



# **Little Tern (*Sterna albifrons*) Recovery Plan**



**October 2003**

**NSW  
NATIONAL  
PARKS AND  
WILDLIFE  
SERVICE**

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# Recovery Plan for the Little Tern (*Sterna albifrons*)

## Executive Summary

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The Little Tern (*Sterna albifrons*) is listed as Endangered (Schedule 1, Part 1) in New South Wales under the *Threatened Species Conservation Act 1995* (TSC Act). This document constitutes the approved NSW State Recovery Plan for the Little Tern (*Sterna albifrons*) and, as such, considers the conservation requirements of the species across its known range. It identifies actions to be undertaken to ensure the long-term viability of the species in nature and the parties who will undertake these actions.

Prior to management, the Little Tern had undergone a decline in abundance across coastal NSW. The population had declined chiefly because of its poor breeding success, which had resulted from a combination of natural and human-related factors. The Little Tern is an exclusively coastal species and the smallest Australian representative of the family Laridae (gulls and terns). This Recovery Plan is concerned with the management and recovery of the south-eastern Australian population of the Little Tern subspecies *sinensis* which migrates down the east coast of Australia during spring-summer to nest as solitary pairs or in colonies. Actions identified in the Recovery Plan include: (i) recommendations for threat abatement, (ii) liaison and consultation with other land managers, (iii) the intensive management of eight major Little Tern colonies and selected minor colonies, (iv) consider opportunities involving the incidental creation of island nesting sites using dredge spoil, (v) research, survey and monitoring activities, (vi) a co-ordinated Statewide approach to management, (vii) facilitation of community participation in the Recovery Program, (viii) the production of a Little Tern Field Manual to enhance future management, (ix) data analysis and reporting activities.

It is intended that this Recovery Plan will be implemented over a five-year period, by which time the success of the proposed recovery actions will be assessed and an updated plan prepared. Responsibility for implementation of the NSW Little Tern Recovery Program will rest primarily with the NSW National Parks and Wildlife Service (NPWS) and rely on the ability of other land managers to effectively implement their statutory responsibilities with regard to coastal land management. The NSW NPWS is especially indebted to the numerous volunteers who have worked countless hours towards ensuring the breeding success of Little Tern; their contribution and dedication to the recovery of Little Tern cannot be overstated.



**BRIAN GILLIGAN**  
Director-General



**BOB DEBUS MP**  
Minister for the Environment

### **Dedication to Keith Egan**

No one government can conserve threatened species without the help and support of the community. If the conservation of threatened species requires a champion to hold the banner high then surely the champion of Little Tern conservation was Keith Egan. Keith's life revolved around the Little Tern each October through to March. As a volunteer, his contribution of time and support for the conservation of Little Tern is undeniable. Three days every week (often more) for six months Keith would join the NSW National Parks & Wildlife Service tern team on the research and management program. Keith's support did not end there though. His contribution to community education and his political awareness meant that the plight of Little Tern in NSW was always clear to the community and government.

Little Tern populations in NSW are on the road to recovery and it is the contributions of community volunteers, especially Keith Egan, that has made this possible. This document is testament to the contribution made by Keith and those other dedicated volunteers who assist in the management of shorebird colonies throughout NSW. Keith's dream was that every child should be given the opportunity to see the flutter and hear the happy chirp of Little Tern along our shoreline. It is my fervent hope that these contributions will continue to be acknowledged by the ongoing successful management of Little Tern in NSW to make this dream a reality.



**Geoffrey A Ross**  
**Wildlife Management Officer**  
**NSW National Parks & Wildlife Service**

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## Acronyms and abbreviations used in this document

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CAMBA:	China-Australia Migratory Birds Agreement
DSE:	Victorian Department of Sustainability and Environment
EP&A Act:	NSW <i>Environmental Planning and Assessment Act 1979</i>
EPBC Act:	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESP Act:	Commonwealth <i>Endangered Species Protection Act 1992</i>
FoxTAP:	NPWS Fox Threat Abatement Plan
IUCN:	International Union for Conservation of Nature and Natural Resources
JAMBA:	Japan-Australia Migratory Birds Agreement
NPW Act:	NSW <i>National Parks and Wildlife Act 1974</i>
NPWS:	New South Wales National Parks and Wildlife Service
RAMSAR:	Convention on Wetlands of International Importance
RAOU:	Royal Australasian Ornithologists Union
SIS:	Species Impact Statement
TSC Act:	NSW <i>Threatened Species Conservation Act 1995</i>
TSSC:	Commonwealth Threatened Species Scientific Committee

## 1. Legislative Context

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### 1.1 Commonwealth Legislation and International Agreements

In 1999 the Little Tern (*Sterna albifrons*) was removed from the Commonwealth *Endangered Species Protection Act 1992*. The Commonwealth Threatened Species Scientific Committee (TSSC) has determined that the two Australian breeding populations (i.e. a northern Australian population that nests in northern Australia and a south-eastern Australian population that nests in eastern Australia) are not sufficiently distinct to warrant them being treated separately for the purposes of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The TSSC found insufficient evidence to support the notion that the two populations are genetically distinct (see Section 3.1 for a fuller discussion). Moreover, the boundaries separating the two Australian breeding populations are not sufficiently clear and there is evidence of overlapping ranges with two or three representatives of each of the populations occurring in one area at the same time (Environment Australia 2003a). The Commonwealth advise, however, that if conservation programs which focus upon the south-east Australian population are removed, then it would likely decline. The impact of such a decline on the Australian breeding population is not likely to be significant as the majority of Little Tern (i.e. those that utilise breeding sites in northern Australia) are stable and secure. Therefore, from a national perspective the Little Tern (western Pacific) is currently not eligible for listing under EPBC Act criteria (Environment Australia 2003a).

A further regulatory component to the EPBC Act is that it provides for Commonwealth assessment and approval of actions that are likely to have a significant impact on migratory species protected under international agreements (i.e. the Bonn Convention, China-Australia Migratory Birds Agreement (CAMBA), and Japan-Australia Migratory Birds Agreement (JAMBA)). The Little Tern is listed as a migratory species under the EPBC Act. As such, a person must not take an action that has, will have, or is likely to have, a significant impact on a listed migratory species, without approval from the Commonwealth Environment Minister. To obtain approval, the action must undergo an environmental assessment and approval process (Environment Australia 2003b).

The following international agreements are applicable to the conservation of the Little Tern:

- JAMBA: Provides for co-operation between the Governments of Australia and Japan to protect birds which migrate between the two countries. The Little Tern is one of the species listed.
- CAMBA: Provides for co-operation between the Governments of Australia and the People's Republic of China to protect birds which migrate between the two countries. The Little Tern is one of the species listed.
- *Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)*: Provides a framework for enhancing the conservation status of rare and threatened migratory species throughout their international range.
- *Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention)*: Promotes the conservation of wetlands and waterfowl. In Australia, individual States are responsible for identifying wetlands as suitable for nomination to the List of Wetlands of International Importance maintained under the Convention. Two RAMSAR listed

sites in NSW are relevant to Little Terns - Towra Point Nature Reserve and Kooragang Nature Reserve. Commonwealth approval requirements may be triggered by some works on RAMSAR listed sites.

## 1.2 State Legislation and Policies

The following State legislation and policies are discussed as they apply to the conservation of the Little Tern:

- *Threatened Species Conservation Act 1995* (TSC Act): Provides for the protection and recovery of threatened species, the declaration of Critical Habitat for those species, the proper assessment of any action affecting threatened species or their habitat, and the licensing of actions that are likely to result in harm to a threatened species or damage to its habitat. The Little Tern is listed on Schedule 1 of the TSC Act as Endangered.
- *National Parks and Wildlife Act 1974* (NPW Act): Provides for the reservation, protection and management of natural areas, and the protection of native fauna. Includes provisions for conservation agreements with other landholders and provisions for licensing of scientific investigation of threatened species. This Act has been amended in regard to threatened species by the TSC Act.
- *Environmental Planning and Assessment Act 1979* (EP&A Act): Provides for the proper assessment of the environmental impact of proposed activities. Assessment of the impact on threatened species has been integrated into this Act through amendments under the TSC Act.
- *Catchment Management Act 1989*: Provides for co-ordination of policies, programs and activities for protection and management of natural resources on a total catchment management basis.
- *Coastal Protection Act 1979*: Establishes the Coastal Council of NSW, a specialist body which advises the Minister for Infrastructure and Planning on coastal management issues.
- *NSW Government Estuary Management Policy*: Addresses resource planning and management in estuaries under the umbrella of total catchment management. Aims for the production and implementation of management plans for all estuaries in NSW.
- *NSW Government Coastal Policy*: Provides a framework for making decisions about the planning and management of the State's coastline. This policy aims to protect the coastline and beaches and to ensure that coastal development is balanced, well planned and environmentally sensitive.
- *NSW Government Coastal Crown Lands Policy*: Translates the Coastal Policy into specific strategies and actions for responsible management of coastal Crown lands.

## 1.3 Recovery Plan Preparation

The TSC Act provides a legislative framework to protect and encourage the recovery of threatened species, endangered populations and endangered ecological communities in NSW. Under this

legislation the Director-General of National Parks and Wildlife has a responsibility to prepare Recovery Plans for all species, populations and ecological communities listed as endangered or vulnerable on the TSC Act Schedules. The TSC Act (S59) includes specific requirements to be addressed by Recovery Plans and the process for preparing Recovery Plans. This plan satisfies these provisions.

#### **1.4 Recovery Plan Implementation**

The TSC Act requires that a public authority must take any appropriate measures available to implement actions included in a Recovery Plan for which they have agreed to be responsible. Public authorities and councils identified as responsible for the implementation of Recovery Plan actions are required by the TSC Act to report on measures taken to implement those actions. In addition, the Act specifies that public authorities must not make decisions that are inconsistent with the provisions of the Plan. The public authority responsible for the implementation of this Recovery Plan in NSW is the NPWS. Due to the dynamic nature of the conservation biology of the Little Tern, the NPWS will liaise on an ongoing basis with other government agencies and authorities regarding assistance and/or approval for specific implementation measures.

#### **1.5 Critical Habitat**

The TSC Act makes provision for the identification and declaration of Critical Habitat for species, populations and ecological communities listed as endangered. Critical Habitat, as defined in the TSC Act (S37), is considered to be “the whole or any part or parts of the area or areas of land comprising the habitat of an endangered species ... that is critical to the survival of the species”. Once declared it becomes an offence to damage Critical Habitat (unless the action is specifically exempted by the TSC Act). A species impact statement (SIS) is mandatory for all developments and activities proposed within Critical Habitat unless the impact is deemed trivial or negligible by the Director-General of National Parks and Wildlife. A SIS requires the concurrence of the Director-General of NPW before any approval is given.

To date, Critical Habitat has not been declared for the Little Tern. The recovery team will consider eligible nesting, resting and fledgling feeding habitat as part of the ongoing Little Tern Recovery Program, however, difficulties may arise in declaring Critical Habitat because nesting sites are not static. The condition and location of nesting, resting and fledgling feeding habitats in individual estuaries varies over the years through both natural and human induced processes, which means that if areas are declared Critical Habitat they will need to be reviewed regularly. The most important estuaries for Little Terns may be different in the future and the location of nesting, resting and fledgling feeding areas within particular estuaries may also change.

#### **1.6 Environmental Assessment**

Consent and determining authorities are advised that it would be appropriate to give considerations to relevant Recovery Plans when exercising a decision-making function under Parts 4 and 5 of the EP&A Act. Therefore all councils and other government agencies along the coast as consent and determining authorities should take into account the recovery actions outlined in this plan when considering any activity or development within known or potential habitat of the Little Tern. The responsibilities of statutory authorities relevant to the management of Little Tern habitat are identified in Table 9.

## 2. Current Conservation Status

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The Little Tern (*Sterna albifrons*) is listed as an endangered species in New South Wales on Schedule 1, Part 1, of the TSC Act. The species is considered to be an ecological specialist, which has a population and distribution reduced to a critical level, poor recovery potential and severe threatening processes.

In a comprehensive assessment of the conservation status of Australian birds for the Australian Nature Conservation Agency and the Royal Australasian Ornithologists Union (RAOU), Garnett (1992, 1993) classified the Australian breeding population of the Little Tern as vulnerable. He concluded that the breeding population in northern Australia is small, though not in immediate danger of extinction. The breeding population in south-eastern Australia, however, has declined and its beach-nesting sites are particularly prone to human disturbance, predation and natural catastrophes. The small size of the south-east Australian breeding population is masked by the presence of relatively large numbers of migrants from breeding sites in Asia in summer.

Internationally, the Little Tern has a wide but patchy distribution in Europe, Africa, Asia and Australia. It is not listed as a threatened species on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species (World Conservation Monitoring Centre 2002). However, there have been marked declines in Europe, including Britain, Ireland, France, Belgium, Netherlands, Germany and Spain (Cramp 1985), resulting in intensive conservation efforts (eg. Haddon and Knight 1983). A population decline has also been described in India (Holloway 1993).

## 3. Description

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### 3.1 Taxonomic Description

The Little Tern is the smallest Australian representative of the family Laridae (gulls and terns). Three subspecies of Little Terns are recognised by Higgins and Davies (1996). Little Terns breeding in Australia are classified with those breeding in eastern Asia as subspecies *sinensis*, which is distinguished by the white shafts of the wing feathers. However, the subspecific taxonomy of the Little Tern requires further investigation (Higgins and Davies 1996). The recovery team is of the opinion that birds breeding in Australia may eventually be recognised as a separate subspecies from those breeding in Asia. Differences may also be recognised within Australia. A preliminary investigation (using electrophoresis) indicated genetic differences between Little Terns breeding in south-eastern Australia and those breeding in the Gulf of Carpentaria, although the study was inconclusive in clarifying whether separate populations exist (Donnellan 1994).

Two further studies were conducted in order to detect: (i) differentiation among terns sampled from Australia that includes both breeders and non-breeders, and (ii) genetic differentiation between Australian and northern hemisphere (Japanese) populations (Donnellan 1995, 1996). Donnellan (1995) found that the data provided a tentative indication of genetic differentiation between populations both in Australia and Japan, however, urged that limits to the number of loci able to be tested and an insufficient sample size rendered the results inconclusive. In a further study, which examined variation in the mitochondrial genome of the Little Tern using the same

sample material, the greatest genetic divergence was found to occur between the Japanese haplotype and the Australian samples (Donnellan 1996). Again, the limited number of samples successfully sequenced in the study did not provide an adequate test of the null hypothesis, i.e. that populations of Little Terns in the western Pacific randomly breed. Significant variation in the Little Tern control region was found to warrant further research (Donnellan 1996).

The Little Tern is closely related to five other species: Fairy Tern, Saunders' Tern, Least Tern, Peruvian Tern and Yellow-billed Tern (Table 1). The six species have essentially separate distributions and form a superspecies. This is the taxonomic ranking given to a set of species that were once races of a single species and have retained separate distributions (Amadon 1966). Opinions differ about whether the Least Tern and Saunders' Tern should be classified as separate species or as subspecies of the Little Tern (Harrison 1985, Cramp 1985, Chandler and Wilds 1994, Higgins and Davies 1996). Another species, the Damara Tern, although more distinctive, should also perhaps be included within the superspecies (Table 1).

**Table 1. Taxonomy and distribution of the Little Tern and related species.**

Species	Subspecies	Breeding distribution
Little Tern <i>Sterna albifrons</i>	<i>albifrons</i>	Europe to N Africa and W Asia
	<i>guineae</i>	W and central Africa
	<i>sinensis</i>	E Asia and N and E coasts of Australia
Fairy Tern <i>Sterna nereis</i>	<i>nereis</i>	W and S coasts of Australia
	<i>exsul</i>	New Caledonia
	<i>Davisae</i>	New Zealand
Saunders' Tern <i>Sterna saundersi</i>		Persian Gulf and Red and Arabian Seas
Least Tern <i>Sterna antillarum</i>	<i>antillarum</i>	E coast of North America and Caribbean
	<i>athalassos</i>	Mississippi basin
	<i>browni</i>	SW coast of North America
Peruvian Tern <i>Sterna lorata</i>		W coast of South America
Yellow-billed Tern <i>Sterna superciliaris</i>		Coasts and rivers of E South America
Damara Tern <i>Sterna balaenarum</i>		SW coast of Africa

Until recently, the Fairy Tern was a rare, non-breeding vagrant in NSW (Hoskin and Hindwood 1964). The first confirmed breeding record was at the south coast site of Wallagoot Lake in the 1994/95 season (Jones 1995) and the species may be in the process of extending its breeding range to this State. Condon (1975) recorded Saunders' Tern for NSW on the basis of a specimen labelled as collected at Wollongong in May 1903. However, this specimen is now thought to be a Little Tern subspecies *albifrons* and there are doubts that it was actually collected in Australia (Higgins and Davies 1996).

Note that problems may arise in identification of birds in transition between breeding and non-breeding plumage. For more information on identification see Higgins and Davies (1996), Chandler and Wilds (1994) and Cramp (1985).

## 3.2 Distinguishing Characteristics

### Little Tern *Sterna albifrons sinensis*

The Little Tern is 20-28 cm long, with a wingspan of 45-55 cm and a weight of approximately 50 g. It is white in colour, with pale blue-grey wings and back, and a black cap. The bill is approximately as long as the head and is yellow with a black tip in breeding birds, changing to all black in non-breeding birds.

Breeding adult - Bill yellow with black tip, sometimes all yellow. Legs orange-yellow. Crown, nape and lores black. Forehead white, tapering back over each eye. Back and wings pale grey, contrasting with white rump and tail. Outermost primaries in folded wing grey-black, contrasting with pale grey inner primaries (although the latter darken with wear). White shafts to primaries.

Non-breeding adult - Bill black. Legs brown-black to dull orange-brown. Crown dirty white with varying amounts of black mottling. Lores white. Black band on shoulder (may be concealed at rest). Rump and tail pale grey, similar to back and wings. Tail shorter, less deeply forked than in breeding plumage.

Juvenile - Similar to non-breeding adult though with varying amounts of brown mottling in plumage and shorter, browner bill.

The distinguishing features of breeding, non-breeding and juvenile Little Terns are shown in Figure 1.

### Fairy Tern *Sterna nereis nereis*

Breeding adult - Slightly larger and bulkier than Little Terns. Bill orange-yellow, sometimes retaining black tip from non-breeding condition. Legs orange-yellow to orange. Crown and nape black. Forehead and lores white. Back and wings paler than Little Terns, contrasting less with white rump and tail. Primaries pale grey with a narrow black line along leading edge of outermost primary.

Non-breeding adult - Bill orange-yellow with black tip or sub-terminal band and grey-black base. Legs orange-yellow. Crown white with heavy black mottling. No dark band on shoulder or sometimes a faint one. Tail shorter, less deeply forked than in breeding plumage.

Juvenile - Similar to Little Tern juvenile. Best identified from the parents.

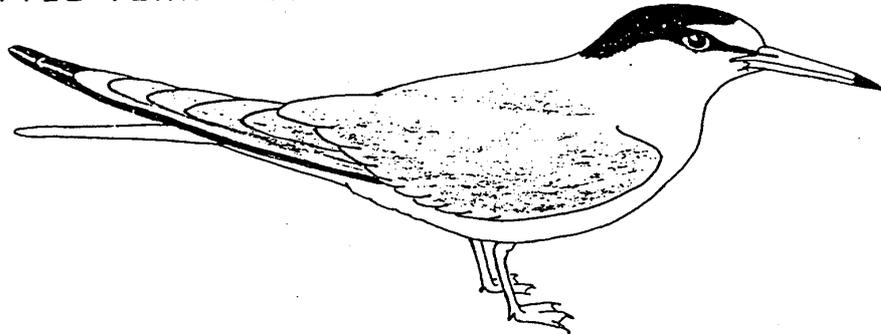
### Saunders' Tern *Sterna saundersi*

Breeding adult - Slightly smaller than the Little Tern. Bill yellow with black tip. Legs dull yellow-brown. Crown, nape and lores black. Forehead white, not tapering back over each eye as in Little Tern. Back and wings paler than in Little Tern and similar in colour to rump and tail. Typically, shows more black on outer primaries in folded wing than Little Tern, however, this character is not consistent. Black shafts to primaries.

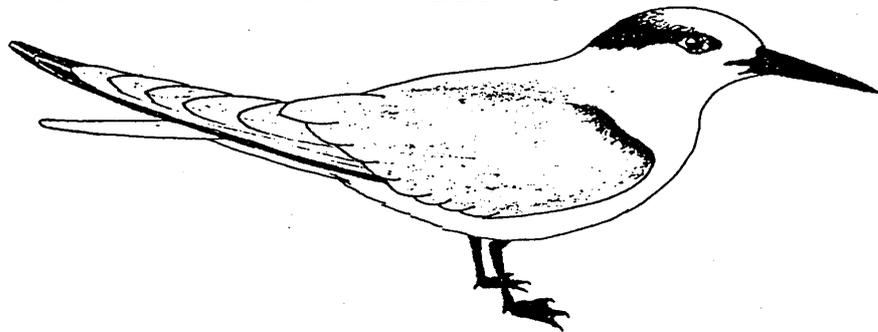
Non-breeding adult - Similar to non-breeding Little Terns. Best distinguished from *Sterna albifrons sinensis* by black shafts to outer primaries (usually visible only in the hand), however, note that *S. a. albifrons* and *S. a. guineae* also have dark shafts.

Figure 1. Identification of breeding, non-breeding and juvenile Little Tern

LITTLE TERN - BREEDING



LITTLE TERN - NON-BREEDING



LITTLE TERN - JUVENILE



Approximately 20-28 cm

## 4. Distribution and Habitat

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### 4.1 Current and Historical Distribution

The Little Tern subspecies *sinensis* has a breeding range from Sri Lanka and southern India east to China and Japan, and south through the Philippines and Indonesia to New Guinea and Australia. It is a non-breeding visitor to New Zealand. Within Australia, the breeding distribution extends from Gove Peninsula, around the Gulf of Carpentaria and down the east coast to Corner Inlet, Victoria, and north-eastern Tasmania, with occasional breeding records from South Australia and a recent breeding record near Broome in Western Australia (Blakers *et al.* 1984, Higgins and Davies 1996, Collins and Jessop 1997). Breeding has been reported on islands of the Great Barrier Reef and Bass Strait, though, not on Lord Howe Island or Norfolk Island. Little Tern are regular non-breeding visitors west of the Gulf of Carpentaria across the north coast of Australia to Port Hedland, Western Australia, with sporadic records further west to Shark Bay. Little Terns are rarely recorded in western Victoria and South Australia, however, they occur regularly and have bred at Price Saltfields, their westernmost site in southern Australia.

The migratory patterns of the various populations of subspecies *sinensis* are poorly understood. Some populations in Asia are believed to be sedentary (eg. in Taiwan, Philippines, Malay Peninsula and New Guinea). However, populations in northern Asia are wholly migratory (eg. in Korea, Japan and northern China), apparently moving south to southern China, Malay Archipelago, Philippines (uncommon), Indonesia, New Guinea, Australia and New Zealand (Higgins and Davies 1996).

There appear to be three separate populations of subspecies *sinensis* in Australia (two of which are known to occur in NSW):

**Northern Australian population:** There is a gap in the breeding distribution of the Little Tern along the Queensland coast between Bundaberg (25°S) and Mackay (21°S) (O'Neill 1995, Higgins and Davies 1996). Little Terns breed in northern Australia throughout the year. Most of the autumn and winter breeding records are from the Gulf of Carpentaria (Higgins and Davies 1996), with a few records on or off the north-east coast of Queensland at Elliott River (20°S, Ey 1990) and Willis Island (16°S, Serventy 1959). Most of the spring and summer breeding records are from north-eastern Queensland, from Mackay north to Lowrie Island (13°S), including records from Elliott River (Ey 1990, O'Neill 1995, Higgins and Davies 1996). Breeding has also been recorded in summer in the Gulf of Carpentaria at South Mitchell River (O'Neill 1995), and near Broome in Western Australia (Collins and Jessop 1997). It is unclear whether the birds breeding in northern Australia are sedentary, migratory or both. Numbers around known nesting sites in the Gulf of Carpentaria are similar in winter and summer, suggesting that at least this part of the population is sedentary (Garnett 1993). As previously mentioned, genetic differences have been found between Little Terns breeding in south-eastern Australia and those breeding in the Gulf of Carpentaria (Donnellan 1994).

**Asian population:** Non-breeding spring-summer migrants from Asia, where they breed in the austral autumn and winter. Most of the Little Terns present in Australia each spring and summer are in non-breeding plumage. Although it had long been suspected that these birds came from breeding colonies in Asia, this has only recently been confirmed by records of banded birds

moving between Japan and Queensland, NSW and Victoria (Smith 1995c, Minton 1996). Like the breeding population, non-breeding Little Terns arrive in NSW in Late August to November and depart in March to May.

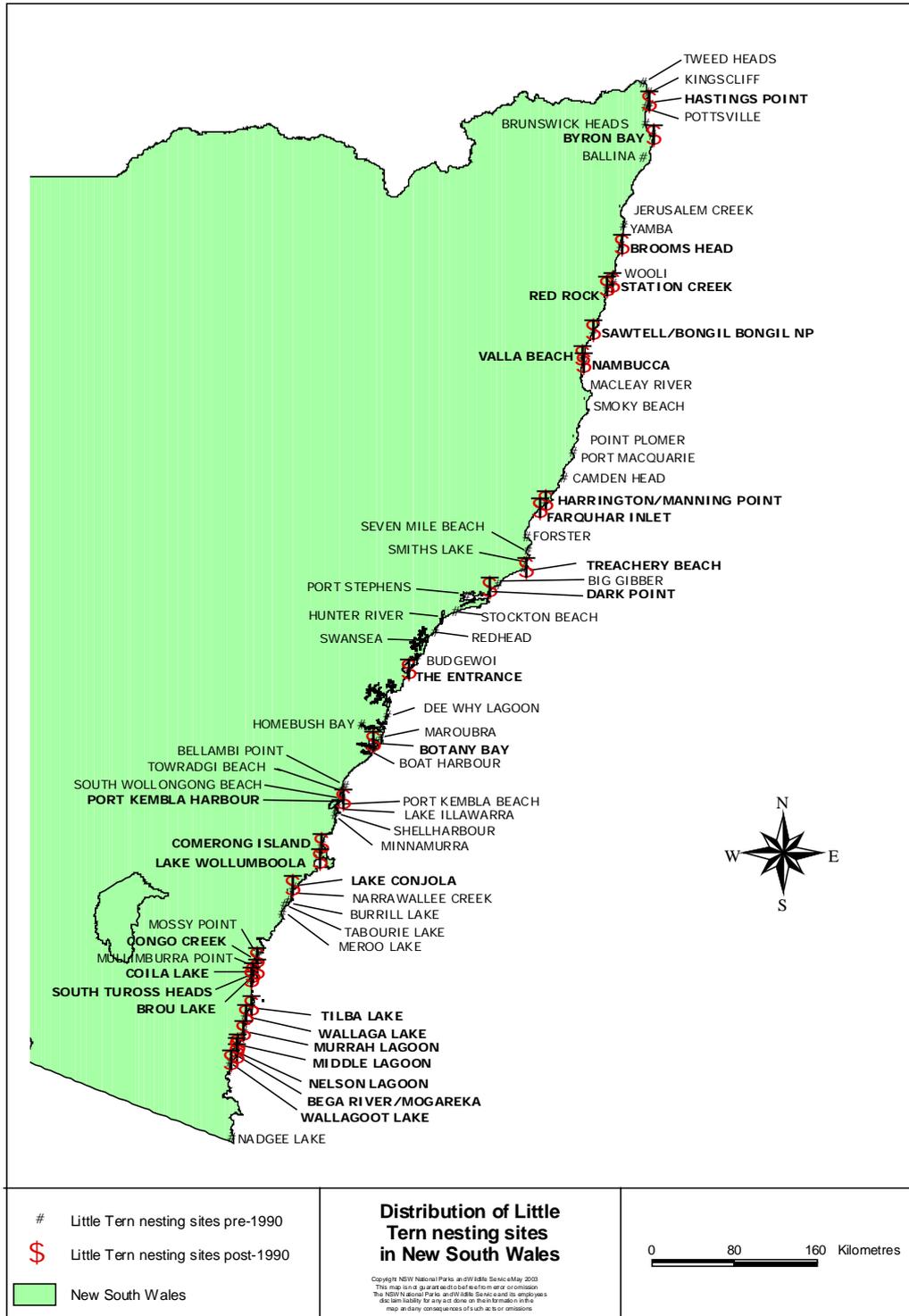
**South-eastern Australian population:** Spring-summer breeding migrants to South Australia, Tasmania, Victoria, New South Wales and south-eastern Queensland (north to Bundaberg). The great majority of the population breeds in eastern Victoria and New South Wales. Little Terns return to NSW during September to November. At Harrington/Manning Point, Little Terns are said to arrive on some occasions as early as August (H. Hole pers. comm.). Nesting begins in October or November and continues through into January or February. Numbers then decline as the birds leave on migration from March to May. Winter records are very rare. The non-breeding range is thought to include Java, Lesser Sunda Islands, Moluccas, Celebes and possibly the Philippines (Cramp 1985, Higgins and Davies 1996), however, this has not been confirmed.

Although there are two separate populations of subspecies *sinensis* known to occur in NSW, the non-breeding Asian population is currently stable and does not require management. This Recovery Plan is therefore concerned with the management and recovery of the south-eastern Australian population of the Little Tern subspecies *sinensis* which has declined in NSW chiefly because of its poor breeding success. This Recovery Plan will use the term 'Little Tern' to refer to the south-eastern Australian population of the Little Tern subspecies *sinensis* throughout the remainder of the document.

## 4.2 Current and Historical Nesting Sites in New South Wales

The historical distribution of Little Tern sites along the NSW coast is provided in Figure 2. Little Terns have been recorded nesting at 70 sites along the NSW coast but only at 44 sites since 1977 and 31 sites since 1987 (Table 2). During the mid to late 1990s, nesting was recorded at 12 sites in 1995/96, 16 sites in 1996/97, 8 sites in 1997/98 and 11 sites in 1998/99 (Table 3). During this period, the largest, most successful colonies were at Sawtell/Bongil Bongil, Harrington/Manning Point, Botany Bay, Lake Wollumboola and more recently Farquhar Inlet (formerly known as Old Bar) (Table 3). In recent years nesting has been recorded at 13 sites during season 1999/00, 11 sites in 2000/01, 13 sites in 2001/02 and 15 sites in 2002/03 (Table 3). The implementation of a shorebird recovery program across six additional nesting sites throughout the NSW south coast in 1999 has succeeded in increasing the number of productive colonies within NSW. Breeding sites producing more than 20 fledglings in any one season have been South Tuross Heads, Bega Rivermouth/Mogareka and Wallagoot Lake (Table 3). Equally intensive conservation efforts by NPWS staff and community volunteers at nesting sites at The Entrance (NSW Central Coast) and Station Creek (NSW North Coast) have also led to the fledging of a greater number of chicks where previously there were few reported (Table 3).

Figure 2 Distribution of Little Tern nesting sites in NSW



**Table 2. Nesting sites of the Little Tern in NSW listed from north to south, showing nesting records up to 2002/03.**

<b>Nesting site</b>	<b>Last record</b>	<b>Largest colony recorded</b>
Tweed Heads	Pre-1963	No data
Kingscliff	1964/65	No data
Hastings Point	1993/94	3 pairs 1979/80
Pottsville	1980/81	1 pair 1980/81
Brunswick Heads	1981/82	c.5 pairs 1979/80
Byron Bay	1992/93	c.30 pairs Pre-1974
Ballina	1963/64	2-3 pairs 1963/64
Jerusalem Creek	1985/86	6 pairs 1981/82
Yamba	Pre-1963	No data
Brooms Head	1994/95	3 pairs 1976/77
Wooli	1984/85	8 pairs 1980/81
<i>Station Creek</i>	2002/03	14 pairs 2002/03
<i>Red Rock</i>	2002/03	20 pairs 1988/89
<i>Sawtell</i>	2002/03	47 pairs 2000/01
Valla Beach	2001/02	3 pairs 1995/96
<i>Nambucca Heads</i>	2001/02	22 pairs 1986/87
Macleay River	1976/77	2 pairs 1976/77
Smoky Beach	1984/85	4 pairs 1976/77
Point Plomer	1976/77	1 pair 1976/77
Port Macquarie	1989/90	6 pairs 1987/88
Camden Head	Pre-1959	No data
<i>Harrington/Manning Point</i>	2002/03	97 pairs 1996/97
<i>Farquhar Inlet/Old Bar</i>	2002/03	74 pairs 1999/00
<i>Forster</i>	1996/97	50 pairs 1994/95
Seven Mile Beach	1937/38	12 pairs 1937/38
Smiths Lake	c.1963/64	1 pair c.1963/64
Treachery Beach	1994/95	2-3 pairs 1994/95
Big Gibber/Fiona Beach	1986/87	15 pairs 1986/87
Dark Point/Little Gibber	1996/97	10 pairs 1986/87
Port Stephens	1979/80	c.10 pairs 1972/73
Stockton Beach	1988/89	4 pairs 1988/89
Hunter River	1972/73	7 pairs 1932/33
Redhead	Pre-1969	No data
Swansea	1959/60	4 pairs 1959/60
Budgewoi	1960s	No data
<i>The Entrance</i>	2002/03	35 pairs 2001/02
Dee Why Lagoon	1947/48	2-3 pairs 1947/48
Homebush Bay	1964/65	1 pair 1964/65
Maroubra	1943/44	1 pair 1943/44
<i>Botany Bay</i>	2002/03	60 pairs 1996/97
Boat Harbour	1958/59	4-5 pairs Pre-1950
Bellambi Point	1977/78	20 pairs 1964/65
Towradgi Beach	Pre-1950	No data
South Wollongong Beach	1984/85	c.50 pairs 1956/57

Nesting site	Last record	Largest colony recorded
Port Kembla Harbour	1965/66	c.50 pairs 1955/56
Port Kembla Beach	Pre-1977	a few pairs Pre-1977
Lake Illawarra	1978/79	1 pair 1978/79
Shellharbour	1930s	No data
Minnamurra	1967/68	4 pairs 1967/68
Comerong Island	1996/97	13 pairs 1976/77
<i>Lake Wollumboola</i>	2002/03	50 pairs 2001/02
<i>Lake Conjola</i>	2002/03	17 pairs 2002/03
Narrawallee Creek	1984/85	2 pairs 1984/85
Burrill Lake	Early 1950s	c.10 pairs 1940s/50s
Tabourie Lake	Early 1950s	c.10 pairs 1940s/50s
Meroo Lake	Pre-1963	No data
Mossy Point	1960/61	2-3 pairs 1960/61
Congo Creek	1994/95	1-2 pairs 1994/95
Mullimburra Point	Early 1980s	3 pairs early 1980s
Coila Lake	1994/95	3 pairs 1982/83
<i>South Tuross Heads</i>	2002/03	65 pairs 2002/03
<i>Brou Lake</i>	2002/03	53 pairs 2001/02
<i>Tilba Lake</i>	1994/95	35 pairs 1988/89
<i>Wallaga Lake</i>	2002/03	34 pairs 1993/94
Murrah Lagoon	1995/96	4 pairs 1989/90
Middle Lagoon	1996/97	1 pair 1996/97
Nelson Lagoon	1996/97	1 pair 1996/97
<i>Bega Rivermouth/Mogareka</i>	2002/03	44 pairs 2001/02
<i>Wallagoot Lake</i>	2002/03	74 pairs 2002/03
Nadgee Lake	1984/85	9 pairs 1980/81

Sites in *italics* are considered of greater contemporary conservation significance, i.e. they have supported colonies of at least four pairs in recent years (1990-2003).

**Table 3. Nesting records of the Little Tern in NSW, 1993-2003 (Smith 1995c, NPWS records). N = nests, F = fledglings, NC = data not confirmed.**

Note: Nesting and fledging data for season 2000/01 for Harrington/Manning Point and Farquhar Inlet/Old Bar was combined.

Nesting Site	1993/94		1994/95		1995/96		1996/97		1997/98		1998/99		1999/00		2000/01		2001/02		2002/03		Total	
	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F	N	F
Hastings Point	1	3																			1	3
Brooms Head			1	0																	1	0
Station Creek	3	0	2	0	12	0	14	2	3+	0	4	0	0	0	6	0 NC	5	0 NC	14	20	63+	22
Red Rock	7+	19	12	0			4	0	0	2	3	0	0	0	1	0	0	0	0	0	27+	21+
Sawtell/ Bongil Bongil			1	0	3	0	16+	6	9	0	31	37	42	38	44	81	48	32	37	21	231+	215
Valla Beach	2	0	3	0	2		1	1	1	0	1	0	0	0							10	1
Nambucca Heads	6	0	2	0	1	2			0	0	6	0	0	0			16	0	1	0	32	2
Harrington/ Manning Point	76+	70+	62	4	62	30	135	104	124	233	87	72	81	37	219	83	97	74	166	107	1109+	814
Farquhar Inlet/Old Bar			4	0	0	0	13	0			53	36	111	79			73	59	24	14	278	188
Forster	51	48	90	2	18	8	2	0	0	0	1	0									162	58
Treachery Beach			2	0	0																2	0
Big Gibber/Fiona Beach											2	6									2	6
Dark Point/ Little Gibber							2	2													2	2
The Entrance			4	0											27	30	35	50+	64	27	130	107
Botany Bay	16	0	50	22+	76	11+	94	22	96	34	73	43	37	24	70	22+			101	43	613	221
Comerong			3	0	10	1	2	0													15	1
Lake Wollumboola	2	0	22	12	30		14	17	21	27	49	36	59	35	127	21	114	26	80	0	518	174
Lake Conjola					3	1	4	0									15	7	19	4	41	12
Congo Creek			1	2																	1	2
Coila Lake			1	0																	1	0
South Tuross Heads			3+	0							0	1NC	33	32	33	10	19	0	126	65	214+	108
Brou Lake	6	0									0	0					109	4	5	0	120	4
Tilba Lake	10	0	8	0																	18	0
Wallaga Lake	48	0	4	0			13	6	4	4NC			13	8	16	16	59	0	21	4	178	38
Murrah Lake					3	0			1NC	0											4	0
Middle Lagoon							1	0													1	0
Nelson Lagoon							1	0													1	0
Bega Rivermouth/ Mogareka			4	0	4+	0	13+	9				10+	18	6	18	22	41	40	3	0	101+	87+
Wallagoot Lake			2	2-3									15	12	2	1			109	109	128	124-125
<b>Total</b>	<b>228+</b>	<b>140+</b>	<b>281+</b>	<b>45+</b>	<b>224+</b>	<b>53+</b>	<b>329+</b>	<b>169</b>	<b>259</b>	<b>300</b>	<b>310</b>	<b>241+</b>	<b>409</b>	<b>271</b>	<b>563</b>	<b>286</b>	<b>631</b>	<b>292</b>	<b>770</b>	<b>414</b>	<b>4004+</b>	<b>2210+</b>

**Table 4. Land tenure of Little Tern nesting sites known to have been used since 1990. NPWS = National Parks and Wildlife Service, NP = National Park, NR = Nature Reserve.**

Nesting site	Largest colonies between 1990 – 2003	Land tenure	Management authorities
Hastings Point	1 pair 1993/94	Crown land	Tweed Shire Council, Dept. of Lands
Byron Bay	1 pair 1992/93	Crown land	Byron Shire Council, Dept. of Lands
Brooms Head	2 pairs 1994/95	Crown land	Maclean Council, Dept. of Lands
Station Creek	14 pairs 1996/97	Yuraygir NP	NPWS
Red Rock	10-11 pairs 1993/94	Crown land/ Yuraygir NP	Pristine Waters Shire Council, Dept. of Lands/NPWS
Sawtell/Bongil Bongil	47 pairs 2000/01	Bongil Bongil NP	NPWS
Valla Beach	3 pairs 1995/96	Crown land	Nambucca Shire Council, Dept. of Lands
Nambucca Heads	7 pairs 1990/91	Crown land	Nambucca Shire Council, Dept. of Lands
Harrington/ Manning Point	97 pairs 1996/97	Crown land	Greater Taree City Council, Dept. of Lands
Farquhar Inlet/ Old Bar	74 pairs 1999/00	Crowdy Bay NP	NPWS
Forster	50 pairs 1994/95	Crown land	Great Lakes Shire Council, Dept. of Lands
Treachery Beach	2-3 pairs 1994/95	Myall Lakes NP	NPWS
Dark Point	2 pairs 1996/97	Myall Lakes NP	NPWS
The Entrance	35 pairs 2001/02	Crown land	Wyong Shire Council, Dept. of Lands
Botany Bay	60 pairs 1996/97	Crown land	Sydney Ports
Comerong Island	6-7 pairs 1994/95	Comerong Island NR/Crown land	NPWS/Shoalhaven City Council, Dept. of Lands
Lake Wollumboola	40 pairs 2002/03	Jervis Bay NP	NPWS
Lake Conjola	17 pairs 2002/03	Crown land	Shoalhaven City Council, Dept. of Lands
Congo Creek	1 pair 1994/95	Eurobodalla NP	NPWS
Coila Lake	1 pair 1994/95	Crown land	Eurobodalla Council, Dept. of Lands
South Tuross Heads	62 pairs 2002/03	Eurobodalla NP	NPWS
Brou Lake	35 pairs 1990/91	Eurobodalla NP	NPWS
Tilba Lake	12-13 pairs 1993/94	Eurobodalla NP/ Crown land	NPWS/Eurobodalla Council, Dept. of Lands
Wallaga Lake	34 pairs 1993/94	Crown land	Eurobodalla Council, Bega Valley Shire Council, Dept. of Lands
Murrah Lagoon	3 pairs 1995/96	Crown land	Bega Valley Council, Dept. of Lands
Middle Lagoon	1 pair 1996/97	Mimosa Rocks NP	NPWS
Nelson Lagoon	1 pair 1996/97	Mimosa Rocks NP	NPWS
Bega Rivermouth/ Mogareka	13 pairs 1996/97	Crown land	Bega Valley Council, Dept. of Lands
Wallagoot Lake	74 pairs 2002/03	Bournda NP	NPWS

### 4.3 Tenure

All of the 29 nesting sites known to have been used by Little Terns in NSW in the 1990s and early 2000s are either in national parks or nature reserves managed by the NPWS, Crown lands managed by local councils and the Department of Lands, or, in one case (Botany Bay), Sydney Ports Corporation (Table 4). No sites are on freehold or leasehold land. Several nesting sites are adjacent to marine reserves: the Station Creek and Red Rock nesting sites adjoin the Solitary Islands Marine Park managed by NSW Marine Parks Authority, while the current Botany Bay nesting site (Towra Spit Island) adjoins Towra Point Aquatic Reserve managed by NSW Fisheries.

### 4.4 Significant Locations

The most significant locations for the Little Tern at present are the sites that have been used for nesting in recent years (>1990) and have supported colonies of at least four pairs during that period. These colonies are listed below in geographical order from north to south, with the colonies that have supported particularly large numbers of birds (20+ pairs) shown in italics. Note, however, that the importance of these and other nesting sites varies from year to year, so the list of most significant sites is likely to change over time.

- Station Creek
- Red Rock
- *Sawtell*
- Nambucca Heads
- *Harrington/Manning Point*
- *Farquhar Inlet/Old Bar*
- *Forster*
- *The Entrance*
- *Botany Bay*
- Comerong Island
- *Lake Wollumboola*
- Lake Conjola
- *South Tuross Heads*
- Brou Lake
- Tilba Lake
- *Wallaga Lake*
- Bega Rivermouth/Mogareka
- *Wallagoot Lake*

### 4.5 Habitat

#### 4.5.1 Nesting habitat

The Little Tern in NSW is strictly a coastal species, nesting in estuaries or on coastal beaches, and feeding in nearby waters. In some other parts of the world they may be found feeding and nesting along rivers and lakes far from the sea, however, this is unknown in Australia. Most of the nesting sites in NSW are sand-spits, sand islands or beaches within or adjacent to the estuaries of rivers,

creeks and coastal lakes (Appendix 1). Nesting usually occurs at or near the mouth of the estuary. The furthest nesting sites from the sea are Homebush Bay in Port Jackson (20 km from the sea), Corrie Island in Port Stephens (7 km), and Duck Creek in Lake Illawarra (6 km), none of which are known to have been used since 1980.

Nesting also occurs at some sites on ocean beaches well away from estuaries. Such sites often have a large coastal lake nearby that probably provides additional food resources for the birds. Nesting is irregular at these sites, however, they may at times support moderately large colonies, for example, along the beaches of Myall Lakes National Park in the mid 1980s (see Appendix 1).

Little Terns nest on the ground in the open. The nest is a simple scrape, usually unadorned, although sometimes lined by the birds with shell fragments, tiny pebbles or other material. Nests are typically located on flat or gently sloping ground, on a loose, sandy substrate with abundant surface shell-grit or pebbles, and bare or almost bare of vegetation. The birds appear to select sites with good visibility all around for the sitting bird, and with good camouflage for the mottled eggs and chicks (see cover photograph). Some birds will nest on bare sand, however, such nests are more prone to predation.

Nests are usually located close to the water, mostly within 150 m of, and less than 1.5 m above the high water mark. Because of this, many nests are washed away by king tides or rough seas. However, the unstable conditions help to prevent vegetation encroachment. Higher nesting sites provide greater security from flooding, however, tend to become rapidly overgrown and unsuitable.

Little Terns tend to avoid vegetated areas and will abandon a traditional nesting site if it becomes too overgrown. However, clumps of vegetation, driftwood and other beach debris are important for providing shelter and shade for the chicks once they leave the nest. For example, Larkins (1984) mentions chicks at Port Botany moving a distance of 150 m from their nest site to shelter in a patch of dense vegetation used by the colony as a creche. In Britain, chicks have been reported moving distances of 1 km or more to reach suitable cover, including swimming across 50 m of open water (Davies 1981, Haddon and Knight 1983).

Suitable nesting habitat can be created artificially. The birds readily nest on newly deposited dredge-spoil and similar artificial sites, with numerous examples in NSW (see Appendix 1). If conditions are suitable, these sites may support large and highly successful colonies, as occurred, for example, on an artificial sand island at Forster in the 1993/94 season (Smith 1994a). This Recovery Plan will seek to identify and evaluate opportunities for the incidental creation and/or enhancement of nesting habitat in NSW (Action 3.1).

## **5. Biology and Ecology**

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### **5.1 Abundance**

Morris (1979) reported a major decline in the Little Tern breeding population in NSW between the 1950s and 1970s. In three breeding seasons in the late 1970s, he recorded a maximum count of 86 breeding pairs in 1977/78 (NPWS 2000a), although he suggested that the actual population could have been as large as 126 pairs. By comparison, the breeding population in the mid 1950s was

estimated at approximately 340 pairs, based on historical records provided by a number of observers. Clancy (1987) made counts of Little Terns in the northern half of NSW over three breeding seasons in the early 1980s and concluded that the size of the breeding population in this part of the State was approximately 60 pairs.

A Statewide census of the Little Tern was carried out in December 1984 (Martindale 1985, Morris 1985), from which Smith (1990) estimated the size of the breeding population at 110 pairs (allowing for some birds being missed in the census). Similar Statewide censuses were carried out in December 1989, 1993 and the last in 1994 (Starks 1992, Smith 1995c). The results suggested that the breeding population had increased to an estimated 169 pairs by 1994 (NPWS 2000a). It corresponded to reports of productive seasons at several nesting sites: Forster in 1989/90 and 1993/94; Brou Lake in 1990/91; Botany Bay in 1992/93 and 1994/95; and Harrington/Manning Point in 1993/94 and possibly 1992/93 (Smith 1995c). There may also have been an influx of birds from Victoria, where an intensive long-term management program resulted in a series of successful breeding seasons between 1989 and 1997 (Murray 1994, DSE Records). On the basis of intensive management and monitoring, approximately 437 breeding pairs are known to have visited NSW nesting sites in season 2002/2003 (NPWS records).

The numbers of nests recorded in NSW during the last ten breeding seasons have ranged from 228+ in 1993/94 to 770 in 2002/03 (Table 3). These figures are greatly inflated by birds re-nesting during the season, and are thus poor estimates of population size. They do, however, indicate a continuing trend of increase in the breeding population.

Counts of the Asian non-breeding population of the Little Tern in NSW indicate that it is substantially larger than the south-east Australian breeding population. Counts of the non-breeders have ranged from 723 in 1993 to 1411 in 1994 (NPWS 2000a). The low count in 1993 was probably a result of fewer sites being surveyed that year, especially the absence of counts from the Hunter estuary and Lake Illawarra, which normally support several hundred Asian non-breeding birds (Smith 1995c).

## **5.2           Reproduction**

### **5.2.1        Reproductive biology**

Little Tern in NSW breed as solitary pairs or in colonies. Most colonies are small, although managed sites have been recorded with up to 97 pairs (Table 4). Of 183 colony size records in NSW since 1950, 16.4% were single nests, 30.6% were colonies with 2-5 nests, 11.5% were colonies with 6-10 nests, 14.2% were colonies with 11-25 nests, and 27.3% were larger colonies (Table 5). The largest colony recorded in NSW was at Harrington/Manning Point in the 1996/97 season, with an estimated 97 breeding pairs and a total of 135 nests during the season (Smith 1997). In more recent years, the larger colonies have been at Wallagoot Lake and Harrington/Manning Point with 74 and 79 breeding pairs respectively recorded during season 2002/03 (Keating and Jarman 2003, Hole and Hole 2003). Larger colonies have been reported outside NSW. For example, approximately 265 breeding adults (approximately 130 breeding pairs) were recorded in a colony on Rigby Island, Victoria, in the 1988/89 season (Reside *et al.* 1989), while colonies in Great Britain may contain up to approximately 200 pairs (Norman and Saunders 1969).

**Table 5. Size of Little Tern nesting colonies in NSW.**

Records for 1950-79 from Morris (1979). Records for 1993-03 from Table 3.

No. of nests	No. of colonies			
	1950-79	1993-03	Total	%
1	15	15	30	16.4
2	7	12	19	10.4
3	7	10	17	9.3
4	3	9	12	6.6
5	6	2	8	4.4
6	1	4	5	2.7
7	3	1	4	2.2
8	2	1	3	1.6
9	3	1	4	2.2
10	3	2	5	2.7
11-25	4	22	26	14.2
>25	5	45	50	27.3
<b>Total</b>	<b>59</b>	<b>124</b>	<b>183</b>	<b>100</b>

The birds first reappear in NSW each year in late August through to October. Courtship displays begin soon after their return, involving courtship flights and courtship feeding (Sefton 1959, Higgins and Davies 1996). The pair then typically engages in repeated scrape-making, moving from place to place until they finally select a suitable nest site. Breeding typically begins in NSW in mid-October to mid-November and continues through into January or February. The timing of breeding of individual colonies can vary greatly between years, nevertheless there is a general pattern of breeding beginning earlier in colonies on the North Coast (October or November) than in colonies on the south coast (November or December) (Hitchcock 1959).

The first wave of nesting in a colony may be staggered over a month or more as the colony builds in numbers. This is often followed by a second wave of nesting later in the season, especially at the larger colonies. Studies of the Least Tern in California have shown that the later nesters include both young birds breeding for the first time and older birds re-nesting after failing earlier in the season (Massey and Atwood 1981). An interval of 4-16 days between loss of eggs or chicks and re-nesting has been recorded for the Least Tern (Massey and Fancher 1989). Similar nesting patterns have been observed for the Little Tern in NSW with 10-12 days found to be the most common interval between loss of all eggs/chicks and re-nesting at Harrington/Manning Point (H. Hole pers. comm.).

The spatial configuration and density of nests at colonies is highly dependent upon the availability of optimal habitat. At Sawtell/Bongil Bongil a typical nesting configuration may comprise between 2 and 5 nodes, or clusters of nests, and distances between each nest inside each cluster may be between 10 and 25 metres. Distances may be up to 150 metres between individual nests in different nodes (M. Smith pers. comm.). At Brou Lake, an island nesting site on the NSW south coast, nests can be spaced as little as 20 cm apart (J. Keating pers. comm.). Nest densities reported for Victorian colonies have been 1 nest/400 m<sup>2</sup> and 1 nest/100 m<sup>2</sup> (Hill and Montague 1985), 1 nest/42 m<sup>2</sup> (Reside *et al.* 1989) and 1 nest/7 m<sup>2</sup> (Owen 1990). A colony of 23 nests at Botany Bay

occupied approximately 1.25 ha, which equated to 1 nest/550 m<sup>2</sup> or an average distance between nests of 23 m (Larkins 1984). A typically large distance between nests may help to conceal terns from predators. Little Tern actively defend their nests and many pairs may combine to drive away potential predators. However, they are less effective in repelling predators than other tern species that nest in larger, denser colonies and make little effort to conceal their nests.

The normal clutch size in NSW is two or three, occasionally only one. The mean clutch size at Forster over two seasons was 2.3, declining through each season from 2.6 in November to 2 in January (Smith 1994a). Three-egg clutches were more common earlier in the season, while one-egg clutches were only recorded later in the season (not including clutches that were predated before completion). Eggs are usually laid on alternate days, sometimes on successive days (Campion 1963). Both parents incubate the eggs. Incubation may begin after the first egg is laid, however, is irregular until the clutch is complete. The incubation period in NSW has been recorded as 17-22 days at Forster (Smith 1994a) and 20-21 days at Botany Bay (Campion 1963). At Harrington/Manning Point the incubation period has been recorded at 18-26 days, with the longer incubation period during cold weather and when hatching is delayed by rain or when disturbance during the first week of incubation delays them settling properly (H. Hole pers. comm.). In general, hatching of the eggs is nearly synchronous, usually within a 24-hour period, however, at Farquhar Inlet hatching has been recorded over a four day period, with two days being the most common for a clutch of three (H. Hole pers. comm.).

After hatching, the chicks are cared for and fed by both parents. Chicks typically leave the nest within 24 hours of hatching and shelter in nearby vegetation or debris. As they become more mobile, they may move well away from the nesting area to seek better cover. The period from hatching to fledging has been recorded as 17-19 days at Forster (Smith 1994a) and approximately 21 days (once 18 days) at Botany Bay (C. Campion pers. comm.). After fledging, the family may remain in the general area until the end of the season or they may move to another estuary, sometimes within a few days of fledging. The parents continue to feed the young long after fledging. Because of this, birds that successfully raise young are unlikely to re-nest until the following season (Cramp 1985).

The age of independence of the young is not known. Least Terns in North America have been recorded still being fed by their parents two to three months after fledging (Hardy 1957), and have been seen accompanying their parents on migration and being fed at stopovers (Massey 1982). In an eight-year study of the Botany Bay colony in the 1950s and 1960s, nine birds banded as chicks were later recorded nesting, six birds at age three years, one at age four and two at age five (C. Campion pers. comm.). Only two of these birds returned to Botany Bay to nest - the other seven were found nesting at Port Kembla, some 65 km away.

The age of first breeding of Little Terns in Europe is sometimes two years, though usually older (Cramp 1985). Least Terns in California, however, usually begin breeding at the age of two (Massey 1982). At Harrington in NSW the age of first breeding has been confirmed at two years (two chicks banded at Harrington in November 1997 were colour flagged as breeding adults at the same site in December 1999) (H. Hole pers. comm.).

Least Terns in California are known to exhibit strong year-to-year fidelity (philopatry) to particular colony sites, with a mean annual return rate of 78% (Atwood and Massey 1988). A similar pattern

is indicated for Little Terns in NSW. For example, 30 of 38 adult Little Terns, both breeders and non-breeders, banded at Forster in the 1992/93 season were re-sighted there the following breeding season, with most of them re-sighted repeatedly during the season (Smith 1994a). In the Botany Bay study in the 1950s and 1960s, individual birds were recorded returning to nest in the colony in up to seven of the eight years (C. Campion pers. comm.).

Although the Little Tern tend to exhibit strong site affinity, birds of the breeding population have also been recorded changing colonies between years or during the season. Movements have been reported between colonies within NSW and between New South Wales and Victorian colonies (Smith 1994a, Priddel and Ross 1996). Keating and Jarman (2002) re-sighted 11 colour-flagged adults at the Wallaga Lake and Bega Rivermouth/Mogareka colonies during the 2001/2002 breeding season. These individuals had dispersed from as far as Lake Wollumboola, Botany Bay, Forster to the north and from several sites in Victoria. Banding data and general observations have indicated that when an early nesting attempt fails, the birds may either re-nest in the same locality or abandon the area (as single pairs or whole colonies) and re-nest elsewhere. In a study of re-nesting in the Californian Least Tern, 52% of pairs re-nested at the same colony site, while of the pairs that moved, 81% went to an adjacent colony (Massey and Fancher 1989).

### 5.2.2 Reproductive success

Data on the hatching and fledging success of Little Tern in NSW are shown in Table 6. Overall, hatching success was higher at colonies studied in the 1960s than in the 1980s, 1990s and 2000s. This was chiefly due to lower levels of egg predation in the 1960s, at least at the colonies studied (C. Campion, unpublished data). Fledging success was poor at colonies studied in the 1980s, but noticeably better at colonies studied in the 1990s and 2000s, when more intensive management efforts were being made. Between 1993 and 2003 at least 2210 young are known to have fledged in NSW from a total of at least 4004 nests (Table 3); this represents a mean success rate of 0.55 fledglings per clutch per year.

A preliminary analysis of banding data from Britain has indicated that the minimum fledging rate needed to maintain a stable population of Little Terns is approximately 0.5 fledglings per breeding pair per year (Haddon and Knight 1983). Holloway (1993) has provided a similar estimate of 0.4 fledglings per pair per year based on extrapolation from studies of other long-lived seabirds. Support for these estimates also comes from Victoria, where the Little Tern fledging rate averaged approximately 0.5 per pair per year between 1979 and 1988. The size of the breeding population remained fairly stable over this period and was estimated at approximately 120 pairs in 1988 (Hill *et al.* 1988). Subsequently, the fledging rate almost doubled and some 1000 fledglings were raised in the seven breeding seasons from 1989 to 1996 (Murray 1994, Murray and Reside 1995, J. Reside pers. comm.). There had been a corresponding increase in the breeding population, which in 1998 was approximately 210 pairs.

Conversely, a declining fledging rate over successive years may lead to a reduction in adult numbers over time. Data from Victoria indicates that a significant reduction in fledgling success between 1999 and 2003 may be partly responsible for a substantial decline in numbers of breeding adults visiting East Gippsland nesting sites (from 227 in 1997/98 to 123 in 2002/03 (DSE records)). Although the most recent data is yet to be confirmed (L. Waldegrave-Knight pers. comm.), the total number of chicks fledged in five seasons to 2002/03 was 161 or an equivalent

mean fledging rate per breeding pair per season of 0.25 chicks. In comparison, the total number of chicks fledged in the five seasons prior to 1996/97 was 615 or a mean fledging rate of 0.63 chicks per season per breeding pair.

Further analysis of the banding data is required to accurately define the causes of the decline in Victoria, however, the apparent reduction may be attributed to Victorian birds relocating to nesting sites throughout the south coast of NSW (J. Keating pers. comm.) and/or a severe hailstorm in season 2001/02 which was responsible for the death of a number of adult birds (Bedford 2003). Victorian numbers were down by approximately 35 pairs during the 2002/2003 breeding season and there was a corresponding increase in numbers within the adjacent NPWS Far South Coast Region (C. Minton pers. comm.). The decline in adult birds may also be contributing to lower fledging rates with smaller colonies less effective in warding off predators (L. Waldegrave-Knight pers. comm.).

Management efforts within NSW over recent years have clearly met the recovery targets as outlined within the *Draft Recovery Plan* (NPWS 2000). The maintenance of, and potential increase to, the fledging rate should thus be a priority for the duration of the life of this Recovery Plan. Management efforts should continue to be directed to the intensive management of threatening processes at nesting sites.

**Table 6. Breeding success of Little Tern in NSW.**

Note that these figures include re-laid clutches and thus underestimate the hatching and fledging success per pair. For season 2000/01 the results for Harrington/Manning Point and Farquhar Inlet/Old Bar was combined

Nesting site	Season	Nests	Eggs	Hatched	Number hatched per clutch	Fledged	Number fledged per clutch	Reference
Botany Bay	1959/60	23	55	38	1.65	?	?	C. Champion pers. comm.
Botany Bay	1960/61	25	59	33	1.32	?	?	C. Champion pers. comm.
Botany Bay	1961/62	16	37	24	1.50	?	?	C. Champion pers. comm.
Botany Bay	1962/63	19	45	43	2.26	?	?	C. Champion pers. comm.
Botany Bay	1963/64	17	39	28	1.65	?	?	C. Champion pers. comm.
Botany Bay	1964/65	11	29	11	1.00	?	?	C. Champion pers. comm.
Botany Bay	1965/66	10	29	16	1.60	?	?	C. Champion pers. comm.
Port Kembla	1963/64	48	112	81	1.69	?	?	C. Champion pers. comm.
Port Kembla	1964/65	34	86	67	1.97	?	?	C. Champion pers. comm.
Port Kembla	1965/66	29	66	30	1.03	?	?	C. Champion pers. comm.
Bellambi Point	1965/66	10	27	12	1.20	?	?	C. Champion pers. comm.
<b>1960s records</b>		<b>242</b>	<b>584</b>	<b>383</b>	<b>1.53</b>	<b>?</b>	<b>?</b>	
Botany Bay	1980/81	29	74	30	1.03	12	0.41	Larkins (1984)
Botany Bay	1981/82	40	84	30	0.75	1	0.03	Larkins (1984)
Botany Bay	1982/83	25	57	28	1.12	1	0.04	Larkins (1984)
Sawtell	1981/82	16	30	14	0.88	3	0.19	Clancy (1982)
Nambucca Heads	1985/86	19	39	7	0.37	1	0.05	D. Secomb pers. comm.
Nambucca Heads	1986/87	39	79	3	0.08	1	0.03	D. Secomb pers. comm.
<b>1980s records</b>		<b>168</b>	<b>363</b>	<b>112</b>	<b>0.67</b>	<b>19</b>	<b>0.11</b>	
Forster	1992/93	104	184	33	0.32	17	0.16	Smith (1994a)
Forster	1993/94	51	111	85	1.67	48	0.94	Smith (1994a)
Forster	1994/95	90	183	64	0.71	2	0.02	Smith (1995a)
Forster	1995/96	18	30	23	1.28	8	0.44	A. Rose pers. comm.
Botany Bay	1993/94	16	26	2	0.13	0	0.00	Priddel and Ross (1996)
Botany Bay	1994/95	50	106	69	1.38	22-66	0.44-1.32	Priddel and Ross (1996)
Botany Bay	1995/96	76	141	34	0.45	11-27	0.14-0.36	Priddel and Ross (1996)
Botany Bay	1996/97	94	184	118	1.26	22	0.23	G. Ross pers. comm.
Botany Bay	1997/98	96	228	139	1.45	34	0.35	G. Ross pers. comm.
Botany Bay	1998/99	73	160	93	1.27	43	0.59	G. Ross pers. comm.
Harrington/Manning Point	1996/97	139	323	167	1.20	104	0.75	Smith (1997)
Harrington/Manning Point	1997/98	124	294	251	2.02	233	1.88	Parsons (1998)
Harrington/Manning Point	1998/99	87	191	108	1.24	72	0.83	Mardell (1999)
Farquhar Inlet/Old Bar	1998/99	53	129	83	1.57	36	0.68	Mardell (1999)

Nesting site	Season	Nests	Eggs	Hatched	Number hatched per clutch	Fledged	Number fledged per clutch	Reference
<b>1990s records</b>		<b>1071</b>	<b>2290</b>	<b>1269</b>	<b>1.18</b>	<b>652-712</b>	<b>0.61-0.66</b>	
Botany Bay	1999/00	37	61	43	1.16	24	0.65	Egan (2000)
Botany Bay	2000/01	70	153	81	1.16	22	0.31	Ross and Jarman (2001)
Botany Bay	2002/03	101	194	73	0.72	43	0.43	Ross <i>et al.</i> (2003)
Bega Rivermouth/Mogareka	2001/02	41	72	42	1.02	40	0.98	Keating and Jarman (2002)
Bega Rivermouth/Mogareka	2002/03	3	7	0	0.00	0	0.00	Keating and Jarman (2003)
Brou Lake	2001/02	109	217	10	0.09	4	0.04	Keating and Jarman (2002)
Brou Lake	2002/03	5	7	3	0.60	0	0.00	Keating and Jarman (2003)
Farquhar Inlet/Old Bar	1999/00	111	231	114	1.03	79	0.71	NPWS (2000b)
Farquhar Inlet/Old Bar	2001/02	73	138	103	1.41	59	0.81	Hole and Hole (2002)
Farquhar Inlet/Old Bar	2002/03	24	47	30	1.25	14	0.58	Hole and Hole (2003)
Harrington/Farquhar Inlet	2000/01	219	453	197	0.90	83	0.38	Hole and Hole (2001)
Harrington/Manning Point	1999/00	81	175	58	0.72	37	0.46	NPWS (2000b)
Harrington/Manning Point	2001/02	97	164	10	1.10	74	0.76	Hole and Hole (2002)
Harrington/Manning Point	2002/03	166	313	107	0.64	71	0.43	Hole and Hole (2003)
Lake Conjola	2001/02	14	34	14	1.00	7	0.50	Keating and Jarman (2002)
Lake Conjola	2002/03	19	40	6	0.32	4	0.21	Keating and Jarman (2003)
Lake Wollumboola	2001/02	114	218	66	0.58	26	0.23	Keating and Jarman (2002)
Lake Wollumboola	2002/03	80	158	12	0.15	0	0.00	Keating and Jarman (2003)
Sawtell/Bongil Bongil	2000/01	44	119	106	2.41	81	1.84	Parramore and Parramore (2001)
Sawtell/Bongil Bongil	2001/02	48	103	72	1.50	32	0.67	Parramore and Parramore (2002)
Sawtell/Bongil Bongil	2002/03	37	76	35	0.95	21	0.57	Parramore and Parramore (2003)
The Entrance	2001/02	72	158	76	1.06	50	0.69	Morris (2002)
The Entrance	2002/03	64	150	72	1.13	27	0.42	Morris (2003)
South Tuross Heads	2001/02	19	31	0	0.00	0	0.00	Keating and Jarman (2002)
South Tuross Heads	2002/03	126	275	67	0.53	65	0.52	Keating and Jarman (2003)
Wallaga Lake	2001/02	59	100	3	0.05	0	0.00	Keating and Jarman (2002)
Wallaga Lake	2002/03	21	52	11	0.52	4	0.19	Keating and Jarman (2003)
Wallagoot Lake	2002/03	109	239	109	1.00	109	1.00	Keating and Jarman (2003)
<b>2000s records</b>		<b>1963</b>	<b>3985</b>	<b>1617</b>	<b>0.82</b>	<b>976</b>	<b>0.50</b>	

### 5.3 Longevity

A preliminary analysis of banding data for Little Terns in Britain has indicated a high yearly survival rate for adults of approximately 78% (Haddon and Knight 1983). For Least Terns in California, Massey *et al.* (1992) calculated that the overall survival rate for adults, once they had returned to breed, was 88%. The survival rate for young breeders (2-3 years old) was 81%, compared with 92% for older breeders (4+ years old). The expected breeding life of an adult (once it had bred) was calculated as 9.63 years. The oldest banded birds in the Californian study were 13 years, which was also the age of the oldest birds in the British study. The oldest Little Tern recorded in Australia was a non-breeding bird recovered in the Hunter River estuary over 17.5 years after being banded there (Leishman 1995). Although records are currently limited in Australia, one banded bird recaptured at Botany Bay in 1998 was still breeding at 13 years, and birds are capable of breeding at 2 years (G. Ross, pers. comm.)

### 5.4 Diet

Little Tern in NSW, both south-east Australian breeders and Asian non-breeders, feed predominantly on small fish (less than 10 cm long). The chief prey species at Forster is the Port Jackson Perchlet, which is the common 'whitebait' species in the estuary (Smith 1994a). At least seven other fish species are also taken at Forster, including an estuary flying-fish and a surf species, the Surf Fish (Table 7). Four additional species have been recorded as prey at Botany Bay, including the introduced Plague Minnow (Table 7). For eight species of fish, Little Terns took only juveniles, which suggests that fish nursery areas play an important role.

**Table 7. Fish species recorded as prey of the Little Tern at Forster (Smith 1994a) and Botany Bay (C. Champion pers. comm.).**

Family	Species	Common name	Age class	Site
Centropomidae	<i>Ambassis jacksoniensis</i>	Port Jackson Perchlet	adult	Forster
Eleotrididae	<i>Gobiomorphus australis</i>	Striped Gudgeon	juvenile	Forster
Eleotrididae	<i>Hypseleotris compressa</i>	Empire Gudgeon	juvenile	Botany Bay
Clupeidae	<i>Hyperlophus vittatus</i>	Sandy Sprat	adult	Forster
Mugilidae	<i>Mugil cephalus</i>	Sea Mullet	juvenile	Botany Bay
Mugilidae	<i>Myxus elongatus</i>	Sand Mullet	juvenile	Forster
Poeciliidae	<i>Gambusia holbrooki</i>	Plague Minnow	Adult	Botany Bay
Pomatomidae	<i>Pomatomus pedica</i>	Tailor	juvenile	Botany Bay
Scorpididae	<i>Scorpius lineolatus</i>	Silver Sweep	juvenile	Forster
Sillaginidae	<i>Sillago maculata</i>	Trumpeter Whiting	juvenile	Forster
Tetraodontidae	<i>Tropidostethus rhotophilus</i>	Surf Fish	adult	Forster
Exocoetidae	Unidentified	Flying-fish	juvenile	Forster

Although terns feed almost exclusively upon fish, Chafer and Brandis (1991) suspected that from the feeding behaviour of Asian non-breeding birds at Lake Illawarra that they were taking insects and crustaceans in addition to fish. Similar observations were reported at Croki on the NSW mid-North Coast where older Little Tern fledglings were seen to feed on small prawns (Parsons 1998). In Europe and Africa, their diet includes a significant proportion of invertebrates, particularly crustaceans and insects (Cramp 1985, Urban *et al.* 1986).

Little Terns feed diurnally, flying over the water with quick wing-beats, their heads directed downward. When prey is sighted they often hover briefly before dropping to the water, typically stalling momentarily and then continuing with a shallow dive into the water. In NSW, most feeding occurs inside or at the mouths of estuaries, although birds are also seen feeding along the coast away from estuaries. At Wallis Lake, the birds have been seen feeding inside the lake up to 9 km from the entrance, however, most feeding occurs within 4 km of the entrance and within 3 km of the nesting site; the more distant feeding observations involved Asian non-breeders or south-east Australian breeders with fledglings, rather than birds with eggs or chicks at the nesting site (Smith 1994a). Off shore, the terns generally fish beyond the breaker line to a distance of 500 m from shore (Chafer and Brandis 1991). Most feeding occurs in saline or brackish waters, although Egan (1992) observed both breeders and non-breeders feeding on a freshwater lake near Botany Bay.

## 6. Previous Management Actions

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The NPWS has been involved in the monitoring and management of Little Tern nesting sites in NSW since the late 1970s, when Morris (1979) first drew attention to the declining status of the local breeding population. Nesting sites in northern NSW were monitored from 1979/80 to 1982/83 (Clancy 1979, 1980a, 1980b, 1981, 1982, 1983, 1987). Statewide surveys were carried out in 1984/85 (Martindale 1985, Morris 1985), 1989/90 (Starks 1992), and in 1993/94 and 1994/95 (Smith 1995c). A management report and draft management plan for the species were published in 1990 (Smith 1990, NPWS 1990). Intensive management has been carried out at a number of nesting sites since that time, involving fencing, signs, wardening, community education, predator control and other actions designed to increase breeding success. Draft management plans have been prepared for the colonies in the Grafton Area (Smith 1995d), Dorrigo Area (Smith 1995e), Nowra Area (Smith 1995f) and Narooma Area (Smith 1995g).

A two-year study of the Forster colony was carried out in 1992/93 and 1993/94 with funding support from NSW Public Works through the Estuary Management Program, resulting in a management report and draft management plan for the colony (Smith 1994a, 1994b). The study was extended to the Harrington/Manning Point colony in 1993/94 and a report with management recommendations was prepared for that colony (Smith 1994c). The Botany Bay colony was the subject of an intensive study from 1993/94 to 1995/96 in conjunction with construction of the third runway at Sydney Airport in 1993/94 and relocation of the colony from the northern side of the Bay to Towra Spit Island (Straw and Priddel 1992, Priddel and Ross 1996). The study was commissioned by the Federal Airports Corporation.

The most consistently productive colony over the last seven seasons has been Harrington/Manning Point, with at least 104 fledglings raised in 1996/97, 72 fledglings in 1998/99 and 83, 74 and 107 chicks fledged in the three seasons to 2002/03 (Table 3). Highly productive seasons were also

recorded at Wallagoot Lake and South Tuross Heads (both NSW south coast) during season 2002/03 with 109 and 65 juveniles fledged respectively (Table 3). The most intensively managed colonies in NSW during the 1990s were Forster, Harrington/Farquhar Inlet, Botany Bay and Lake Wollumboola. In recent years, intensive management has broadened to include six extra nesting sites on the NSW south coast as well as sites within the Central and North Coasts (The Entrance and Station Creek). The number of chicks fledged within NSW each season, as a consequence, has increased steadily over the past decade, numbering 140 in 1993/94, 241 in 1998/99 and increasing to 414 in 2002/03 (see Table 3).

Prior to 1999, when intensive conservation efforts were being implemented at four major sites and a select number of minor sites, the relative success of the NSW Little Tern breeding season was highly variable - typically an alternating succession of good and bad seasons. For example, a catastrophic loss of eggs and chicks from natural or human induced factors at one nesting site would often equate to the NSW season total being significantly affected in any given year. While management efforts have been redoubled in recent years, primarily through wider use of measures such as electric fencing and fox baiting at existing and additional sites, threats to chicks and eggs from predation and/or inundation still continue to factor heavily. Broadening the management arc has not altered the fact that the species remains highly conservation dependent. Instead, additional sites now serve only to ensure that nesting failure at one or two sites in any given season will not necessarily equate to significant losses across the entire State.

A debriefing session was held each year between 1994 and 1999 to compare and discuss the results of Little Tern management in each coastal NPWS Area, however, due to insufficient funds they have not occurred since this time. Each debriefing session was considered to be a valuable opportunity to exchange ideas by all that attended and its reinstatement on a biennial basis is the subject of Action 7.3. Representatives of Little Tern management authorities in Victoria and Queensland have also attended some of these meetings.

## **7. Management Issues**

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### **7.1 Threats and Reasons for Decline**

#### **7.1.1 Threats to breeding success**

Nesting on open ground, where they are subject to high levels of predation in exposed sites close to water and prone to frequent natural disturbance, Little Terns tread a fine line between nesting success and failure even under completely natural conditions. Their breeding success rate has been further inhibited by a variety of human-related factors. This pattern of poor breeding success through a combination of natural and human factors has been the chief cause of population decline in Little Terns in Australia (Morris 1979, Vincent 1983, Hill *et al.* 1988, Smith 1990, Garnett 1993) and elsewhere around the world (eg. Cramp 1985, Holloway 1993).

Threats to breeding success in NSW are:

#### **Natural threats**

##### *(1) Nest flooding*

Many nests fail when the eggs or chicks are washed away by king tides, rough seas or rising lake or river levels. The most common cause of nest flooding is king tides. Nest flooding was the second most frequently recorded cause of nest failure in NSW in the 1993/94 and 1994/95 breeding seasons, when at least 88 nests were flooded (Smith 1995c). It was also noted as the major natural threat to Little Tern colonies in northern NSW in the early 1980s (Clancy 1987). Colonies where nest flooding is known to have been a cause of failure are Station Creek, Red Rock, Nambucca Heads, Harrington/Manning Point, Farquhar Inlet (Old Bar), Botany Bay, Lake Wollumboola, South Tuross Heads, Brou Lake, Tilba Lake, Wallaga Lake and Bega Rivermouth/Mogareka (Smith 1995c-g, Gow 1997). At coastal lakes on the south coast such as Brou Lake and Wallagoot Lake, the birds face a dual threat of nests being flooded by king tides when the lake entrance is open, and being flooded by rising lake levels when the entrance is closed (J. Keating pers. comm.).

## (2) Native Predators

Predation or suspected predation of eggs and young was the most frequently reported cause of nest failure at Little Tern colonies in NSW in the 1993/94 and 1994/95 seasons (Smith 1995c), and again in the 1995/96 season (NPWS records). Various native and introduced predators are involved. The native predators identified in NSW are:

- Silver Gull (*Larus novaehollandiae*). The most frequently reported native predator at NSW colonies. In the 1993/94 and 1994/95 seasons, it was involved in predation on at least 31 nests (Smith 1995c). It has been identified as a particular threat at Forster (Smith 1994a, 1995c), Harrington/Manning Point (Smith 1994b, 1995b, Smith 1997), Nambucca Heads (Secomb 1994) and most recently at Farquhar Inlet (formerly known as Old Bar) (H. Hole pers. comm.). Gull predation has also been observed at Botany Bay (Egan 1990), although the main predators there in recent seasons have been foxes and Australian Ravens (Priddel and Ross 1996). Gull numbers have increased considerably in NSW over the past 50 years in parallel with the increase in the human population and the additional food resources that this has provided for gulls (Smith 1995). The population of gulls at their main breeding colony in the State (the Five Islands group off Wollongong) has increased from only a few pairs before 1940 to an average of approximately 50 000 pairs between 1978 and 1991 (Gibson 1979, Smith 1995).
- Australian Raven (*Corvus coronoides*). The species has been a major nest predator at Botany Bay in recent years, notably in the 1995/96 season, when ravens were implicated in the loss of at least 37 eggs (Priddel and Ross 1996).
- Peregrine Falcon (*Falco peregrinus*). The frequent presence of a Peregrine Falcon at a nesting site at Botany Bay in the 1993/94 season apparently caused all the pairs there to abandon their nests, although whether or not it was actually preying on the adults is unknown (Priddel and Ross 1994).
- Nankeen Kestrel (*Falco cenchroides*). Observed with a freshly killed large chick, almost at flying stage, at Botany Bay in the 1982/83 season, and thought to have been a major cause of chick losses that year (Larkins 1984). Also seen to take a chick at Botany Bay in the 1962/63 season (C. Champion pers. comm.).
- Whimbrel (*Numenius phaeopus*). A determined but unsuccessful attack on a large chick was observed at Forster in the 1993/94 season. Tracks indicated that Whimbrels regularly wandered over the nesting area and were responsible for losses of both eggs and young chicks, especially

the latter, possibly accounting for approximately half the chick losses for the season (Rose 1994, Smith 1994a). The following season, they were again implicated in the loss of at least two eggs or just hatched chicks at Forster (Smith 1995a).

- Galah (*Eolophus roseicapilla*). Galahs feeding on Sea Rocket in amongst nest sites caused constant disturbance to terns at Myall Lakes National Park. Runners have been taken and believed eaten (A. Rose pers. comm.).
- Forest Raven (*Corvus tasmanicus*). Implicated by their tracks in the loss of eggs from at least two nests at Forster in the 1992/93 season (Smith 1994a).
- Pied Oystercatcher (*Haematopus longirostris*). At least one chick was taken by a Pied Oystercatcher at Forster in the 1994/95 season (Smith 1995a).
- Swamp Harrier (*Circus approximans*). A number of chicks were taken at Wallaga Lake during the 2001/02 and 2002/03 seasons (Keating and Jarman 2002).
- Owl. An unidentified owl species was implicated in predation at the Botany Bay colony in the 1996/97 season (G. Ross pers. comm.).
- Beach Stone Curlews (*Esacus neglectus*) are known to prey upon chicks and eggs at Harrington (H. Hole pers. comm.).
- Lace Monitor (*Varanus varius*). A Lace Monitor was implicated in the loss of 7 clutches of eggs at Sawtell/Bongil Bongil (Morris 2003).
- Ghost Crab (*Ocypode cordimana*). Implicated in the loss of at least 18 eggs and chicks at Forster in the 1994/95 season (Smith 1995a). Crab holes appeared in the nests at the same time as the eggs or young disappeared. One crab was found clasping a freshly hatched chick. At another nest, two small chicks were found partly eaten inside a crab hole. A captive crab was tested with an infertile tern egg placed in its container. The egg was buried and completely devoured. Predation by crabs has also been recorded at Botany Bay in 1994/95 (Priddel and Ross 1996) and Harrington/Manning Point in 1996/97 (Smith 1997).
- Ants. Small black ants, species unknown, have been observed attacking young chicks at Botany Bay (Larkins 1984, G. Ross pers. comm.) and Forster (D. Turner pers. comm.), attacking the eyes or swarming all over the chick, causing blindness or death. This appears to be a particular problem when the birds nest in relatively well vegetated sites. It is thought to have been a significant cause of chick losses at Botany Bay in 1996/97.

Another likely predator at colonies in northern NSW is the Torresian Crow (*Corvus orru*), judging by the known predatory habits of its congeners, the Australian Raven and Forest Raven and at Victorian colonies, the Little Raven (*Corvus mellori*) (DCNR 1994). Another predator recorded taking Little Tern eggs in Victoria is the White-bellied Sea-Eagle (*Haliaeetus leucogaster*) (Hill and Montague 1985).

### (3) Adverse Weather Conditions

Adverse weather conditions can at times cause heavy losses, even the total failure of a nesting attempt. This occurred at Forster in the 1989/90 season, when 23 nests were buried by sand during three days of strong winds (D. Turner pers. comm.), and again in the 1994/95 season, when chicks and eggs from at least 29 nests were lost during two three-day periods of cold, wet, windy weather

(Smith 1995a). In the latter case, the losses were due to burial by sand, increased predation, death of chicks from starvation and exposure, and abandonment of the site by adult terns. The relative importance of these various factors was unclear. A similar three-day period of bad weather, combined with king tides, resulted in the loss of 17 eggs and two nestlings at Harrington/Manning Point in 1996/97 (Smith 1997). Similar events were reported at Sawtell/Bongil Bongil during the 2001/02 season where 26 nests containing 52 eggs were washed away despite the best efforts of local volunteers and NPWS staff (Parramore and Parramore 2002). Death of chicks has also been noted during periods of very hot weather, such as at The Entrance in 1994/95 (Smith 1995c).

## Human-induced threats

### *(4) Human Disturbance*

In many parts of the world, human disturbance of nesting Little and Least Terns has been identified as a major factor, often the most important one, leading to poor breeding success and abandonment of nesting sites (eg. Norman and Saunders 1969, Thomas and Richards 1977, Massey 1982, Burger 1984, Cramp 1985, Kotliar and Burger 1986). This has also been the case in Australia (eg. Morris 1979, Vincent 1983, Clancy 1987, Hill *et al.* 1988, Smith 1990).

#### *Non-vehicular*

Beaches are a focus for recreational activities and Little Tern colonies may be subject to continual disturbance by walkers, swimmers, sunbathers, fishermen, picnickers, boaters and others. A single fisherman sitting quietly by the edge of the water may keep the terns off their nests for hours at a stretch. Eggs and chicks may be accidentally trodden on or the prolonged absence of the parent birds may leave the eggs and chicks more vulnerable to hot or cold conditions, to burial by wind-blown sand, or to predators, especially gulls. The problems are exacerbated when people bring dogs to the site, which may prey on the eggs and young or harass the parents. Other predators such as gulls and ravens may be attracted to the site by the presence of people and the food scraps they leave.

As an example of the effects of human disturbance, ten nests and 21 eggs were lost on one occasion at Forster in January 1993, when a group of ten children ran across the nesting area. One egg was found to have been trodden on, two others were half buried and deserted, and the remainder had disappeared, apparently taken by gulls (judging by tracks) when the birds were disturbed from their nests (Smith 1994a).

Most human disturbance of nesting colonies is accidental, however, there have also been cases of deliberate vandalism or egg collecting. For example, many eggs were taken from the Byron Bay and Station Creek colonies by egg collectors in the late 1970s and early 1980s (Morris 1979, Clancy 1987). More recently, three children took a total of 44 eggs from the Harrington/Manning Point colony in the 1996/97 season (Smith 1997).

#### *Vehicular*

Another form of human disturbance is by off-road vehicles. Beaches are a favourite site for recreational off-road vehicles, and nesting colonies and resting areas may be subject to repeated intrusion. Destruction of Little Tern nests by off-road vehicles is known to have occurred at Station Creek (Morris 1979) and Tilba Lake (Bolger 1989). The potential for heavy losses to off-road vehicles at certain sites is illustrated by their impact on Hooded Plovers (*Thinornis rubricollis*) nesting on ocean beaches in the Coorong region, South Australia, where Buick and Paton (1989) found that 81% of all nests were likely to be run over during the incubation period, and further losses were likely after the eggs hatched. Disturbance to resting Little Terns was recorded at Myall Lakes National Park in the 1998/99 season with 4WD vehicles frequently driving into mixed flocks of Silver Gulls, Crested Terns and Little Terns resting on the beach. On one occasion a 4WD vehicle killed a Little Tern fledgling as it drove through a resting flock of birds (D. Turner pers. comm.).

#### (5) Introduced Predators

Introduced species that have been identified as predators at NSW Little Tern colonies are:

- Fox (*Vulpes vulpes*). The fox is the most frequently recorded introduced predator at NSW colonies. A single fox can cause significant egg losses within one night. It was the chief predator at Botany Bay in 1993 to 1996, taking at least 55 eggs and two chicks over three seasons (Priddel and Ross 1996). Statewide, foxes had a particularly heavy impact on Little Terns in the 1995/96 season, when they were the main cause of nest failure in the State, being implicated in the loss of at least 41 eggs at Botany Bay (Priddel and Ross 1996) and predation on at least 45 nests at Harrington/Manning Point, 30 nests at Lake Wollumboola, 11 nests at Bega Rivermouth/Mogareka and two nests at Shoalhaven Heads (NPWS records). Foxes apparently decimated the Station Creek colony in 1996/97 (Burns 1997) and, in concert with Silver Gulls, have had a major impact on the Farquhar Inlet colony (H. Hole pers. comm.). They have also been major predators at Victorian colonies (Reside 1994).
- Domestic dog (*Canis familiaris*). Domestic dogs accompanying people or straying from nearby houses cause frequent disturbance to nesting and resting Little Terns at many sites, however, there have been few specific records of predation in NSW. One nest was lost to dogs at Red Rock in 1996/97 (Burns 1997), and the loss of four eggs from four nests at Forster in 1992/93 coincided with a visit to the site by three people with a dog (Smith 1994a). Dogs have been observed chasing young terns and breaking eggs in Victoria (Vincent 1983), and were implicated in the loss of 59 eggs and two chicks at two colonies there in 1984/85 (Hill and Montague 1985).
- Wild dog (*Canis lupus familiaris*). Wild dogs are considered a potential threat to Little Tern colonies and according to D. Turner (pers. comm.) were implicated in the loss of chicks and eggs at Myall Lakes National Park. Following a control program carried out in September 1998, the best result of breeding Little Terns for the previous ten years occurred the following season. In previous years, wild dog prints had been observed around nesting areas and, whilst these cannot be directly related to poor breeding results because of a lack of direct observations, the sudden improvement on fledgling numbers implied losses caused by them.

- Feral cat (*Felis catus*). A feral cat was present at one nesting site at Forster in the 1992/93 season. Tracks indicated that it was springing at adult terns sitting on their nests at night. It is unclear whether there were any losses of adult terns, but the attacks were implicated in the failure of at least five nests (Smith 1994a). At Harrington/Manning Point during December 1999, a feral cat was responsible for 48 known losses over a three-night period. It only took nestlings and eggs just about to hatch, with the chick cheeping in the egg, as it does for two days before hatching (H. Hole pers. comm.).
- Black rat (*Rattus rattus*). Implicated by their tracks in the loss of at least one egg and three newly hatched chicks at Forster in the 1992/93 season (Smith 1994a), and the loss of 12 nestlings at Harrington/Manning Point in 1996/97 (Smith 1997). Also suspected predators at Botany Bay in the early 1980s (Larkins 1984).
- Norwegian rat (*Rattus norvegicus*). Norwegian rats have been implicated in the loss of several chicks at Harrington/Manning Point prior to 1998 (Parsons 1998, H. Hole pers. comm.).

### 7.1.2 Habitat destruction

Little Tern nesting habitat in NSW has been lost to foreshore development (industrial, residential and recreational) and to estuary stabilisation works such as construction of training walls at estuary entrances. Nesting habitat is also lost to the natural process of overgrowth by vegetation. Under natural conditions, these losses are balanced by the continual creation of new nesting habitat through disturbance of estuarine sand deposits by water and wind. In the long term, the supply of nesting habitat for the Little Tern depends on the dynamic nature of estuarine geomorphological processes. However, in many NSW estuaries, these processes have been deliberately dampened by human activities to produce a more stable environment.

### 7.1.3 Threats to food resources

Many human activities can have adverse effects on estuarine habitats, processes and productivity, and hence affect the food resources available to the Little Tern. Food quantity, quality and availability could potentially be affected by pollution, over-fishing, loss of important estuarine habitats (such as mangroves, saltmarshes, seagrass beds and intertidal mudflats), and changes to estuarine morphology and hydrology.

## 7.2 Social and Economic Consequences

The nesting sites currently used by Little Tern in NSW are all located in national parks or nature reserves or on Crown land administered by local councils, the Department of Lands or Sydney Ports. No sites are in private ownership.

Many nesting, resting and fledgling feeding sites are near popular summer recreational areas. To prevent disturbance of nesting, resting and fledgling feeding terns, people, vehicles and dogs are restricted from the vicinity of active nesting sites during the breeding season. The areas involved are small, the breeding season relatively short, and in the context of the whole estuary or local coastline, represent only a minor imposition on recreational amenity. Experience has shown that,

with education, most beachgoers respect the need to protect the species and their contact with the management program enhances rather than detracts from their recreational experience.

The actions in this plan have strong community involvement and will continue to raise community awareness of the plight of the Little Tern and the importance of biodiversity more generally. Management to date has involved voluntary assistance from various community groups and individuals in wardening, monitoring and other activities. At the Harrington/Manning Point colony, in particular, volunteers from the local community have carried out most of the management activities in recent years. The use of volunteers is beneficial for expanding the management program beyond its financial and staff restraints, and also provides a valuable opportunity for the volunteers to enhance their ecological knowledge and assist in the management of a threatened species. The broader community also benefits from the general education campaign on Little Terns. This plan will seek to continue community involvement in the recovery of the Little Tern (see Action 8.2).

Conflicts could potentially arise in future between development proposals or other proposed activities in estuaries, and the need to protect Little Tern nesting and resting sites as well as their food resources. In such cases, the economic and social consequences of protection would be assessed as part of the normal environmental planning and assessment process.

The chief cost of the Little Tern Recovery Program will be the financial, staff and other resources of the NPWS that need to be devoted to the program. Because of the nature of the problem, a long-term commitment will be necessary for the successful recovery and subsequent maintenance of the breeding population of the Little Tern in NSW.

As Little Tern management activities are typically carried out in popular recreational areas, they provide a prominent example of threatened species management in action. The Little Tern program is also directly involving increasing numbers of volunteers in management activities. It represents a flagship program for threatened species management in NSW. Community understanding and support is being gained not only for the Little Tern program itself, but also for threatened species management in general.

An amendment to the TSC Act in 2002 now requires the Director-General, when preparing a Recovery Plan, to consider any special knowledge or interests that indigenous Australians may have in the species, population or ecological community that is the subject of the Recovery Plan, and the measures to be contained in the plan. The cultural and historic significance of the Little Tern to indigenous communities is unknown. The NPWS will encourage and support projects which seek to investigate the cultural significance of the Little Tern to indigenous people. This issue is the subject of Action 6.3.

### **7.3 Biodiversity Benefits**

The measures taken to protect the Little Tern will also benefit other species that share their habitat. This applies particularly to several beach-nesting birds that have been recorded nesting with Little Terns in NSW: the Beach Stone-curlew (*Esacus neglectus*), Hooded Plover (*Thinornis rubricollis*), Pied Oystercatcher (*Haematopus longirostris*), Fairy Tern (*Sterna nereis*) and Red-capped Plover (*Charadrius ruficapillus*). The Beach Stone-curlew and Hooded Plover are

endangered species in NSW and the Pied Oystercatcher is a vulnerable species. The Fairy Tern is a very rare visitor to this State and the first confirmed nesting record was only in 1994/95. The Red-capped Plover is more common than the other species and has the advantage of nesting around inland lakes as well as on the coast. However, declining numbers of Red-capped Plovers have been noted in busy coastal areas such as the Sydney region (Hoskin *et al.* 1991). The establishment of the South Coast Shorebird Recovery Program by the NSW NPWS in 1999 to assist the recovery of threatened shorebirds that breed in NSW such as the Pied Oystercatcher, Sooty Oystercatcher, Hooded Plover and Little Tern exemplifies how a combined management approach can be beneficial for a range of threatened species.

## 8. Management Options

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The Little Tern Recovery team has considered the following options for future management of the species:

1. *No management action.*
2. *Reservation of nesting, resting and fledgling feeding sites outside NPWS lands, but minimal active management of human disturbance, predators and other factors threatening breeding success.*
3. *Collection of Little Tern eggs for incubation and rearing in captivity then return to the wild.*
4. *Intensive management and monitoring of a single priority site, which produces the majority of juveniles within each of eight Little Tern regions across coastal NSW. In addition, if resources allow the management and monitoring of important minor colonies which have the potential to become priority sites.*

Experience has shown that intensive management of nesting colonies leads to breeding success through an increase in recruitment of juveniles. It is expected that as these juveniles mature they will begin to breed and thus contribute significantly to the colony. Without this type of management, predation and other threats decimate eggs and fledglings and the population goes into decline as a result of ageing. The recovery team therefore recommends that Option 1 is inadequate for the recovery of this species.

Although reservation of nesting, resting and fledgling feeding sites provides security of habitat, successful recovery of the Little Tern requires intensive complementary management of threatening processes. Therefore, Option 2 by itself is also an inadequate management option.

It is not known whether Little Terns can be bred in captivity. Even if it was possible it would involve a substantial increase in the intensity of management and come at a high cost. The young birds would have to be released at the end of the breeding season, before the wild population departs, or else maintained in captivity until the following breeding season. There are many hazards and uncertainties associated with such a program, especially with a migratory species like the Little Tern. The NPWS therefore recommends that Option 3 should only be considered if Option 4 fails.

The recovery team therefore recommends Option 4 as the minimum effort required for the adequate recovery of the population across its range in NSW. This involves the intensive management of a single priority site, which produces the majority of juveniles within each of eight Little Tern regions across coastal NSW. Monitoring and management of minor nesting sites, which have the potential to form major colonies, may also be undertaken if resources allow.

In addition, the recovery team considers that there is the potential for minimising some of the threats to the Little Tern through the incidental creation/enhancement of habitat using dredge spoil, especially on sand islands. As such, the NPWS will also evaluate opportunities for the creation or enhancement of island nesting habitat using dredge spoil.

## **9. Recovery Objectives, Actions & Performance Criteria**

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### **9.1 Recovery Action Rationale**

The Draft Little Tern Recovery Plan was prepared because the NSW Little Tern population was in steady decline as a result of poor fledgling success. Very few Little Tern offspring are successful in reaching fledgling (independent) status in situations where intensive management is not undertaken.

The Draft Little Tern Recovery Plan therefore sought to restore the breeding population to its estimated 1950 population of 340 breeding pairs within a five-year period. This was an initial objective that was considered achievable based on existing knowledge of the species response to intensive management. As such, four priority sites (and some minor sites) were selected for management based on their relative productivity, geographic position, attractiveness to Little Terns, and logistical concerns such as finances, security and ease of access for NPWS staff and community volunteers. Ongoing intensive management over this five-year period was successful and resulted in the current (2002/03) population of approximately 437 breeding pairs (NPWS records).

In light of the apparent increase in breeding pairs, the Draft Recovery Plan objective has been updated based on an increased understanding of the species life history and ecology. Experience and banding evidence over the preceding five years indicates that Little Terns display a moderately high degree of philopatry (site affinity) and limited dispersal between colonies. Banding studies have shown that Botany Bay Terns, for example, occasionally utilise nest sites at The Entrance or Lake Wollumboola, though are rare visitors to sites such as Harrington/Manning Point or Bega Rivermouth/Mogareka, which are further afield (G. Ross pers. comm.).

In view of this growing evidence it is the intent of this plan to manage the Little Tern on a regional basis. The NSW coast has been divided into eight Little Tern regions based on current knowledge and understanding of colony dynamics (see Figure 3). The NPWS will aim to intensively manage the most successful colony (priority site) within each of the eight Little Tern regions (Table 8). Continued management of each colony is expected to result in a steady increase in breeding pairs over time.

#### **Table 8: Priority sites (based on current breeding success) within each Little Tern Region**

<b>Little Tern Region</b>	<b>Current Priority Site</b>
Northern Rivers	Station Creek
Coffs Coast	Sawtell/Bongil Bongil
Taree	Harrington/Manning Point
Central Coast	The Entrance
Sydney	Botany Bay
Shoalhaven Coast	Lake Wollumboola
Eurobodalla Nature Coast	South Tuross Heads
Bega Valley Sapphire Coast	Wallagoot Lake

The recovery team is of the opinion that properly managed colonies will continue to increase exponentially. This is on the basis that the rate of successful fledglings returning to breed will continue to be greater than the adult death rate. If each priority site is managed intensively and continues to be successful it is predicted that these colonies will reach a growth limit (site and resource dependent). Furthermore, it is predicted that once carrying capacity has been reached, managed colonies will operate as source populations for other sites along the New South Wales coast (and potentially Victoria) and establish colonies at previously successful, but now uninhabited sites, or establish new sites.

Little Tern nesting sites occur in a dynamic coastal environment and banding observations indicate that Little Terns will generally select the nearest suitable site once the existing site is no longer suitable. Therefore, sites to be managed will be open to change if any of these sites are superseded by greater concentrations of Little Terns nesting elsewhere within the region. Potentially, terns may prefer to nest in significant numbers at more than one site within a given region, and multiple priority sites may be the result. In this event, flexibility is advised and managers should implement, if possible, conservation measures at more than one priority site per region to maximise fledgling success. Management of promising minor sites will also be encouraged but undertaken at a level in accordance with the availability of local resources. The protection of minor colonies such as Lake Conjola on the Shoalhaven Coast, which regularly contributes ten fledglings each season to the total count (J. Keating pers. comm.) cannot be overemphasised. Furthermore, the intensive management of nesting, resting and fledgling feeding sites on a regional basis will significantly reduce the probability that a stochastic event will result in an overall breeding failure for a particular breeding season or, in a worst case scenario, eliminate all NSW breeding pairs.

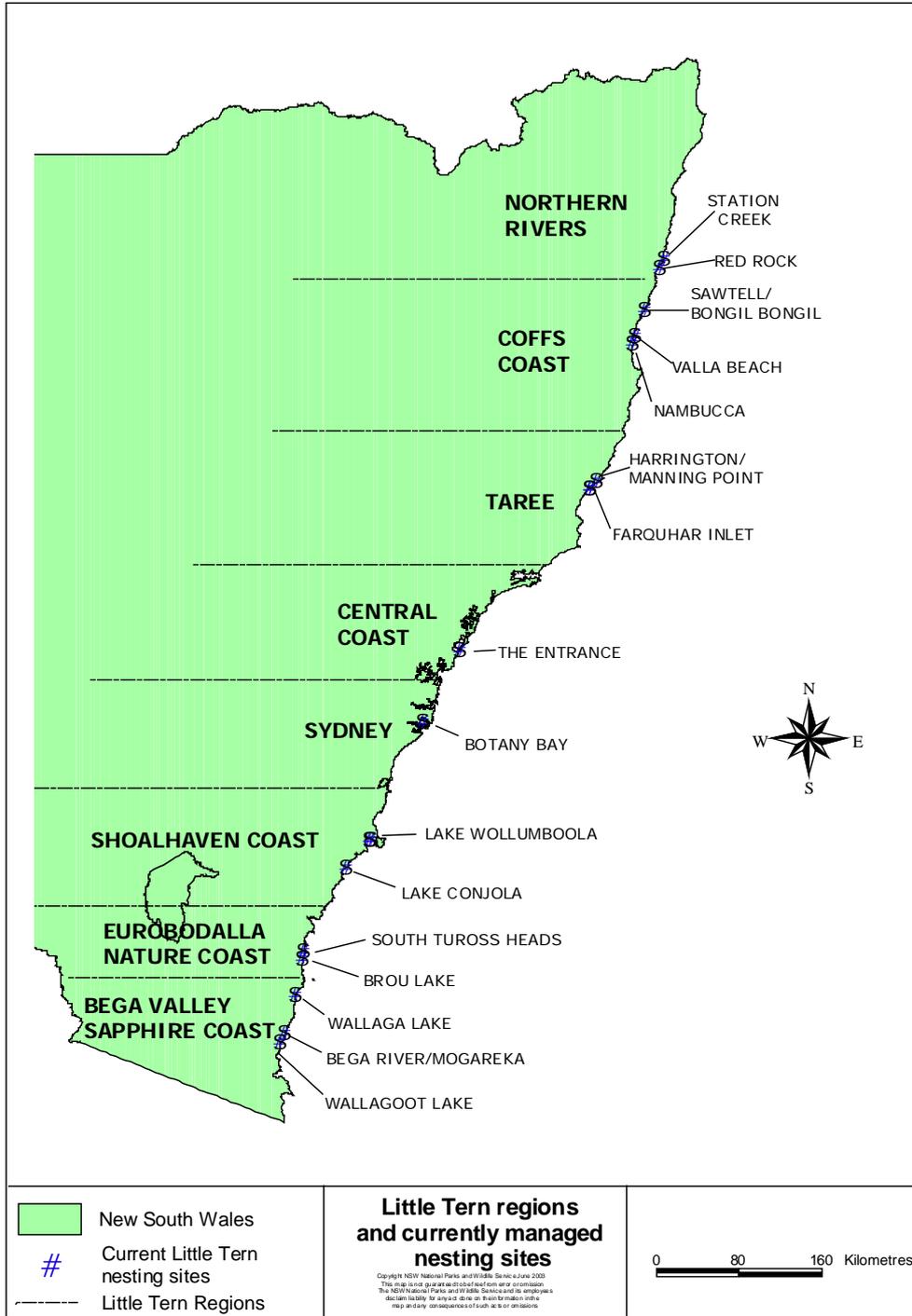
## **9.2 Recovery Plan Goal**

Records held by the NPWS indicate that the number of breeding pairs has increased from an estimated 169 in 1993/94 to approximately 437 in 2002/03. This equates to an average approximate growth rate of 9.4% per annum over the past ten seasons. This Recovery Plan seeks to continue to increase the number of breeding pairs within NSW. On the basis that there are currently approximately 437 pairs (and allowing for an exponential growth rate of 9.4% per annum over five years) it is estimated that there is the potential for the NSW Little Tern population to reach approximately 700 pairs by 2008.

The total number of breeding pairs in 2008 may be lower than estimated on the basis of any or all of the following:

- Carrying capacity of each colony is unknown at this stage,
- Current rate of population growth reflects some immigration from Victorian birds and it is unknown whether this will continue, or conversely, whether any birds from New South Wales will emigrate to Victoria,
- Colony management ceases to occur or is otherwise proved to be ineffective,
- Major stochastic events occur.

Figure 3 Little Tern regions and currently NPWS-managed nesting sites



### 9.3 Recovery Objectives

To achieve this objective, this Recovery Plan seeks to implement a management regime that:

- promotes *in situ* habitat management, including recommendations for threat abatement and liaison and consultation with other land managers;
- intensively manages eight major colonies and selected minor colonies of the Little Tern in NSW;
- seeks to enhance habitat through the evaluation and possible creation of new nesting habitat;
- informs and guides management through survey, monitoring and research;
- promotes a co-ordinated Statewide approach to Little Tern management; and
- continues to educate and welcome community participation in the Recovery Program.

The consequences of not implementing this Recovery Plan is the high likelihood of a decline in breeding success and subsequent decline in population size of the Little Tern. The success of the program will be reliant, in part, on the continued support and co-operation of other land managers and the community at large, and is dependent on ongoing intensive management and monitoring of key source colonies.

#### **Specific Objective 1: Inform land managers of their responsibilities regarding the conservation requirements of Little Tern**

##### *Action 1.1 Inform and consult with land managers*

State and local government authorities and community groups with responsibilities relevant to the protection of Little Terns and their habitats will be made aware and kept informed by the NPWS of Little Tern conservation requirements and the locations of the nesting colonies. Authorities with responsibilities to protect Little Terns and their habitats are identified below (Table 9).

**Table 9. Land management authorities and community groups with responsibilities relevant to the protection of Little Terns and their habitats (apart from NPWS).**

<b>Organisation</b>	<b>Relevant responsibilities</b>
Local Councils	<ul style="list-style-type: none"> <li>• Management of Crown Land with nesting sites (Table 4)</li> <li>• Land-use planning and management in estuaries and their catchments and along the coastline</li> <li>• Formation and chairing of estuary management committees for the Estuary Management Program</li> <li>• Consent authorities for development proposals</li> <li>• Control of domestic dogs</li> </ul>
Estuary Management Committees	<ul style="list-style-type: none"> <li>• Co-ordination of estuary management planning in individual estuaries</li> </ul>

Department of Lands	<ul style="list-style-type: none"> <li>• Ownership of Crown lands with nesting sites (Table 4)</li> <li>• Land-use assessment of Crown lands</li> <li>• Development of policy and strategies for land and water resource management</li> <li>• Co-ordination of total catchment management and Landcare programs, including the Estuary Management Program</li> <li>• Advice and assistance with estuary and coastal management</li> <li>• Advice and assistance with soil and vegetation management on beach dunes and other foreshore lands</li> </ul>
Planning NSW	<ul style="list-style-type: none"> <li>• Development of policy and strategies for land-use planning and environmental assessment</li> <li>• Advice and assistance on environmental planning matters</li> <li>• Assessment of major development applications</li> <li>• Administration of the Coastal Lands Protection Scheme for acquisition of environmentally sensitive coastal lands</li> </ul>
Coastal Council of NSW	<ul style="list-style-type: none"> <li>• Advice to NSW Government on coastal planning and management issues</li> <li>• Review of NSW Government Coastal Policy</li> </ul>
NSW Fisheries	<ul style="list-style-type: none"> <li>• Protection and management of fish and other aquatic animals, including the food sources of Little Tern</li> <li>• Management of aquatic reserves, including Towra Spit Aquatic Reserve which adjoins Little Tern nesting habitat in Botany Bay</li> <li>• Ensure NSW Fisheries operations are undertaken in accordance with relevant industry Environmental Impact Statements and Fisheries Management Strategies, particularly where they refer to shorebirds</li> </ul>
NSW Marine Parks Authority	<ul style="list-style-type: none"> <li>• Management of marine parks, including Solitary Islands Marine Park which adjoins Little Tern nesting habitat at Station Creek and Red Rock</li> </ul>
Environment Protection Authority	<ul style="list-style-type: none"> <li>• Protection, restoration and enhancement of environmental quality, including environmental monitoring and pollution control in estuaries</li> <li>• Preparation of coastal resource atlases for oil spill response planning, showing environmentally sensitive areas, which should include Little Tern habitats</li> </ul>
Sydney Ports Corporation	<ul style="list-style-type: none"> <li>• Ownership of Crown lands in Botany Bay, including the current Little Tern nesting site (Towra Spit Island)</li> <li>• Protection and enhancement of the Botany Bay port environment</li> </ul>
Coastcare groups	<ul style="list-style-type: none"> <li>• Community Landcare groups formed to address local land degradation problems along the coast, especially revegetation and stabilisation of beach dunes</li> </ul>

The appropriate NPWS Directorates will disseminate information and advice to land managers for conservation issues of regional significance, whilst NPWS Regions and Area Offices will be responsible for site-specific issues. The recovery team will provide advice to the NPWS, as

requested, regarding development proposals and other activities affecting or potentially affecting Little Terns and their habitats.

### ***Performance Criterion 1***

Land managers are informed of the conservation requirements of, and their individual responsibilities to, the Little Tern.

### **Specific Objective 2: Site Management**

The objective of this composite series of actions is to ensure the long-term protection of Little Tern and their habitat in NSW. Threatened species are best managed in perpetuity when conserved in their natural habitat. This is termed *in situ* habitat conservation and in terms of this Recovery Plan involves actions that seek to protect habitat and ameliorate actual or potential threatening processes on the ground. The major factor affecting the ability of the Little Tern to recover is its poor breeding success, which can be attributed to the cumulative impacts of natural and human induced threats identified in Section 7. To improve breeding success to the level necessary for population recovery (on average 0.5 fledglings or more raised per breeding pair per year) it will be necessary to undertake intensive management of nesting colonies to arrest the impact of known threats.

#### ***Action 2.1 Intensive management of nesting, resting and fledgling feeding sites***

As the Little Tern may breed as solitary pairs or in colonies of 100 or more it is unlikely that sufficient resources will be available to undertake intensive management at all Little Tern nesting sites. The NPWS will therefore undertake to implement two courses of action:

1. Intensively manage eight Little Tern colonies such that there is a geographic spread along the NSW coastline so the effects of any catastrophic event are minimised. This action is of highest priority. Priority sites should be changed if any of these sites are superseded by greater concentrations of Little Terns nesting elsewhere;
2. Intensively manage selected minor colonies that show good potential for the future establishment of a large colony. These sites should be judged on their attractiveness to Little Terns, security and ease of management, geographic position across the state and local infrastructure. Management of all smaller nesting sites should be undertaken at a level in accordance with the availability of local resources. The implementation of this action is dependent upon available finances and logistical constraints such as site access.

The management of Little Tern colonies will target the following known natural and human induced threats:

#### ***Site Preparation: Control of encroaching vegetation***

Nesting sites can be gradually rendered unsuitable for Little Tern through the natural process of vegetation encroachment. Regular clearing of the vegetation, preferably in August-September, just before the breeding season, may be necessary to maintain these sites in an optimal condition for

nesting. There should be little or no vegetation on the nesting area itself. However, patches of low vegetation should be retained around the fringes of the area as these provide valuable shelter for the chicks once they leave the nest.

### *Discourage nesting in unfavourable sites*

At the start of the breeding season, the terns may attempt to nest at sites where success is very unlikely for reasons such as the increased probability of nests being flooded during king tides. The birds should be actively discouraged from nesting in these situations. Techniques that have proved effective include crisscrossing the area with bunting attached to starpickets or continually rubbing out the nest scrapes before any eggs are laid.

### *Control human disturbance*

Specific measures to control impacts from human induced threats are identified below:

- Community education programs during each breeding season to increase awareness of Little Terns and the threats to their viability, to seek co-operation and to emphasise the penalties for wanton interference. Possible measures include: media releases and interviews; talks to local groups; distribution of pamphlets and posters; erection of information boards near the nesting sites or at appropriate boat ramps; and preparation of displays for exhibition at local venues. The education programs should focus on the local community and visitors at major colonies. As described below, major nesting colonies should be wardened during busy periods to increase public awareness.
- Off-road vehicles should be prohibited from the vicinity of active nesting sites. Access should be blocked (where feasible) during the breeding season with physical barriers.
- Dogs should also be prohibited from the vicinity of active nesting and resting sites, especially unleashed dogs. Local councils should be made aware of the threat to the nesting colonies posed by dogs, and the need to impose and enforce restrictions. The NPWS will seek to increase public awareness concerning restrictions to dogs at nesting sites in national parks and nature reserves.
- Signs should be erected around nesting sites warning of the presence of nesting and resting terns, and of the restrictions on vehicles and dogs. Depending on the situation, these may be permanent or temporary signs to be removed when nesting is completed.
- Colonies subject to high levels of disturbance should be fenced. A simple guidance fence is usually sufficient unless electric fencing is required for fox and dog control. Permanent fences may be feasible in some situations, however, temporary fencing is generally preferable. The fence should be erected when it becomes clear exactly where the birds are going to nest. It should be removed at the completion of nesting.
- Major nesting colonies should be wardened during busy periods, namely weekends and school holidays. The main period of concern is from Christmas to the end of January, if the terns are still nesting at this time. Wardening is generally unnecessary on rainy or windy days. Volunteers should be sought to assist with wardening (Action 8.3). Involvement of the local community in wardening activities is highly desirable. A training session for volunteer wardens should be held at the start of the breeding season, providing general information on Little Terns and outlining the role of volunteer wardens, including how to handle difficult situations.

Wardens should approach people near the nesting site to warn them of the presence of nesting terns, provide information on the species, answer any questions and request that they stay clear of the area and do not leave any food scraps for gulls and corvids (ravens and crows).

### *Predator control*

Specific measures to control predation are identified below:

- Fox control measures should be implemented at colonies subject to fox predation. Fox tracks should be checked for daily, and regular baiting carried out before and during the nesting season. Electric fences (8-strand) may also be erected around major colonies to control foxes and dogs, with signs and a separate guidance fence erected outside the electric fence to keep people away. Electric fencing should be used in conjunction with baiting, rather than as an alternative. Other possible fox control measures include shooting, trapping and auditory deterrent devices (available commercially, however, their effectiveness needs further evaluation). The same management principles apply to the control of wild dogs.
- A Statewide program to reduce the gull population has been proposed (Smith 1995) and is supported by the recovery team. At colonies subject to high levels of gull predation often only one or a few 'rogue' gulls are responsible. These 'rogue' gulls should be culled during the breeding season in the immediate vicinity of the colony by shooting, baiting or trapping. If the tern colony is tending to disperse into small, scattered sub-colonies (as occurred at Forster in 1992/93; Smith 1994a), concentrating them in a single large colony at one location can improve their capacity to repel avian predators. This can be achieved by flagging the less favourable sites before the birds become established there. The management of silver gulls and other pest bird species at waste disposal sites by minimising opportunities to access food is also proposed (a fuller appraisal of the issue and appropriate guidelines for waste management can be viewed in the document *Environmental Guidelines Solid Waste Landfills* (NSW Environment Protection Authority 1996)).
- Corvids (ravens and crows) pose a threat at some colonies and may need to be culled in a similar fashion to gulls. This approach should be adopted where necessary for Australian Ravens and Torresian Crows, however, Forest Ravens, which are an uncommon species in NSW, should be otherwise dissuaded.
- Introduced rats and feral cats are known predators of Little Terns and should be removed humanely by trapping or baiting if they occur in the vicinity of nesting colonies.
- Nesting colonies should be regularly checked during the breeding season for evidence of predation. Direct observations of predation are rare and the predators involved usually have to be identified from tracks and other signs, or by the general interest they show in the nesting colony. Appropriate control measures should be implemented where necessary, i.e. placing tern eggs on a small sheet of plywood covered with sand and shell grit to reduce predation by Ghost crabs which burrow up through the sand to prey on eggs (D. Priddel pers. comm.).
- The capture and relocation of troublesome raptors is advised, however, such measures should not be used if the predators are species of special conservation concern, such as the Pied Oystercatcher and the Whimbrel.
- Predation on chicks once they leave the nest can be reduced by providing additional shelter for them around the nesting area. A standard chick shelter design that has proved effective is a

teepee of wooden slats around a central stake. Other options, which are less likely to attract inquisitive people, are small piles of brushwood, broken pipes and similar debris.

### *Protection from flooding*

Potential sites that are likely to be flood prone should be identified prior to nesting. The terns can be dissuaded from nesting in flood-prone sites by covering these sites with bunting. This will encourage the birds to nest on higher ground, where suitable nesting habitat may need to be created and then kept clear of encroaching vegetation.

If some birds do nest in situations where flooding is inevitable (usually during king tides and/or storms), individual nests may be either raised or moved. Nests may be raised by picking up the eggs, forming a ring with sandbags, filling it with sand, then placing the eggs back on top of the mound. Alternatively, the eggs may be gradually moved to higher ground at a rate of 1-2 m per day. Both methods have been used successfully in the past.

### *Performance Criterion 2*

Intensive habitat management to ameliorate known threatening processes is undertaken at a single priority site and selected minor colonies in each of the eight Little Tern regions.

**Specific Objective 3: To evaluate and provide secure additional nesting, resting and fledgling feeding habitat for Little Terns on estuarine islands at a range of sites along the NSW coast.**

### *Action 3.1 Investigate the potential for the incidental creation of island nesting sites using dredge spoil*

The NPWS will evaluate opportunities for the creation or enhancement of island nesting habitat using dredge spoil. Island sites are less susceptible to human disturbance and mammalian predators, and tend to attract large, tight nesting colonies that are more effective in defending their nests against avian predators.

Dredge spoil has been used successfully in the past to create or improve island-nesting sites. Dredge spoil sites are readily colonised by the terns and can support large and highly productive colonies, as demonstrated at Forster in NSW (Smith 1994a) and several sites in Victoria (Murray 1994, Reside 1994). Artificially created island nesting sites have been the basis of the highly successful Little Tern management program in Victoria since the late 1980s. The loss of the nesting site at Forster to Silver Gulls and Pelicans and the subsequent relocation of the terns to Harrington/Farquhar Inlet in 1996 suggests that ongoing management of the artificially created site is necessary to ensure continual breeding success over time.

Opportunities for creation of island nesting sites should be sought through liaison with Estuary Management Committees and local councils. Estuary Management Committees have a role in providing advice to approval authorities on the disposal of dredge spoil. Dredging operations and other estuary works often provide incidental opportunities for habitat creation. At other sites, specific habitat creation works may be warranted, involving creation of nesting habitat by either sand deposition or vegetation removal. Shingle or shell-grit may need to be spread over the new

site to attract the terns, which generally avoid areas of bare sand. In all cases it is the relevant consent/determining authority who are responsible for the final decision regarding dredge spoil.

Natural island sites often suffer from heavy losses through nest flooding. One way to enhance such sites to overcome this problem is to raise the height of the nesting area, which can be achieved by deposition of dredge spoil or use of earth-moving equipment, or by removal of vegetation from higher ground.

Sites in NSW where nesting island creation/enhancement works warrant investigation are identified below:

- Red Rock. The nesting island has supported large colonies in the past, but has periodically suffered heavy losses from nest flooding. In 1995/96 the island had become so eroded that the terns abandoned the site, apparently moving to nearby Station Creek to nest. Possibilities for habitat restoration works on the island should be investigated.
- Nambucca Heads. A site with a long history of use, often by large colonies, but used only by small numbers of terns in recent years, apparently because of a current shortage of suitable nesting habitat. Creation of a secure island-nesting site could result in the re-establishment of a major breeding colony at this location.
- Forster. A new nesting island was created here in 1989 and had been used successfully by terns. However, in 1996 it became unsuitable through its adoption as a high tide roost by large numbers of Silver Gulls, Crested Terns and Pelicans that formerly roosted on two other islands that have now been largely eroded away. Creation or enhancement of an alternative nesting site for the terns is one possible solution to the problem, however, a better approach may be to restore or create alternative roost sites for the gulls and other birds.
- Comerong Island (Shoalhaven River estuary). In previous years the terns have had limited breeding success on the sand-spit across the mouth of the river, where they are subject to disturbance by people, dogs and off-road vehicles, predation by foxes, and loss of nests to sand movement. The site could probably be made more productive by creation of a small sand island as an alternative nesting site.
- South Tuross Heads. In years past, the terns have occasionally experienced poor fledging rates at their sand-spit site and would benefit from creation of an alternative nesting site on an island.
- Brou Lake. A sand island near the lake entrance supported a large and highly successful colony in 1990/91. However, all subsequent nesting attempts on the island have failed through inundation of the island either by the lake level rising when the entrance was closed or by king tides when the entrance was open. Raising the level of the island would make the site more secure for nesting.
- Tilba Lake. Although not used in the last 4-5 years (M. Jarman pers. comm.), Tilba Lake had been the most regular nesting site close to Narooma over the last two decades and has supported large colonies. The birds nest either on the sand-spit at the entrance or on an island inside the lake. The island is prone to inundation in the same ways as the island at Brou Lake. Possible methods of raising its level should be investigated.
- Wallaga Lake. A large colony attempted to nest on a sand island here in 1993/94 though failed when the island was repeatedly flooded by king tides. This is another site where possible methods of raising the level of the nesting island should be investigated.

- Pelican Island at Port Macquarie.
- Sand Island at Harrington.

Habitat creation or enhancement projects are most likely to be successful at current nesting sites. However, projects could also be undertaken at former nesting sites. An example is Lake Illawarra, which still supports large numbers of non-breeding birds, suggesting that there is no shortage of suitable feeding habitat there. As the Little Tern breeding population hopefully recovers in NSW, re-colonisation of former nesting sites is expected.

### *Performance Criterion 3*

Opportunities for the incidental creation or enhancement of island nesting habitat will be investigated as required for a range of sites along the NSW coast.

**Specific Objective 4: To investigate the potential for reservation of nesting, resting and fledgling feeding habitat.**

#### *Action 4.1 Acquisition of Little Tern nesting sites by NPWS*

The recovery team will investigate opportunities for the acquisition by NPWS of important Little Tern nesting sites adjacent to national parks or nature reserves. In recent years, nesting habitat at Lake Wollumboola, Sawtell and Farquhar Inlet has been acquired by NPWS. The NPWS will consider proposals for the appropriate acquisition of nesting, resting and fledgling feeding habitat over the life of the Recovery Plan.

### *Performance Criterion 4*

The recovery team will investigate opportunities for the inclusion of Little Tern nesting, resting and fledgling feeding habitat into NPWS managed lands within the first two years of this plan. Nesting sites will be acquired by NPWS where appropriate.

**Specific Objective 5: Monitor active nesting sites, breeding success and population trends of Little Terns in NSW in order to guide management actions, identify problems and gauge management success.**

#### *Action 5.1 Monitoring of individual colonies*

At the commencement of each season there is a need to identify the nesting sites being used, and determine which of the active sites are likely to support the major concentrations of breeding terns during that particular season (priority sites for management). All potential sites should be inspected regularly throughout October, November and December to ascertain which particular sites are attracting significant numbers of Little Terns. Details regarding the numbers of birds present and signs of breeding activity should be recorded and forwarded to the Little Tern recovery co-ordinator.

All potential nesting sites should also be inspected opportunistically at other times during the breeding season to check for the presence of nesting birds. Reports of nesting, particularly at unexpected sites, should be sought from local naturalists and followed up.

Once sites attracting the greater concentrations of terns (priority sites) and other additional minor colonies have been identified, they should be inspected regularly during each breeding season to follow the progress of nesting and to guide management activities. Information sought from each site should include:

- the size and fluctuations of the south-east Australian breeding and non-breeding Asian populations
- nesting commencement and conclusion times
- minimum number of breeding pairs
- total number of nests during the season
- total egg count
- average clutch size
- percent hatching rate
- causes of nest failure
- minimum number of young fledged
- percent fledged from total number of eggs laid
- percent fledged from total number of chicks hatched and
- number of fledglings per breeding pair

Colour-banded or flagged birds should be observed closely to determine the specific colour combinations so that the identity of these birds can be discerned. Data pertaining to the sightings of banded birds should be forwarded to the Recovery Program co-ordinator for collation and analysis.

Nesting sites should be inspected at least once per week while nesting is in progress. Large colonies should be inspected at least three times per week. Experienced or trained observers should carry out the inspections. Care must be taken to ensure that the inspections do not cause any nest failures through accidental trampling of eggs or young, keeping the adults away from their nests for too long (especially under adverse weather conditions), or attracting gulls to the site. Nests should be mapped or marked so that each nest can be identified in later inspections and its progress followed. Any nest markers used should be as inconspicuous as practically possible and should not be placed any closer to the nest than is necessary. Inspections should be abandoned if they are causing too much disturbance. Determining the causes of nest failure is critically important for effective management. All direct observations of nest failure should be recorded, and also any indirect evidence such as predator tracks at empty nests.

Movements of birds between colonies can occur during the course of the season. These may involve birds that have failed at one site moving to another estuary to re-nest, or birds that have successfully fledged young taking them away from the nesting site. Monitoring data will be collated in accordance with the generic site pro-forma (see Action 9.1).

#### ***Action 5.2 Analysis of monitoring data and preparation of status report***

Effectively communicating the results from monitoring and surveys throughout the recovery program to inform future management is considered a high priority. To this effect, information recorded during monitoring will be analysed and presented in a status report detailing the success of management actions at both site-specific and Statewide levels.

### *Performance Criterion 5*

To identify active nesting sites, monitor, analyse and report on the breeding success and population trends of Little Terns in NSW in order to guide management actions, identify problems and gauge management success.

**Specific Objective 6: Conduct and promote research on the Little Tern in NSW in order to increase the biological, ecological and cultural knowledge of the species.**

### *Action 6.1 Banding Studies*

A banding study of Little Terns will be conducted by NPWS Area staff to complement other survey and monitoring actions. This study will enhance management by providing a better understanding of:

- nest site fidelity;
- local population movements;
- inter-colony movements;
- recruitment;
- re-nesting patterns, age at first nesting; and
- other life history aspects.

Data obtained over a number of years will also provide important insights into longevity, the rate of population turnover, and recruitment. Sightings or recaptures of banded birds overseas may also provide information on the wintering range of the population.

Techniques that have been used to capture adults are nest-traps, mist nets and cannon-netting. Nestlings can be readily captured by hand and banded, although this must only be done by experienced and licensed personnel taking appropriate care. Special care and training is needed when capturing and banding adults, particularly when using nest-traps, however, it has been shown in studies at Botany Bay that this can be done without disrupting nesting activities and without causing nest failures.

### *Action 6.2 Promote research opportunities*

The NPWS will encourage individuals and organisations to undertake management related research projects on the Little Tern to guide management actions, identify problems and gauge management success.

Recommended research topics include:

- Little Tern feeding ecology and its influence on breeding patterns and success; and

- threats to food resources and feeding habitats, in particular the potential impact of small rises in seawater temperature on food resource availability.

### ***Action 6.3 Investigate the cultural and historic significance of the Little Tern***

The cultural and historic significance of the Little Tern to indigenous Australians has not been investigated. The NPWS will encourage research projects, which seek to define any cultural and historic significance of the Little Tern.

### ***Performance Criterion 6***

Research, which investigates the life history of the Little Tern or enhances our understanding of the cultural and historic significance of the species, will be actively encouraged. An increased understanding of the relationship between the species biology, ecology and cultural significance will refine management of the Little Tern.

### **Specific Objective 7: To provide for the cost-effective and efficient Statewide co-ordination of recovery actions for the Little Tern in NSW during each breeding season**

#### ***Action 7.1 Maintain the Little Tern recovery team for the duration of the plan***

The NPWS will maintain the Little Tern recovery team throughout the implementation of the Recovery Plan. The primary role of the recovery team is to provide advice and support to the Director-General of National Parks and Wildlife regarding Little Tern conservation and management. In particular, the team will oversee and provide advice on the implementation of the Little Tern Recovery Plan. The team will also evaluate current management activities and report on the success of the recovery actions included in the plan.

#### ***Action 7.2 Provide efficient and cost-effective Statewide co-ordination***

Little Terns are distributed along the entire NSW coast at widely dispersed sites. On-ground management of each site/group of sites occurs independently on a day to day basis. In addition, threats to the Little Tern are numerous and mitigation of these threats requires exchange of information and adaptive management. It is therefore crucial that recovery efforts be centrally co-ordinated by the NPWS in liaison with the Little Tern recovery team.

#### ***Action 7.3 Biennial de-briefing session***

Debriefing sessions are considered a valuable and critical component to the success of any management activities as they provide a forum to exchange ideas and improve management of the Little Tern across NSW. A debriefing session will be sought by the Recovery Program coordinator every two years for those involved in the Little Tern Recovery Program.

### ***Performance Criterion 7***

A Statewide Little Tern Recovery Program will be maintained for the life of the Recovery Plan and be implemented in an efficient and cost-effective manner by the NPWS. A biennial debriefing session will be sought for those involved in the Little Tern Recovery Program.

**Specific Objective 8: Raise awareness of the conservation status of the Little Tern and involve the community in the Recovery Program for the species**

***Action 8.1 Species profile and educational material***

The NPWS has produced a species profile to provide information about the conservation status and management issues affecting Little Terns (Appendix 3). The profile will be distributed to site visitors and local communities utilising potential Little Tern nesting, resting and fledgling feeding sites and is available from local wardens, NPWS Area Offices and the NPWS Internet Homepage.

***Action 8.2 Targeting community groups***

A community education and involvement program targeting key local issues regarding the protection of Little Tern nesting habitat will be implemented by NPWS to enhance the recovery of the species. Target groups include local residents, local businesses and holidaymakers at caravan parks proximate to Little Tern nesting, resting and fledgling feeding sites. Forms of community education may include: newsletters and newsletter articles, posters which are fixed to NPWS information boards within national parks, radio and television interviews and stories, public speaking and newspaper articles. Community members that are engaged as volunteers can play a significant role in the monitoring and protection of terns at nesting sites. Volunteers can assist with inundation protection activities and the collection of survey and monitoring data during the breeding season.

***Action 8.3 Training of site wardens for each priority nesting site***

Site wardens (local community volunteers) will be sought at the start of each breeding season to patrol and assist with the protection of nesting and resting sites. Wardens will then be trained by NPWS Area staff and will be clearly identifiable by a NPWS armband. As stated in Action 2.1, human disturbance to nesting and resting sites, particularly during busy holiday periods, can have an adverse impact upon breeding success. Wardening of tern nesting sites reduces these impacts. A shade awning should be provided for wardens at each priority nesting site and a mobile phone to contact NPWS staff or local police if law enforcement is required. Wardens are advocates for the Little Tern and beach conservation in general; a supply of pamphlets on Little Terns should also be available for distribution. A local debriefing session will be held to thank wardens and volunteers and to evaluate the success of the program.

***Action 8.4 Liaison with interest groups***

The NPWS will liaise with ornithological societies to seek the services of experienced and trained observers to participate in survey and monitoring of Little Terns at active nesting sites. The involvement of environmental and vegetation management groups such as Dunecare will be also sought in regard to vegetation management at breeding sites.

### *Performance Criterion 8*

The NPWS will raise the profile of the Little Tern Recovery Program with an aim to recruit site wardens and involve the general community within the program. Educational literature will be prepared and disseminated across a variety of media prior to and during each breeding season to highlight the conservation significance of the Little Tern.

### **Specific Objective 9: To develop a field manual to advise on ‘best practice’ field-based methodologies**

A Little Tern Field Manual will be developed by the NPWS to address several specific aims: (i) to share knowledge and experience between managers of different colonies, (ii) to ensure that acquired knowledge and experience is not lost, and (iii) to provide new managers with details of site management techniques. The manual will capture the collective experience of volunteers, wardens and NPWS staff working with the Little Tern.

#### *Action 9.1 Production of a Little Tern Field Manual*

The NPWS will compile and disseminate a Little Tern Field Manual for use by NPWS staff, site wardens and community volunteers in order to achieve ‘best practice’ in terms of the management of Little Tern breeding colonies. The manual will describe detailed site methodologies employed at NSW breeding colonies and will contain input from an array of stakeholders such as NPWS staff, site wardens and volunteers. More than one method may be described for the management of a threat. It is proposed that the field manual would be a ‘living’ document and be amended as new information regarding the management of the Little Tern becomes available.

The field manual will include the following information:

1. Methods for establishing nesting sites including site preparation and site discouragement techniques
2. Management of Little Tern Wardens and volunteers
3. Methods for managing natural and human induced threats
4. Monitoring (and reporting) methods:
  - The field manual will include a generic site pro-forma to ensure a consistent methodological approach for monitoring colony dynamics and breeding activities (see Action 5.2 for the type of data that should be recorded at each nesting site). A consistent approach to data collection over time will allow for stronger analysis and subsequent reporting of colony dynamics. A status report will be compiled every five years to gauge trends and assess management success (Action 5.2).
5. Advice on the use of local media (radio, television and newspapers), newsletters and letterbox drops to raise the profile of the Little Tern; and
6. Banding and identification techniques to inform management of colony dynamics.

### *Performance Criterion 9*

The recovery team will compile and disseminate a Little Tern Field Manual for use by NPWS staff, site wardens and community volunteers in order to achieve 'best practice' in terms of the management of Little Tern breeding colonies.

## **10. Implementation**

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### **10.1 Implementation Schedule**

Responsibility for implementation and funding of the Little Tern Recovery Program will rest primarily with the National Parks and Wildlife Service (Appendix 2) although other public authorities, specified in Action 1.1, will be responsible for Little Tern recovery actions as part of their statutory obligations.

Management flexibility will be important to the success of the program. Management requirements will need to be assessed each season and the available resources allocated accordingly, depending on where and in what numbers the birds nest and what problems they face at each site. As Little Tern nesting changes in distribution (sometimes dramatically) from year to year, funding should not be tied too closely to specific sites. The implementation of these actions will depend on substantial input from community groups and volunteers.

### **10.2 Implementation Costs**

An annual funding schedule for the Recovery Program is provided in Appendix 2. Figures quoted are the approximate costs associated with undertaking all recovery actions. The primary cost is attributed to ongoing intensive management and monitoring of eight major and selected minor Little Tern colonies Statewide. It represents the average cost of maintaining a warden and undertaking threat abatement activities such as signage, fencing, predator control and other miscellaneous costs, and includes approximate time invested by NPWS Area staff.

## **11. Preparation Details**

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Jim Anderson and Lloyd Van der Wallen of the Biodiversity Research and Management Division prepared this Recovery Plan. Lloyd Van der Wallen and Ron Haering (NPWS) prepared the draft version of the Recovery Plan. All background material is substantially based on an earlier draft of the Recovery Plan prepared by Dr. Peter Smith (P&J Smith Ecological Consultant). The content of the plan is a result of the combined knowledge and expertise of the Little Tern recovery team.

### **11.1 Date of Last Amendment**

No amendments have been made to date.

### **11.2 Review Date**

This Recovery Plan will be reviewed within 5 years of the date of publication.

### 11.3 Acknowledgments

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## 11.4 Personal Communications

Successful recovery planning utilises both past and current research literature, and the wealth of personal experiences from those that work closely with the terns in the field. The following people are acknowledged for their contribution to this Recovery Plan:

C. Champion	Alan Morris: Consultant (formerly NPWS)
Brian Crisp: Local volunteer Harrington/Farquhar Inlet	Dr. David Priddel: NPWS Senior Research Scientist Hurstville
M. Dwyer	Peter Reed: NPWS Ranger Nowra Area
Kathryn Gall: NPWS Ranger Manning Area	Jim Reside: Formerly DSE Bairnsdale
P. Gow	A. Rose
R. Harmer	Geoff Ross: NPWS Wildlife Management Officer Botany Bay Area
Gina Hart: NPWS Ranger Clarence South Area	D. Secomb
Heather Hole: Little Tern Warden Harrington/Manning Point	A. Smith
Michael Jarman: NPWS South Coast Shorebird Recovery Co-ordinator	Martin Smith: NPWS Ranger Coffs Coast Area
B. Jones	David Turner: NPWS Ranger Great Lakes Area
Jillian Keating: NPWS South Coast Shorebird Recovery Co-ordinator	Leona Waldegrave-Knight: DSE Bairnsdale.
Dr. Clive Minton: Victorian Wader Study Group	M. Williams

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- Grafton Area: Smith (1995d)
- Dorrigo Area: Smith (1995e)
- Harrington: Smith (1994c, 1995b), Smith (1997)
- Forster: Smith (1994b, 1995a)
- Botany Bay: Priddel and Ross (1996)
- Nowra Area: Smith (1995f)
- Narooma Area: Smith (1995g)

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## APPENDIX 1. Little Tern Nesting Sites in New South Wales

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- 1. Tweed Heads** Recorded as a nesting site by Hitchcock (1959) and Campion (1963). Exact location unknown, but probably on sand-spit on southern side of Tweed River mouth (Letitia Spit). No confirmed nesting records since, although 1-2 pairs present in 1979/80 and nesting suspected (Clancy 1979).
- 2. Kingscliff** On sand-spit at mouth of Cudgen Creek. Last nesting record October 1964 (Morris 1979).
- 3. Hastings Point** On sand-spit on northern side of Cudgera Creek mouth. Used by 2-4 pairs in 1963/64 and reported to be a regular nesting site (Campion 1964). The only subsequent records are three pairs and two nests in 1979/80 (Clancy 1979), and one pair seen feeding three fledglings in 1993/94 (Smith 1995c).
- 4. Pottsville** On sand-spit on southern side of Mooball Creek. Only nesting record one pair in 1980/81 (Clancy 1987).
- 5. Brunswick Heads** On inner side of sand-spit north of Brunswick River mouth, within Brunswick Heads Nature Reserve. Recorded as a nesting site by Hitchcock (1959) and used regularly by 1-5 pairs in 1979/80 to 1981/82 (Clancy 1987). No subsequent records.
- 6. Byron Bay** On sand-spit at mouth of Belongil Creek. A traditional site known to have been used in the past by up to 30 pairs (Smith 1990). Since 1974, used irregularly by up to seven pairs (Morris 1979, Clancy 1987), most recently by one pair in 1992/93 (Morris and Burton 1995).
- 7. Ballina** On sand dunes on southern side of Richmond River mouth. Last nesting record 2-3 pairs in December 1963 (Morris 1979).
- 8. Jerusalem Creek** On sand-spit on southern side of Jerusalem Creek mouth, within Bundjalung National Park. Used regularly by 1-6 pairs between 1980/81 and 1985/86 (Clancy 1987, Martindale 1985, Smith 1990). No subsequent records.
- 9. Yamba** Recorded as a nesting site by Hitchcock (1959) and Campion (1963). Exact location unknown.
- 10. Brooms Head** Nesting reported on sand dunes approximately one kilometre south of Brooms Head in 1974 and by three pairs in 1976/77 (Morris 1979). Two pairs and one fledgling seen on beach south of Brooms Head in January 1992 (Morris and Burton 1994). Two pairs and one nest recorded at Lake Cakora in 1994/95 (Smith 1995c).
- 11. Wooli** Nesting recorded on sand dunes around the Wooli River mouth between 1974/75 and 1984/85, with the largest colony eight pairs (12 nests for the season) in 1980/81 (Morris 1979, Clancy 1980b, 1981, 1987, Martindale 1985, Smith 1995d). No subsequent records. The main nesting site was on the southern side of the river at Jones Beach, within Yuraygir National Park. Nesting occurred on both sides of the river in 1980/81 and 1981/82, apparently in response to increasing vegetation encroachment at Jones Beach (Clancy 1980b, 1982).
- 12. Station Creek** On beach across mouth of Station Creek, within Yuraygir National Park. Used regularly by 1-3 pairs since at least 1971/72 (Morris 1979, Clancy 1987, Smith 1995d). Numbers increased in the 1990s, apparently because of deteriorating nesting conditions at nearby Red Rock: 12 pairs nested in 1995/96 (M. Williams pers. comm.), 14 pairs in 1996/97 (Burns 1997) with an additional seven nests to 1998/99 (Table 3). More recently in season 2002/03, intensive conservation efforts lead to the fledging of 20 chicks from 14 nests (G. Hart pers. comm.).

**13. Red Rock** Main nesting site is a small sand island in the Corindi River estuary, although nesting also occurs on the sand-spit on the northern side of the river mouth, especially after a failure on the island. The sand-spit is within Yuraygir National Park. Site used regularly since at least 1972/73, with the largest colony 20 pairs in 1988/89, and the largest nest count for the season 22 in 1981/82 (Morris 1979, Clancy 1987, Smith 1995d). Erosion of the island has resulted in poor conditions for nesting in the last couple of seasons. No nests were found in 1995/96 (M. Williams pers. comm.), four nests in 1996/97 (Burns 1997) and an additional three nests to 1998/1999 (Table 3). Despite the development of suitable nesting habitat at Red Rock in 2002/03 by local volunteers and NPWS staff, no Little Tern were observed at the site (Hart 2003).

**14. Sawtell** On sand-spit on southern side of Bonville Creek mouth within Bongil Bongil National Park. Used regularly in the 1970s and 1980s, with the largest colony nine pairs (16 nests for the season) in 1981/82 (Morris 1979, Clancy 1982, 1987, Martindale 1985, Starks 1992, Smith 1995e). No records in the early 1990s, but four pairs and one nest recorded in 1994/95 (Smith 1995c), three nests in 1995/96, 16 pairs and 16+ nests in 1996/97 (M. Dwyer pers. comm.) and 46 nests to 1998/99. Season 2000/01 provided 81 fledglings from 44 successful nests and in season 2001/02 there was 32 confirmed fledglings from 48 nests (Parramore and Parramore 2002).

**15. Valla Beach** On the sand-spits on either side of the mouth of Deep Creek. Nesting by 1-3 pairs recorded in 1989/90 (Starks 1992) and in every season 1993/94 to 1998/99 (Smith 1995c, M. Dwyer pers. comm.).

**16. Nambucca Heads** A traditional site recorded by Hitchcock (1959) and Champion (1963) and known to have been used nearly every year since 1974/75, with the largest colony 22 pairs (27 nests for the season) in 1986/87 (Morris 1979, Clancy 1987, Smith 1990, 1995e, D. Secomb pers. comm.). Numbers have been lower during the 1990s, with a maximum count of seven pairs in 1990/91 (Smith 1995e). Despite a large number of breeding adults recorded within the area, there were no successfully fledged chicks during season 2001/02, high tides and predation by foxes and cats was attributed to the loss of eggs (Wallace 2002). Nesting occurs either on sandbars in the Nambucca River estuary near the mouth of Warrell Creek or on the sand-spit on the southern side of the river mouth.

**17. Macleay River** Nesting reported on sand-spit at mouth of Macleay River and on sand dunes north towards Grassy Head. Last nesting record two pairs in 1976/77 in dunes 2-3 km south of Grassy Head (Morris 1979).

**18. Smoky Beach** On sand dunes between Smoky Cape and Hat Head, within Hat Head National Park. Nesting reported approximately four kilometres north of Hat Head by unknown numbers in 1974 and by four pairs in 1976/77 (Morris 1979). Two pairs nested approximately 5 km south of Smoky Cape in 1984/85 (Martindale 1985). No other records.

**19. Point Plomer** One pair reported nesting just south of Point Plomer at Queens Head, within Limeburners Creek Nature Reserve, in 1976/77 (Morris 1979). No other records.

**20. Port Macquarie** Recorded as a nesting site by Hitchcock (1959) and Champion (1963), however, the exact location is unknown. No other records until dredge spoil was deposited on the eastern side of Pelican Island in 1987. A colony of six pairs (eight nests for the season) was found here in 1987/88 (Smith 1990, R. Harmer pers. comm.), and five pairs nested in 1989/90 (Starks 1992). However, the site has since been abandoned by the terns.

**21. Camden Haven** Recorded as a nesting site by Hitchcock (1959). Exact location unknown, presumably near the mouth of Camden Haven River. No subsequent records.

**22. Harrington/Manning Point** Nesting first reported in 1979/80, when 1-2 pairs nested on sand dunes on northern side of southern river mouth of Manning River (Clancy 1979). No other records until the 1990s. In 1990 a large sand island was formed when the river broke through the long sand-spit on the southern side of the mouth. The island was the nesting site for at least 20 pairs in 1992/93 and 50+ pairs (76+ nests for the season) in 1993/94 (Smith 1994b). It then joined onto the northern bank of the river and formed a sand-spit, where 31 pairs and 62 nests were recorded in 1994/95 (Smith 1995b), 38 pairs and 83+ nests in 1995/96 (A. Smith pers. comm.), 104 fledglings and 135 nests in 1996/97 to 124 nests in 1997/98 and 87 nests in 1998/99 (Table 3)(Smith 1997). In more recent years, 74 chicks were fledged from 97 nests in season 2001/02 (Hole and Hole 2002) and in 2002/03 an estimated 79 breeding pairs provided 71 fledglings (Hole and Hole 2003).

**23. Farquhar Inlet (formerly Old Bar)** On sand-spit on northern side of the southern river mouth of Manning River (locally known as Scotts Creek). Approximately 12 pairs nested in 1964/65 and two pairs in 1965/66 (Morris 1979). One pair nested in 1990/91 (Smith 1994b) and seven pairs and four nests were recorded in 1994/95 (Smith 1995c). A colony of 12-15 pairs was recorded in 1996/97 (B. Crisp pers. comm.), which has increased to 53 nests in 1998/99 (Table 3). In more recent years, extensive conservation efforts lead to the fledging of at least 59 chicks from 73 nests in season 2001/02 (Hole and Hole 2002). During season 2002/03, however, the importance of Farquhar Inlet as a nesting area was greatly diminished with 40 breeding pairs of terns leaving the site to take up roost at Harrington/Manning Point. Wardens counted 14 fledglings from a total of 24 nests in that year (Hole and Hole 2003).

**24. Forster** The Wallis Lake estuary at Forster was recorded as a nesting site by White (1922), Sharland (1938), Hitchcock (1959) and Campion (1963). Nesting has been recorded in most years since 1976/77, with the largest colony 50 pairs in 1994/95 (Smith 1995a), and the largest nest count for the season 104 in 1992/93, even though no more than 20 pairs were recorded at any one time during this season (Smith 1994a). Nesting occurred on a recently dredged sand-spit at Forster Keys in 1976/77, however, subsequent nesting records have all been from sand islands near the mouth of the lake, most of which have been created or augmented with dredge spoil (six different islands used). Nesting sites used during the 1990s are 'Sand Island' (constructed from dredge spoil in 1989) and the northern end of Miles Island. The size of the colony declined alarmingly in the mid to late 1990s, with 11 pairs and 18 nests recorded in 1995/96, and 15 breeding plumage birds and two nests in 1996/97 (Newton 1997) and a single nest in 1998/99 (Table 3). Terns have not nested at Forster in recent years (1999/00 to 2002/03) (Table 3).

**25. Seven Mile Beach** On sand dunes between Cape Hawke and Booti Booti, within Booti Booti National Park. Used by 12 pairs in 1937/38 (Sharland 1938). No other records.

**26. Smiths Lake** On sand-spit across mouth of lake, adjacent to Myall Lakes National Park. Only nesting record describes one pair in 1963/64 (Smith 1990).

**27. Treachery Beach** On sand dunes between Treachery Head and Submarine Beach, within Myall Lakes National Park. Two pairs and one nest were recorded in 1986/87 (Moffatt 1986) and 2-3 pairs and two nests in 1994/95 (Smith 1995c).

**28. Big Gibber/Fiona Beach** On sand dunes behind the beaches on either side of Big Gibber, within Myall Lakes National Park. Nesting recorded S of Middle Camp in 1984/85 (six nests), 5 km N of Dees Beach access in 1985/86 (five nests), and near Middle Camp in 1986/87 (15 pairs, eight nests) (Moffatt 1986). No subsequent records.

**29. Dark Point (Little Gibber)** On sand dunes behind the beaches on either side of Dark Point, within Myall Lakes National Park. Nesting recorded 3 km N of Dark Point in 1983/84 (six nests), 1.5 km S of Dark Point in 1985/86 (6+ pairs, four nests), and close to Dark Point in 1986/87 (ten

pairs, four nests) (Moffatt 1986). No other records until two pairs were found nesting in a midden swale approximately 1 km S of Dark Point in 1996/97 (Newton 1997) and a single nest in 1998/99.

**30. Port Stephens** Corrie Island was recorded as a nesting site by Hitchcock (1959) and Campion (1963). Approximately ten pairs nested on a sand-spit on the island in 1972/73 (Morris 1979). Several pairs nested on a sand-spit at nearby Winda Woppa in 1979/80 (Smith 1990). No subsequent records.

**31. Stockton Beach** Four pairs nested on sand dunes behind Stockton Beach in 1988/89 (Cooper 1992). No subsequent records.

**32. Hunter River** Recorded as a nesting site by Gwynne (1933), Hitchcock (1959), Campion (1963) and Morris (1979). Nesting occurred on sand-spits, sandbanks and areas of dredge spoil around Walsh, Smedmore and Moscheto Islands. These islands and sandbanks have since been formed through dredging into one large island, Kooragang. A colony with seven nests was recorded in 1932/33 (Gwynne 1933). Last nesting record one pair in 1972/73 (Morris 1979).

**33. Redhead** On sand dunes near headland. Nesting recorded prior to 1969 (Morris 1979). No subsequent records.

**34. Swansea** Site near Pelican Point at entrance to Lake Macquarie. Last nesting record four pairs in 1959/60 (Morris 1979).

**35. Budgewoi** On sand dunes near beach. Nesting reported in the 1960s (Morris 1979), however, no subsequent records.

**36. The Entrance** A nesting site in the 1960s (A. Morris pers. comm.). No subsequent records until two pairs nested, failed and re-nested on reclaimed land on the inner southern side of Tuggerah Lake entrance in 1994/95 (Smith 1995c). Since season 2001/02, terns have been known to nest at Karagi Point (a sandspit on the northern side of the entrance to Tuggerah Lakes). The importance of The Entrance as a major breeding area for terns has increased in recent years and through the implementation of an intensive volunteer assisted conservation program 24 breeding pairs had 27 nesting attempts and fledged 27 to 30 chicks in season 2000/01 and in 2001/02 at least 37 chicks were fledged by 35 breeding pairs (Morris 2002).

**37. Dee Why Lagoon** On sand dunes on southern side of lagoon mouth. Last nesting record 2-3 pairs in 1947/48 (Morris 1979).

**38. Homebush Bay** On sand-spit at Homebush Bay, 20 km up Parramatta River from the sea. Last nesting record one pair in 1964/65 (Morris 1979).

**39. Maroubra** Sand extraction for industrial purposes left a huge area of bare sand on the present site of Heffron and Coral Sea Parks, Maroubra, during the 1940s. One pair nested here in 1942/43 and again in 1943/44 (Bell 1983). The nesting site was at least three km away from likely feeding sites at Botany Bay or along the coast.

**40. Botany Bay** Several different nesting sites have been used within the Bay:

a) **Sydney Airport** The main nesting site in the bay was originally at the old entrance to Cooks River, where some 50 pairs nested in 1941/42 (Morris 1979). This site was destroyed in 1950 to allow extension of Sydney Airport. Nesting has since occurred on dredge spoil sites created during various airport works: 10-25 pairs nested each year from 1958/59 to 1965/66 (Campion 1963, 1964, pers. comm.), and up to eight pairs between 1967/68 and the last record, eight pairs on the Third Runway extensions in 1993/94 (Morris 1979, Smith 1990, Straw and Priddel 1992, Priddel and Ross 1996).

- b) **Georges River Entrance** Nesting formerly occurred at Shell Point in Woollooware Bay, last record two pairs in 1951/52 (Morris 1979). One pair nested on a man-made site in nearby Gwawley Bay in 1967/68 (Morris 1979).
- c) **Port Botany** Dredging and reclamation for the construction of Port Botany created extensive but temporary nesting habitat where 20-40 nests were found each season from 1979/80 to 1982/83 (Larkins 1984). Fifteen pairs and six nests were recorded in 1984/85 (Morris 1985) and single pairs nested in 1986/87 and 1990/91 (Straw and Priddel 1992).
- d) **Towra Spit** Two pairs nested on Towra Spit, on the edge of Towra Point Nature Reserve, in 1986/87 (Smith 1990). Heavy seas broke through the spit in 1990, creating an island which has been the main nesting site in Botany Bay since 1991/92, increasing in size to 35+ pairs and 50 nests in 1994/95, 50+ pairs and 76 nests in 1995/96, and 60 pairs and 94 nests in 1996/97 (Straw and Priddel 1992, Priddel and Ross 1994, 1995, 1996, G. Ross pers. comm.). In 1996/97 a nesting pair of one Fairy Tern and one Little Tern was observed, and succeeded in raising one fledgling (G. Ross pers. comm.). In season 2002/03 101 nests were created by 45 breeding pairs, 43 chicks were known to fledge (Ross *et al.* 2003)
- e) **Molineux Point** Little Tern re-established this site as a potential colony site after a disastrous nesting attempt at Towra Spit Island in 2001/2002. Number of chicks fledged is unknown. During season 2002/2003, Sydney Ports contractors deployed over four kilometres of bunting streamers and 400 starpickets around the site to dissuade the terns nesting at Molineux Point (Ross *et. al* 2003).
- 41. Boat Harbour** On sand-spit at Boat Harbour, Kurnell Peninsula, adjacent to Captain Cook's Landing Place Historic Site. Used regularly by 4-5 pairs up to 1949/50, then one pair in 1958/59 (Morris 1979). No subsequent records.
- 42. Bellambi Point** On sand dunes. First noted in the 1950s. Largest colony was 20 pairs nesting in December 1964 (records of D. Gibson). Used most years in the 1960s and 1970s, but by declining numbers of birds, until the last record of two pairs in 1977/78 (Morris 1979).
- 43. Towradgi Beach** On sand dunes behind beach. Nesting noted before 1950 (Morris 1979). No subsequent records.
- 44. South Wollongong Beach (Coniston Beach)** On sand dunes behind beach. Approximately 50 pairs nested in December 1956 (records of D. Gibson), then no further records until one pair in 1977/78, two pairs in 1978/79 and one pair in 1984/85 (Morris 1979, Smith 1990). No subsequent records.
- 45. Port Kembla Harbour** Original site was at the entrance of Tom Thumb Lagoon. Used regularly during the 1950s, with the largest colony estimated at 50 pairs in 1955/56 (records of D. Gibson). The site was destroyed in the early 1960s during development of the Port Kembla Inner Harbour complex. At the same time, a new site was incidentally created a few hundred metres away by deposition of dredge spoil at the coal-loading terminal. The latter site was used regularly in 1963/64 to 1965/66, with 29-48 nests recorded per season (records of D. Gibson). However, vegetation encroachment and industrial use soon rendered it unsuitable and there have been no subsequent nesting records.
- 46. Port Kembla Beach (North Beach)** On sand dunes at northern end of beach. A few pairs nested at the site in the past, however, by 1977 it had become unsuitable through sand mining and waste disposal (records of D. Gibson). No subsequent records. Morris (1979) and Smith (1990) mention 50 pairs nesting here in 1963/64, however, this record actually refers to the coal-loading terminal in Port Kembla Harbour.

- 47. Lake Illawarra** The sand dunes on the northern side of the lake entrance were formerly a regular nesting site. The last nesting record here was in 1962/63 (Morris 1979). One pair nested at the mouth of Duck Creek, on the western side of Lake Illawarra, in 1978/79 (Morris 1979). No records since.
- 48. Shellharbour** Nesting reported at Shellharbour Beach in the 1930s (Sharland 1938). No other records.
- 49. Minnamurra** On sand-spit at mouth of Minnamurra River. Only nesting record four pairs in 1967/68 (Morris 1979).
- 50. Comerong Island** On sand-spit across the mouth of the Shoalhaven River between Shoalhaven Heads and Comerong Island, usually at the Comerong Island end within Comerong Island Nature Reserve. Used by fewer than ten pairs in 1965/66 and 4-13 pairs in 1976/77 to 1978/79 (Morris 1979). Subsequently, there were sporadic reports of single nests until 1994/95, when 13 breeding plumage birds were seen and three separate nests were found at different times during the season (Smith 1995f). In 1995/96, ten nests were found, although no more than four were active simultaneously, and in 1996/97 two pairs nested (P. Reed pers. comm.).
- 51. Lake Wollumboola** Nesting usually occurs on the sand-spit across the mouth of the lake. In 1994/95, some nesting also occurred on an exposed mudflat within the lake. Used by 5-15 pairs in 1973/74 to 1978/79 (Morris 1979). No further records until 1991/92. Nesting recorded almost every season since, with 22 nests found in 1994/95, 30 nesting pairs in 1995/96, 14 nests in 1996/97, 70 nests in 1998/99, 50 nesting pairs in 2001/02 proceeding to 40 breeding pairs in 2002/03 (Smith 1995f, P. Reed pers. comm., Keating and Jarman 2003).
- 52. Lake Conjola** Nesting of up to ten pairs on a sand-spit at lake entrance in late 1940s and early 1950s (Morris 1979, records of C. Humphries). No subsequent records until three pairs nested in 1995/96, four pairs in 1996/97, ten pairs in 2001/02 and 17 pairs in 2002/03 (Smith 1995f, P. Reed pers. comm., Keating and Jarman 2003).
- 53. Narrawallee Creek** Two pairs nested at the mouth of Narrawallee Creek, probably within Narrawallee Creek Nature Reserve, in 1984/85 (Smith 1990). No other records.
- 54. Burrill Lake** Nesting by up to ten pairs on a sand-spit at lake entrance in late 1940s and early 1950s (Morris 1979, records of C. Humphries). No records since.
- 55. Tabourie Lake** Nesting by approximately ten pairs on a sand-spit at lake entrance in late 1940s and early 1950s (Morris 1979, records of C. Humphries). No records since.
- 56. Meroo Lake** Listed as a nesting site by Champion (1963). No other records.
- 57. Mossy Point** On sand-spit on northern side of Tomaga River mouth. Last nesting record 2-3 pairs in 1960/61 (Morris 1979).
- 58. Congo Creek** Three adults and one nest recorded at the mouth of Congo Creek in 1994/95 (Smith 1995c). No other records.
- 59. Mullimburra Point** Three pairs nested at the mouth of the creek north of Mullimburra Point on one occasion in the early 1980s (Smith 1990). No other records.
- 60. Coila Lake** Nesting occurs on the sand-spit at the mouth of Coila Lake or further north on sand dunes behind Bingie Beach. Recorded as a nesting site by Champion (1963). Other records are one pair in 1977/78 (Morris 1979), three pairs in 1982/83 (Lindsey 1985) and one pair in 1994/95 (Smith 1995c).
- 61. South Tuross Heads** On sand-spit on southern side of lake entrance, within Eurobodalla National Park. Nesting also suspected on a nearby sandbank in 1994/95. Used by 6-10 pairs in

1964/65, one pair in 1978/79, and by up to 12 pairs since 1984/85, with the last record 11 pairs and three nests in 1994/95 (Morris 1979, Smith 1990, 1995g). Nesting recorded each season from 1984/85 to 1988/89, 1994/95 and 1998/99 to 2002/03. Due to an intensive conservation effort by NPWS staff and community volunteers 65 chicks were fledged by 62 breeding pairs in season 2002/03 (Keating and Jarman 2003).

**62. Brou Lake** Nesting reported on the sand dunes between the lake and the ocean beach in 1966/67 by fewer than ten pairs (Morris 1979). No other records until nesting was recorded on a sand island inside the lake entrance in most seasons between 1987/88 and the last record 1993/94, with the largest colony 35 pairs and 33 nests in 1990/91 (Smith 1995g). The area has recently been acquired by NPWS and forms part of Eurobodalla National Park. The artificial opening of the lake at its southern end in mid-October 2001 marked the arrival of large numbers of Little Tern that had not established a significant breeding colony in eight years. One hundred and nine pairs rapidly commenced nesting activity, however, strong sea swells flooded the entire colony on January 2<sup>nd</sup> 2002, allowing only four chicks to fledge despite the best efforts of volunteers and NPWS staff. The suitability of Brou Lake as a nesting site in the future will be highly dependant upon lake activities (Keating and Jarman 2002). Five nesting attempts in 2002/03 with no fledglings recorded (Keating and Jarman 2003).

**63. Tilba Lake** Nesting occurs either on the sand-spit across the mouth of the lake or, in some years, on a mud island inside the lake. The sand-spit has recently been reserved as part of Eurobodalla National Park. The first recorded nesting was by 25 pairs in 1977/78, apparently a re-nesting of birds that had failed earlier in the season at nearby Wallaga Lake (Morris 1979). Birds have since been recorded nesting in most seasons, especially since 1985/86, with the largest colonies 35 pairs (only 8 nests found) in 1988/89 and 27-28 pairs (25 nests found) in 1989/90 (Bolger 1989, Smith 1995g). Ten nests were found in 1993/94 and eight nests in 1994/95 (Smith 1995g), however, there have been no nesting reports since. There was an unconfirmed report of a mixed Fairy Tern/Little Tern nesting pair in 1980/81 (Lindsey 1981). No nesting activity has been recorded in the last four years (1999/00 to 2002/03) (Table 3).

**64. Wallaga Lake** Morris (1979) noted that Wallaga Lake was a regular nesting site used by 12-15 pairs in 1976/77 and 30 pairs in 1977/78. Nesting has been less frequent since then, while nesting reports from nearby Tilba Lake have increased. Nesting was recorded in 1984/85, 1986/87, 1993/94, 1994/95 and 1996/97, with the largest colony 34 pairs (48 nests for the season) in 1993/94 (Smith 1990, 1995g, P. Gow pers. comm.). The birds have usually nested on the sand-spit on the northern side of the lake entrance or on Wallaga Beach to the north. However, the main nesting site in 1993/94 was a sand island inside the lake, east of the bridge. In 1996/97, 13 pairs nested on the sand-spit (Gow 1997, pers. comm.). In 2002/03, 12 breeding pairs and 21 nests were recorded (Keating and Jarman 2003).

**65. Murrah Lagoon** Four pairs and three nests recorded in 1989/90 (Starks 1992), and three nests in 1995/96 (Whiter 1996).

**66. Middle Lagoon** One pair nested in 1996/97 on the sand-spit on the northern side of the closed lagoon entrance (Gow 1997). The site is within Mimosa Rocks National Park.

**67. Nelson Lagoon** One pair nested in 1996/97 on the sand-spit on the southern side of the open lagoon entrance (Gow 1997). The site is within Mimosa Rocks National Park.

**68. Bega Rivermouth (Mogareka Inlet)** On sand-spit on northern side of Bega River mouth. Two pairs and one nest were recorded in 1989/90 (Starks 1992), ten pairs and four nests in 1994/95 (Smith 1995c), 4+ nests and five Fairy Tern nests in 1995/96 (K. Gall pers. comm.), and

13 nesting pairs in 1996/97 (Gow 1997, pers. comm.) to ten recorded fledglings in 1998/99. Three breeding pairs and three nests recorded for season 2002/03 (Keating and Jarman 2003).

**69. Wallagoot Lake** On small sand islands close to shore at the north-eastern end of the lake, adjacent to Bournda National Park. First nesting record two pairs in 1987/88, then three pairs in 1988/89 and 12 pairs in 1989/90 (Smith 1990, Starks 1992). The original nesting island has since been colonised as a nesting site by large numbers of Silver Gulls and Crested Terns. In 1994/95, two pairs of Little Tern and three pairs of Fairy Terns nested on a smaller island nearby (Jones 1995). No nesting records exist for the period 1994/95 to 1998/99, due to the closing of the lake entrance and the subsequent inundation of the nesting islands by rising lake levels (B. Jones pers. comm.). Recently in 2002/03, Wallagoot Lake enjoyed its best fledgling success since 1987 with 74 nesting pairs producing 109 fledglings from 239 eggs (Keating and Jarman 2003).

**70. Nadgee Lake (Salt Lake)** On sand-spit at mouth of Nadgee Lake, within Nadgee Nature Reserve. Used regularly by up to eight pairs until 1973/74 (Morris 1979). Since then, the only nesting records have been nine pairs in 1980/81 and two pairs in 1984/85 (Smith 1990).

## APPENDIX 2. Annual Funding Schedule for Little Tern Recovery Program

Table 10: Costing Table. Estimated costs of implementing the actions identified in the Little Tern Recovery Plan are provided below.

Action No.	Action Title	Priority	Estimated Cost/Year					Total cost over 5 years			
			Year 1	Year 2	Year 3	Year 4	Year 5	NPWS In-Kind	Threatened Species Fund Requirement	FoxTAP Fund Requirement	Total Cost
1.1	Inform and consult with land managers	Essential	✓	✓	✓	✓	✓	✓	✓	✓	✓
2.1	Intensive management of nesting, resting and fledgling feeding sites Eight major colonies and selected minor colonies <i>Threatened Species Fund Requirement*</i> <i>NPWS Region-In-Kind</i> <i>FoxTAP Fund Requirement</i>	Essential	*\$9,000 \$30,346 \$35,359	*\$7,500 \$30,346 \$35,359	*\$7,500 \$30,346 \$35,359	*\$7,500 \$30,346 \$35,359	*\$7,500 \$30,346 \$35,359	\$0 \$151,730 \$0	*\$39,000 \$0 \$0	\$0 \$0 \$176,795	*\$39,000 \$151,730 \$176,795
3.1	Investigate the potential for the incidental creation of island nesting sites using dredge spoil	Desirable	✓	✓	✓	✓	✓	✓	✓	✓	✓
4.1	Acquisition of Little Tern nesting sites by NPWS	Desirable	✓	✓	✓	✓	✓	✓	✓	✓	✓
5.1	Monitoring of individual colonies Eight major colonies and selected minor colonies <i>Threatened Species Fund Requirement*</i> <i>NPWS Region-In-Kind</i> <i>FoxTAP Fund Requirement</i>	Essential	*\$4,000 \$5,082 \$75,100	*\$2,500 \$5,082 \$75,100	*\$2,500 \$5,082 \$75,100	*\$2,500 \$5,082 \$75,100	*\$2,500 \$5,082 \$75,100	\$0 \$25,410 \$0	*\$14,000 \$0 \$0	\$0 \$0 \$375,500	*\$14,000 \$25,410 \$375,500
5.2	Analysis of monitoring data and preparation of status report	Essential	\$3,500	\$0	\$0	\$0	\$3,500	\$0	\$0	\$7,000	\$7,000
6.1	Banding Studies	Highly Desirable	\$2,000	\$2,000	\$2,000	\$2,000	\$2,000	\$10,000	\$0	\$0	\$10,000
6.2	Promote research opportunities	Desirable	✓	✓	✓	✓	✓	✓	✓	✓	✓
6.3	Investigate the cultural and historic significance of the Little Tern	Highly Desirable	\$0	\$0	\$5,000	\$0	\$0	\$5,000	\$0	\$0	\$5,000

Action No.	Action Title	Priority	Estimated Cost/Year					Total cost over 5 years			
			Year 1	Year 2	Year 3	Year 4	Year 5	NPWS In-Kind	Threatened Species Fund Requirement	FoxTAP Fund Requirement	Total Cost
7.1	Maintain the Little Tern recovery team for the duration of the plan	Essential	✓	✓	✓	✓	✓	✓	✓	✓	✓
7.2	Provide efficient and cost effective Statewide coordination	Essential	\$5,000	\$5,000	\$5,000	\$5,000	\$5,000	\$25,000	\$0	\$0	\$25,000
7.3	Biennial debriefing session	Desirable	\$3,000	\$0	\$3,000	\$0	\$3,000	\$9,000	\$0	\$0	\$9,000
8.1	Species profile and educational material	Desirable	✓	✓	✓	✓	✓	✓	✓	✓	✓
8.2	Targeting community groups	Highly Desirable	✓	✓	✓	✓	✓	✓	✓	✓	✓
8.3	Training of site wardens for each priority nesting site	Essential	✓	✓	✓	✓	✓	✓	✓	✓	✓
8.4	Liaison with interest groups	Highly Desirable	✓	✓	✓	✓	✓	✓	✓	✓	✓
9.1	Production of Field Manual	Essential		\$3,500	\$0	\$0	\$0	\$3,500	\$0	\$0	\$3,500
	<b>Total Cost</b>		<b>\$172,387</b>	<b>\$166,387</b>	<b>\$170,887</b>	<b>\$162,887</b>	<b>\$169,387</b>	<b>\$229,640</b>	<b>\$53,000</b>	<b>\$559,295</b>	<b>\$841,935</b>

(1) Much of the cost for threat abatement and monitoring of tern colonies is offset by the Fox Threat Abatement Plan (FoxTAP) (refer to Table 11 for a comprehensive breakdown of costs offset by the FoxTAP). There are two components: Firstly, In-Kind funds represent salary component of NPWS staff utilising current resources; and secondly, the non-salaried component, funding for which is sought by the FoxTAP.

(2) Key:✓ indicates that the cost of the action is included as part of core functions of NPWS staff and as such is not costed out.

\* Although much of the cost for threat abatement and monitoring of tern colonies is offset by the FoxTAP, the colony at The Entrance is a recently established colony and as such has not been included in the FoxTAP to date (this may change in the future). As a consequence, this plan has made financial provision for intensive management of this site. This includes \$8000 in the first year to allow for the establishment of the Recovery Program at the site and \$5000 p/a. in subsequent years to maintain the program (see Table 11). In addition, a non-colony specific allocation of \$5000 p/a. has been made to allow for capital items to be replaced as required. In both cases the costs have been divided so that 50% has been allocated for management related activities and 50% for monitoring activities.

Table 11: Costing for Little Tern Regions reflecting the inputs from the Fox Threat Abatement Plan

Little Tern Regions	Current Nesting Sites	Fox Control			Fox Monitoring			Fox-Related Activities Total	Recovery Plan	Grand Total
		Fox TAP Fund Requirement	Region In-Kind	Total	Fox TAP Fund Requirement	Region In-Kind	Total			
Northern Rivers	Station Creek	\$3550	\$5950	\$9500	\$100	\$5082	\$5182	\$14682		\$14682
Coffs Coast	Sawtell/Bongil Bongil	\$2700	\$8016	\$10716	\$0	\$0	\$0	\$20096		\$20096
	Nambucca/Valla Beach	\$2700	\$6680	\$9380	\$0	\$0	\$0			
	<i>Sub-total</i>	<i>\$5400</i>	<i>\$14696</i>	<i>\$20096</i>	<i>\$0</i>	<i>\$0</i>	<i>\$0</i>			
Taree	Harrington/Farquhar Inlet	\$10000	\$0	\$10000	\$5000	\$0	\$5000	\$15000		\$15000
Central Coast	The Entrance	\$0	\$0	\$0	\$0	\$0	\$0	\$0	Yr 1 = \$8000 Yr 2-5 = \$5000 p/a	\$8000
Sydney	Botany Bay	\$1155	\$6500	\$7655	\$10000	\$0	\$10000	\$17655		\$17655
Shoalhaven Coast	Lake Wollumboola	\$1606	\$3200	\$4806	\$30000	\$0	\$30000	\$19806		\$19806
Eurobodalla Nature Coast	South Tuross Heads/Brou Lake	\$5072	\$0	\$5072				\$20072		\$20072
Bega Valley Sapphire Coast	Wallaga Lake/Tilba Lake	\$1815	\$0	\$1815				\$16815		\$16815
	Wallagoot Lake	\$6760	\$0	\$6760	\$21760		\$21760			
	<i>Sub-total</i>	<i>\$8575</i>	<i>\$0</i>	<i>\$8575</i>						
	<b>Total</b>	<b>\$35358</b>	<b>\$30346</b>	<b>\$65704</b>	<b>\$75100</b>	<b>\$5082</b>	<b>\$80182</b>	<b>\$145886</b>	Yr 1 = \$8000 Yr 2-5 = \$5000 p/a	<b>\$153886</b>

## APPENDIX 3: Species Profile for the Little Tern (*Sterna albifrons*)

### THREATENED SPECIES INFORMATION

## Little Tern

*Sterna albifrons* Pallas, 1764

Other common names **Sea swallow, White-shafted Ternlet**

#### Conservation status

The Little Tern is listed as an **Endangered Species** on Schedule 1 of the New South Wales *Threatened Species Conservation Act, 1995* (TSC Act).

**Description** (summarised from Higgins & Davies 1996)

*Length*

200-280mm

*Wingspan*

450-550mm

*Tail*

80-110mm

*Bill*

26-32mm

*Tarsus*

16-18mm

*Weight*

50g

The Little Tern is a slender, very small, migratory or partly migratory seabird. Grey plumage covers most of the body with the tips of the wings and the head being predominantly black. The wings are very narrow and the tail is moderately long and deeply forked. The tip of the tail falls short of the wing tips at rest.

During the breeding season, the legs, feet and bill change from black to yellow. Further, the heads of breeding birds have a black cap that contrasts with a white forehead. The Little Tern is very similar in size and shape to the Fairy Tern *Sterna nereis*.

The species is very vocal. The usual flight call is a repetitive shrill high-pitched *kik* or *kip* or a high-pitched, slightly rasping, disyllabic *gi-wick* or *kid-ik*.

Little Terns breeding in Australia are classified with those breeding in eastern Asia as subspecies *sinensis*.

#### Distribution

In Australia, the Little Tern occurs from Shark Bay in Western Australia, around northern and eastern

Australia, to the east coast of Tasmania and around to the Gulf of St Vincent in South Australia. Increased development around estuaries and coastal areas has led to the worldwide decline of Little Terns (Murray 1994).

There are three populations of the Little Tern subspecies *sinensis* in Australia. Two of these populations are known to occur in NSW; the South-eastern Australian population and the Asian population. It is the South-eastern Australian population that breeds along the NSW coast and is declining. This population is migratory, breeding in the spring and summer along the entire east coast from Tasmania to northern Queensland. Migrant individuals are present predominantly September to May with only occasional birds seen in the winter months (Morris *et al.* 1981).

The species was once quite common in NSW, however, recent records indicate that Little Terns now exist in a medium-sized, non-breeding Asian population and a small, threatened breeding population (Chafer & Brandis 1991). The small size of the South-eastern Australian breeding population is masked by the presence in summer of numerous migrants from these populations that breed in eastern Asia.

#### Recorded occurrences in conservation reserves

Lord Howe Island World Heritage Area, Nadgee NR, Wyrabalong NR, Comerong Island NR, Towra Point NR, Moon Island NR, Kooragang NR, Narrawallee NR, Broadwater NP, Eurobodalla NP, Bongil Bongil NP, Booti Booti NP, Mimosa Rocks NP, Myall Lakes NP, Bournda NP, Yuraygir NP, Bundjalung NP (NPWS 1999).

#### Habitat

The Little Tern is almost exclusively coastal with sheltered environments preferred. However, the species may also occur several kilometres from the sea in harbours, inlets and rivers (Smith 1990). Occasionally, the species may be recorded on offshore

islands or coral cays (Hill *et al.* 1988). The Little Tern nests in small, scattered colonies on sandy beaches or shingle pits. These nesting sites are particularly vulnerable to human disturbance, predation and natural catastrophes (Garnett 1992; Murray 1994).

### Ecology

The Little Tern is carnivorous, preferring small fish but also eating crustaceans, insects, annelids and molluscs (Higgins & Davies 1996). The species forages by plunging in the shallow water of channels and estuaries and in the surf on beaches (Owen 1991).

Nesting has been recorded at 60 sites along the NSW coastline but only about half of these have been used recently (Smith 1990).

Both parents incubate a clutch of 1-3 eggs for a period of 17-22 days. The newly hatched young are also cared for by both parents during the fledging period of 17-19 days (Smith 1994).

### Threats

- Nesting at flood-prone locations
- Predation of eggs and chicks by a range of species including foxes, silver gulls, ravens and whimbrels (Egan 1990; Secomb 1994; Rose 1994)
- Human disturbance by coastal recreational activities; adults leave nests when approached resulting in the chicks or eggs being exposed and vulnerable (Hill *et al.* 1988)
- 4WDs, trail-bikes and walkers may crush nests, eggs and chicks (Hill *et al.* 1988)

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- NPWS 1999. Atlas of NSW Wildlife. NPWS, Hurstville.

- Coastal development, including sand and rutile mining and the establishment of waste disposal dumps and construction (Smith 1990)
- Availability of food affected by modification of drainage patterns including damming of tidal creeks, reclamation of intertidal areas and destruction of seagrass beds, mangroves and saltmarsh (Martindale 1985; Smith 1990)
- Potentially susceptible to pesticides and contamination of estuaries by oil-spills and heavy metals (Hill *et al.* 1988)

### Management

- Protection and maintenance of known or potential habitat, including the implementation of protection zones around recent records
- Erection of fences and interpretative signage to minimise human disturbance
- Displacing birds from flood-prone sites by flagging beaches with lines of bunting or raising nests on sandbags (Owen 1991; Murray 1994)
- Control of introduced animals around potential habitat areas including electric fencing
- Local community groups acting as nesting site wardens

### Recovery plans

A recovery plan has been prepared for the Little Tern

- Owen R. 1991. A Report of the Management of Little Tern *Sterna albifrons* in the Bairnsdale Region during the 1990/1991 Breeding Season. Unpublished Report, Victorian Department of Conservation and the Environment, Bairnsdale.
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- Smith P. 1990. The biology and management of the Little Tern *Sterna albifrons* in NSW. NPWS, Hurstville.
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## APPENDIX 4: Report on the consultation process for the Draft Little Tern Recovery Plan

The *Threatened Species Conservation Amendment Act 2002* has made provision for the Director-General to include within an approved Recovery Plan a summary of any advice given by the Scientific Committee with respect to the plan, details of any amendments made to the plan to take account of that advice, and a statement of the reasons for any departure from that advice (Section 66A TSC Act).

Comments	NPWS Response
<p>The Committee is concerned at the proposed activities involving baiting the holes of ghost crabs and the capture and relocation of raptors (Section 10.1.4). The Committee considers these to be unacceptable management measures without further investigation into other management options. What investigations into alternative control strategies have been undertaken? NSW Fisheries may have some comment on the baiting of ghost crabs.</p>	<p>The activity of baiting ghost crabs has been removed from the plan in favour of an alternative management strategy described within the plan, i.e. placing tern eggs on a small sheet of plywood covered with sand and shell grit to reduce predation by Ghost crabs which burrow up through the sand to predate on eggs.</p> <p>Raptors have never been captured to date in NSW for Little Tern management, however, a Peregrine Falcon caused the nesting failure at Towra Point in one season. Raptors also caused the failure of a major colony in Victoria last season. The only methods available are to capture and relocate, capture and hold for release at end of breeding season or culling which is not preferred. Appropriate advice and licences would be sought once identified as an issue.</p>
<p>The Committee has serious concerns with activities involving coastal engineering (Section 10.2 Habitat Enhancement). The Spit Island proposals have been extremely controversial. Changing tidal flushing at Farquhar Inlet based on the suggestion of local oyster farmers without a full hydrological study would be dangerous.</p>	<p>The purpose of this section of the plan was to highlight opportunities for Little Tern habitat enhancement when agencies were seeking to undertake hydrological works. NSW laws provide for impact assessment depending on the nature of the proposed works. As such proponents and the NPWS would consider the environmental impacts of such works including the impacts on Little Tern.</p>
<p>Removal from the Commonwealth Schedules – The de-listing from the Commonwealth Schedules should be explained in terms of the whole species level and not because of any</p>	<p>Advice has been made available by the Commonwealth Threatened Species Scientific Committee to explain more fully why the species was de-listed in 1999 from the <i>Commonwealth</i></p>

improvement in conservation status.	<i>Endangered Species Protection Act 1992.</i> The plan has now been amended to accommodate this new information.
Should Fairy Terns be listed under the TSC Act?	Until recently, the Fairy Tern was only a rare, non-breeding vagrant in NSW (Hoskin and Hindwood 1964). The first confirmed breeding record was at Wallagoot Lake in the 1994/95 season (Jones 1995) and the species may be in the process of extending its breeding range to this State. More recently it has been observed as far north as Botany Bay. It is also suspected that the Fairy Tern is interbreeding with the Little Tern as a result of observing interactions between individuals of the two species, and observations of apparent hybrids. The NPWS has provided information on these matters to the Scientific Committee (separate to this process); the Committee may wish to investigate this issue further.
Is it known that the Little Tern can be reared in captivity for subsequent release?	It is not known whether the Little Tern can be bred in captivity. The purpose of this section of the Recovery Plan is to present all potential options and then to discount those options, which are not suitable. The Recovery Plan will be amended to clarify this point.
Why adopt a 1950 target of 340 breeding pairs? Is this considered to be a viable population? Given the between year fluctuations, would it not be more desirable to set a range rather than an absolute target?	<p>The Draft Recovery Plan set a target of 340 breeding pairs as a target for the life of the plan. At the time it was unknown whether the 1950 target of 340 breeding pairs constituted a viable population. In spite of this, the 1950 target was the earliest data that was available on the population size of the Little Tern and for these reasons was selected as the most appropriate target to aim for. The recovery team also believed that this target was achievable for the life of the plan in accord with the then increasing success in fledgling survivorship.</p> <p>It is unlikely that 340 breeding pairs would constitute a viable population. Given that, the recovery team does not</p>

	<p>have sufficient data on the Little Tern at this stage of the recovery process to undertake a meaningful population viability analysis. The validity of the target will be investigated during the life of this plan as more data is acquired, and as our understanding of the Little Tern increases.</p> <p>Since the release of the Draft Recovery Plan, ongoing intensive management has resulted in the current (2002/03) population of approximately 437 breeding pairs surpassing the target originally set. Consequently, the approved version of the plan has been updated to reflect these changes.</p>
<p>Do estuary management committees have executive responsibilities for such things as disposal of dredge spoil?</p>	<p>These committees have a role in providing advice to approval authorities on the disposal of dredge spoil. It is the approval authorities who will make a decision on these matters within the context of the planning system. The plan will be amended to better reflect this role of the committees.</p>
<p>The Coastal Committee no longer exists – the current body is the Coastal Council. Are Dunecare and Coastcare synonymous?</p>	<p>Comments are noted and changes made as appropriate. In New South Wales Dunecare is supported by the Coastcare program.</p>
<p>Electric fencing (and baiting) is prohibitively expensive, and it is not clear that this has been recognised in the budget.</p>	<p>Electric fencing has been undertaken at Lake Wollumboola, and is proposed to be established at Manning Point and Farquhar Inlet. The budget provides funding for a range of actions that might be appropriate for a particular season. The usefulness of electric fencing is still under investigation and the budget has some flexibility in relation to which management actions are undertaken depending on priorities.</p> <p>A comprehensive baiting program has been developed through the Fox Threat Abatement Plan (FoxTAP) for Little Tern sites. This plan identifies costs associated</p>

	<p>with fox control and identifies stakeholders who have a role in undertaking this control. The FoxTAP will provide the majority of funding required for fox control (not only for Little Tern but other species that are likely to be impacted by foxes).</p>
<p>The Committee asks whether shooting, baiting and trapping of rogue gulls, foxes, cats etc, and nesting sites inspected at least once a week while nesting is in progress is likely to be a deleterious factor?</p>	<p>Personal experience from Little Tern managers has shown that the management techniques undertaken in close proximity to the colonies are not having a deleterious effect. Human disturbance has been introduced to the colonies on an increasing basis. The Little Tern were initially introduced to low levels of human disturbance, which the birds quickly adjusted to. The level of disturbance has been increased to the point where managers can visit colonies at regular intervals (up to three times a week) without significant impact on the birds. Although individual pairs lift from the nest as a nest is passed, these birds return within a minute or two of passing, and remain on the nest even where an observer is seated close by the nest. The birds are particularly tolerant of site visitors where they become used to particular people. Nonetheless, the birds are quickly disturbed when they do not recognise visitors, and for this reason visitation is restricted.</p>
<p>The intensity of checking nests (up to three times a week) for evidence of predation (Section 10.3.2 Monitoring of Individual Colonies) is likely to exacerbate the problem of predation as foxes often follow the footsteps of humans on beaches and hence are led to the nests of beach nesting birds. Peter Catling notes from personal experience that foxes follow footsteps of humans on beaches and hence are led to the nests of beach nesting birds. The intensity of checking nests (up to three times a week) is likely to exacerbate the problem.</p>	<p>The recovery team is not aware of any scientific evidence to support the view that foxes follow human footsteps on beaches. Foxes readily identify Little Tern colonies even in situations where no footprints lead to sites. Even if there is a possibility that this might be the case the Little Tern colonies are obvious within the beach environment due to the fencing that surrounds them. Most colonies are within populated areas or are frequented by people in 4WDs or boats. The fences are necessary to encourage people not to disturb the sites but also attract interest. It would not be feasible to stop people from</p>

	<p>walking up to the fence line to satisfy their curiosity, nor would it be desirable in terms of gaining public support for the plight of the Little Tern. The recovery team is of the opinion that the intensity of monitoring currently carried out is desirable in terms of data collected, for population dynamics, nesting and fledgling success, and to understand the threats that the Little Tern faces. The recovery team supports widespread fox baiting within the fox catchment area surrounding Little Tern colonies, and intensive baiting closer to the site. Although fox baiting is carried out prior to the Little Tern breeding season there are situations where this is not always possible or effective, and some lands are private which reduces the area in which foxes can be baited, pet dogs are also an issue, in terms of bait uptake in populated areas. The NPWS will establish electric fences where necessary and where the terrain and other public authorities allow.</p>
<p>Peter Catling also comments that it is doubtful that cats would be a major problem for Little Tern colonies because in 28 years of monitoring there has never been any record of cats on the beaches in Nadgee Nature Reserve.</p>	<p>Cats have been observed to be a significant problem to Little Tern eggs. A cat took a large number of newly hatched chicks from Harrington in the 1999/2000 season. The cat would wait until the birds started making noises just prior to hatching and singled out these eggs for predation.</p>
<p>Section 3.1 <u>Taxonomy</u> needs to clearly spell out what the current accepted thinking is at the sub-specific level and with the three forms of the sub-species <i>sinensis</i> that are elaborated in section 4.1. Does this distinction have any recognition at the Commonwealth level or by the Australian Museum? It will become the crux of the listing process, particularly if they are to be re-listed at the Federal level. The work of Donnellan is critical to this section and perhaps deserves some discussion and maybe contact with him to see if there have been any recent</p>	<p>The plan has been updated to include the latest research from Donnellan (reports written in 1995 and 1996 which Environment Australia referenced during the process of de-listing the species). Dr. Stephen Donnellan was also contacted personally at the SA Museum to discuss any recent developments. His research provided a tentative indication of genetic differentiation between populations both in Australia and Japan, however, limits to the number of loci able to be tested and an insufficient sample size rendered the results for the most part inconclusive. Donnellan has advised that further</p>

<p>developments that may clarify these taxa. What is the current status at a Commonwealth level?</p>	<p>research is needed, and has specifically raised the need for more sampling to be done across a range of different sub-populations to strengthen the analysis. The Recovery Plan has been updated to reflect the current status at the Commonwealth level.</p>
<p>The abundance section was confusing because the units of population measure keep changing. How equivalent are breeding pairs to the total breeding population (do you multiply by two?) and how does this link to your Performance Criteria. Further confusion in the third paragraph where nests is the count but these figures “are greatly inflated”....” But do indicate a continuing trend.”</p>	<p>Several historical reports from which data on Little Tern abundances has been sourced, fail to report numbers of breeding pairs visiting nesting sites and instead opt for numbers of breeding adults as the preferred indicator of abundance (Victorian data provided by Dept. Sustainability and Environment being a good case in point). While it would be preferable for the sake of consistency to provide counts of breeding pairs as the sole indicator of abundance, the recovery team has the view that simply dividing by two to arrive at an estimate of breeding pairs could potentially be incorrect. The recovery team will amend the text to reflect the points made. Nest counts are only provided as further trend indicators. In future, data collection will be consistent in accord with the production of a generic site pro-forma.</p>
<p>Is there a column missing off the right hand side of Table 8?</p>	<p>No, merely an error in formatting. Changes made as appropriate.</p>
<p>Why do sections 5.2.2 and 5.3 within the draft plan start with the overseas or interstate information rather than the NSW data? The reverse would make for more coherent reading.</p>	<p>Comments are noted and changes made as appropriate.</p>
<p>The Victorian work seems to show the link between population size and fledgling success. Are they doing anything different? The Victorian experience is alluded to but not spelt out. What were the specific actions that lead to the recovery in this population and are they appropriate for the NSW population?</p>	<p>The Victorian Little Tern occur in relatively unpopulated areas, occur in larger colonies, and often on sand islands. Management has included fox baiting, fencing, and monitoring by wardens from a distance. Since 1999, however, the Victorian tern population has undergone a significant decline, apparently, primarily due to increased depredation over several years and a severe hailstorm in season 2002/02. Sites previously known to</p>

	<p>produce 200+ fledglings are now producing &lt;10 per annum. Although the data is yet to be confirmed, only one chick was known to fledge for the whole East Gippsland Region in season 2002/03. There is also some evidence provided by Dr. Clive Minton of the Victorian Wader Study Group that terns are using NSW south coast sites in preference to Victorian sites – 35 pairs are purported to have been sighted within the region. Further research into colony dynamics using banded birds will be necessary to assist in clarifying why the Victorian sites have become significantly depleted.</p>
<p>Community Education Awareness and Involvement is listed as an essential activity yet it is very light on in terms of commitment and how it will fit in with some of the other actions. It should spell out some of the specific groups which will be targeted, and how they will be made aware, and what contribution they will make.</p>	<p>This has been made clearer within the plan.</p>



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