

Little Tern breeding on Worimi Conservation Lands, Stockton Beach, summer 2022/23

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A colony of Little Tern *Sternula albifrons* which nested on Worimi Conservation Lands, Stockton Beach was monitored from early December 2022 to the end of January 2023. A maximum of 39 breeding pairs were present in early January. A total of 107 eggs were laid and at least 45 chicks hatched. However, only six chicks successfully fledged, a breeding success rate of 5.6%. Although several potential mammalian and avian predators were identified, the most active predator was the Ghost Crab *Ocypode cordimana* which established burrows and became increasingly active across the site from late-December. Human disturbance at the end of the monitoring period probably contributed to early abandonment of the site. Investigation of Ghost Crab control techniques is recommended to support future breeding events.

INTRODUCTION

The Little Tern *Sternula albifrons* that breeds along the NSW coast in summer is listed as a migratory species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. In NSW it is listed as an endangered species on Schedule 1 of the *Biodiversity Conservation Act 2016*. The breeding population in south-eastern Australia has declined and its beach-breeding sites are particularly prone to human disturbance, predation and natural catastrophes (NSW Office of Environment and Heritage 2021).

Little Tern established a breeding colony on Worimi Conservation Lands (WCL), Stockton Beach in late November 2022 (**Figure 1**). The colony was regularly monitored from early December 2022 until the end of January 2023. This article describes the breeding event on WCL in the summer of 2022/23, summarizes the monitoring results, estimates breeding success, identifies predators and other threats, and provides recommendations for management of future events.

The protection of Little Tern is listed as a desired outcome in the WCL Plan of Management (NSW Office of Environment and Heritage 2015). The plan notes that beachfront vehicular activity disturbs foraging and nesting activity of migratory birds and increases the risk of exposure and predation on eggs and chicks from Silver Gull *Larus novaehollandiae*, Australian Raven *Corvus coronoides* and Red Fox *Vulpes vulpes*.

Recent previous breeding attempts on Stockton Beach/WCL

In December 2010 up to 31 birds were recorded but no breeding activity was observed. However, Little Tern have bred on Stockton Beach, mainly within WCL, on a number of occasions since 2012 (<https://birddata.birdlife.org.au/home>).

2012-2018

In the summers of 2012/13, 2013/14, 2014/15, 2016/17 and 2017/18, breeding colonies were established on the sandhills immediately north of the Ganyamalbaa camping area at the southern end of WCL (**Figure 1**). In the summer of 2015/16, the birds nested south of the WCL boundary. Nests with eggs, chicks and runners were reported on all six occasions. Birds were present from late-November to early-February. The maximum count was 95 adult birds in November 2014. The outcomes of any of these breeding attempts are unknown; no fledglings were recorded and the survey were irregular. In December 2018, up to 37 birds were in the area but no breeding activity was observed, nor in the two subsequent breeding seasons.

Summer 2021-2022

In the summer of 2021/22 two nesting colonies around 500 m apart were established on the beach at WCL, around 4 km north of the Lavis Lane beach access point. It is possible that some of the birds present in this colony were from an earlier abandoned breeding attempt on the western end of Corrie Island, Port Stephens.

Birds were first noted in the area in early November 2021. The site was regularly surveyed from 22 December. The two colonies had a maximum of 30 breeding pairs present on 30 December 2021 and between five and ten fledglings were recorded. The

maximum number of adult birds present was 131 on 14 January 2022. Fox tracks were recorded at the site on several occasions and a fox probably predated many eggs and chicks (P. Blair pers. com.) Both sites were deserted at the end of January 2022.



Figure 1. Location of Little Tern nest sites in the Worimi Conservation Lands. Image from Google Earth.

METHODS

Location and description of the breeding site

The breeding colony was located on Stockton Beach, 4 km north of the Lavis Lane beach access point (32° 49.734'S, 151° 54.254'E). The site was situated in a wide, shallow, north-south trending swale that was open to the beachfront. The site covered approximately 2 ha and was bound by a freshwater lagoon to the northwest and sandhills to the east and west. A line of marine debris extended north-south through the centre of the site. Debris consisted mainly of Giant Reed *Arundo donax* fragments and lesser amounts of anthropogenic waste (**Figure 2, Figure 3**). Several larger tree branches and logs were also present. Vegetation was sparse and comprised isolated clumps of Sea Rocket *Cakile maritima* along the central debris line. Spinifex Grass *Spinifex sericeus* and Juncus Rush *Juncus acutus* surrounded the lagoon to the northwest.

The majority of nests were located in the central part of the site along or close to the marine debris line. Nests were located from 80 to 200 m from the shore line and between 1.5 and 40 m apart. Temporary fencing and

signage were erected around most of the site to protect it from interference by beach users.

Details of the monitoring program

The site was monitored weekly around low tide by staff from the NSW National Parks and Wildlife Service (NPWS) and the Department of Planning and Environment, Biodiversity Conservation Department (DPE BCD), assisted by the author and other volunteers. Each survey involved at least two people. Monitoring was conducted in accordance with best practice guidelines (Department of Environment and Climate Change 2008). New nests were located and flagged, and all known nests were checked. Nests were flagged with a marker bearing the nest number, number of eggs and date of discovery. Once hatching commenced, beach debris and clumps of vegetation around the nest site were searched for chicks that had been moved from the nests. Nest locations and the numbers of eggs and chicks were recorded on monitoring sheets. Geolocated plots of nest sites were prepared. Evidence of predation or other losses and site disturbance details were recorded. The flock of Little Tern on the adjacent beachfront was surveyed for fledglings. The numbers of breeding, non-breeding and fledged Little Tern plus all other avian species in the

vicinity of the nest site and on the adjacent beachfront were recorded.

The non-breeding birds are part of a population that breeds in Asia during the austral winter and then migrate to Australia (Higgins & Davies 1996). They are present in small numbers amongst breeding birds roosting on the beachfront and are recognisable as they are adult birds that are not in breeding plumage. Fledglings are young birds, 4-5 weeks old with incompletely developed plumage and limited flight ability. They roost amongst the breeding birds on the beachfront where they are fed by adults.



Figure 2. Breeding site looking east.



Figure 3. Breeding site looking west towards lagoon. Both images show central marine debris line, nest markers and small patches of Sea Rocket. (Images by N. Fraser)

RESULTS

Results of the weekly site monitoring are summarised in **Table 1** and breeding statistics are summarised in **Table 2**. Records of tracks or other indications of potential predators and evidence of human disturbance on or near the site are summarised in **Table 3**.

Table 1. Weekly site monitoring results at the WCL Little Tern colony, December 2022 to January 2023.

	6 Dec	13 Dec	20 Dec	27 Dec	3 Jan	10 Jan	17 Jan	24 Jan	31 Jan
Breeding birds	15-20	30	40-45	42	88	80	80	60	32
Non-breeding birds			7	2		6	8	10	8
Active nests	6	12	15	19	39	39	30	8	
Eggs	17	32	37	26	53	49	43	12	
Chicks			2	9	21	7	9	7	
Fledglings						1	3	6	4
Dead chicks						3		1	

Table 2. Summarised breeding statistics for Little Tern at the 2022/23 colony.

Breeding pairs	39
Total active nests	53
Total eggs	107
Total fledglings	6
Fledglings/nest site	0.11
Birds fledged/egg	5.6%

Table 3. Tracks of potential predators and records of human interference, December 2022 to January 2023.

Predator / Site Interference	6 Dec	13 Dec	20 Dec	27 Dec	3 Jan	10 Jan	17 Jan	24 Jan	31 Jan
Fox tracks	✓	✓	✓	✓	✓	✓	✓	✓	✓
Dog tracks		✓							✓
Human tracks		✓							
Whistling Kite	✓								
Australian Pied Oystercatcher		✓	✓						
Silver Gull	✓	✓	✓	✓	✓	✓	✓	✓	✓
Australian Raven									✓
Ghost Crab burrows & tracks	✓	✓	✓	✓	✓	✓	✓	✓	
Off-road vehicle tracks								✓	✓

DISCUSSION

The first chicks were discovered on 20 December, indicating that incubation commenced around 30 November, assuming an average incubation period of 21 days (Higgins & Davies 1996). Birds are estimated to have started to arrive on site around mid-November and egg-laying would have commenced soon after. The initial clutches were each of 2-3 eggs. The maximum number of breeding pairs was 39, present on 3 and 10 January 2023. Newly hatched chicks remained in the nest scrape for one to two days before being moved to patches of Sea Rocket or under logs. New nests after 3 January contained only 1-2 eggs; they were from repeat nesting attempts by pairs that had lost eggs or chicks. There was no indication of egg predation up to 3 January, but after that date eggs and many chicks appeared to have been taken. Newly-fledged birds joined the main flock on the beachfront. Four abandoned eggs were found on 24 January. On the morning of 31 January, following several hours of steady overnight rain, no eggs, chicks or breeding birds were located on the nesting site and there were no tracks of Little Tern, Ghost Crab or any other species. It is probable the birds abandoned the site before the end of January following disturbance by recreational vehicles on 24 and 27 January (Table 3).

The low percentage of fledglings produced per nest site, 5.6% is indicative of a high level of breeding failure. The fledgling production rate is however comparable to that of many other Little Tern colonies in eastern Australia, which have experienced breeding success of only 6.5 - 17.9% in recent years, due to predation and disturbance (Australian Government Department of Agriculture, Water and Environment 2022).

Predation

Higgins & Davies (1996) listed the following species as reported to predate Little Tern nest sites: Red Fox, feral and domestic dogs *Canis familiaris*, feral and domestic cats *Felis catus*, Black Rat *Rattus rattus*, gulls *Laridae* spp., Black-breasted Buzzard *Hamirostra melanosternon*, Whimbrel *Numenius phaeopus*, Australian Kestrel *Falco cenchroides*, ravens *Corvus* spp., snakes *Serpentes*, lizards *Lacertilia* and Peregrine Falcon *Falco peregrinus*. In a study of Little Tern breeding colonies on sand islands in Wallis Lake near Forster, NSW, Rose (2001) identified predation, or possible predation, by Cat, Silver Gull, Whimbrel, Australian Pied Oystercatcher *Haematopus longirostris*, Caspian Tern *Sterna caspia*, corvids, Galah *Cacatua roseicapilla*, various raptor species, Black Rat, Ghost Crab *Ocypode cordimana* and ants *Iridomyrmex gracilis*.

The low percentage of birds fledged indicates that the colony was subjected to significant predation. However, no active predation was observed during monitoring. Red Fox tracks were regularly observed around the adjacent lagoon, and domestic dog tracks that appeared to accompany off-road vehicle intruders were observed on two occasions. However, these tracks did not venture onto the site. There was no evidence of the presence of other potential predators including Cats, Black Rats, Dingo *Canis lupus dingo*, or Lace Monitor *Varanus varius*.

Potential avian predators recorded at the 2022/23 WCL colony were Australian Pied Oystercatcher, Whistling Kite *Haliastur sphenurus*, Silver Gull and Australian Raven. Tracks of two Australian Pied Oystercatchers crossed the Little Tern breeding site when only eggs were present and apparently there was no predation. A Whistling Kite was recorded at the start of the monitoring and three Australian

Raven at the end; in both instances there were very few eggs or chicks offering any opportunity for predation. A flock of Silver Gull was regularly present around the lagoon and on the beachfront with a maximum number of 86 birds on 20 December. Their numbers decreased subsequently. Although Silver Gull were not observed on the site or displaying an interest in the nesting activities, active defense of nests/chicks by Little Tern against over-flying Silver Gull was observed.

While there were several potential predators present in the area during the monitoring period, the only species from the above list that was continually active on the nesting site was the Ghost Crab *Ocypode* spp.

Ghost Crab

There are six species of Ghost Crab *Ocypode* spp. found in Australia (Lucrezi & Schlacher 2014). The most common species on NSW beaches is *O. cordimana* (Figure 4). It is relatively small, up to 3.5 cm, and is almost translucent, with flecks of pink and yellow. It is well camouflaged against the sand and is very fast-moving. The species is largely nocturnal and spends all day in a burrow, emerging at twilight to hunt along the waterline. The burrow, which is built high up on the beach, is sometimes over 100 m from the sea and can be over one metre deep (Lucrezi & Schlacher 2014).



Figure 4. A Ghost Crab *Ocypode cordimana*. (Image The Australian Museum.)

Ghost Crab are often the apex invertebrate predator and scavenger on sandy shores. They consume a broad range of organic matter ranging from small interstitial diatoms and plant matter to the eggs and young of sea turtles and shore-breeding birds. Worldwide, the crabs have been recorded preying on eggs and chicks of terns, plovers, oystercatchers, tropicbirds, storm petrels and shearwaters (Lucrezi & Schlacher 2014). A study of Piping Plover *Charadrius melodus* nesting success at Cape

Hatteras, North Carolina, USA, showed daily survival rates for nests were lowest in areas where Ghost Crabs were present (Kwon *et al.* 2018).

Initially at the 2022/23 WCL colony there were a few tracks across the site where crabs had travelled to or from their burrows to the beachfront. However, after the third week of monitoring, active crab burrows were noted to be present around the nest sites, particularly in the central breeding area, and the number of burrows increased over time. Crab tracks were most prominent around patches of Sea Rocket and around logs where chicks were hidden. A crab burrow was inevitably located nearby. Drag marks were observed on two occasions leading to burrows. On the final survey on 31 January when no eggs or chicks were present, there were no crab tracks or burrows on site.

The presence of Ghost Crabs on the site may also be related to off-road vehicle activity on the adjacent beachfront. The beachfront was closed to vehicles until early January which approximates with the observed increase in Ghost Crab activity. Several studies in Australia and elsewhere in the world have shown that vehicle activity on sandy beach environments has an impact on Ghost Crab population densities and distribution (Moss & McPhee 2006; Noriega *et al.* 2012; Lucrezi *et al.* 2014). Larger Ghost Crabs sometimes relocate their burrows away from the beachfront in response to vehicular activity (Lucrezi *et al.* 2014). Without access to beachfront foraging, those crabs will shift their foraging to the eggs and chicks of beach-nesting birds (C. Tourenq pers. comm.).

Rose (2001) experimented with deterrents to control Ghost Crab and found that the pesticide Chlorpyrifos (Australian Pesticides and Veterinary Medicines Authority 2019) proved effective. He baited small fish with the chemical and placed them in crab burrows. The majority of burrows disappeared within two days and the baiting stopped further crab predation of the Little Tern colony. In 2019 the registration of Chlorpyrifos for domestic and agriculture use was cancelled by the Australian Pesticides and Veterinary Medicines Authority due to the risk to human health and the environment.

Other losses

Four dead chicks were discovered over the survey period. Two advanced chicks were found dead beneath a log and a recently hatched chick was found dead in an exposed location. These chicks could have been killed by a predator such as a Silver Gull and not eaten, or they may have died of

starvation. A broken egg containing an unborn chick was also located, possibly indicating the actions of an unknown predator. Additionally, four abandoned eggs were found during the monitoring period.

Human disturbance

Apart from regular weekly monitoring, there was no human disturbance of the site until the last two weeks of monitoring. Human footprints were observed near the fence on 13 December, but did not enter the site. Beach closures throughout December and early January undoubtedly reduced disturbance by beach users. Tracks from off-road vehicles were observed across the site in late-January. A regular route used by a quadbike tour operator approached close to the northern end of the site.

A remotely monitored camera was installed at the northern end of the site on 24 January. It did not identify any predators but recorded two off-road vehicles on the evening of 24 January (Figure 5), a trail bike on the morning of 27 January and three quad bikes on the evening of 27 January (Figure 6). These vehicles traversed the immediate western end of the site but did not encroach onto the active nest areas. The margins of the lagoon at the northwest end of the site were also extensively churned up by off-road vehicles during this period. This lagoon was not within the area covered by the camera. It is probable that this vehicular activity with its associated noise and driving lights contributed to the birds abandoning the site before the end of January.



Figure 5. Off-road vehicle near the breeding colony at 2016 h on 24/01/2023.

It seems probable that human disturbance and off-road vehicle activity around the previous breeding site north of the Ganyamalbaa Camping Area resulted in birds permanently abandoning that area as well. The site is within the WCL Recreational Vehicle Area and an examination in January 2023 revealed it was covered in vehicle tracks. This

location, however, was atypical of Little Tern breeding sites that are generally located closer to the ocean – they are either on the beach or within frontal dunes (Higgins & Davies 1996).



Figure 6. Quad bikes near the breeding colony at 1907 h on 27/01/2023. (Images from NPWS remote site monitoring camera.)

Dispersal

Birds began to disperse from the site after 17 January and by 31 January the numbers on site had halved. Although the locations to which the birds initially disperse are unknown, there were a number of sightings of Little Tern from nearby areas where the birds had not bred. Eight birds in breeding plumage were at the mouth of the Myall River, Port Stephens (21 km northeast) on 24 January (Trish Blair pers. comm.) and a mixed flock of 20+ birds in breeding and non-breeding plumage with two fledglings was at the southern end of Stockton Beach (14.5 km southwest) on 31 January (Paul Fuller pers. comm.).

From late December 2022, increasing numbers of birds in non-breeding plumage were observed by the author foraging and roosting in Salamander Bay, Port Stephens. The maximum number was 50 birds on 25 January 2023. This count included a number of recently fledged birds. All birds had departed by 3 February (Table 5). A previous observation by the author of 83 birds in the same locality in February 2018 suggests this may be a regular assembly point for the species from around the region prior to commencing its northern migration. Little Tern did not nest in Port Stephens in summer 2022/23.

Table 5. Little Tern numbers at Salamander Bay, December 2022 to February 2023. Observations by the author.

5 Dec	21 Dec	6 Jan	19 Jan	25 Jan	3 Feb
0	20	33	38	50	0

Other local breeding colonies

There were three other monitored breeding colonies of Little Tern in or near the Hunter Region over the 2022/23 summer period; two colonies in the Manning River estuary at Harrington and at Farquhar Inlet, and a colony at the Karagi Point sandspit in The Entrance channel. The latter site is the second most successful nesting site in NSW.

In the Manning estuary, Ghost Crabs were present around the nesting sites but were not a major predator. In December 2020 a Ghost Crab was observed dragging a 2-3-day old chick from its nest towards a burrow (A. Morris pers. comm.). The crabs predated relatively small numbers of eggs and chicks compared to Australian Gull-billed Tern *Gelochelidon macrotarsa* and foxes (Darnell 2020).

At the Karagi Point sandspit in the 2022/23 summer nesting season, 31 chicks fledged from an estimated 150 chicks hatched (Central Coast Community News 2023). Silver Gull moved onto the sandspit following the loss of their nearby sand island roosts due to heavy rains and high tides, and predated many chicks. The nesting site is reshaped annually by winter storms and Ghost Crabs are unlikely to become established on this site (A. Morris pers. comm.).

CONCLUSIONS

The Little Tern breeding event on WCL in the summer of 2022/23 largely failed. Breeding success of 5.6% (6 fledglings from 53 nests and 107 eggs) was low, but sadly that success rate is comparable to other sites in eastern Australia that have suffered significant predation and human disturbance. Although a flock of Silver Gull was present during the monitoring period and the presence of other potential predators was observed in the area, the most active predator on the site appears to have been Ghost Crab, which mainly took young chicks. Human disturbance late in the breeding period is unlikely to have affected breeding success but probably led to the early abandonment of the site.

If the Ghost Crab is confirmed to be a major predator of Little Tern nesting colonies, it is recommended that NPWS investigate the use of baiting or non-lethal methods to control their presence on breeding sites. Other recommended measures are the complete fencing and signposting

of the site and restriction of recreational and commercial ORV activity in the immediate vicinity.

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