Fairy Tern Monitoring on Bird Island, South Australia
Report on the 2021/22 Breeding Season

Executive summary

The South Australian Fairy Tern (*Sternula nereis)* population is in decline and breeding success is threatened. Bird Island, Outer Harbour, South Australia, is one of 16 known Fairy Tern breeding sites in South Australia (DENR 2012). The purpose of the Fairy Tern monitoring project on Bird Island is to monitor breeding success, establish the main threats to breeding success for future prioritisation of recovery actions, and to mitigate threats in real time where possible. Monthly monitoring of colony breeding birds on Bird Island began in 2015 and included Fairy Terns (Johnston 2018). A finer temporal scale was required for Fairy Terns, so a weekly census began during the 2018/19 breeding season. Weekly Fairy Tern censuses are coordinated through the Sharing our Shores with Coastal Wildlife Project staff, hosted by BirdLife Australia, and supported by the Green Adelaide Board. In 2021/22, the Australian Government's Department of Agriculture, Water and the Environment became a funding partner to support ongoing monitoring and threat management of Endangered Fairy Terns on Bird Island.

This report is for 2021/22 breeding season monitoring on Bird Island, Outer Harbor. Twelve trained and skilled volunteers assisted the project monitoring team in 2021/22. Birdlife Australia staff and volunteers made 19 trips to the Island from December 2021 to March 2022. Monitoring data is recorded into Birdata's colonial nesting birds' program which is automatically shared with Biological Database of South Australia (BDBSA).

In 2021/22, 7 colonies were recorded and monitored with a total of 23 adult birds, 16 nests, 31 eggs and 4 chicks. From the 4 chicks, one fledged reaching 21-22 days and was observed being closely supervised by the adult Fairy Tern parent. The cause of the failure of the 3 chicks is unknown. It is strongly suspected that Silver Gulls may have been the cause of loss of the other chicks, due to their dominance as a predator on the island, but this cannot be confirmed.

Recommendations for continued Fairy Tern monitoring and species conservation in line with the Recovery Plan are provided at the end of the report.

Contents

Background

The Australian Fairy Tern (*Sternula nereis nereis*) population is in decline and breeding success is threatened. The Fairy Tern is listed as Endangered under the SA National Parks and Wildlife Act, and Nationally Vulnerable under the Environment Protection Biodiversity Conservation Act.

Bird Island (photo 1) is one of 16 known Fairy Tern breeding sites in South Australia (DENR 2012). It is uncertain if that number remains at 16 today, and whether the other sites are still regularly used for breeding. l. In 2018 a coordinated Fairy Tern monitoring project was initiated by Green Adelaide, formerly the Adelaide and Mount Lofty Natural Resource Management Board (AMLR NRM), delivered via the Sharing our Shores with Coastal Wildlife Project team hosted by BirdLife Australia. The aim was to monitor the breeding success, obtain more information on threats, and mitigate threats where possible. The project has continued over the last 4 breeding seasons (18/19, 19/20, 20/21, 21/22) and in the 2021/22 breeding season, received funding support from the Australian Government's Department of Agriculture, Water and the Environment. Monitoring is carried out with assistance from highly trained and skilled volunteers and is in line with the national monitoring framework of BirdLife Australia's National Beach-nesting Birds Program. In addition to regional training and mentoring support, volunteers active within the project have access to species-specific inductions, training resources and online workshops from BirdLife's national program.

The rationale for the program is to support actions within the 2019 Draft National Recovery Plan for the Australian Fairy Tern (now the National Recovery Plan – effective May 2022). The program is also linked directly to the Bird Island Biodiversity Action Plan (BIBAP) developed by Natural Resources AMLR (Ecological Evaluation Pty Ltd., 2014). The BIBAP guides Green Adelaide's investment in conservation works on the island and also provides vegetation baselines to monitor improvement. One of the high priority actions in the BIBAP is to monitor locations and nesting success of Fairy Tern colonies. The BIBAP also uses the Fairy Tern as a flagship species and a means of assessing the effectiveness of management actions on the island. The Australian Government's Department of Agriculture, Water and the Environment become a funding partner in 2021/22 joining BirdLife Australia and Green Adelaide in ongoing monitoring and threat management of Endangered Fairy Terns on Bird Island. Flinders Ports now also supports the Program by providing some funding for on ground weed control, monthly censuses of colony breeding birds, and a Flinders University PhD research project to obtain a comprehensive overview of the threats and potential threat mitigation strategies for Australian Fairy Terns on Bird Island and more broadly across South Australia.

Fairy Tern monitoring projects are also occurring in the Coorong (SA) led by David and Fiona Paton at University of Adelaide; in the South East (SA) led by Friends of Shorebirds South East (FoSSE), Western Australia and Victoria. As such, the Bird Island project contributes to the knowledge of the Fairy Tern population and breeding trends across Australia.

The project aims align closely with the recommended actions within the National Recovery Plan for the Australian Fairy Tern (*Sternula nereis nereis*), (NRP).

Project Aims

- To monitor the occurrence of breeding and the success of colonies of Fairy Terns on Bird Island to improve our understanding of breeding at this site.(BIBAP)
- To record threats to the colony on each visit made to Bird Island, and to use this data to guide real time threat mitigation to improve breeding success where possible, but also to review this data to guide future, long-term conservation actions (aligns with NRP strategy 3).
- To gather additional ecological data that could further contribute to our understanding of the species and its recovery needs, for example, breeding behavioural observations, banded bird resightings and prey species information. To share findings with the national Fairy Tern network (NRP Strategy 4).
- To raise awareness amongst community and industry (Flinders Ports) and provide data to key Government Agencies and stakeholder of the significance of Bird Island as a key breeding site for the Endangered Fairy Tern (NRP Strategy 5).

Photo 1: Oblique aerial photograph of the Outer Harbour taken from the north-west in 1993. Bird Island is circled in the foreground. The extent and density of vegetation cover across the island has increased since that time. Image sourced from Johnston 2017. Photo: South Australian Department of Lands

Methods and volunteer engagement

Monitoring of the island and active Fairy Tern breeding colonies follow BirdLife Australia's national protocols for Fairy Tern monitoring. These are available within the Beach-nesting Birds program participant hub. It is here also where volunteers who participate undertake an online induction, which focuses on the health and safety of volunteers, the aims of the project and on the finer details around monitoring the birds so both volunteers and the sensitive nesting birds are not inadvertently placed at risk.

Since 2019/20 all data collected is recorded in Birdata, an online citizen-science gathered observational database, through the 'Colonial nesting birds' program. No digital photo sampling of prey species was undertaken during the 2021/22 season due to limited number of Fairy Terns observed courting or flying in to feed chicks during the monitoring sessions.

A refresher of monitoring methodology undertaken at the start of season training event with volunteers and staff and a monitoring schedule devised for the season. The frequency of monitoring throughout the season was fortnightly while colonies established, and then weekly survey trips were undertaken when eggs/chicks were observed, up to a maximum of twice weekly at the peak of breeding. There was a minimum of two people per monitoring trip from November to the end of March.

For each trip, the following was undertaken:

- Survey the Island (on foot) focusing on known breeding locations for Fairy Terns.
- If nesting birds are suspected, observe the site/colony from a distance that does not cause birds to move from nests (approximately 80m).
    - Monitor nesting sites (colonies) for:
        - habitat characteristics ie vegetation type, distance to high tide mark, substrate
        - breeding success
        - threats (within 100m radius)

- A Fairy Tern breeding colony is defined as a group of adult Fairy Terns nesting within close proximity ie 1-3 metres apart. Different colonies can occur throughout the breeding season on Bird Island if they are separated by geographic location and / or time.
- Use spotting scope or binoculars to observe and record details of breeding colony on datasheet or directly on Birdata app.
- Maximum time spent observing colony is 30 minutes if colony has not been disturbed. Maximum of 20 minutes spent observing colony if birds have been disturbed from nesting sites.
- All data are entered while in the field directly in to Birdata via the app. or using the data sheet and later transferred to Birdata.

Breeding Season Results

Monitoring visits to Bird Island

Over the 2021/22 season a total of 19 trips were made from the beginning of December 2021 to April 2022 (see Table 1) when breeding colonies were active. Weather prevented a number of trips from occurring in November, December and January but the aim was to have weekly trips, particularly when chicks were present. Green Adelaide engage Greg Johnston (with Steve Papp) to undertake monthly trips to Bird Island as part of ongoing monthly surveys of colony breeding birds of Bird Island and the Northern Revetment Mound, Outer Harbour. BirdLife Australia are alerted if Fairy Terns are observed during their visits. This enabled targeted monitoring to occur from November 2021 when Fairy Terns were first recorded using the island (pers. comm. 2021/22).

Table 1: Number of monitoring trips across the four seasons of the Fairy Tern monitoring project from 2018/2019 to 2021/22 (Lamanna & Stephens 2022).

Month	2018/19 Season	2019/20 Season	2020/21 Season	2021/22 Season
August	1			
September				
October	2			
November	2	2	2	*
December	4	2	3	5*
January	5	4	2	4*
February	3	3	4	4
March	5	4	4	5
April	2	3	1	1
Total # trips	**24**	**18**	**16**	**19**
Total Volunteers	**7**	**7**	**10**	**12**

***3 scheduled trips were cancelled in November, December 2021, and January 2022 due to inclement weather.**

Once again volunteers contributed enormously to the Fairy Tern project on Bird Island. There were 12 dedicated volunteers throughout the 2021/22 season. Overall volunteers contributed 270 hours. In total, there is an impressive 1,140 volunteer in-kind hours contributed across the four seasons of monitoring for the project to date. This is a fantastic effort and very much appreciated. There was an average of 3 volunteers per trip, and each monitoring trip took approximately 5 hours. This also underestimates volunteer hours as it does not include travel time for volunteers to and from the site and the time spent emailing reports and downloading / editing photographs.

Table 2: Dates of Individual Volunteer Monitoring sessions to Bird Island 2021/22 Season

	Colony	A		B		C		D		E		F			G	
Date	Monitors	Adults	Nests	Adults	Nests	Adults	Nests	Adults	Nests	Adults	Nests	Adults	Nests	Chicks	Adults	Nests
24/11/21	Cancelled due to inclement weather															
01/12/21	3	2	1	6	2	9	2									
08/12/21	2	0	0	0	0	23	1									
15/12/21	3						0	5	2							
16/12/21	3							21								
21/12/21	3							0	0							
28/12/21	Cancelled due to inclement weather															
02/01/22	GJ & SP									18	2					
04/01/22	3									16	2					
12/01/22	Cancelled due to inclement weather															
20/01/22	3									0	0					
25/01/22	3											2				
02/02/22	3															
08/02/22	3											16	6			
18/02/22	3											1				
23/02/22	3											6	4			
01/03/22	3											9		4		
09/03/22	3											2	1	1	1	1
18/03/22	3											1		1		
22/03/22	3											0		0		
29/03/22	3											0		0		
03/04/22	GJ & SP											0		0		
TOTAL		**2**	**3**	**6**	**2**	**23**	**2**	**21**	**2**	**18**	**2**	**16**	**6**	**4**	**1**	**1**

Photo 2: Monitoring team wearing appropriate COVID-19 safe PPE, February 2022. Photo: Kerri Bartley

Breeding success

The 2021/22 breeding season resulted in 7 Fairy Tern nesting colonies (A - G). A maximum of 23 adults were recorded on the island at any one time within colony C (~12 breeding pairs). Overall, from the seven colonies there were a total of 16 nests, 31 eggs and 4 chicks were recorded (Table 3). The 4 chicks were first observed on 01/03/2022 in colony F. Two siblings were approximately 10 days old (Photo 7), one chick ~ 5 days old and one chick 3 days old. Only one of the four chicks subsequently fledged on 18/03/2022 having reached 21 days of age (Photo 8).

Nesting success across the season was calculated by the number of fledglings produced per nest attempt, not fledglings produced per pair. Calculating fledglings per pair across the breeding seasons is problematic due to the limitations in determining exactly how many pairs we have in total, due to repeated nesting on the island, and not knowing if they are the same pairs or new pairs coming in. Without banded adults it is impossible to know if colonies had the same birds nesting repeatedly in new (non-overlapping) colonies.

Overall, nesting success (fledglings produced per nest attempt) was again poor and slightly lower at 0.06 in 2021/22 than the previous season 2020/21 at 0.08 (refer Table 4). From a total of 31 eggs, only 4 eggs (13%) of those hatched across the 7 colonies. The percentage of chicks that then went on to fledge was 25% (1 of 4 chicks) for the season.

A very young juvenile Fairy Tern was observed at Parham (45km flight) by volunteer Ian Forsyth on 21st April 2022 which may have been the fledged chick from Bird Island, if this chick had been banded then we would have been able to confirm it as a Bird Island Fairy Tern fledgling.

Figure 1 shows the breeding colony locations on Bird Island for the 2021/22 season of monitoring.

Photo 3 & 4 (above and below): Breeding adults incubating nests in colony F, during the 8th February 2022 monitoring trip. Photos: Mary-Ann van Trigt.

Table 3. 2021/22 dates of breeding events, suspected cause of colony failure, number of adults, nests, eggs, chicks, fledglings and threats within 100 metres of the colony that were recorded for each colony during monitoring trips.

Colony Date	Colony Failed Y / N Suspected cause	Max # Adults	# Nests	# Eggs	# Chicks	# Fledglings	Threats observed within 100m colony
A 01/12/2021 to 08/12/2021	Y - unknown	21	1	2	0	0	Suspected one pair nesting, sitting low. But didn't approach due to silver gulls nearby and flying over.
B 01/12/2021 to 08/12/2021	Y - unknown	6	2	4	0	0	Two birds sitting presumably incubating. A third pair scrape making. Didn't approach due to silver gulls flying over. ~1,000 silver gulls observed
C 01/12/2021 to 15/12/2021	Y - unknown	23	2	4	0	0	Silver gulls observed flying low over nesting fairy terns with adult FT defending area ie flying at silver gulls.
D 15/12/2021 to 21/12/2021	Y - unknown	5	2	4	0	0	Majority of silver gulls on fringing dunes/vegetation still breeding. 3 silver gulls on flat beach area about 50m from fairy terns.
E 04/01/2022 to 20/01/2022	Y - unknown	16	2	4	0	0	Silver Gulls observed harassing FTs but numbers were lessening a bit, and most of the chicks were fledged.
F 08/02/2022 to 18/03/2022	N - 3 chicks missing, unknown cause	16	6	12	4	1	40 silver gulls and 2 ravens observed close by ~50 m from nesting area.
G 09/03/2022 to 18/03/2022	Y - unknown	2	1	1	0	0	40 silver gulls and 2 ravens observed close by ~50 m from nesting area.
		23	**16**	**31**	**4**	**1**	

NB. In 2021/22 the total estimated maximum egg count was 31 based on maximum nest count observed with Fairy Tern's typical clutch size of 2 eggs per nest (Greenwell 2020). However, colony G's only nest also had only one egg present (personal observation Bartley 2022).

Figure 1. Map of Bird Island showing the location of 7 breeding colonies in 2021/22.

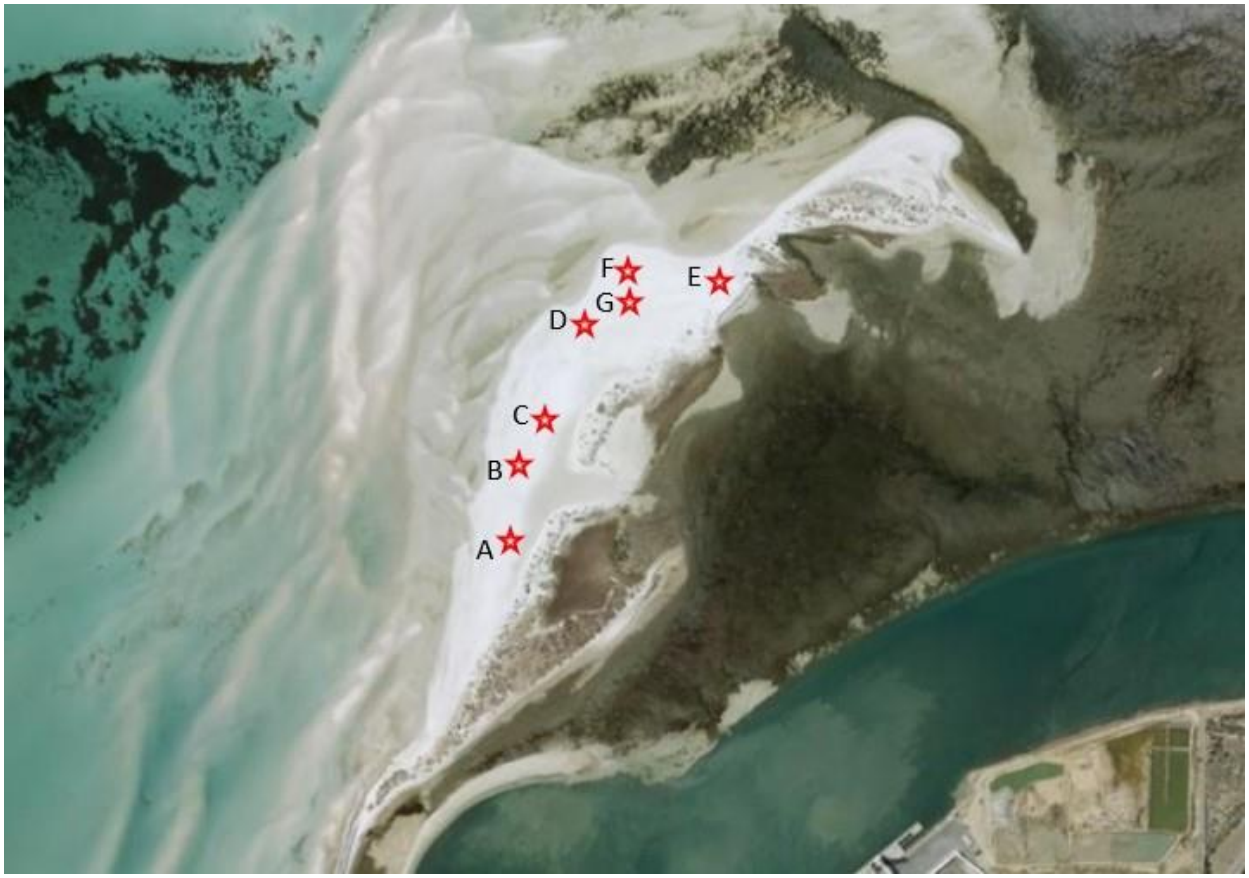

Photo 5: The one nest containing one egg in Colony G 09/03/2022. Photo: Kerri Bartley

Table 4. The table shows each season result for approximate total number of pairs (based on maximum number of nests observed at one time on the island), total number of colonies, nests, eggs, chicks (% of eggs that went onto hatch), fledglings (% of chicks that went onto fledge) and the fledgling per nest attempt rate over the past 4 breeding seasons. 2018/19 – 2020/21 data sourced from Lamanna and Stephens (2019 & 2022).

Season	~ Total # pairs	Total # colonies	Total # nests	Total # eggs	Total # chicks (% eggs)	Total # fledglings (% of chicks)	Fledgling / Nest Attempt Ratio
2018/19	~66	7	74	130*	71 (55%)	0**	0.00
2019/20	~ 26	14	84	159*	8 (5%)	5 (63%)	0.06
2020/21	~28	2	38	62*	5 (8%)	3 (60%)	0.08
2021/22	~12	7	16	31	4 (13%)	1 (25%)	0.06

*The estimated maximum egg count is based on maximum nest count observed with Fairy Tern's typical clutch size of 2 eggs per nest (Greenwell 2020), for most colonies. Some nests were observed to only contain one egg.
**No fledglings could be confirmed in the 2018/19 season, as three 17-19 day old chicks were not observed on the following trip (approximately 1 week later).

Photo 6: Fairy Tern monitoring team on Bird Island, 9th March, 2022. Photo: Kerri Bartley

Figure 2: Comparison of Fairy Tern breeding success across 4 seasons, including numbers of adults, nests, chicks and fledglings on Bird Island from 2018/19 to 2021/22.

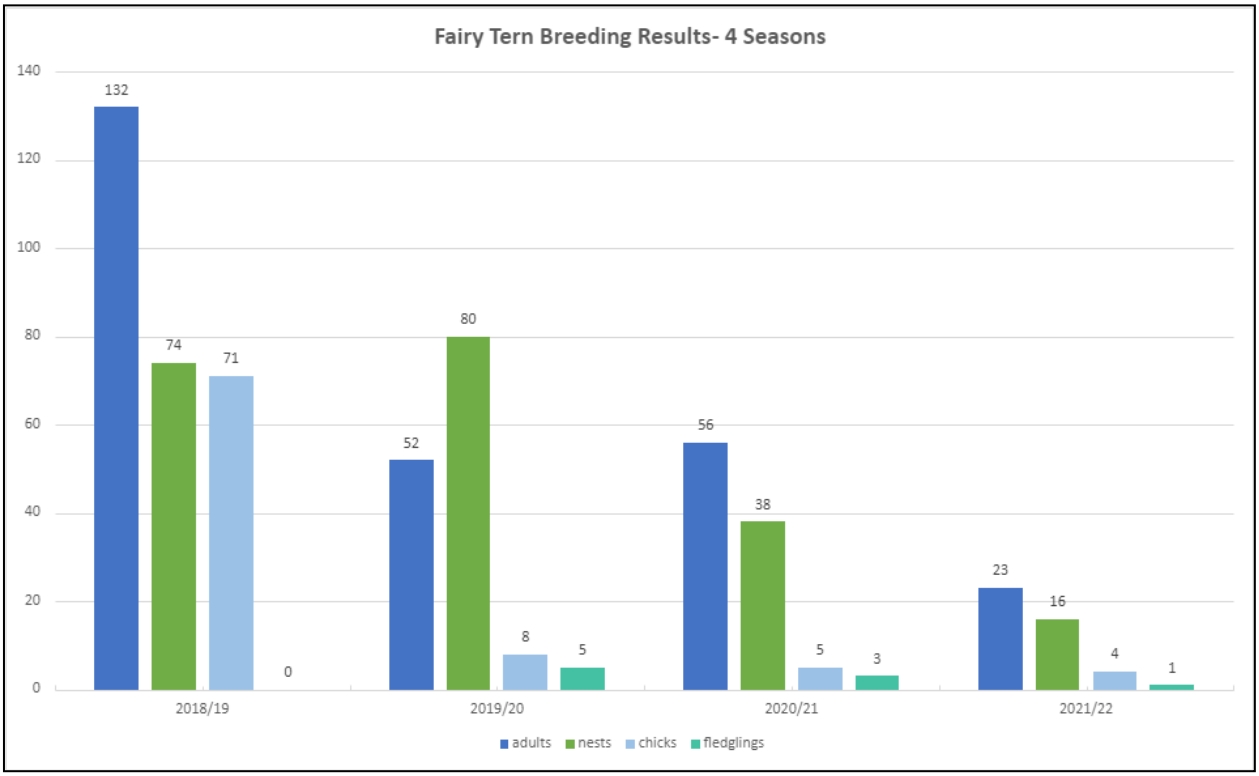

Photo 7: 2 x 10 day old Fairy Tern chick siblings being fed by parent 01/03/2022. Photo: Mary-Ann van Trigt

Photo 8: Fairy Tern fledgling (21-22 days old) from colony F, 28/03/2022. Photo: Ian Forsyth.

Threats

Threats to breeding Fairy Terns during the 2021/22 season were made via direct observation from volunteers during the scheduled monitoring sessions and recorded on the Birdata app. Silver gull (*Chroicocephalus novaehollandiae*) presence was consistently observed and recorded at each Fairy Tern breeding colony and in 2021/22 season appeared to be the major threat to Fairy Tern breeding on Bird Island. 2 Little Ravens (*Corvus mellori*) were also observed on 18th March 2022 (see Table 3). Remote cameras were not deployed at nesting sites this season due to concerns that cameras might attract avian predators like silver gulls and ravens to the nesting areas through learned behaviour.

Silver Gulls: Monthly bird counts are conducted on Bird Island by Dr Greg Johnston under contract to the Green Adelaide Board. There continues to be very large numbers of breeding silver gulls recorded on the island (Figure 2) which is not surprising given the distance of the island (~8km flight path) from the Wingfield Waste and Recycling Centre. Silver gull numbers peaked in July at almost 19,000 individuals and numbers stayed above 7,000 until January 2022 (8,602 individuals in December 2021). Fairy Tern nesting failure continued until silver gull numbers reduced and hatching of eggs coincided with smaller number of silver gulls (30 individuals) in February 2022, which was similar timing as for the past two breeding seasons on Bird Island.

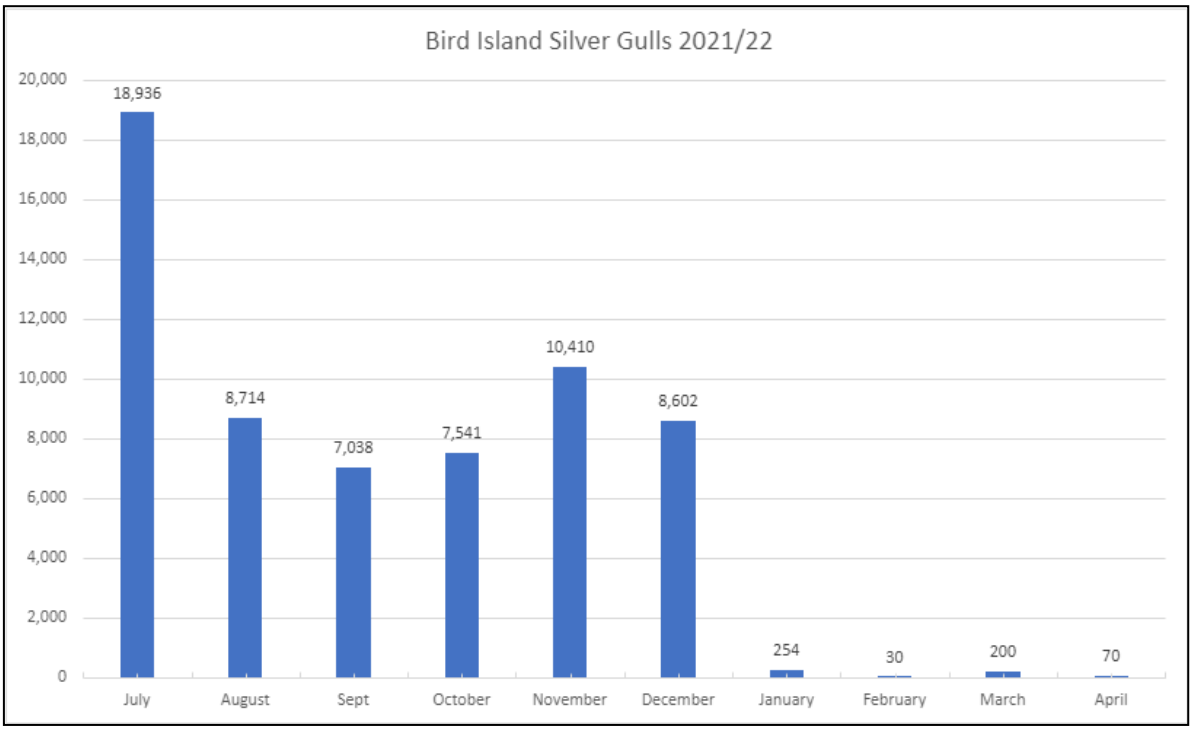

Figure 2: Silver gull population counts on Bird Island July 2021 to April 2022 (data source: Greg Johnston)

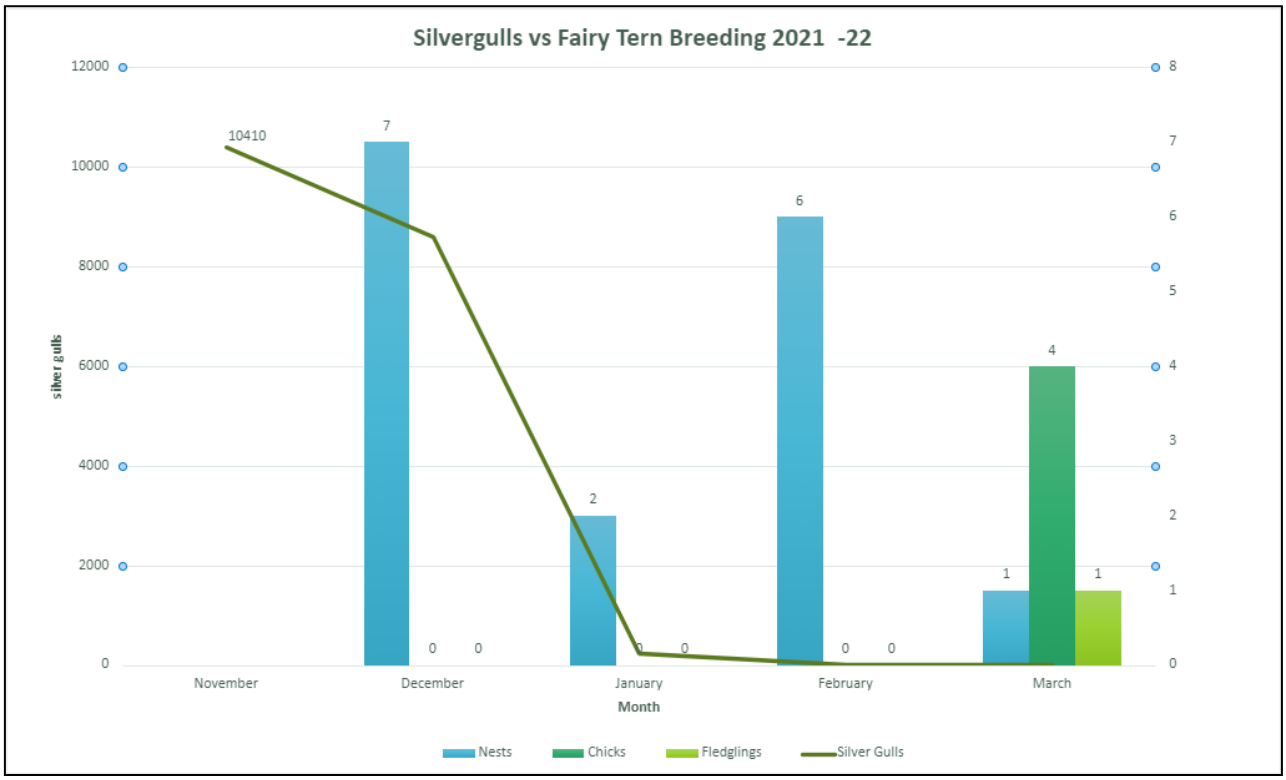

Figure 3: Silver gull numbers compared to Fairy Tern breeding success (data source: Greg Johnston)

A remote camera installed on Colony A in 2020/21 season, confirmed egg predation on Bird Island through photos captured from a field camera – motion sensing that was installed on Colony A. See camera photo 8 below.

Photo 9: Silver Gull predation on Fairy Tern nest as seen on motion-sensing cameras. Bird with Fairy Tern egg in its beak circled in red, 4th December 2020.

During the 2021/22 breeding season other potential threats were recorded by volunteers during monitoring trips to the island. The following threats were observed on Bird Island but not sighted within the immediate (within 100m radius) Fairy Tern breeding areas:

- A juvenile, White-bellied Sea Eagle (*Haliaeetus leucogaster*) was observed flying over Bird Island on 23rd February (photo 10) and an adult was also recorded on 29th March 2022.

- A Swamp Harrier (*Circus approximans*) was observed flying across the northern end of the island during a monitoring trip on 8th March 2022.

- Black rat (*Rattus rattus*) tracks (photo 11) were regularly recorded away from the Fairy Tern breeding areas, in and around dense vegetation, towards the eastern side of the island.

Photo 10: Juvenile white bellied sea eagle flying over Bird Island 23rd February 2022. Photo: Ian Forsyth

Photo 11: Black rat tracks under dense vegetation on the eastern side of Bird Island, January 20th 2022. Photo: Kerri Bartley

Other shorebirds observed during visits, either on route to the colony sites or nearby were:

- Red-capped Plovers - ~1,000 observed 15th December 2021. One pair nested ~50m from colony G on 9th March 2022, which is quite late in the season to be nesting (see photo 12).
- Red-necked Stints – ~3,500 observed on 15th December 2021.
- Pied Oystercatchers (known to nest on Bird Island)
- Sooty Oystercatchers
- Caspian Terns
- Crested Terns
- White-fronted Chat
- Double-banded Plover, a winter migrant (photo 13)

Photo 12: Red-capped Plover nest near Colony G, 9th March 2022. Photo: Kerri Bartley

Photo 13: Double banded Plover near Colony G, 18th March 2022. Photo: Kerri Bartley

Discussion

Fairy Tern population and breeding success

Of concern is that the size of the breeding colony continues to decline on Bird Island with a maximum of 23 adult Fairy Terns observed during the 2021/22 breeding season compared to the previous year when 56 breeding adults were recorded (Figure 2- Fairy Tern Breeding Results). Furthermore, breeding success continues to decline, already from very poor success rates, with a fledging per nest attempt ratio of 0.06 in 2019/20, 0.08 in 2020/21 and then back down to 0.06 in this 2021/22 (Table 4, page 10).

Over the past 3 seasons, poor hatching success continues to drive overall poor fledgling output for Bird Island. The egg hatching ratio in 2021/22 season was slightly higher at 13% (but from fewer nesting attempts ie 4 chicks from 16 eggs) compared to 8% in 2020/21, and 5% in 2019/20 (Table 4, page 10).

Over the past 3 breeding seasons all Fairy Tern chicks have hatched late in the season (March), and this timing also appears to correlate with when there is a vast reduction in silver gull numbers on Bird Island. While there could be other factors at play, including easing weather and tidal conditions late in the season and possibly less resource competition from other nesting birds on the island, it seems likely that silver gull depredation is a major factor that shapes success of Fairy Terns on Bird Island. Fairy Tern nests were observed in December 2021, and it took until the 6th breeding attempt in March 2022 (colony F) for 4 chicks to finally emerge.

More information on adult and chick movements is needed to establish whether colonies are of the same individuals over the course of the season (also allowing for more accurate assignment of fledglings/breeding pair figures); to detect movements between sites; and to assist with tracking survival of chicks from colonies. Leg banding would allow us to determine whether individual adults make more than one breeding attempt per season, allow survival of marked juveniles and adults to be determined, provide information on movements away from the breeding colony on bird island during non-breeding period, the age at first breeding, whether individual show natal philopatry or breed at more than one breeding colony. Such demographic information will provide a basis for better management, by highlighting critical risk phases of the Fairy Tern life-cycle.

Prey Photo Sampling

Due to limited number of Fairy Terns nesting on Bird Island in the 2021/22 season, prey photo sampling opportunities were limited and hence unfortunately no photos were captured that could identify prey species. During 19/20 season, volunteer Dr. Davide Gaglio undertook photo sampling of adult Fairy Terns returning to the nest with prey for their partner or chicks. Using digital photo sampling to gain a better understanding of diet was a technique Davide used in his PhD research on Greater Crested Terns in South Africa (Gaglio et al 2017). The need for further information on diet is noted in the National Recovery Plan. Understanding diet is important for many reasons including, how prey abundance and diversity influence nesting site choice and prey availability can impact on breeding success. Whether other co-occurring species of terns compete with Fairy Tern for the same prey may influence the Fairy Tern breeding activity and success. Prey quality and abundance is something that has not been examined through this project and is a variable we are not monitoring but would impact greatly upon the adult population and breeding success.

Threats discussion

Foxes:
There was no suspected predation from foxes during the 2021/22 season. A Felixer unit (photo 9) was installed on Bird Island in February 2021, and one fox subsequently controlled the following month in March 2021. The Felixer unit is kept in place as a precautionary measure in case of future fox colonisation on Bird Island because of the considerable diversity of shorebird species breeding, foraging, and roosting on the island.
Throughout the 2021/22 season the unit did not 'fire' but numerous photographs of 'non target' prey species were captured Another Felixer unit has been deployed on adjacent Torrens Island, where foxes are able to swim to Bird Island. This unit has recorded confirmed targeting of 4 foxes and one cat. (Steve Papp pers comm, March 2022).

Photo 13: Felixer unit deployed February 2021 for fox control on Bird Island. Photo: Kerri Bartley

King Tides:
No management actions were undertaken to mitigate against king tides inundating colonies in 2021/22. Over the last 4 seasons of monitoring, we have not recorded any nest failures due to tidal inundation (Lamanna & Stephens, 2022). However tidal inundation did occur on Bird Island in 2015, 2016 and 2017 causing significant Fairy Tern nesting failures (Johnston, 2018) and is a major consideration for future success of Fairy Tern breeding on Bird Island.

Climate change:
Other factors like Climate Change that may affect Fairy Tern prey species requires further research and modelling. Greenwell et al (2021c) notes that climate-driven threats add further pressure to already challenging conditions for breeding success. Managed (engineered) sites can provide an opportunity when facing high levels of human disturbance, lack of habitat, or inundation through sea-level rise (Greenwell et al., 2020).

Rats:
There were regular sightings of heavy numbers of rat tracks adjacent to vegetation during monitoring sessions more broadly across Bird Island, but there was no evidence found that rats posed a direct threat to the breeding success of the Fairy Terns during the 2021/22 breeding season. However, it is possible that rat numbers could increase to levels that would cause significant predation on Fairy Tern eggs, possibly those closer to vegetation. If predation is thought to be occurring, or tracks sighted amongst colonies, then an intensive rat control program using baiting stations (as was done in 2017/18) should be undertaken (AMLRNRM 2017).

Silver Gulls:
Low hatching success in Fairy tern colonies adjacent to silver gull breeding areas (see figure 2) suggest that gulls may limit breeding success of Fairy terns.
Silver gull numbers have continued to increase on Bird Island with nearly 19,000 individuals recorded in July 2021 (Johnston pers comms 2022), suspected to be due to the abundant, readily available, artificial food sources like open land fill sites, poor management of waste at food processing factories, eateries, and the relatively new FOGO (Food Organics & Garden Organics) waste stream implemented nearby at the Wingfield Waste & Recycling Centre. FOGO is a relatively new initiative rolling out across Adelaide suburbia in 2020, whereby diversion of food waste from land fill (from the 'waste' bin to the 'green' bin) is now processed into a mulch product and resold to the public by a landscaping company. The FOGO waste comprises of dairy, meat, bones, seafood, fruit and vegetable scraps and is stored outside in large open-air mounds to compost for approximately 8 to 10 weeks (www.eastwaste.com.au). Increases in anthropogenic food sources in general has allowed silver gull populations to increase historically in many parts of Australia (Johnston 2018 and references there in).

An opportunity to progress a series of 'Wildlife and Waste' Workshops for waste industry management is encouraged to discuss possible solutions to house the FOGO waste as to not be readily accessible by avian scavengers. A similar scenario occurred back in the early 2,000's when the Wingfield Dump provided a ready source of food for silver gulls breeding on Bird Island until operations at the dump were largely enclosed by buildings in late 2005 (Johnston 2018). The number of breeding gulls on Bird Island declined notably from 50,000 in 1987 to about 15,000 in 2006, and only 150 nests were attempted in the particularly dry year of 2007 (Johnston unpublished data 1990-2007). The numbers of silver gulls breeding on Bird Island increased again between 2008-2010 to about 15,000 individuals (Johnston unpublished data). Silver gulls have not returned to the high numbers as previously recorded when Wingfield dump offered a ready source of food (Harrison 2010).

Ravens:
2 ravens were observed on the last monitoring trip (18th March) during the 2021/22 monitoring sessions on Bird Island. However, camera images and observations during monitoring trips in the 2020/21 season revealed a small increased presence of ravens compared to previous seasons. There was no evidence of predation on the cameras in 2020/21, however, it is important to continue to monitor presence and abundance of ravens as they are known predators of breeding beach nesting birds.

Weeds:
Earlier assessment of Birds of the Section Bank (Carpenter 2008) notes that more open sites are favoured for nesting by terns, whereas areas where weedy ground cover is high favour Silver Gulls. As such, decrease in weed ground cover is seen as a positive outcome to favour more desirable seabird species nesting.
Habitat condition re-assessment of sites originally established in 2014 was undertaken on 16th March 2022. There has been a decrease in high threat woody weeds (African boxthorn) cover of weed species was observed to have generally declined as a result of weed control. Decrease in weed ground cover such as Galenia and Marshmallow on the south of the island, is a positive outcome which favours the nesting of seabird species. A key consideration in managing this island as a significant seabird and shorebird area is maintaining open spaces for nesting and roosting. In the Atriplex / Nitraria Open Shrubland (Management Zone 3), there was a notable increase in *Cakile maritima* (Beach Rocket). This increase in cover is not considered a high threat at this stage, although vigilance should be maintained to ensure that it does not impact on key seabird breeding habitat (such as open beach areas used by Fairy Terns).

Samphire communities remain weed free, however Grey Mangrove cover continues to increase. Expansion of mangroves can limit the availability of the open spaces for shorebird habitat. Ongoing monitoring of mangrove expansion will be needed to assess if shorebird roosting and feeding habitat is being compromised.

Recommendations

Recommended actions for 2022/23 season

- Continue to monitor Fairy Tern breeding success and threats on Bird Island, and to enter all monitoring data into Birdata's colonial nesting birds program which automatically is shared with Biological Database of South Australia (BDBSA).
- Continue fox control using Felixer device already installed on Bird Island.
- Maintain vegetation restoration actions recommended in the Bird Island Biodiversity Action Plan to maintain open habitat for fairy tern nesting. Monitor potential occurrence or increase in weeds such as Beach Rocket, and sea wheat and marram grasses and control.
- Consider the use of 'chick shelters' once fairy tern chicks hatch to offer a place of refuge away from silver gulls, ravens, and other avian predators.
- Monitor the sand movement and weeds on Bird Island to compare to previous years' mapping to ensure there is enough suitable habitat available for breeding prior to season start.
- Investigate the possibility of deploying 'decoys' in an appropriate nesting location (on higher ground) to attract Fairy Terns to nest in areas where silver gulls nest in smaller numbers. Install cameras to determine if these locations are appropriate for nesting leading up to the breeding season to monitor inter-species considerations (ie crested and Caspian terns), sand movement, tidal inundation, and predator visits, to inform whether this idea would be advantageous.
- Investigate options for silver gull control and/or deterrent from nesting on Bird Island. Work with the Port Lincoln Silver gull project to explore the best means of managing silver gulls.
- Continue to use digital photo sampling to collect information on prey and use in diet analysis.
- Encourage the existing Waste & Wildlife project to broaden its focus to include Silver Gulls in their applied research and management goals of available sources of anthropogenic sources of food.
- Instigate a leg banding program to mark individual fairy terns to establish whether colonies are of the same individuals over the course of the season; to detect movements between sites; and to assist with tracking survival of chicks from colonies.
- When scheduling the monitoring trip roster, consider high tide trips when chicks are close to fledging age. High tide trips allow for closer observations and less chance of 'missing' chicks when the tidal flats are not exposed.
- Review the use of motion sensor cameras with consideration to placement, timing, and possible silver gull and raven learned behaviour. Where motion sensor cameras are used, ensure guidelines in permit are followed for placement etc. Investigate the likelihood of silver gulls and ravens being attracted to nest cameras by installing 'cameras on cameras' during winter when Fairy Terns aren't breeding but silver gulls are, to determine if cameras act as an attractant. Support research for this recommended action.
- Devise a plan for Fairy Tern abundance and movements on the Samphire Coast and within the Adelaide International Bird Sanctuary (AIBS) to look for any possible juvenile birds after they leave Bird Island. The benefit of this area search would be enhanced by flagging of chicks.
- Further our understanding of Fairy Tern ecology through collaboration with other researchers. Attend and contribute to National Fairy Tern meetings coordinated through BirdLife Australia and contribute to National Recovery Team once established.
- Consider the landscape scale dispersion of Fairy Terns and whether declines in number of breeding pairs using the island over time are indicative of population decline or differential site use.
- Raise the profile of Fairy Terns in South Australia with the community, key project partners and stakeholders (kayak clubs) around Bird Island such as Flinders Ports. Do this through media articles, e-mails, and social media.

- Investigate opportunities for funding to continue monitoring through grants. Leverage the Island's inclusion as part of Adelaide International Bird Sanctuary to assist with grant opportunities.

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Sharing our Shores with Coastal Wildlife Project
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