

BEACH-NESTING BIRDS WITHIN CORNER INLET

*Monitoring of beach-nesting shorebird and seabird breeding success in
Corner Inlet to assess the health of the Ramsar site*

November 2021 – March 2022

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Boxbank Island (Grainne Maguire).

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Executive Summary

Beach-nesting birds were monitored on four barrier islands during the breeding season (November – March):

- 27 Hooded Plover nesting attempts and 6 suspected nesting attempts by 15 pairs, 2 fledglings from Boxbank Island. Another 3 juveniles observed on Snake Island at the end of the season, but these could be from the broader region as no Snake Island pairs had success in 2021/22.
- 71 Pied Oystercatcher breeding attempts and 6 suspected nesting attempts by 54 pairs, 5 chicks hatched, unknown fates of 3 chicks which potentially fledged. Another 4 juveniles observed on Clonmel (3) and Boxbank (1) Islands.
- 2 large (350 and 400 birds) Crested Tern colonies on Boxbank Island and 1 on Clonmel Island (220 birds). Minimum 5 chicks hatched on Clonmel Island with 2 confirmed fledglings.
- Concurrent Caspian Tern colonies on Boxbank (120 birds) and Clonmel (70 birds) Islands, 11 confirmed fledglings on Boxbank and 2 on Clonmel.
- A small Fairy Tern colony nested on Boxbank Island producing 6 fledglings.

Introduction

Beach-nesting birds (BNB) are a suite of birds including resident shorebirds and migratory seabirds, that are largely dependent on coastal habitats for breeding. Beach-nesting shorebirds are excellent indicators of coastal health, providing coastal managers with insight into the threats present within the coastal environment, and a measure of the effectiveness of investment in threat mitigation (Schlacher et al. 2014). They are therefore an important group of birds for coastal managers to focus their efforts. Six key indicator species were selected to assess the health of the Ramsar site: Hooded Plover (*Thinornis cucullatus*), Australian Pied Oystercatcher (*Haematopus longirostris*), Caspian Tern (*Hydroprogne caspia*), Crested Tern (*Thalasseus bergii*), Little and Fairy Terns (*Sternula* spp.) and to a lesser extent, Red-capped Plover (*Charadrius ruficapillus*).

Study aims

The Corner Inlet barrier islands contain important breeding areas for beach-nesting shorebirds and seabirds. Under Ramsar site obligations, the critical processes and services (CPS's) identified at the time of listing must be intermittently assessed against Limits of Acceptable Change (LAC's). The below Limits of Acceptable Change monitoring requirements have been outlined for Waterbird (beach-nesting shorebird and seabird) Breeding:

Limit of Acceptable Change (LAC)	Spatial / temporal scale of measurements
Nesting of the following species recorded in at least 50% of years: Australian Fairy Tern Australian Pied Oystercatcher Caspian Tern Crested Tern Hooded Plover	Recommended baseline monitoring program should comprise a minimum of two annual sampling periods separated by at least one year (and within a five-year period).

The specific aims of this study were to inform the above LAC monitoring regime as well as to document the breeding success of beach-nesting species in this unique island system by:

1. Surveying the three most important barrier islands in Corner Inlet (Snake, Clonmel, Boxbank) across the breeding season to map the distribution of breeding beach-nesting shorebirds and seabirds. Dream Island would be surveyed in the peak months of breeding to search for any evidence of tern nesting, for which this island is important within the landscape;
2. To identify consistent locations of breeding birds to estimate the number of territories on each island in a given breeding season, as well as map tern nesting sites;
3. To follow the progress of any nests or chick sightings to document fates of nesting attempts and overall rates of success for each of the focal species of beach-nesting birds as an indicator of health of the Ramsar site;
4. Where suitable, set remote cameras on active nests to assist in identifying nest fates, and;
5. Carry out threat assessments at each site where nesting or chicks are observed.

Please refer to Adams and Maguire (2020) for detailed study aims.

Methods

Three of the islands within Corner Inlet were repeatedly visited across the entire breeding season – Snake Island, Clonmel Island, and Boxbank Island (Table 1). Dream Island was surveyed less frequently during the same survey period, to search for any evidence of nesting terns (Table 1).

Figure 1 shows the areas surveyed during each of the survey periods. We aimed to carry out surveys approximately four weeks apart to capture unique nesting attempts and allow for nest or chick fate to be determined based on the breeding cycles of the birds. Unfortunately, due to the Covid-19 pandemic, no surveying could occur during the September-October months due to lockdowns and travel restrictions. Survey periods were sometimes smaller or larger than the targeted four weeks due to weather/tidal conditions, and one trip was cancelled due to the boat driver contracting Covid-19 the day before scheduled surveys. We made additional targeted trips to the tern colonies outside of the regular trip scheduling so as to continue to track colony progress, and ensure we did not miss critical dates of hatching, fledging or failure.

Standardised survey methods were utilised and provided to each team prior to the survey period. All participants were experienced and have conducted these surveys before. Each island team had a leader with substantial expertise in monitoring and field techniques. All observations of the target species were entered into Birddata on the smart phone in the field using the Beach-nesting Birds program. All nests or signs of breeding were accompanied by additional data collection methods (see Adams and Maguire 2020). For a sub-set of nests, remote cameras were installed to follow nest fates. Fewer cameras were deployed this season due to the greater risk of tidal inundation associated with La Nina. Detailed survey methodology can be found in Adams and Maguire (2020).

Beach surveys, nest monitoring and remote camera monitoring of nests was carried out under Department of Environment, Land, Water and Planning Wildlife Act and National Parks Act permit numbers 10009068 (Oystercatcher and tern species) and 10009536 (Hooded Plovers).

Table 1. The dates and team composition for each complete survey period and for the targeted tern surveys.

Survey #	Date	Island	Observers
Targeted 1	6/10/2021	Boxbank	Stephen Johnson
Survey 1	2/11/2021	Boxbank	Daniel Lees
	2/11/2021	Clonmel	Kasun Ekanayake, Grainne Maguire, Joris Driessen
	18/11/2021	Snake	Grainne Maguire, Meg Cullen
Targeted 2	4/11/2021	Boxbank	Jonathon Stevenson, David Farrar
Targeted 3	18/11/2021	Clonmel	Jonathon Stevenson
Survey 2	24/11/2021	Boxbank	Grainne Maguire, Cara Schultz
	24/11/2021	Clonmel	Kasun Ekanayake, Chris Purnell
	24/11/2021	Dream	Mark Lethlean, Stacey Lethlean
	14/12/2021	Snake	Grainne Maguire, Glenn Ehmke
Survey 3	14/12/2021	Boxbank	Kasun Ekanayake, Bridget Nicholson
	23/12/2021	Clonmel	Kasun Ekanayake, Stuart Inchley
	23/12/2021	Dream	Mark Lethlean, Tanya Cowell
	10/01/2021	Snake	Grainne Maguire, Phil Barrett, Mark Lethlean
Targeted 4	23/12/2021	Boxbank	Jonathon Stevenson
Targeted 5	10/01/2022	Boxbank	Jonathon Stevenson
Survey 4	16/01/2022	Boxbank	Sonia Sanchez, Janine Thomas
	16/01/2022	Clonmel	Mark Lethlean, Stuart Inchley
	16/01/2022	Dream	Glenn Ehmke
	4/02/2022	Snake	Grainne Maguire, Jon Fallaw
Targeted 6	27/01/2022	Boxbank	Jonathon Stevenson, Stephen Johnson
Survey 5	4/02/2022	Boxbank	Glenn Ehmke, Amy Adams
	4/02/2022	Clonmel	Kasun Ekanayake, Chris Willocks
	4/02/2022	Dream	Peter Hudson, Bridget Nicholson
	19/02/2022	Snake	Grainne Maguire, Phil Barrett
Survey 6	22/02/2022	Boxbank	Kasun Ekanayake, Finn Saurine
	22/02/2022	Clonmel	Mark Lethlean, Stacey Lethlean
	29/03/2022	Snake	Kasun Ekanayake, Stuart Inchley
Survey 7	12/03/2022	Boxbank	Kasun Ekanayake, Jonathon Stevenson, Rosemary Swart
Targeted 7	29/03/2022	Boxbank	Kasun Ekanayake, Stuart Inchley, Jonathon Stevenson



Snake Island (Mark Lethlean)



Figure 1. Extent of survey coverage for the complete surveys on A) Snake Island (6 visits); B) Clonmel Island (6 visits); C) Boxbank Island (7 visits); and Dream Island (4 visits).

Results

Beach-nesting bird sightings and distribution

Figures 2-5 show the distribution of beach-nesting shorebirds and Figures 6-9 show the distribution of seabirds for each island across all surveys.

Table 2 presents the average number of adults for each of the beach-nesting shorebird and seabird species sighted. Table 3 presents the total number of adults and juveniles for each species. Of the three main islands regularly monitored over the six complete survey periods:

- Hooded Plovers were most common on Snake Island (average of 14 adults, range 10 - 22)
- Hooded Plovers on Clonmel Island ranged from 5 – 20 (average 13 adults)
- Hooded Plovers on Boxbank ranged from 2 – 6 (average 3 adults)
- Pied Oystercatcher numbers were largest on Clonmel Island (average 88 adults), with numbers varying throughout the breeding season
- The highest numbers of Red-capped Plovers were recorded on Clonmel Island (average 29 adults)
- Sooty Oystercatcher numbers were the highest on Clonmel Island reaching a peak of 28 in January
- Caspian and Crested Terns had large numbers on both Boxbank and Clonmel Islands with numbers decreasing from January
- Numbers of Fairy and Little Terns peaked in January and February with Fairy Tern fledglings occurring in March (at the end of this species' breeding season)

Table 2. Average number of adult beach-nesting bird species sighted for the three main barrier islands visited for the six trips where all islands were completely surveyed.

Species	Adults
Hooded Plover	30.2
Red-capped Plover	36
Pied Oystercatcher	151.7
Sooty Oystercatcher	12
Caspian Tern	108
Crested Tern	255
Fairy Tern	19.5
Little Tern	33.8
Fairy/Little Tern*	3.2

*Couldn't be identified to species

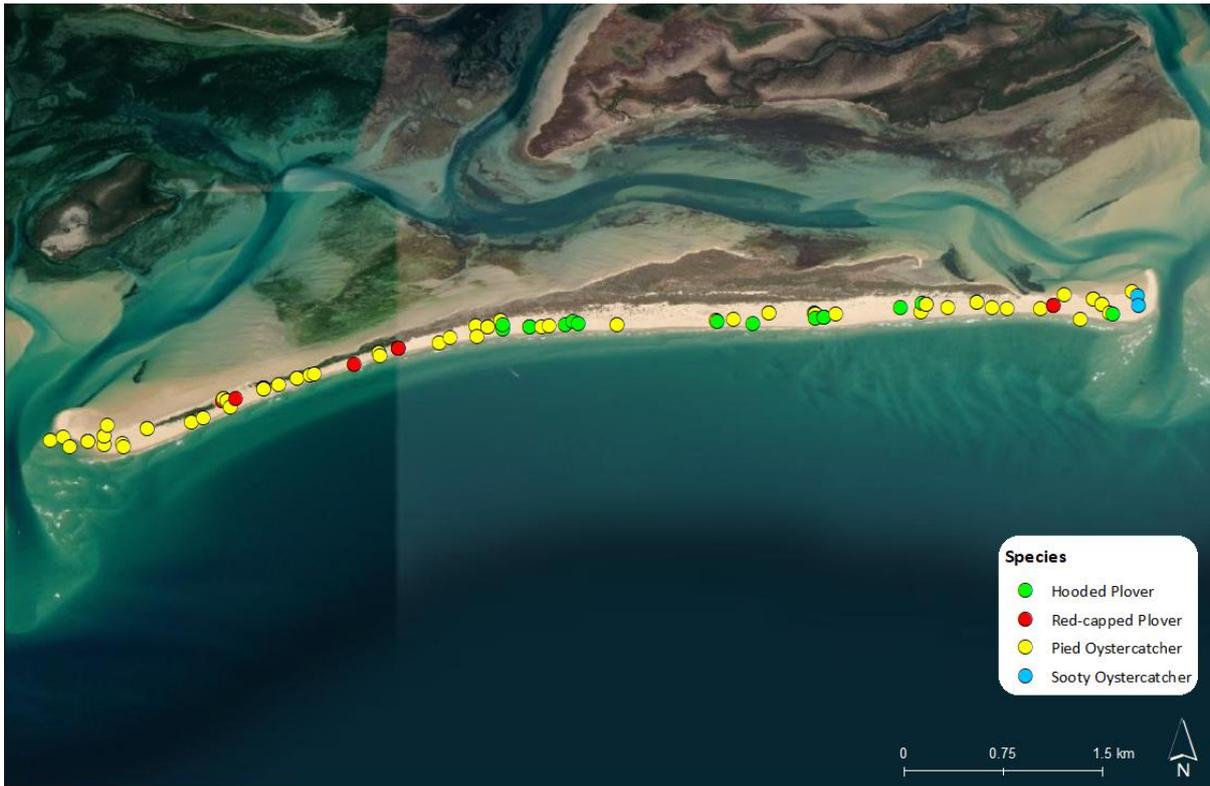


Figure 2. Distribution of beach-nesting shorebirds on Boxbank Island over the seven complete surveys and the six targeted surveys.



Figure 3. Distribution of beach-nesting shorebirds on Clonmel Island over the six complete surveys and the one targeted survey.

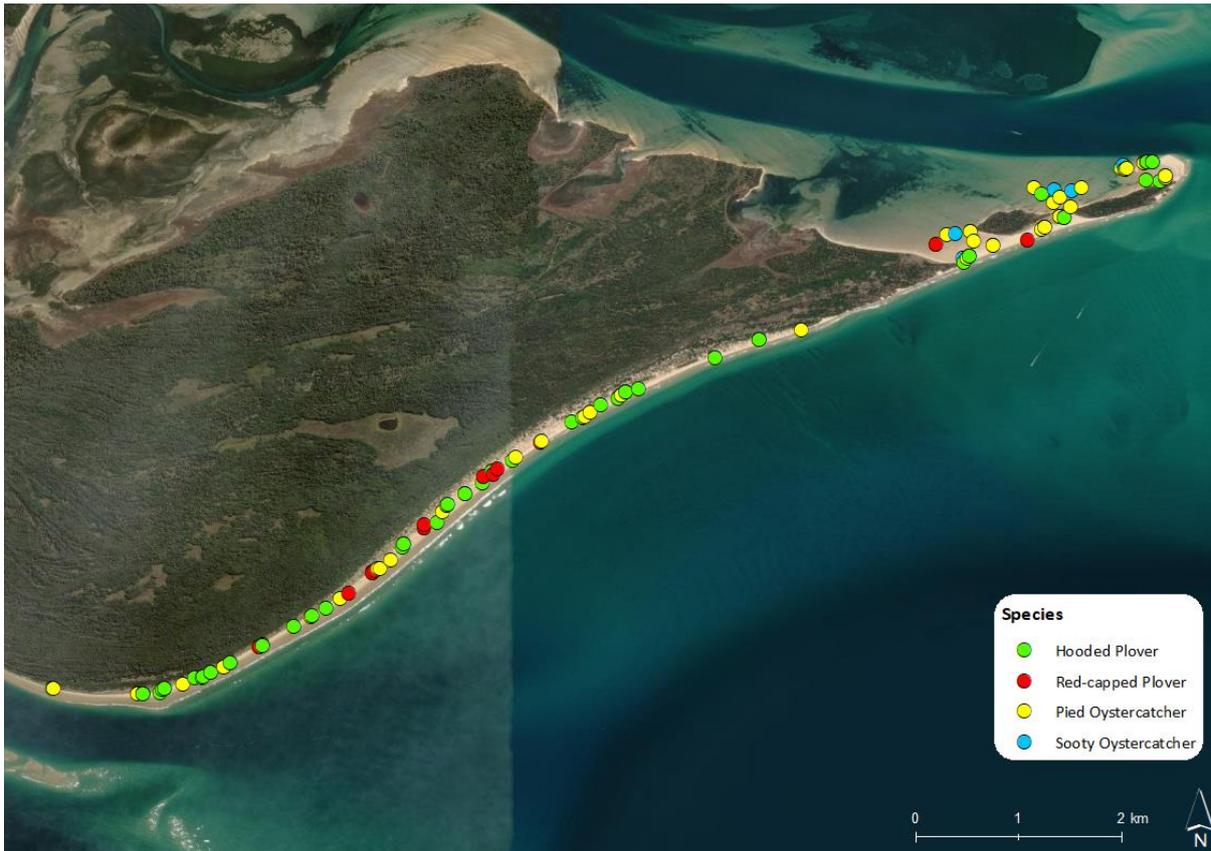


Figure 4. Distribution of beach-nesting shorebirds on Snake Island over the six complete surveys.



Figure 5. Distribution of beach-nesting shorebirds on Dream Island over the four complete surveys.

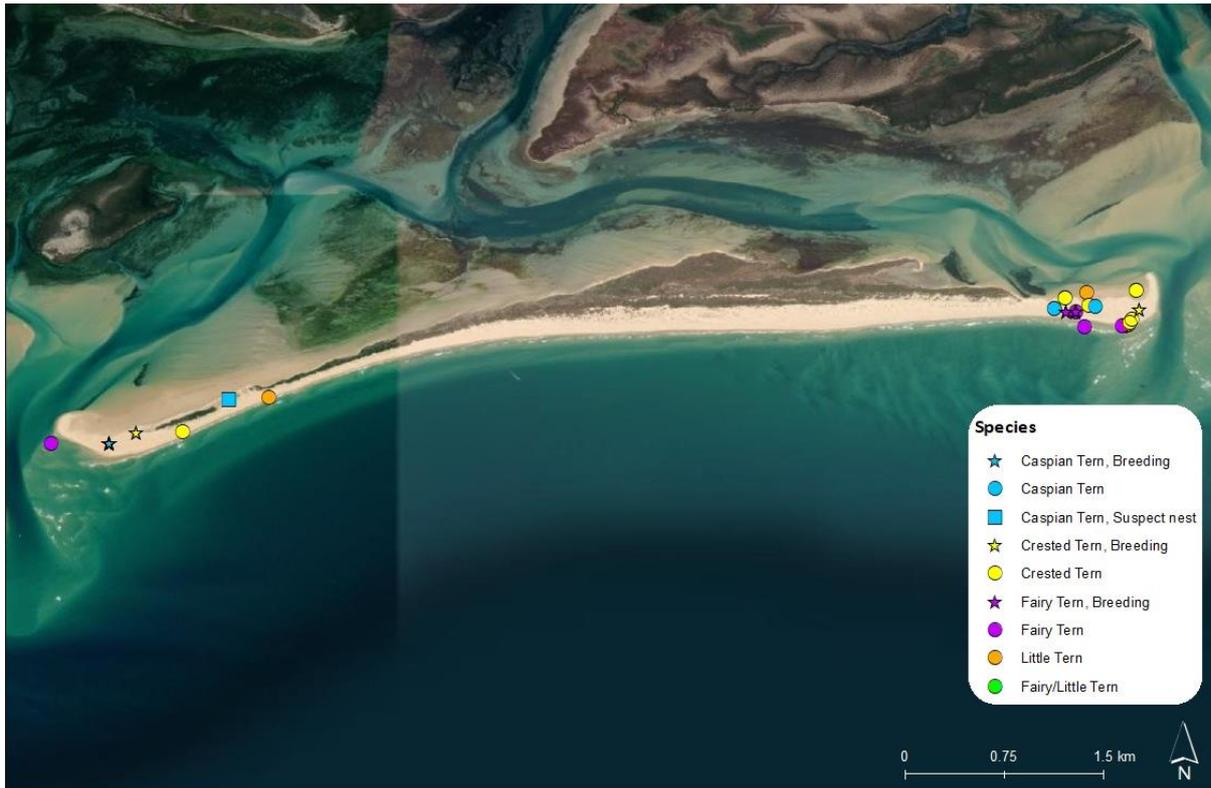


Figure 6: Distribution and breeding activity of seabirds on Boxbank Island over the seven complete surveys and the six targeted surveys.

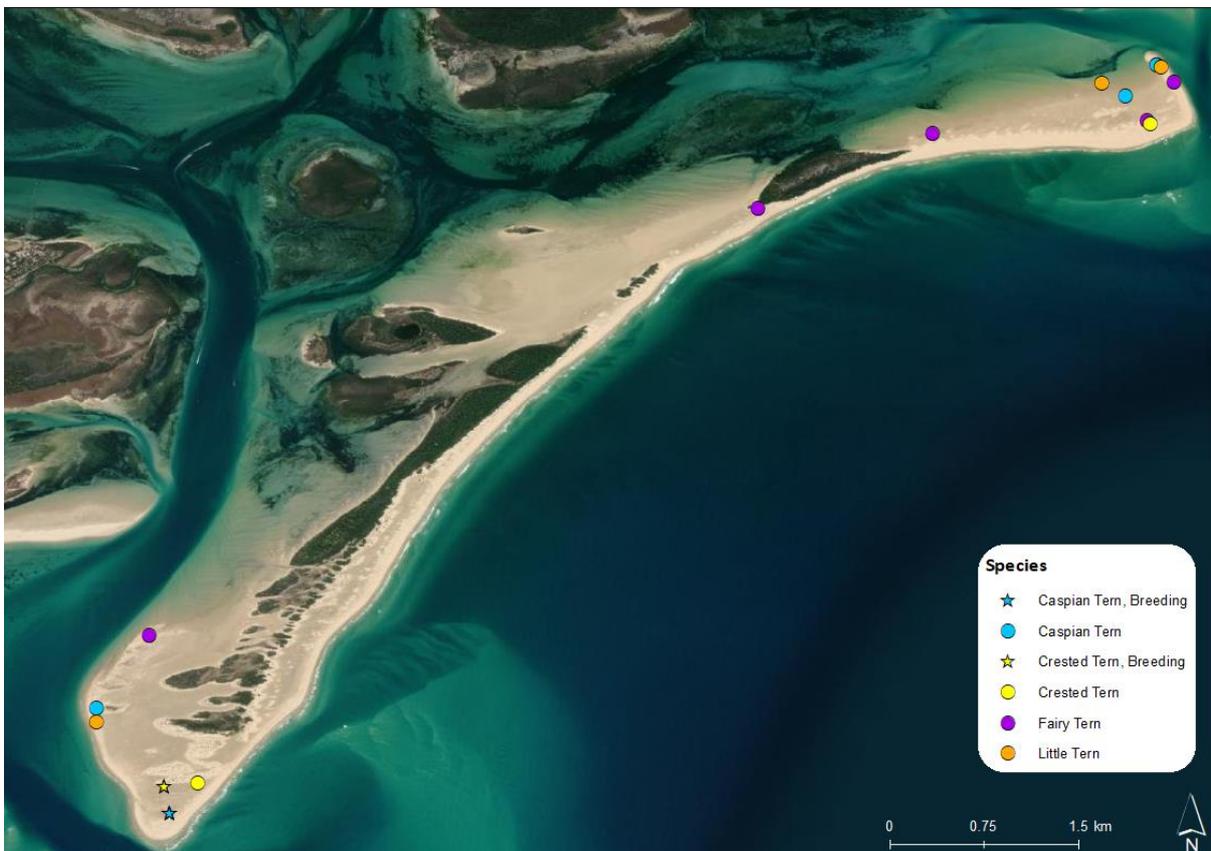


Figure 7: Distribution and breeding activity of seabirds on Clonmel Island over the six complete surveys and the one targeted survey.

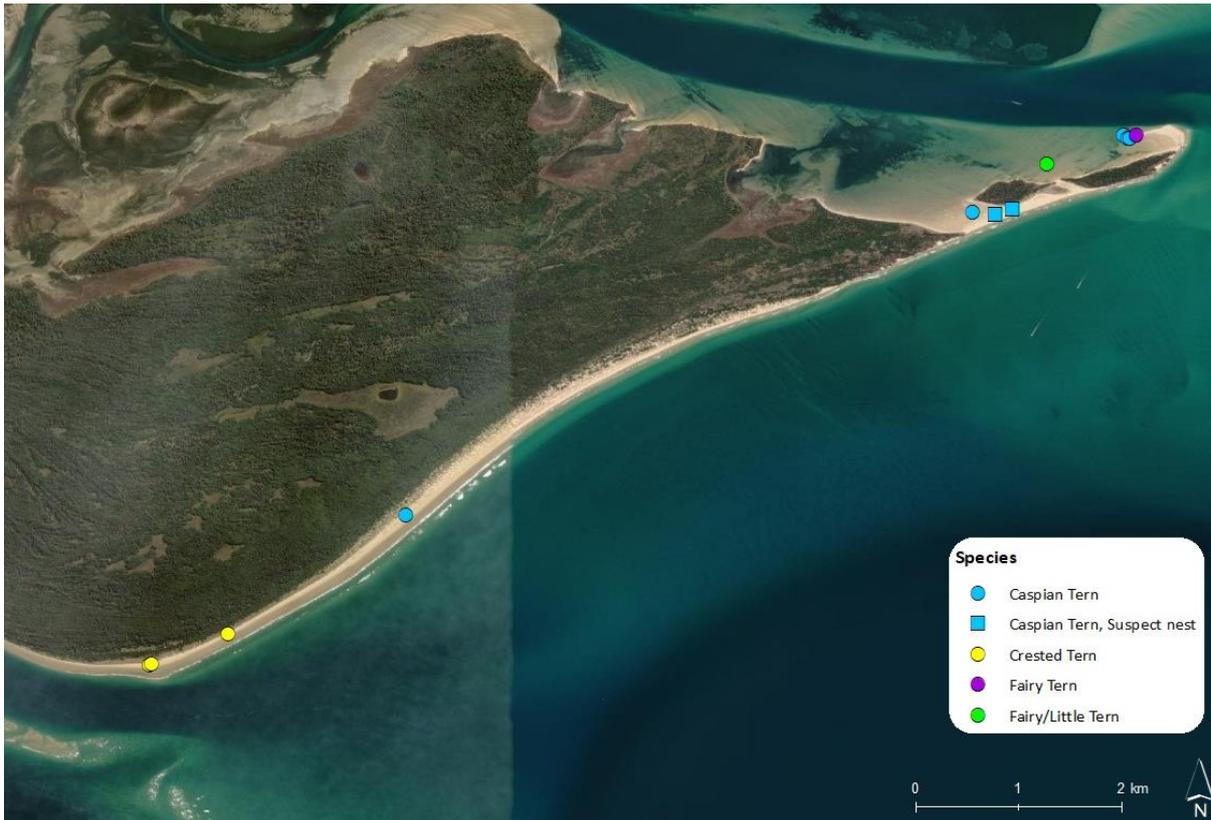
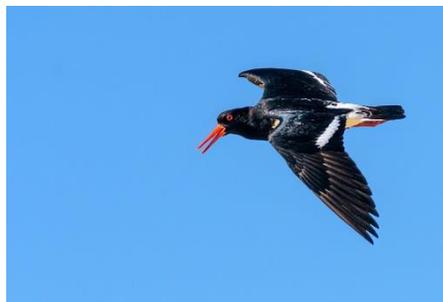


Figure 8. Distribution and breeding activity of seabirds on Snake Island over the six complete surveys.



Figure 9. Distribution and breeding activity of seabirds on Dream Island over the four complete surveys.

Species	Survey period	BOXBANK		CLONMEL		DREAM		SNAKE		TOTAL	
		Adults	Juvs	Adults	Juvs	Adults	Juvs	Adults	Juvs	Adults	Juvs
Fairy Tern	Trip 1 - November	0	0	0	0	-	-	0	0	0	0
Fairy Tern	Trip 2 - November (December Snake only)	0	0	2	0	0	0	1	0	3	0
Fairy Tern	Trip 3 - December (January Snake only)	16	0	3	0	12	1	0	0	31	1
Fairy Tern	Trip 4 - January (February Snake only)	17	0	4	0	0	0	0	0	21	0
Fairy Tern	Trip 5 - February	15	0	43	0	0	0	0	0	58	0
Fairy Tern	Trip 6 - February (March Snake only)	16	0	0	0	-	-	0	0	16	0
Fairy Tern	Trip 7 - March	15	6	-	-	-	-	-	-	15	6
Fairy Tern	Trip 8 - March	0	0	-	-	-	-	-	-	0	0
Little Tern	Trip 1 - November	0	0	0	0	-	-	0	0	0	0
Little Tern	Trip 2 - November (December Snake only)	12	0	0	0	0	0	0	0	12	0
Little Tern	Trip 3 - December (January Snake only)	0	0	0	0	200	0	0	0	200	0
Little Tern	Trip 4 - January (February Snake only)	2	0	13	0	0	0	0	0	15	0
Little Tern	Trip 5 - February	0	0	0	0	30	0	0	0	30	0
Little Tern	Trip 6 - February (March Snake only)	150	0	26	0	-	-	0	0	176	0
Little Tern	Trip 7 - March	0	0	-	-	-	-	-	-	0	0
Fairy/Little Tern	Trip 1 - November	17	0	0	0	-	-	0	0	17	0
Fairy/Little Tern	Trip 4 - January (February Snake only)	0	0	0	0	0	0	2	0	2	0



L-R: Hooded Plover, Pied Oystercatcher, Red-capped Plover, Fairy Tern (photos: Mark Lethlean)

Hooded Plover: Evidence of breeding

Figures 10-13 represent the breeding territories on each of the four barrier islands monitored, derived from repeated observations of pairs over the 2021-22 breeding season. Table 4 summarises the Hooded Plover breeding activity observed across all islands during the 2021-22 breeding season. Three chicks were observed from one pair on Boxbank with two fledging. A further three juveniles were observed on Snake Island in February but weren't associated with a known nest and due to the timing of this visit, at the end of the breeding season, are likely to have moved in from anywhere in the broader region.

- Boxbank had 2 territories with a total of 2 nesting attempts and 2 fledglings
- Clonmel had 4 territories with a total of 7 nesting attempts with no known hatching and no fledging success
- Snake had 8 territories with a total of 16 nesting attempts and 6 suspected nesting attempts with no known hatching and no fledging success
- Dream had 1 territory with a total of 2 nesting attempts

Three Hooded Plover nests had remote cameras set. Nest fates were able to be determined from two cameras:

- Raven predation (Dream and Snake Island)



Figure 10. Hooded Plover breeding territories on Boxbank Island. Each colour represents a cluster of breeding attempts for a predicted territorial pair. Grey diamonds represent non-breeding observations.

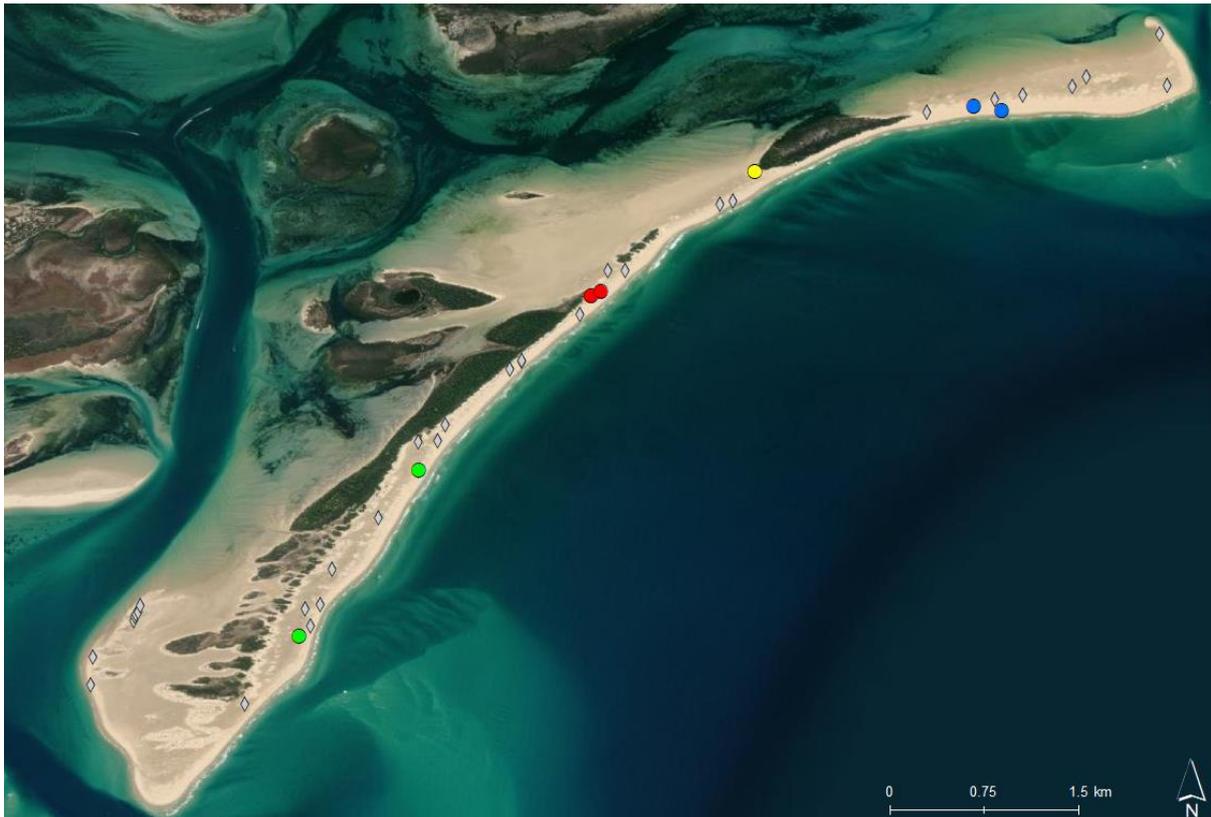


Figure 11. Hooded Plover breeding territories on Clonmel Island. Each colour represents a cluster of breeding attempts for a predicted territorial pair. Grey diamonds represent non-breeding observations.



Figure 12. Hooded Plover breeding territories on Snake Island. Each colour represents a cluster of breeding attempts for a predicted territorial pair with squares indicating suspected nesting. Grey diamonds represent non-breeding observations.



Figure 13. Hooded Plover breeding territories on Dream Island. Each colour represents a cluster of breeding attempts for a predicted territorial pair. Grey diamonds represent non-breeding observations.



Clockwise: A Hooded Plover nest on Snake Island; Hooded Plover 'PB' on Snake Island; Hooded Plovers on Snake Island; A 3-egg Hooded Plover nest, Dream Island; (photos: Mark Lethlean).

Table 4: Summary of Hooded Plover breeding activity and nest fates per territorial pair across all four islands.

Island	Pair	Nesting attempts	# eggs	# chicks	# fledged	Nest Fate
Boxbank	B1	1	U	3	2	Fledged
Boxbank	B2	1	0	0	0	Failed: unknown cause
Clonmel	C1	2	0	0	0	Failed: tidal inundation; unknown cause
Clonmel	C2	2	2	0	0	Failed: unknown cause
Clonmel	C3	1	0	0	0	Failed: unknown cause
Clonmel	C4	2	2	0	0	Failed: likely tidal
Snake	S1	2 + 3 SN	3	0	0	Failed: unknown cause
Snake	S2	2 + 2 SN	3	0	0	Failed: raven predation
Snake	S3	1	0	0	0	Failed: unknown cause
Snake	S4	3	3	0	0	Failed: unknown cause
Snake	S5	2	2	0	0	Failed: unknown cause
Snake	S6	2	2	0	0	Failed: unknown cause
Snake	S7	3	4	0	0	Failed: unknown cause
Snake	S8	1 + SN	0	0	0	Failed: unknown cause
Dream	D1	2	4	0	0	Failed: Raven predation

SN = Suspect nest; U = Unknown

Pied Oystercatcher: Evidence of breeding

Figures 14-17 represent the breeding territories on each of the four barrier islands, derived from repeated observations of pairs over the 2021-22 breeding season. Table 5 summarises the Pied Oystercatcher breeding activity observed across all islands during the 2021-22 breeding season:

- Boxbank had 14 territories with a total of 17 nesting attempts and one suspected nest
- Clonmel had 25 territories with a total of 36 nesting attempts and one suspected nest
- Snake had 12 territories with a total of 15 nesting attempts and 4 suspected nests
- Dream had 3 territories with a total of 3 nesting attempts

Chicks were observed for five pairs with another pair having suspected chicks. There were four instances where it is unknown if the chicks fledged (2 on Boxbank and 2 on Snake) and three juveniles observed on Clonmel and one on Boxbank in February without a clear association to a nesting pair.

- Boxbank: 3 pairs with 1 chick, 2 unknown if fledged (due to timing between surveys)
- Clonmel: 1 pair with 1 chick
- Snake: 1 pair with 1 chick (unknown if fledged due to timing between surveys), 1 pair with suspected chicks

Five Pied Oystercatcher nests had remote cameras set. Nest fates were able to be confirmed from two cameras with a probable fate narrowed for one other:

- White-bellied Sea-eagle predation (Clonmel Island)
- Swamp Harrier predation (Boxbank Island)
- Suspect predation or nest abandonment after discovery by Swamp Harrier (Clonmel Island)

Another nest camera showed the nesting area being inundated. It is assumed the egg was displaced but continued to be incubated as a chick appears at a later date. The fate of the chick is unknown but likely failed.



Figure 14. Pied Oystercatcher breeding territories on Boxbank Island. Each colour represents a cluster of breeding attempts for a predicted territorial pair with squares indicating suspected nesting. Grey diamonds represent non-breeding observations.



Figure 15. Pied Oystercatcher breeding territories on Clonmel Island. Each colour represents a cluster of breeding attempts for a predicted territorial pair with squares indicating suspected nesting. Grey diamonds represent non-breeding observations.



Figure 16. Pied Oystercatcher breeding territories on Snake Island. Each colour represents a cluster of breeding attempts for a predicted territorial pair with squares indicating suspected nesting. Grey diamonds represent non-breeding observations.



Figure 17. Pied Oystercatcher breeding territories on Dream Island. Each colour represents a cluster of breeding attempts for a predicted territorial pair. Grey diamonds represent non-breeding observations.



Clockwise: A Pied Oystercatcher nest, Boxbank Island (Grainne Maguire); A Pied Oystercatcher nest, Snake Island; Pied Oystercatchers, Clonmel Island (photos: Mark Lethlean).

Table 5: Summary of Pied Oystercatcher breeding activity and nest fates per territorial pair across all four islands.

Island	Pair	Nesting attempts	# eggs	# chicks	# fledged	Nest Fate
Boxbank	B1	2	2	0	0	Failed: unknown cause
Boxbank	B2	1	U	1	U	Fate unknown
Boxbank	B3	2	3	0	0	Failed: Swamp Harrier predation; unknown cause
Boxbank	B4	2	1	0	0	Failed: unknown cause
Boxbank	B5	1	0	0	0	Failed: unknown cause
Boxbank	B6	1	0	0	0	Failed: unknown cause
Boxbank	B7	2	1	0	0	Failed: likely tidal inundation; unknown cause
Boxbank	B8	1	1	0	0	Failed: unknown cause
Boxbank	B9	1	1	1	0	Failed: unknown cause
Boxbank	B10	1	0	0	0	Failed: unknown cause
Boxbank	B11	1	1	1	U	Fate unknown
Boxbank	B12	1	2	0	0	Failed: unknown cause
Boxbank	B13	SN	0	0	0	Suspect scrape: no nest confirmed
Boxbank	B14	1	U	0	0	Failed: unknown cause
Clonmel	C1	1	2	0	0	Failed: unknown cause
Clonmel	C2	1	1	0	0	Failed: unknown cause
Clonmel	C3	1	1	0	0	Failed: unknown cause
Clonmel	C4	1	0	0	0	Failed: unknown cause
Clonmel	C5	1	2	0	0	Failed: unknown cause
Clonmel	C6	2	2	0	0	Failed: likely tidal inundation; unknown cause
Clonmel	C7	1	1	0	0	Failed: likely tidal inundation
Clonmel	C8	1	0	0	0	Failed: likely tidal inundation
Clonmel	C9	1	2	0	0	Failed: unknown cause
Clonmel	C10	1	0	0	0	Failed: unknown cause
Clonmel	C11	3	5	0	0	Failed: White-bellied Sea-eagle predation; unknown cause (x2)
Clonmel	C12	2	3	0	0	Failed: likely tidal inundation; unknown cause
Clonmel	C13	2	3	1	0	Failed: Swamp Harrier discovery of nest - uncertain whether predated or abandoned
Clonmel	C14	1	2	0	0	Failed: unknown cause
Clonmel	C15	2	3	0	0	Failed: unknown cause
Clonmel	C16	2	0	0	0	Failed: unknown cause
Clonmel	C17	3	2	0	0	Failed: unknown cause
Clonmel	C18	1	0	0	0	Failed: unknown cause

Island	Pair	Nesting attempts	# eggs	# chicks	# fledged	Nest Fate
Clonmel	C19	2	2	0	0	Failed: unknown cause
Clonmel	C20	1	2	0	0	Failed: unknown cause
Clonmel	C21	2	2	0	0	Failed: unknown cause
Clonmel	C22	1	0	0	0	Failed: unknown cause
Clonmel	C23	2	0	0	0	Failed: likely tidal inundation; unknown cause
Clonmel	C24	SN	0	0	0	Suspect scrape: no nest confirmed
Clonmel	C25	1	2	0	0	Failed: likely tidal inundation
Snake	S1	2	0	0	0	Failed: unknown cause
Snake	S2	2	0	0	0	Failed: unknown cause
Snake	S3	2	1	0	0	Failed: unknown cause
Snake	S4	1	0	0	0	Failed: unknown cause
Snake	S5	2	0	0	0	Failed: unknown cause
Snake	S6	2 + SN	0	0	0	Failed: tidal inundation; unknown causes
Snake	S7	2	4	0	0	Failed: likely tidal inundation; unknown cause
Snake	S8	1	U	1	U	Unknown fate
Snake	S9	1	0	0	0	Failed: unknown cause
Snake	S10	SN	0	0	0	Suspect scrape: no nest confirmed
Snake	S11	SN	U	U	U	Suspect scrape and chicks, not confirmed
Snake	S12	SN	0	0	0	Suspect scrape: no nest confirmed
Dream	D1	1	1	0	0	Failed: tidal inundation
Dream	D2	1	0	0	0	Failed: unknown cause
Dream	D3	1	0	0	0	Failed: unknown cause

SN = Suspect nest; U = Unknown

Red-capped Plover: Evidence of breeding

Evidence of Red-capped Plover breeding was detected on all four islands with three juveniles observed during the 2021-22 breeding season on Clonmel:

- Boxbank: 4 nesting attempts (3 eggs)
- Clonmel: 3 nesting attempts (2 eggs), 2 suspected nesting attempts, 3 juveniles observed
- Snake: 1 nesting attempt, 9 suspected nesting attempts, 1 suspected pair with chicks
- Dream: 1 nesting attempt (2 chicks), 2 suspected nesting attempts

Time was not invested in monitoring Red-capped Plovers intensively due to time constraints in locating nests of these, the most cryptic, of the beach-nesting species, and because they were not the primary focus of the project.

Terns: Evidence of breeding

Breeding activity was observed in three of the four monitored tern species (Caspian, Crested and Fairy), on Boxbank, Clonmel and Snake Islands (Table 6; Figures 6-9). Two large Crested Tern colonies (400 and 350 birds respectively) were present on Boxbank Island from November to December and a large Crested Tern colony (220 birds) was present on Clonmel from November to January. Fledglings were only observed from the Clonmel Island colony which partially failed due to tidal inundation with the remaining chicks moving locations in January prior to fledging. The Caspian Tern colonies on Boxbank (120 birds, colony present October to March) and Clonmel (70 birds, colony present November to February) both produced fledglings. All known Fairy Tern chicks fledged on Boxbank Island in March. This represents a significant population recruitment event for this Critically Endangered species in Victoria, particularly as the majority of breeding sites in Victoria in 2021/22 were unsuccessful.

Boxbank Island:

- 1 Caspian Tern nesting colony (36 known eggs, 30 chicks, 11 fledglings)
- 2 Crested Tern nesting attempts (104 known eggs)
- 1 Fairy Tern nesting colony (11 known eggs, 6 chicks, 6 fledglings)

Clonmel Island:

- 1 Caspian Tern nesting colony (59 known eggs, 10 chicks, 4 fledglings)
- 1 Crested Tern nesting colony (4 known eggs, 5 chicks, 2 fledglings)

Snake Island:

- 1 Caspian Tern suspected nesting attempt



Clockwise: A Caspian Tern colony – nests with eggs, Clonmel Island (Mark Lethlean); A Fairy Tern chick, Boxbank Island (Finn Saurine); A Caspian Tern colony on nests, Clonmel Island (Mark Lethlean); A Crested Tern on a nest, Clonmel Island (Mark Lethlean).

Table 6. Summary of tern breeding activity and nest fates across all four surveyed islands. Minimum numbers are provided as exact counts are not attempted to minimise disturbance levels to nesting tern colonies.

Island	Species	Trip	# adults	# nests	# eggs	# chicks	# fledged	Nest fate
Boxbank	Caspian	1-7; Targeted: 1, 3-4, 6-7	120	33	36	30	11	Partial failure and movement of colony prior to trip 3. Partial success – fledglings.
Boxbank	Crested	1; Targeted: 2	400	40	N/C	0	0	Failed: unknown cause
Boxbank	Crested	3; Targeted 3	350	300	104	N/C	N/C	Failed: signs of predation, abandoned
Boxbank	Fairy	4-7	22	7	11	6	6	Partial success at main colony – all known chicks fledged. Single nest ~50 m away from main colony failed prior trip 6.
Clonmel	Caspian	1-6; Targeted: 6	70	38	59	10	4	Partial failure prior to trip 4 (tidal inundation). Partial success – fledglings.
Clonmel	Crested	2-5	220	22	4	5	2	Partial failure: tidal inundation prior to trip 4, remaining chicks moved location. Partial success – fledglings.
Snake	Caspian	1-2	2	SN	0	0	0	Suspect scrape: no nest confirmed

N/C = not checked; SN = suspected nest



A Crested Tern colony on Clonmel Island (Mark Lethlean)

Remote camera monitoring of nesting attempts

Ten Faunatech Snap remote cameras were deployed on various nests across the four barrier islands to monitor nest fates (Table 7):

- Boxbank: 4 cameras on 2 Pied Oystercatcher nests, 1 Caspian Tern colony and 1 Fairy Tern colony
- Clonmel: 3 cameras on 3 Pied Oystercatcher nests
- Snake: 2 cameras on Hooded Plover nests (1 was a Fox camera but had a scrape in view)
- Dream: 1 camera on 1 Hooded Plover nest

Nest fates were able to be determined from 4 cameras, with 1 additional fate narrowed to one of two causes:

- Raven predation of two Hooded Plover nests (Dream and Snake Island)
- Swamp Harrier predation of a Pied Oystercatcher nest (Boxbank Island)
- White-bellied Sea-eagle predation of a Pied Oystercatcher nest (Clonmel Island)
- Pied Oystercatcher chick hatches (Boxbank Island) – unknown chick fate (likely failed)
- Swamp Harrier lands near a Pied Oystercatcher nest (Clonmel Island). Adults do not return. Unknown if this was predation or abandonment due to the Swamp Harrier discovery.

One camera fell over and was buried under sand (Boxbank Fairy Tern colony) and another had battery failure (Snake fox camera with Hooded Plover nest in view).



Selection of remote camera images. Clockwise: Tidal inundation of a Pied Oystercatcher nest (Boxbank Island); White-bellied Sea-eagle predation of a Pied Oystercatcher nest (Clonmel Island); Caspian Tern colony (Boxbank Island); Pied Oystercatcher chick with parent (Boxbank Island).

Table 7. Summary of the remote cameras set to monitor the nest fates of beach-nesting birds over the breeding season on the four barrier islands.

Island	Species	Date		# days operational	# images	# trigger events							Nest fate	Fate date	Notes
		Deployed	Retrieved			Raven	Gull	Magpie	Fox	Deer	People	Other			
Boxbank	CaT	2/11/21	14/12/21	2	19,308	0	0	0	0	0	0		Undetermined via camera, 11 fledged (monitoring result)	29/03/2022	SD card full upon retrieval
Snake	HP	18/11/21	14/12/21	15	1,503	0	0	0	1	6	0		Failed: Unknown cause	Prior to 14/12/2021	Batteries failed. Was a fox camera with HP scrape in view.
Dream	HP	24/11/21	23/12/21	29	3,501	13	0	0	0	0	0		Failed: Raven predation	24/11/2021	Camera fell onto side on 28/11/21
Snake	HP	18/11/21	14/12/21	27	142	3	0	0	0	5	0		Failed: Raven predation	18/11/2021	
Clonmel	PO	2/11/21	24/11/21	22	3,922	2	0	0	0	4	0	Raptor: 1	Failed: Swamp Harrier discovery of nest - uncertain whether predated or abandoned	7/11/2021	
Clonmel	PO	24/11/21	23/12/21	3	17,370	0	0	0	0	0	0		Failed: Unknown cause	Prior to 23/12/2021	
Clonmel	PO	23/12/21	16/01/22	25	12,444	1	10	0	0	0	0	Raptor: 5	Failed: White-bellied Sea-eagle predation	30/12/2021	
Boxbank	PO	2/11/21	14/12/21	42	6,821	6	4	0	0	0	0		Chick hatches after nest washed out and egg displaced (unknown cause of failure)	Prior to 14/12/21	Batteries/SD card swapped on 24/11/21. Image dates incorrect.
Boxbank	PO	14/12/21	16/01/22	5	20,535	0	6	0	0	0	0	Raptor: 2	Failed: Swamp Harrier predation	18/12/2021	
Boxbank	FT	4/02/22	12/03/22	37	15,129	0	0	0	0	0	0		Undetermined via camera, 6 fledged (monitoring result)	29/03/2022	Camera fell over and buried in sand after image 666 (day 2).

CaT = Caspian Tern; HP = Hooded Plover; PO = Pied Oystercatcher; FT = Fairy Tern

Threat summary

Threat assessments were made for 84% of the observations of beach-nesting birds. Table 8 presents the threats encountered while monitoring beach-nesting birds on the four islands. The most common threats observed on each island were:

- Boxbank: Silver Gulls (13% of observations)
- Clonmel: People (6% of observations)
- Snake: Foxes (49% of observations)
- Dream: Foxes (49% of observations)

Table 8. The number of threat assessments recorded (in brackets) on each island and the proportion of visits where each threat type was present (prints and observations combined).

Threat type	Boxbank (n=113)	Clonmel (n=213)	Snake (n=84)	Dream (n=37)
People	7.96%	5.63%	7.14%	0.00%
Dogs	4.42%	0.00%	0.00%	2.70%
Vehicles	0.00%	0.00%	0.00%	0.00%
Foxes	0.00%	0.00%	48.81%	48.65%
Horses	0.00%	0.00%	0.00%	0.00%
Deer	0.00%	0.47%	27.38%	0.00%
Magpies	0.00%	0.00%	4.76%	0.00%
Ravens	1.77%	4.23%	19.05%	2.70%
Pacific Gulls	7.08%	0.94%	5.95%	2.70%
Silver Gulls	13.27%	2.82%	2.38%	0.00%
Rats	0.00%	0.47%	0.00%	0.00%
Raptors	1.77%	0.00%	0.00%	0.00%

Other notable threats included:

- A Swamp Harrier was directly observed taking a Caspian Tern chick from the colony on Boxbank Island in December
- Tidal inundation appeared to be a significant contributor to nest failure
- The majority of evidence of people on Clonmel occurred in November while on Snake and Boxbank, this occurred between January and March
- Balloon litter was once again observed on islands

Large flocks of avian predators were noted on two of the four barrier islands:

- 100 (Nov) and 50+ (Jan) Silver Gulls observed on Boxbank Island
- Flocks of 90 and 30 ravens observed on Clonmel Island (Feb)
- Large Silver Gull nesting colonies observed within 15 m and 30 m of nesting Pied Oystercatchers on Clonmel Island (Nov)

- A large Silver Gull colony nested adjacent to the Caspian and Crested Tern colonies on Boxbank Island (Dec)



Selection of observed threats. Clockwise: Raven with Hooded Plover egg (Snake Island); Deer walking through Pied Oystercatcher nesting area (Clonmel Island); Swamp Harrier at a Pied Oystercatcher nest (Boxbank Island); Balloon litter (Snake Island, Jon Fallaw); Silver Gulls on Clonmel Island (Mark Lethlean).

The frequency of detection of particular weed species was also assessed for each island as part of the threat assessment (Table 9). Marram Grass (*Ammophila Arenaria*) was the most commonly detected weed species on all four islands.

Table 9. The number of threat assessments recorded (in brackets) on each island and the proportion of visits where each weed species was present.

Species	Boxbank (n=113)	Clonmel (n=213)	Snake (n=84)	Dream (n=37)
Marram Grass	50.44%	30.52%	69.05%	24.32%
Sea Spurge	8.85%	21.60%	13.10%	10.81%
Sea Wheat Grass	14.16%	8.45%	0.00%	0.00%
Sea Rocket	0.00%	2.82%	0.00%	0.00%
Beach Daisy	0.00%	0.00%	0.00%	0.00%
Pyp Grass	0.00%	0.00%	0.00%	0.00%

Recommendations

All monitored species that are outlined in the Ecological Character Description for Corner Inlet bred during the 2021/22 season which meets the current LAC requirement. However, the breeding attempts do not signal breeding success and thus health of the Ramsar site. Total breeding failure would lead to long term population trajectory declines and could signal the area is acting as a sink. This is why it is critical to assess the breeding success of key indicator species within the Corner Island system.

In the 2021/22 breeding season, two Hooded Plover fledglings were produced from 15 actively nesting pairs. This represents a 0.13 fledglings/pair breeding success rate, which is extremely low compared to elsewhere across Victoria and South Australia, and far below targets of between 0.4-0.5 for maintaining population viability. Hatching success seems to be very low. The greatest number of breeding pairs occurs on Snake Island where foxes and ravens were frequently detected, and ravens identified as cause of nest failure in one case where the nest fate was known. Boxbank was the only island with Hooded Plover success and it had the lowest frequency of detection of ravens and no foxes, despite having the highest number of Silver Gulls. Of additional concern is that compared to 2020/21, there were 6 fewer Hooded Plover breeding pairs present. This starts to trigger concern about potential loss of breeding pairs or habitat.

Foxes are the threat that could be mitigated with greater investment, while impacts of tidal inundation could be explored through improvements to habitat (e.g. targeted weed removal), and potential impacts of the large flocks of ravens, previously identified as a major threat, could be explored via trials of non-lethal and lethal control techniques.

Pied Oystercatchers had similar success in 2021/22 to the year prior, with at least five confirmed fledglings and potentially three more could have fledged. Given the high number of pairs breeding on the barrier islands (54 pairs this season) and their repeated nesting efforts, this is incredibly low as a breeding success rate (0.15 fledglings/pair) and indicative of being below the rate required to sustain populations over time.

There were large Caspian and Crested Tern breeding colonies on Clonmel Island in 2021/22 and they used both Boxbank and Clonmel Islands with some success. Partial colony losses due to tidal inundation were recorded, and it was likely some predator loss of nests within colonies occurred, as Silver Gulls were observed sitting at the edge of colonies and harassing the incubating birds, looking for opportunities to predate nests. There was also a direct observation of a Swamp Harrier taking a Caspian Tern chick. Boxbank had successful breeding of three species of tern, and of most significance was the presence and success of a Fairy Tern colony late in the season. Fairy Terns are diminishing from the Victorian coast, using fewer breeding locations and declining in number. They have had poor breeding success from the majority of Victorian sites where they attempt to breed, particularly in smaller colony sizes. At all known breeding locations, investment is made at the breeding site to reduce threats to increase success of the colony. People were present on Boxbank Island during the summer and there was a near miss where it was only due to the presence of our survey team that walkers were asked to avoid moving through this colony of critically endangered birds. If in future this species attempts to nest in Corner Inlet, all effort should be made to protect the nesting site from human disturbance.

This is the third breeding season for which we now have confidence in saying resident shorebirds using the islands are investing in high breeding effort for low to no breeding output. The islands are a breeding sink for Hooded Plovers and Pied Oystercatchers, and while several species of tern had success this season, these rates of success are low relative to the number of pairs using the islands.

The following recommendations are made to assist in mitigating key threats to beach-nesting birds detected on the Corner Inlet barrier islands to return these islands as a potential site for successful breeding:

- Repeated monitoring of breeding success of key indicator species on at least Clonmel, Snake and Boxbank Islands over at least two more breeding seasons to review trends and evidence of the area becoming a population sink.
- Fox control is carried out on Snake and Dream Islands, which includes trialling alternative types of control in addition to baiting (to control trap-shy, older foxes). This may include shooting plus exploring the use of pest injector devices or Fox Watch devices. This is a critical action for Snake Island which contains the highest number of Hooded Plovers within the inlet system.
- Ensure Clonmel and Boxbank Islands continue to remain fox free.
- Explore non-lethal methods of controlling raven and Silver Gull predation.
- Regular liaison at the start of each season with key stakeholder groups, such as Parks Victoria and the Cattleman's Association, using the islands to ensure best practice beach use is understood. This could be an opportunity to establish the best means of communicating locations of active breeding sites so that visiting stakeholders are aware of areas to be cautious in.
- Improved awareness among locals and boaties of the value of the barrier islands to beach-nesting birds, including ways to avoid doing harm. Some suggested ideas for outreach include presence at local events; targeted events at boat ramps during peak launching periods; exploring opportunities through fisheries apps or boat ramp signage to provide warnings about

nesting birds on islands. This includes warning people that dogs are not permitted on the barrier islands.

- If Fairy Terns attempt to breed on the islands again during summer, ensuring all effort is made to warn boaters and beach users of the presence of this critically endangered species. Some on-ground signage may be required (placed at a safe distance from the colony) to ensure nests aren't accidentally crushed by walkers.
- Protection of important native dune vegetation from foraging deer, e.g. Hairy Spinifex dunes on Snake Island.
- Targeted control of weeds on some breeding sites where habitat is limited or reduced due to tidal impacts.
- Review of habitat rehabilitation options for overcoming future climate-change related impacts of sea level rise and tidal inundation of tern colonies. Artificially raising substrate heights through addition of sand or dredge spoil has been used successfully in areas such as the Gippsland Lakes. Proactive future planning will be critical to ensuring the islands remain viable tern nesting sites.



Sooty Oystercatchers, Clonmel Island (Mark Lethlean)

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Red-capped Plovers on Dream Island (Mark Lethlean).