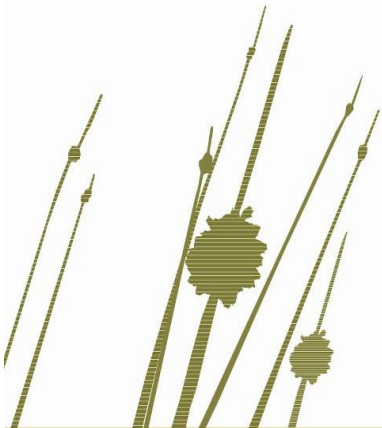


# Status of Fairy Terns in South Australia



Final Report  
to  
Nature Foundation SA



**Government of South Australia**  
Department of Environment  
and Natural Resources



Government  
of South Australia

[www.environment.sa.gov.au](http://www.environment.sa.gov.au)



**Status of Fairy Terns in South Australia**

**Final Report**

**to**

**Nature Foundation SA**

Department of Environment and Natural Resources

Coorong and Lower Lakes District

PO BOX 314

Goolwa

South Australia 5214

Department of Environment and Natural Resources (DENR) (2012) Status of fairy terns in South Australia.  
Final Report to Nature Foundation SA.

#### DISCLAIMER

The author(s) do not warrant that the information in this report is free from errors or omissions, the author(s) do not accept any form of liability, be it contractual, tortuous or otherwise, for the contents of this report or for any consequences arising from its use or any reliance placed upon it. The information, opinions and advice contained in this report may not relate to, or be relevant to, a reader's particular circumstances. Opinions expressed by the author(s) are the individual opinions of those persons and are not necessarily of the publisher or research provider.

## **Acknowledgements**

Part funding for the South Australia fairy tern Census was provided by Nature Foundation SA Inc.

No one government can conserve threaten species without the help and support of the community. The Department of Environment and Natural Resources would like to thank all volunteers and local tour operators for their contribution of local knowledge, time and support. As volunteers, your commitment and energy to the project was undeniable and so gratefully appreciated.

In particular, special thanks to the Regional Coordinators who took on the mammoth task of organising staff and volunteers across the State; Jane Cooper, Katrina Pobke, Catherine Dickson, Brook Halkyard, Cristina Vicente, Luke Price, Maureen Christies, Jeff Campbell, Deborah Davis and Cassandra Hlava.

Thanks also to Darren Herpich for production of all mapping and photographers Karen Hicks, Nick Tebnuff, Andrew Brooks, Teresa Jack, Alan Fletcher and Peter Gower.

## Abstract

The fairy tern (*Sterna nereis nereis*) listed as *Vulnerable* under the *IUCN Red List of Threaten Species* and under *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The total population has undergone a substantial decline over the past few decades and this decline is expected to continue at a substantial rate over, as there is no evidence that the threats affecting this species are abating.

To determine the current status of fairy terns in South Australia, three surveys occurred during the 2011-12 breeding season with over 1,500km of coastline covered by over 200 volunteers.

Fairy terns were detected in all regions of South Australia including Kangaroo Island however, the birds were primarily located in two regions 1) south-east of South Australia including the Coorong and 2) the coastline of Eyre Peninsula including the West Coast and a number of neighbouring offshore islands

Breeding was detected in all regions of South Australia excluding Kangaroo Island. A total of 16 breeding sites and 19 colonies were detected. Nine colonies were monitored for breeding success. The average number of adults per colony (*i.e.* colony size) ranged from 0 to 119, and the known minimum breeding population of fairy terns in South Australia is estimated at 472 pairs (or 944 individuals). The number of breeding pairs may have declined by 83.1%.

There has been a downward trend in colony size and in the number of colonies within each region over time. Of these, 55.6 % (or 5 colonies) succeeded in rearing chicks to independence, 33.3% (or 3 colonies) failed due to fox predation and 11.1 % (1 colony) failed due to human disturbance. At state level, survival of the fairy tern is primarily threatened by human disturbance but mammalian predators and water inundation also threaten fairy terns. Remaining habitat is at risk of disturbance by inappropriate water management. The impacts of altered hydrology may be local (*e.g.* within the Coorong), the relationship between locally impacted populations and the state-wide population can result in local declines leading to state-wide declines. Consequently, inappropriate water management should be viewed as a major threat to fairy terns in South Australia

The development of a state recovery plan with recommendations for the bird's conservation is warranted.

## 1.0 Introduction

The fairy tern (*Sterna nereis*) is a piscivorous bird found along the coast of Australia (subspecies *nereis*), New Caledonia (*exsul*) and New Zealand (*davisae*). The fairy tern is listed as *Vulnerable* under the *IUCN Red List of Threatened Species* and under *Environment Protection and Biodiversity Conservation Act 1999* and *Endangered* under the *South Australian National Parks and Wildlife Act 1972*.

The fairy tern has an estimated Australian population size of < 5,000 birds (IUCN 2011). The total population has undergone a decline of approximately 24 per cent over the past three decades and this decline is expected to continue at a substantial rate, as there is no evidence that known threats affecting this species are abating (TSSC, 2010). In South Australia, fairy terns were considered relatively common 20-years ago (D. Paton 2011, *pers.comm.*). Historical evidence suggests that fairy terns are primarily located in two regions 1) south-east of South Australia and 2) the coastline of Eyre Peninsula (Hitchcock, 1959; Blakers et al., 1984; Paton, 2003). There are up to 2,800 breeding pairs (Garnett, cited Paltridge, unpublished research, undated), although Copley (1996) reported 650 pairs and 20-30 breeding colonies. Over the last decade localized declines have been reported *e.g.* recent population estimates for the Coorong are < 180 individuals, an 88% population decline since the 1980's (see Paton, 2010; Paton and Rogers, 2009; Baker-Gabb and Manning, 2011). Fairy terns are relatively long lived, with an estimated lifespan of 14 years (Paton and Roger, 2009), therefore if the population is not monitored, changes to breeding success are not likely to be detected for some years after the impact.

In parts of South Australia, regular and systematic assessments suggest that nesting failures and the current age of individuals *e.g.* 10-12 years (Paton, 2003; Paton and Rogers, 2009) indicate that without a successful breeding event this species may face a localized extinction (Paton and Rogers, 2009). Inappropriate water resource management (Paton et al., 2009; Paton 2010) combined with increased human disturbance by recreational activities and predation *e.g.* silver gulls (*Larus novaehollandiae*) and foxes (*Vulpus vulpus*) are thought to contribute to the decline of fairy terns (Hill et al., 1988; Baker-Gabb and Manning, 2011).

In South Australia, the last known fairy tern census was undertaken in 1996-98 (Paton, 2003). The South Australian coast line is 5067 km in length including 1251 km of the total islands (Australian Government 2010). Part funding was provided by Nature Foundation SA Inc to undertake an up to date state-wide fairy tern census. A census will contribute to a long-term strategy for recovery of the species at state and national level.

## 2.0 Method and Materials

### 2.1 Regional Coordination

Coastal South Australia was divided into seven regions; West Coast, Eyre Peninsula (inc. lower and eastern Eyre Peninsula), Yorke Peninsula, Fleurieu Peninsula, Coorong, Lower South East and Kangaroo Island. Within several of these regions were numerous offshore islands (> 2km from mainland Australia). Each region was overseen by a Regional Coordinator to ease workload of a single coordinator and to provide local advice to agency staff and volunteers whom collected counts.

### 2.2 Community Talks and Volunteer Training Workshops

Informing the public about the fairy tern is fundamental to relaying information and bringing about positive effectiveness for the future management options. Public talks supported by media release *e.g.* newspapers and radio, were utilized. Presentations to community groups were also given. These types of education options also sought to recruit volunteers.

After volunteer registration, training workshops were held across the state, and delivered by the DENR staff with support from the Regional Coordinators. Training workshops aimed to aid

identification, provide participants with a set of guidelines for carrying out on the survey so that the degree of consistency can be achieved and to minimised safety risks to observers and the birds.

## 2.3 Frequency of Survey

In order to have confidence in the data collected and to make conclusive statements about the data the frequency and type of surveys were considered.

Several surveying options including monthly, seasonal and annual counts were considered. Monthly counts would be useful for providing a finer resolution dataset but funding availability combined with participation capacity and resources were the limiting factor. An annual count would provide a coarse resolution dataset and participation capacity and resources were readily available however monitoring the breeding success would not have been greatly monitored nor would an annual count determine the proportion of fledged juveniles. To accommodate the logistics of organising such extensive surveys it was deemed sensible to space the surveys throughout the breeding season rather than monthly. Surveys took place on three occasions within the breeding season, in the months of November, February and April.

Survey One took place in mid-November because at this time of the year the birds normally display courtship feeding (food offering to potential mates) and therefore less likely to be widely dispersed within an area - thus keeping the probability of recounting individuals low but also indicate an approximately vicinity of where birds are likely to breed. Survey Two took place in early February, generally considered the middle of the breeding season in South Australia. This means the birds were unlikely to be widely dispersed and breeding sites could be identified. Survey Three took place at the end of March/beginning of April to determine the proportion of juveniles.

## 2.4 Ground, Boat and Aerial surveys

Ground surveys are the most used method and an inexpensive way to supplement information from a boat or aerial survey. Ground surveys however, have their limitations in that not all areas e.g. offshore islands can be accessed. Using boats is a very useful way to survey coastal areas that are often inaccessible by foot, and aerial surveys can be costly. Boats can be used as a means of transport to inaccessible or remotely situated areas. Identification and counting of birds from a boat however can be difficult. Aerial surveys have been used worldwide to identify key sites for birds, to evaluate bird numbers, to map vegetation and to identify threats however aerial surveys are expensive. A minimum height of 500ft is required in South Australia.

The use of ground and boat surveys were deemed the most effective means to survey allowing inaccessible areas to be covered.

## 2.5 Survey Techniques

Within each region, smaller count areas (or sites) were allocated to pairs of volunteers and the Regional Coordinator ensured there was no overlap. To count the birds precisely, each count area was walked (ground survey) or motored/kayaked (water survey) or observers stopped at predefined spots and made observation over a 20-min period. Birds were individually counted. The observer was provided with a count forms.

## 2.6 Bird Counts

### 2.6.1 Count areas

Historical records of fairy terns and known breeding sites were retrieved from the SA Biological Database (SA DSDB), Birds Australia, literature and field notebooks (primary evidence). Further information was sought from community groups e.g. bird watching groups (secondary evidence). The primary and secondary evidence were mapped by date and location.



As fairy terns are generally found in coastal areas, in particular shallow estuarine, lagoon and offshore islands where shell grit, sandy material is often the preferred nesting habitat, habitat mapping was also overlaid primary and secondary evidence. Scrapes however have been reported above high water mark - on the beach, at the base of foredunes and on sandy spits, and occasionally pairs may breed on pebbles and rocky *e.g.* granite outcrops (Shaughnessy 2007; Shaughnessy et al., 2008). Breeding pairs prefer open areas where they have a wide field of view, usually away from vegetation and in that respect are similar to hooded plovers. Collectively, the information identified primary count areas (Table 1).

**Table 1.** Target count areas based on historical records and preferred nesting habitat

Region	Coverage
Lower South East	Coastline between Glenelg River estuary, Victoria and Kingston SE.
Coorong	Coastline plus lagoons between Kingston SE and Murray River mouth including islands in the Coorong South and North Lagoon
Fleurieu Peninsula	West, Wright and Pullen Island in Encounter Bay, Cape Jervis, coastline between Sellicks Beach and Port Willunga. Coastline between Port Adelaide and Webb Beach, near Windsor including Section Bank at Port Adelaide.
Yorke Peninsula	Coastline between Port Arthur and Formby Bay, coastline between The Pines and Hardwicke Bay, coastline between Port Hughes and Wallaroo, coastline between Port Broughton and Fishermans Bay, coastline between Port Pirie and Port Germein and Troubridge and Althorpe Island
Eyre Peninsula	Coast between northern boundary of Coffin Bay National Park and Lincoln National Park with focus on Longnose Peninsula, Seven Mile Beach, Murray Point, Horse Peninsula, Donnington Rocks, Rabbit Island, Goat Island, Bickers Island, The Brothers Islands, Carcasses Rock, unnamed island by Dutton Bay jetty, Sir Joseph Banks, North and the South Rocky, Cap, Four Hummocks, Little Hummocks, Price, Linguanea, Lewis, Hopkins, and Smith Island in Encounter Bay, Great Australian Bight. Whyalla, Franklin Harbour, Tumby Bay, Arno Bay, Port Lincoln foreshore area and Boston Island.
West Coast	Coastline between Fowlers Bay and northern boundary of Coffin Bay National Park with focus on Tourville Bay, St Peter and Eyre Island, Streaky Bay, Sceale Bay, Baird Bay, Lake Newland CP, Anxious Bay, Sheringa, Murat Bay, Laura Bay, Venus Bay and Lake Hamilton.
Kangaroo Island	Coastline between Emu Bay and Penneshaw including Busby and Beatrice Islet, coastal areas of Flinders Chase National Park including islands plus Antechamber Bay, Vivonne Bay, D'estrees Bay, Stokes Bay, Snellings Beach and Western River Cove.

### 2.6.2 Best state estimate for fairy terns

For each survey, at each location the total number of adult fairy terns was recorded, including zero for nil returns, thus providing a total abundance per survey. Any variation between surveys was assumed to be missed counts as it was deemed unlikely that the state population had fluctuation between the time periods *i.e.* 2011-12 breeding season. The maximum count from the surveys thus provided a best state estimate for fairy terns in South Australia.

### 2.6.3 *Monitoring reproductive success*

For the purpose of monitoring reproductive success, key breeding sites were selected. Breeding sites were selected based on the number of birds breeding, site accessibility and human resources. At selected breeding sites colonies were monitored over the course of the breeding cycle. Courtship feeding was used as a trigger for potential breeding about to occur within the vicinity of count areas. Fairy terns may lay between 1-3 eggs, and the incubation period spans 19-21 days and once a breeding site was established the site was visited at least once during this period. Once scrapes with eggs were located, hatching success was monitored. After hatching, the chicks remain in the scrape for 3-5 days. During this period, chicks were visited every other day. After which chicks become highly mobile for a period of about 21-days before the chick reached flying age. A visit to an active colony did not exceed more than 35 minutes once the birds were aware of observers. A visit to individual scrapes or brood was much shorter.

A population count at the end of the breeding season was carried out to determine the proportion of juveniles. A census in April was considered beneficial for estimating juvenile numbers from the season however this does not provide information on the locations where these young birds came from.

In addition, a camera set to take a 10 second movie every 10 minutes was installed 5 m from selected colonies.

## 2.7 Threats

The threat from predators was assessed from direct observation and by the presence of tracks. Surveys often involve walking long stretches of beach, therefore useful to record predator observations on each beach or section of beach as these surveys are conducted, to save duplicating effort. Some predators, such as foxes, range over large areas, so the absence of prints or other signs in an area were not to be taken as an absence of the threat. Repeated visits to a site were undertaken at different times of the day to maximise the likelihood of observing or detecting predators.

## 2.8 Data Storage and Analysis

All records were captured and validated on the SA Biological Surveys Database. These data were transferred into ArcView Geographical Information System to produce maps to determine spatial distribution.

## 3.0 Results

### 3.1 Community Talks and Volunteer Training

A total of 14 community talks and 10 community training workshops were held across the state, with up to 30 participants attending a single event.

### 3.2 Surveys and Coverage

Surveys took place on 12-13<sup>th</sup> November 2011, 11-12<sup>th</sup> February and 31<sup>st</sup> March-1<sup>st</sup> April 2012 although a 2-week window overlapping these dates was applicable. A total of 253 count areas (or sites) were visited and 29% (or 1,500 km) of the South Australian coastline was covered between east of Tourville Bay, on the West Coast and the Glenelg Estuary in Victoria including numerous offshore islands (Figure 1). Over 200 volunteers and 30 DENR staff undertook a combination of ground and water surveys (Plate 1, 2 and 3), equating to a nearly 4,000 volunteer hours.

Figure 1. Approximate census coverage as indicated in red.



**Plate 1.** Stunning Troubridge Island with its sandy spits surrounded by shallow waters providing the preferred habitat for fairy terns, Gulf St Vincent. Photo K. Hicks.



**Plate 2.** Volunteers surveyed at a numerous lagoons and lakes across the state. Photo. C. Manning



**Plate 3.** Volunteers prepare to use kayaks to access remote islands and sandy spits in the Coorong National Park. Photo. N. Tebneff.



### 3.3 Best State Estimate for Fairy Terns in South Australia

In November 2011, a total of 1,092 adult fairy terns were sighted (Table 2). Of these, the greatest abundance was sighted across the West Coast and on remote offshore islands with 46% (or 497) adult fairy terns recorded (Table 2). In a single observation, up to 110 fairy terns were recorded at Seagull Lake, near Sceale Bay (J. Cooper 2011, *pers.comm.*). Flocks of >45 adults were also observed at St. Peters Island, Eyre Island, Lake Newland and Lake Hamilton. Three hundred and fifty three fairy terns (or 32%) were recorded on the eastern and lower Eyre Peninsula (Table 2) where 37% of islands visited, fairy terns were present including up to 100 fairy tern were recorded in the vicinity of Rocky Island North, a 2 ha island of the coast near Coffin Bay (S. Goldsworthy, 2011, *pers.comm.*). Other notable observations were recorded on Boston Island, Curta Rock and English Island. Between Kingston SE and the Glenelg Estuary in Victoria, 121 adult fairy terns (or 11% of the state-wide count) were recorded. Of which, 50 adults were sighted at Stoney Point, near Port MacDonnell (C. Minton 2011, *pers.comm.*), including a colour flagged individual. This bird had been flagged by Prof. David Paton on a small island near Woods Well in the Coorong Southern Lagoon on 19 February, 2010 (D. Paton, 2011, *pers.comm.*). Time lapse since flagging was 1 year 8 months and 20 days. While the Coorong, Yorke Peninsula and Fleurieu Peninsula accounted for < 5% of the total state-wide count, flocks between 10 and 20 fairy terns were recorded at Troubridge Island (Gulf St. Vincent), Cheetcham Salt Fields at Price, Cape Jervis and Section Bank at Port Adelaide. A single adult was recorded at Pelican Lagoon on Kangaroo Island, accounting for < 1% of the November count, yet in mid-September 2011, a flock of 14 non-breeding adults were recorded at the Bay of Shoals (C. Hlava 2011, *pers. comm.*).

In February 2012, a total of 1,148 adult fairy terns were recorded state-wide (Table 2). The greatest abundance of fairy terns were sighted across the West Coast with 50% (or 574) adult fairy terns recorded (Table 2), of which, almost 110 fairy terns were recorded in a single observation at Eyre Island, (J. Cooper 2012, *pers.comm.*). East of Encounter Bay, in the Coorong, the best estimate for fairy terns was 28% of the state count (or 322). In the lower South East, 13.7% (or 157) fairy terns were recorded (Table 2), of which 98.7% (or 155 adults) were sighted on an unnamed island at Lake George. In addition, between November and February a banded fairy tern was found dead on 21 December 2011 at Cowie Island. The bird had been banded as a chick, at the same location in 2009, a time lapse of approximately 2 years (M. Christie 2011, *pers. comm.*). The Yorke, Fleurieu and eastern and lower Eyre Peninsula accounted for < 5% of the total state-wide count. Fifty three fairy terns were sighted on the Fleurieu, 64.1% (or 34) of which were nesting at Section Bank and 28.3% (or 15) adults were reported resting and foraging at St. Kilda, and 4 adults were recorded at Greenfields Wetland. No fairy terns were reported on islands within Encounter Bay Nil return was recorded for Kangaroo Island.

In April and under unfavourable weather conditions, a total of 192 adult fairy terns were recorded state-wide (Table 2). The greatest number of fairy terns was sighted at Lake George in the Lower South East with 43.3% (or 83) recorded (D. Mount 2012, *pers.comm.*). The West Coast and eastern and lower Eyre Peninsula combined however recorded 52% (or 99) of the state-wide count. In a single flock, 27 adults were also noted at Point Gibson near Streaky Bay. The Coorong, Yorke Peninsula and Fleurieu Peninsula and Kangaroo Island accounted for < 2% of the total state-wide count.

The best state estimate for fairy terns in South Australia is 1,148 adults (or approximately 1,500).

### 3.4 Distribution of Fairy Terns in South Australia

From east of Fowlers Bay, fairy terns were detected in all regions of South Australia including Kangaroo Island (Figure 2). On the West Coast, fairy terns were mostly distributed and abundant between Tourville Bay and Smoky Bay and at Seagull Lake, Baird Bay and Lake Newland and particularly on offshore islands and on islands inside estuaries and coastal lagoons *e.g.* on the Nuyts Archipelago Conservation Park and on Eyre and Little Eyre Island (Figure 3A). Fairy terns were not present at Sheringa, Laura Bay, Cape Bauer Tidal Creek or between Point Brown and Point Lindsay, near Streaky Bay. Nor were fairy terns present on EBA and Pigface Island.

**Table 2.** State-wide observations for (A) November (B) February and (C) April.(A)

<b>(A) Region</b>	# of total adults	# of immature *	# of juveniles	# of live chicks	# of unhatched eggs	# of scrapes	# of active colonies
Lower South East	121	0	0	0	0	0	0
Coorong	48	0	0	0	13	11	1
Fleurieu Peninsula	31	0	0	0	NOT COUNTED	NOT COUNTED	1
Yorke Peninsula	41	0	0	0	0	0	0
Eyre Peninsula	353	0	0	0	NOT COUNTED	NOT COUNTED	2
West Coast	497	4	0	1	10	13	7
Kangaroo Island	1	0	0	0	0	0	0
<b>TOTAL</b>	<b>1,092</b>	<b>4</b>	<b>0</b>	<b>1</b>	<b>23</b>	<b>24</b>	<b>11</b>

<b>(B) Region</b>	# of total adults	# of immature *	# of juveniles	# of live chicks	# of unhatched eggs	# of scrapes	# of active colonies
Lower South East	157	0	0	NOT COUNTED	NOT COUNTED	NOT COUNTED	1
Coorong	322	0	40	6	48	36	2
Fleurieu Peninsula	53	0	2	3	NOT COUNTED	NOT COUNTED	1
Yorke Peninsula	32	0	9	0	0	0	1
Eyre Peninsula	10	0	0	0	0	0	0
West Coast	574	23	26	1	0	0	1
Kangaroo Island	0	0	0	0	0	0	0
<b>TOTAL</b>	<b>1,148</b>	<b>23</b>	<b>79</b>	<b>10</b>	<b>48</b>	<b>36</b>	<b>6</b>

<b>(C) Region</b>	# of total adults	# of immature *	# of juveniles	# of live chicks	# of unhatched eggs	# of scrapes	# of active colonies
Lower South East	83	0	0	NOT COUNTED	NOT COUNTED	NOT COUNTED	1
Coorong	2	0	1	0	0	0	0
Fleurieu Peninsula	1	0	0	0	0	0	0
Yorke Peninsula	4	0	1	0	0	0	0
Eyre Peninsula	20	0	0	0	0	0	0
West Coast	79	9	23	0	0	0	0
Kangaroo Island	3	0	0	0	0	0	0
<b>TOTAL</b>	<b>192</b>	<b>9</b>	<b>25</b>	<b>NOT COUNTED</b>	<b>NOT COUNTED</b>	<b>NOT COUNTED</b>	<b>1</b>

\* Stage of birds life from time it fledge until adulthood i.e. all plumages between the first moult and breeding plumage e.g. from >2010-11 season (see Section 3.4.9).

**Figure 2.** Distribution of fairy terns and breeding sites in South Australia 2011-12.



On the lower and eastern Eyre Peninsula fairy tern were concentrated at Coffin Bay National Park and around Port Lincoln (Figure 3B). Sightings were also noted on several offshore islands including Cap, Rocky North, Four Hummocks, Curta Rock, Boston, and islands part of the Sir Joseph Banks including English, Langton and Winceby Island and Dangerous Reef (Figure 3B). With the exception of a single fairy tern at Munyaroo Conservation Park, zero fairy terns were sighted between Louth Bay and Whyalla (Figure 3B).

Fairy terns were present but widely distributed on the Yorke and Fleurieu Peninsula with the Port Adelaide area being the only area within these regions where their presence was consistently sighted, particularly on Section Bank (Figure 3C). Further south on the Fleurieu Peninsula, a flock of 14 adults were recorded at Cape Jervis flying in a south-west direction but no fairy terns were recorded at Encounter Bay. On Kangaroo Island, fairy terns were only sighted ( $< 3$ ) on the eastern side of the island, specifically at Antechamber Bay and Pelican Lagoon (Figure 3C).

East of Encounter Bay, in the Coorong, 72% (or 231) of fairy terns were in the Coorong South Lagoon, with 28% (or 91) sighted in the Coorong North Lagoon mainly around the Pelican Point area. Only a few birds (ca. 10-15) were sighted away from the breeding colonies in the Coorong South Lagoon, suggesting the birds quickly move away from breeding islands once immature birds have fledged. No fairy terns were sighted between 28-mile crossing and Kingston SE (Figure 3D). South of Kingston SE, fairy terns were present at Robe, Nora Creina, Beachport Conservation Park, McIntyres Beach, Cape Douglas Conservation Park, Browns Beach, Blanche Bay, Carpenters Rock, Stoney Point, Danger Point, and Lake George and at the Glenelg Estuary in Victoria (Figure 4). The greatest concentration of fairy terns in the lower south east was at Lake George and Stoney Point.

### 3.5 Reproductive Success

Breeding was detected in all regions of South Australia excluding Kangaroo Island (Figure 2 and Appendix A). A total of 16 breeding sites and 19 colonies were detected, including 2 independent colonies on Eyre Island and St Peter Island and 2 attempts on Section Bank (Table 3). Nine colonies (including 2 attempts on Section Bank) were monitored for breeding success (Table 3). The average number of adults per colony (*i.e.* colony size) ranged from 0 to 119, and an average of 471.50 breeding pairs state-wide (or 472 pairs) (Table 4). Generally, there has been a downward trend in colony size and in the number of colonies within each region over time. Of these, 55.6 % (or 5 colonies) succeeded in rearing chicks to independence, 33.3% (or 3 colonies) failed due to fox predation and 11.1 % (1 colony) failed due to human disturbance.

#### 3.5.1 Seagull Lake Colony, West Coast

Seagull Lake is an 88 ha lake near Sceale Bay on the western side of the Eyre Peninsula. It lies about 20 km south of Streaky Bay and 280 km north of Port Lincoln. Seagull Lake is a sub-coastal saline lake fed by a marine spring. There are grassed sand-dunes on the west between the lake and the bay. On the east the lake is bordered by about a kilometre of whipstick mallee and paper barks, before a series of ephemeral saline wetlands. The surrounds retain much native vegetation, especially samphire and halophytic shrub land. The threatened Beaded Samphire and West Coast Mintbush are found at the lake. Although some parts are permanently wet, much of the lake bed dries up during droughts. Part of the lake is protected in the Sceale Bay Conservation Park. Seagull Lake has been identified by BirdLife International as an Important Bird Area (IBA).

Courtship behaviour and active scraping was initially observed in late October 2011, when 35 adults were recorded all in breeding plumage and at least 2 pairs were with active scrapes. On Survey 1, 55 adults all in breeding plumage were recorded however the total number of scrapes and unhatched eggs was not recorded. By mid November, the colony had increased to 110 (or approximately 55 breeding pairs) and reported as "... a hive of activity with adult birds feeding small mouthed hardyheads to incubating pairs". Shortly after fox tracks and scats were reported throughout the nesting area and the colony abandoned Seagull Lake. Despite regular coverage fairy terns were not sighted at the site nor was there a second breeding attempt post November 2011.



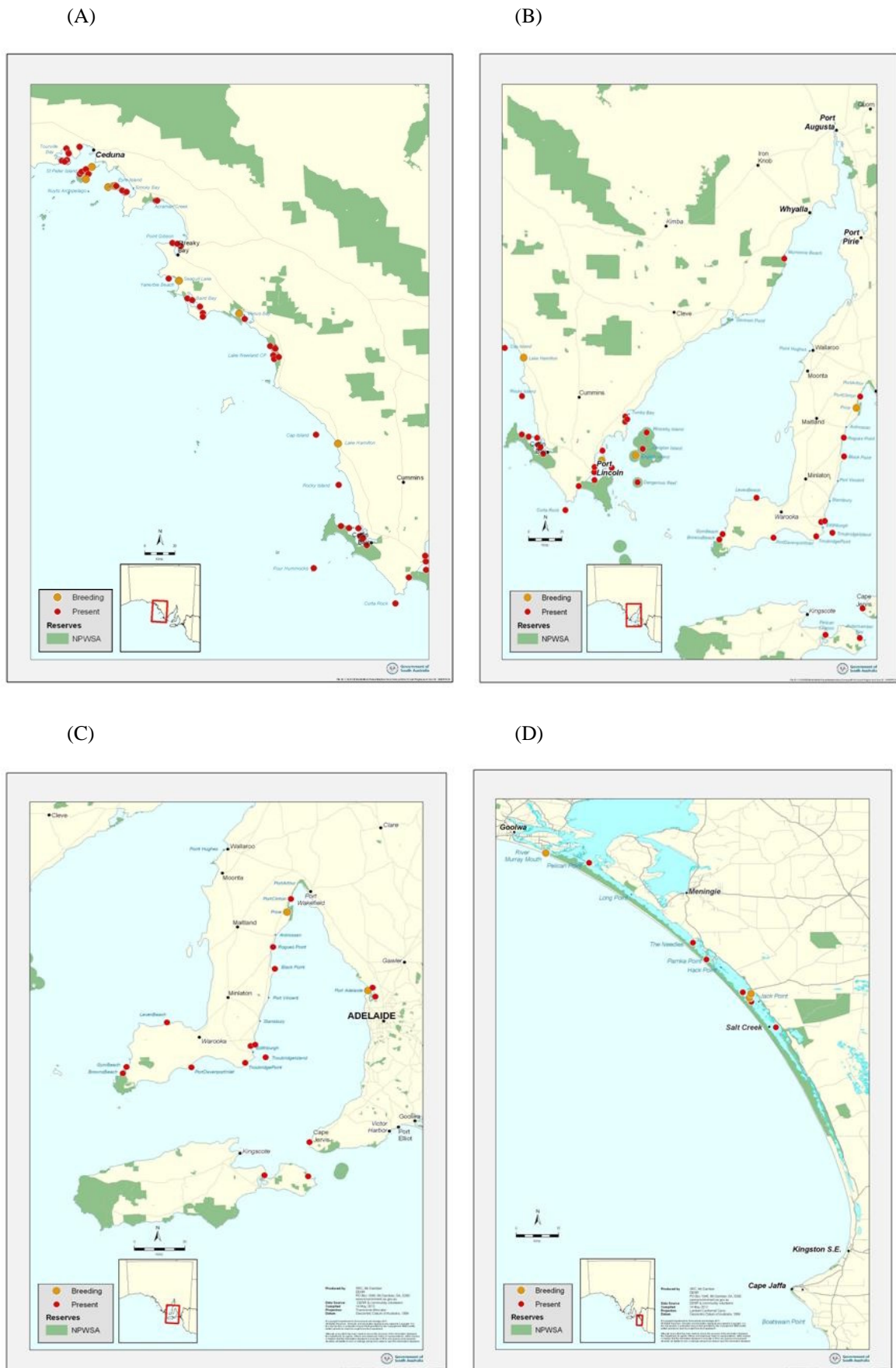
**Table 3.** Location of known fairy tern breeding events 2011-12.

Breeding Site	Conservation Area	Region	General Outcome
Teal Island	✓	Coorong	Succeeded in rearing chicks to independence
Ocean Beach	✓	Coorong	Failed and abandoned. Fox predation.
Unnamed island of Fat Cattle Point	✓	Coorong	Succeeded in rearing chicks to independence
Unnamed island of Cattle Island	✓	Coorong	Succeeded in rearing chicks to independence
Section Bank	✓	Fleurieu Peninsula	1 <sup>st</sup> attempt failed. Fox predation. 2 <sup>nd</sup> attempt. Succeeded in rearing chicks to independence
Point Maria, Boston Island		Eyre Peninsula	Unknown
English Island, Sir Joseph Banks	✓	Eyre Peninsula	Unknown
Island B, Venus Bay	✓	West Coast	Unknown
Eyre Island, Smokey Bay	✓	West Coast	Unknown
Eyre Island, Smokey Bay	✓	West Coast	Unknown
Little Eyre Island, Smokey Bay	✓	West Coast	Unknown
St Peter Island, Nuyts Archipelago	✓	West Coast	Unknown
St Peter Island, Nuyts Archipelago	✓	West Coast	Unknown
Seagull Lake, Sceale Bay	✓	West Coast	Failed and abandoned. Fox predation
Lake Hamilton		West Coast	Unknown
Lake George		Lower South East	Unknown
Obelisk, Robe		Lower South East	Failed and abandoned. Human disturbance
Cheetcham Salt Fields, Price		Yorke Peninsula	Succeeded in rearing chicks to independence

**Table 4.** Average number of adults per colony (i.e. colony size) by decade and number of colonies in brackets (Paltridge, unpublished research, undated) compared to 2011-12.

Time	Lower South East	Coorong	Fleurieu	Yorke	Eyre	West Coast	Kangaroo Island
1940-1949							54.00 (1)
1950-1959						200.00 (1)	
1960-1969	36.00 (2)	166.67 (3)			100.00 (1)	120.00 (1)	100.00 (1)
1970-1979	54.00 (3)	70.00 (1)		63.00 (4)	80.00 (2)		170.00 (1)
1980-1989	24.33 (6)	160.00 (2)		36.00 (3)	20.00 (1)		
1990-1999	76.67 (3)	66.95 (2)		27.00 (7)	25.00 (2)	10.00 (1)	
2000-2009	unavailable						
2011-2012	119.00 (1)	76.21 (4)	18.61 (1)	23.00 (1)	47.50 (2)	42.28 (8)	0 (0)
<b>Average number of breeding pairs state wide</b>							<b>471.50</b>

**Figure 3.** Distribution of fairy terns and observed breeding sites on (A) West Coast, (B) the eastern and lower Eyre Peninsula, (C) Yorke and Fleurieu Peninsula and Kangaroo Island (D) Coorong.



**Figure 4.** Distribution of fairy terns and observed breeding sites between Kingston SE and the Glenelg Estuary in Victoria.



### 3.5.2 Cheetcham Salt Fields Colony, Yorke Peninsula

Cheetham uses natural sea water and lake brines to produce solar salt. These solar salt fields provide a habitat for many species of birds and animals, including fairy terns. The average number of adults in the colony was 18.61 (Table 4). Eight adults in breeding plumage were recorded in November but no displays of courtship were noted. In early February, 23 adults all in breeding plumage were recorded on the unsealed vehicle tracks between the sand pans together with three immature (recently fledged) birds (Plate 4). The total number of scrapes, unhatched eggs and chicks is unknown and the main breeding event is assumed to have taken place between December 2011 and February 2012.

### 3.5.3 Section Bank Colony, Fleurieu Peninsula

At the northern tip of the Lefevre Peninsula, on the Fleurieu Peninsula, is an exposed artificial island made of coarse shell-grit that extends for approximately 800 m, known as Section Bank. Section Bank is bounded to the south by a residential area and in every other direction by Gulf St Vincent and the Port River. The island was constructed in 1977 from spoil when the Port River basin was deepened for shipping.

The average number of adults in the colony was 18.61 (Table 4). Twenty one adults all in breeding plumage were recorded in November, of which six pairs were noted with active scrapes and incubating eggs, however the number of unhatched eggs was not recorded. Despite local fox baiting effort, fox tracks and scats were reported throughout the nesting area and the colony was later abandoned (Table 3). By January 2012, the birds had returned to the area and displayed courtship behaviour and by early-February, 34 adults were recorded including 11 breeding pairs (12 adults were

not associated with a scrape but were in breeding plumage). At this time, 3 chicks plus 2 immature birds were observed (Table 2), and the colony displayed highly protective behaviour. The total number of scrapes and unhatched eggs was not recorded. A single adult in non-breeding plumage was recorded at the site in April.

**Plate 4.** Juvenile and adult fairy tern at Cheetcham Salt Fields near Price, Yorke Peninsula. Note the pebbly substrate. Photo. T. Jack.



#### 3.5.4 Coorong

Within the Coorong, four known colonies established and the average number of adults per colony was 69.1 (Table 4). Nesting attempts in region suggest 20% of the maximum number of scrapes from each colony combined (*i.e.* 202 scrapes) (Table 5) succeeded in rearing chicks to independence, as judged by the maximum number of juveniles observed (*i.e.* 40) (Table 2).

##### 3.5.4.1 Ocean Beach Colony, Coorong

The Youngusband Peninsula is a long narrow peninsula that separates Encounter Bay from the Coorong. It lies entirely within the Coorong National Park. The peninsula is over 110 kilometres long, but less than 3 kilometres wide at its widest point. Its narrowest point is less than 350 metres wide. The Youngusband Peninsula is defined by sand dunes. At the north tip of the Youngusband Peninsula a single colony was recorded in November 2011 with a total of 24 adults, 21 of which were in breeding plumage. Several pairs were observed courting and one adult were seen offering garfish (*Hyporhamphus melanochir*) to incubating mate. A total of 11 scrapes and 13 unhatched eggs were recorded (Table 5). Despite local fox control efforts, fox tracks and scats were reported throughout the nesting area and the colony was later abandoned. Fairy terns were not sighted at the site nor a second breeding attempt post November 2011.

##### 3.5.4.2 Fat Cattle Point Colony, Coorong

On an unnamed island near Fat Cattle Point, a point on the eastern side of the Coorong about 5 km north of Policemen Point a single colony established in early January 2012. At that time, the colony had 48 individual adults, 7 scrapes and 12 unhatched eggs (Table 5). By end of January, 85 adults and 6 free-flying immature birds were present (D. Paton 2012, *pers.comm.*). At least 19 scrapes with 1 egg and 26 scrapes with 2 eggs (or 71 unhatched eggs) were observed (D. Paton 2011, *pers.comm.*). Ten chicks were recorded and estimated a maximum age of 10-days, suggesting a point of lay

between 27 and 29<sup>th</sup> December 2011. Via a banding program, adults birds were recaptured, one of which was of a bird that had also bred on Teal Island (see Section 3.5.7).

In early February, 104 adults were present with at least 33 pairs associated with an active scrape, although a total of 36 scrapes were noted with a total of 48 unhatched eggs. Six chicks were present and 3 chicks were found dead. Sixteen free-flying immature birds were sighted, and these birds were fed small mouth hardyheads by adult birds seen flying to/from the shallow water between the Younghusband Peninsula and West Cattle Islands with fish. In mid-February, 46 adults were present on the island and 9 juveniles. At least, 15 scrapes were noted with 19 unhatched eggs, 5 eggs appeared dissipated. Ten chicks were recorded (Table 5).

#### 3.5.4.3 Cattle Island Colony, Coorong

On an unnamed island near Cattle Island, below Woods Well a single colony was detected in early January 2012. The colony had 120 adults present with 27 scrapes with 1 egg; 48 scrapes with 2 eggs and 4 scrapes with 3 eggs (or 79 scrapes and 135 unhatched eggs) (D. Paton 2012, *pers.comm.*). Shortly after, 118 adults were present as was a single non-breeding flagged immature bird, which had been flagged in Gippsland Lakes, Victoria (D. Paton 2012, *pers.comm.*). Eighteen scrapes with 1 egg; 41 scrapes with 2 eggs, 6 scrapes with 1 egg and 1 chick; 1 scrapes with 1 egg and 2 chicks; 6 scrapes with 1 chick; 5 scrapes with 2 chicks, 1 scrape with 3 chicks (or 78 scrapes and 107 unhatched eggs) were recorded. A total of 27 chicks had hatched and being fed < 10 mm small mouth hardyheads. Hatching was also in progress suggesting a point of lay between 22 and 24<sup>th</sup> December 2011. In early February, 108 adult were sighted however due to poor weather condition access to the island was hindered however a later count revealed 62 adults, 14 immature birds and 3 chicks estimated 5-10 days old (Table 5).

#### 3.5.4.4 Teal Island, Coorong

Teal is a small island about 3 km north of Policeman Point. The island mainly consists of non-native species, notably *Lycium ferocissimum* (African boxthorn), *Mesembryanthemum cristallinum* (common ice plant) and *Malva* species (mallows). These species are well established and widely spread. *Euphorbia paralias* (sea spurge) occupies a narrow band for most part of the island perimeter where it co-exists with *Cakile maritima* (sea rocket) and native *Tecticornia pergranulata* (blackseed glasswort). *Muehlenbeckia gunnii* (coastal lignum) is also presence. A single colony established among open areas of common ice plant and sea rocket on a shell-grit substrate (Plate 5).

Nesting adjacent to breeding Australian pelicans (*Pelecanus conspicilatus*), the colony had 98 individual adults, 62 scrapes and 132 unhatched eggs (Table 5). In mid December, 110 adult birds were counted in attendance, with 30 scrapes with 1 egg, 35 nests with 2 eggs and 2 nests with 3 eggs (or 106 unhatched eggs) (D. Paton 2011, *pers.comm.*). Thirty eight chicks were also sighted, the majority of which had left their scrape. Thirty five of these chicks were 1-3 days old; 2 were estimated to be 3-6 days old and 1 was estimated 6-9 days old. Nearly fledged birds were also observed exercising their wings and making short (< 100m) flights. There were also 6 dead chicks and ants were seen attacking a hatching chick. Fairy terns were seen bringing back 10-25 mm small mouth hardyheads (*Atherinosoma microstoma*) to feed chicks, and several birds regurgitated 2-3 fish when caught (D. Paton 2011, *pers.comm.*).

In early January 2012, 95 adults were in attendance and a single free flying immature bird was sighted. Eleven scrapes with 1 egg, 15 scrapes with 2 eggs and 1 scrape with 3 eggs (or 44 unhatched eggs) were sighted with at least 20 chicks (D. Paton 2011, *pers.comm.*). By mid-January, 33 adults were in the vicinity of Teal Island together with 8 free flying immature birds that continued to be fed by parent birds but were also seen to practice fishing. Two breeding pairs continued to nest on Teal Island however the birds were not disturbed and the number of unhatched eggs or chicks not known (Table 4). Post 27 January 2012, fairy terns were not sighted in the vicinity and no scrape contents in the area remained where the birds were breeding except that a few scrapes were still discernible.

A remote camera was installed on Teal Island, and captured 1,170 10-sec movies (or 3.25 hrs) showing chicks emerging, adults exchanging food and greetings and a flagged adult although the detail of the flag was unclear.

**Plate 5.** A single colony on Teal Island established among common ice plant and sea rocket on a shell-grit substrate. Photo. C. Manning.



### 3.5.5 *Obelisk Colony, Lower South East*

On the rocky headland at Cape Dombey, near Robe, a single colony was detected on 9 January 2012 with 12 adults reported in breeding plumage together with 1 advance young but not yet fledged bird and two chicks estimated < 5days old. Despite local signage and fencing initiatives, the area remained an extremely high profile, highly disturbed site, with reports of visitors observed beyond the fence line and among the colony. Post 23 January 2012, fairy terns were not sighted at the site nor were a second breeding attempted.

**Table 5.** Breeding for colonies in the Coorong.

<b>Date</b>	<b># of adults</b>	<b># of juveniles</b>	<b># of chicks</b>		<b># of eggs</b>		<b># of scrapes</b>
	<i>actual count</i>	<i>actual count</i>	<i>alive</i>	<i>dead</i>	<i>unhatched</i>	<i>disserted</i>	<i>actual count</i>
<b><i>Ocean Beach</i></b>							
8 Nov 2011	16	0	0	0			
12 Nov 2011	24	0	0	0	13	0	11
<b><i>Unnamed island, Fat Cattle Point</i></b>							
5 Jan 2012	48	0	0	0	12	0	7
27 Jan	85	6	10	0	71	0	45
4 Feb 2012	104	16	6	3	48	0	36
14 Feb 2012	46	9	10	0	19	5	15
<b><i>Unnamed island, near Cattle Island</i></b>							
5 Jan 2012	120	0	0	0	135	0	79
12 Jan 2012	118	0	27	0	107	0	78
4 Feb 2012	108	0	Not Counted	Not Counted	Not Counted	Not Counted	Not Counted
14 Feb 2012	62	14	3	0	0	0	0
<b><i>Teal Island</i></b>							
6 Dec 2011	98	0	0	0	132	0	62
20 Dec 2011	110	0	38	6	106	2	67
5 Jan 2012	95	1	20	1	44	11	29
16 Jan 2012	33	8	Not Counted	0	Not Counted	Not Counted	2
<b>maximum number of scrapes from each colony combined</b>							<b>202</b>

Data source: D. Paton and C. Manning.

### 3.5.2 *Immature Birds*

Immature birds (Plate 6) were occasionally reported as birds in "*first basic plumage*", and represented the proportion of juvenile birds (Plate 7) from at least the season passed i.e. 2010-11, although these birds did not provide information on the locations from where they came from. During the census, up to 23 immature birds were reported on the West Coast (Table 2), suggesting some success in rearing chicks to independence pre 2011-12 breeding season had occurred.

## 3.6 Threat Assessment

### 3.6.1 *Types of Threats*

At state level, five categories of threats to fairy terns were identified, including human disturbance, mammalian predators, water inundation, avian predators and other (Figure 5). Of these identified threats, human disturbance accounted for 37% of the identified threats. Both mammalian predators *e.g.* fox and domestic dogs and water inundation accounted for almost 25% of the threats at all sites in the state. Foxes were not deemed a threat on Kangaroo Island. While avian predators *e.g.* silver gulls (*Larus novaehollandiae*) and white-bellied sea eagle (*Haliaeetus leucogaster*) was much less, only 12%. Two dead adult fairy tern remains with the flesh picked off the sternum were reported amongst an active colony (D. Paton 2011, *pers.comm.*). Remote cameras also captured nesting adults disturbed by the common starling (*Sturnus vulgaris*). There was no evidence of common starlings attacking eggs or chicks but their presence disturbed nesting birds enough for them to frequently lift of scrapes (C. Manning 2011, *pers.comm.*). At Section Bank, 35 pairs attempted to breed in late 2010, but following high winds, the colony was unsuccessful as a result of water inundation (G Johnston 2011, *pers. comm.*). The remaining 3% accounted for sites where fairy terns were reported roosting or nesting yet the habitat availability was reported to reduce under high tide conditions and/or storm events, and this was particularly notable at island locations on the Eyre Peninsula, Fleurieu Peninsula and in the Coorong. Structural and floristic vegetation changes were also identified. At most sites multiple threats were noted, however the severities of threats were not assessed.

### 3.6.2 *Types of Human Disturbance*

At state level, four types of human disturbances to fairy terns were identified; walkers (39%) recreational driving (*e.g.* 4WD) accounted for almost 29% and beach fishing accounting for 19% Low flying air craft, irregular water management and oyster farms accounted for 13% of other human related disturbances (Figure 6).



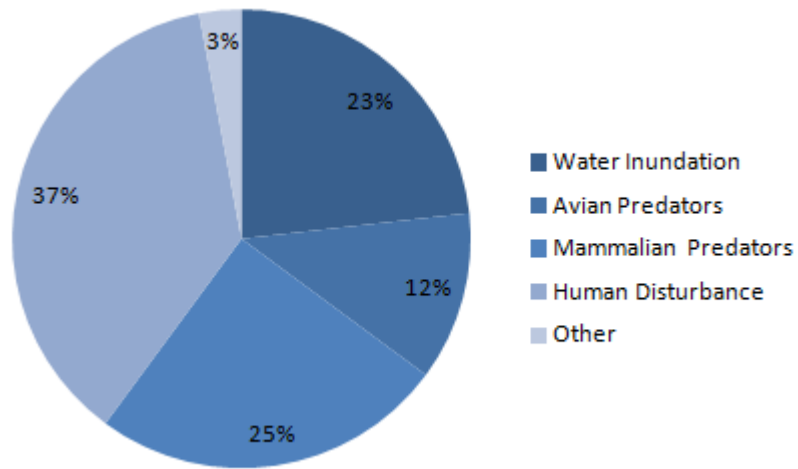
**Plate 6.** Immature presented pale upper parts with a darker leading edge to the wing, almost white head and crown was white, sometimes streaked with a dark grey-black bill with hint of yellow-grey along the mid section. Photo. A. Brooks.



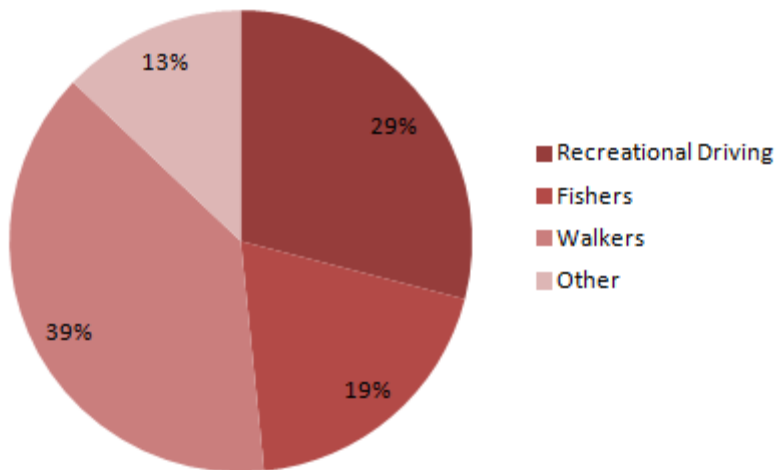
**Plate 7.** Juvenile (recently fledged) bird present heavily mottled medium-brownish grey, especially along leading edge of wing, and the tail is pale grey with the tips of the outer tail also mottled medium-brownish grey, most of the head and crown is light brown almost to the back of head which was often streaked, and duller bill and legs. Photo. A. Fletcher.



**Figure 5.** Types of threats to fairy terns identified at state level.



**Figure 6.** Types of human disturbances to fairy terns identified at state level.



## 4.0 Discussion

### 4.1 Distribution and Abundance

Fairy terns were detected in all regions of South Australia including Kangaroo Island however, the birds were primarily located in two regions 1) south-east of South Australia including the Coorong and 2) the coastline of Eyre Peninsula including the West Coast and a number of neighbouring offshore islands supporting previous observations (Hitchcock, 1959; Blakers et al., 1984; Paton, 2003). Whether these are two distinctive populations in South Australia is unknown but further banding work of birds on the West Coast may help examine the movement of birds within and between South Australia.

The best state estimate for fairy terns in South Australia is approximately 1,500 individuals but their abundance across the state varies considerably. Garnett (cited Paltridge, unpublished research, undated) estimated a state population of 2,800 breeding pairs. This figure excludes non-breeding adults but suggests a minimum state population of 5,600 adult individuals. Based on these figures the state population has declined by 73.2%. Reid and Vincent (1979) reported fairy terns as being "fairly plentiful" (p.7) in South Australia. This no longer appears applicable. Reasons for their decline in central regions of South Australia (Kangaroo Island, Fleurieu and Yorke Peninsula) are unclear but on the Fleurieu and Yorke Peninsula coastal development and human population increase are likely factors (see below).

On the West Coast, limited information is available west of Tourville Bay, however there are incidental records of fairy terns near Lake MacDonnell south-west of Penong (J. Cooper 2012, *pers. comm.*) but further investigation is needed. There are historic observations of fairy tern on the Nuyts Archipelago Conservation Park and on Kirby Langdon and Stickney Island on the Sir Joseph Banks archipelago (J Van Weenen 2011, *pers. comm.*, J Cooper 2011, *pers. comm.*). Paton (2003) also reported fairy terns on the Sir Joseph Banks, in particular Hareby and Reeves Island however fairy terns were not sighted on this island in this census. On the other hand, Paton (2003) reported no fairy terns for Boston Island, when in 2008-09 and in this census the island supported an active colony at Point Maria. Sightings have also been noted on Waldegrave and Lilliput Island (Shaughnessy 2007; Shaughnessy *et al.*, 2008) as well as areas on the mainland at Sceale Bay Conservation Park and Lake Hamilton (J Cooper 2011, *pers. comm.*). Since 1980, 12-25 breeding pairs have been consistently reported at Point Gibson, near Streaky Bay (J Cooper 2011, *pers. comm.*). Despite historical records, suitable habitat and coverage however there were no fairy terns reported at Franklin Harbour.

A limitation of any comparative work is that repeat visits on the West Coast have not been regularly carried out systematically over any extended periods of time – in particular repeat visits to known colonies so the ongoing success of a colony have rarely been noted. It is hence difficult to say whether fairy terns on the West Coast are in decline or indeed stable. This may also be an artefact of the land-based survey method and future investigation via boat is warranted *e.g.* Franklin Harbour.

Historically, fairy terns have been observed on Yorke and Fleurieu Peninsula, with up to 300 breeding pairs reported at Ward Spit north of Port Pirie (Wilson 2000) however their distribution is now widely scattered and their numbers low, ca. < 25 individuals. Troubridge Island, Cheetcham Salt Fields, near Price and Section Bank near Port Adelaide are assumed to provide the preferred habitat as their presence was consistently sighted. Further south on the Fleurieu Peninsula, 100-200 individual fairy terns have been recorded at Encounter Bay, but there have not been sightings let alone breeding records since the late 1970s (Copley, 1996; D Paton 2011, *pers. comm.*). Similarly, fairy terns were largely absent from the southern Fleurieu Peninsula and this species could be considered locally extinct from these southern areas.

In 1984-85, the Coorong supported a fairy tern population of c.1, 500 individuals (Paton 2010). In January 2011, the estimated Coorong fairy tern population was 169 individuals (D Paton 2011, *pers. comm.*), a decline of almost 89%. The best estimate for fairy terns in the Coorong for this census was

322, a 48% increase on the January 2011 count but still a 78.5 % decline on 1984-5. South-east of the Coorong the fairy tern has been reported at Beachport and Port MacDonnell. Fairy terns have been recorded at Lake George (M. Christie 2011, *pers. comm.*), and on Cowrie Island near Beachport with records of fairy terns at Robe and Nora Creina Bay (Bransbury 1992). The best estimate for fairy terns in the lower South East was 155 individuals at Lake George. Inappropriate water management at this site threaten fairy terns in this part of South Australia (see below), and will contribute to an overall decline unless sufficient water levels maintained to preserve the aquatic vertebrate and invertebrate fauna.

In recent decades, up to 120 adult fairy terns were reported on Kangaroo Island Baxter and Berri (cited in Paton et al., 2002) including a flock of 100 at Cape du Couedic in 2006 (C. Baxter 2011, *pers.comm.*). These observations together with the small flock sighted prior to the official census suggest that their presence on Kangaroo Island is periodic, as are breeding events.

The greatest abundance of fairy terns observed on the West Coast and Coorong may reflect the presence of more favourable, sheltered feeding sites and more islands in the lakes and estuarine environments adjacent to the coast. These offshore islands however are quite inaccessible, which may help minimise the impacts of known threats but by their nature combined with unfavourable weather conditions and low population and therefore survey capacity, means repeat visits are often difficult to carry out. This is reflected by the apparent low (*i.e.* 192) abundance of fairy terns at state level in April. The regularity of fairy tern's present at some of these island locations is also unclear.

#### 4.2 Reproductive Success

Breeding was detected in all regions of South Australia excluding Kangaroo Island however the breeding was primarily located in the south-east of South Australia including the Coorong and on the West Coast particularly on neighbouring offshore islands supporting previous observations (Paton, 2003; Paltridge, unpublished research, undated; (J. Cooper 2011, *pers. comm.*).

Until the early 1990s, colonies of 40-60 pairs of fairy terns were reported breeding on Kangaroo Island at Paisley and Casuarina Islets, with other pairs nesting on sheltered sandy beaches at Busby Inlet Conservation Park and Cape Rouge (Paltridge (unpublished research, undated; C Baxter 2011, *pers. comm.*). Since then, little to no breeding has been reported on Kangaroo Island with the exception in 2010, a single adult and two juveniles were sighted at Cape du Couedic (C. Baxter 2011, *pers.comm.*) although no breeding site was detected. Similarly, a colony of 50-100 pairs formerly bred on West and Bluff Island near Victor Harbor, on the southern coast of Fleurieu Peninsula (Paton 1982; Copley 1996) but breeding attempts have not been recently reported, although see section 4.3.4 below. The fairy tern may be regarded as functionally extinct on Kangaroo Island and southern Fleurieu Peninsula.

Based on the colony size and number of colonies reported, the minimum number of breeding pairs in South Australia is estimated at 472 pairs (or a minimum of 944 adult individuals). This suggests 63% of the best state estimate for fairy terns in South Australia attempted to breed in 2011-12. Garnett (cited Paltridge, unpublished research, undated) estimated 2,800 breeding pairs. Copley (1996) reported 650 breeding pairs (or a minimum of 1,300 adult individuals). Based on these figures the number of breeding pairs in South Australia has decreased by 83.4% or increased by 13.2%, respectively. In 1997-98, Paltridge (unpublished research, undated) however estimated that the minimum number of breeding pairs in South Australia was 301 pairs (or a minimum of 602 adult individuals) that also suggest a breeding population increase of 36.2%. Overall however, there is a trend of decline. Hill *et al.*, (1998) reported "hundreds of pairs" (p.6), this is rather ambiguous but no longer appears applicable.

During 2010-12, increased inflows from the Murray-Darling Basin, improved water and salinity levels in the Coorong, and small mouth hardyheads re-colonised the Coorong South Lagoon, which secured a source of prey item close to their traditional breeding islands (Paton and Rogers, 2009). Indeed, fairy terns foraged near (< 2 km) of the breeding islands or were sighted near the breeding

colonies and resting, suggesting the birds had no difficulty in securing food. This is contrary to previous years when fairy terns in the Coorong were foraging in the Southern Ocean and beyond the surf zone > 2km from their colonies (Paton and Rogers, 2009).

Within the Coorong, the number of colonies may have increased in 2011-12 but the average size of colonies has decreased by 45%. By the birds establishing multiple colonies their vulnerability to catastrophic events impacting at any individual site (*e.g.* DENR, 2011) may reduce, resulting in greater fledging success. In the 2000s, when inflows from the Murray-Darling Basin had reduced and salinity levels were beyond the salinity threshold of small mouth hardyheads, fairy terns were disrupted by foxes for at least five breeding seasons, as the birds bred on mainland nesting sites and < 5% of fairy terns counted each year in the Coorong were juveniles (D. Paton 2011, *pers. comm.*). Whereas, recent nesting attempts in region suggest 20% of the maximum number of scrapes from each colony combined succeeded in rearing chicks to independence, as judged by the maximum number of juveniles observed. This combined evidence strengthens the need for suitably timed and adequate inflows in the Murray-Darling Basin (Rogers and Ralph, 2011; Paton, 2010; Rogers and Paton, 2009; Paton et al., 2009).

The census in April was considered beneficial for estimating juvenile numbers from the season however the immature figures are likely to be an under estimate because of unfavourable weather conditions across the state and less survey capacity.

On the West Coast, a handful of juveniles of 2011-11 progeny were sighted suggesting successful breeding had occurred however from where these birds bred are unknown.

#### 4.2.1 Defining Success

Defining success may vary between breeding sites and stages of the bird's life cycle. For example, breeding attempts may occur in at more favourable sites *e.g.* islands, which are generally devoid of land-based predators in their natural state and therefore improve the likelihood of breeding success, this is particularly applicable for fairy terns that bred in the Coorong. Chicks may successfully fledge to independence however breeding might only be considered successful if those birds recruit into the adult population and later breed. Early indicators of success (especially during the onset of breeding) are difficult to measure without resident observers (Jones and Kress, 2012).

For the latter, realistic timelines need to be considered to calculate budgets and predict the time required for employing personnel. Often monitoring breeding success is labour intensive in the beginning *e.g.* locating colonies, monitoring critical stages of early breeding *e.g.* active scrapes, unhatched chicks, dead chicks, and requires less time and effort later *e.g.* the time when birds fledge. The use of in situ camera can compliment ground observations.

It is suggested that the ultimate measure of success is when a population is self-sustaining however the fact that fairy terns in the Coorong returned to island locations and reared chicks to independence for the first time in a number of years, is in its own right, a success for the Coorong region.

#### 4.2.2 Immature Birds

Immature birds were those birds from time it fledged until adulthood *i.e.* all plumages between the first moult and breeding plumage. The plumage of immature birds presented pale upper parts with a darker leading edge to the wing. Most of the head and crown was white almost to the back of head which was often streaked. These birds appeared to have a dark grey-black bill with a hint of yellow-grey along the mid section, and their legs were reported various shades of greyish-brown-yellow (see Plate 4). These birds were seen before and during the 2011-12 breeding season with flocks of both non-breeding and breeding adults. Juvenile (recently fledged) birds differed from immature birds in that the plumage of juvenile birds presented heavily mottled medium-brownish grey, especially along leading edge of wing, and the tail is pale grey, most of the head and crown was light brown almost to the back of head which was often streaked and duller bill and leg (see Plate 5).

### 4.3 Threats

Many bird species are threatened with extinction (IUCN 2012). A range of existing and potential threats to fairy tern in South Australia have been identified. Most threats are similar to those that threaten ground nesting birds (DECC, 2008; Maguire, 2008) however some threats such as inappropriate water management have the far reaching potential to impact on all components of a system that depends ultimately on a particularly hydrological regime that also includes populations of fairy terns (Paton and Rogers, 2009). Disturbances can cause the direct destruction of nests or the desertion of nests. Once birds have fledged they have the option of flying away from some of the threats that make them vulnerable as chicks, however this is only if the birds can react in time.

#### 4.3.2 Human Disturbance

Much of the fairy tern's littoral and estuarine habitat in South Australia has been, and continues to be, degraded by coastal development and human population increase, which directly and indirectly leads to poor breeding success and abandonment of nesting sites. Indeed, fairy terns that had attempted to breed at the Obelisk did so for the first time since 2007-08 (M.Chrsitie 2012, *pers.comm.*) but abandoned the site shortly after visitors were observed among the colony.

Human disturbance by off-road vehicles was identified as a major threat to nesting fairy terns. Beaches are a favourite site for recreational off-road vehicles, and nesting colonies and resting areas may be subject to repeated intrusion. Buick and Paton (1989) reported that 81% of artificial Hooded Plover *Thinornis rubricollis* nests are run over by off-road recreational vehicles. In the Coorong, fairy terns have benefited from annual beach closures to off-road recreational vehicles from 24 October to 24 December however this closure only partly coincides with the fairy tern and other beach nesting birds breeding season. Off-road recreational vehicles are permitted in much on much of South Australia's coastline.

#### 4.3.3. Inappropriate Water Management

Remaining habitat is at risk of disturbance by inappropriate water management. Inappropriate water management - in particular water manipulation and extraction operations (*e.g.* Lake Hamilton, Lake George, and Murray-Darling Basin) was recorded at few sites however such operations result in water levels being too high, flooding nests, or too low allowing land-based predators to access islands that are generally devoid of land-based predators in their natural state (Paton and Rogers, 2009; DENR 2011). Inappropriate water management can lead to increase salinity in waters adjacent to fairy tern colonies, resulting to a collapse in the numbers of prey fish, causing dramatic decline in localised fairy tern populations (Paton, 2010; Paton and Rogers 2009; TBC 2008). While the impacts of altered hydrology may be local (*e.g.* within the Coorong), the relationship between locally impacted populations and the state-wide population can result in local declines leading to state-wide declines (Paton & Rogers 2009; Baker-Gabb and Manning, 2011). Consequently, inappropriate water management should be viewed as a major threat to fairy terns in South Australia. The opinion on water level management however will vary depending on the interests of the particular user group. Adjoining landholders for example at Lake George may prefer maximum lake levels to be kept at a relatively low level to reduce degradation of their pastures. Recreational users of the lake (water skiers, sail boarders, fishers, etc.) may prefer a relatively high level to be maintained over the summer months. Those interested in habitat protection for wildlife expect the mudflats of the lower lake to be fully exposed for part of the year, the fringing vegetation of the lake to be protected from inundation and consequent wave damage, and sufficient water levels maintained to preserve the aquatic vertebrate and invertebrate fauna. Striking a balance of these interest is highly complex *e.g.* Murray-Darling Basin Plan.

#### 4.3.4 Predator Control

Islands are generally devoid of land-based predators in their natural state, and waterbirds have therefore evolved in the absence of land-based predators and lack the defence mechanisms required to avoid predation (Igual et al., 2007). The fox was the most frequently recorded introduced predator at

colonies. A single fox can cause significant egg losses within one night (DENR 2011). At three sites, foxes were responsible for abandonment of nesting. At Section Bank, birds attempted a second breeding, which did succeed in rearing at least two chicks to independence.

Gull populations have been steadily increasing due to anthropogenic food sources (Weiser and Powell, 2010), and their expansion may impact on nesting birds (DECC, 2008; Maguire, 2008). Avian predators accounted for much less of the threats identified suggesting avian predators may be viewed as a minor threat to fairy terns in South Australia, although the severities of avian predators were not assessed. In addition, altered hydrology can increase in the local risk of avian predation, where adult birds are forced to spend longer away from nests.

#### 4.3.5 Inundation

The dynamic nature of the preferred nesting habitats for fairy terns presents further natural challenges and threats. The combination of high tides and big seas can be devastating for fairy terns that may nest near the high tide mark. Nesting on offshore islands may provide protection from predators such as foxes, but storms and big swells can be disastrous. The risk of water inundation accounted for 23% of sites visited. Strong winds were equally devastating for fairy terns with windblown sand covering eggs and newly hatched chicks, forcing adults to abandon them.

#### 4.3.4 The Importance of Habitat Suitable for Nesting

Habitat has been shown to be a key factor in establishing new bird colonies (Kildaw et al., 2005). Terns may require active intervention to produce their preferred low-growing vegetation for nesting (Dunlop et, 1991; DECC, 2003; Golder et al., 2008). On West and Bluff Island near Victor Harbor, *Malva* species (mallows) were first detected in the late 1990s and rapidly spread reducing nesting habitat that excluded fairy terns, and the crested tern (*Sternula bergii*), from their former nesting area in the 1970s (Paton 1982). On West Island, recent weed control works have reduced the cover of mallows from 70 to 40%, and improved nesting habitat availability, which has seen crested terns bred once again on the island (S. Iwao, 2012 *pers. comm.*). While ongoing maintenance can remain a challenge, breeding opportunities can improve markedly when known breeding sites are clear of vegetation.

## 5.0 Conclusions

There is evidence for changes in the overall status of fairy terns in South Australia. This species is an episodic breeder at most breeding sites adding a layer of complexity to regular monitoring that is challenged by favourable habitats at remote locations often where human population is low and therefore local capacity to regular monitor, especially breeding events may be difficult.

Based on the outcome of the current assessment, regular monitoring of this species particularly breeding events is requirement to ensure further changes to the state population is detected early. To reduce the problem of a small population size and the associated high probabilities of localized extinctions, the development of a state fairy tern recovery plan with recommendations for the bird's conservation is also warranted as a matter of priority.

## References

- Australian Government Geoscience Australia. Coastline Lengths. Available from: <http://www.ga.gov.au/education/geoscience-basics/dimensions/coastline-lengths.html> Accessed 30 May 2012.
- Baker-Gabb, D., and Manning, C., (2011). Local Action Plan the Coorong fairy tern *Sternula nereis*, South Australia. Final Plan for the Department of Environment and Natural Resources.
- Blakers, M., Davies, S., and Reilly, P.N., (1984) *The Atlas of Australian Birds*. Melbourne University Press, Melbourne.
- Bransbury, J., (1992). Fairy Tern breeding records from southeastern South Australia. *South Australian Ornithologist*. March p.97
- Buick, A.M., and Paton, D.C., (1989) Impacts of off-road vehicles on the nesting of Hooded Plovers *Charadrius rubricollis* in the Coorong region of South Australia. *Emu* 89: 159-172.
- Copley, P., (1996) The Status of Seabirds in South Australia. In: Ross, G.J.B., K. Weaver & J.C. Greig, eds. *The Status of Australia's Seabirds: Proceedings of the National Seabird Workshop, Canberra, 1-2 November 1993*. Page(s) 139-172. Canberra: Biodiversity Group, Environment Australia.
- Dunlop, C., Blokpool, H., and Jarvie, S., (1991 ). Nesting rafts as a management tool for declining common tern (*Sterna hirundo*) colony. *Colonial Waterbirds*, 14: 116-120.
- Golder, W., Allen, D., Cameron, S., and Wilder, A., (2008). Dredged material as a tool for management of tern and skimmer nesting habitat. Corps of Engineers Dredging Operations and Environmental Research (DOER), USA.
- Hill, R., Banford, M., Rounsevell, D., and Vincent, J., (1988). Little terns and fairy terns in Australia. An RAOU Conservation Statement. RAOU report No. 53, Melbourne.
- Hitchcock, B., (1959) A review of least terns in Australian waters. *South Australia Ornithologist*. 22:87-107.
- Igual, J., Forero, M., Gomez, T., and Oro, D., (2007). Can an introduced predator trigger an evolutionary trap in a colonial seabird? *Biological Conservation*. 137: 189-196.
- International Union for Convention for Nature (IUCN) (2011). *Sterna nereis*. In: IUCN 2011. IUCN Red List of Threaten Species. Version 2011.1 Available from: [www.iucnredlist.org](http://www.iucnredlist.org). Accessed 17 June 2011.
- International Union for Convention for Nature (IUCN) (2012). *Red list of threaten species* Available from: [www.iucnredlist.org](http://www.iucnredlist.org). Accessed 31 May 2012.
- Jones, H., and Kress, S., (2012). A review of the worlds active seabirds restoration projects. *The Journal of Wildlife Management*, 76(1): 2-9.
- Kildaw, S., Irons, D., Nysewander, D., and Buck, C., ( 2005). Formation and growth of new seabird colonies: the significance of habitat quality. *Marine Ornithology*, 33: 49-58.
- Maguire, G., (2008) A practical guide to managing beach-nesting birds in Australia. Birds Australia.



- Paton, P., (1982) Biota of the Coorong: A study for the Cardwell Buckingham Committee.
- Paton, D., Gates, J., and Pedler, L., (2002). Birds. In M. Davies, C.R. Twidale, & M.J. Tyler (eds). Natural History of Kangaroo Island. 2nd edition. pp 88-110. Royal Society of South Australia Adelaide.
- Paton, D., (2003). Status of fairy terns in South Australia. Final report to Wildlife Conservation Fund Project 2507. University of Adelaide.
- Paton, D., (2005). Monitoring of biotic systems in the Coorong region 2004-2005. Project report for Earthwatch Australia and for the Department for Environment and Heritage.
- Paton, D., and Rogers, D., (2009). Ecology of breeding fairy terns *Sternula nereis* in the Coorong. . University of Adelaide.
- Paton, D., Rogers, D., Hill, B., Bailey, C., and Ziembicki, M., (2009). Temporal changes to spatially stratified waterbird communities of the Coorong, South Australia: implications for the management of heterogenous wetlands. *Animal Conservation*. 12:408-417.
- Paton, D., (2010). At the End of the River: The Coorong and Lower Lakes. ATF Press.
- Paltridge, A (unpublished research, undated) Status of fairy terns in South Australia. University of Adelaide.
- Reid, N., and Vincent, D.J., (1979). Report on an ornithological survey of South Australian National, Conservation and Recreation Parks and Game Reserves, with comments on the adequacy of bird conservation in South Australia. South Australia Ornithological Association, Adelaide
- Rogers, K., and Ralph, T., (2011). Floodplain Wetland Biota in the Murray-Darling Basin: Water and Habitat Requirements. CSIRO.
- Rogers, D., and Paton, D., (2009). Spatiotemporal variation in the waterbird communities of the Coorong. Water for a Healthy Country Flagship Report.
- Shaughnessy, P., ( 2007) Lilliput Island (small north-east Franklin Islet), Eyre Peninsula, South Australia. *Corella*. 31(3/4): 83-84.
- Shaughnessy, P., Dennis, T., and Armstrong, D., (2008). West Waldegrave Island, Eyre Peninsula, South Australia. *Corella*. 32(1): 20-21.
- State of NSW Department of Environment and Climate Change (DECC) (2003). Little tern (*Sterna albifrons*) Recovery Plan. NSW National Parks and Wildlife Service, State of NSW Department of Environment and Climate Change, Sydney.
- State of NSW Department of Environment and Climate Change (DECC) (2008). Best practical guidelines: Managing threatened beach-nesting shorebirds. State of NSW Department of Environment and Climate Change, Sydney.
- State of SA Department of Environment and Natural Resources (DENR) (2011). Murray Mouth Bird Nesting Habitat Rescue Final Report 2010-2011. Department of Environment and Natural Resources, Adelaide.
- Threatened Species Scientific Committee (TSSC) (2010). Listing advice for *Sternula nereis* (Fairy Tern). DEWHA. Canberra

Threatened Birds Committee (TBC) (2008). Globally Threatened Bird Forums, Birdlife International. Appendix II. Available from: <http://www.birdlifeforums.org> Accessed 17 June 2011.

Weiser, E., and Powell, A., (2010). Does garbage in the diet improve reproductive output of Glaucous Gulls? *Condor*, 112: 530-538.

Wilson, J. R., (2000). *South Australian Wader Surveys, January and February 2000*. Australasian Wader Studies Group and South Australian Ornithological Association.

**APPENDIX A**

Location of breeding sites as recorded during the Census.

<b>Breeding Site</b>	<b>Region</b>	<b>Zone</b>	<b>Easting</b>	<b>Northing</b>
Cheetcham Salt Fields, Price	Yorke Peninsula	53	775804	6200794
Section Bank	Fleurieu Peninsula	54	271548	6151515
Point Maria, Boston Island	Eyre Peninsula	53	583982	6162760
English Island, Sir Joseph Banks	Eyre Peninsula	53	609645	6166470
Island B, Venus Bay CP	West Coast	53	464890	6328794
Eyre Island, Smokey Bay	West Coast	53	386900	6419717
Eyre Island, Smokey Bay	West Coast	53	387957	6419697
Little Eyre Island, Smokey Bay	West Coast	53	383408	6419182
St Peter Island, Nuyts Archipelago CP	West Coast	53	373259	6433259
St Peter Island, Nuyts Archipelago CP	West Coast	53	368844	6425211
Seagull Lake, Sceale Bay CP	West Coast	53	426530	6353332
Lake Hamilton	West Coast	53	525165	6237192
Unnamed island <1km W of Fat Cattle Point	Coorong	54	368290	6012300
Unnamed island <1km SE of Cattle Island	Coorong	54	368800	6013750
Teal Island	Coorong	54	370100	6011000
Ocean Beach	Coorong	54	321286	6059196
Obelisk, Robe	Lower South East	54	271548	6151515
Lake George	Lower South East	54	413186	5853656

Datum WGS84.