MANAGEMENT STRATEGY FOR THE AUSTRALIAN FAIRY TERN

Lower West Coast Management Unit

Prepared by J.N. Dunlop for the WA Fairy Tern Conservation Network, October 2021.

Photo: Dorina Chapman

FREMANTLE PORTS

Conservation Council of Western Australia ccwa Look forward

Western Australian FAIRY TERN NETWORK

Contents

Acknowledgements

The Lower West Coast Conservation Strategy for the Australian Fairy Tern was prepared by the participants in the WA Fairy Tern Conservation Network supported by a grant from Fremantle Ports.

The Network has brought together voluntary researchers, observers and local community coordinators, staff from the region's DBCA offices, the Department of Defence, the Ports, the Peel-Harvey Catchment Council, BirdLife WA and two relevant Local Governments in a coordinated approach to protecting the Australian Fairy Tern in this critically important region.

The Network is grateful to all those participants who have been prepared to commit their time and resources to the conservation of this threatened species.

RED CLOUD DESIGN

1 Distribution and Conservation Status of the Australian Fairy Tern *Sternula nereis nereis*

Photo: Cherilyn Corker

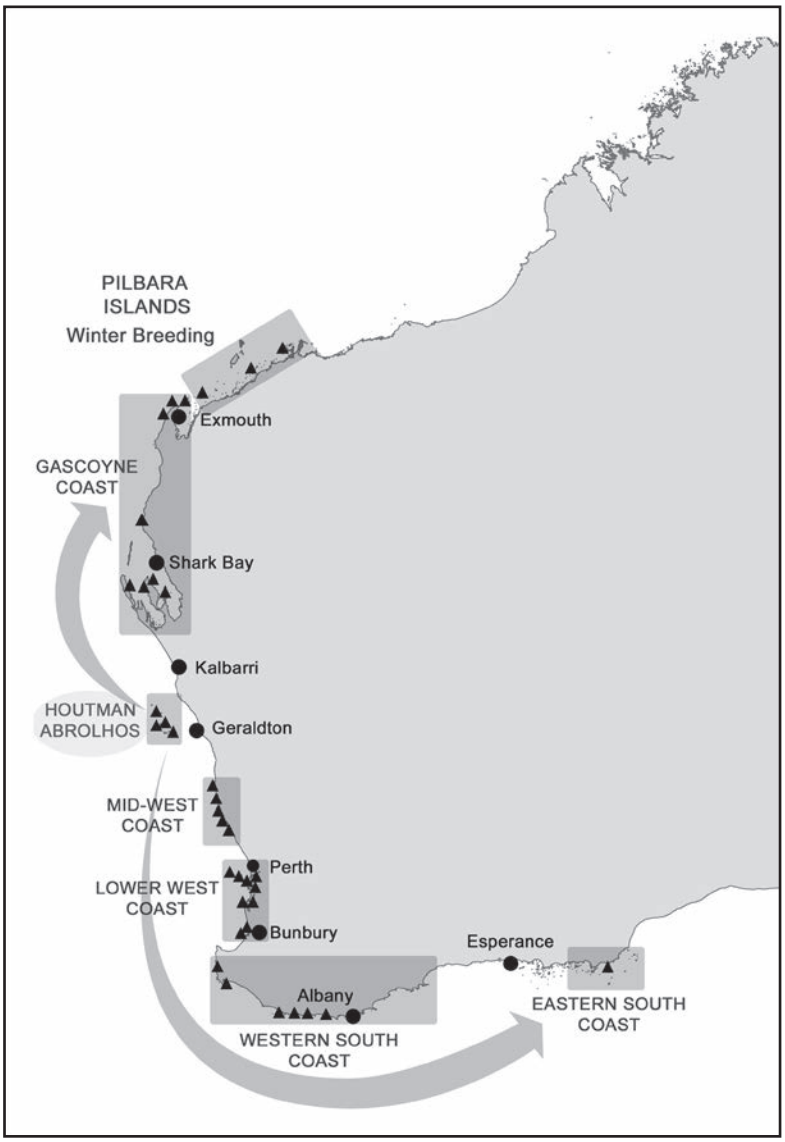
The Australian Fairy Tern, *Sternula nereis nereis*, occurs as a coastal breeding species in Western Australia, South Australia, Victoria and Tasmania. The Australian Fairy Tern population was estimated in 1996 at a minimum of 2021-2551 pairs (Burbidge, Johnstone and Fuller, 1996). However, the current estimate of the Western Australian metapopulation, based on more recent records, is around 3000 breeding pairs or 7000 individuals including juvenile and immature birds (Dunlop and Greenwell 2020, WA Fairy Tern Conservation Network).

This WA metapopulation may include two winter-breeding (June to September), and probably sedentary populations, one in Shark Bay, and the other on the islands off Pilbara coast. The main WA population is migratory, breeding in spring and summer (September to March) at colonies between North West Cape and Point Malcolm in Israelite Bay, located 170 km east of Esperance on the eastern south coast.

The Australian Fairy Tern was listed as threatened (Vulnerable) under the Commonwealth *Environmental Protection and Biodiversity Conservation Act (1999)* in 2011 and that status is also reflected in the state legislation (i.e. *Biodiversity Conservation Act [2016]*) (Department of the Environment, 2011, 2018). A draft National Recovery Plan has been prepared but is currently inactive (Commonwealth of Australia 2019).

2 Movements and Population Structure in the Western Australian Meta-population

A large proportion of the Western Australian migratory population moves north or south from the wintering grounds at the Houtman Abrolhos Islands to establish breeding colonies along the western and southern coasts of Western Australia (Dunlop and Greenwell 2020). However, a number of birds remain within the Houtman Abrolhos Archipelago and have been recorded breeding on a number of islands (Surman and Nicholson 2009). A survey across 126 islands in December 2006 found 547 pairs of Fairy Terns breeding on 13 islands Surman and Nichols 2009).



Within Western Australia, colonies are clustered into seven 'neighbourhoods' where there is significant interchange of both adults and recruits between nesting locations that could incorporate at least 300 km of coastline. A lower level of interchange has been recorded between adjacent neighbourhoods (e.g. between the lower and mid-west coasts). These neighbourhoods provide the relevant management units to provide for the management of the Australian Fairy Tern in Western Australia (Dunlop and Greenwell 2020).

Figure 1: *Structure of the Western Australian Meta-population of the Australian Fairy Tern*

2 Movements and Population Structure in the Western Australian Meta-population

continued

Migratory spring-breeding Fairy Terns nest around south-west WA and along the north-west coast from Shark Bay north to the tip of North-West Cape. However, in this north-west region there a smaller, winter (June to August) breeding groups that appear to be relatively sedentary, or undertake local seasonal movements. The situation in Shark Bay/ Quobba region remains unclear. On the Pilbara coast between Exmouth Gulf and the Dampier Archipelago there appear to be around 400 pairs of Fairy Terns breeding in the winter months (Dunlop and Greenwell 2020) and aggregating around Barrow Island in their non-breeding period.

Photo: Claire Greenwell

3 Demographic parameters

The longevity record for the Australian Fairy Tern is held by a male that was banded as a chick on Tern Island Safety Bay in January 1997 (24 y, 0 m, 13 d at last sighting). This bird has been observed in breeding colonies at the Mandurah Marina and Pyramids Beach, Dawesville between 2016 and 2021, demonstrating the movements of an experienced individual within the Lower South West neighbourhood.

At Rous Head, North Fremantle, less than half of the adults (n = 31, 24%) nesting at a successful colony were recorded there again following seasons. Colour-marked terns from this colony were observed at almost all the other colonies in the neighbourhood in years following banding at Rous (Dunlop and Greenwell 2020). One might expect that an experienced adult would have nested at most locations within the neighbourhood during its lifetime. Individual colonies are not representative of the status of the population at any level.

Fairy Terns in the Lower South West neighbourhood recruit to the breeding population as early as two years of age, i.e. as soon as they reach adult plumage and sexual maturity (Dunlop and Greenwell 2020). Although, the average age at first breeding probably occurs at age three, similar to other small *Sternula* terns (Gochfeld and Burger 1992). In many tern species there are non-breeding pools of sexually mature birds awaiting entry into the colonies. This occurs particularly in growing populations and the early age of first breeding in our population may indicate that the numbers are below carrying capacity (Morris and Chardine 1995; Dunlop 2009) and possibly in decline.

Photo: Cherilyn Corker

4 Management Units and the Importance of the Lower West Coast Region

The Lower West Coast management unit covers the region between the Perth-metropolitan area and Bunbury (Figure 2), where there is a high degree of interchange of both breeding adults and recruits between colony sites.

Since the 2016 season, the region has consistently supported a breeding population (clutches initiated prior to 31 December) of around 700 pairs. This suggests it remains the most important region for maintaining the migratory population with the possible exception of the Abrolhos Islands. It is also the region with the most concentrated human settlement and threats associated with development and human activity.

Since 2016, breeding colonies have established in about 20 different localities most of which are aggregated near estuary mouths or in the sheltered waters of Cockburn Sound. The largest number of colonies (n = 16) were recorded in 2020/21, of which 14 failed to produce any progeny. Predation by invasive species and tidal inundation were the main drivers of colony failure.

There appears to be important pre- and post-breeding aggregations (including night roosts) at Parkin Point on Garden Island and on the islands inside Peel Inlet (Dunlop and Greenwell 2020). Rottnest Island functions as a late season staging area for the neighbourhood (Dunlop and Greenwell 2020).

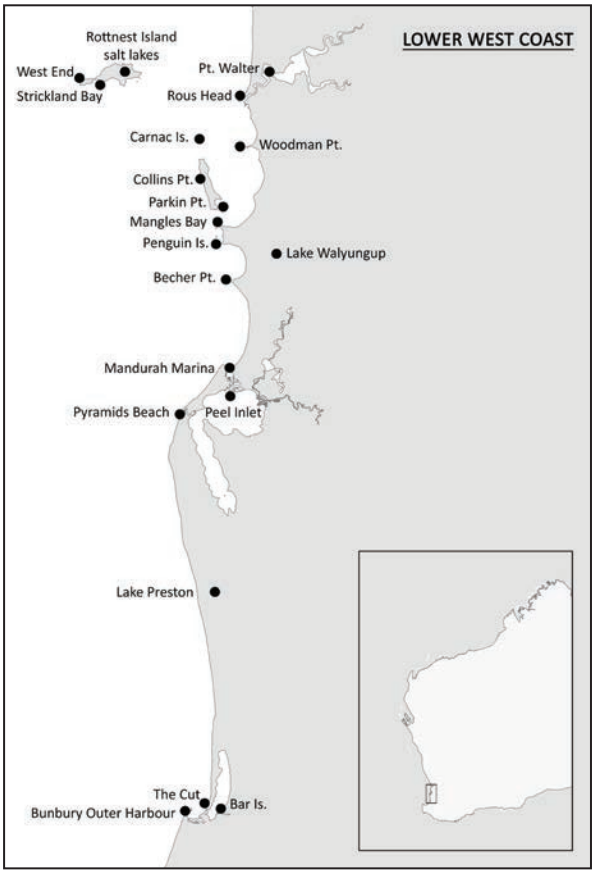


Figure 2: *The colony sites within the Lower West Coast management unit since 2012.*

Photo: Nic Dunlop

5 Biological Conservation Objectives

Photo: Nic Dunlop

Maintain a Lower West Coast breeding population of circa 700 pairs.

This will be measured as the 5-year rolling average number of nesting attempts (+ or minus SD) recorded prior to 1 January each season across the neighbourhood (management unit).

6 Land Managers

The movements of Fairy Terns between roosts and breeding colonies within the Lower West Coast neighbourhood (Dunlop and Greenwell 2020) encompass a range of land tenures and management jurisdictions. These are known to include Department of Biodiversity, Conservation and Attractions (DBCA), Department of Defence, Fremantle Ports, Southern Ports (Bunbury), Rottnest Island Authority, and local government agencies, i.e. cities of Melville, Cockburn, Rockingham, Mandurah and Bunbury. Effective management of the Lower West Coast region will require the cooperation of all these land / sea managers.

7 Threats

The shoreline and beach-nesting behaviour of Fairy Terns, and the occupation of mainland sites, makes these birds vulnerable to a wide-range of threats. The frequency at which different threats were recorded on our database from colonies in the region since 2018 is summarized below (Figure 3).

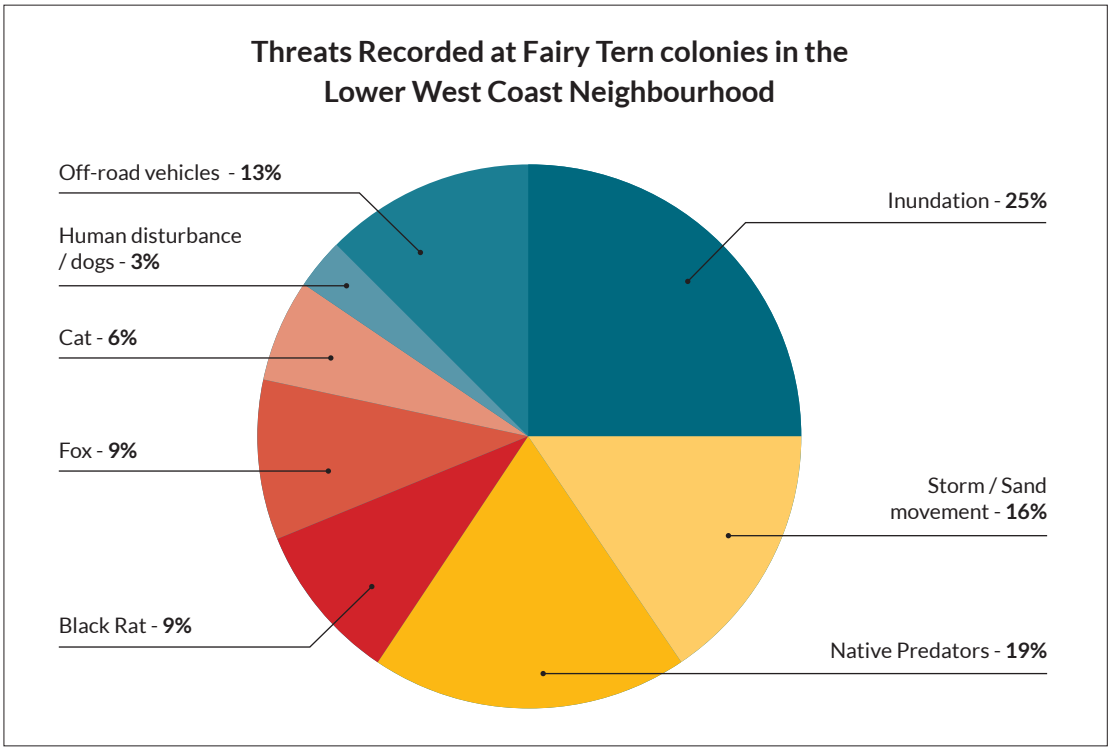


Figure 3. *Threats recorded at active colonies in the Lower West Coast Region*

Photo: Nic Dunlop

These threats presented after the colonies had established and eggs/chicks produced. Colonies frequently fail to establish when there is disturbance during the pre-settlement period so the effect of human disturbance, dogs and off-road vehicles will be underestimated in this analysis. Similarly, habitat loss or change (e.g. vegetation encroachment) precedes colony formation and thus impacts are not able to be measured. The overall threats recorded in the Lower South West management unit are summarized on the following page.

7 Threats continued

a. Storm events and rising sea/estuary levels

Many colonies on beaches were washed out during storms and high tides. No doubt this has always occurred from time to time but is now exacerbated by rising sea-levels and by engineered interventions such as the Dawesville Cut in the Peel Inlet. The problem is probably greatest in *La Nina* years where sea level and temperature are higher (e.g. in 2020). There appear to be no natural sites in the Peel that are likely, under current conditions, to remain above high- water levels for the duration of an entire nesting cycle.

b. Changes in habitat structure

Fairy Terns prefer open shoreline habitats with little vegetation cover. The dynamic nature of beaches usually prevents over-growth. However, perched (e.g. Rous Head) or accreting sites (e.g. Point Walter island) may be colonized by vegetation over time, making the habitat unsuitable for colony establishment. This is a threat that can be readily managed.

c. Changes in prey abundance or availability

The presence of prey aggregations within foraging range (about 2km, Paton and Rogers 2009) is probably a critical factor in colony site-selection and subsequent breeding success. Many fish species are taken as prey but Blue Sprat *Spratelloides robustus* are the mainstay around marine colonies, while Hardyheads *Atherinidae* spp., and to a lesser extent, Blue Sprat, around estuarine colonies (Greenwell *et al.* 2021a).

Seasonal factors such as the nutrient flows from the estuaries, sea-wrack accumulation and inter-annual variations in fish recruitment will affect the abundance and distribution of the preferred prey. Human induced threat factors might include changes in shorelines caused by coastal engineering, commercial bait-fish fisheries and recreational boating intensity.

d. Human intrusion and disturbance (including beach and water-based activities)

Human activity on shorelines and beaches is intense adjacent to densely populated areas such as the greater Perth metropolitan region. Little secure space is now available in mainland areas that were historically used for nesting, such as the mouth of the Swan River, the Peel inlet and Leschenault Inlet. Human intrusion is also an issue on the offshore islands. Uncontrolled dogs being exercised by their owners can have a particularly adverse impact on nesting birds as they excite a strong anti-predator response.

Human intrusion is probably one of the major causes of colony desertion prior to or shortly after laying. Established colonies are often protected by temporary fencing and signage which, if effective, will reduce disturbance impacts.

e. Off-road vehicles

The beaches at some historical breeding locations such as the tip of the Leschenault Peninsula (The Cut) near Bunbury and Becher Point in Rockingham have become indefensible due unauthorized, off-road activity. The problem is more significant outside the greater metropolitan region where most beaches are still accessible to off-road vehicles.

f. Aircraft and drones

Incidents involving helicopters landing in or immediately adjacent to Fairy Tern colonies have been observed (e.g.on the seawall at the Mandurah Marina). These intrusions have apparently been unauthorized activities. Drones are an emerging threat, which have been observed to cause nesting birds to leave their nests, including at Point Walter and Mandurah. To overcome this issue, local councils would be required to develop drone policies and install signage at relevant locations.

g. Plastics and other pollutants

Currently little is known about the impacts of contaminants on the health of Fairy Terns. Phthalates (the plasticizers used in fabricated materials) were detected in the uropygial (preen-gland) secretions of 48 % of the Fairy Terns sampled on the Abrolhos Islands. Three species of pelagic terns / noddies at the Abrolhos all had phthalates detected at higher frequencies (>75 %) indicating that pelagic species foraging in pelagic food-chains were more exposed. The impact of phthalate residues on birds have yet to be investigated.

In March 2021 moulted tail feathers (primary 9) were collected at a night roost site used by migrating Fairy Terns on Rat Island. The 33 feathers were analysed for a range of metals.

Figure 4. *Concentrations of 7 metals in the moulted (primary 9, N=33) feathers from Australian Fairy Terns deposited at a migratory night-roost sites at the Houtman Abrolhos.*

Metal	Mean Concentration (g/mg)	Standard Deviation
Al	215.23	126.58
Cu	8.71	1.11
Fe	87.38	27.49
Se	2.82	0.65
Cd	0.05	0.059
Pb	0.43	0.1
Hg	0.41	0.43

None of the elements analysed were at levels above expected background or known to be harmful in birds. At this stage there is no evidence metals contamination is a threat.

f. Introduced predators (Red foxes, cats and Black Rats)

Foxes, cats and/or Black Rats have been observed at most mainland sites adjacent to both residential and industrial areas (Greenwell et al. 2019a; Greenwell et al. 2021b). Cats include domestic, stray and feral individuals. Black Rats have higher concentrations at sites where there are rock walls, particularly along the Garden Island Causeway, Pyramids Beach (Dawesville) and at Point Walter.

The use of baits, firearms and traps is highly regulated in built-up areas presenting very few options to remove introduced predators in a timely fashion. The regulatory framework for the various predator control options is summarised in Appendix 1.

g. Native predators (Ravens, raptors, gulls and Ruddy Turnstones)

The density and diversity of native predators tends to be higher around island colonies and/or in areas where scavengers are attracted to the site by human activity (particularly food scraps). Native predators are protected and therefore difficult to get approval for management interventions that target them.

8 Colony Management

Different colonies are exposed to different threats. At some remote sites (e.g. on the Abrolhos Islands) intervention may not be necessary. Unfortunately, if the reproductive output in the Lower South West management unit is to be maintained, almost all colonies will require some protective measures.

a. Natural sites

The timing and location of most colonies are determined by a chain of factors that influence settlement including the presence of prey aggregations, suitable nesting habitat, groups of individuals in breeding condition and the activities of people and predators (see Greenwell et al. 2021c).

Colony management in this context involves rapid response to the ongoing threats at the sites selected by the terns. This commonly involves the deployment of temporary fencing and signage to prevent human intrusion into the colony area. Predator control measures should be taken at mainland sites where nesting has been occurring repeatedly and is relatively predictable, during the pre-breeding season. Details of a range of management techniques can be found in the Fairy Tern Conservation Guide (Dunlop 2018).

Management responses to protecting colonies at natural sites are often implemented after the threat has occurred in the Lower West Coast region, by which stage colonies may be abandoned. Some locations selected by the terns are not defendable under any circumstances. The lack of remaining secure natural sites in the region now requires the establishment of engineered or 'managed' sites, where the location of tern colonies becomes more predictable and threats are mitigated by pre-emptive action.

8 Colony Management continued

b. Managed sites

Photo: Nic Dunlop

At managed sites, nesting habitat is selected or modified close to marine / estuaries areas in historically important breeding areas or where nuptial Fairy Terns are roosting and/or foraging. At present, our operating and planned managed sites are on land constructed from dredge spoil or artificial islands (mimics the substrates of natural sites). The target areas are located above the high-water level to avoid inundation. Coarse substrates have been selected to avoid sand movement and nest burial. Shell material from the screens at Cockburn Cement have been (or will be) spread over the ground surface, enhancing the attractiveness of the site to nesting birds and provide a cryptic background for eggs and chicks (Greenwell et al. 2021c).

Managed sites are provided with signage and permanent fencing to reduce human incursions. As these sites are likely to be repeatedly used, the signage can also be long-term and present 'interpretive' as well as 'warning' material.

Reproductively active terns (usually in small nuptial flocks) can be induced to lay within fenced areas by using social facilitation methods (Greenwell et al. 2021b). This usually involves deploying models of incubating terns (decoys) and using sound playbacks of active colony noises (Greenwell et al. 2021b). Facilitation ceases when the first nesting scrapes have eggs and birds are observed to be incubating.

The WA Fairy Tern Network 'Managed Site Protocol' (Appendix 1) outlines the circumstances in which social facilitation methods may be used, including meeting the conservation criteria and managing the risks from predators.

9 Predators and predator control

The Lower West Coast Region is densely populated with most Fairy Tern colonies establishing in close proximity to urban, industrial or recreational areas. In these areas, the use of traps or baits is heavily regulated to ensure public safety and the options for timely and effective control of predators are very limited. The three principal introduced predators in the region are the Red Fox, cats (domestic, stray and federal) and Black Rats (particularly near breakwaters).

a. Options for Fox Control

Foxes are 'Declared' pests under the *Biosecurity and Agriculture Management Act (2007)*, which means that land-managers have an obligation to control them. Predation by foxes is listed as a *Key Threatening Process under the EPBC Act (1999)* and the *Draft National Recovery Plan for the Australian Fairy Tern (2019)*.

Surveillance is necessary at all mainland colony sites in the lead up to breeding season. This may involve deploying camera traps or tracking.

Hunting by a Licensed Pest Management Technician (LPMT) is likely to be most effective in areas where firearms use is permitted or could be authorized. Trapping could also be conducted by experienced LPMT. Cage traps can be used but are rarely effective. Padded leg-hold traps baited with fox or cat faeces are more effective but require a licence from DPIRD for use in metropolitan areas.

Unfortunately, 1080 baiting is NOT an option in built-up areas except at sites with restricted access.

Foxes may be attracted to other introduced animals, particularly rabbits. Prey animals need to be removed by pindone baiting or warren fumigation by a LPMT. Food waste/bait left by people may also attract foxes to areas with breeding colonies. Rubbish bin placement is an important consideration for land managers.

9 Predators and predator control continued

b. Options for Cat control

From a regulatory perspective, there are three categories of cats – domestic, stray and feral. Feral cats were finally declared as pests in the *Biosecurity and Agricultural Security Act* in 2017 (Reg.45) allowing, but not mandating, the use of control measures. However, domestic and stray cats are managed by Local Government under the Cat Act 2011. This Act requires cats to be micro-chipped, sterilised and collared and straying animals can be captured and impounded by Local Governments. Unfortunately, most of the cats threatening Fairy Tern colonies in the metropolitan, Peel and Bunbury areas will be domestic or stray, requiring the status of the animal to be determined and ruling out the most effective trapping methods or baiting programs. Some Local Authorities (e.g. Mandurah) have now enacted local laws that will phase out cat ownership in precincts adjacent to conservation areas.

Predation by **feral** cats is listed as a Key Threatening Process under the *EPBC Act 1999* but not domestic / stray cats.

Surveillance at managed sites in the lead up to breeding season using camera traps and tracking is essential. Nesting should not be facilitated if there is any evidence of cat activity as the available control measures are not likely to be effective (see Appendix 1).

Trapping by authorised personnel/experienced LPMTs can be conducted with cage traps. Unfortunately, leg-hold traps (which are effective when baited with cat faeces) are not permitted for use on cats in Western Australia. Shooting is generally not an option in urban areas due to the difficulty in getting police clearances. Eradicat (1080 baiting) is not available, unless it is part of an authorized research project in an area with tightly controlled access.

Controlling prey species that may attract cats to an area including rabbits and rodents may reduce the risk. Letter drops to residents warning of the consequences of their domestic cats straying, and their potential impact on Fairy Tern colonies, may be effective adjacent to urban areas (Greenwell et al. 2019a).

c. Options for Black Rat control

Black Rats are common in urban and industrial settings and particularly favour rock walls or breakwaters in the coastal zone. These habitats commonly occur adjacent to Fairy Tern colonies in the Lower West Coast Region.

Baiting programs can be conducted 'on label' in most situations using anchored, locked bait stations with immovable baits to decrease risk to public and non-target species. To meet regulatory requirements, the bait-stations need to be placed within, or adjacent to, structures including buildings, fences and rock walls, in a controlled area and out of public view.

9 Predators and predator control continued

c. Options for Black Rat control continued

Managers should aim to eradicate any rat populations which become established on islands used by Fairy Terns. Large-scale, off-label baiting projects for eradication or control may require permits from the Australian Pesticides and Veterinary Medicines Authority. Applying for these licenses will likely take years.

d. Native Predators

The egg and chick predators at Fairy Tern colonies In the Lower West Region have included Silver Gulls, Australian Ravens, Nankeen Kestrels, Crested Terns, Australian Pied Oystercatchers, Ruddy Turnstones and snakes. Breeding adults have been taken by Peregrine Falcons, Australian Hobby falcons and Ospreys.

All native wildlife is protected in WA under the *Biodiversity Conservation Act 2016* from 'taking' or disturbing. This makes it very difficult to take any action to protect breeding Fairy Terns from the depredations of native species, even where the hunting is facilitated by built structures or human activities.

Licenses to remove or destroy fauna are available under the *Biodiversity Conservation Act 2016*, where native animals are causing a health issue or damaging crops or property. However, provision has been made to authorize measures to take or disturb native animals in order to protect threatened species.

Two methods might be used to provide relief from native predators. These are diversionary feeding and conditioned taste aversion. Both methods may be effective where the predation is being carried out by one or two fixated individuals. Both would require a license to disturb fauna and an approval from an Animal Welfare Committee long before nesting commenced. Since the impact of native predators is difficult to predict, it is unlikely that approvals for these measures could be organized in time.

Conditioned aversion methods involve injecting eggs (of similar size and patterning) or fresh chick carcasses with an emetic. The bad taste or regurgitation response then teaches the predator to avoid this prey type in the area. Information may be transmitted from the exposed animal to others in the flock or group producing an avoidance 'culture'. This may work better in the long-term than culling the predator because that treated animal may continue to defend its territory area from others.

The conditioned taste (or emetic) aversion may also have the potential to protect colonies from introduced predators.

9 Predators and predator control continued

d. Native Predators continued

Relevant Legislation and Permits/Licences

Conservation Act Conservation Act 2016 and Regulations

- Authorisation to disturb threatened fauna under Section 40
- Fauna causing damage license
- Fauna disturbing (feeding) license

Animal Welfare Act 2002

- Any trials or research into predator control methods e.g. Conditioned Taste Aversion, will require a Scientific Use License from DPIRD with AEC approval.

Australian Pesticides and Veterinary Medicines Authority (APVMA)

- Permits required for any baits/poisons that are unregistered and/ or used off-label

Biosecurity and Agricultural Management Act 2007 Reg 45

- Permit to trap declared pest in built-up areas using traps other than cage traps

Cat Act (2011). Sets out cat control measures and roles and responsibilities of Local Government Authorities on managing domestic and stray cats

Pest Management Technician contractors will already have many licenses and permits including a Technician's License from Department of Health to use baits and poisons and firearm Licenses.

10 Conservation Strategy for the Lower West Coast Management Unit

a. Planning Process

The first step in developing the strategy was to summarize the last 3 years of records on the Network's colony database. These records include colony locations, dates, success if known and causes of breeding failure. Sites were then allocated into those that could not be practically managed, natural sites where management would need to be reactive, and managed sites that are permanently set up to enclose Fairy Tern colonies.

Specifically, at sites where the nesting birds cannot be protected the only actions may be to dissuade nesting by changing the habitat in some way. For example, the background colour on the shoulders of the Garden Island Causeway has effectively been altered to reduce their attractiveness to breeding birds.

At natural sites, the managers may respond with surveillance, temporary fencing and signage, wardens and emergency predator control. Managed sites are constructed at suitable locations, the habitat is constructed or enhanced, there is permanent fencing, interpretive signage and pre-emptive predator control.

Next the Network invited critical land and water managers and the most committed conservation volunteers to a workshop to discuss our recommendations and to coordinate the next seasons program. Forty-two people/organisations were invited from the Network database. After one postponement, due to a Covid 19 lockdown, the workshop was conducted on 1 June at the Naragebup, Rockingham Regional Environment Centre. Twenty of the invited participants were able to attend.

The sites used in recent years by nesting Fairy Terns (Appendix 2a) have been allocated to

a) Sites that are not practicable to defend
b) Natural Sites, and
c) Managed Sites

Five sites were identified as being subject to unmanageable threats (Appendix 2a). The Cut (Bunbury), Becher Point, Nairns and the low-lying islands in Peel Inlet, Mangles Bay dredge spoil dump and the shoulders of the Garden Island Causeway. No action would be taken at these localities and nesting attempts would be prevented, where possible. There was some debate at the workshop about whether Penguin Island should be placed in the unmanageable category due to the activities of native predators (e.g. Silver Gulls) but it was decided that this location should be treated as a Natural Site.

10 Conservation Strategy for the Lower West Coast Management Unit continued

a. Planning Process continued

Eleven locations were listed as Natural Sites likely to be selected by prospecting terns for breeding in some years (Appendix 2b). Regular surveillance was necessary at these sites (by the Network and Land Managers) and reactive protected measures taken as soon as the colony area could be determined. At a minimum this would consist of temporary fencing and warning signage, increased observation and patrols). At some sites pre-emptive fencing/signage and/or predator control measures should be undertaken (e.g. at McKinnon Point, Parkin Point and Point Walter). The identified managers (Appendix 2b) include DBCA, Rottnest Island Authority, Department of Defence, Department of Transport, Southern Ports (Bunbury), City of Melville, City of Bunbury, City of Cockburn, City of Mandurah.

There are 4 Managed Sites listed in Appendix 2c. Rous Head (Fremantle Ports) and Mandurah Marina (City of Mandurah) continue to be maintained although did not have colonies in 2019/20 or 2020/21. Rous Head probably functions as an alternative site for Point Walter but site selection may be subject to suitable prey availability (Greenwell et al. 2021a). The Mandurah Marina has a history of problems with nearby sand bypassing management and predation by stray and domestic cats (Greenwell et al. 2019a). In order to provide a secure site in the Peel inlet region, a new trial Managed Site has been established on Boundary Island, well above the high-water level. This project is a partnership between BirdLife WA, DBCA and the Network and should be fully operational in the 2021/22 season. If successful, the Mandurah Marina site will be decommissioned.

Another managed site is being developed at Woodman Point (a historical and recent nesting location) by the City of Cockburn with assistance from DBCA (the land-managers) and the Network.

Photo: Nic Dunlop

11 Interaction with National Recovery Plan for the Australian Fairy Tern

At the time of writing this document, the National Recovery Plan is awaiting final approval from the Federal Environment Minister. This plan will recommend that Recovery Teams be established for the Australian Fairy Tern in Western Australia and another for south-eastern Australia, with some opportunity for remote interaction. Small grants may be available, occasionally, from the Commonwealth to fund research activities but beyond that the management of fauna is the responsibility of the State. It is therefore recommended that the WA Recovery Team be established to service both jurisdictions.

Photo: Tegan Douglas

Appendix 1:

Managed Sites Protocol

Background

The Australian Fairy Tern is a listed threatened (Vulnerable) species that breeds on the mainland and island shorelines (mainly beaches). The migratory population occupying south-western Australia is likely to decline into the future without active conservation intervention. The known threats include:

- the loss of nesting and foraging habitat as the result of coastal development;
- disturbance at mainland and island colonies by people, dogs, watercraft, aircraft and off-road vehicles;
- predation by introduced predators including foxes, cats and Black Rats;
- increased predation by native predators (interacting with human activities) including kestrels, gulls and ravens;
- accelerating coastal erosion;
- increasing sea levels (particularly within the estuaries); and
- extreme spring - summer storm events.

The location of breeding sites is probably determined by prey fish aggregation / biomass within about 2 km of nesting habitat (Greenwell et al 2021a, Greenwell et al. 2021c). Eggs can be laid anywhere between October and March, depending on the onset of suitable foraging conditions. The breeding season is quite protracted because individuals vary in the timing of their reproductive cycles leading to discontinuities in the formation of colonies.

Potentially suitable nesting habitats are wide shoreline areas with a light-coloured, coarse-grained, substrates with little vegetation cover. Sites with shell or other fragments in the surface matrix and nearby vegetation or rock cover (to hide the chicks) are preferred.

Managed Sites for Fairy Tern Colonies

'Managed Sites' are a conservation measure to maintain local breeding flocks of Fairy Terns where, as the result of coastal development and human population pressures, there are no longer any secure natural nesting areas. Such sites are often on artificial substrates (e.g. dredge-spoil, rafts) and are protected by appropriate fencing and signage. The substrate must be kept clear of encroaching vegetation and may be modified to make it attractive (e.g. by adding shell material). The terns may initially be encouraged into the protected area using social facilitation methods (incubating decoys and/or playbacks of colony sounds, Greenwell et al. 2021b). Social facilitation will only induce nesting in the presence of prospecting nuptial birds and when there are sufficient prey resources within foraging range to provision egg production by the females.

Appendix 1: Managed Sites Protocol continued

Managed Sites for Fairy Tern Colonies continued

In some circumstances, Fairy Terns may have to be dissuaded from breeding at natural and artificial sites that are at risk from established predators, coastal erosion or other threats. This could involve changing the nesting habitat to make it unattractive or actively disturbing the terns at the site during the prospecting / pre-laying period.

The Role of Predators and Anti-Predator Behaviour

The breeding behaviour of all 'small terns' (*Sternula* spp.) makes them more vulnerable to predators than other tern species. There is evidence that Fairy Terns test potential colony sites for predators by delaying tending or incubating the earliest eggs (Greenwell et al. 2019b). All the birds in a colony may also temporally vacate a nesting area to prevent targeting by volant predators (e.g. Australian Hobby or Peregrine Falcon). Colonies that are disturbed during the early stages, either by predators or people, are readily abandoned. Later, once the colony is established, adult Fairy Terns will threaten intruders by flying at them, defaecating on them, and calling aggressively. This behaviour may distract predators searching for the cryptic eggs and chicks.

Natural colony sites are often occupied for several seasons but at some stage nesting will shift elsewhere. These shifts may sometimes be triggered by a shift in the location of prey resources but may also be part of the anti-predator behaviour of Fairy Terns. Over time, more predators are likely to become aware of colony locations, targeting them earlier and more efficiently. Fallowing nesting sites from time to time may avoid this predator build-up. Increasing predator awareness is a potential problem at managed sites where the terns nest each season. Increased attention to predator monitoring and control may be required over time and/or alternative managed sites may need to be constructed within a foraging region.

Appendix 1: Managed Sites Protocol continued

Operational Protocol for Fairy Tern Managed Sites in South West Western Australia

Month(s)	Management action
July	Establish monitoring program for feral predators and domestic cats (night inspections, trap cameras, track pads)
August	Commence removal of any detected feral predators and domestic cats (cat traps, soft-jaw traps [foxes]). Integrate feral predator controls with local government or DBCA programs wherever possible.
August	Organise and train conservation volunteers as wardens and for monitoring of predators at Fairy Tern colonies.
September	Continue monitoring of feral predators and domestic cats.
September	Repeat feral predator removal measures if required.
September	Remove colonizing coastal vegetation from nesting area
September	Bait rock walls for Black Rats
September	Prepare conservation volunteers for wardening tasks and for citizen-science monitoring of any colony
September	Check and repair fencing, deploy or re-deploy signage, screen nesting areas from passing foot-traffic and dogs. Continue monitoring feral predators.
October/November	Monitor general area for presence of prospecting Fairy Tern flocks or club sites. If prospecting terns are present, and predators have been effectively controlled, social facilitation methods may be used to either: • attract breeding adults to commence nesting within the managed site; or if necessary • to move the location of the colony within the managed site. **NB. Do not continuously use social facilitation methods once the managed site has been utilized by nesting terns.**
October-March	Record the number of incubating pairs every week (volunteers)
November-March	Deploy anti-kestrel chick shelters near hatching date (conservation volunteers)
October - March	Census large runner production at the appropriate times. Record success as the number of large runners/fledglings per nesting pair.

Appendix 2:

Colony locations allocated to undefendable, natural (reactive management) and managed (proactive management) sites

Sites that are not practicable to defend

Colony Location (s)	Unmanageable Threats
The Cut (Bunbury)	Off-road vehicles
Becher Point	Off-road vehicles and foxes
Nairns, and low-lying islands in Peel Inlet	Inundation from high sea-levels and predators
Mangles Bay	High disturbance from people, dogs and fox predation
Garden Island Causeway (shoulders)	Mortality from vehicles, Black Rats

Natural Sites

Colony Site	Manager (s)	Threats
Bar Island, Bunbury	City of Bunbury	Inundation, vegetation encroachment
McInnon Point	Bunbury Port / DBCA	Sand movement, cat, Black Rats
Lake Preston	DBCA	Water levels, foxes?
Pyramids Beach	Department of Transport	Bypass sand movement, human disturbance, dogs and Black Rats
Penguin Island	DBCA	Native predators
Parkin Point, Garden Island	Defence / DBCA	Sand movement, inundation, Black Rats
Collins Point, Garden Island	Defene / DBCA	Human disturbance
Carnac Island	DBCA	Human disturbance, natural predators, sealions
Pt Walter, Swan River	DBCA (River Park), City of Melville	Vegetation change, human disturbance, fox predation
Rottnest Salt Lakes	RIA/ DBCA	Inundation and native predators
Strictland Bay / Cape Vlamingh	RIA/DBCA	Sand movement, inundation and human disturbance

Appendix 2: Colony locations allocated to undefendable, natural (reactive management) and managed (proactive management) sites continued

Managed Sites

Colony Site	Manager (s)	Threats
Rous Head	Fremantle Ports / WA Fairy Tern Conservation Network	Human disturbance, foxes, cats and noise from adjacent container handling.
Mandurah Marina	City of Mandurah	Domestic and stray cats, bypass sand movement
Boundary Island (prepared 2020)	DBCA, Birdlife WA and WA Fairy Tern Conservation Network	Foxes, vegetation encroachment on site
Woodman Point (proposed 2021)	City of Cockburn, DBCA, Fairy Tern Conservation Network	Human encroachment (fishers, kite surfers), foxes and Silver Gulls

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