2015. It was also sighted the following day by a number of local observers before its assumed departure. At that time, it was the fourth confirmed record of the species in NSW. The bird was likely to have originated from the eastern Pacific population (subspecies *ridgwayi*) based on the colour of the beak and orbital ring. This appears to be the first record of that subspecies for NSW.

INTRODUCTION

The Great Frigatebird *Fregata minor* is a large seabird that is highly adapted as an aerial feeder (Marchant & Higgins 1990; Weimerskirch *et al*. 2003). The global population occurs across tropical and sub-tropical parts of the Indian and Pacific Oceans (Marchant & Higgins 1990) consisting of five subspecies (Gill *et al.* 2024). Within Australia, the general range of the Great Frigatebird is from the Timor Sea east through the Coral Sea to K'gari (Fraser Island), with occasional sightings south to Brisbane and into NSW (Marchant & Higgins 1990).

Here we document the presence of an adult female Great Frigatebird within Newcastle Harbour in January 2015. At the time of this sighting, there were three accepted records of the species in NSW assessed by the NSW Ornithological Records Appraisal Committee (NSW ORAC), with several documented accounts prior to the formation of NSW ORAC in 1992 (NSW ORAC 2016). The details of this sighting were submitted to NSW ORAC (as NSW ORAC Case no. 638) and the record was accepted (NSW ORAC 2023).

THE SIGHTING

From around 1300 h on 7 January 2015, two observers at separate locations noticed a frigatebird flying around Newcastle Harbour (J. Cockerell pers. comm.; L. Grenadier pers. comm.). At the time the bird could not be identified to species level.

About three hours after those initial sightings, the bird was watched at close range by two of the authors, one (AF) from the north-eastern side of the harbour at Stockton, and the other (IB) from the south-western side, at Carrington. Both authors monitored the bird for close to an hour from 1600 h as it moved backwards and forwards along the Hunter River between the two observation points. Using binoculars and spotting scopes, they were able to identify the bird as a female Great Frigatebird based on diagnostic features with reference to relevant field guides (Slater *et al*. 2009; Morcombe & Stewart 2014; Pizzey *et al*. 2012). Following the initial identification, the bird was observed (MR) and photographed at close range at 1800 h near Nobbys Beach and Lighthouse. The locations of the observation points are shown in **Figure 1**.

On 8 January 2015, the bird was seen by the authors and several local birders (A. Richardson pers. comm.; L. Mee pers. comm.; J. Goswell pers. comm.), continuing to soar around Nobbys Lighthouse and parts of the lower Newcastle Harbour. The bird was last observed around midday on 8 January 2015.

Conditions during both days were clear with no cloud or rain and good visibility. Winds were strongly onshore from the east at 28 knots gusting to 32 knots. Both of the viewing points used by the authors for the identification had good sight lines that were not impaired by infrastructure or glare from the sun.

Figure 1. Observation locations of Great Frigatebird in Newcastle Harbour, 7 January 2015.

Figure 2: Ventral, side-on view showing the sullied grey throat, lack of spurs on the underwing, white belly with a rounded demarcation to the black at the rear of the underparts. Note also the pink eye ring. (Photo: Allan Richardson)

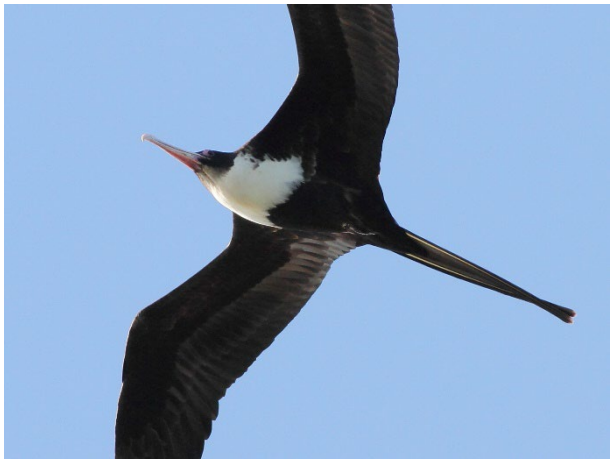

Figure 3: Ventral view showing all of the features noted in Figure 2, but with a clearer view of the sullied grey throat. (Photo: Allan Richardson)

Figure 4: Ventral view in stronger light. All features noted in the previous two images can be seen here, with a clearer view of the reddish-pink eye ring when in full sun. (Photo: Allan Richardson)

DESCRIPTION

The single Great Frigatebird was an adult female based on plumage colours and markings (see **Figures 2-6**). It was a large bird, up to a metre in size with the distinctive Fregatidae shape with large, bent, swept-back wings and a long tail. The forked tail was visible when the bird turned sharply, but the fork was not observable when the bird was soaring.

The body plumage was primarily black with white breast and throat extending to the chin which was lighter in colour but not necessarily white (sullied or grey). The belly had a broad black border which was not obviously pointed. The head had a black hood and the back of the neck was not white but with

brownish hind collar (more obvious from photos). Narrow and brown alar bars were present on the upper wing (more obvious from photos). In a single instance when the bird was directly overhead, IB noted that when the tail was forked and the bird manoeuvred quickly, the abdomen appeared black with mottled white.

The bill had a pink lower mandible and light pink to white upper mandible. Eyes were black in colour with a reddish-pink eye-ring, ovoid in shape with a larger width at the front and narrower at the back of the eye. Feet were black.

The frigatebird made no calls while under observation on either day. It soared along the Hunter River as far north as Walsh Point and down to the Honeysuckle area of the harbour. It used few wing beats and soared or floated along the river in the strong easterly wind. It was seen several times preening its wings and underbelly while in flight. No feeding was undertaken while being watched and no interaction with other bird species was noted.

Figure 5: Side-on view showing the upper wing. The pale brown and narrow alar bars are visible in this image, as is the pink orbital eye ring. (Photo: Allan Richardson)

Figure 6: Side-on view showing how the hind collar is obviously missing on the bird. The complete lack of 'spurs' in the underwing is also obvious. (Photo: Allan Richardson)

Possible identification as a Lesser Frigatebird (*F. ariel*) or Christmas Frigatebird (*F. andrewsii*) was rejected due to the lack of an obvious white neck collar and absence of white underarms or 'spurs' auxiliary feathers emanating off the belly. The belly pattern on this individual was also not consistent with those recorded for both the Lesser and Christmas Frigatebirds (James 2004). Identification as either a Magnificent Frigatebird (*F. magnificans*) or Ascension Frigatebird (*F. aquila*) was also eliminated due to the lack of a blue eye-ring plus the lack of any of the other diagnostic features for those species.

DISCUSSION

This sighting of a Great Frigatebird is the first confirmed sighting of the species in the Hunter Region (Stuart 2016) and is also the most southerly confirmed mainland record of the species in NSW (NSW ORAC 2023). All previous NSW records for the species were located from Nambucca Heads north along the NSW coast between 1981 and 2003, along with one offshore record at Montague Island in 2010 (McAllan & James 2020; NSW ORAC 2023). Since the Newcastle sighting, there has been one further confirmed record of the species within NSW at Lord Howe Island in 2021 (NSW ORAC 2023). There is an unconfirmed record of this species in 2008 from the Hunter Estuary (Eremaea Birdlines 2023); the record has not been submitted to NSW ORAC for appraisal (A. Morris pers. comm.).

It is possible the female Great Frigatebird had been present in the area for two to three days before being sighted on 7 January 2015, with several local residents reporting seeing one, if not two frigatebirds around Newcastle Harbour. Of note, there was a possible sighting of a female Great Frigatebird at Redhead on 5 January 2015 between 0800 and 0900 h (B. Watts pers. comm.). While not confirmed, it is considered highly possible this was the same bird observed in Newcastle Harbour two days later. Another potential sighting of a female Great Frigatebird was reported from Norah Head Lighthouse on 7 January 2015, sometime between 1300 and 1500 h (D. Hogan pers. comm.). That sighting overlaps with the sighting in Newcastle, suggesting a second bird may have been in the area. Additionally, another possible female Great Frigatebird was reported at Norah Head on the evening of 8 January 2015 after the last sighting in

Newcastle (R. McDonell pers. comm.). A potential sighting of a female Great Frigatebird was also reported on 14 January 2015 at Shelley Beach, Port Macquarie (Eremaea Birdlines 2023). None of those sightings were referred to the NSW ORAC for validation.

The International Ornithological Congress (IOC) recognises five sub-species of the Great Frigatebird. These are *F. minor minor* found across the northern central Indian Ocean through Indonesia to northern Australia; *F. minor aldabrensis* found across the tropical south-western Indian Ocean; *F. minor nicolli* found across the south Atlantic Ocean islands; *F. minor palmerstoni* found across the western and central Pacific Ocean islands; and *F. minor ridgwayi* found across the eastern Pacific Ocean (Gill *et al.* 2024). While there is still some debate about whether the taxonomy of the subspecies has been fully resolved (D. James pers. comm.), the colour combination of the bare parts (bill and orbital ring) can be used to identify the subspecies of female Great Frigatebird (James 2004). Great Frigatebird females breeding within the western and central Pacific (including the Coral Sea) are known to have a blue bill and blue orbital ring. However, the female sighted in Newcastle had a pink bill and red orbital ring. This would suggest the individual was either from the northern Indian Ocean subspecies (*F. minor minor*) or eastern Pacific subspecies (*F. minor ridgwayi*), both of which are known for the red orbital ring and pink bill (D. James pers. comm.). As the weather in the lead-up to the sighting was of strong and consistent easterly winds, it is considered more likely the bird was from the eastern Pacific subspecies. Records of eastern Pacific (or Indian Ocean) Great Frigatebird in NSW appear not to have been documented prior to this 2015 observation.

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Same-day fledging of a brood of Galahs in the Hunter Region, New South Wales

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INTRODUCTION

The Galah *Eolophus roseicapillus* is a small pink and grey cockatoo which is widespread and abundant in open habitats in Australia (Higgins 1999). It forages on the ground for seeds and other foods in the morning and afternoon (Noske 1980; Pidgeon 1970). It forms monogamous pairs and breeds in hollows in *Eucalyptus* spp. trees from July to December in southern Australia (Australian Museum 2021). A clutch usually contains 3-4 eggs which hatch on average 23.4 days after being laid (Rowley 1990). Incubation of the eggs and care of the young is by both parents. The mean nestling period is 49.4 (Rowley 1990) to 52 days (Smith & Saunders 1986).

Fledging occurs when a chick leaves the nest and flies away with its parents. The Galah fledging process has been described by Rowley (1990). Fledging is preceded by escalating calls from the parents and chick, and demonstration flights by the parents. The parents may refuse to feed a chick, to encourage it to leave, and they call for it to leave for hours or even days. When a chick fledges, its parents fly on either side of it to a crèche (nursery) where Galah fledglings are cared for in a group. Chicks usually fledge in the early morning (Higgins 1999) or late afternoon (Pryor 2018). The interval from the first chick fledging to the third chick fledging is 2-15 days (Pryor 2018) and the last chick may fledge up to 12 days after its siblings (Rowley 1990).

Parental and chick behaviour during fledging of young Galahs in a suburban environment is not well documented. To gain insights into this behaviour, since 2002 I have observed wild Galahs nesting in my backyard at Thornton (32º24'S, 150º38'E), New South Wales (Pryor 2018; Pryor 2023). Since 2008 I have recorded the fledging times of the chicks. This report describes previously undocumented breeding behaviour by Galahs in 2023 and compares the annual fledging behaviour by Galah chicks over 2008-2023.

METHODS

Since 2002, nest boxes of various sizes have been built to attract Galahs, Eastern Rosellas *Platycercus eximius* and Common Brushtail Possums *Trichosurus vulpecula* (Dengate 1997). They have been installed in *Eucalyptus* spp. trees or on steel poles at heights of 2, 5.5 or 6.5 m in the back right corner of our residential property (total area 765 m²). The native shrub understorey includes *Callistemon* spp., *Banksia* spp. and *Grevillea* spp. (Pryor 2018). The wild birds that nested were passively observed without interference in their behaviour unless the chicks were at risk from lice or mites while in the nest box or from pets while on the ground after fledging.

On 14 August 2023, a nest box containing fresh *Eucalyptus* leaves sprayed with lice and mite spray was mounted 5.5 m above the ground on a steel pole in our backyard beside a *Eucalyptus* tree (approximately 21 m tall). A custom-made camera was fixed to the ceiling of the nest box to allow opportunistic viewing of the eggs and young. The photograph of Chick 1/2023 fledging (**Figure 1**) was saved from a video (https://youtu.be/yKpRmAuLrk8) taken with an Apple iPhone 12 Pro. The photograph of the Galahs in the nest box was taken with a Canon 5D Mark IV camera with a Sigma 150-600 mm f/5-6.3 DG OS contemporary lens. Sunrise and sunset times were obtained using an online geodetic calculator (Geoscience Australia 2024). Fledging times relative to sunrise or sunset were calculated manually and graphed using Microsoft Excel.

RESULTS

In 2023, all three chicks fledged on the same day, 12 November (**Table 1**). Chick 1/2023 fledged at 0509 h while Chick 2/2023 was beside it and also looking out of the nest box entrance hole (**Figure 1**). It flew away with the parents while Chick 2/2023 watched. Chick 2/2023 fledged 167 min

later, at 0756 h. Chick 3/2023 was last seen at 1430 h and the nest box camera confirmed that it had left by 1540 h. Thus, the three chicks fledged in less than 631 min.

From 2002 to 2007 inclusive, up to 14 chicks fledged (times not recorded). From 2008 to 2023 inclusive, a total of 27 Galah chicks fledged (**Table 1**). I was able to record the exact fledging time of 22 of those chicks. Fifteen of them (68%) fledged in the morning, and 13 of these 15 (86.7%) fledged within 120 min after sunrise (**Figure 2**; **Table 1**). The average fledging time for all 15 morning-fledging chicks was 66 min after sunrise. The other seven chicks (32%) fledged in the late afternoon and five of these seven (71.4%) fledged within 120 min before sunset (**Figure 3**; **Table 1**). The average fledging time for all seven was 89 min before sunset. Overall, 81.8% of chicks fledged either within 120 min of sunrise or 120 min of sunset. None of 23 Galah chicks (the 22 recorded plus Chick 3/2023) fledged between 0756 h and 1410 h, a 374 min window in the middle of the day.

Figure 1. Chick 2/2023 watched from the nest box entrance hole while Chick 1/2023 fledged and flew to the crèche with the parents.

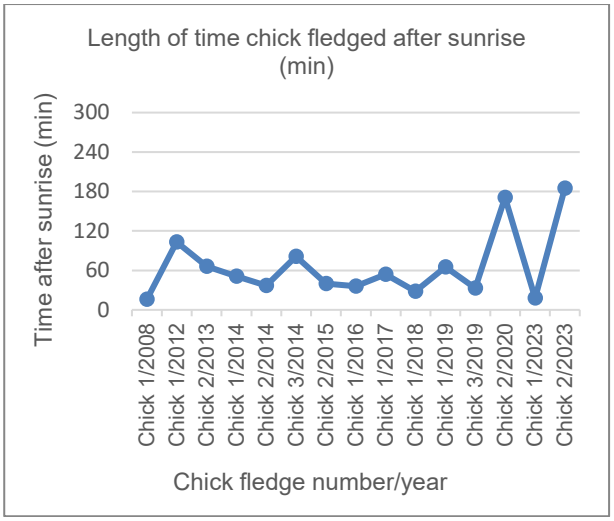

Figure 2. Length of time chick fledged after sunrise (min)

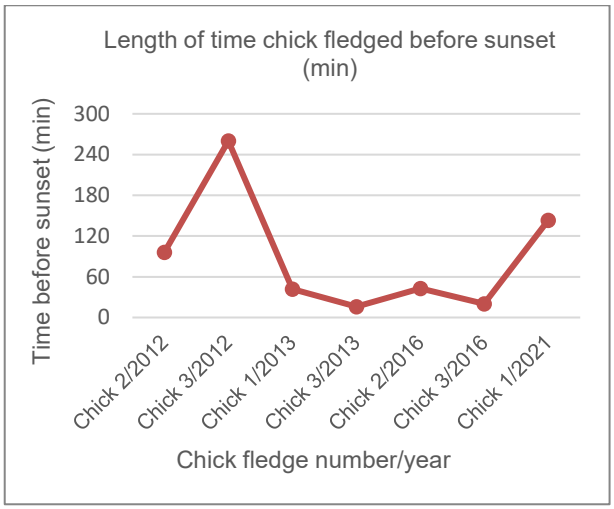

Figure 3. Length of time chick fledged before sunset (min)

Figure 4. (Right) Chick 1/2023 and Chick 2/2023 looked out of the nest box entrance hole at the same time while their parents perched on the roof.

Table 1. Timing of fledging of Galah chicks relative to sunrise and sunset (Australian Eastern Standard Time)

Chick hatch number / year	Date chick left nest box	Time chick left nest box (h)	Sunrise [1] (h)	Time after sunrise (minutes)	Sunset [1] (h)	Time before sunset (minutes)
Chick 1/2008	10/12/08	0500	0444	16	1857	
Chick 1/2012	2/11/12	0641	0458	103	1824	
Chick 2/2012	4/11/12	1650	0457		1826	96
Chick 3/2012	9/11/12	1410	0453		1830	260
Chick 1/2013	19/10/13	1730	0513		1812	42
Chick 2/2013	20/10/13	0618	0512	66	1813	
Chick 3/2013	21/10/13	1758	0511		1814	16
Chick 1/2014	23/10/14	0600	0509	51	1815	
Chick 2/2014	3/11/14	0535	0458	37	1824	
Chick 3/2014	7/11/14	0615	0454	81	1828	
Chick 1/2015	Not observed					
Chick 2/2015	13/11/15	0530	0450	40	1833	
Chick 1/2016	22/10/16	0545	0509	36	1815	
Chick 2/2016	26/10/16	1735	0505		1818	43
Chick 3/2016	27/10/16	1759	0504		1819	20
Chick 1/2017	16/10/17	0610	0516	54	1810	
Chick 1/2018	20/10/18	0540	0512	28	1813	
Chick 1/2019	24/10/19	0613	0508	65	1816	
Chick 2/2019	24/10/19	Not observed	0508		1816	
Chick 3/2019	25/10/19	0540	0507	33	1817	
Chick 1/2020	24/12/20	Not observed	0449		1905	
Chick 2/2020	25/12/20	0740	0449	171	1906	
Chick 1/2021	20/12/21	1640	0447		1903	143
Chick 1/2022 [2]	19/11/22	Not observed	0447		1839	
Chick 1/2023	12/11/23	0509	0451	18	1832	
Chick 2/2023	12/11/23	0756	0451	185	1832	
Chick 3/2023 [3]	12/11/23	Not observed	0451		1832	

[1] (Geoscience Australia 2024)
[2]Chick 1/2022 left nest box in the morning (confirmed with nest box camera)
[3]Chick 3/2023 left nest box between 1430 h and 1540 h (confirmed with nest box camera)

DISCUSSION

These appear to be the first ever reports of: 1) a Galah chick fledging while a sibling was in the nest box entrance hole; 2) two siblings leaving on the same morning; and 3) three siblings leaving on the same day. Other studies have not detailed the time intervals between fledging events (Higgins 1999; Rowley 1990; Smith & Saunders 1986). These new observations will enhance our understanding of parental and chick behaviour during fledging.

1. A Galah chick was capable of fledging when perched beside a sibling in the entrance hole of a nest. This was a surprising finding because a chick usually leans forwards, filling the entrance hole with its body, immediately before leaving the nest (KP pers. obs.). Moreover, although two chicks often look out of the entrance hole at the same time (**Figure 4**), younger siblings usually stay in the bottom of the nest box while the parents are urging a chick to leave (KP pers. obs.). In the 2023 fledging event, it is assumed that Chick 1/2023 and Chick 2/2023 were ready to fledge at the same time and Chick 1/2023 responded to the parents' urging first.

2. Two Galah siblings fledged on the same morning. This was an unexpected finding because in previous years, after a fledging event, Galah parents did not urge another chick to leave until the next afternoon or morning (KP pers. obs.). In 2023, it is likely that the parents responded to cues from Chick 2/2023 that indicated its readiness and eagerness to fledge.

3. Three Galah chicks in a brood fledged on the same day. Moreover, the strong third chick left shortly after its siblings, with minimal urging

from the parents. In my long-term study, three strong siblings have left on two and three consecutive days (2019 and 2013 respectively) (**Table 1**). However, in many other broods, the youngest sibling has taken longer to fledge and has sometimes leapt from the nest box and lived in the garden for several days before achieving enough lift to fly from the backyard (e.g. Chick 2/2007, Chick 3/2014).

The new observations spanning 2018 to 2023 support my earlier finding that Galah chicks usually fledge either within 120 min after sunrise or within 120 min before sunset (Pryor 2018). They are also in line with other studies which found that young Galahs usually fledge in the morning (Higgins 1999). Galahs forage for 1-4 h soon after sunrise and again in the mid to late afternoon (Noske 1980; Pidgeon 1970). It is likely that after foraging, the parents return to the nest, feed younger nestlings then urge a nestling that is ready to fledge to leave the nest. Such parental behaviour would ensure that younger nestlings are satiated in case the parents spend more time than expected escorting a fledgling to the crèche.

The new observations spanning 2018 to 2023 also support the previous finding that Galah chicks do not fledge between mid-morning and mid-afternoon (Pryor 2018). This is likely because during the hottest part of the day, the parents shelter in trees (Australian Museum 2021) and do not call to their chicks and while the chicks often spend hours in the nest box entrance hole, they do not call to their parents (KP pers. obs.).

CONCLUSIONS

If all Galah chicks in a brood are strong and healthy, they may fledge in quick succession on the same day. They are most likely to fledge within 120 min after sunrise or within 120 min before sunset.

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Did Australian Pied Oystercatchers on Lake Macquarie benefit from the 2021 lockdowns?

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Reports of the Australian Pied Oystercatcher *Haematopus longirostris* on Lake Macquarie were reviewed for breeding records. Although between 2006 and 2020 there were occasional reports of breeding attempts or of fledged juveniles, there were no confirmed successful local breeding events during that 15-year period. However, in late 2021 four pairs of oystercatchers were observed with unfledged young. Several subsequent sightings of juvenile birds during 2022-23 suggest the successful fledging and maturation of the 2021 nestlings. The reduction in human recreational activities around the lake during the COVID-19 lockdowns in 2021 may have been a factor in this unprecedented local breeding success.

INTRODUCTION

The Australian Pied Oystercatcher *Haematopus longirostris* is present in small numbers in the Lake Macquarie estuary. Data from the Hunter Region Annual Bird Reports indicate its presence in low numbers (of up to five birds) in the Swansea area between 1993 and 2007 (Stuart 1994-2008). Since February 2008, members of the Hunter Bird Observers Club (HBOC) have conducted monthly surveys of shorebirds and waterbirds at Lake Macquarie. Australian Pied Oystercatchers have regularly been observed on the sandbanks and small mangrove islands at Marks Point, Pirrita (formerly Coon) Island, Swansea Channel, and Black Neds Bay (**Figure 1**). They also have been recorded elsewhere around the lake (e.g. Coal Point, Wangi Wangi, Murrays Beach, Green Point) and on the adjacent coastline (e.g. Nine Mile Beach and Catherine Hill Bay). The HBOC surveyors have recorded an average count of six Australian Pied Oystercatchers in summer and three individuals in winter.

Despite regular sightings around Lake Macquarie, breeding records have been circumstantial. The main breeding-related observations by the HBOC shorebird survey team prior to 2021 were of failed breeding attempts in 2015 and 2018, plus sporadic records of juvenile fledged birds originating from unknown nesting sites. There were concerns among the HBOC shorebird survey team that the longevity of individual birds was masking a lack of breeding success. Thus, reports of parents with unfledged young at four separate sites on the lake between October and November 2021 were noteworthy.

Those reports prompted me to review all the available records of Australian Pied Oystercatchers around Lake Macquarie and assess them for reports of breeding. This paper compiles all the suspected and confirmed breeding events in the Lake Macquarie estuary and documents all sightings of potentially nesting birds and records of unfledged young and juvenile birds. This study has also highlighted the negative effects on breeding success from near-relentless human disturbance.

METHODS

Location

Lake Macquarie is located in the Hunter Region of NSW. It is a large (110 square kilometre) estuarine lake with a narrow entrance to the ocean at Swansea. The lake's entrance, between the ocean and the "drop-over" to deeper waters within the lake, is characterised by a mixture of habitats including shifting sandbanks, seagrass meadows, mangroves, saltmarsh, artificial rock emplacements and sandy shorelines (see **Figure 1**). Pirrita, Spectacle and Elizabeth Islands support mangroves, saltmarsh and casuarinas. There are also several smaller unnamed islands and tidal sandbars, and a large expanse of mangrove and saltmarsh habitat east of Swansea Bridge at Black Neds Bay.

Sourcing Australian Pied Oystercatcher records

Entries in the Hunter Region Annual Bird Reports were examined to determine the presence of any breeding records in Lake Macquarie. Records in Birdata (https://birdata.birdlife.org.au) with associated breeding activity including "adult(s) on nest", "young out of nest",

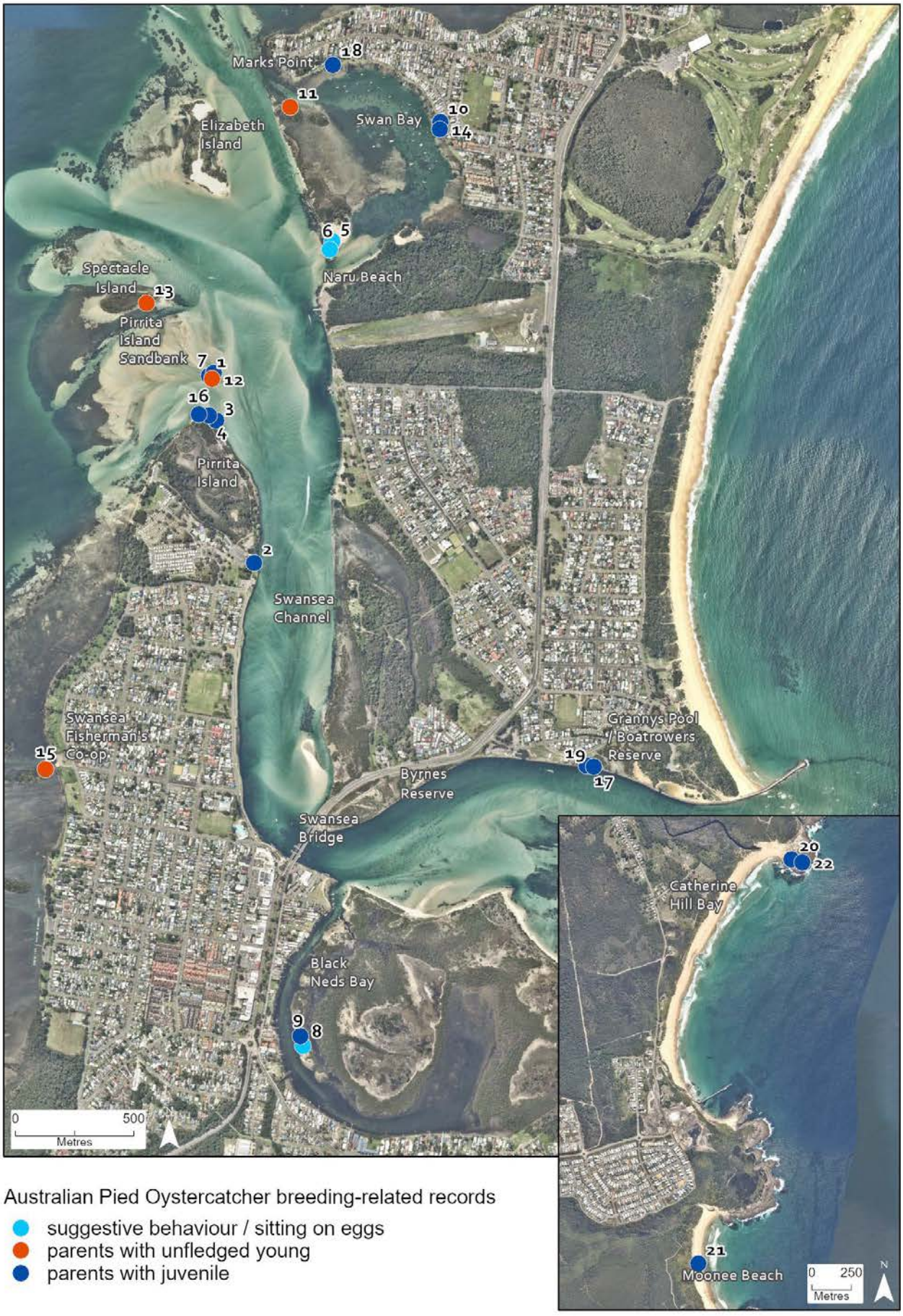

Figure 1. Map showing Australian Pied Oystercatcher breeding records on Lake Macquarie 2006-2023.

Table 1. Details of Australian Pied Oystercatcher breeding records on Lake Macquarie 2006-2023.

Date	Description	Type	Observer/s and source	Number on map
10/12/2006	A pair with young, on a small island directly north of Pirrita Island.	Juvenile	Frank Cosgrove (Stuart 2007)	1
13/12/2008	A juvenile bird begging from an adult at Swansea near Pirrita Island.	Juvenile	Maureen Goninan (Flickr)	2
19/12/2009	A juvenile bird with adult at Pirrita Island.	Juvenile	Greg Miles (Flickr)	3
12/01/2013	Two young birds with adults on Pirrita Island rock foreshore.	Juvenile	Jack Adams, Mandy McDonald (shorebird surveys)	4
14/09/2015	A breeding attempt at Marks Point, believed to have been unsuccessful.	Sitting on eggs	Anthony Marchment (pers. comm.)	5
8/09/2018 and 10/11/2018	An apparent breeding attempt in September through to November 2018, believed to have been unsuccessful.	Sitting on eggs	Jack Adams, Mandy McDonald (HBOC shorebird surveys)	6
7/12/2019	A young bird with two adults on the small mangrove island north of Pirrita Island.	Juvenile	Jack Adams, Mandy McDonald, David White (shorebird surveys)	7
7/12/2019	Pair displaying suggestive breeding behaviour in Black Neds Bay	Suggestive behaviour	John Craig (shorebird surveys)	8
22/02/2020	A juvenile bird with two adults at Black Neds Bay.	Juvenile	Mandy McDonald (shorebird surveys)	9
4/11/2020	Two adult birds with a young bird at Marks Point.	Juvenile	Dennis Neader (Birdata)	10
2/10/2021	Two adult birds with a fluffy chick on the northern mangrove island of Swan Bay, just south of Marks Point	Unfledged young	Geoff Coates (Birdata)	11
14/10/2021	Two adults plus two chicks on the small island directly north of Pirrita Island.	Unfledged young	Meryl Newton (Facebook)	12
6/11/2021	Two adults and one small fluffy chick on the southern side of Spectacle Island.	Unfledged young	Jack Adams, Mandy McDonald, David White (shorebird surveys)	13
6/11/2021	Two adult birds feeding a recently fledged young bird at Marks Point.	Juvenile	Dennis Neader	14
12/11/2021	Two adults and two unfledged chicks on a mangrove island behind Swansea Fishermen's Co-op.	Unfledged young	Meryl Newton (Facebook)	15
10/12/2021	Two adults plus two fledged juvenile birds at Pirrita Island.	Juvenile	Meryl Newton (Facebook)	16
2/01/2022	A sub-adult bird with an adult bird at Boatrowers Reserve, Blacksmiths	Juvenile	Jim Stone (eBird)	17
9/12/2022	A group of three birds including one sub-adult on the northern shoreline of Swan Bay.	Juvenile	Friend of Dennis Neader (pers. comm.)	18
24/02/2023	One maturing juvenile among a group of eight birds at Boatrowers Reserve, Blacksmiths.	Juvenile	Allan Johns (eBird)	19
10/03/2023	Nine birds including one maturing juvenile* at the north end of Catherine Hill Bay.	Juvenile	Allan Johns (eBird)	20
15/03/2023	Maturing juvenile* with seven adult birds at Moonee Beach.	Juvenile	Allan Johns (eBird)	21
02/06/2023	Seven birds including one maturing juvenile* at the north end of Catherine Hill Bay.	Juvenile	Allan Johns (eBird)	22

***** These juvenile birds had distinctive upturned bills and most likely they all were the same individual.

"recently fledged young", and "suggestive behaviour" were selected and investigated. The "Explore" function in eBird was used to search for breeding records in Lake Macquarie (https://ebird.org/species/pieoys1/au-nsw-lak). Although it was technically possible to filter photos by age (e.g. "immature", "juvenile"), behaviour ("feeding young", "courtship"), and tags ("nest"), the photos were not always tagged with all relevant information, so each photo was checked for the exact location of the record and the presence of sub-adult birds.

The Birds of the Hunter and Central Coast Facebook photography page (www.facebook.com/groups/465610836974827) provided several records of shorebirds in the Lake Macquarie area, including two of the recent (2021) records of nesting oystercatchers, which were also reported to the HBOC records officer by the photographer.

A search of the photo sharing application Flickr (www.flickr.com) yielded two photographs of juveniles with their parents in the Lake Macquarie area. Tags such as "Coon Island", "near Coon Island", "Swansea, NSW", and "Lake Macquarie" confirmed the location of the photographs.

Observers were contacted, where possible, to verify their reports and clarify record details.

Age of birds

When photographs were available, assessment of juvenile/immature bird age was made based on "Bird in the Hand" field information sheets produced by the Australian Bird Study Association (2019). Birds with a fluffy, downy appearance were recorded as unfledged young. Fledged juvenile birds (of less than four years of age) were differentiated from adult birds by their brown rather than black feathers, and the darker/duller colours of their bill, eyes and legs. No distinction was made between first, second and third-year birds.

RESULTS

A summary of all documented breeding-related activity of Australian Pied Oystercatcher in Lake Macquarie is presented in **Table 1**. The locations for each such activity are shown in **Figure 1**.

Below are some specific comments in relation to the reports in **Table 1**:

- The report of two adult birds feeding a recently fledged young bird at Marks Point on 6 November 2021 is considered likely to involve the same family of three birds observed at that location early in the previous month (2 October).
- The report of two adults plus two fledged juvenile birds at Pirrita Island on 10 December 2021 is considered likely to involve the same family which bred nearby (recorded there on 14 October).
- Three records over March-June 2023 of adults with a juvenile are considered likely to involve the same juvenile each time. All three juvenile birds had distinctive upturned bills; hence most likely they all were the same individual.
- Evidence of post-breeding dispersal included records of juvenile birds at Marks Point, Pirrita Island, Boatrowers Reserve Blacksmiths, Catherine Hill Bay and Moonee Beach (see **Figure 1** for locations).

DISCUSSION

The successful hatching of chicks from four separate pairs of Australian Pied Oystercatchers within an area of three square kilometres in the spring of 2021 was encouraging news for the local oystercatcher population. This endangered species is reported to consist of fewer than 200 breeding pairs in NSW (NSW Office of Environment and Heritage 2021). Subsequent records of juvenile and sub-adult birds in the Lake Macquarie area suggest that the chicks survived to fledging and then dispersed to nearby locations on the lake and coast. The dispersal of Lake Macquarie juvenile oystercatchers (observed among flocks of up to eight adult birds between February and June 2023) suggests a similar pattern of movement to that observed on the Worimi Conservation Lands, where Australian Pied Oystercatchers congregate in mixed-age flocks along the coastline outside the breeding season (Fraser & Lindsey 2018).

One possible explanation for the spike in breeding events in 2021 is the decreased human activity on the lake resulting from the 2021 lockdowns associated with controlling the COVID-19 pandemic. It is known that the Australian Pied Oystercatcher is particularly vulnerable to human disturbance, the peak of which usually occurs during their breeding season in Spring and Summer (NSW Local Land Services 2021). Breeding attempts on the sandy island near Naru Beach in 2018 had previously been abandoned due to high numbers of people, boats and dogs at the site. The COVID-19 lockdowns, which included restrictions on recreational activities and on inter-LGA travel, resulted in less activity on the lake. For example, there were fewer boat trailers at the Pirrita Island boat ramp at that time (J. Adams pers. comm., 11 November 2021). This may have freed up the mangrove and sand islands for the oystercatchers to complete their breeding cycle relatively undisturbed, while the increase in people walking

and observing nature in their local area may have contributed to the increase in incidental sightings and visits by photographers to previously overlooked locations.

Managing the increasing threats from disturbance

The ability of oystercatcher pairs to successfully complete a breeding cycle within their established territories on the lake is compromised by human disturbance during the breeding season. The Lake Macquarie Local Government Area (LGA) experienced a population increase of more than 30,000 people between 2006 and 2021 (Australian Bureau of Statistics 2016, 2021), and the population is projected to increase to approximately 250,000 by 2050 (Lake Macquarie City Council 2018). There has been a corresponding increase in recreational pressure on the lake, particularly on the sand banks and islands between Swansea bridge and the "drop-over". Tourism campaigns have highlighted the white sands of Naru Beach and surrounding sand islands as places to recreate and explore (Lake Macquarie City Council 2022). Potential impacts on local birdlife include the crowding out of beach-nesting endangered shorebirds such as Australian Pied Oystercatcher and Little Tern *Sternula albifrons* and the inability of resident and migratory shorebirds to find undisturbed feeding and roosting habitat. This situation has already been observed by the wader survey team on days of high visitation. It is likely to intensify as recreational pressure grows.

Much is still unknown about the nesting behaviour of oystercatchers at Lake Macquarie and about their movements around the lake or between the lake and nearby coastal beaches. It is possible that some pairs retreat to quieter, more secluded sites to breed and only return to favoured territories in Swansea Channel once they have fledged young. Port Stephens birds are believed to originate largely from natal territories outside the area due to the sparsity of suitable breeding habitat and recorded breeding observations (Stuart 2011; Fraser & Stuart 2018), although breeding was recorded at Winda Woppa in 2017 and Corrie Island in 2018 (Fraser & Stuart 2018). Reports of a further four nesting pairs at Corrie Island in 2019 highlight the importance of isolated shoreline and secluded islands on which the birds can nest relatively undisturbed and in higher densities than beach-nesting oystercatchers (Fraser 2020).

Long-term studies of Australian Pied Oystercatchers in south-east Tasmania charted a decrease in breeding success, despite improvements in estuary health and oystercatcher prey availability over the same period. The impact of recreational disturbance and sea level rise on traditional nesting sites in the study area resulted in limited availability of suitable breeding habitat, and birds of breeding maturity effectively "queueing for a territory" (Fletcher & Newman 2010). Human recreational activity been implicated in multiple nest failures and in the selection of inferior nesting territories with resultant lower breeding success on the Worimi Conservation Lands (Russell & George 2012). Given the documented impacts of recreational activities on oystercatcher populations, the breeding successes on Lake Macquarie in 2021 may be interpreted as a response to reduced habitat disturbance at a critical time in the breeding cycle, finally providing the birds of breeding age with an opportunity to hatch and fledge chicks.

CONCLUSIONS

Reports of four separate Australian Pied Oystercatcher breeding events on Lake Macquarie in 2021 and the subsequent sightings of juvenile birds on the lake and nearby coastline are important for two reasons: they are the first local breeding records in which the nesting sites were able to be confirmed, and they followed many previous unsuccessful breeding attempts.

The reduction in recreational activity due to the 2021 COVID-19 lockdowns may have been a factor in the successful 2021 breeding events. The return to pre-pandemic levels of human activity and the projected population increase with a corresponding recreational pressure should be managed, so as to ensure that this threatened species is able to continue living and breeding at Lake Macquarie.

Further study of Australian Pied Oystercatcher breeding preferences and movements around the lake (and beyond) would assist in guiding habitat management to protect this threatened and iconic Lake Macquarie shorebird.

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Ground-based crepuscular hunting by the Peregrine Falcon: records of birds taking adult Wedge-tailed Shearwaters

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INTRODUCTION

This article reports observations of ground-based crepuscular hunting by the Peregrine Falcon *Falco peregrinus* on Broughton Island. The island, which is located about 3 km offshore from the New South Wales coastline to the northeast of Port Stephens, is an important seabird breeding island (Carlile *et al*. 2012). The main breeding seabird is the Wedge-tailed Shearwater *Ardenna pacifica*, with the most recent population estimate being 64,500 pairs (Carlile *et al*. 2022). There is a small breeding population of Little Penguins *Eudyptula minor* (Carlile *et al*. 2012). In 2022 we (MS and MS) set up ten motion-activated cameras ("trail cameras") on the rocky shoreline of Providence Point. The cameras were installed for a number of months at known landing sites for the Little Penguin, which we were attempting to monitor. Although the results from that effort were mixed, the cameras did record many interesting insights about wildlife on Broughton Island. This article reports one of those insights – an uncommon or under-reported behaviour by a Peregrine Falcon. Beginning from 5.26 am on 27 October 2022, one of the trail cameras captured images of a Peregrine Falcon killing and beginning to dismember and eat a Wedge-tailed Shearwater. Sunrise on Broughton Island on that date was at about 5.31 am; i.e. the event occurred about five minutes before dawn. **Figure 1** shows three examples from the 13 images captured on camera – in combination they clearly confirm the identities of the two species.

Similar series of images were taken on seven subsequent pre-dawn mornings during late October and early November 2022 ending in the same result: a single shearwater captured, partially eaten and then the carcass left *in situ* at the point of capture. In each case, the Peregrine Falcon took an individual from a gathering of shearwaters readying to take off in the pre-dawn flyout.

DISCUSSION

Worldwide there are as many as 19 subspecies of Peregrine Falcon. Three of those occur in Australia although subspecies *calidus* (the Siberian Peregrine Falcon) is an uncommon to rare migrant from the northern hemisphere. Another subspecies, *submelanogenys* (South-west Australian Peregrine Falcon), is only found in the southwestern parts of Australia. The subspecies *macropus* (Australian Peregrine Falcon) is widely distributed across much of the remainder of Australia, including on Broughton Island.

Australian Peregrine Falcon

The Australian Peregrine Falcon is usually considered to be a diurnally active raptor, hunting small to mid-sized birds as its main prey (Marchant & Higgins 1993; Olsen *et al*. 1993). Its predominant hunting technique involves fast diving attacks upon its targeted prey, using visual cues to strike and kill the prey in flight.

There are three prior reports of crepuscular/ nocturnal hunting/feeding by Australian Peregrine Falcon. Calaby (1951), in an article about the hunting of rabbits by the Little Eagle *Hieraaetus morphnoides*, briefly mentioned nocturnal hunting by the Peregrine Falcon. Baker-Gabb (1986) reported them taking adult Short-tailed Shearwaters *Ardenna grisea* returning to burrows at night. Similarly, Lane (1989) noted that the falcons took adult Gould's Petrels *Pterodroma leucoptera* at night.

Marchant & Higgins (1993) listed many prey items for the Australian Peregrine Falcon, predominantly bird species (about 100 species were named) but also rabbits, hares and bats. Surprisingly, only one seabird species was mentioned even though they state elsewhere "hunts petrels returning from sea at night" (Marchant & Higgins 1993: 312). That

Figure 1. Three of the trail camera images captured on 27 October 2022, collectively showing a Peregrine Falcon taking an adult Wedge-tailed Shearwater pre-dawn using a ground-based attack.

statement presumably was based upon Lane's brief note published four years earlier (Lane 1989). The only seabird listed as an Australian Peregrine Falcon prey item was the Fluttering Shearwater *Puffinus gavia* (Marchant & Higgins 1993: 312).

A pair of Australian Peregrine Falcon are often recorded on Broughton Island (Stuart *et al*. 2017; Stuart 2020). There is at least one record of the pair with a fledged juvenile (AS pers. obs.). We have long assumed that the falcons would be predating shearwaters on their way to/from their burrows, but this has never been proven.

Nocturnal hunting by other Peregrine Falcon subspecies

In general, all the subspecies of Peregrine Falcon are considered to be diurnal raptors, but there have been several reports of crepuscular or nocturnal activity especially in city environments (Raptor Refuge 2024). For example, DeCandido & Allen (2006) reported many instances of nocturnal hunting by urban-dwelling birds in New York (probably subspecies *anatum*; there are three subspecies in North America but the other two have limited ranges).

Wynn *et al*. (2010) reported that subspecies *pelegrinoides* (the "Barbary Falcon") was taking adult and juvenile Balearic Shearwaters *Puffinus mauretanicus* at night at the shearwater breeding grounds on Menorca Island in Spain. Compounding the problems for that endangered shearwater, subspecies *brittanicus* also was hunting Balearic Shearwater in southern United Kingdom waters in in the post-breeding season (but only by day; no nocturnal events were noted).

A Peregrine Falcon in Hokkaido, Japan (subspecies *japanensis*) was observed to kill a Mallard *Anas platyrhynchos* about 40 minutes before sunrise (Hirata *et al*. 2013). The area was dimly lit and the authors concluded that it suggested the potential of the Peregrine Falcon to forage successfully in non-urban habitat under low-light conditions.

A trail camera at a nest of subspecies *brittanicus* in Nottingham, England, recorded several instances of a male bringing food to its chicks at night (Kettel *et al*. 2016). Although the authors did not observe any nocturnal activity at two other *brittanicus* nests in their study, they mentioned some other examples and commented that "nocturnal behaviours at the nests are increasingly observed" as a result of the use of trail cameras at urban nest sites (Kettel *et al*. 2016).

In bright light, the Peregrine Falcon has very fast speed of vision, as measured by its flicker fusion frequency (FFF). At lower light levels its FFF slows to less than half (Potier *et al*. 2020). However, it seems that is sufficient for it to be able to hunt successfully in low-light conditions.

Peregrine Falcon and seabirds

It is common for Peregrine Falcons to take seabirds, and there are numerous reports from around the world. For example, the largest subspecies, *pealei* ("Peale's Falcon"), feeds almost exclusively on seabirds, flying long distances at sea to capture its prey (White 1975). The Barbary Falcon (subspecies *pelegrinoides*) regularly takes adult and young Manx Shearwaters *Puffinus puffinus* from around the breeding colonies (Wynn *et al*. 2010). It seems surprising that the Marchant & Higgins (1993) list of prey items of the Australian Peregrine Falcon contains so few seabirds.

Figure 2. Fairy Prion wings found at a Peregrine Falcon feeding roost at Shark Island Nature Reserve in June 2021.

It is evident from some locally used Peregrine Falcon island feeding sites that seabirds are a component of the diet. At Shark Island Nature Reserve on 15-16 June 2021 and on 28 October 2021, several Fairy Prion *Pachyptila turtur* wings were found strewn around the ground at a Peregrine Falcon feeding site (**Figure 2**). Additional seabird remains found at this feeding site were from a Fluttering Shearwater *Puffinus gavia* and three White-faced Storm-petrels *Pelagodroma marina* (Schulz 2021a). Also, a single set of Fairy Prion wings was found below a Peregrine Falcon's nocturnal roost at Fingal Island lighthouse on 16 June 2021 (Schulz 2021b). These seabirds are likely to have been taken aerially by a Peregrine Falcon while it was hunting offshore, because none of them breed on either Shark or Fingal islands.

Ground-hunting by the Peregrine Falcon

The Peregrine Falcon's prey is mostly taken in flight, although there have been occasional reports of it feeding on carrion (Marchant & Higgins 1993). Catching of prey while the falcon is on the ground appears not to have been reported previously in Australia; for example, such behaviour is not reported in Marchant & Higgins (1993). Similarly, in detailed studies of the feeding habits of the Peregrine Falcon elsewhere in the world such observations were not reported. For example, that hunting method was not described in a detailed study of foraging behaviour conducted over eight years in three areas of South Africa (Jenkins 2008). Neither was it mentioned in a study of 355 foraging observations of the species in the Grand Canyon (Stevens *et al.* 2009), or in 328 hunting sequences observed in a study in Italy (Zoratto *et al.* 2010). However, this ground-catching behaviour may be more widespread than previously reported, particularly by individuals at seabird nesting colonies.

Other species taking advantage of the kills

When the falcons had finished feeding on the shearwater carcasses, the remains were left *in situ* on the rock platform/vegetation edge. As the sun rose, the carcasses were then fed upon by White-bellied Sea-Eagles *Haliaeetus leucogaster*, Whistling Kites *Haliastur sphenurus* and Australian Ravens *Corvus coronoides*.

CONCLUSIONS

A crepuscular feeding event by an Australian Peregrine Falcon on Broughton Island is one of the few documented instances of that behaviour by this subspecies, and also one of the few times it has been confirmed as preying upon a seabird. Given that most other Peregrine Falcon subspecies are known to display both of those behaviours, it seems probable that the behaviours are under-reported for the Australian subspecies *macropus*. The capturing of prey whilst the Peregrine Falcon itself was on the ground appears to be an unusual prey-catching tactic, not previously reported for this species.

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The status of the White-fronted Chat in the Hunter Region, NSW

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Records of White-fronted Chat *Epthianura albifrons* in the Hunter Region from 1969-2023 were analysed for annual Reporting Rate and maximum monthly count. The majority of the records were from Ash Island, Kooragang Island, Hexham Swamp and Tomago Wetland in the Hunter Estuary, Gir-um-bit National Park in the Port Stephens estuary, and the Worimi Conservation Lands. The populations at Hexham Swamp and Tomago Wetland have increased while the populations at Ash Island, Kooragang Island and Gir-um-bit National Park have decreased. The population trend at Worimi Conservation Lands could not be determined.

The population increases at Hexham Swamp and Tomago Wetland are attributed to the increase in area of saltmarsh, due to rehabilitation projects. The decrease at Kooragang Island and to a lesser extent at Gir-um-bit National Park is attributed to loss of habitat. The reason for the decrease at Ash Island is uncertain although disturbance may be a factor.

The regional decline in Reporting Rate from 2010 to 2023 was shown to be 64.5% which was in agreement with previous state-wide determinations. The study also highlighted that the sites used to collect data represented a limited selection of the suitable habitat available for this species in the Hunter Region, and the actual distribution and size of the population are not fully understood.

INTRODUCTION

The White-fronted Chat *Epthianura albifrons* is a member of the family Meliphagidae, the honeyeaters and Australian Chats, which is the largest passerine family in Australia (Higgins *et al.* 2001). The species is a saltmarsh and wetland specialist, preferring damp low shrubby open habit such as samphire flats, saltmarsh, saltbush plains and grasslands, especially on the edge of lakes, swamps, dams, estuaries and other wetlands, whether fresh or saline, permanent or ephemeral. In coastal areas, it frequents saltmarsh including samphire and sedges and also can be found in tussock grasslands, sand dunes, the edges of mangrove forests, and paperbark woodlands (Cooper *et al.* 2020). It forages on the ground, mainly for invertebrates and occasionally seeds. Nesting by the species is reported to be concentrated round areas of fresh water (Higgins *et al*. 2001).

The Australian IUCN Red List Status 2020 lists the species as Least Concern due to its extremely large range across southern Australia (BirdLife International 2024). However, in New South Wales (NSW) it is listed as Vulnerable on Schedule 1 of the NSW *Biodiversity Conservation Act 2016*, due to a moderate reduction in population size (NSW Department of Planning and Environment 2021). Jenner *et al*. (2011) analysed NSW Bird Atlassers data to determine change in annual Reporting Rate (RR) for all NSW Bioregions. The majority of White-fronted Chat records from the Hunter Region lie within the Sydney Bioregion. The analysis found a 53% relative decline in RR from 1981 to 2005 and a 32% decline from 1995 to 2005 for the region. Similarly, there was a 52% decline in RR for all of NSW between the 1977-81 and 1998-2002 BirdLife Australia Atlas periods (Barrett *et al*. 2007). Cooper *et al*. (2020) found the species was in serious decline in NSW with the annual RR changing from around 3.5% to less than 1% over the period 1986 to 2006 (70% relative decline). These studies all confirm the Vulnerable listing for the species in NSW based on a moderate reduction in population size.

Hunter Region

Although few bird lists for the Hunter Region prior to the 1960s exist, there were reports of several small flocks of White-fronted Chats between Newcastle and Nelson Bay in 1928 (Chisholm & Cayley 1929) and a bird at Salt Ash in 1931 (Hordern & Hordern 1931). In more recent times, birds were described as being locally common on Kooragang Island (van Gessel & Kendall 1972) and

on Ash Island (Stuart 2002). Throughout the Hunter Region, the species mainly inhabits coastal wetlands and is often seen in small flocks in the Hunter Estuary where it is resident and where it has been recorded breeding (Gosper 1981, Herbert 2007). In 2012 on Ash Island, White-fronted Chats were found to respond rapidly to new foraging opportunities created as the result of a fire that removed existing vegetation (Kyte & Newman 2013).

The objectives of our current study were to establish the distribution of White-fronted Chat in the Hunter Region and determine its population status. The location of the region is shown in **Figure 1**.

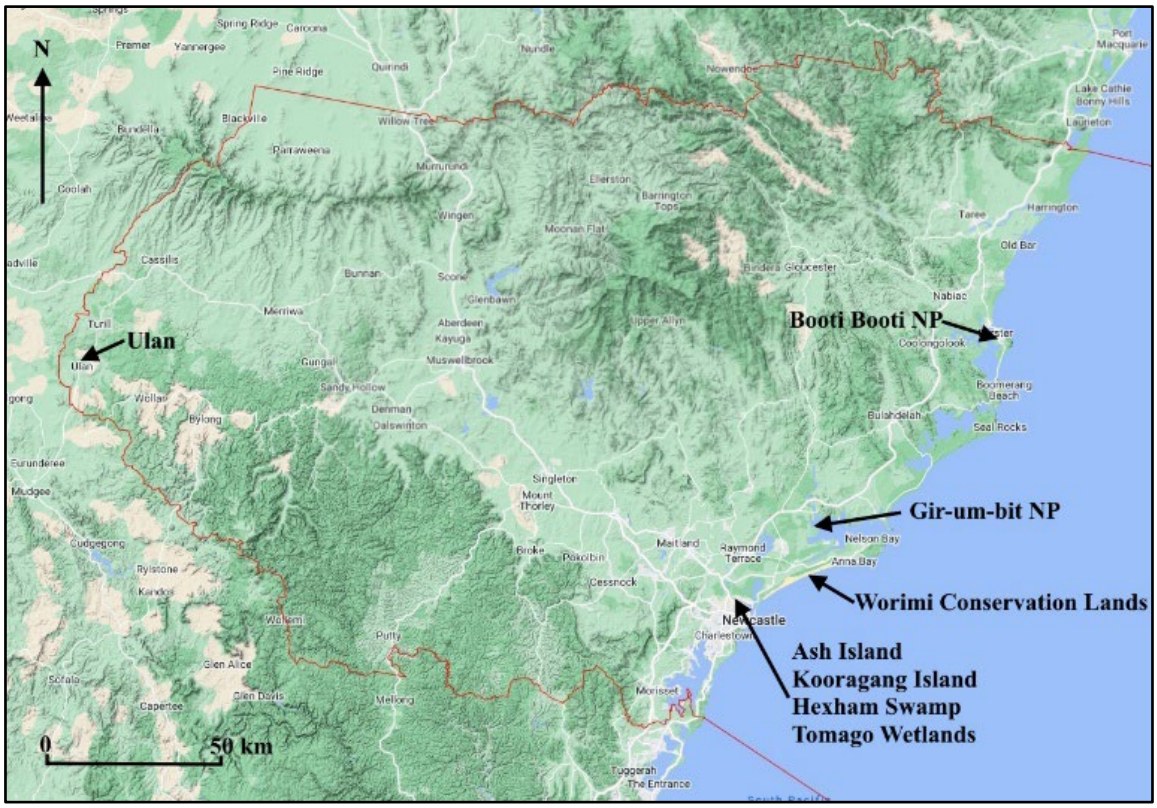

Figure 1. Map showing Hunter Region boundary (in red) and main sites with White-fronted Chat records. Image Birdata https://birdata.birdlife.org.au/explore#map=-33.2829441_153.1320520_7&region_id=20.

METHODS

Records for White-fronted Chat were extracted from the BirdLife Australia Birdata portal (https://birdata.birdlife.org.au/home), the Cornell Lab of Ornithology eBird Australia portal (https://ebird.org/australia/home) and the NSW Department of Environment and Heritage BioNet Atlas (https://atlas.bionet.nsw.gov.au/). Other records were extracted from Annual Bird Reports for the Hunter Region (https://www.hboc.org.au/publications/annual-bird-report/) for years 1993-2019 and from a spreadsheet of early avian records (1979-1993) for the Hunter Region (A. Stuart pers. comm.). Additional early records were obtained from Kooragang Island Bird Counts for 1969-1977 (van Gessel & Kendall 2015).

Sites with regular survey effort over extended periods were identified and their records compiled. The maximum and mean counts for months that birds were present were determined for each site and for the region.

The annual RRs for the sites were extracted from the BirdLife Australia Birdata portal. Birdata only provided RRs for those years that had more than 30 surveys. (RR is the number of records for a species divided by the number of surveys, expressed as a percentage). Only the data from 500 m, 5 km, fixed route and shorebird surveys were used. This was done to minimise potential bias resulting from the large number of 2 ha/20 min and incidental surveys from Ash Island and Hexham Swamp in some years. The annual RR data for six sites and for the region were charted using Microsoft Excel.

RESULTS

A total of 53 sites with White-fronted Chat records were identified, extending from Coopernook in the north of the region to Lake Macquarie in the south. Most of the sites were in near-coastal regions, with outliers at Gloucester and Maitland. A single inland site was identified at Ulan on the region's western

boundary. The records located spanned 1970-2023. The period over which records were available, the numbers of records and the maximum and mean monthly counts are summarised in **Table 1**.

Table 1. The record periods for each White-fronted Chat site, and the numbers of records and the maximum and mean monthly counts at each site.

Site	Record Period	Number of Records	Maximum Monthly Count	Mean Monthly Count
Hunter Region	1969-2023	2,737	85	10.2
Ash Island	1997-2023	734	60	6.5
Kooragang Island + Stockton Sandspit	1969-2017	256	60	8.6
Hexham Swamp	1979-2023	1,101	75	12.6
Tomago Wetland	2007-2023	324	47	10.0
Gir-um-bit NP, Swan Bay	1980-2023	144	34	5.6
Worimi Conservation Lands, Stockton Bight	1999-2023	44	14	8.9
Booti Booti NP, Wallis Lake	1985-2010	30	4	1.3
Ulan	2013-2021	20	4	2.3
Other (45 sites)	1970-2019	84	20	-

The majority of the records (95%) were from six sites: Ash Island; Kooragang Island; Hexham Swamp; Tomago Wetland; Gir-um-bit National Park (NP); and Worimi Conservation Lands (WCL). The first four sites are located in the Hunter Estuary, the Swan Bay site (Gir-um-bit NP) is in the Port Stephens Estuary and the WCL site is on Stockton Bight. The Kooragang Island site included records from Stockton Sandspit. Records for Ash Island and Kooragang Island were from 1999 onwards, Gir-um-bit NP from 2000, Tomago Wetland from 2007, and Hexham Swamp and Worimi Conservation Lands from 2009. Total count data were available for most sites from 2010 onwards. Apart from Booti Booti NP and Ulan, the other sites generally had only 1-2 records each.

Charts of Annual RR for the region are presented in **Figure 2** and for the six main sites in **Figures 3-8**. All available Birdata RR records from 500 m, 5 km, fixed route and shorebird surveys were used.

Hunter Region

The annual RRs for the Hunter Region for 2000-2023 are shown in **Figure 2** together with the linear trendline. Applying the trendline equation to the annual rates indicates a change in RR from 6.6% to 2.3% over the period. This is a decline of 64.5% over 24 years.

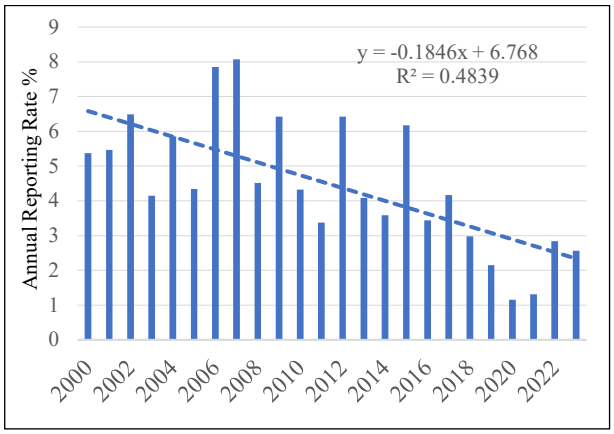

Figure 2. Annual Reporting Rate for White-fronted Chat in the Hunter Region, 2000-2023 with linear trendline and regression equation.

Ash Island

Figure 3 shows the annual RRs for Ash Island for 1999-2023. A decline was evident from 2003 and from 2012 it declined exponentially. After 2017 there were almost no records from the site until 2023 when there was a one-off record of 50 birds.

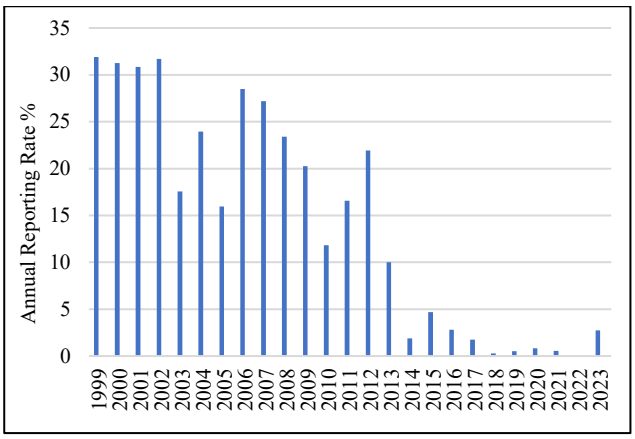

Figure 3. Annual Reporting Rate for White-fronted Chat at Ash Island 1999-2023.

Hexham Swamp

Figure 4 shows the annual RRs for Hexham Swamp from 2009-2023. It shows an uncertain trend increasing from 2012 to 2015, then remaining relatively unchanged.

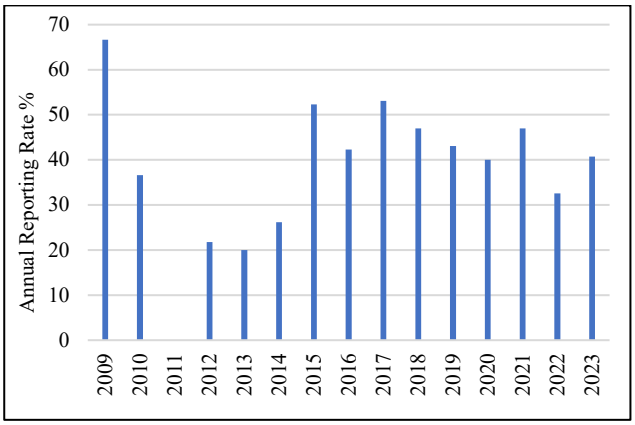

Figure 4. Annual Reporting Rate for White-fronted Chat at Hexham Swamp 2009-2023.

Kooragang Island and Stockton Sandspit

The annual RRs for Kooragang Island and Stockton Sandspit from 1999-2023 are shown in **Figure 5**. The majority of the records were from Kooragang Island and only 12 were from Stockton Sandspit. A rapid decline is evident from 1999 until 2012. Subsequently, the only record was in 2017.

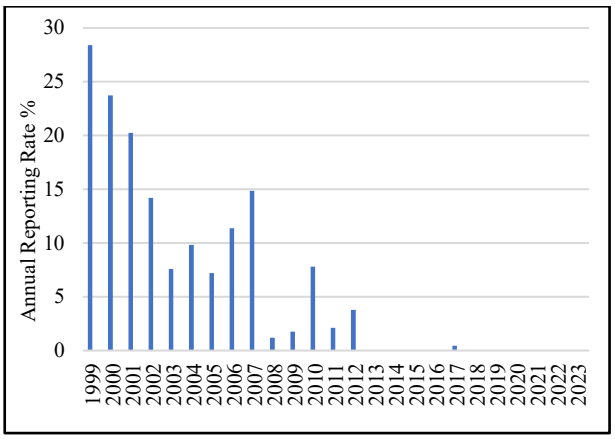

Figure 5. Annual Reporting Rate for White-fronted Chat at Kooragang Island and Stockton Sandspit 1999-2023.

Gir-um-bit National Park

Figure 6 shows the annual RRs for Gir-um-bit NP from 2010-2023. The number of data points is limited and there is no trend evident.

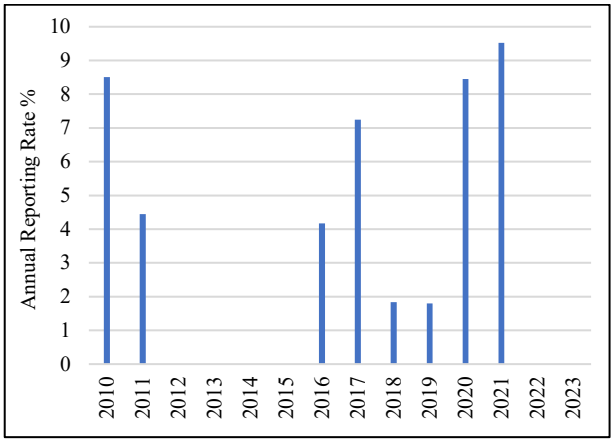

Figure 6. Annual Reporting Rate for White-fronted Chat at Gir-um-bit NP 2010-2023.

Tomago Wetland

The annual RRs for Tomago Wetland for 2010-2023 are shown in **Figure 7**. There is an uncertain trend: RR increased from 2010 to 2020, followed by a decline.

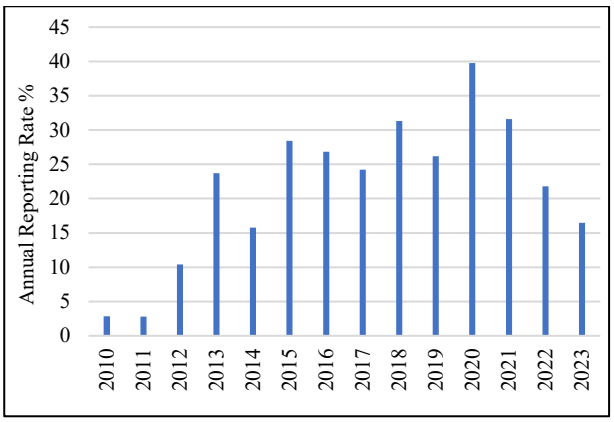

Figure 7. Annual Reporting Rate for White-fronted Chat at Tomago Wetland 2010-2023.

Worimi Conservation Lands

Figure 8 shows the annual RRs for Worimi Conservation Lands from 2014-2023. The data set is limited and no clear trend is evident.

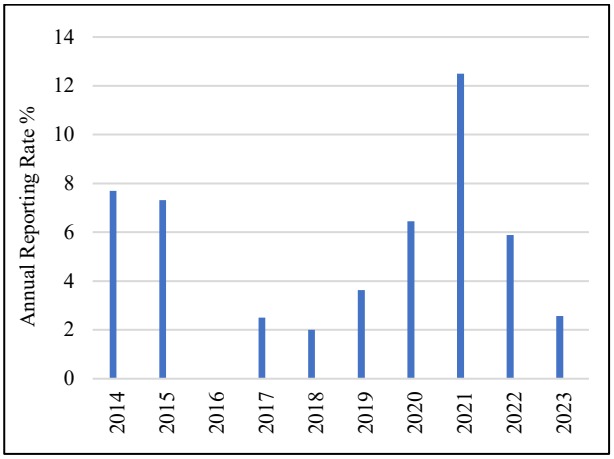

Figure 8. Annual Reporting Rate for White-fronted Chat at Worimi Conservation Lands 2014-2023.

DISCUSSION

The majority of the White-fronted Chat records were from sites in coastal areas, mainly around the Hunter and Port Stephens estuaries, plus a small number from Wallis Lake. However, these sites were chosen for surveying mainly because of their shorebird roosting habitat. There are many other sites in Hunter coastal regions with potentially suitable habitat for chats, which have not been surveyed. These include other parts of the Hunter and Port Stephens estuaries, the Lower Myall River, other parts of Wallis Lake and the Manning Estuary.

Threats to White-fronted Chat

The major threats to White-fronted Chat populations in coastal areas are reduction in habitat size and quality, human disturbance, and elevated nest-predation levels (NSW Department of Planning and Environment 2021). The species nests on the ground. Mangrove encroachment and sea-level rise associated with climate change present additional future threats to their preferred habitat. The species is strongly habitat-specific and sensitive to human disturbance and is unable to persist in the urbanised environments that often impinge on coastal saltmarsh (Jenner *et al.* 2011; Major & Sladek 2012). As populations become smaller and more isolated, genetic variability is lost along with recruitment opportunities from other nearby populations (Jenner *et al*. 2011; Major & Sladek 2012).

In the Hunter Region the White-fronted Chat is subject to all of the above threats although the extent of the threat may vary at different sites. However, as the sites in the Hunter Estuary are only a few km apart, the factors that influence population at a particular site should not be considered in isolation.

Hunter Estuary

Among the reasons for the decline of species numbers in the Hunter Estuary is the destruction of habitat. Over the past 200 years, tidal creeks have been filled in and the number of major islands in the river delta reduced from 21 to six (Williams *et al.* 2000). It has been established that over 80% of saltmarsh in the Hunter Estuary has disappeared since European settlement; in the lower estuary the area with saltmarsh decreased by 1400 ha between 1954 and 1994 (Williams *et al.* 2000). Construction of the Port Waratah Coal Terminal from 1982 and the Newcastle Coal Infrastructure Group terminal from 2008 resulted in the destruction of most of the remaining estuarine habitat on Kooragang Island, e.g. the Big Pond (Stuart & Lindsey 2021). Efforts to redress the situation began with the gazetting of Kooragang Nature Reserve in 1983, followed by the commencement of the Kooragang Wetland Rehabilitation Project (which included Stockton Sandspit, Ash Island and Tomago Wetland) in 1993 and the Hexham Swamp Rehabilitation Project in 2006.

Ash Island

The cause of the population decline on Ash Island is not known but the factors may include a combination of habitat change and increased

disturbance. However, recent habitat rehabilitation and modification may have been beneficial for White-fronted Chat populations. At the Fish Fry Flats site, mangroves were removed and mudflats and saltmarsh re-established as part of a rehabilitation project (Reid 2019). In June 2023, 50 chats were observed moving through the new saltmarsh (A. Stuart pers. comm.).

Kooragang Island and Stockton Sandspit

White-fronted Chat are no longer recorded on Kooragang Island or Stockton Sandspit although the reasons for its demise may be different at each site. In their *Checklist of the birds of Kooragang Island*, van Gessel and Kendall (1972) describe it as a breeding resident and rather common, with a maximum number of 50 birds recorded in August 1971 (van Gessel & Kendall 1972). At that time chats inhabited the areas where the two coal terminals were subsequently built (F. van Gessel pers. comm.).

On the other hand, Stockton Sandspit is within the Hunter Wetlands National Park and efforts to maintain it as a shorebird roost site have been successful. However, it is a small area of only approximately 10 ha. It is likely that the chat population was not large enough to be sustainable on such a small site which is constantly visited by fishermen and birdwatchers. In addition, there is little opportunity for population recruitment as the surrounding area has unsuitable habitat (being either urban, or riverine mangroves).

Hexham Swamp

Regular surveys of the eastern side of Hexham Swamp commenced in 2009, not long after the process of restoring tidal flushing to part of the swamp began in 2008. Although a range of wetland vegetation existed in the swamp (total area 2000 ha), over 1000 ha was Common Reed *Phragmites australis* (Winning & Saintilan 2009) which is unsuitable for White-fronted Chat. Tidal gates were progressively opened between 2008 and 2013 (Local Land Services 2022). A vegetation survey in 2021 found the area of mangroves had increased to 185 ha, saltmarsh to 109 ha and tidal mudflats and shallow ponds to 135 ha. The area of freshwater reed had reduced to 792 ha (Local Land Services 2022). The decrease in Common Reed and the creation of a mosaic of saltmarsh, mudflats and shallow ponds provided more habitat for White-fronted Chat and its population has increased. This is also evident in the RR trend which has increased until 2015, the remained relatively unchanged. Whilst the population of the species is stable at the moment, Grey Mangrove *Avicennia marina* is becoming the dominant vegetation on the eastern side of the swamp (AL pers. obs.) and its progressive advance into areas of saltmarsh may affect the chat population in the future.

Tomago Wetland

In 2007, members of Hunter Bird Observers Club commenced regular monthly surveys of a section of Tomago Wetland (450 ha in total area) to gather baseline data before the Tomago Wetland Rehabilitation Project commenced and tidal flushing to part of the wetland was reinstated (Lindsey & McNaughton 2012). White-fronted Chat was recorded in small numbers (1-3 birds) although the presence of 12 birds in June 2008 (Lindsey & McNaughton 2012) may indicate that a larger population was present. Expansions to the tidal footprint occurred in three stages – in 2008, 2011 and 2012-2015 (Lindsey 2021). The change from grassland to saltmarsh and sedges benefitted chats by providing additional habitat, and the maximum monthly count increased to become regularly more than 15 birds. The annual RR increased accordingly until 2020. However, the replacement of grassland by estuarine vegetation continues to be compromised by the limited tidal flushing of large areas to ensure that salt water does not encroach on adjacent private land. Human disturbance is minimal as the site is closed to the general public. The only site visitors are birdwatchers twice monthly, researchers and site managers. A fox abatement program and a program to manage introduced deer by National Parks and Wildlife Service (J. Erskine pers. comm.), have both contributed to the prevention of nest predation and trampling of saltmarsh.

Gir-um-bit National Park

White-fronted Chat are limited to the mudflats and saltmarsh in the Gir-um-bit National Park section of the Swan Bay survey area. The earliest record from the area was Bartrim (1980) who reported up to 18 birds in the saltmarsh year-round. Since 2000, maximum monthly counts of around ten birds were common. With limited data, the population trend is uncertain. Habitat loss has occurred gradually over the past 45 years. Mangroves have encroached on areas of saltmarsh and inundation of the site by high tides has become more frequent (Fraser *et al.* in prep.). The site is generally undisturbed, apart from monthly bird surveys by HBOC members.

Worimi Conservation Lands

During regular monthly surveys of the Worimi Conservation Lands, White-fronted Chats were mostly found behind the foredunes, in swales which fill with water after heavy rain, but then dry out rapidly. The vegetation in these swales is generally thicker and more diverse than surrounding areas and thus provides constant habitat for White-fronted Chat, except under drought conditions. Disturbance from off-road vehicles is common along the beach front and in some areas of the dunes.

Hunter Region population trend

The species is listed as Vulnerable under the NSW *Biodiversity Conservation Act 2016*. This listing requires a demonstrated decline of 30% over 10 years (NSW Department of Planning and Environment 2021). Our study has shown a decline of 64.5% in annual RR for the Hunter Region over the period 2010-2023. This change is in accord with the determination of the NSW Scientific Committee in 2010 (NSW Department of Planning and Environment 2021) and subsequent findings by other researchers (Jenner *et al.* 2011; Cooper *et al*. 2020).

CONCLUSIONS

Our study has confirmed that the population of White-fronted Chat in the Hunter Region is declining at rates comparable with previous state-wide determinations. However, the analysis is limited largely to a geographically restricted area comprising parts of the Hunter and Port Stephens estuaries only.

In the Hunter Region, White-fronted Chat populations are small, fragmented and vulnerable to extinction as a result of habitat destruction/ modification and disturbance. Populations continue to survive in the Hunter Estuary at Tomago Wetland and Hexham Swamp where, as part of two restoration projects, tidal flushing was reintroduced. As a result, the area of saltmarsh expanded and water quality and biodiversity improved, potentially resulting in more foraging opportunities for this wetland habitat specialist. However, both sites are compromised as there is a lack of reliable tidal flushing at Tomago Wetland to support the saltmarsh and, at Hexham Swamp, mangroves are taking over the re-established saltmarsh areas. Human disturbance would increase at the latter site if a proposed cycleway was installed.

The populations on Kooragang Island and Stockton Sandspit disappeared due to habitat loss and/or disturbance. The causes for the species' demise on Ash Island are uncertain but habitat modification and disturbance have probably played a role. Habitat loss may also be influencing a reduction in the population at Gir-um-bit NP.

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First Hunter Region breeding record for Red-chested Button-quail

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In this note I report the first confirmed breeding record for Red-chested Button-quail *Turnix pyrrhothorax* in the Hunter Region of New South Wales. The breeding record was at Cattle Lane, Parraweena (GPS co-ordinates 31º41.76' S, 150º30.42'E). Cattle Lane is accessed via Merriwa Road approximately 27 km west of Willow Tree on the New England Highway (**Figure 1**).

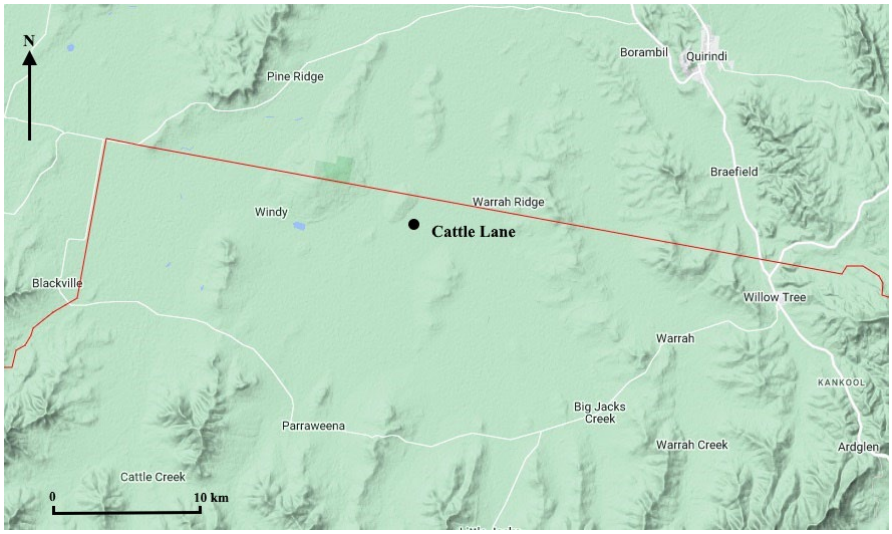

Figure 1. Location map for Red-chested Button-quail site, Cattle Lane, Parraweena, NSW, also showing the Hunter Region northern border (red). Source https://birdata.birdlife.org.au/home

OBSERVATIONS

From December 2020 through January 2021 there was an irruption of seed-eating birds on the Liverpool Plains in the north-west of the Hunter Region (Williams in prep.). Most sightings were concentrated around Cattle Lane where weather conditions had been ideal for wheat and other grain crops to be planted and thrive. I visited Cattle Lane on 10 December 2020, arriving around 6 pm and staying for more than two hours. In that time, I recorded the following seed-eating birds: Stubble Quail *Coturnix pectoralis* five birds; Little Button-quail *Turnix velox* five birds; Red-chested Button-quail *Turnix pyrrhothorax* 25 birds. In addition to the birds seen, there were many Stubble Quail calling.

I saw many Red-chested Button-quail and Stubble Quail feeding on, and just off, the edge of the dirt road. Also, a male Red-chested Button-quail was having a dust bath on the road. Around 8 pm another male Red-chested Button-quail emerged from the verge onto the road, with three chicks stumbling along with him. I was able to obtain photographs (**Figures 2** and **3**) before the four birds disappeared into the grass on the other side.

Figure 2. Male Red-chested Button-quail with three chicks, crossing Cattle Lane in December 2020 (photo: author).

Figure 3. Two of the Red-chested Button-quail chicks at Cattle Lane in December 2020 (photo: author).

DISCUSSION

The Red-chested Button-quail is endemic to northern, eastern and inland Australia (Marchant & Higgins 1993). In NSW, although rare and often overlooked as they are nocturnal/ crepuscular, it has been recorded in every region of the state although the majority of reports are from the Western Slopes and Riverine Plains regions (Cooper *et al*. 2016). The preferred habitats in NSW are areas of dense ground cover such as grasslands and crops; it can also be found in low open shrublands of, for example, saltbush and bluebush (Cooper *et al*. 2016).

Hunter Region records are uncommon. A specimen was collected by John Gould in the Upper Hunter in 1839 although he was not the first to record the species as he had already received a male bird from Charles Coxen that was collected somewhere on the Liverpool Plains (Cooper *et al*. 2016). However, during the period from 1993-2019 of the Hunter Region Bird Reports there were only three accepted records, involving four birds overall: an adult female and immature male at Widden Valley 2 October 2005; a female bird at Wingen 31 October to 1 November 2008; a female bird at Hexham Swamp 28 December 2017 (Williams in prep.). There has never before been a report of Red-chested Button-quail breeding in the Hunter Region.

There are scattered breeding records from throughout this species' range (Marchant & Higgins 1993; Cooper *et al*. 2016). In northern Australia nesting was reported to occur from February to July as well as late September, though for southern Australia breeding occurs from September to February (Cooper *et al*. 2016). The 2020 Cattle Lane breeding record fits with the latter view. However, Beruldsen (2003) suggested that the Red-chested Button-quail may breed in any month following sufficient inland rain to produce good grass growth.

The breeding biology of the Red-chested Button-quail is not well understood. It is reported to be polyandrous, with the male solely caring for the eggs and young (Marchant & Higgins 1993). However, a female was observed attending four chicks in June 1998 and captive females have been observed incubating eggs and participating in the rearing of young (Emmerson 1999). My sighting was of a male with chicks, which fits with the general view.

During the 2020/2021 summer irruption of seed-eating birds at Cattle Lane, there were several records of Stubble Quail breeding there (Williams in prep.). Given the numbers of Red-chested Button-quail present during my December 2020 visit, it seems likely that there was more than one breeding event for the latter species as well.

ACKNOWLEDGEMENTS

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Estuarine habitat change and its impact on shorebirds at Swan Bay, Port Stephens, NSW

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A small coastal wetland is located at Cockle Shell Point in the Gir-um-bit National Park, Swan Bay, in Port Stephens, NSW. It is a significant roost site, at times accommodating 25-50% of the shorebirds that use Port Stephens. An attempt to drain the site around 1985 caused tidal access to become regular. As a result, an open ephemeral lagoon became increasingly tidal, and surrounded by mangroves. Mangroves also replaced areas of saltmarsh and the area of open mud has been reduced. Rising sea level, possibly associated with climate change, has eroded the shoreline and eliminated a previous beach-front shorebird roost site.

Records sourced for the period from 1980 to 2023 revealed 20 species of migratory shorebirds and nine species of non-migratory shorebirds had used the area. However, many of the smaller species are no longer recorded, and the numbers of the larger birds have declined. In 2023 there were only eight migratory shorebird species and two non-migratory shorebird species using the site. The roosting behaviour of some species has also changed. The declining trend for five local shorebirds, Far Eastern Curlew *Numenius madagascariensis*, Whimbrel *N. phaeopus*, Bar-tailed Godwit *Limosa lapponica*, Grey-tailed Tattler *Tringa brevipes* and Red-capped Plover *Charadrius ruficapillus*, exceeds the national trend.

The study highlighted the importance of providing of artificial roosts and the need to maintain existing maritime infrastructure used by shorebirds for roosting, such as abandoned oyster leases, groynes, rock walls and wrecks. Careful planning and management of proposed changes to tidal regimes is essential to preserve coastal wetlands.

INTRODUCTION

Coastal and estuarine wetlands are vital to our marine life, avifauna and even our lifestyles and livelihoods. However, increasing coastal development and infrastructure has put many of these ecosystems in jeopardy.

The small Gir-um-bit National Park (NP) in Port Stephens hosts one of these wetlands (**Figure 1**). The National Park was established in 2007 and consists of a number of parcels of land located around the western shores of Port Stephens. It surrounds the settlement of Swan Bay and encompasses dry sclerophyll forests, wetlands and saltmarsh that provide key habitat for a variety of migratory and non-migratory shorebirds (Office of Environment and Heritage 2014). Many of these shorebirds are protected under the NSW *Biodiversity Conservation Act 2016* (BC Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The site hosting the wetland is south of the village of Swan Bay and was named Cockle Shell Point by Bartrim (1980).

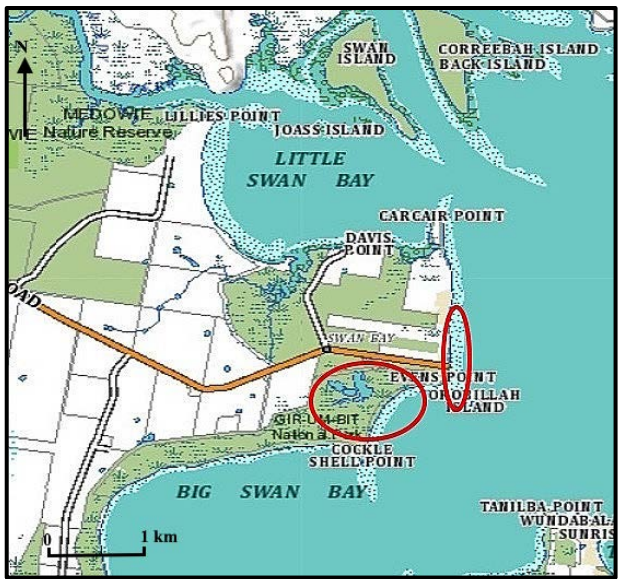

Figure 1. Location map, showing section of Gir-um-bit National Park, Swan Bay and two survey areas. (Image https://maps.six.nsw.gov.au/)

The Port Stephens estuary is recognised as the second most important site in NSW for shorebirds after the Hunter Estuary. Smith (1991) described it

as the most important site in NSW for Whimbrel *Numenius phaeopus* and one of the two most important sites for Far Eastern Curlew *Numenius madagascariensis*. He noted that both these species and the Pacific Golden Plover *Pluvialis fulva* had been recorded in Port Stephens in numbers exceeding 1% of the national population estimate. Stuart (2005) further confirmed its importance, documenting shorebird numbers that showed the estuary as internationally significant for Far Eastern Curlew and Australian Pied Oystercatcher *Haematopus longirostris,* and nationally significant for Bar-tailed Godwit *Limosa lapponica*, Whimbrel and Grey-tailed Tattler *Tringa brevipes*.

Swan Bay, including Cockle Shell Point, has been surveyed for birds since the early 1980s. Numerous reports have documented shorebird numbers and described roosting sites in Port Stephens (Bartrim 1980; Stuart 2004; Stuart 2005; Stuart 2010; Stuart 2011; Wooding & Stuart 2013; Wooding 2016; and Stuart 2020). Stuart (2004) estimated 25-50% of the total Port Stephens shorebird population roost there. However, over the past 40 years significant changes have occurred to the wetland. Considerable decline in shorebird numbers has accompanied these changes and many species are no longer recorded. This study documents changes to the Cockle Shell Point site and their impact on the most common shorebirds that use the site.

Current description of the site

The Cockle Shell Point site extends for around 2 km southwest from Swan Bay Road and Evens Point along the western shore of Big Swan Bay (**Figure 1**). The site is bordered to the north and west by casuarina woodland and heathland scrub. To the northeast around Evens Point, there is a small area of coastal woodland with a thick fringe of shoreline mangroves. To the southwest, the shoreline comprises a narrow shingle beach which is partially fringed by low mangroves. Two lagoons are located in the centre of the site, the largest of which is 300 m long and 80 m wide (**Figure 2**). Both are tidal and surrounded by mangroves (**Figure 3**). The substrate of the lagoons is soft black mud. Mangrove forest extends south and southwest from the lagoons to the shoreline. Tidal flows access the lagoons through this area and nearby drains.

Figure 2. Satellite image (2024) showing two lagoons surrounded by mangroves, surrounded by saltmarsh and mudflats, and narrow mangrove-lined beach at adjacent shoreline. Network of excavated drains evident. (Image Google Earth 2024)

The area surrounding the lagoons is mainly saltmarsh with occasional small patches of mud. Between the saltmarsh and the casuarina woodland, there are wide areas of mud with dead casuarinas. Areas of shallow open water are present between saltmarsh and mud. A series of tidal drains up to one metre deep are present to the east of the lagoons (**Figure 2**).

Figure 3. Lagoon at high tide surrounded by mangroves, view to west. Image N. Fraser, March 2024.

At high tide some areas of saltmarsh and mud become inundated. During periods of spring tides (>1.8m), the entire site is covered by 10-30 cm of water (**Figure 4, Figure 5**). At low tide, mudflats and sea grass are widely exposed along the Big Swan Bay shoreline, and from Evens Point out to Orobillah Island. Shorebirds and waterbirds forage on these mudflats. Remnant poles from abandoned oyster leases are located 200-300 m from the shoreline. At high tide, some shorebirds and waterbirds roost amongst saltmarsh while others roost offshore on oyster poles.

Figure 4. View to south towards mangrove covered Cockle Shell Point. Mangroves to east (left) define location of earlier shoreline. Current shoreline with saltmarsh and casuarina 20 m to west (right), at high tide. Image N. Fraser, March 2024.

Figure 5. High-tide survey at the Cockle Shell Point site. The surveyor is walking across submerged saltmarsh towards submerged shoreline. Black Swan ahead, view to southeast. Image S. Fleming, January 2024.

METHODS

Site changes

To assess the extent of habitat change, early aerial photographs were obtained from SIX Maps NSW (https://maps.six.nsw.gov.au) and compared with recent satellite imagery from Google Earth (https://www.google.com/). Habitat mapping was obtained from NSW Estuarine Habitat Maps (https://nsw-dpi.shinyapps.io/NSW_Estuarine_Habitat/) and compared with earlier aerial photography. Early published vegetation maps and accounts of the Swan Bay area (Bartrim 1980) were also reviewed.

Shorebird records

Records were extracted from five sources: BirdLife Australia Birdata portal (https://birdata.birdlife.org.au/home), Cornell Lab of Ornithology eBird Australia portal (https://ebird.org/australia/home), BioNet portal of the NSW Department of Planning and Environment (https://www.environment.nsw.gov.au/topics/animals-and-plants/biodiversity/nsw-bionet), old HBOC records (A. Stuart pers. comm.) and a resource study (Bartrim 1980).

Most Birdata records were from monthly high-tide surveys conducted from 2000-2023 by HBOC members and recorded as shorebird surveys or 500-m area searches. Data used were from land-based surveys only. Surveys of the northern part of the area covered the shoreline north from Evens Point to a rocky breakwater hosting the foundations of a former oyster farm and included roosts on nearby oyster leases. Surveys of the southern area within the Gir-um-bit National Park extended from Evens Point south to Cockle Shell Point and included nearby oyster leases and roosts on Orobillah Island (**Figure 1**). Birdata records included twice yearly surveys conducted by the Australasian Wader Study Group from 1982 to 1985. Bartrim (1980) conducted weekly surveys in 1978 and 1979. Records from eBird and BioNet were generally incidental.

Maximum annual counts for all shorebird species were charted using MS Excel.

RESULTS

Changes to the Cockle Shell Point site

An aerial photograph from 1976 showed the Cockle Shell Point site with a large open lagoon and a smaller lagoon to the west (**Figure 6**). Both lagoons appeared to be dry in the photograph, and to be fringed by saltmarsh. Surrounding areas to the east and west were mainly saltmarsh and mudflats.
Open woodland and heathland scrub surrounded the site to the north and west. A relatively wide, open beach along the adjacent shoreline extended northeast to southwest.

Bartrim (1980) produced a detailed vegetation map of the site as part of a resource study for the then-proposed Pipeclay Creek Nature Reserve. The map showed a single large lagoon surrounded by saltmarsh, which consisted of a mixture of Samphire *Salicornia quinqueflora* and Saltwater Couch *Sporobolus virginicus* interspersed with areas of mud. A large area of mud was present to the north of the lagoon. Grey Mangrove *Avicennia marina* shrubland existed southwest of the lagoon and extended to the shoreline. Small mangroves were scattered amongst the saltmarsh and along a small

western section of the lagoon. A northern fringing woodland was mapped as Swamp Oak *Casuarina glauca* and closed heathland scrub *Melaleuca nodosa* and included areas of dead casuarinas. A photograph taken at high tide showed the lagoon as an open water body surrounded by saltmarsh with nearby areas of mud (**Figure 7**). Bartrim (1980) stated that the entire wetland site became inundated by tides above 1.8 m.

Figure 6. Aerial photograph (1976) showing two open lagoons at wetland site surrounded by mudflats and a wide, open beach at adjacent shoreline. (Image https://portal.spatial.nsw.gov.au/portal/apps/webappviewer/).

Figure 7. A section of the lagoon at Cockle Shell Point at maximum capacity in 1980. View to west. Note saltmarsh around edges of lagoon, areas of bare mud nearby and no surrounding mangroves. Image G. Bartrim.

Bartrim (1980) described the lagoon as the most significant wetland in the then-proposed reserve owing to its use by shorebirds. The lagoon contained water most of the time, to a maximum depth of approximately 0.5 m, but dried up during prolonged dry spells. The water source was a mixture of high-tide inundation and freshwater runoff.

Adjacent tidal flats were described as the most significant area for shorebird foraging in the resource study (Bartrim 1980). At low tide, tidal flats were exposed for 100-200 m and hosted a 30 m wide mat of sea grass. Of the 13 shorebird species recorded by Bartrim (**Table 1**), 11 foraged on these flats, while Pied Stilt *Himantopus leucocephalus* foraged on the lagoon and Masked Lapwing *Vanellus miles* foraged on the saltmarsh and mud. Large shorebirds such as Far Eastern Curlew and Whimbrel foraged across all local tidal flats at low tide. Most smaller shorebirds such as Pacific Golden Plover, Red-capped Plover *Charadrius ruficapillus*, Double-banded Plover *Charadrius bicinctus*, Lesser Sand Plover *Charadrius mongolus* and Red-necked Stint *Calidris ruficollis* were restricted to the tidal flats around Cockle Shell Point. Bartrim attributed this to the substrate having a higher proportion of sand, making it relatively firm and supporting invertebrate fauna that were suitable prey for short-billed shorebirds. At high tide, most shorebirds roosted around the lagoon.

Aerial photography revealed a network of drains up to a metre deep that were excavated east of the lagoons between 1985 and 1986 (**Figure 2)**. Anecdotal reports state that this was done for agricultural purposes.

Estuarine habitat mapping by the NSW Department of Primary Industries documented vegetation changes since 1980. By 2004, the area of saltmarsh had expanded northwards, an area of mixed saltmarsh and mangrove extended southwest of the lagoons to the shoreline, and a narrow fringe of mangroves had developed along the western margin of the main lagoon. A small number of isolated mangroves were growing along the adjacent shoreline (**Figure 8A**). By 2017, the area of mangroves had increased to surround both lagoons, a large mangrove forest was present southwest of the lagoons, and a fringe of mangroves was present along most of the shoreline (**Figure 8B**).

A 2024 satellite image showed that mangrove forest had completely overgrown the area southwest of the lagoons (**Figure 6**). Saltmarsh west and east of the lagoon and along one of the drains was being overgrown with mangroves. The beach had narrowed to a thin strip behind a fringe of mangroves.

In summary, the observed macro-level changes to the site since 1976 owing to increasing salt-water inundation were as follows: the tidal prism across the site increased; casuarinas at the north of the site died; the two lagoons changed from ephemeral to tidal; the shoreline of the lagoons changed from open saltmarsh to mangroves; the substrate of the lagoons changed from silt to black mud; mangroves southwest of the lagoons became a forest and expanded into areas of adjacent saltmarsh;

Table 1. Shorebird species, numbers recorded and status, Cockle Shell Point (CSP) and other sites. Data extracted from Bartrim (1980).

Common name	Scientific Name	Records	Status	Location
Pied Stilt	*Himantopus leucocephalus*	2	Rare	CSP site only
Pacific Golden Plover	*Pluvialis fulva*	1 - 10	Common	CSP site only
Red-capped Plover	*Charadrius ruficapillus*	1 - 80	Common	CSP site only
Double-banded Plover	*Charadrius bicinctus*	1 - 150	Common	CSP site only
Lesser Sand Plover	*Charadrius mongolus*	1 - 150	Common	CSP site only
Greater Sand Plover	*Charadrius leschenaultii*	10 - 30	Rare	CSP site only
Masked Lapwing	*Vanellus miles*	1 - 4	Common	CSP + 11 other sites
Bar-tailed Godwit	*Limosa lapponica*	1 - 15	Common	CSP + 1 other
Whimbrel	*Numenius phaeopus*	1 - 60	Common	CSP + 10 other sites
Far Eastern Curlew	*Numenius madagascariensis*	2 - 400	Common	CSP + 10 other sites
Ruddy Turnstone	*Arenaria interpres*	1	Rare	CSP site only
Red-necked Stint	*Calidris ruficollis*	10 - 50	Common	CSP site only
Sharp-tailed Sandpiper	*Calidris acuminata*	2 - 15	Common	CSP + 3 other sites

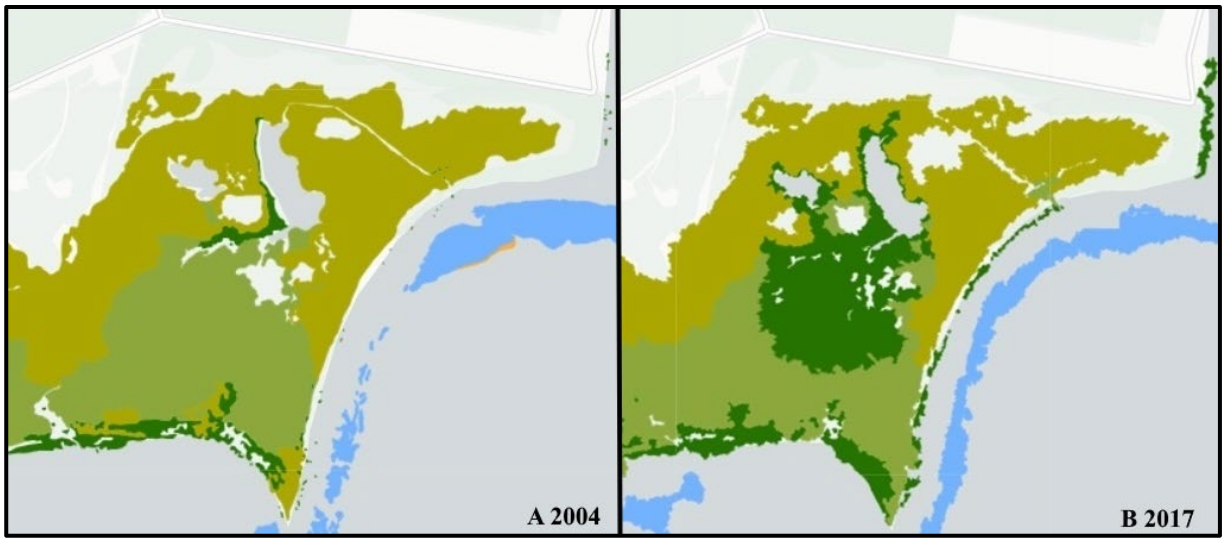

Figure 8A. Estuarine habitat mapping Cockle Shell Point 2004, NSW Dept. Primary Industries. (Colours: olive = saltmarsh; yellow-green = mangrove/saltmarsh; dark green = mangrove, blue = Zostera.)
Figure 8B. Estuarine habitat mapping Cockle Shell Point 2017, NSW Dept. Primary Industries.

saltmarsh expanded into areas of bare mud; the adjacent beach changed from relatively wide and open to narrow and fringed with mangroves.

Shorebird records

The number of surveys, their sources and survey time periods are summarised in **Table 2**. The earliest report (Bartrim 1980) identified 13 shorebird species using the site; 11 migratory and two non-migratory ones. Mostly, these species were restricted to the Cockle Shell Point site where they foraged on tidal flats and roosted around the lagoon. The species recorded by Bartrim, numbers observed, and locations are listed in **Table 1**.

Table 2. Data sources and records or surveys at Swan Bay, 1971-2023

Data source	Records or surveys	Years
Birdata records (incl. AWSG surveys)	332	1981-2023
eBird records	14	2021-2023
BioNet records	26	1982-2002
Old HBOC records	10	1971-1988
Bartrim resource study (1980)	55 approx.	1978-1979

Overall, 29 shorebird species have been recorded at the site since 1980, 20 of which are migratory and nine non-migratory. The total numbers of records, maximum counts, date last recorded, and conservation status are shown in **Table 3**. Thirteen of the species are listed as threatened under either

the BC Act or the EPBC Act. Eleven species have been recorded in only small numbers (ten birds or fewer) and nine of the smaller shorebird species have not been recorded for more than ten years.

Table 3. Numbers of records, maximum counts, last record, and conservation status for shorebird species, Swan Bay 1980-2023.

Common name	Scientific name	Records	Max. count	Last record	Threatened species
Australian Pied Oystercatcher	*Haematopus longirostris*	269	76	Dec-23	✓
Sooty Oystercatcher	*Haematopus fuliginosus*	152	38	Oct-23	✓
Pied Stilt	*Himantopus leucocephalus*	7	12	Jan-15	
Red-necked Avocet	*Recurvirostra novaehollandiae*	8	41	Jan-12	
Banded Stilt	*Cladorhynchus leucocephalus*	5	1	Jan-01	
Pacific Golden Plover	*Pluvialis fulva*	106	55	Dec-23	
Grey Plover	*Pluvialis squatarola*	1	1	Nov-13	✓
Red-capped Plover	*Charadrius ruficapillus*	159	70+	May-23	
Double-banded Plover	*Charadrius bicinctus*	93	55	Jul-23	
Lesser Sand Plover	*Charadrius mongolus*	32	150	Apr-17	✓
Greater Sand Plover	*Charadrius leschenaultii*	1	1	Sep-21	✓
Black-fronted Dotterel	*Elseyornis melanops*	1	1	Jun-01	
Red-kneed Dotterel	*Erythrogonys cinctus*	2	15	Jul-85	
Masked Lapwing	*Vanellus miles*	280	31	Dec-23	
Black-tailed Godwit	*Limosa limosa*	7	2	Sep-21	✓
Bar-tailed Godwit	*Limosa lapponica*	305	550+	Dec-23	
Whimbrel	*Numenius phaeopus*	204	260	Dec-23	
Far Eastern Curlew	*Numenius madagascariensis*	274	700+	Dec-23	✓
Terek Sandpiper	*Xenus cinereus*	2	1	Nov-81	✓
Common Sandpiper	*Actitis hypoleucos*	1	1	Nov-81	
Grey-tailed Tattler	*Tringa brevipes*	160	56	Nov-23	
Common Greenshank	*Tringa nebularia*	15	10	Jul-17	✓
Marsh Sandpiper	*Tringa stagnatalis*	2	2	Nov-09	
Ruddy Turnstone	*Arenaria interpres*	7	20	May-15	✓
Red Knot	*Calidris canutus*	18	12	Nov-18	✓
Red-necked Stint	*Calidris ruficollis*	81	150+	Nov-22	
Pectoral Sandpiper	*Calidris melanotos*	1	4	Dec-01	
Sharp-tailed Sandpiper	*Calidris acuminata*	34	261	Sep-21	✓
Curlew Sandpiper	*Calidris ferruginea*	10	7	Sep-14	✓

Shorebird numbers during 2000-2023

Systematic monthly surveys have been carried out since September 2000, allowing shorebird population trends to be analysed. The maximum annual number of shorebird species over this period was 17, in 2008. In 2023, only ten shorebird species were recorded, five migratory and five non-migratory. The decline in shorebird species numbers from 2000 to 2023 is illustrated in **Figure 9**. Charts showing maximum annual counts for nine migratory and one non-migratory species are presented in **Figure 10**. Most of those species were recorded until recently, however, Lesser Sand Plover has not been seen since 2016.

Six migratory species have been recorded over-wintering; Pacific Golden Plover, Bar-tailed Godwit, Whimbrel, Far Eastern Curlew, Grey-tailed Tattler and Sharp-tailed Sandpiper.

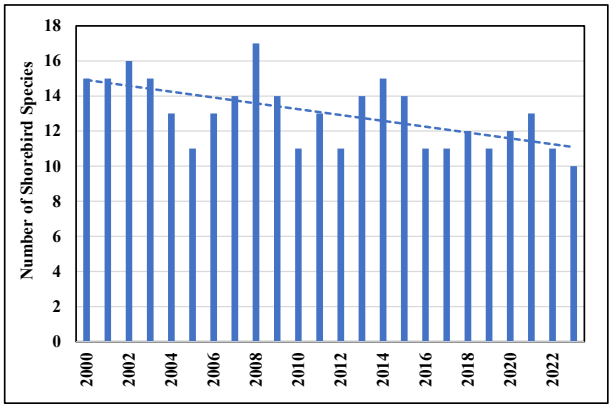

Figure 9. Number of shorebird species recorded annually at Swan Bay over 2000-2023, with linear trend line.

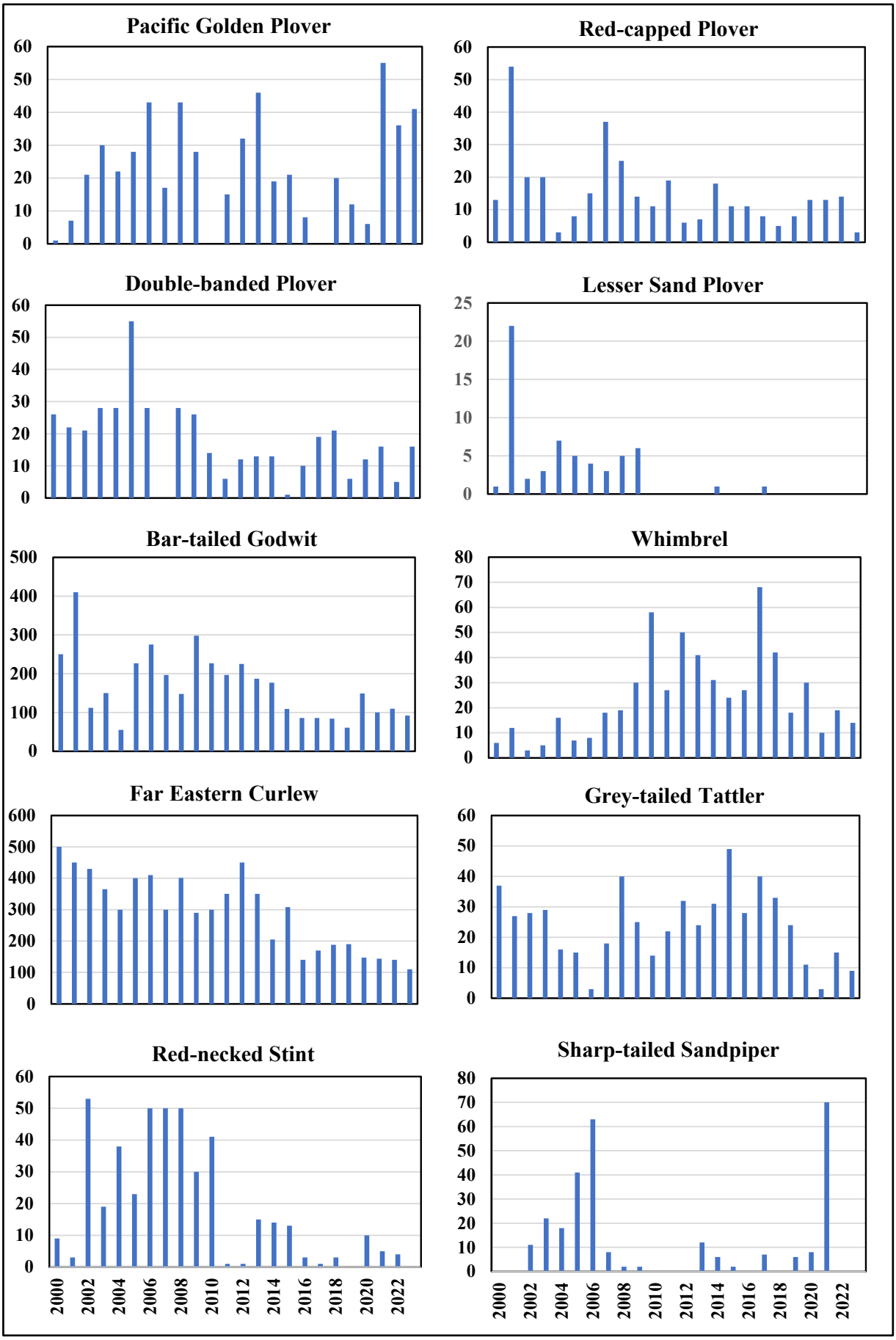

Figure 10. Maximum annual counts for selected species at Swan Bay over 2000-2023.

DISCUSSION

There are many reasons for the decline of migratory shorebird numbers across Australia. The main one however is the loss of habitat along the East Asian-Australasian Flyway (Hansen *et al*. 2016; Clemens *et al*. 2016). Non-migratory shorebirds which use inland habitats are declining while those using coastal habitat are stable (Clemens *et al*. 2016). The decline in numbers exhibited by species using the Cockle Shell Point site is a relatively small subset of a much larger picture. Nevertheless, numerous small local changes are cumulative and ultimately can result in larger national and global changes.

Stuart (2004) identified Port Stephens as the second-most important estuary for shorebirds in NSW, and Bartrim (1980) described the Gir-um-bit lagoon as the most significant wetland in the then-proposed nature reserve owing to its use by shorebirds. Of the 20 migratory shorebird species that have been recorded over 54 years at Swan Bay, only six were regularly observed in 2023: Pacific Golden Plover, Double-banded Plover, Bar-tailed Godwit, Whimbrel, Far Eastern Curlew and Grey-tailed Tattler.

Clemens *et al*. (2016) analysed continental-scale changes to the shorebird population in Australia including Port Stephens. They identified a significant continental-wide decline for Pacific Golden Plover and Sharp-tailed Sandpiper. No significant continental trends were identified for Whimbrel, Grey-tailed Tattler or Red-capped Plover. However, for Port Stephens, the authors identified a local trend for these five species as one or two standard deviations below the mean continental trend. This was also confirmed by Stuart (2020) who identified declining population trends for Far Eastern Curlew, Bar-tailed Godwit and Whimbrel in Port Stephens from boat-based shorebird surveys. An earlier study of Grey-tailed Tattler population in Port Stephens (Wooding and Stuart 2013) noted a decline since 1980 but suggested the population subsequently had stabilised. However, the current data indicate that the population has been in decline since 2015.

Although the records from Gir-um-bit NP are not necessarily representative of all of Port Stephens, the declining population trends identified in this study support the findings of Clemens *et al*. (2016) and Stuart (2020). The one possible exception is the Pacific Golden Plover whose local population trend fluctuates wildly (**Figure 10**).

Roost sites preferred by shorebirds are generally close to foraging habitats, in order to reduce energy expenditure, and provide an open, undisturbed area where birds can remain vigilant for predators (Rogers *et al*. 2006). While the decreasing use of the Cockle Shell Point saltmarsh roosting sites undoubtedly resulted in the local decline of shorebird numbers, it is impossible to distinguish definitively between decline in response to local factors and global factors. Additionally, some of the small shorebirds may have relocated permanently to more suitable sites within Port Stephens or elsewhere. Another factor impacting declining populations at the site may be mammalian predation. However, there have been no observations of these predators on the site, no dismembered bird carcasses and no predator tracks have been seen.

Broad generalisations can, however, be made relating habitat change to the declining numbers and the behaviour of some species. Because the site is relatively secluded, human disturbance is unlikely to be an important factor. Loss of suitable roosting sites at the lagoon and the beach has made the site unsuitable for small shorebirds including Lesser Sand Plover, Red-necked Stint and Sharp-tailed Sandpiper, and possibly Red Knot. Declining numbers of Red-capped Plover could be partially attributed to the loss of the beach and other areas of bare mud. While Pacific Golden Plover numbers fluctuate in Port Stephens, the local trend suggest numbers may be stable. Changes in roosting behaviour of Bar-tailed Godwit, which no longer roost amongst the samphire, may be attributed to mangrove growth removing the clear line-of-sight. Grey-tailed Tattler and Whimbrel do not use the lagoon and surrounding saltmarsh and therefore their decline cannot be attributed to site changes. The availability of suitable prey around the site for shorebird species has not been assessed as part of this study.

Human intervention

Construction of a series of drains east of the lagoons in 1985 or 1986 accelerated habitat change by allowing a larger tidal prism to access the site**.** The drains, combined with sea-level rise, have allowed more regular tidal flows to enter the large lagoon, altered the salinity and allowed mangroves to establish a fringe around the lagoon, removing the clear line-of-sight required by shorebirds. The substrate of the lagoon also changed to soft black mud. These conditions made the lagoon unsuitable for foraging or roosting by shorebirds. Mangroves also started to grow along the beach front, further

removing line-of-sight from the previous beach roost site. The essential nature of a clear line-of-sight in contributing to shorebirds' use of a roost site is well known (Jackson & Straw 2021) and has recently been demonstrated locally by Clarke (in prep.) as an essential component of the rehabilitation of Stockton Sandspit roost site in the Hunter Estuary. The detrimental impact of an increased tidal prism on important shorebird habitat through mangrove encroachment in the Hunter Estuary has been discussed by Herbert (2007).

The drains have continually widened over time, causing increased erosion. The increased tidal prism now inundates a wider area which has resulted in an expansion of saltmarsh and a reduction in the areas of bare mud. Small mangroves have started to encroach on the saltmarsh and along the drains. While Far Eastern Curlew, Pacific Golden Plover, and Double-banded Plover continue to roost amongst the saltmarsh, it is apparent that the area is becoming increasingly unsuitable for Red-capped Plovers due to the loss of clear, open areas of bare mud for foraging. This may also have contributed to the recent disappearance of Red-necked Stints.

Climate change

Sea-level rise and changes in wind patterns are two factors resulting from climate change that may be impacting shorebird habitat in the tide-dominated estuary of Port Stephens.

Sea-level rise for Port Stephens has been estimated to be 2.1 mm per year over the last half century (Coast Adapt 2017). This has resulted in an increased tidal prism with higher velocity flows entering the bay as larger tidal volumes are accommodated. Rising sea levels result in the inundation of low-lying areas, increased shoreline erosion, changes to seagrass distribution, altered estuarine tidal range and circulation patterns, and altered sediment transport regimes (Office of Environment and Heritage 2018). The increased inundation across the Cockle Shell Point site has resulted in the lagoon and some adjacent areas becoming tidal, the encroachment of mangroves into areas that were previously saltmarsh, and expansion of saltmarsh into areas that were previously bare mud. Thus, the lagoon has changed from an open ephemeral body inundated by only the highest tides, to a mangrove-fringed tidal body. This combined with the loss of a clear line-of-sight make it unsuitable for all shorebirds.

The Southern Annular Mode (SAM) is a global belt of low pressure in the southern hemisphere strongly associated with cold westerly winds. It has exhibited increasing periods in a positive phase across Australia since the early 1980s. Increased positive change in SAM has resulted in westerly winds associated with cold fronts tracking further southwards and allowing more frequent winds from the east (Hendon *et al*. 2007). In Swan Bay, increasing periods of easterly onshore airflow produce extended periods of onshore wind waves. These produce changes to hydrodynamic flows and littoral sediment transport along the shoreline resulting in increased erosion. This erosion is evidenced by the displacement of the fringing mangroves from the current shoreline. The mangroves, which originally propagated on the shoreline around 2004 (**Figure 8B**) are now around 20 m east of the current shoreline.

Wind pattern changes combined with higher sea levels have produced increased shoreline erosion. The shoreline has changed from a relatively wide, open beach to a narrow strip of westward retreating shingle. The high tide beachfront roost site formerly used by many small to medium sized shorebirds including Red-necked Stint, Curlew Sandpiper, Sharp-tailed Sandpiper, Red Knot and Bar-tailed Godwit, has been lost.

CONCLUSION

While availability of suitable foraging habitat is important for shorebirds, no less important is the availability of safe high-tide roost sites in proximity to the habitat. Due to the loss of clear line-of-sight, the previously ephemeral lagoon at Cockle Shell Point and the adjacent beach front are no longer suitable roost sites. The lagoon was once the most important roost site in the Swan Bay area. The main driver of on-site changes is an increased tidal prism which has facilitated encroachment by mangroves. Climate change is also having a detrimental impact on suitability of the site for shorebird roosting.

While the site no longer provides a suitable roost site for most smaller shorebirds, a reduced number of medium sized and larger shorebirds such as Far Eastern Curlew and Pacific Golden Plover continue to use the site. One small shorebird, the Double-banded Plover is present on site in the winter months. Bar-tailed Godwit, which previously roosted amongst the saltmarsh, now roost offshore on oyster leases. Eventually, the continuing encroachment of mangroves onto areas of saltmarsh will make the site unsuitable for all shorebirds. Remedial action to block the drain would prevent diurnal tidal access to the area east of the lagoons

and may prevent or delay mangrove encroachment of this area, as well as prevent onsite erosion.

How the additional impact of human intervention contributed to the change of the lagoon's character cannot be accurately measured, but the outcome provides some important lessons. Before manipulating existing tidal regimes, such as by installing drainage channels, a full understanding of anticipated tidal change is required in order to inform monitoring strategies and remedial works, and to ensure the maintenance and protection of preferred roost and foraging sites. A clear line-of-sight, particularly in coastal wetlands prone to mangrove encroachment, should be maintained. Future impacts of sea-level rise on coastal areas have been extensively researched and documented and should provide a sound basis for planning the protection of important shorebird roosts or dictate the provision of alternatives (Jackson *et al*. 2021).

While habitat change associated with climate change is inevitable, the provision of artificial roosts and the maintenance of existing maritime infrastructure such as abandoned oyster leases, groynes, rock walls and wrecks will assist shorebirds in the short to medium term.

ACKNOWLEDGEMENTS

This article is dedicated to three stalwarts of HBOC; the late Sue Hamonet who led the early surveys of Swan Bay, the late Wilma Barden, and Charles Mann. Sue conducted some of the earliest surveys of the site in the early 1980s with the AWSG. The three members conducted regular monthly surveys at Swan Bay for nearly 20 years from their commencement in 2000. Two other HBOC members who regularly assisted with the surveys were Lois Wooding and Lorna Mee. Sue and Wilma also mentored many new birders who started their involvement with HBOC at Swan Bay. Swan Bay is an isolated location and access for most surveyors required travel of one hour or more each way. Conditions on the Gir-um-bit NP were at times difficult. Traversing tidal inundations and hundreds of metres of thick, heavy mud was often necessary to access birds on the lagoons and mudflats. Sue kept meticulous records and never failed to provide a sociable morning tea following the surveys. Our thanks are also extended to the many other surveyors who supported Sue's team over many years and who have continued their legacy. Today, Swan Bay is the most extensively studied shorebird site in Port Stephens.

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Martindale Valley surveys 2018-2024: insights into seasonal and climatic effects on the valley's bird populations

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A total of 190 bird species were recorded in quarterly surveys in the Martindale Valley, near Denman in New South Wales, during 2018-2024; 145 of those species each having multiple records. Eighteen threatened species were found, including eight species with regular records: Spotted Harrier *Circus assimilis*, Little Lorikeet *Glossopsitta pusilla*, Brown Treecreeper *Climacteris picumnus*, Speckled Warbler *Pyrrholaemus sagittatus*, Grey-Crowned Babbler *Pomatostomus temporalis*, Varied Sittella *Daphoenositta chrysoptera*, Dusky Woodswallow *Artamus cyanopterus* and Hooded Robin *Melanodryas cucullata*.

Another threatened species, the Painted Honeyeater *Grantiella picta* was not detected after 2021. Conversely, Martindale Valley has become a regional stronghold for the Spiny-cheeked Honeyeater *Acanthagenys rufogularis*.

Twenty-six species having multiple records were only ever recorded in the spring or summer visits. Mostly they were well-known to be spring-summer migrants in the Hunter Region but others, such as Australasian Figbird *Sphecotheres vieilloti,* are not considered migratory. Five species were only ever recorded in the autumn or winter visits, most notably Rose Robin *Petroica rosea* and White-eared Honeyeater *Nesoptilotis leucotis*.

Spring and summer generally had the greatest abundance and diversity of birds, with winter having the lowest diversity. An El Niño drought period in 2018-2019 brought several species into the valley, although mainly as vagrants or short-term visitors. In 2021-2022 a La Niña period of much above-average rainfall brought different species, and in particular, waterbirds and other species associated with wetlands. The effects were felt beyond 2022 with the arrival of three crake species: Australian Spotted Crake *Porzana fluminea*, Baillon's Crake *Zapornia pusilla* and Spotless Crake *Z. tabuensis.*

The study showed that during very wet La Niña periods, the valley did not become a refuge for coastal species, but rather functioned more like habitat of inland Australia.

INTRODUCTION

The Martindale Valley (**Figure 1**) has long had a reputation for hosting a rich and diverse range of birds (Tarrant 2008; Stuart 1994-2018). However, because most of the valley comprises privately-held property with restricted access, there has been little opportunity for any systematic study of its bird populations. Tarrant (2008) monitored two sites at Martindale over 1998-2008, making quarterly visits to them. Both were riparian sites lying alongside Martindale Creek, and hence not necessarily providing a comprehensive picture of the birdlife in the valley. Most other bird records for the valley were opportunistic ones, involving roadside birding by visiting birdwatchers. These records offered only limited insights into Martindale Valley birdlife. There was some systematic survey effort over 2014-2016 by Conservation Volunteers Australia; six consecutive quarterly visits were made to several riparian sites within the valley (T. Clarke pers. comm.). However, the results from those surveys are not publicly available. Also, there were occasional visits by birdwatchers to a private property which abutted one of Tarrant's Martindale sites (A. Lindsey pers. comm.).

In 2018, the Hunter Bird Observers Club Inc. (HBOC) entered into an informal collaboration with the Martindale Landcare Group, for the purpose of undertaking a systematic study of the birds of Martindale Valley. The collaboration allowed HBOC to access several private properties; hence there was an opportunity to develop a comprehensive view of the valley's birdlife. The objectives of the study were to assess the status of resident and visiting species and to monitor how the populations of those species varied seasonally and

over time. Various sites were selected to be surveyed once per season; collectively those sites comprised riparian, woodland, wetland and other habitats considered to be typical for the valley.

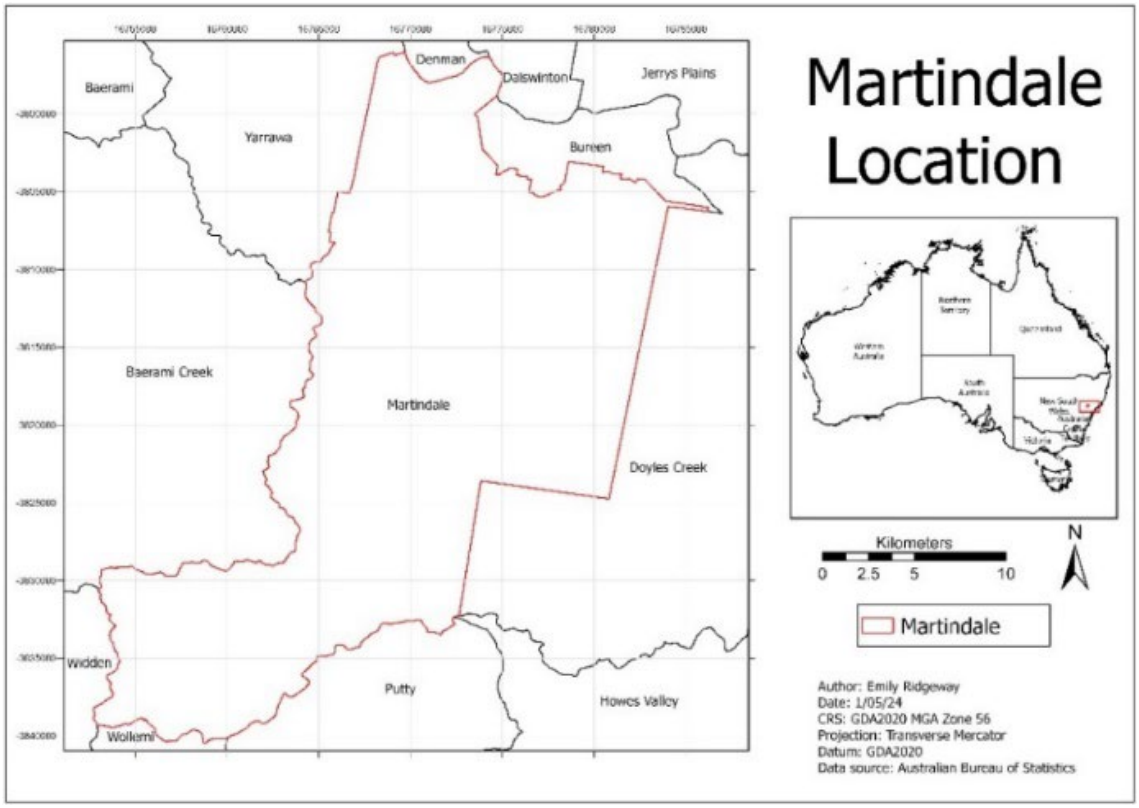

Figure 1. Location of the Martindale Valley.

METHODS

Site descriptions

The Martindale Valley straddles Martindale Creek, which flows from the Wollemi National Park until it joins the Goulburn River near Denman in New South Wales. In early 2018, we (BW and AS, with Dennis Neader) selected fifteen sites to be surveyed. Most of those sites were 2 ha in size; two of them were of nominal 500-m radius. After 2020, access to one of the 2-ha sites (MVS 11, a woodland site) was lost after the property was sold. In replacement, two woodland sites on the adjoining property were added from the beginning of 2021 (sites MVS 16 and MVS 17). In October 2020, a new survey site (MVS 12-1) was added, it being a larger area (of *c*. 500-m radius) surrounding what until then had been a fruitful 2-ha woodland site (MVS 12).

In addition to the above survey sites, data were collected for two nominally 5-km radius sites, named in this report as MVS Upstream and MVS Downstream. These two sites were located, respectively, upstream and downstream from Medhurst Bridge (sites MVS 7 and MVS 8 are located near that bridge). **Table 1** summarises some details about all of sites, while **Figure 2** shows where the 2-ha and 500-m radius sites were located.

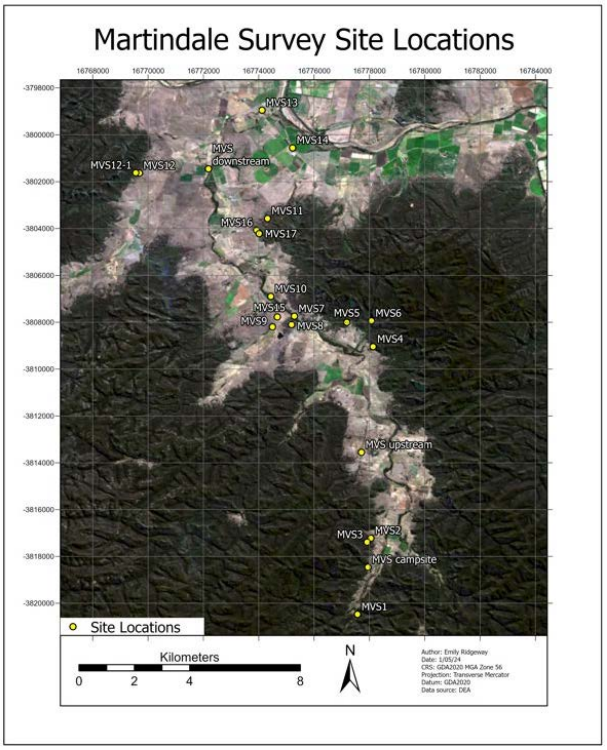

Figure 2. Location of the main survey sites in the Martindale Valley.

Five sites were riparian – straddling Martindale Creek and with varying extents of vegetation. Ten sites were woodland ones, with varying extents of vegetation. There were two wetland sites, one having a few trees and the other with none. Other 2-ha sites were a well-established garden and a dry rainforest gully. The two 5-km radius sites had multiple habitats (although, principally they were open paddocks with a limited number of trees). More extensive site descriptions (covering vegetation and topography) are available in Ridgeway (2024).

The 500-m radius woodland site MVS 8 was the same property that was surveyed occasionally by A. Lindsey (pers. comm.) and it abutted one of Tarrant's survey sites.

Survey methods

The surveys, which commenced in July 2018, were conducted quarterly – in January, April, July and October. There was no survey in April 2020 because of travel restrictions associated with the COVID-19 pandemic. In 2022, only the January survey was able to be carried out, because heavy rains later that year prevented access to most of the sites. Also, occasionally we were unable to access sites MVS 12 and MVS 12-1.

Each visit to the valley spanned three days. The survey team members (2-8 people, typically 4-5 people) convened in the afternoon of Day 1, collecting data for the Upstream and Downstream sites that afternoon and evening. In the morning of Day 2, sites MVS 1-7 and MVS 16-17 were surveyed using Birdata's 2-ha/20-minute methodology (https://birdata.birdlife.org.au). During 2018-2020, site MVS 11 was surveyed on Day 2 instead of sites MVS 16 and MVS 17. In the afternoon of Day 2, the hilly woodland behind the campsite was surveyed as a nominal 500-m radius site, for a period of about two hours. The remaining 2-ha and 500-m radius sites were surveyed during the morning of Day 3. The MVS Upstream and MVS Downstream surveys essentially were continuous, being underway whenever team members were not actively surveying a 2-ha or 500-m radius site.

The surveys were done in the same general order on each visit to the valley. However, whenever there were four or more surveyors available, the teams were split so that several sets of two sites could be surveyed simultaneously (MVS 2 and MVS 3; MVS 16 and MVS 17; MVS 9 and MVS 15; MVS 12 and MVS 12-1; MVS 13 and MVS 14). For every 2-ha and 500-m radius survey, the numbers present for each species were estimated as accurately as possible (by consensus amongst the survey team). In general, numbers were not recorded for the MVS Upstream and MVS Downstream surveys, except when the survey team felt confident about the accuracy of the count.

Data management

During or immediately after each quarterly visit, we entered the results for each site into Birdata (https://birdata.birdlife.org.au). We retrieved the complete survey dataset for 2018-2024 in April 2024 and exported it into an Excel file, and we then used standard Excel tools for analysing and charting.

For each site we determined how many species were recorded there annually and across various time periods as specified later in the report. We also calculated a relative abundance measure, by summing the counts for every individual species in each survey and for each visit to the valley, as well as summing the counts for various time periods as specified later. In most cases, the same individuals will have been counted multiple times over the specified time period.

We sourced information about quarterly and annual rainfall patterns in eastern Australia, and the rainfall at various Australian locations, from the Bureau of Meteorology website (Bureau of Meteorology 2024). We assigned a rainfall rating for each quarter year from Q4 2017 to Q2 2024 by assessing the rainfall deciles for the eastern half of Australia and classifying that quarter's rainfall as either: very dry (below 20th percentile); below average (20-40 percentile); average (40-60 percentile); above average (60-80 percentile); very wet (above 80th percentile).

RESULTS

Overview

From 20 visits to the Martindale Valley spanning mid-2018 to mid-2024, 190 species were recorded including 18 species which are classified as threatened under Commonwealth or NSW legislation. We have summarised the annual results in **Table 2**. A total of 67 species were recorded in at least 15 of the 20 visits, and 92 species were recorded in at least ten of the visits. Full details about the 190 species (dates recorded, the numbers present etc.) are available in Ridgeway (2024).

Many of the 190 species were recorded infrequently – 27 of them were only found during one of our visits to the valley and an additional 18 species were only present in two visits.

Figure 3 shows the number of species found at each site over the full survey period. At most of the 2-ha sites, around 50-60 species were recorded. The exceptions were MVS 2 (a garden, 45 species) and MVS 15 (a wetland, 37 species). Four woodland sites (MVS 3-5, MVS 12) and two riparian sites (MVS 1, MVS 7) had more than 60 species

recorded. Species counts were greater at the three 500-m radius sites (78-105 species) and highest for the two 5-km radius sites. Similar patterns occurred when we assessed the total numbers of birds found at each site over the full survey period (**Figure 4**). However, site MVS 8 had a total of more than 2,500 birds (an average of around 125 birds per visit), substantially more than for the two other 500-m radius sites.

Table 1. Details of the Martindale Valley survey sites

Habitat type	Site ID	Centrepoint coordinates	Site nominal size	Survey duration	Survey period	No. of surveys
Riparian	MVS 1	-32.609, 150.715	2 ha	20 min	2018-2024	20
	MVS 7	-32.512, 150.695	2 ha	20 min	2018-2024	20
	MVS 10	-32.506, 150.687	2 ha	20 min	2018-2024	20
	MVS 13	-32.445, 150.684	2 ha	20 min	2018-2024	20
	MVS 14	-32.457, 150.694	2 ha	20 min	2018-2024	20
Garden	MVS 2	-32.584, 150.720	2 ha	20 min	2018-2024	20
Dry Rainforest	MVS 6	-32.513, 150.720	2 ha	20 min	2018-2024	20
Wetland	MVS 9	-32.515, 150.688	2 ha	20 min	2018-2024	20
	MVS 15	-32.512, 150.689	2 ha	20 min	2018-2024	20
Woodland	MVS 3	-32.585, 150.719	2 ha	20 min	2018-2024	20
	MVS 4	-32.522, 150.721	2 ha	20 min	2018-2024	20
	MVS 5	-32.514, 150.712	2 ha	20 min	2018-2024	20
	MVS 8	-32.515, 150.694	500 m radius	*c* 45 min	2018-2024	20
	MVS 11	-32.480, 150.686	2 ha	20 min	2018-2020	9
	MVS 12	-32.465, 150.645	2 ha	20 min	2018-2024	18
	MVS 12-1	-32.465, 150.644	500 m radius	*c* 45 min	Oct 2020-2024	11
	MVS 16	-32.484, 150.683	2 ha	20 min	2021-2024	11
	MVS 17	-32.485, 150.683	2 ha	20 min	2021-2024	11
	MVS Campsite	-32.594, 150.719	500 m radius	*c* 2 h	2018-2024	20
General	MVS Upstream	-32.556, 150.717	5 km radius	*c* 10 h	2018-2024	20
	MVS Downstream	-32.464, 150.667	5 km radius	*c* 10 h	2018-2024	20

Table 2. Number of species and number of threatened species recorded annually in the Martindale Valley surveys.

Year	Number of visits	All species			Threatened Species		
		Number of species	Total birds	Birds/ visit	Number of species	Total birds	Birds/ visit
2018	2	111	1422	711	12	46	23
2019	4	126	3621	905	9	98	25
2020	3	129	3134	1045	9	95	32
2021	4	147	5370	1343	11	116	29
2022	1	93	885	885	5	13	13
2023	4	143	4905	1226	10	128	32
2024	2	118	2448	1224	7	45	23

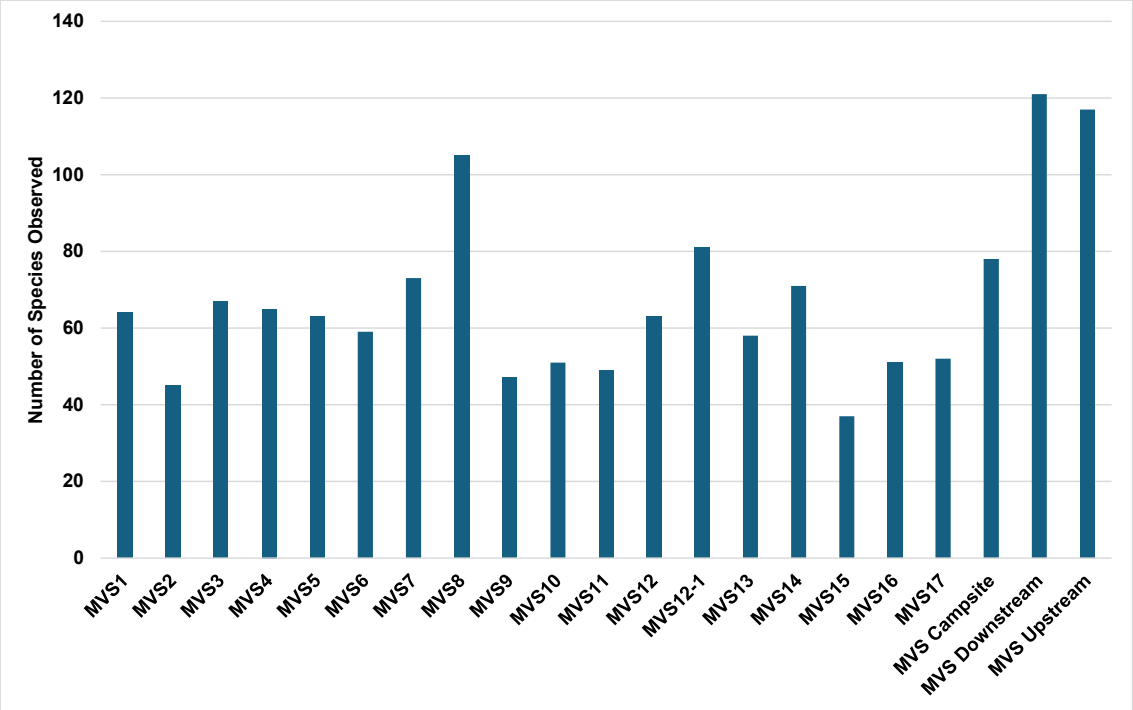

Figure 3. Number of species recorded at each site in the Martindale Valley 2018-2024.

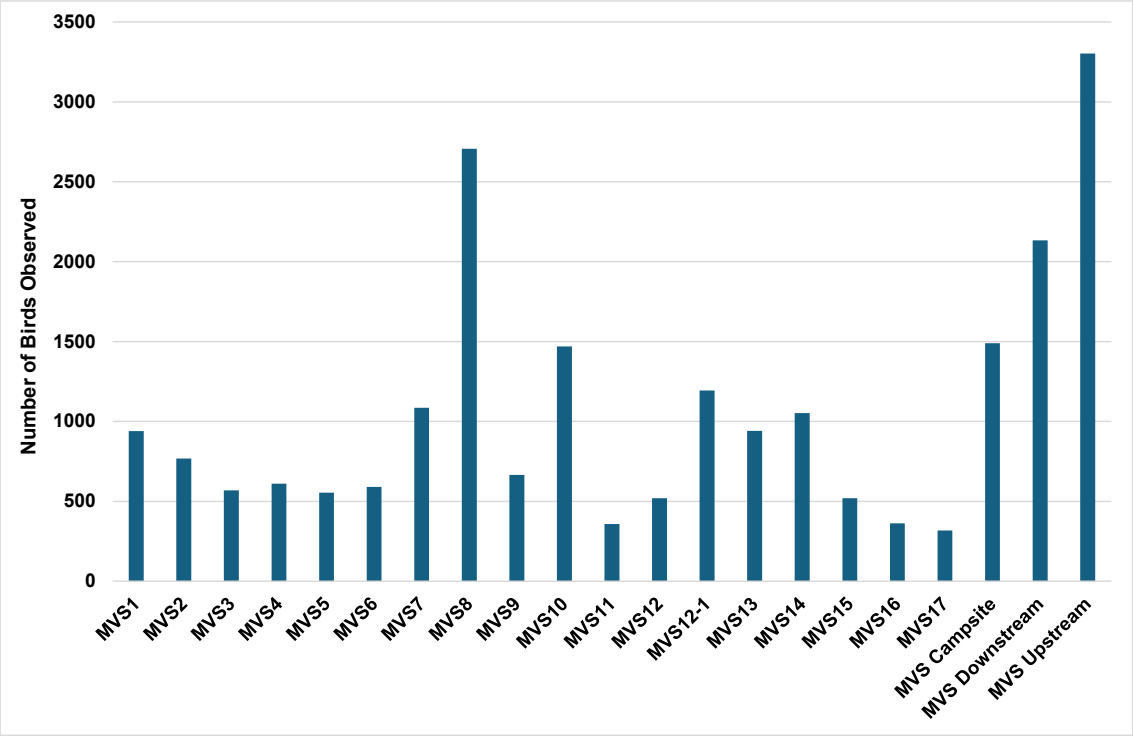

Figure 4. Total number of birds recorded at each site in the Martindale Valley 2018-2024.

Threatened species

The 18 threatened species found during the surveys are listed in **Table 3**, with their total annual counts. There was only one set of surveys carried out in 2022. Ten threatened species were only recorded occasionally (with 1-2 records of each in six years). The Painted Honeyeater *Grantiella picta* was detected annually but not after 2021. Eight species were regularly recorded, albeit in fluctuating numbers: Spotted Harrier *Circus assimilis*, Little Lorikeet *Glossopsitta pusilla*, Brown Treecreeper *Climacteris picumnus*, Speckled Warbler *Pyrrholaemus sagittatus*, Grey-Crowned Babbler *Pomatostomus temporalis*, Varied Sittella *Daphoenositta chrysoptera*, Dusky Woodswallow *Artamus cyanopterus* and Hooded Robin *Melanodryas cucullata*.

Table 3: Total numbers of threatened species recorded annually

Species	2018	2019	2020	2021	2022	2023	2024
Sharp-tailed Sandpiper *Calidris acuminata*	1	0	0	0	0	0	0
Latham's Snipe *Gallinago hardwickii*	1	0	0	0	0	1	0
Powerful Owl *Ninox strenua*	0	0	0	0	0	1	0
Little Eagle *Hieraaetus morphnoides*	2	0	0	0	0	0	0
Spotted Harrier *Circus assimilis*	1	4	1	3	0	3	0
Black Falcon *Falco subniger*	0	0	0	4	0	1	0
Glossy Black-Cockatoo *Calyptorhynchus lathami*	1	0	0	0	0	0	0
Gang-Gang Cockatoo *Callocephalon fimbriatum*	0	0	1	6	0	0	0
Little Lorikeet *Glossopsitta pusilla*	0	6	2	4	0	7	0
Brown Treecreeper *Climacteris picumnus*	0	2	0	14	2	8	3
Painted Honeyeater *Grantiella picta*	8	7	1	4	0	0	0
Speckled Warbler *Pyrrholaemus sagittatus*	14	24	24	28	2	29	4
Grey-Crowned Babbler *Pomatostomus temporalis*	6	41	38	34	3	72	23
Varied Sittella *Daphoenositta chrysoptera*	2	7	12	12	0	3	6
Dusky Woodswallow *Artamus cyanopterus*	2	4	16	1	1	0	3
Scarlet Robin *Petroica boodang*	0	0	0	0	0	0	1
Hooded Robin *Melanodryas cucullata*	4	3	1	10	2	3	5
Diamond Firetail *Stagonopleura guttata*	3	0	0	0	0	0	0

Habitat types

Including the discontinued woodland 2-ha site MVS 11, we surveyed at seven 2-ha woodland sites and three 500-m radius ones, five 2-ha riparian sites, two 2-ha wetland sites, a dry rainforest gully and a native garden, plus the two 5-km radius sites. The latter had the largest species diversity, with an average of 119 species recorded. The average number of species per habitat are shown in **Figure 5**. The two wetland sites had the lowest species diversity, closely followed by the native garden.

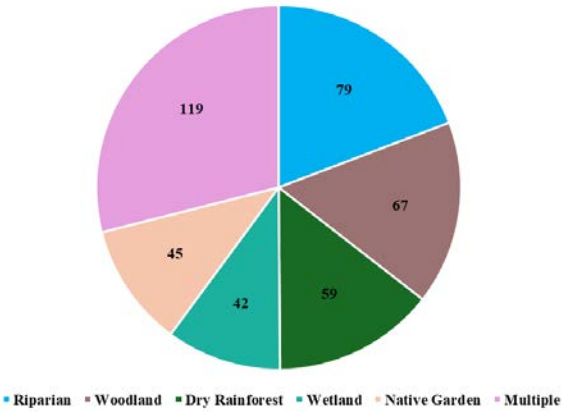

Figure 5. Average number of species recorded per quarterly visit in each group of habitat types 2018-2024.

Honeyeaters

During the six years of surveys, 22 types of honeyeater were recorded. Thirteen of those species were recorded on at least 50% of our visits to the valley, hence probably they were resident. The Spiny-cheeked Honeyeater *Acanthagenys rufogularis* was one of seven honeyeater species recorded in every visit; its mean count was 11 birds and there were five visits when 15-20 birds were recorded. We also had breeding records for the species.

Seasonal differences

In **Table 4** we show the total numbers of birds and total numbers of species recorded in each season over 2018-2024. The highlighted cells indicate periods when eastern Australia was experiencing either very dry conditions (much-below-average rainfall) or very wet conditions (much-above-average rainfall) based upon our assessment of the quarterly rainfall decile maps. The most birds and species were in spring (averages: 1160 birds, 109 species). Winter had the least number of species (an average of 62 species; and three times with only 44-46 species) but the second highest average number of birds (1150).

The results for summer 2019 were substantially lower than for the four other summer visits. It was during an extended El Niño period but we note that there were only two surveyors that visit, also there were heatwave conditions plus several of the woodland sites had unusually high levels of cicada activity, which suppressed calling by birds and decreased their detectability. If that year's data are excluded, the summer results were similar to the spring ones (with averages of 1033 birds and 101 species).

Table 4. Annual and seasonal numbers of species and numbers of birds. The highlighted cells indicate seasons where eastern Australia had well-below-average rainfall and well-above-average rainfall.

Season	Total visits		2018	2019	2020	2021	2022	2023	2024
Summer	6	No. of birds	–	558	1013	1068	885	1012	1187
		No. of species	–	64	97	112	93	100	103
Autumn	4	No. of birds	–	726	–	1456	–	613	1261
		No. of species	–	70	–	95	–	95	93
Winter	5	No. of birds	662	1271	959	1570	–	1288	–
		No. of species	46	46	81	92	–	44	–
Spring	5	No. of birds	1047	1066	1162	1276	–	1154	–
		No. of species	98	100	110	117	–	109	–

Some seasonal specialists could be identified. Species which were only recorded in spring and/or summer are listed in **Table 5** (which ignores any species with only one-off season records). There were 26 species although ten of those only had records in four visits or fewer (of the 11 spring or summer visits carried out in the six-year time period). Three additional species should be mentioned: Shining Bronze-Cuckoo *Chalcites lucidus* (present in two summer and three spring visits, but also recorded in July 2021); Australian Reed-Warbler *Acrocephalus australis* (present in five summer and five spring visits, but also recorded in April 2023); Dusky Woodswallow *Artamus cyanopterus* (present in four summer and four spring visits, but also recorded in July 2020).

Three species were recorded in every summer visit: Eastern Koel *Eudynamys orientalis*; Oriental Dollarbird *Eurystomus orientalis*; Common Cicadabird *Edolisoma tenuirostre*. Two species were recorded in every spring visit: Channel-billed Cuckoo *Scythrops novaehollandiae* and Rainbow Bee-eater *Merops ornatus*.

Table 5. Spring-summer specialists in the Martindale Valley surveys (species with records from more than one set of summer or spring surveys).

Species	No. of spring seasons	No. of summer seasons
Stubble Quail *Coturnix pectoralis*	1	3
White-throated Nightjar *Eurostopodus mystacalis*	3	4
Eastern Koel *Eudynamys orientalis*	3	6
Channel-billed Cuckoo *Scythrops novaehollandiae*	5	3
Horsfield's Bronze-Cuckoo *Chalcites basalis*	1	1
Brush Cuckoo *Cacomantis variolosus*	0	2
Pallid Cuckoo *Heteroscenes pallidus*	4	0
Buff-banded Rail *Hypotaenidia philippensis*	2	0
Little Black Cormorant *Phalacrocorax sulcirostris*	2	0
Pied Stilt *Himantopus leucocephalus*	1	1
Latham's Snipe *Gallinago hardwickii*	0	2
Rainbow Bee-eater *Merops ornatus*	5	4
Oriental Dollarbird *Eurystomus orientalis*	4	6
Sacred Kingfisher *Todiramphus sanctus*	1	1
Painted Honeyeater *Grantiella picta*	4	0
Large-billed Scrub-wren *Sericornis magnirostra*	1	1
Buff-rumped Thornbill *Acanthiza reguloides*	2	2
Australasian Figbird *Sphecotheres vieilloti*	3	2
Common Cicadabird *Edolisoma tenuirostre*	1	6
White-winged Triller *Lalage tricolor*	3	2
White-browed Woodswallow *Artamus superciliosus*	1	1
Leaden Flycatcher *Myiagra rubecula*	1	4
Brown Songlark *Cincloramphus cruralis*	3	1
Rufous Songlark *Cincloramphus mathewsi*	4	4
Tawny Grassbird *Cincloramphus timoriensis*	0	2
Fairy Martin *Petrochelidon ariel*	4	3

Five species were only recorded in autumn and/or winter, as listed in **Table 6**. Rose Robin *Petroica rosea* was recorded in seven of the nine autumn or winter visits carried out in the six-year time period, and White-eared Honeyeater *Nesoptilotis leucotis* in four of them. The three other species each had only 2-3 seasonal records.

Table 6. Autumn-winter specialists in the Martindale Valley surveys (species with records from more than one set of autumn or winter surveys).

Species	No. of autumn seasons	No. of winter seasons
Australian White Ibis *Threskiornis moluccus*	0	2
Whistling Kite *Haliastur sphenurus*	1	1
White-eared Honeyeater *Nesoptilotis leucotis*	3	1
Rose Robin *Petroica rosea*	3	4
Painted Button-quail *Turnix varius*	1	2

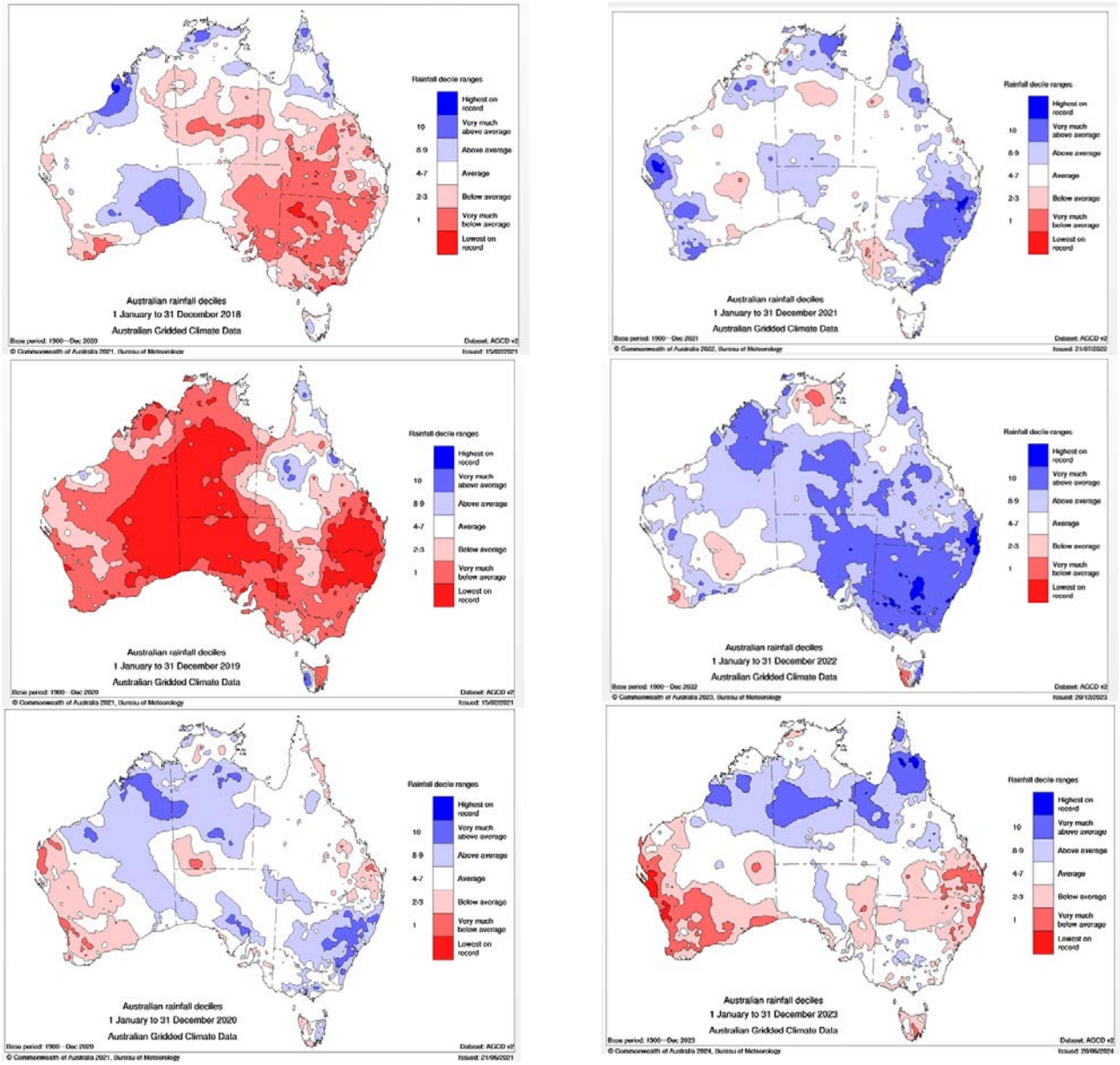

Figure 6. Annual rainfall distributions in Australia for 2018-2023 (Bureau of Meteorology 2024.)

El Niño and La Niña events

Figure 6 shows the rainfall distribution across Australia for each year spanning 2018-2023

(source: Bureau of Meteorology 2024). Years 2018 and 2019 were very dry ones in eastern Australia (and more widely). Only the fourth quarter of 2018 had about the average rainfall; overall, 2018-2019 was an extended El Niño period. There was a shorter very dry period in eastern Australia in 2023, lasting for about six months. Rainfall in 2020 was patchy; the first and fourth quarters were much wetter than the middle two quarters. Years 2021 and 2022 were very wet ones in eastern Australia – only the second quarter of 2021 had normal rainfall i.e. this was an extended La Niña period. Another very wet period began in April 2024.

For additional insights into rainfall patterns, in **Table 7** we present rainfall information for four inland Australian sites plus Doyles Creek (which is the closest weather station to Martindale). The data are presented as the percentage of each location's mean annual rainfall. **Table 7** shows that the 2018-2019 El Niño was widespread, as was the 2021-2022 La Niña. Rainfall in 2020 and 2023 was heavier in central Australia than it was at more easterly locations, particularly in 2023.

Eleven species only had records during the 2018-2019 El Niño event; they are listed in **Table 8**. Another three species had elevated numbers during that period. The mean counts of Double-barred Finch *Taeniopygia bichenovii* and Zebra Finch *T. castanotis* were 30-40 birds; their means were 8-10 birds in later years. Pallid Cuckoos *Heteroscenes pallidus* were present over 2018-2021 (only in the spring visits), but as single birds except in October 2019 when seven birds were recorded.

Table 7. Annual rainfall at specified weather stations, as percentages of the average annual rainfall.

Weather Station	2018	2019	2020	2021	2022	2023
Wilcannia	31%	62%	124%	110%	237%	55%
Alice Springs	60%	23%	86%	142%	155%	139%
Coober Pedy	56%	17%	171%	136%	141%	157%
Birdsville	66%	30%	148%	92%	159%	56%
Doyles Creek	64%	49%	111%	122%	147%	63%

Table 8. Species recorded in the Martindale Valley surveys during 2018-2019 only.

Species	No. of seasons present	Maximum count
Great Egret *Ardea alba*	1	1
Glossy Ibis *Plegadis falcinellus*	1	6
Sharp-tailed Sandpiper *Calidris acuminata*	1	3
Little Eagle *Hieraaetus morphnoides*	1	1
Black Kite *Milvus migrans*	2	8
Brown Honeyeater *Lichmera indistincta*	1	2
Fuscous Honeyeater *Ptilotula fusca*	1	1
Masked Woodswallow *Artamus personatus*	1	2
White-browed Woodswallow *Artamus superciliosus*	2	19
Spangled Drongo *Dicrurus bracteatus*	1	1
Diamond Firetail *Stagonopleura guttata*	1	3

In **Table 9** we have listed the 30 species that were not recorded in the valley prior to 2021, which is when the La Niña event began. Fourteen of those species appeared for the first time during 2021-2022 although most of those were only recorded in one to two of our five visits. The exception was the Eurasian Coot *Fulica atra*, which was present in low numbers during four of the five visits. **Table 9** also lists the species recorded during the six visits of 2023-2024, that had not been present prior to 2021. Most noteworthy amongst those are the crake and rail species, and the egrets.

Table 9. Species recorded in the Martindale Valley surveys only after 2020.

Species	2021-2022		2023-2024	
	No. of seasons present	Maximum count	No. of seasons present	Maximum count
Plumed Whistling-Duck *Dendrocygna eytoni*	1	3	0	–
Wandering Whistling-Duck *Dendrocygna arcuata*	0	–	1	11
Hardhead *Aythya australis*	1	1	0	–
Topknot Pigeon *Lopholaimus antarcticus*	1	3	0	–
Pheasant Coucal *Centropus phasianinus*	1	1	0	–
Brush Cuckoo *Cacomantis variolosus*	0	–	2	3
Lewin's Rail *Lewinia pectoralis*	0	–	1	1
Buff-banded Rail *Hypotaenidia philippensis*	1	2	1	1
Australian Spotted Crake *Porzana fluminea*	0	–	3	4
Baillon's Crake *Zapornia pusilla*	0	–	1	3
Spotless Crake *Zapornia tabuensis*	0	–	3	3
Eurasian Coot *Fulica atra*	4	3	0	–
Cattle Egret *Bubulcus ibis*	1	12	3	6
Plumed Egret *Ardea plumifera*	0	–	1	1
Little Pied Cormorant *Microcarbo melanoleucos*	0	–	2	1
Banded Lapwing *Vanellus tricolor*	0	–	1	2
Barn Owl *Tyto alba*	0	–	2	1
Powerful Owl *Ninox strenua*	0	–	1	1
Whistling Kite *Haliastur sphenurus*	1	1	0	–
Black Falcon *Falco subniger*	2	2	1	1
White-cheeked Honeyeater *Phylidonyris niger*	1	1	1	1
White-eared Honeyeater *Nesoptilotis leucotis*	1	4	3	6
Western Gerygone *Gerygone fusca*	0	–	1	1
Large-billed Scrubwren *Sericornis magnirostra*	2	3	0	–
Black-faced Monarch *Monarcha melanopsis*	0	–	1	1
Scarlet Robin *Petroica boodang*	0	–	1	1
Horsfield's Bushlark *Mirafra javanica*	0	–	1	1
Tawny Grassbird *Cincloramphus timoriensis*	0	–	2	3
Plum-headed Finch *Neochmia modesta*	1	3	0	–
House Sparrow *Passer domesticus*	1	1	0	–

DISCUSSION

It is unsurprising that the greater counts of species and of total birds occurred at the 500-m radius and 5-km radius sites, as they were larger than the 2-ha sites and far more time was spent surveying at them. However, the species richness at site MVS 8 was noteworthy, as were the total counts of birds there. MVS 8 is an acacia-rich woodland near Medhurst Bridge, with many mistletoe plants (probably *Amyema* spp). It was the only site where we recorded Painted Honeyeaters, and also the predominant site for finding Spiny-cheeked Honeyeaters. Site MVS 7, a riparian site abutting MVS 8 at Medhurst Bridge, also had noteworthy species diversity, possibly because of movement of species between the two sites. It is no coincidence that Medhurst Bridge is the most popular destination in the Martindale Valley for visiting roadside birdwatchers. It is also where both Tarrant and Lindsey focussed their survey efforts.

Threatened species

Eighteen threatened species were recorded during the surveys but nine of those each had only one or two records. For those latter species, the Martindale Valley played a minor, albeit possibly quite important, role in their survival strategies. For the other nine species, the valley was important to them. They were recorded in at least four visits during the 20 visits spanning six years.

Painted Honeyeaters were only found at the two sites near Medhurst Bridge (MVS 7, MVS 8) and not after 2021, but we found the other eight species at multiple sites (where there was suitable habitat) on multiple occasions.

The Painted Honeyeater is closely associated with mistletoe species (Allen *et al*. 2022; Oliver *et al*. 2003). Its absence from the sites near Medhurst Bridge after 2021 might be associated with there

being better conditions available in other parts of the species' range. However, it might also indicate that there is an issue about the quality of the mistletoe in the MVS 8 woodland. It would be useful to have a botanical assessment made of the site.

Comparisons with earlier studies

Tarrant (2008) surveyed at two riparian locations in the Martindale Valley regularly during 1998-2008. One site was at Medhurst Bridge, the other was at Smiths Bridge near the Martindale school (H. Tarrant pers. comm.). Although he did not have physical access to the adjoining properties, his regular visits helped develop insights about the bird populations at those two locations. Two of the sites in our surveys, MVS 7 and MVS 8, abut Medhurst Bridge, hence comparisons with Tarrant's findings are of interest.

Tarrant found the Diamond Firetail *Stagonopleura guttata* to be prospering at Medhurst Bridge, with its reporting rate about doubling during the period of his study. We only recorded it in July 2018; three birds near Medhurst Bridge. Tarrant concluded that the populations of three other finch species (Double-barred Finch, Zebra Finch, Red-browed Finch *Neochmia temporalis*) had declined. In contrast, we found good numbers of the former two species during the 2018-2019 El Niño, and also recorded them during almost every other visit. We recorded Red-browed Finches in almost every visit, including a peak count of 69 birds in April 2023.

Tarrant did not record the Spiny-cheeked Honeyeater at Martindale until he found a single bird in late 2008. In recent decades the species has substantially increased its range within NSW including in the Hunter Region (McAllan & Lindsay 2016; Williams 2020; Williams in prep.). Martindale in particular has become a stronghold for the species in the Hunter Region, although they are also recorded at many other locations. Tarrant did not find the Striped Honeyeater *Plectorhyncha lanceolata* at Medhurst Bridge until 2002, but then it occurred there regularly. We recorded it in almost every visit (including at the Medhurst Bridge sites on most occasions). Tarrant's first record of Painted Honeyeater was in November 2001 (with subsequent breeding records that year).

There were drought years in 2002 and 2006, but Tarrant did not find any White-browed Woodswallows *Artamus superciliosus* at Martindale (although he recorded them several times in those years at his sites at nearby Doyles Creek). Lindsey made nine visits to the MVS 8 site spanning 2002-2016, plus twice there during the period overlapping with our study (A. Lindsey pers. comm.). She recorded 82 species, which is comparable to the 105 species we found there in our 20 visits. The Striped Honeyeater was regularly present, and she also recorded the Painted Honeyeater in October 2003 and on every other spring visit (but not in other seasons). Her first records of Spiny-cheeked Honeyeater were in April 2010; after that they were recorded regularly.

Seasonal effects

Spring and summer usually had the greatest abundance and diversity of birds; the results for January 2019 are anomalous when compared with the five other January visits . The number of species recorded in April 2019 also are anomalous when compared with the three other April visits. The number of species recorded in those three visits were 85-95% of the spring and summer totals, when many common migratory species had arrived back. Winter had much lower diversity than the other seasons, in particular there were three winter visits with only 44-46 species recorded each time.

Most of the 26 species that were recorded exclusively in the spring-summer surveys (on more than one of our visits) were well-known to be spring-summer migrants in the Hunter Region (Williams in prep.). However, eight species currently are not categorised in that way: Stubble Quail *Coturnix pectoralis*; Buff-banded Rail *Hypotaenidia philippensis*; Little Black Cormorant *Phalacrocorax sulcirostris*; Pied Stilt *Himantopus leucocephalus*; Large-billed Scrub-wren *Sericornis magnirostra*; Buff-rumped Thornbill *Acanthiza reguloides*; Australasian Figbird *Sphecotheres vieilloti*; Tawny Grassbird *Cincloramphus timoriensis*. Although only recorded occasionally, there were some interesting insights.

Stubble Quails are cryptic, and they are mainly detected when calling. There seems no compelling evidence that they migrate, but irruptions do occur (Marchant & Higgins 1993).

It is unclear if the apparent absences at Martindale were due to the movement of birds away from the area, or due to changes in their detectability.

Australasian Figbirds were recorded in five of the eleven spring or summer visits, and none of the autumn or winter ones – which seems to be sufficient to suggest a pattern of movement. Cooper *et al*. (2020) suggested that it was a partial nomad in NSW, with some birds moving to southerly locations in summer. Martindale possibly is one of the places into which they move.

The records for Buff-rumped Thornbill seem intriguing. From three locations, there were two spring and two summer records, in 2010 and 2023. It is unclear if these records point to a pattern of movement, or to a detectability issue. The two records of Large-billed Scrub-wren both occurred in spring-summer of 2021/22, during La Niña; they were records of single birds in the dry rainforest gully (MVS 6) and at a well-vegetated riparian site (MVS 1). All the records for Buff-banded Rail, Little Black Cormorant and Tawny Grassbird occurred during or after the 2021-2022 La Niña event and are discussed in the following section.

Only five species potentially were autumn-winter specialists. However, three of those species did not have many records and the findings should be considered as tentative. Rose Robin and White-eared Honeyeater had many more records. In the Hunter Region, the Rose Robin is an altitudinal migrant – breeding in elevated altitude rainforests and forests in spring and summer, and subsequently moving to sites at lower altitudes (Stuart & Williams 2016). At Martindale (where the altitudes of survey sites were 100-150 m) that behaviour was replicated – Rose Robins were only recorded in the autumn or winter visits. The White-eared Honeyeater has not been identified as making seasonal movements within the Hunter Region (Williams in prep.). However, in HANZAB it is described as "sedentary over most of range, with some local movements, partial altitudinal migrant in the high country of SE Australia" (Higgins *et al*. 2001). The Martindale findings suggest this species might be an altitudinal migrant within the Hunter Region. Another possibility is that some birds of the western subspecies *novaenorciae*, which occurs in western NSW and further to the west (Cooper *et al*. 2020) move eastwards in winter. These possibilities warrant closer investigation, using a larger database of Hunter Region records.

Climatic effects

1. El Niño

The 2018-2019 El Niño event led to one-off records of several species (Great Egret *Ardea alba*, Glossy Ibis *Plegadis falcinellus*, etc.), and to increased numbers of some finches, woodswallows and raptors. However, overall, it caused a decrease in the number of species recorded in the valley. The summer, autumn, winter and spring visits all had lower total numbers and lower total species counts than in subsequent years. The winter 2023 result was comparable with the 2018 and 2019 winter visits, perhaps because it was during another dry period in eastern Australia.

2. La Niña

It was unfortunate that we were unable to carry out three of the scheduled surveys in 2022, as that denied us the opportunity to assess how Martindale bird populations were affected during what was the peak of the 2021-2022 La Niña event. However, the heavy rains replenished local water bodies which brought longer-lasting effects. Martindale Creek was dry in 2018-2020 but it has been flowing ever since. The two spring-fed wetland sites that we surveyed were dry for two years from summer 2019, but they have been wet ever since. Thirteen of the 30 species that only were recorded at some date after 2020 were waterbirds and two others have a known wetland association – Whistling Kite *Haliastur sphenurus* and Tawny Grassbird. Also, Little Grassbirds *Poodytes gramineus*, which disappeared after our April 2019 visit, returned to the wetland sites in October 2023 and later bred there.

Although a Buff-banded Rail was recorded in January 2021, the main records of crakes and rails were in 2023-2024. Possibly they had been further inland during the main La Niña period and only came to Martindale as inland waterbodies began to dry (for example, Wilcannia and Birdsville each had much below-average rainfall in 2023).

3. General comments

Nix (1972) developed a model to describe bird movements in Australia in response to changing environmental conditions (droughts and floods). From that work, if not before, it is now known to be the norm for inland birds to move towards coastal areas during droughts and to move back again inland after replenishing rains have fallen. Such movements have also been documented for waterbirds (Wen *et al*. 2016) and birds of prey (Baker-Gabb & Fitzherbert 1989).

The Martindale Valley experienced changes in its bird populations during the 2018-2019 El Niño event but there was not a massive influx of birds to the valley. The greater changes were during and after the subsequent La Niña period. These findings suggest that the valley is not a refuge for coastal species (Garnett *et al*. 2013), and that it functions more like a habitat of inland Australia.

The environmental value of retaining or reinstating native vegetation

The Martindale Valley is surrounded on three sides by the Wollemi National Park, but much of the privately held parts of the valley have been cleared for pasture or agriculture. However, we estimate that around 10-15% of the original native vegetation in the valley has been retained or reinstated. Most of the open paddocks have some trees, the riparian zone alongside Martindale Creek has trees and (usually) understorey for virtually its full length, and there are many other sizable pockets of natural vegetation, some with understorey and some not. Godoi *et al*. (2018) identified that bird species richness, composition and abundance in pastures are affected by vegetation structure and distance from natural habitats. This point is confirmed in the Martindale Valley – the national park is close by and the valley including its paddocks are well-vegetated, and hence there is abundant birdlife.

CONCLUSIONS

Six years of surveys in the Martindale Valley have shown its importance for birds, with 190 species recorded in that period including multiple records for about 75% of those species. There were regular records for eight threatened species; all were found at multiple sites: Spotted Harrier, Little Lorikeet, Brown Treecreeper, Speckled Warbler, Grey-crowned Babbler, Varied Sittella, Dusky Woodswallow and Hooded Robin. Another threatened species, the Painted Honeyeater, known to be present in the valley from at least 2001, was not recorded after 2021.

Bird populations in the valley were affected by seasonal factors and by climatic events. A two-year El Niño period brought several species into the valley, mainly as vagrants or short-term visitors. A subsequent La Niña period resulted in the arrival of some different species, and in particular, waterbirds and other species associated with wetlands. The study showed that during very wet La Niña periods, the valley did not become a coastal refuge, but rather functioned more like habitat of inland Australia. The prolonged period of rain replenished local water bodies, providing longer-lasting habitat for wetland species.

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Why has the Whistling Kite population in Port Stephens plummeted?

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Twice-yearly surveys in Port Stephens New South Wales have revealed a statistically significant decline in the local population of Whistling Kite *Haliastur sphenurus*. Birdata records support that conclusion. The decline seems to be linked with increases in the numbers of White-bellied Sea-Eagle *Haliaeetus leucogaster*, Osprey *Pandion haliaetus* and Brahminy Kite *Haliastur indus* in Port Stephens. It is speculated that the Whistling Kite is being out-competed by those three other species.

INTRODUCTION

In 2016 when I analysed data for raptors from the 2004-2016 Port Stephens waterbirds surveys, the Whistling Kite *Haliastur sphenurus* population had been fluctuating but possibly had begun to decline (Stuart 2016). However, because there were only 13 years of data available at that time and the change was recent, that was a tentative conclusion. After another eight years of surveying, there can be no doubt that the Whistling Kite population in Port Stephens has plummeted. In this note I present evidence for the population decline and speculate about possible reasons for it.

METHODS

All birds of prey are counted when teams do the summer and winter boat-based surveys of Port Stephens. The methods used for those surveys are described elsewhere (Stuart 2011; Stuart 2020). I maintained a database of survey records in MS Excel and used standard Excel graphing and statistical packages to analyse the data and calculate Reporting Rates (number of records divided by number of surveys, expressed as a percentage). When comparing data from differing time periods, I used two-tailed t-tests, assuming unequal variance, to test the significance of differences in the means for the two time periods.

There was a summer survey every year over 2004-2024 (total of 21 surveys), while twelve winter surveys were conducted over 2008-2024 (winter surveys in all seven years spanning 2008-2014; five surveys during 2015-2024). For reader convenience, a map of Port Stephens (reproduced from Stuart 2020) is included in this report (**Figure 1**).

For additional insights, I interrogated the Birdata archives (https://birdata.birdlife.org.au/home) for records of Whistling Kite and other raptors from within the boundaries of the Port Stephens Council LGA. I then calculated the annual ratios of the number of records of Whistling Kite and the comparison raptor species e.g. White-bellied Sea-Eagle.

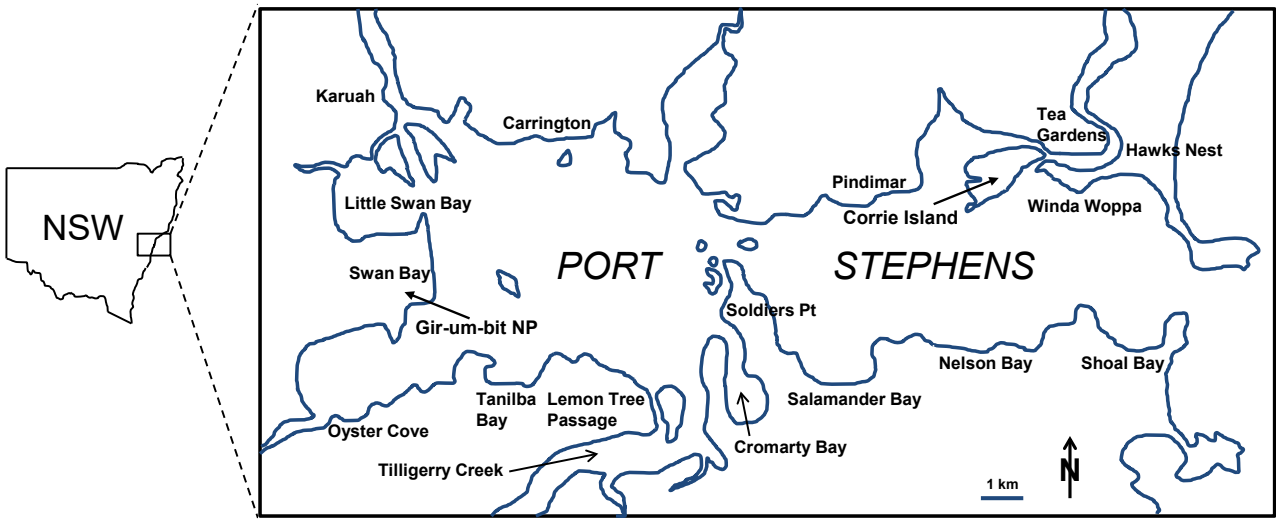

Figure 1. Port Stephens in New South Wales, showing the main towns and topographic features (source: Stuart 2020)

PORT STEPHENS WHISTLING KITE POPULATION

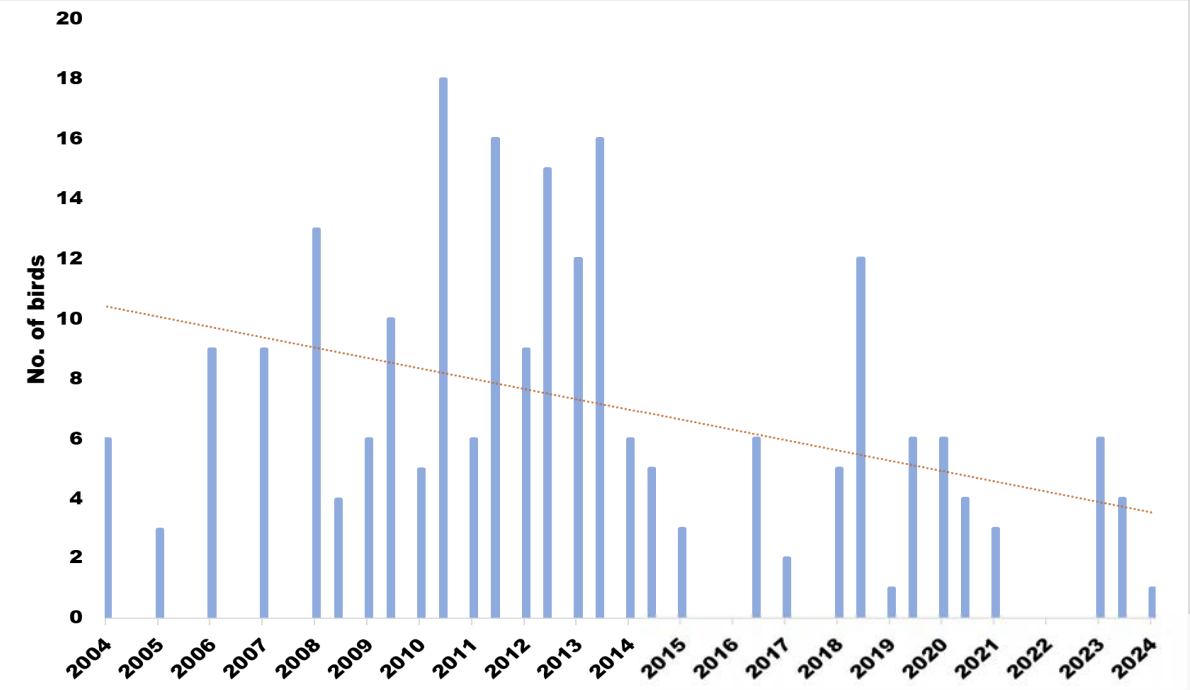

Figure 2. Whistling Kite numbers from every Port Stephens survey since the surveys started in summer 2004.

Figure 2 shows the results for Whistling Kite from every survey since the surveys started in summer 2004. There was a count of 12 birds in July 2018 but all the other counts after 2013 were of six birds or fewer. Therefore, for some of the subsequent analyses, I treated the pre-2014 and post-2014 results separately. I also analysed the summer and winter counts separately.

Table 1 summarises the results from the pre-2014 and post-2014 surveys. The average summer count dropped from eight birds to three and the change was statistically highly significant (two-tailed t-test, p = 0.001). Notably, there were two post-2014 summer surveys where no Whistling Kites were recorded, and their Reporting Rate for summer dropped from 100% to 80%. Whistling Kites were recorded in every winter survey, but their average count dropped from twelve birds to seven. The change was near-significant (two-tailed t-test, p = 0.058).

Table 1 shows that there were more Whistling Kites in Port Stephens in the winter surveys than the summer ones. Using the counts from every summer and winter survey, the difference was statistically significant (two-tailed t-test, p = 0.029).

Table 1. Mean counts, standard deviations (SD), and Reporting Rates (RR), for Whistling Kite in Port Stephens 2004-2024**.**

		Mean (SD)	**RR (%)**
Summer only	All years	6 (4)	90.0
	2004-2013	8 (3)	100
	2014-2024	3 (2)	80.0
Winter only	All years	10 (6)	100
	2008-2013	12 (6)	100
	2014-2023	7 (5)	100

In the 21 years of Port Stephens surveys, nine other raptor species were recorded. However, six of those species were present infrequently – in most cases they only had single records during the surveys. Three species were regularly present: White-bellied Sea-Eagle *Haliaeetus leucogaster*, Osprey *Pandion haliaetus* and Brahminy Kite *Haliastur indus*. As will be demonstrated later, the boat-based surveys indicate that the populations of all three of those species have increased in Port Stephens. After looking closely at the annual data, it seemed that population trends began to change from about 2010. There had only been three winter surveys to that time, making comparisons of pre- and post-2010

winter data of little value. However, there had been seven summer surveys (and 14 summer ones since 2010). In **Table 2** I present the relevant summer data for all four species. The "Whistling Kite ratio" is the mean of the yearly summer ratio of Whistling Kite numbers to the total numbers for all four species.

Table 2. Mean counts, standard deviations (SD), and Reporting Rates (RR), for four raptor species in Port Stephens from the summer surveys for 2004-2010 and 2011-2024, and *p* values from t-tests of the two means**.**

Species	2004-2010			2011-2024			*p* of means (t-test)
	Mean	SD	RR (%)	Mean	SD	RR (%)	
Whistling Kite	7	3	100	4	4	85.7	0.077
White-bellied Sea-Eagle	11	5	100	19	7	100	0.001
Osprey	2	1	85.7	8	2	100	<<0.001
Brahminy Kite	0	0	0	1	1	42.9	0.022
Total birds	20	9	-	32	9	-	0.018
Whistling Kite ratio (%)	41	13	-	13	11	-	0.003

The change in Whistling Kite numbers was near-significant ($p > 0.05$). The changes for Brahminy Kite and for the total number of birds were statistically significant ($0.01 < p < 0.05$), as was the change in Whistling Kite ratio. The changes for White-bellied Sea-Eagle and Osprey over the two time periods were statistically highly significant ($p < 0.001$). Brahminy Kites were not recorded in summer surveys until 2011. The majority of summer records were of single birds. I also note that the winter Reporting Rate for Brahminy Kite from 2014 onwards was 100%, with an increasing frequency of records of 2-3 birds.

Similar trends (decline in Whistling Kites, rise in numbers of the other species) were apparent from the Birdata records for the Port Stephens LGA. For example, **Figure 3** shows the ratios, since 2004, of the number of records each year for Whistling Kite and White-bellied Sea-Eagle. Prior to 2004 there were not enough records for those species in Birdata to warrant analysis.

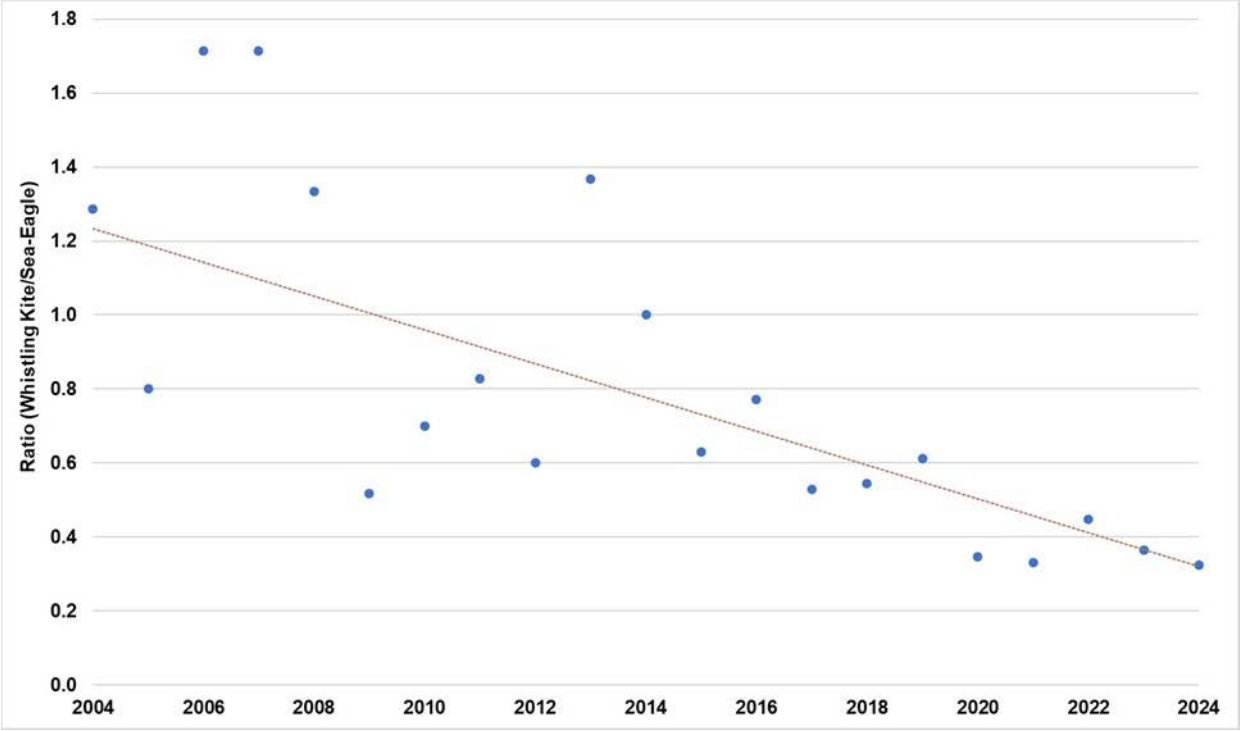

Figure 3. Annual ratios of the numbers of Birdata records for Whistling Kite and White-bellied Sea-Eagle for the Port Stephens LGA, with trend line.

DISCUSSION

The high count of 12 Whistling Kites in July 2018 (**Figure 2**) is anomalous for the post-2014 surveys. In that survey, two of the six survey vessels had mechanical issues and the surveys took longer than usual. Perhaps that was a factor in the high count, as those two survey sectors recorded the most Whistling Kites (five and four birds respectively). The possibility of some double-counting cannot be excluded. If the July 2018 result is disregarded, the change after 2014 become further magnified.

Across its range, which spans Australia (including coastal islands), New Caledonia and much of New Guinea, the Whistling Kite is a species in decline (Planet of Birds 2011; Cooper *et al*. 2014; Animalia 2023). Although the population trend is a decreasing one, the decline is not believed to be sufficiently rapid to approach the thresholds for classification as Vulnerable. Factors suggested for the general population decline include loss of wetland habitat and loss of suitable nest sites (Cooper *et al*. 2014).

Those factors seem not to apply in any direct way for Port Stephens, which mostly is an undeveloped and largely pristine estuary bordered by several national parks. What may be of greater relevance is that the populations of the other three main raptor species have increased in Port Stephens. Osprey numbers have increased statistically significantly, Brahminy Kite numbers have risen, as has their Reporting Rate, and there are more White-bellied Sea-Eagles as well. Those three species are prospering in Port Stephens whereas the Whistling Kite population has plummeted. For example, the boat-based waterbirds surveys and the Birdata records both indicate that White-bellied Sea-Eagles are now 3-5 times as common as Whistling Kites in Port Stephens.

Possibly these population changes may be the result of Whistling Kites being out-competed by the three other species. An alternative explanation is that the habitat and/or general conditions in Port Stephens have changed, detrimentally for Whistling Kites and positively for the other species.

The extent of inter-species competition for food may be a factor. Whistling Kites eat fish, small animals and carrion, as do Brahminy Kites and White-bellied Sea-Eagles (Cooper *et al*. 2014). Mammal carrion is a higher proportion of the diet of Whistling Kites, and conversely waterbirds in sea-eagle diets (Olsen *et al*. 2013); however, all three species probably will eat whatever they find. The diet of Ospreys primarily is fish and they are not reported to take carrion (Marchant & Higgins 1993). All four species potentially will compete for fish (Thomson *et al*. 2016), and the two kite species and sea-eagles will compete for most other food items.

Competition for nesting sites may also be a factor. All four species build large stick nests near the top of an emergent tree, although Ospreys will often choose artificial nest structures instead (Clancy 2009; Moffatt 2009; Thomson *et al*. 2019). There seems to be no shortage of suitable nest trees around Port Stephens, given the many surrounding national parks and similar reserves. There have been few studies of either the inter-species or intra-species spacing requirements for nest sites for these four raptor species. Lutter *et al*. (2006) reported Brahminy Kites successfully defending a nest against a Whistling Kite, although the latter initiated the aggression. White-bellied Sea-Eagles and Brahminy Kites were found to have different habitat preferences for their nest trees, and they had differing intra-species spacing requirements (Khaleghizadeh & Anuar 2014). Those authors did not investigate the inter-species spacing requirements. It seems plausible that a dominant raptor species at a nest tree would chase away other raptor species attempting to nest in a nearby tree. What is unclear is how Whistling Kites would fare in such a contest, nor is it known what is the minimum required inter-species nest spacing distance.

Have conditions in Port Stephens changed, to the detriment of Whistling Kites? There seems to be no strong evidence to support that conclusion. Most of Port Stephens is a marine park, and a considerable amount of its surrounds are national parks and similar conservation reserves. However, the human population has increased (Port Stephens Council 2024) and presumably therefore, so has the amount of disturbance by humans. A related effect from human population change in Port Stephens is that Whistling Kites are the most likely of the four species to scavenge roadkill and thus get killed on roads.

One other factor might be contributing to the Whistling Kite's decline, although not exclusive of the other factors suggested. Being more of a scavenger of mammal carrion and a predator of rodents than the other three species, Whistling Kites might also be subject to secondary poisoning from scavenging or catching dead and dying rats and mice in or near urban areas where people poison rodents. The highly toxic second-generation anticoagulant rodenticides are readily available and commonly used (Australian Pesticides and

Veterinary Medicines Authority 2024). There are many reports about their acute toxicity to apex avian predators (BirdLife Australia 2024).

Status of competitor raptor species in Port Stephens

The first records in Birdata for Brahminy Kite in the Port Stephens LGA were in 1999 and the first Annual Bird Report record was in 2000 (Stuart 2001). The species was uncommon in Port Stephens until about 2015, but now it is a breeding resident (Wooding 2017; Wooding 2019). Their range in New South Wales contracted northwards after European settlement, and they also were impacted by egg-shell thinning caused by the ingestion of DDT (Cooper *et al*. 2014). However, now their population and range are rebounding – which are reflected in the increasing numbers and Reporting Rate in the Port Stephens surveys.

In the decades before 1980 there were no known active Osprey nests in NSW (Cooper *et al*. 2014). By 2009 there were at least 140 nesting pairs in the state (Clancy 2009; Moffatt 2009). The first records in Birdata for Osprey in the Port Stephens LGA were in 1999. However, a pair was seen at a nest tree at Tanilba Bay in 1996 (Stuart 1997). In 2017 there were at least five active nests in Port Stephens (Stuart 2018) and the number of pairs probably has increased since then (pers. obs.). The dramatic recovery of the species in NSW has been suggested to be due to a combination of the new protective status (it is now classified as Vulnerable in NSW), cessation of hunting, efforts to improve nesting options, and heightened public awareness (Cooper *et al*. 2014).

The White-bellied Sea-Eagle is also classified as Vulnerable in NSW, with the loss of suitable breeding sites from habitat clearance being a factor in that listing decision (NSW Department of Environment 2016). It also is sensitive to disturbance around its nest site and its populations around heavily industrialised or urbanised areas have declined (NSW Department of Environment 2016). The species was one of the more affected by DDT egg-shell thinning, probably due to its feeding in areas heavily treated with pesticide such as swamps (Wikipedia 2024). The population in Port Stephens has increased – from a mean of 11 birds in summer surveys over 2004-2010 to a mean of 19 birds in the post-2011 surveys.

The timing of the changes

As presented earlier, the populations of White-bellied Sea-Eagle, Osprey and Brahminy Kite in Port Stephens began to rise from about 2010 and the changes for all three species were statistically significant or highly significant. The decline in the Whistling Kite population did not begin to manifest until a few years later. The differences between 2004-2010 and 2011-2024 summer counts were statistically near-significant but the differences between 2004-2013 and 2014-2024 were statistically highly significant.

The 2-3-year lag period, before Whistling Kite numbers began to decline, might indicate lack of breeding success for the species, i.e. older birds not being replaced. Lack of breeding success could result from competition for breeding sites or competition for food for young birds, or a combination of those two issues.

CONCLUSIONS

The Whistling Kite population in Port Stephens has plummeted. In 2004, the local populations of Whistling Kite and White-bellied Sea-Eagle were about equal. Now, sea-eagles out-number Whistling Kites by a factor of about five, from a combination of kite population decline and sea-eagle population rise. The populations of Ospreys and Brahminy Kites have also risen significantly.

The Whistling Kite decline in Port Stephens is most likely because of their being out-competed by the three other main raptor species. Whether that is a result from competition for food or from competition for nest sites is unclear.

ACKNOWLEDGEMENTS

Almost 70 members of HBOC have participated in one or more of the Port Stephens surveys and their willing assistance is much appreciated. The surveys were conducted in collaboration with the NSW National Parks and Wildlife Service (Hunter Coast office), with numerous NPWS staff making major organisational contributions over the 21 years of surveys. Assistance (provision of both skippers and vessels) from Port Stephens – Great Lakes Marine Park, Marine Rescue Port Stephens and various commercial enterprises is gratefully acknowledged as well. I also thank the reviewer, Steve Debus for his helpful comments and suggestions.

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Effect of rainfall on the occurrence and numbers of Red-browed Finches in the Lower Hunter near Paterson

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The role of annual rainfall on the population dynamics of Red-browed Finches *Neochmia temporalis* on a small farm near Paterson in the Lower Hunter region of NSW was evaluated for the period 1996 to 2013, inclusive. The analyses were based on quarterly surveys of 20-min duration at four 2-ha sites where presence and count data were recorded. Despite large interannual fluctuations in Reporting Rate (mean 30.0%, standard deviation 11.9%), the Red-browed Finch population demonstrated long-term stability. The study period overlapped with the seven-year "Millenium Drought".

A highly significant ($p<0.01$) correlation with annual rainfall lagged by one year explained ~38% of the interannual variation in annual Reporting Rate. Analysis of the count data indicated a parallel increase in the number of birds/survey ($p<0.05$) and an increase in group size with rainfall lagged by two years. These results demonstrate how the Red-browed Finch, a multi-brooding granivore with a large clutch size can respond opportunistically to advantageous climatic conditions.

Highly structured bird surveys with a quarterly sampling rate generated data with sufficient statistical power to provide information on species-specific responses to changes in environmental conditions. A preliminary analysis of data for four other species suggests that the approach has wider applicability.

INTRODUCTION

In this short paper, we present an analysis of interannual variation in the occurrence and numbers of Red-browed Finches *Neochmia temporalis* on a small farm near Paterson in the Lower Hunter Valley, NSW between 1996 and 2013. The Red-browed Finch was selected for the analysis because grassfinches are potentially capable of responding quickly to favourable climatic conditions.

The aim of this study was to see if the results of quarterly monitoring had sufficient statistical power to identify short-term fluctuations in the occurrence and abundance of birds, and whether these changes were explained by variations in rainfall. We also looked for evidence of long-term changes in status using both presence data (Reporting Rates) and count data (numbers of individuals). Although we focussed on Red-browed Finches in this study, we also did a preliminary analysis of data for four other species, Grey Fantail *Rhipidura albiscapa*, Superb Fairy-wren *Malurus cyaneus*, Yellow-faced Honeyeater *Caligavis chrysops* and Yellow Thornbill *Acanthiza nana*, to assess the wider applicability of our approach (presented in the **Appendix**).

METHODS

Quarterly surveys were undertaken between 1996 and 2013 inclusive at four survey sites on a small farm adjacent to Green Wattle Creek Road near Paterson in the Lower Hunter Valley in NSW. The sites all were located in remnant vegetation patches on the farm (**Figure 1**). Detailed habitat descriptions for each site are provided in Newman (2007). The standard Birdata 2ha-20min survey method was used (https://birdata.birdlife.org.au/home), and the numbers of individuals of each species were counted. All surveys were conducted in the mornings by the senior author.

Data from the four survey sites (16 surveys/annum) were assessed to calculate:

1. Annual Reporting Rates – the percentage of surveys in which a species was present,
2. Two measures of annual abundance:
   a. The mean number of individuals/survey, and
   b. The mean group size (i.e. the number of individuals/survey for those surveys in which the species was present), All analyses and plots were undertaken using DataGraph 5.3 software https://www.visualdatatools.com/DataGraph/. Statistical significance was assessed at 5% and 1% levels (Sokal & Rohlf 1995).

The following analyses were undertaken:

1. Linear and curvilinear regressions of the annual Reporting Rates.
2. Linear and curvilinear regressions of Reporting Rate against annual rainfall lagged by one to three years.
3. Linear regressions of the mean numbers of birds/survey against annual rainfall, and annual rainfall lagged by one to three years.
4. Linear regressions of the mean group size of birds/survey against annual rainfall, and annual rainfall lagged by one to three years.

The rainfall records of the nearby Tocal Agricultural College were used for the rainfall analysis. The rainfall patterns were complex and included an extended seven-year period of low rainfall between 2000 and 2006 (**Figure 2**), the so-called "Millennium Drought" (van Dijk *et al*. 2013).

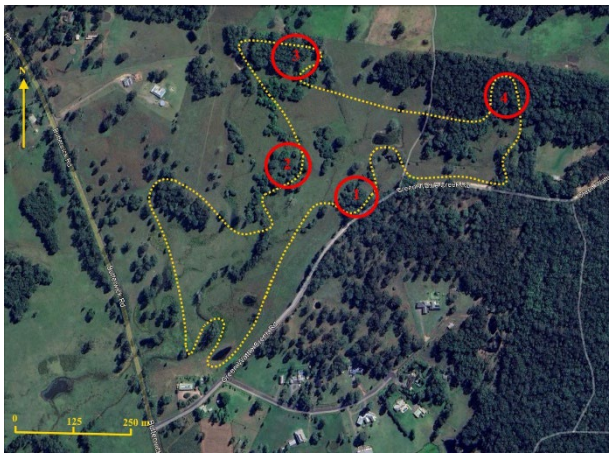

Figure 1. Locations of the 2-ha survey sites and the survey route conducted by walking from site 1 in a clockwise direction.

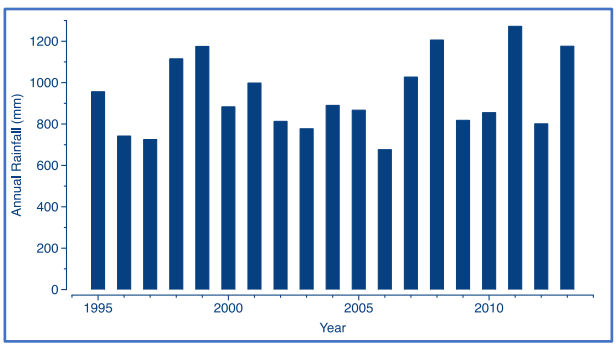

Figure 2. Annual rainfall (mm) for the Tocal Agricultural College near Paterson NSW: BOM for 1995-2013. (http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=139&p_display_type=dataFile&p_startYear=&p_c=&p_stn_num=061250).

RESULTS

Reporting Rate

There were large inter-annual variations in annual reporting rates (**Figure 3**). The slope of the linear regression line indicated a relative decrease in Reporting Rate/decade of 13.5%, but this result was not statistically significant. The low value of the Coefficient of Determination (r^2 = 0.044) indicates that the linear model explained <5% of the interannual variance present. The linear and curvilinear trends were almost identical (**Figure 3**).

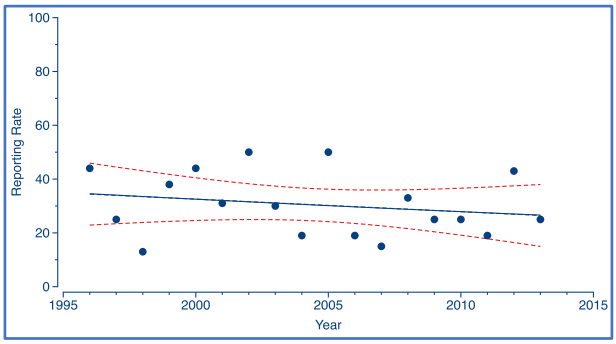

Figure 3. Red-browed Finch – Linear regression of annual Reporting Rates for the period 1996 to 2013, inclusive. The red dashed lines are the upper and lower 95% Confidence Limits for the linear regression. The regression was not statistically significant.

Seasonal Occurrence

Red-browed Finches were present throughout the year forming larger groups in winter (**Table 1**). The mean group size decreased in summer (January surveys) which coincided with the peak of the breeding season at Blackbutt Reserve, Newcastle (Todd 1997).

Table 1. Summary statistics for the seasonal occurrences of Red-browed Finches at a property in the Lower Hunter Valley NSW, 1996 – 2013, inclusive.

Metric	Summer	Autumn	Winter	Spring
Reporting Rate (%)	35.2	21.3	27.9	36.1
Mean group size	2.9	4.8	6.5	4.5
Standard Deviation of group size	3.8	4.8	7.0	3.6
Maximum number	13	15	25	16
Median number	2	2.5	4.5	4

Rainfall analysis

There was a highly significant correlation between annual Reporting Rate and annual rainfall lagged by one year (**Figure 4**). The high value of the correlation coefficient indicates that variations in annual rainfall explain ~38% of the interannual variation in annual Reporting Rate.

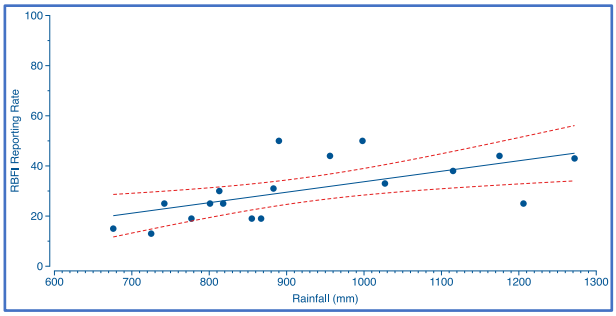

Figure 4. Red-browed Finch (RBFI) – Increasing linear trend in annual Reporting Rates and annual rainfall lagged by one year. The red dashed lines are the upper and lower 95% Confidence Limits for the linear regression. The trend was highly significant (p <0.01, r^2 = 0.379, r = 0.616, SIG).

A statistically significant linear correlation was identified between the mean number of birds/survey and annual rainfall (**Figure 5**) which accounted for ~24% of the interannual variance in the numbers of birds. The linear correlation between the annual mean group size of birds and annual rainfall lagged by two years approached statistical significance (**Figure 6**). No other significant or near-significant trends were found in the analyses examining the influence of annual rainfall on Red-browed Finch numbers over the study period.

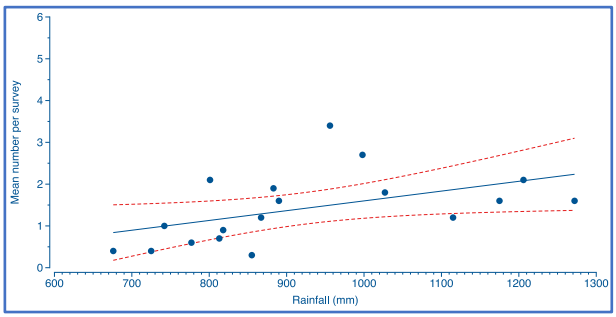

Figure 5. Red-browed Finch – linear regression between the mean number of individuals per survey and annual rainfall lagged by one year. The red dashed lines are the upper and lower 95% Confidence Limits for the linear regression. The trend was significant (0.05>p>0.01), r^2 = 0.238, r = 0.488, SIG).

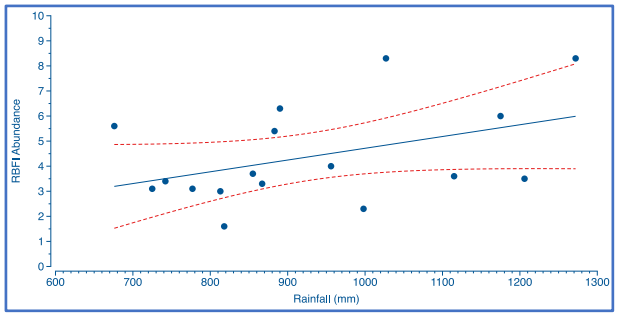

Figure 6. Red-browed Finch (RBFI) – linear regression between the mean group per survey and annual rainfall lagged by two years. The red dashed lines are the upper and lower 95% Confidence Limits for the linear regression. The regression approached significance (r = 0.428, critical value for r is 0.482).

DISCUSSION

Red-browed Finches nest in small colonies and can breed at any time of the year (Higgins *et al.* 2006), although this may not be the case in NSW (M. Todd pers. comm.). With up to three clutches annually, typically involving 4 or 5 eggs, their populations are capable of increasing more rapidly than most passerine species (Yom-Tov Yoram 1987). In central NSW, seeds are the major dietary item throughout the year, but may be supplemented by insects, particularly in the breeding season (Todd 1996). They are mainly sedentary and resident, with some local movements outside the breeding season (Higgins *et al.* 2006). Todd (1997) found that Red-browed Finches at Blackbutt Reserve, Newcastle in the Lower Hunter were largely sedentary.

Fluctuations in bird populations are determined by the balance between birth and mortality, driven by many factors. In the case of finches, which feed on seeds, fluctuations in food availability determine their lifestyle, which can vary between species and between locations (Newton 1972). In the case of the Red-browed Finch, a species considered to be relatively sedentary in the Hunter Region, breeding productivity would be expected to increase in response to climatic conditions (e.g. rainfall) that result in increased grass growth and seed availability, resulting in a population increase. In addition, these favourable conditions would be expected to increase temporarily the spread of locations Red-browed Finches can feed. Hence, favourable breeding conditions would be expected to result in both an increase in the number of survey sites at which finches are recorded (Reporting Rate) and the number of finches (Counts). Conversely, under drought conditions seed production and

breeding success will decrease, and starvation will increase mortality.

Red-browed Finch population dynamics

There was no evidence of a decrease in the occurrence of Red-browed Finch at the location sampled during the study period. The statistically non-significant decrease in RR of 13%/decade is consistent with the "potential long-term decline" of the Red-browed Finch population in the Hunter Region *sensu* Williams (2020). The Red-browed Finch population was deemed stable based on the following metrics:

1. A low, non-significant rate of decadal decrease (13%).
2. A low Coefficient of Determination r^2 (0.044), consistent with the null hypothesis of no change in the population over the study period.
3. The longevity of the study (18 years), which was 10 times the estimated generation time of 1.8 years for the Red-browed Finch (Bird *et al*. 2020). Three generation times is generally considered sufficient (e.g. Garnett & Baker 2021), but Bennett *et al*. (2024) suggested that a longer period may be required in order to understand the recovery of species from extended climatic abnormalities such as the "Millenium Drought".

Fluctuations in annual rainfall explained much of the short-term variation in both presence (Reporting Rates) and abundance (numbers) of Red-Browed Finch. The more frequent occurrence in the year immediately following increased rainfall is attributed to an immediate breeding response to the increased rainfall. This results in an immediate population increase reflected in the next years' statistics, namely the statistically highly significant $p < 0.01$ increase in presence (Reporting Rate) and the near significant increase in abundance (number of birds/survey). Insectivores may respond less rapidly because it takes longer for insect populations to build up following such events compared with the rapid production of seed by grasses and other seed producers.

As the numbers of finches continued to build, flocks increased in size explaining the statistically significant relationship between group size and rainfall lagged by two years. Conversely, as rainfall decreased and food availability decreased, mortality increased, breeding success fell and the population decreased, resulting in decreased Reporting Rates and numbers of birds.

The long-term stability of the Red-browed Finch population in this study is attributed to the sound custodianship of the study location, which involved the retention of shelterbelts and riparian vegetation, and no removal of vegetation other than invasive weeds. A future challenge is to compare the results in this study with those of contemporaneous investigations elsewhere in the Lower Hunter involving comparable methodology at Green Wattle Creek (Newman & Cunningham 2014) and at East Seaham (Kendall 2023).

Efficacy of survey methodology

This analysis showed that quarterly 2-ha 20-min surveys at four sites had sufficient power to identify statistically significant trends in the population dynamics of a species present at an overall Annual Reporting Rate of 30%. Statistically significant trends were apparent in both presence data (Reporting Rates) and count data (measures of species abundance). This is consistent with the assumption that Reporting Rate is a surrogate measure of abundance, a pivotal assumption to the use of Reporting Rates to monitor bird populations throughout Australia.

The statistical power of the methodology was enhanced by the longevity of the study (18 years) that approximates 10 generations of the study species, and the highly structured sampling regime; i.e. one observer conducting replicated standardised surveys at regular intervals. Estimating the number of birds present during woodland surveys is challenging as it is prone to observer-specific error(s). These errors will tend to be systematic in single observer data, and less random than in multiple observer citizen science data sets. In this analysis, it was necessary to pool the seasonal results to provide sufficient observations (statistical power) for interannual comparison of Reporting Rates. Increasing the survey frequency from quarterly to monthly would have provided the statistical power necessary for a more sophisticated evaluation comparing seasonal differences in the species occurrence.

Future challenges

This analysis examined data from a single location, potentially raising questions concerning the relevance of the results at the broader, landscape scale to this and other woodland bird species. Birds are mobile, and for many species their occurrence at any site reflects their status in the local environment. Standardised surveys, such as used herein within a structured monitoring regime may

provide early identification of population decreases. If these decreases are widespread, they may signal that the species meets the criteria for threatened species nomination. A more optimistic alternative is that the community will heed those early signals and implement land management practices that sustain bird populations and prevent them reaching Threatened Species criteria. The short-term challenge is to evaluate the existing data sets, while the long-term challenge is to establish an extended matrix of regularly monitored sites using standard methodologies to provide relevant data at landscape scales.

CONCLUSIONS

Seasonal and interannual fluctuations in the occurrence (Reporting Rates) and numbers (Abundance) of Red-browed Finch on a small farm near Paterson were explained by variations in annual rainfall. Despite these interannual fluctuations, the population was stable over an 18-year study period from 1996 – 2013, which overlapped with the seven-year "Millenium Drought". The methodology, which involved quarterly surveys of 20-min duration at four 2-ha sites has the potential to provide valuable insights into the population dynamics of other species for a modest investment of field work (15 hours/annum in this study). While these conclusions relate to a specific bird population, extension to an array of locations has the potential to provide landscape-scale trends in bird populations.

ACKNOWLEDGEMENTS

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APPENDIX

Other woodland bird species

Data for an additional four species, Grey Fantail *Rhipidura albiscapa*, Superb Fairy-wren *Malurus cyaneus*, Yellow-faced Honeyeater *Caligavis chrysops* and Yellow Thornbill *Acanthiza nana*, were analysed to assess the wider applicability of the data set. Statistically significant and near-significant trends were detected for three of these species including trends with annual rainfall lagged by two and three years for the Grey Fantail and Superb Fairy-wren. No trend was found for the Yellow-faced Honeyeater. It is beyond the scope of the present paper to give detailed context and explanations of these results. See **Table A1** for a summary of preliminary results.

Table A1. Statistically significant and near-significant trends in three additional species, Lower Hunter Valley NSW, 1996 – 2013, inclusive.

Species	**Trend**	**Statistical significance**
Grey Fantail	Positive - Abundance and rainfall lagged 2 years	Near-sig. at $p > 0.05$[1]
Superb Fairy-wren	Positive – Reporting Rate and rainfall unlagged Positive – Group size and rainfall lagged 3 years	Near-sig. at $p > 0.05$[1] Sig. $0.05 > p > 0.01$
Yellow Thornbill	Negative – Reporting Rate and rainfall unlagged Negative – Group size and rainfall unlagged	Sig. $0.05 > p > 0.01$ Near-sig. at $p > 0.05$[1]
Yellow-faced Honeyeater	None	

[1] The near-significant trends involve probabilities slightly exceeding the $p=0.05$ level.

Survival and longevity of an oiled Australian Pelican and a summary of recent data for movement by banded birds in the Hunter Region

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On 4 May 2024 I saw a banded Australian Pelican *Pelecanus conspicillatus* on the beach on the north side of Stockton Sandspit, New South Wales (see **Figure 1**). It was the only banded bird in a small flock of around 20 pelicans. With the aid of binoculars and a spotting scope I was able to read the band numbers (band ID: 17026665). My subsequent enquiry to the Australian Bird and Bat Banding Scheme (ABBBS) revealed that it had been banded on 24 September 2010 (N. Perring pers. comm.). This is the longest recovery interval for an Australian Pelican in the Hunter Region (**Table 1**). The bird had adult plumage when banded, i.e. it was at least one year of age, and thus it was at least 14 years and 7 months old in May 2024.

The close-up image of the pelican's leg profiles (**Figure 1 lower**) highlights the ovoid leg shape of this species. The photo shows clearly the bulky front profile of the left leg, and the narrower side profile of the right leg.

The bird was one of 35 pelicans rescued following an oil spill from the *Magdalene* on 25 August 2010 in the south arm of the Hunter River adjoining Newcastle Harbour, Kooragang Island. The affected birds were captured, carefully cleaned of oil and dried by trained volunteers, and then transferred to Taronga Zoo for rehabilitation (Crawford 2010; WIRES 2010). All the rescued birds were released later at Stockton North Boat Ramp which is located approximately two km south of Stockton Sandspit (**Figure 2**).

Prior to their release back into the Hunter Estuary, each pelican was banded, under an NSW government initiative approved by the ABBBS (N. Perring pers. comm.).

Banded Australian Pelican sightings and movements in the Hunter Region

I also saw a banded pelican on 11 May 2024 amongst a flock of over 350 pelicans on the Kooragang Dykes on the western side of the south arm of the Hunter River but could not read the band number. However, there have been confirmed sightings of eleven banded pelicans in the Hunter and Port Stephens areas since the September 2010 release, with a total of 23 re-sightings i.e. some birds have been seen more than once. The details are provided in **Table 1**. Five of the birds were part of the cohort that was banded following the oil spill, two were banded following rehabilitation, and the other four were banded at breeding locations outside of the Hunter Region.

Figure 1: The banded Australian Pelican (band ID: 17026665) at Stockton Sandspit, New South Wales on 4 May 2024. Upper image is of the bird preening in the water. Lower image is a record of the band on the lower right tarsus. (Photos: G. Little).

Table 1: Australian Pelican re-sightings in the Hunter and Port Stephens estuaries since September 2010, showing banding location and date, age, sex (where known), banding location, recovery location and date, and distance travelled from banding location and time since banding in years and months (data courtesy of ABBBS). N = nestling, M = male, F = female, U = unknown sex.

Band ID	Date Banded	Age when banded	Sex	Banding Locality	Recovery Locality	Date Recovered	Distance km	Interval since banding
17026631	28/04/2015	1+	U	Belmont, Lake Macquarie	Boatrowers Reserve Blacksmiths	2/04/2016	11	11mths
17026648	18/12/2014	1+	U	Pelican Island, Blackwall Bay	Pacific Highway Belmont	15/11/2017	57	2yrs 10mths
17026653	17/09/2010	1+	M	Hunter Estuary	Stockton Fish Cleaning Station	16/03/2014	2	3yrs 5mth
					Stockton Fish Cleaning Station	2/09/2014	2	3yrs 11mths
					Stockton Sandspit	23/01/2016	0	5yrs 4mths
17026660	24/09/2010	1+	M	Hunter Estuary	Stockton Sandspit	23/01/2016	0	5yrs 3mths
17026665	24/09/2010	1+	M	Hunter Estuary	Stockton Sandspit	4/05/2024	9	13yrs 7mths
17026666	28/09/2010	1+	F	Hunter Estuary	Stockton Fish Cleaning Station	13/03/2014	2	3yrs 5mths
					Stockton Fish Cleaning Station	9/08/2014	2	3yrs 10mths
					Stockton Fish Cleaning Station	11/10/2014	2	4yrs
17026674	8/10/2010	1+	F	Hunter Estuary	Hunter River North Arm	07/01/2011	10	2mths
					Stockton Fish Cleaning Station	02/10/2013	2	2yrs 11mths
					Stockton Fish Cleaning Station	13/03/2014	2	3yrs 5mths
					Stockton Sandspit	23/01/2016	0	5yrs 3mths
17027217	12/12/2018	1	U	Crescent Island Gippsland Lakes	Soldiers Point	15/08/2021	702	2yrs 8mths
					Soldiers Point	15/05/2022	702	3yrs 5mths
17027251	7/12/2020	3+	F	North Arm Gippsland Lakes	Little Beach, Nelson Bay	9/07/2022	688	1yr 7mths
					Little Beach, Nelson Bay	4/09/2022	688	1yrs 8mths
					Little Beach, Nelson Bay	15/09/2022	688	1yrs 9mths
17027335	11/02/2022	N	U	Crescent Island Gippsland Lakes	Stockton Sandspit	2/07/2022	673	4mths
					Carrington Boat Ramp, Newcastle	29/09/2022	666	7mths
17027770	8/08/2022	1+	U	Narrabeen Fitness Camp Narrabeen	Little Beach, Nelson Bay	7/08/2023	138	11mths

Figure 2: Map showing approximate location of oil spill (light blue), Stockton North Boat Ramp release location (yellow) and 4 May 2024 sighting of banded Australian Pelican on Stockton Sandspit (red). (Modified from Google Maps, accessed 26 May 2024).

Of the eleven individuals in **Table 1**, all were sighted alive in the Hunter Region except for the bird with band ID 17026648; it collided with a motor vehicle and died of its injuries. Information about the other nine birds is presented below.

In 2022 two Australian Pelicans with red readable bands (reading 251 and 335) were in the Hunter and Port Stephens estuaries. Both had been banded in the Gippsland Lakes area in Victoria at distances of 673-688 km from the Hunter Estuary and 702 km from the Port Stephens site (ABBBS Sept. 2024).

On 2 July 2022 an Australian Pelican with band ID 17027335 and a red band number 335 (J. Little & G. Little pers. obs.) was at Stockton Sandspit. Later, this bird suffered a fishing line/hook injury and was rescued and taken into care by members of Hunter Wildlife Rescue at Carrington, near Newcastle NSW on 29 September 2022 (A. Williams pers. comm.). It was subsequently released within a few days at Soldiers Point in Port Stephens. The bird had been banded originally as a nestling on 11 February 2022 (ABBBS Sept. 2024).

An Australian Pelican with band ID 17027251 and a red band number 251 was observed at Little Beach, Nelson Bay NSW three times in 2022 the first being on 9 July 2022 and then on 4 September 2022 (R. Kyte pers. comm.) and again, at the same location on 15 September 2022 (N. Fraser pers. comm.). This bird had been banded on 07 December 2020 and was aged then as being a 3+ years old female, thus being over 4 years and 9 months old at time of the last sighting (ABBBS Sept. 2024).

The bird with band ID 17026666 was found dead at Patonga Beach on the Central Coast, three and a half months after the last record in the Hunter Region (ABBBS Sept. 2024).

The only pelican in **Table 1** banded as an adult (band ID 17027251) was banded at a breeding site in Victoria. In addition to the Hunter Region

sightings, the bird had several records from outside of the Hunter Estuary, being sighted in Merimbula (28 August 2021), Eden (26 September 2021), Tuncurry Boat Ramp (12 June 2022) and Old Tallawarra Ash Ponds, Lake Illawarra (5 January 2023). The greatest movement (to Tuncurry) being 755 km from the place of banding (ABBBS Sept. 2024). The other two birds banded at breeding sites in Victoria were young birds.

Frequent re-sightings of some of the oiled birds suggest they are part of a local flock. The Hunter Region Annual Bird Reports (Stuart 2012-2018; Williams 2019-2020) indicate that the closest breeding colonies to the Hunter Estuary are in Wallis Lake on Pelican Island and Snake Island. However, the natal origins of these birds are uncertain and further studies, including tracking studies, would be required to determine where the 'Hunter' flocks breed.

There are currently a number of ABBBS-approved projects involving the banding of Australian Pelicans in various inland lakes in New South Wales and Victoria, with readable bands of differing colours being deployed at each lake (ABBBS Sept. 2024). There should be better understandings about pelican movements in south-eastern Australia if birdwatchers report any sightings of banded pelicans to the ABBBS.

ACKNOWLEDGEMENTS

I acknowledge the rescue and clean-up efforts by members of local organisations including the Native Animal Trust Fund (NATF, now Hunter Wildlife Rescue HWR), Australian Seabird Rescue, NSW Wildlife Information Rescue and Education Service (WIRES), the Royal Society for the Prevention of Cruelty to Animals (RSPCA), Hunter Bird Observers Club and National Parks and Wildlife Service following the 2010 oil spill. I also thank Nathan Perring from the ABBBS and Ann Williams (HWR) for the information they provided.

I further acknowledge the following banders: G. Ross; A. F. Silcocks; Taronga Zoo Banding Program.

Thank you to Greg Little for the photographs and assistance with reading and confirming the band details.

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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**
2. **Short Notes**
3. **Book Reviews**

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.

General Instructions for Submission

Manuscripts should be submitted electronically; please attach your manuscript to an email as a Microsoft Word document. Charts should be submitted as an Excel file. Authors should adhere to the instructions for each type of submission:

Contributed Papers

- Manuscripts should be up to 12 pages in length (longer in exceptional circumstances) and of factual style.
- They should include a summary (abstract) 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.
- A section on 'Methods' describes the location of the study, citing map co-ordinates or including a map, and describing how observations were made and data were collected and analysed.
- 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 may be included in tabular form at the end of the submitted article. Usually these will be published on-line and not appear in the hard copy print.
- 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. 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.

- References should be cited and listed as for contributed papers.

Book Reviews

- 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

Formatting of an article for publication is the responsibility of the Whistler production team and is done after the submitted manuscript has been finalised and accepted. Authors are requested to note the following requirements when submitting a manuscript:

1. A4 size pages using portrait layout except for large tables or figures. Margins 2cm all sides.
2. Title of article at top of first page
3. Names and the affiliations or addresses of all authors are to be listed next, with at least one email address included. Each author's preferred first name is to be indicated.
4. The author for correspondence is to be clearly indicated.
5. Typescript for manuscripts is Times New Roman 11 pt.
6. Figures and Tables are to be included at the end of the document, in Times New Roman 11 pt. Each Figure and Table is to have a title that clearly describes the content.
7. Nomenclature and classification of bird species shall follow the current version of BirdLife Australia's "Working List of Australian Birds" (download from: http://birdlife.org.au/conservation/science/taxonomy). The scientific names of all bird species shall be shown in italics after the first mention of their English name in both the text and summary (abstract) and not thereafter.
8. References should be cited in the text in parenthesis as close as possible to the information taken from the paper: for one author (Smith 2000), two authors (Smith & Jones 2001b) and more than two authors (Smith *et al*. 2002) with the authors listed in the same order as the original paper.
9. References shall be listed in alphabetical order and secondarily by year of publication; if published in the same year then in alphabetical order with a, b, or c etc after the year to indicate which paper is being cited in the text (see example below). Each reference shall form a separate paragraph.

Reference Format

Journal articles:
Jones, D.N. and Wieneke, J. (2000a). The suburban bird community of Townsville revisited: changes over 16 years. *Corella* **24**: 53-60.

Edited book Chapters:

Lodge, D.M. (1993). Species invasions and deletions: community effects and responses to climate and habitat change. In 'Biotic interactions and Global change' (Eds. P.M. Karieva, J.G. Kingsolver and R.B. Huey) Pp. 367-387. (Sinauer Associates, Sutherland, MA.)

Books:

Caughley, G. and Sinclair, A.R.E. (1994). 'Wildlife Ecology and Management'. (Blackwell, Cambridge, MA.)

Theses:

Green, R. (1980). 'Ecology of native and exotic birds in the suburban habitat'. Ph.D. Thesis, Monash University, Victoria.

Reports:

Twyford, K.L., Humphrey, P.G., Nunn, R.P. and Willoughby, L. (2000). Investigations into the effects of introduced plants and animals on the nature conservation values of Gabo Island. (Dept. of Conservation & Natural Resources, Orbost Region, Orbost.)

If these examples are not sufficient, please refer to the references given in this issue or in earlier issues.

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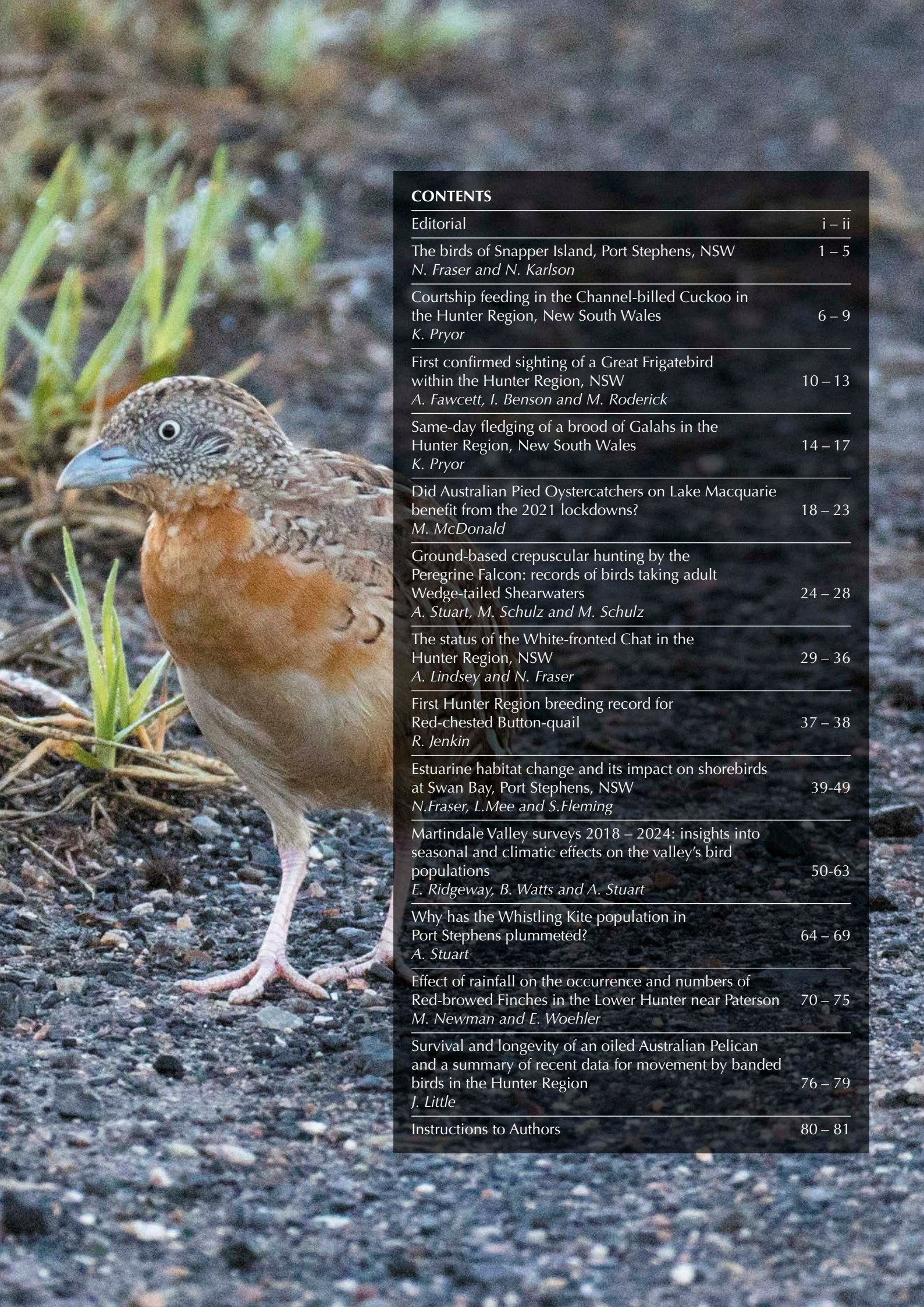

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