VERTEBRATE FAUNA SURVEY
WORIMI CONSERVATION LANDS

FINAL REPORT

Prepared for

NSW DEPARTMENT OF ENVIRONMENT AND CLIMATE CHANGE

ECOTONE ECOLOGICAL CONSULTANTS Pty Ltd
39 Platt Street, Waratah NSW 2298
Phone: (02) 4968 4901 fax: (02) 4968 4960
E-mail: info@ecotoneconsultants.com.au

EEC PROJECT No. 0583CW

SEPTEMBER 2008

EXECUTIVE SUMMARY

The Worimi Conservation Lands (WCL) cover an area of 4,200 hectares and are made up of three reserves: Worimi National Park, Worimi State Conservation Area and Worimi Regional Park. The WCL have been identified as a significant cultural landscape and are co-managed by a board of management.

A vertebrate fauna survey of the Worimi Conservation lands has been undertaken in order to identify the fauna species assemblages within the WCL and record any significant species, including threatened species. As most of the previous studies were situated outside of or on the periphery of the WCL, a more detailed assessment of the fauna communities and habitat would assist in the future management for the WCL.

From the literature review a total of 270 fauna species (excluding marine mammals) have been recorded within the study locality (2 km from the centre line of the WCL). These consisted of 189 bird, 49 mammal, 17 reptile and 15 frog species. It should be pointed out that it is unlikely that all of these species would occur within the WCL as the search area provides a greater variety of habitats than those identified within the WCL.

Prior to the current survey a total of 135 species had been recorded within or very close to the WCL boundary. These consisted of 87 bird, 35 mammal, 6 reptile and 7 frog species. This represents about half of the total species recorded for the study locality based on the literature review. Of the fifty-four threatened species recorded within the locality, fourteen vulnerable listed species have been recorded within the boundaries of the WCL and four additional species have been recorded close to the boundary in continuous vegetation.

Following a desk top review of the study area, four major study sites were chosen in order to represent the two dominant forested habitats, the Coastal Sand Apple-Blackbutt Forest and the Swamp Mahogany-Paperbark Swamp Forest. A habitat assessment of each site was conducted in the field prior to setting traps in order to refine the location of each trap line.

A total of 102 fauna species were identified during the field surveys (comprising 58 bird, 26 mammal, 8 frog and 12 reptile species). Six of the species recorded, common myna, horse, fox, dog, deer species and rabbit, are introduced. Best results were achieved at Sites 2 and 4, probably as a result of more habitat variation with both main vegetation communities sampled. Five threatened species, the squirrel glider, eastern bent-wing bat, little bent-wing bat, grey-headed flying-fox and powerful owl were positively identified within the study area during the survey period. All five species are listed as vulnerable on the TSC Act and the grey-headed flying-fox is also listed as vulnerable on the EBPC Act. The squirrel glider and grey-headed flying-fox were recorded at all four sites and all five threatened species are expected or have the potential to use all of the forested habitats within the WCL. The timing of the survey in Autumn and un-seasonally cool weather resulted in an incomplete inventory of fauna species as summer migratory birds were absent, spring summer frogs were inactive and bat activity was lower than normally expected.

Based on a combination of the results of the 2008 survey and the literature review, 159 fauna species have been recorded in the WCL consisting of 99 birds, 39 mammals, 12 reptiles and 9 amphibians.

The results of the survey and habitat assessment identified the potential for several key threatening processes, as listed in the NSW TSC Act, that need to be considered. Of most importance was high frequency of fire, predation by the European fox and feral cat, invasion of native plant communities by bitou bush, boneseed and lantana, loss of dead wood and dead trees by firewood collection and as a result of high intensity bushfires and the loss of hollow bearing trees, also as a result of high intensity bushfires. Other impacts not listed in the TSC Act include rubbish dumping and damage to dune vegetation and ground nesting birds resulting from the use of off road vehicles.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

1.1 Objectives of the Survey

From the brief the main objectives of the study are:

- Undertake a vertebrate fauna survey of the Worimi Conservation lands (WCL) which identifies fauna species and significant species including threatened species
- Map the location of fauna species and survey sites and prepare this information as spatial data layers
- Identify key management issues impacting on fauna species within the WCL
- Prepare a report of the results which includes a separate appendix with a fauna species list and threatened species profiles.

1.2 Background

The Worimi Conservation Lands (WCL) covers an area of 4,200 hectares and is made up of three reserves: Worimi National Park, Worimi State Conservation Area and Worimi Regional Park. The WCL have been identified as a significant cultural landscape and are co-managed by a board of management.

A number of fauna surveys have been conducted in the Stockton Bight area. A list of some of the pre 1995 studies and a species list derived from the literature are included in a Local Environment Study (LES) and management plan for Stockton Bight prepared for the Newcastle Bight Committee, HLA Envirosciences (1995). Fauna records are also recorded within the NSW Wildlife Atlas database and a number of other wildlife databases. This information was provided by DECC for the literature review process.

As most of the previous studies were situated outside of or on the periphery of the WCL, a more detailed assessment of the fauna communities and habitat including the identification of threatened species would assist in the future management for the WCL. An aspect of this survey also involved working with Aboriginal Traditional Owners and NPWS employees during the field survey component.

1.3 Project Tasks

From the brief, the components of the study are as follows:

1. Literature review of previous studies and records that have been completed for the area.
2. Establish a number of permanent fauna survey sampling plots.
3. Prepare a fauna list and threatened species profiles of the Worimi Conservation lands.
4. Prepare spatial data of fauna survey locations and fauna species recorded which is compatible with Arcview 3.3.
5. Final Report with separate appendices which include a fauna list and threatened species profile sheets.

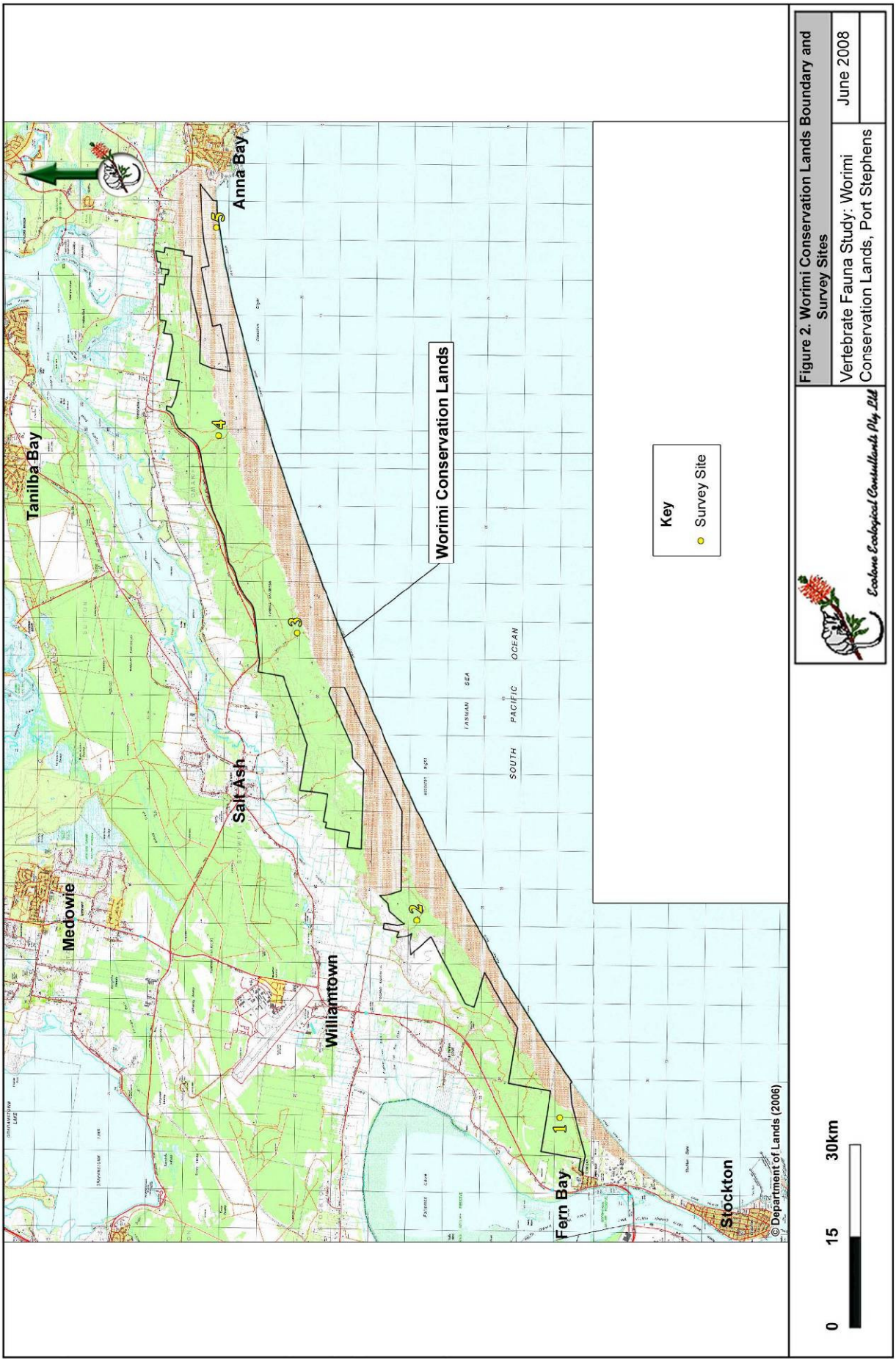
The location of the study area is shown in **Figure 1** and the Worimi Conservation Lands boundary is shown in **Figure 2**.

Figure 1. Study Locality

Vertebrate Fauna Study: Worimi Conservation Lands, Port Stephens

June 2008

Ecotone Ecological Consultants Pty Ltd


Anna Bay
Tanilba Bay
Medowie
Salt Ash
Williamtown
Fern Bay
Stockton
Worimi Conservation Lands
Key
Survey Site
SOUTH PACIFIC OCEAN
TASMAN SEA
1
2
3
4
5
0 15 30km
© Department of Lands (2006)
Ecotone Ecological Consultants Pty Ltd
Figure 2. Worimi Conservation Lands Boundary and Survey Sites
Vertebrate Fauna Study: Worimi Conservation Lands, Port Stephens
June 2008

2.0 LITERATURE REVIEW

In order to create a species list of fauna previously recorded within the WCL and in surrounding lands a search of available data bases and literature for nearby development projects was carried out. The search of the literature was also used to determine where most previous survey effort had been carried out in order to assist in the choice of the survey sites for this study.

The search for local fauna species records primarily consisted of a search of the DECC Wildlife Atlas database. The search of a 10 km radius of the study area was initially carried out by using a buffered boundary region in MapInfo from the approximate centre line of the study area to select the relevant records. Map sheets covered were Newcastle 9232 & Port Stephens 9332 and the data used was dated 07/03/2008. For the purpose of the species list produced in Appendix 1 a buffer of 2 km was applied to the data, thus producing a species list more relevant to the study area.

Information from databases held by Birds Australia, Australian Museum, CSIRO collection was supplied under licence by the DECC Nelson Bay office. This information was buffered to 1 km of the WCL; however the most recent records appeared to be from 2001.

Potential threatened and migratory species and EECs listed in the Commonwealth EPBC Act identified in the Protected Matters Report for the study locality were also considered (**Note:** the species listed in the Protected Matters Report are derived from habitat modelling only rather than actual records and therefore some species may not occur in the available habitats).

As it was apparent that not all fauna recorded for the area is listed within the Wildlife Atlas a search of the following project reports from sites close to or within the study area was carried out:

Ecotone Ecological Consultants 1994. *Bat survey of land proposed for sand extraction by Boral Resources (NSW) Pty Ltd at Fern Bay*. Report prepared for Resource Planning Pty Ltd

Ecotone Ecological Consultants 1995a. *Dual carriageway for Nelson Bay Road between Salt Ash and Bobs Farm, FIS for the proposed Stage 1 Construction at Salt Ash.* Report prepared for Port Stephens Council

Ecotone Ecological Consultants 1995b and 1997. *Dual carriageway for Nelson Bay Road between Salt Ash and Bobs Farm, assessment of impact on threatened species of the proposed stage 2 construction.* Reports prepared for Port Stephens Council

Ecotone Ecological Consultants 2001a. *Lower Hunter and Central Coast Regional Biodiversity Conservation Project, Module 1. Fauna Survey*. Report for LHCCREMS

Ecotone Ecological Consultants 2001b. *Flora and fauna survey and threatened species assessment, proposed subtransmission line upgrade to Tomaree Peninsula, Lavis Lane to Bobs Farm*. Southern, middle and northern section reports prepared for Energy Australia

ERM 2001. *REF for the Nelson Bay Road upgrade Bobs Farm to Anna Bay*. Report prepared for the NSW RTA and Port Stephens Council

ERM 2004. *Supplementary REF for modifications to the Nelson Bay Road upgrade.* Report prepared for NSW RTA (contains additional survey information from 2003)

ERM 2005a. *EIS for the Stockton Sandpit windblown sand extraction, Fern Bay.* Report prepared for Boral Resources (Country) Pty Ltd.

ERM 2005b. *SIS for the Fern Bay Estate Master Plan Study*. Report prepared for the Winton Property Group and CVC Limited.

Insite Planning Engineering Environmental 2007a. *Part 3A preliminary assessment for sand extraction at Lot 332 DP 753204, Jessie Road Anna Bay*. Report prepared for SS & LM Johnston

Insite Planning Engineering Environmental 2007b. *Preliminary assessment for sand extraction at Lot 4042 DP 1090633 and Lots 632 and 633 DP 609506, Nelson Bay Road Salt Ash*. Report prepared for ATB Morton Pty Ltd.

2.1 Review of Local Fauna Species

From the literature review a total of 270 fauna species (excluding marine mammals) have been recorded within the study locality (2 km from the centre line of the WCL). These consisted of 189 bird, 49 mammal, 17 reptile and 15 frog species (see **Appendix 1** for details). It should be pointed out that it is unlikely that all of these species would occur within the WCL as the search area provides a greater variety of habitats than those expected within the WCL.

Prior to the current survey a total of 135 species had been recorded within or very close to the WCL boundary. These consisted of 87 bird, 35 mammal, 6 reptile and 9 frog species. This represents about half of the total species recorded for the study locality as a result of the literature review.

Threatened Fauna Species

A total of fifty-three threatened fauna species listed in Schedules 1 and 2 of the NSW Threatened Species Conservation Act 1995 (TSC Act) have previously been recorded within the study locality (10 km either side of the centre line of the study area) according to DECC Wildlife Atlas Records. This includes terrestrial and some marine species and involves thirty-three bird, fifteen mammal, two reptile, two frog and one invertebrate species. Nineteen of these threatened species have been recorded within 2 km of the study area. An endangered population, the emu (*Dromaius novaehollandiae*) population in the north coast and Port Stephens LGA, has also been recorded in the locality but not within 2 km of the study area. An additional threatened species, the sanderling (*Calidris alba*) was not listed in the DECC Wildlife Atlas but occurs in the Birds Australia data base.

Of the threatened species shown in **Table 1**, eight species are currently regarded as Endangered on Schedule 1, Part 1 of the TSC Act (bush stone-curlew, black-necked stork, little tern, swift parrot, regent honeyeater, green and golden bell frog, loggerhead turtle and giant dragonfly) and the remainder as Vulnerable on Schedule 2 of the Act. However, of the endangered species only the black-necked stork has been recorded within 2 km of the study area.

Four species are also listed as Endangered in the Commonwealth EPBC Act (swift parrot, regent honeyeater, spotted-tailed quoll and loggerhead turtle) and five species are listed as Vulnerable (large-eared pied bat, grey-headed flying-fox, long-nosed potoroo, green and golden bell frog and green turtle). Additional species listed in Table 2 under the EPBC Act are considered unlikely to occur within the habitats available in the study area.

Pelagic seabirds and fully aquatic marine mammals are not listed in Table 1 although occasional strandings of listed whales and dolphins or exhausted, injured or dead seabirds may occur along Stockton Beach. The endangered Gould's petrel is only known to breed on Cabbage Tree Island

(and more recently Boondelbah Island) just off the coast of Port Stephens and therefore is most likely to occur on Stockton Beach as exhausted, injured or dead individuals.

Of the fifty-four threatened species recorded within the locality, fifteen vulnerable listed species have been recorded within the boundaries of the WCL and four additional species have been recorded close to the boundary in continuous vegetation based on the data viewed for the literature review (**Figures 3a-d**). The hoary wattled bat (*Chalinolobus nigrogriseus*) record mentioned in ERM 2005b is considered to be dubious as it is based only on ultrasonic call analysis and the location is well outside of the known distribution of the species.

Threatened Species previously recorded in the WCL

Pied oystercatcher (*Haematopus longirostris*)
Lesser sand plover (*Charadrius mongolus*)
Sanderling (*Calidris alba*)
Terek sandpiper (*Xenus cinereus*)
Powerful owl (*Ninox strenua*)
Grey-crowned babbler (*Pomatostomus temporalis temporalis*)
Koala (*Phascolarctos cinereus*)
Squirrel glider (*Petaurus norfolcensis*)
Brush-tailed phascogale (*Phascogale tapoatafa*)
Grey-headed flying-fox (*Pteropus poliocephalus*)
Eastern bent-wing bat (*Miniopterus schreibersii oceanensis*)
Little bent-wing bat (*Miniopterus australis*)
Greater broad-nosed bat (*Scoteanax rueppellii*)
East-coast (eastern) freetail bat (*Mormopterus norfolkensis*)
Green turtle (*Chelonia mydas*)

Threatened Species previously recorded close to the WCL boundaries

Masked owl (*Tyto novaehollandiae*)
Sooty oystercatcher (*Haematopus fulginosus*)
Black-browed albatross (*Thalassarche melanophrys*)
Spotted-tailed quoll (*Dasyurus maculata*)

Table 1. Threatened Fauna previously recorded in the DECC Atlas within the Study Locality

Scientific Name	Common Name	Status (TSC)	Status (EPBC)	Earliest/ latest record	Number of records within 10km of site	Number of records within 2km of site
Birds						
Anseranas semipalmata	Magpie goose	V	~	1993-2000	3	0
Botaurus poiciloptilus	Australasian bittern	V	~	1980-2002	6	1
Burhinus grallarius	Bush stone-curlew	E1	~	1980-2006	5	0
Calidris tenuirostris	Great knot	V	Mi	1976-1999	34	0
Callocephalon fimbriatum	Gang-gang cockatoo	V	~	1985-1992	1	0
Calyptorhynchus lathami	Glossy black-cockatoo	V	~	1981-2003	6	0
Charadrius leschenaultii	Greater sand plover	V	Mi	1973-1992	10	0
Charadrius mongolus	Lesser sand plover	V	Mi	1972-1999	336	1#
Climacteris picumnus	Brown treecreeper	V	~	1995	1	0
Dromaius novaehollandiae	Emu	E2	~	1964-1992	6	0
Ephippiorhynchus asiaticus	Black-necked stork	E1	~	1972-2004	42	1
Haematopus fulginosus	Sooty oystercatcher	V	~	1987-2006	16	0
Haematopus longirostris	Pied oystercatcher	V	~	1984-2006	23	5
Irediparra gallinacea	Comb-crested jacana	V	~	1984-1988	3	0
Ixobrychus flavicollis	Black bittern	V	~	1998-1999	2	0
Lathamus discolor	Swift parrot	E1	E	1999-2007	21	0
Limicola falcinellus	Broad-billed sandpiper	V	Mi	1972-1995	78	0
Limosa limosa	Black-tailed godwit	V	Mi	1973-2006	284	0
Lophoictinia isura	Square-tailed kite	V	~	1985	1	0
Neophema pulchella	Turquoise parrot	V	~	1982-1991	2	0
Ninox connivens	Barking owl	V	~	2004-2005	2	0
Ninox strenua	Powerful owl	V	~	1986-2006	23	5
Oxyura australis	Blue-billed duck	V	~	1985	1	0
Pandion haliaetus	Osprey	V	Mi	1984-2006	13	0
Pomatostomus temporalis temporalis	Grey-crowned babbler	V	~	1978	1	1
Ptilinopus magnificus	Wompoo fruit-dove	V	~	1989-1996	2	0
Ptilinopus superbus	Superb fruit-dove	V	~	1990-1991	2	0
Stagonopleura guttata	Diamond firetail	V	~	2007	1	0
Sterna albifrons	Little tern	E1	Mi	1973-2006	299	0
Stictonetta naevosa	Freckled duck	V	~	1981-1985	5	0
Tyto capensis	Grass owl	V	~	1993	1	1
Tyto novaehollandiae	Masked owl	V	~	1996-2005	8	2
Xanthomyza phrygia	Regent honeyeater	E1	E,Mi	2002	1	0
Xenus cinereus	Terek sandpiper	V	Mi	1973-2006	563	0
Invertebrates						
Petalura gigantea	Giant dragonfly	E1	~	2006	1	0
Flying Mammals						
Chalinolobus dwyeri	Large-eared pied bat	V	V	1997	1	0
Falsistrellus tasmaniensis	Eastern false pipistrelle	V	~	1998-2003	4	2
Miniopterus australis	Little bent-wing bat	V	~	1995-2006	22	4
Miniopterus schreibersii oceanensis	Eastern bent-wing bat	V	~	1994-2006	10	3
Mormopterus norfolkensis	East-coast freetail-bat	V	~	1998-2006	5	0
Myotis macropus	Southern myotis	V	~	2006	2	0
Pteropus poliocephalus	Grey-headed flying-fox	V	V	1992-2006	32	10
Saccolaimus flaviventris	Yellow-bellied sheathtail-bat	V	~	1992	1	1
Scoteanax rueppellii	Greater broad-nosed bat	V	~	1992-2006	23	10

Table 1. continued

Scientific Name	Common Name	Status (TSC)	Status (EPBC)	Earliest/ latest record	Number of records within 10km of site	Number of records within 2km of site
Non-flying Mammals						
Arctocephalus fosteri	New Zealand fur-seal	V	~	1990-2000	2	0
Dasyurus maculatus maculatus (southeastern mainland population)	Spotted-tailed quoll	V	E	1932-1992	26	4
Petaurus norfolcensis	Squirrel glider	V	~	1985-2007	45	14
Phascogale tapoatafa	Brush-tailed phascogale	V	~	1947-2006	27	1
Phascolarctos cinereus	Koala	V	~	1800-2006	4262	49
Potorous tridactylus tridactylus	Long-nosed potoroo (SE mainland)	V	V	2006	1	0
Frogs						
Crinia tinnula	Wallum froglet	V	~	1997-2007	70	1
Litoria aurea	Green and golden bell frog	E1	V	1996-2006	680	0
Reptiles						
Caretta caretta	Loggerhead turtle	E1	E	2006	1	0
Chelonia mydas	Green turtle	V	V	1989-2003	26	2

Notes:
398000E and 6369000N are the closest coordinates to the centre of the study area (Newcastle 9232 1:100000 mapsheet produced on Geocentric Datum of Australia 1994 [GDA94]).
The following marine species have been excluded due to the lack of habitat within the study area: wandering albatross, southern giant petrel, Gould's petrel, providence petrel, flesh-footed shearwater, masked booby, shy albatross, black-browed albatross, dugong, southern right whale, humpback whale. However these species may occasionally be washed up as dead specimens or stranded on the beach
- record from Chris Herbert, Hunter Bird Observers Club

Status (TSC): refers to the NSW *Threatened Species Conservation Act* 1995 (TSC)
E1 Schedule 1, Part 1: Endangered Species
E2 Schedule 1, Part 2: Endangered Populations
V Schedule 2: Vulnerable Species

Status (EPBC): refers to the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC)
E Endangered Species
V Vulnerable Species
Mi Migratory Species

Please note: These records are based on information supplied by the Department of Environment and Climate Change and other sources, and may contain errors or omissions.

2.2 EPBC Act Protected Matters Search

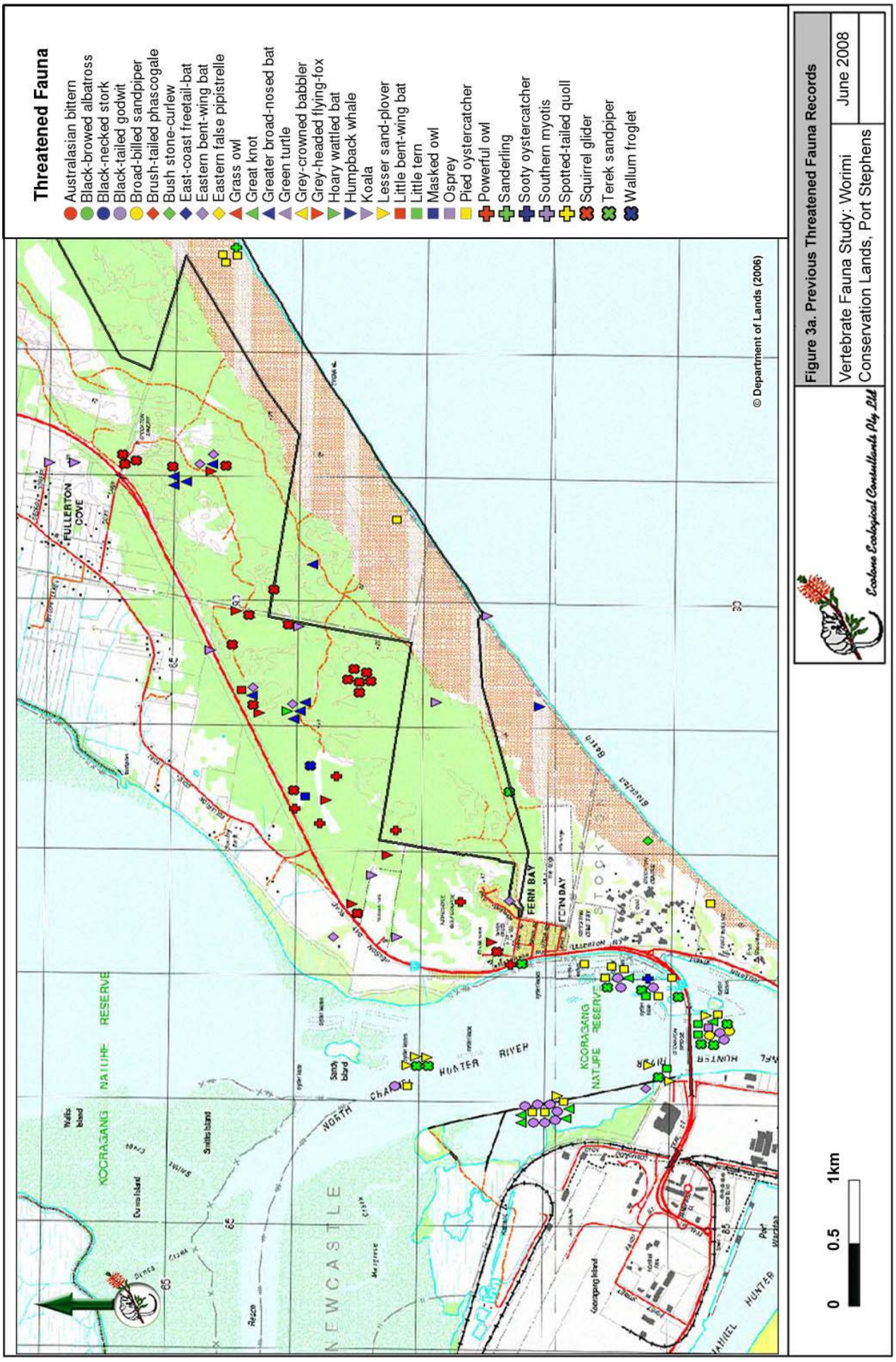
The EPBC Act protected matters search tool was used to investigate a 10km radius around the centre of the study area (**Table 2**). Please note that the data produced does not consist of actual records, rather a prediction based on habitat modelling. Ocean dependant mammals, fish and seabirds have been excluded from the list although individuals could end up being washed up on the beach as strandings or in the case of seabirds, exhausted, injured or dead. The ocean travelling seabirds include eleven species of albatrosses (two endangered), two species of giant petrels (one endangered and two species of petrels. As already mentioned, the endangered Gould's petrel is only known to breed on Cabbage Tree Island (and more recently Boondelbah Island) just off the coast of Port Stephens and therefore is more likely to occur on Stockton Beach as exhausted, injured or dead birds so it has been included in **Table 2**.

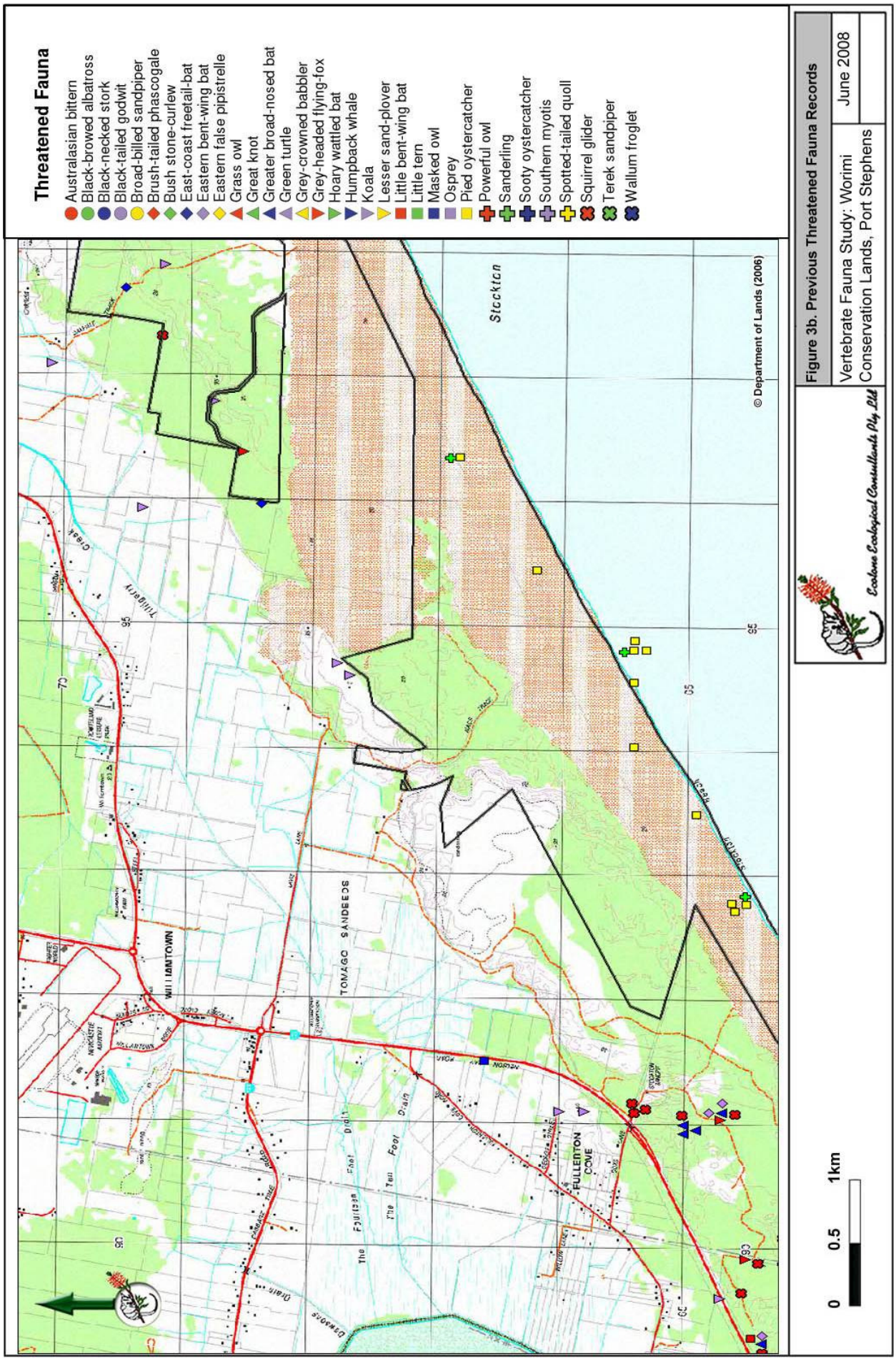
Table 2. Results of EPBC Act Protected Matters Search with Regards to Fauna

Protected Matter	Details
Threatened Species – Fauna (Mainly terrestrial species – green and leatherback turtle have been included as sporadic nesting or stranding records occur along NSW coast and Gould's petrel breeds near to the study area)	13 species: **Roosting known to occur within area according to EPBC modeling.** Grey-headed flying-fox (*Pteropus poliocephalus*) (**V**) **Species or species habitat likely to occur within area according to EPBC modeling.** Green and golden bell frog (*Litoria aurea*) (**V**) Regent honeyeater (*Xanthomyza phrygia*) (**E, Mi**) Stuttering frog (*Mixophyes balbus*) (**V**) **Species or species habitat may occur within area according to EPBC modeling.** Australian painted snipe (*Rostratula australis*) (**V**) Gould's Petrel (*Pterodroma leucoptera leucoptera*) **(E)** Green turtle (*Chelonia mydas*) (**V**) Leatherback turtle (*Dermochelys coriacea*) **(V)** Large-eared pied bat (*Chalinolobus dwyeri*) (**V**) Littlejohns tree frog (*Litoria littlejohni*) (**V**) Long-nosed potoroo (*Potorous tridactylus tridactylus*) (**V**) Spotted-tail quoll (*Dasyurus maculatus maculatus* [SE mainland pop.]) (**E**) Swift parrot (*Lathamus discolor*) (**E**)
Migratory Species (NB: Most marine mammals, fish and pelagic birds have been excluded due to the obvious lack of preferred habitat. The green turtle has been included as sporadic nesting records occur along NSW coast)	Terrestrial Species: **Species or species habitat likely to occur within area according to EPBC modeling.** White-bellied sea eagle (*Haliaeetus leucogaster*) (**Mi**) Regent honeyeater (*Xanthomyza phrygia*) (**E, Mi**) **Species or species habitat may occur within area according to EPBC modeling.** White-throated needletail (*Hirundapus caudacutus*) (**Mi**) Rainbow bee-eater (*Merops ornatus*) (**Mi**) **Breeding likely to occur within area according to EPBC modeling.** Spectacled monarch (*Monarcha trivirgatus*) (**Mi**) Satin flycatcher (*Myiagra cyanoleuca*) (**Mi**) **Breeding may occur within area according to EPBC modeling.** Black-faced monarch (*Monarcha melanopsis*) (**Mi**) Rufous fantail (*Rhipidura rufifrons*) (**Mi**) Wetland Species: **Species or species habitat likely to occur within area according to EPBC modeling.** Bar-tailed godwit (*Limosa lapponica*) (**Mi**) Black-tailed godwit (*Limosa limosa*) (**Mi**) Broad-billed sandpiper (*Limicola falcinellus*) (**Mi**) Common greenshank (*Tringa nebularia*) (**Mi**) Curlew sandpiper (*Calidris ferruginea*) (**Mi**) Eastern curlew (*Numenius madagascariensis*) (**Mi**) Lesser sand plover (*Charadrius mongolus*) (**Mi**) Marsh sandpiper (*Tringa stagnatilis*) (**Mi**) Pacific golden plover (*Pluvialis fulva*) (**Mi**) Ruddy turnstone (*Arenaria interpres*) (**Mi**) Terek sandpiper (*Xenus cinereus*) (**Mi**) Whimbrel (*Numenius phaeopus*) (**Mi**)

Migratory Species, continued	**Species or species habitat may occur within area according to EPBC modeling.** Latham's snipe (*Gallinago hardwickii*) (**Mi**) Painted snipe (*Rostratula benghalensis s. lat.*) (**Mi**) **Breeding likely to occur within area according to EPBC modeling.** Cattle egret (*Ardea ibis*) (**Mi**) Great egret (*Ardea alba*) (**Mi**) Migratory Marine Species (excluding those listed in "Wetland Species" above): **Species or species habitat may occur within area according to EPBC modeling.** Fork-tailed swift (*Apus pacificus*) (**Mi**) Green turtle (*Chelonia mydas*) (**V, Mi**) **Breeding may occur within area according to EPBC modeling.** Little tern (*Sterna albifrons*) (**Mi**)
Places on the Register of the National Estate	Five: Hunter Estuary Wetlands NSW Moffats Swamp Nature Reserve NSW Port Stephens Estuary NSW Snapper Island Nature Reserve NSW Tomaree National Park NSW
Listed Marine Species	Two (additional to those already listed as migratory in this table) (NB: Most marine mammals, fish and pelagic birds have been excluded due to the obvious lack of habitat. The Australian and New Zealand fur-seals have been included as sporadic records occur along NSW coast) **Species or species habitat may occur within area according to EPBC modeling.** New Zealand fur-seal (*Arctocephalus forsteri*) Australian fur-seal (*Arctocephalus pusillus*)
State and Territory Reserves	Seven: Kooragang Nature Reserve, NSW Moffats Swamp Nature Reserve, NSW Myall Lakes National Park, NSW Snapper Island Nature Reserve, NSW Tiligerry Nature Reserve, NSW Tomaree National Park, NSW Worimi Nature Reserve, NSW

Notes:
V Species listed as **Vulnerable** under the Commonwealth *EPBC Act*.
E Species listed as **Endangered** under the Commonwealth *EPBC Act*.
CE Species listed as **Critically Endangered** under the Commonwealth *EPBC Act*.
Mi Species listed as **Migratory** under the Commonwealth *EPBC Act*.


Threatened Fauna
Australasian bittern
Black-browed albatross
Black-necked stork
Black-tailed godwit
Broad-billed sandpiper
Brush-tailed phascogale
Bush stone-curlew
East-coast freetail-bat
Eastern bent-wing bat
Eastern false pipistrelle
Grass owl
Great knot
Greater broad-nosed bat
Green turtle
Grey-crowned babbler
Grey-headed flying-fox
Hoary wattled bat
Humpback whale
Koala
Lesser sand-plover
Little bent-wing bat
Little tern
Masked owl
Osprey
Pied oystercatcher
Powerful owl
Sanderling
Sooty oystercatcher
Southern myotis
Spotted-tailed quoll
Squirrel glider
Terek sandpiper
Wallum froglet
© Department of Lands (2006)
FULLERTON COVE
FERN BAY
KOORAGANG NATURE RESERVE
HUNTER RIVER
NEWCASTLE
0 0.5 1km
Figure 3a. Previous Threatened Fauna Records
Vertebrate Fauna Study: Worimi Conservation Lands, Port Stephens
June 2008
Ecotone Ecological Consultants Pty Ltd


Threatened Fauna
Australasian bittern
Black-browed albatross
Black-necked stork
Black-tailed godwit
Broad-billed sandpiper
Brush-tailed phascogale
Bush stone-curlew
East-coast freetail-bat
Eastern bent-wing bat
Eastern false pipistrelle
Grass owl
Great knot
Greater broad-nosed bat
Green turtle
Grey-crowned babbler
Grey-headed flying-fox
Hoary wattled bat
Humpback whale
Koala
Lesser sand-plover
Little bent-wing bat
Little tern
Masked owl
Osprey
Pied oystercatcher
Powerful owl
Sanderling
Sooty oystercatcher
Southern myotis
Spotted-tailed quoll
Squirrel glider
Terek sandpiper
Wallum froglet
Stockton
© Department of Lands (2006)
TOMAGO SANDBEDS
WILLIAMTOWN
FULLERTON COVE
0 0.5 1km
Figure 3b. Previous Threatened Fauna Records
Vertebrate Fauna Study: Worimi Conservation Lands, Port Stephens
June 2008
Ecotone Ecological Consultants Pty Ltd


Threatened Fauna
Australasian bittern
Black-browed albatross
Black-necked stork
Black-tailed godwit
Broad-billed sandpiper
Brush-tailed phascogale
Bush stone-curlew
East-coast freetail-bat
Eastern bent-wing bat
Eastern false pipistrelle
Grass owl
Great knot
Greater broad-nosed bat
Green turtle
Grey-crowned babbler
Grey-headed flying-fox
Hoary wattled bat
Humpback whale
Koala
Lesser sand-plover
Little bent-wing bat
Little tern
Masked owl
Osprey
Pied oystercatcher
Powerful owl
Sanderling
Sooty oystercatcher
Southern myotis
Spotted-tailed quoll
Squirrel glider
Terek sandpiper
Wallum froglet
© Department of Lands (2006)
TOMAREE
TOMAGO SANDBEDS
Pelican Point
0 0.5 1km
Figure 3c. Previous Threatened Fauna Records
Vertebrate Fauna Study: Worimi Conservation Lands, Port Stephens
June 2008
Ecotone Ecological Consultants Pty Ltd


Threatened Fauna
Australasian bittern
Black-browed albatross
Black-necked stork
Black-tailed godwit
Broad-billed sandpiper
Brush-tailed phascogale
Bush stone-curlew
East-coast freetail-bat
Eastern bent-wing bat
Eastern false pipistrelle
Grass owl
Great knot
Greater broad-nosed bat
Green turtle
Grey-crowned babbler
Grey-headed flying-fox
Hoary wattled bat
Humpback whale
Koala
Lesser sand-plover
Little bent-wing bat
Little tern
Masked owl
Osprey
Pied oystercatcher
Powerful owl
Sanderling
Sooty oystercatcher
Southern myotis
Spotted-tailed quoll
Squirrel glider
Terek sandpiper
Wallum froglet
TOMAREE
ANNA BAY
FINGAL BAY
Stockton Bight
BOBS FARM
© Department of Lands (2006)
Figure 3d. Previous Threatened Fauna Records
Vertebrate Fauna Study: Worimi Conservation Lands, Port Stephens
June 2008
Ecotone Ecological Consultants Pty Ltd
0 0.5 1km

2.3 Site Selection

In order to adequately sample the habitats within the study area the vegetation mapping for the region (LHCCREMS, 2003) was consulted. The mapping shows all of the WCL to be one community: MU 33 - Coastal Sand Apple-Blackbutt Forest.

This community occurs predominantly on Holocene sands often protected by a dune system. Diagnostic tree species in are the smooth-barked apple (*Angophora costata*), blackbutt (*E. pilularis*) and red bloodwood (*Corymbia gummifera*) with the scribbly gum (*E. signata*), Sydney peppermint (*E. piperita*) and broad-leaved white mahogany (*E. umbra*) less dominant.

The mid stratum is dominated by the old man banksia (*Banksia serrata*), *Acacia ulicifolia*, *Dillwynia retorta*, *Bossiaea rhombifolia*, *Macrozamia communis*, *Acacia terminalis* and *Banksia aemula*

Ground cover is dominated by bracken (*Pteridium esculentum*), kangaroo grass (*Themeda australis*), blady grass (*Imperata cylindrica var. major*) and a variety of herbs.

Ground truthing found that additional vegetation communities actually occur with Map Unit 37 - Swamp Mahogany-Paperbark Swamp Forest occurring in poorly drained swales behind and within the dune system.

Diagnostic tree species for this community are the swamp mahogany (*Eucalyptus robusta*), cheese tree (*Glochidion ferdinandi*) and broad-leaved paperbark (*Melaleuca quinquenervia*). Mid story plants include *Acacia longifolia, Gahnia clarkei, Omalanthus populifolius* and bangalow palm (*Archontophoenix cunninghamiana*). Ground covers are a mix of herbs, grasses and ferns including *Blechnum indicum*.

Small patches of Map Unit 50 - Coastal Sand Scrub occur on deep Quaternary sands along the edges of the fore-dune. The diagnostic species are *Leptospermum laevigatum*, coastal banksia (*Banksia integrifolia subsp. integrifolia*), *Acacia sophorae, Banksia serrata and Cupaniopsis anacardioides*. The general lack of trees in this community and exposure to onshore winds excluded this habitat for selection as a major survey site.

Therefore the four main survey sites targeted both the Coastal Sand Apple-Blackbutt Forest (Plate 1) and the Swamp Mahogany-Paperbark Swamp Forest (Plate 2) vegetation communities. Actual site locations were chosen by a range of parameters, including previous survey effort determined from the literature review, ease of access and the habitat type which was checked in the field prior to the setting up of the trapping transects. Features such as hollow bearing trees and a well developed ground cover were also targeted during the selection process. A summary of each site description is as follows:

Survey Area 1 – off Rushland Road, Fern Bay (location of site attribute assessment AMG 56 388986E 6362843N [AGD 66])

Topography – undulating vegetated sand dunes to a height of 10-20 metres ASL

Tree Layer - open blackbutt/smooth-barked apple forest to a height of 12-20 metres. A secondary open tree layer of old man banksia, blackbutt and smooth-barked apple is present to a height of 5-12 metres (**Plate 1**).

Shrub Layer – generally sparse, regenerating trees as above and a heathy growth of *Acacia, Dillwinia*, *Leptospermum laevigatum*, *Banksia serrata* and other shrubs to a height of 1-5 metres.

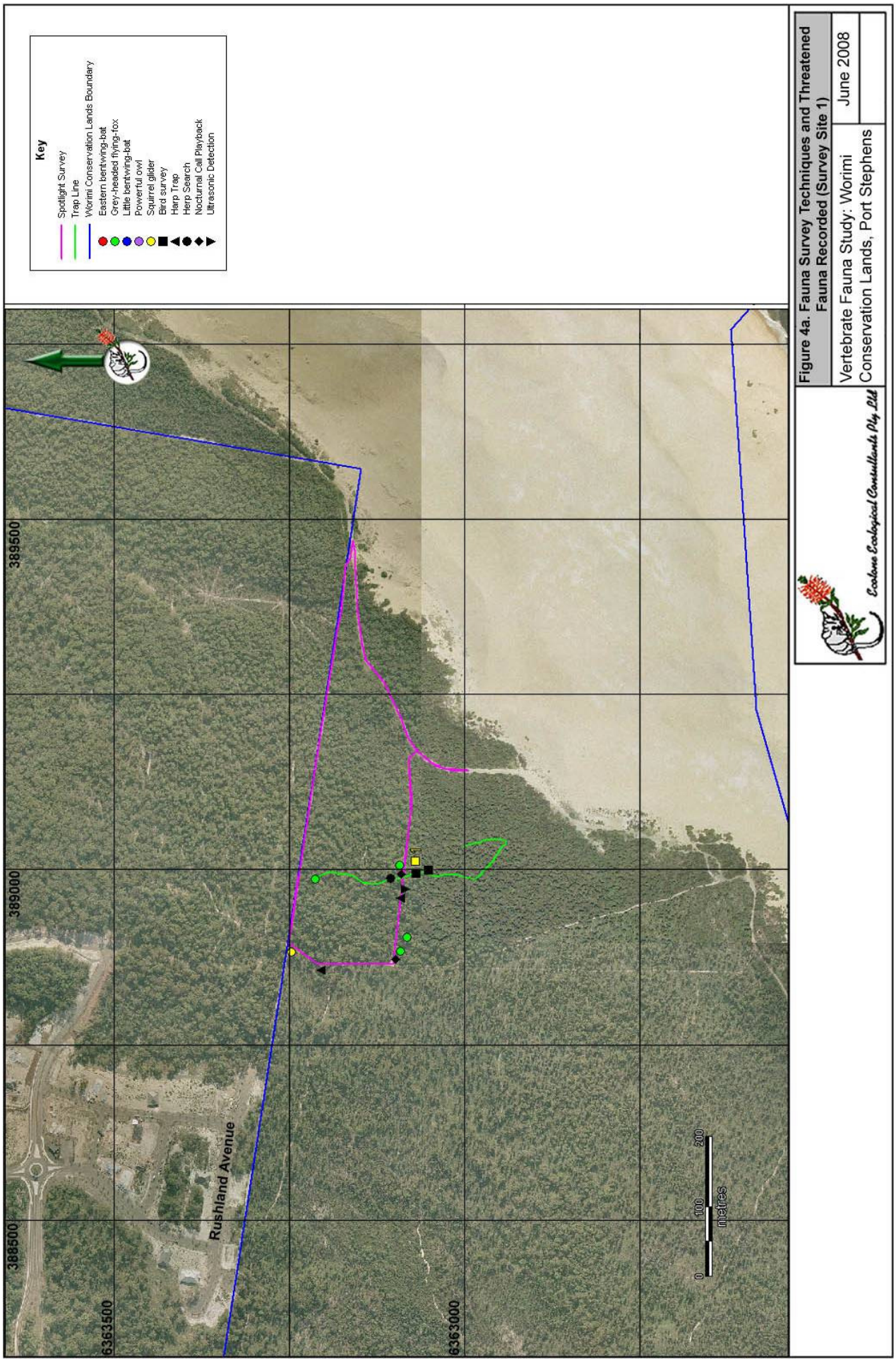
Ground Cover – plentiful leaf litter with a moderate cover of bracken, *Lomandra longifolia*, grasses and herbs to a height of 1 metre.

Disturbance History – fire appears to be a common occurrence throughout the landscape, although the study site itself may not have been burnt for about five years. Weed invasion is low with scattered bitou bush in more open areas. Well used vehicle tracks occur around the edges of the site with a disused track running through the middle of the trap line.

Fauna Habitat Features – hollow bearing trees are scattered throughout Survey Area 1. Many of the older trees are fire damaged and weakened at the base. Large logs on the ground are uncommon, probably as a result of frequent fire. Large old man banksias *Banksia serrata* provide a food resource for the squirrel glider, feathertail glider and grey-headed flying-fox. No flowering eucalypts were noted at the time of the survey. Standing dead hollow bearing trees are infrequent throughout the survey area. **Figure 4a** shows the detailed location of Survey Site 1, survey methodology and threatened species recorded.

Plate1. Open Blackbutt/Smooth-barked Apple/Banksia Forest at Survey Area 1

Plate 2. Squirrel Glider sighted in right hand tree at Survey Site 1


Key
Spotlight Survey
Trap Line
Worimi Conservation Lands Boundary
Eastern bentwing-bat
Grey-headed flying-fox
Little bentwing-bat
Powerful owl
Squirrel glider
Bird survey
Harp Trap
Herp Search
Nocturnal Call Playback
Ultrasonic Detection
388500
389000
389500
6363500
6363000
Rushland Avenue
0
100
200
metres
Figure 4a. Fauna Survey Techniques and Threatened Fauna Recorded (Survey Site 1)
Vertebrate Fauna Study: Worimi Conservation Lands, Port Stephens
June 2008
Ecotone Ecological Consultants Pty Ltd

Survey Area 2 – Williamtown, access via Macs Track via Lavis Lane entry (location of site attribute assessment AMG 56 394135E 6366755N [AGD 66])

Topography – undulating vegetated sand dunes and swales behind the fore-dune to a height of 10 metres ASL

Tree Layer - open smooth-barked apple/old man banksia forest to a height of 12-20 metres. A secondary open tree layer of old man banksia, smooth-barked apple and *Leptospermum laevigatum* is present to a height of 5-12 metres (**Plate 3**). The swale on the dune side of the access track is dominated with broad-leaved paperbark, with some larger specimens up to a height of about 20-25 metres (**Plate 4**).

Shrub Layer – generally moderate-dense, dominated by *Acacia* spp., *Leptospermum laevigatum*, *Banksia serrata*, bitou bush, lantana and *Breynia* and other shrubs to a height of 1-5 metres.

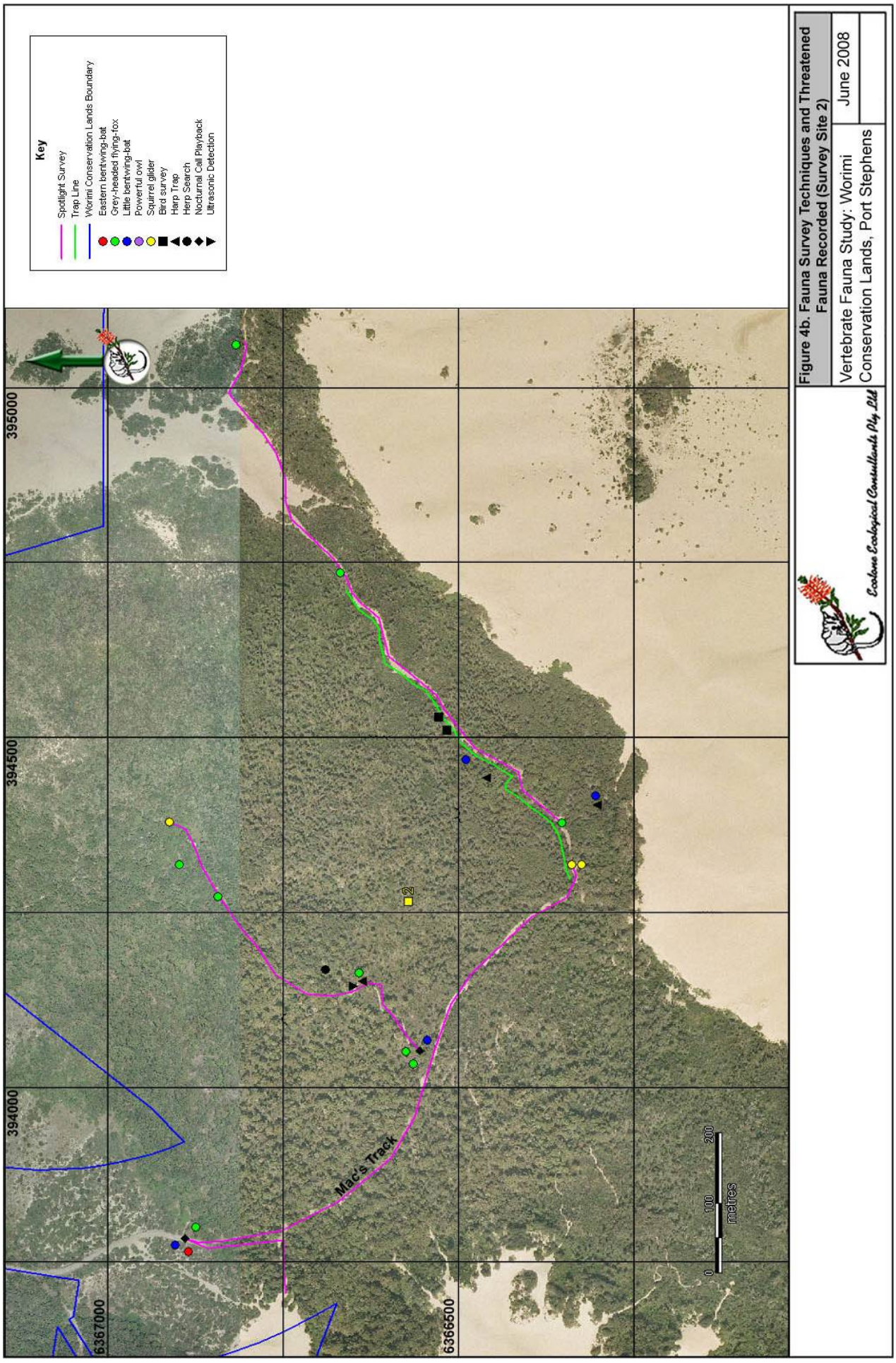
Ground Cover – plentiful leaf litter with a moderate cover of bracken, *Gahnia clarkei*, grasses and herbs to a height of 1 metre.

Disturbance History – fire appears to be a infrequent at this site with the last fire being possibly up to 15 years ago. Weed invasion is moderate with patches of bitou bush and lantana observed. Some weed control has taken place. The main access tracks are well used by off road vehicles however a few disused tracks occur within the survey area.

Fauna Habitat Features – hollow bearing trees are scattered throughout Survey Area 2 but appear to be infrequent. Large logs on the ground were scattered throughout the survey area. Large old man banksias *Banksia serrata* and flowering paperbarks provide a food resource for the squirrel glider, feathertail glider and grey-headed flying-fox. No flowering eucalypts were noted at the time of the survey. No standing dead hollow bearing trees were noted within the survey area. **Figure 4b** shows the detailed location of Survey Site 2, survey methodology and threatened species recorded.

Plate 3. Open Smooth-barked Apple /Banksia Forest at Survey Area 2

Plate 4. Broad-leaved Paperbark Forest in poorly drained areas of Survey Area 2


Key
Spotlight Survey
Trap Line
Worimi Conservation Lands Boundary
Eastern bentwing-bat
Grey-headed flying-fox
Little bentwing-bat
Powerful owl
Squirrel glider
Bird survey
Harp Trap
Herp Search
Nocturnal Call Playback
Ultrasonic Detection
395000
394500
394000
6367000
6366500
Mac's Track
0
100
200
metres
Figure 4b. Fauna Survey Techniques and Threatened Fauna Recorded (Survey Site 2)
Vertebrate Fauna Study: Worimi Conservation Lands, Port Stephens
June 2008
Ecotone Ecological Consultants Pty Ltd

Survey Area 3 – Salt Ash, access via Boyces Track (location of site attribute assessment AMG 56 401654E 6370048N [AGD 66])

Topography – undulating vegetated sand dunes and swales behind the fore-dune to a height of 10 metres ASL

Tree Layer – predominantly open blackbutt/smooth-barked apple/old man banksia forest to a height of 12-20 metres (**Plate 5**). Broad-leaved paperbark with the occasional swamp mahogany occur in the swales. A secondary open tree layer of regenerating old man banksia, blackbutt, smooth-barked apple and acacia is present to a height of 5-12 metres.

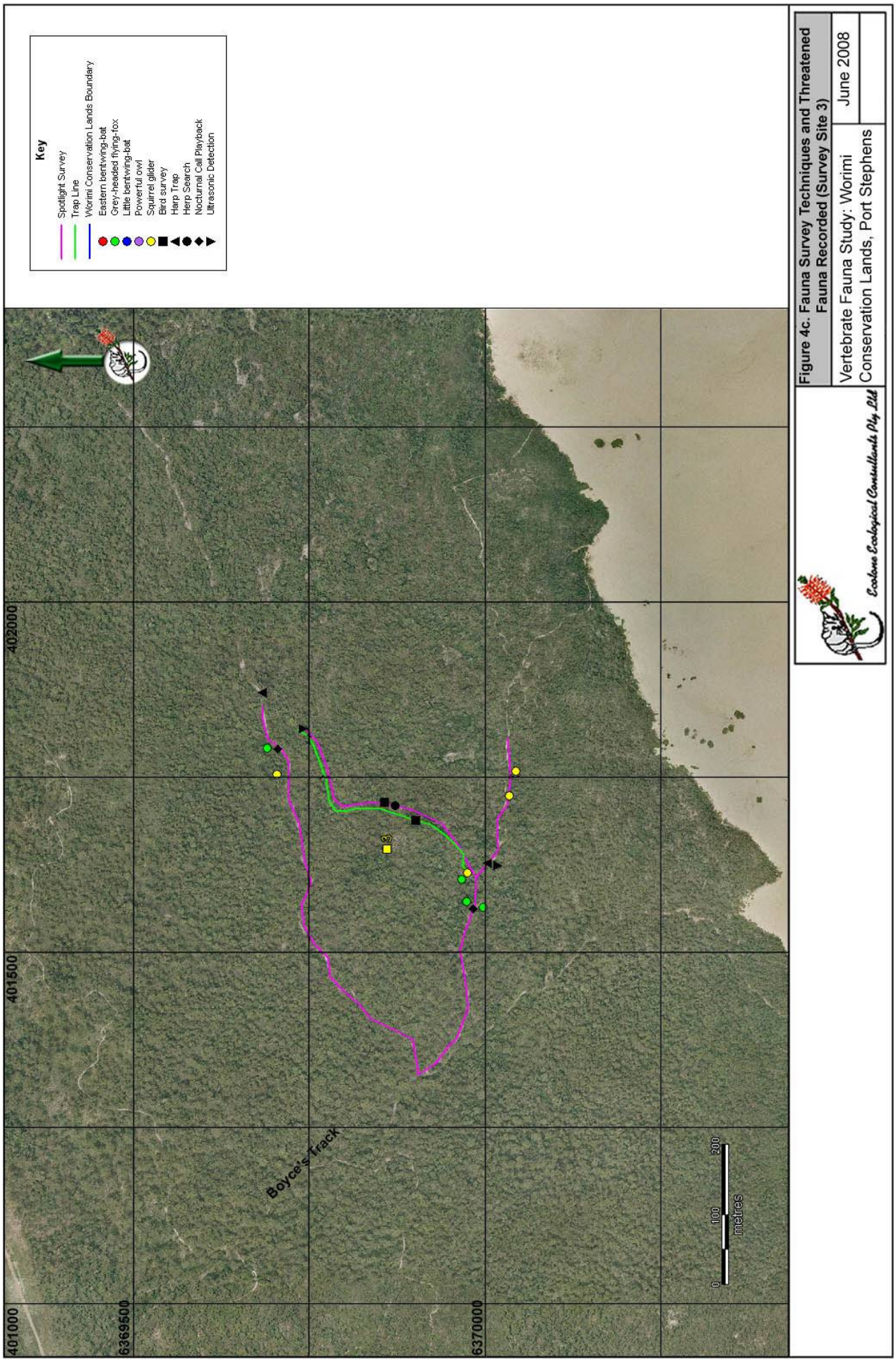
Shrub Layer – generally sparse, regenerating trees and shrubs as above plus *Dodonia*, *Persoonia levis* and other shrubs to a height of 1-5 metres.

Ground Cover – moderate to dense cover of bracken, blady grass, *Lomandra longifolia*, grasses and herbs to a height of 1 metre.

Disturbance History – fire appears to be a common occurrence throughout the landscape and the survey area was estimated to have had a moderately severe fire about 5 years ago. Weed invasion in this area is low with no weeds observed. Vehicle tracks occur on the northern and southern edges of the site with the southern track currently disused.

Fauna Habitat Features – hollow bearing trees are common throughout Survey Area 3. Large logs on the ground were infrequently scattered throughout the survey area. Large old man banksias *Banksia serrata*, flowering paperbarks and swamp mahoganies provide a food resource for the squirrel glider, feathertail glider and grey-headed flying-fox. A few scattered dead hollow bearing trees were noted within the survey area. **Figure 4c** shows the detailed location of Survey Site 3, survey methodology and threatened species recorded.

Plate 5. Coastal Sand Apple – Blackbutt Forest at Survey Site 3.


Key
Spotlight Survey
Trap Line
Worimi Conservation Lands Boundary
Eastern bentwing-bat
Grey-headed flying-fox
Little bentwing-bat
Powerful owl
Squirrel glider
Bird survey
Harp Trap
Herp Search
Nocturnal Call Playback
Ultrasonic Detection
401000
401500
402000
6369500
6370000
Boyce's Track
0
100
200
metres
Figure 4c. Fauna Survey Techniques and Threatened Fauna Recorded (Survey Site 3)
Vertebrate Fauna Study: Worimi Conservation Lands, Port Stephens
June 2008
Ecotone Ecological Consultants Pty Ltd

Survey Area 4 – Bobs Farm, access via powerline easement (location of site attribute assessment a) AMG 56 406852E 6372304N and b) 56 406810E and 6372221N [AGD 66])

Topography – undulating vegetated sand dunes and swales behind the fore-dune to a height of 10 metres ASL

Tree Layer – a) open blackbutt/smooth-barked apple/old man banksia forest to a height of 12-20 metres. A secondary open tree layer of the same species is present to a height of 5-12 metres.
b) Broad-leaved paperbark and swamp mahogany swamp forest in the swale to a height of 12-20 metres (**Plate 6**). A secondary open tree layer of the same species is also present to a height of 5-12 metres.

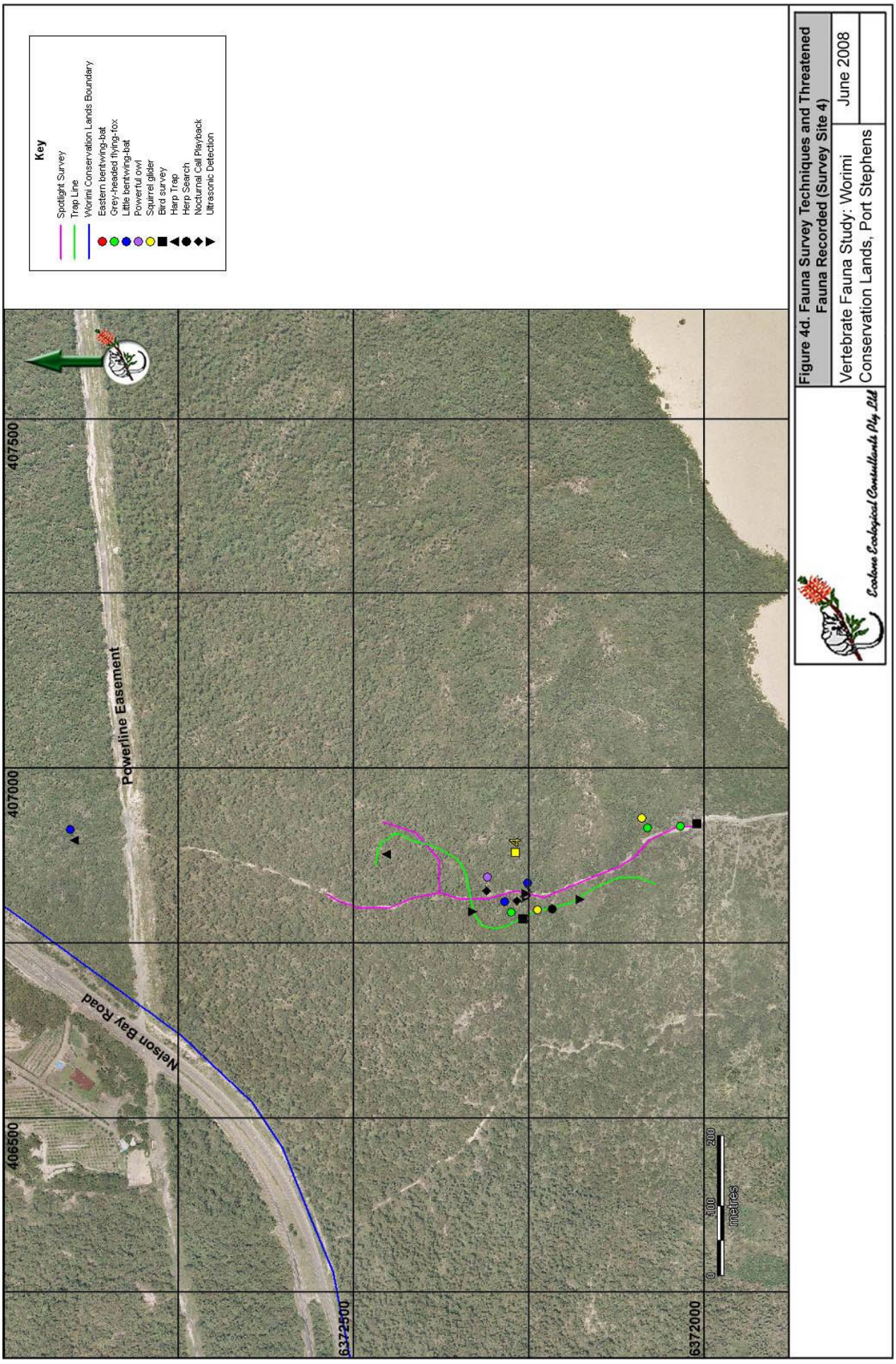
Shrub Layer – a) generally sparse regenerating trees and acacias with denser small shrubs including *Dodonia, Dillwynia, Acacia, Gonocarpus* and other shrubs to a height of 1-5 metres.
b) dense *Dodonia triquetra, Leptospermum laevigatum, Acacia*, *Gonocarpus,* regenerating broad-leaved paperbark and swamp mahogany

Ground Cover – a) moderate to dense cover of bracken, grasses and herbs to a height of 1 metre and a moderate leaf litter depth; b) moderate cover of grasses and herbs to a height of 1 metre with shallow leaf litter.

Disturbance History – fire appears to be a common occurrence throughout the landscape, although the study site itself may not have been burnt for about five to eight years. Weed invasion is low with none recorded although scattered bitou bush is likely to occur in more open areas. A well used vehicle track and motorbike track passes through the trap line.

Fauna Habitat Features – hollow bearing trees are common throughout Survey Area 4. Large logs on the ground are scattered infrequently throughout the survey area. Large old man banksias *Banksia serrata,* flowering paperbarks and swamp mahoganies provide a food resource for the squirrel glider, feathertail glider and grey-headed flying-fox. A few scattered dead hollow bearing trees were noted within the survey area. Figure 4d shows the detailed location of Survey Site 4, survey methodology and threatened species recorded.

Plate 6. Swamp Mahogany-Paperbark Swamp Forest at Survey Site 4


Key
Spotlight Survey
Trap Line
Worimi Conservation Lands Boundary
Eastern bentwing-bat
Grey-headed flying-fox
Little bentwing-bat
Powerful owl
Squirrel glider
Bird survey
Harp Trap
Herp Search
Nocturnal Call Playback
Ultrasonic Detection
406500
407000
407500
6372500
6372000
Nelson Bay Road
Powerline Easement
4
0
100
200
metres
Figure 4d. Fauna Survey Techniques and Threatened Fauna Recorded (Survey Site 4)
Vertebrate Fauna Study: Worimi Conservation Lands, Port Stephens
June 2008
Ecotone Ecological Consultants Pty Ltd

2.4 Determination of Threatened Fauna to be Targeted by the Field Surveys

The following species are considered most likely occur within the habitats available in the WCL study area and therefore field survey techniques were designed to target these subject species and these are discussed in **Section 3**.

Fauna subject species with the greatest potential to occur as either they are known to occur within 2 km of the study area or are mobile species recorded in the locality and preferred habitat is available:

Pied oystercatcher*	Sooty oystercatcher*
Great knot*	Greater sand plover*
Lesser sand plover*	Broad-billed sandpiper*
Black-tailed godwit*	Terek sandpiper*
Sanderling*	Powerful owl
Masked owl	Grey-crowned babbler
Little Tern*	East-coast freetail-bat
Eastern bent-wing bat	Little bent-wing bat
Eastern false pipistrelle	Greater broad-nosed bat
Yellow-bellied sheathtail-bat	Grey-headed flying-fox
Koala	Spotted-tailed quoll
Squirrel glider	Brush-tailed phascogale
Wallum froglet	Green turtle*

Fauna species with some potential to occur as possible habitat is available or they could be occasional visitors:

Barking owl	Bush stone-curlew
Brown treecreeper	Diamond firetail
Glossy black-cockatoo	Osprey
Regent honeyeater	Swift parrot
Green and golden bell frog	Loggerhead turtle*
New Zealand fur seal*	

* open beach sand habitat only and migratory waders absent at the time of the survey

3.0 FIELD SURVEYS

Following a desk top review of the study area, four major study sites were chosen in order to represent the available terrestrial habitat. A habitat assessment of each site was conducted in the field prior to setting traps in order to refine the location of each trap line. Fauna survey investigations took place between the 7th- 11h April 2008 at Sites 1 and 2 and 28th – 2nd May 2008 at Sites 3 and 4. A targeted search for the swift parrot and regent honeyeater was carried out on the 11th May 2008 at Sites 3 and 4 and a 2 km section of the beach at Anna Bay was also visited and checked for waders and seabirds.

3.1 Methodology

The survey methodologies used are in general accordance with the DECC Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (working draft, DEC 2004) and Lower Hunter and Central Coast Regional Environmental Management Strategy (LHCCREMS) flora & fauna survey guidelines (Murray *et al.* 2002). The field survey methodologies carried out in each of the survey areas are as follows:

- Tree and terrestrial Elliott live trapping transects
- Cage traps
- Spotlight survey
- Nocturnal call playback
- Ultrasonic bat call detection
- Harp trapping for insectivorous bats
- Diurnal bird census
- Diurnal reptile census
- Targeted searches for frogs
- Stag watch
- Koala scat search
- Opportunistic observations

It was proposed to carry out mist netting to target the common blossom bat (*Syconycteris australis*) however this was abandoned due to poor weather conditions, limited roosting habitat (littoral rainforest/cabbage palms), limited foraging resources (flowering coastal banksias) and therefore a very low probability of capture.

Live trapping transects (targeting the squirrel glider, brush-tailed phascogale and spotted-tailed quoll)

Live trapping targeting arboreal and terrestrial mammals was carried out at each study site during the survey period. Trap lines were set out for four nights. Details of the number of traps in each line are given below:

Tree traps - 10 “B” Elliott traps (measuring 46cm x 15cm x 15cm)
Ground traps - 25 “A” Elliott traps (measuring 33cm x 10cm x 9cm)
- 3 cage traps

In order to target arboreal mammals, particularly the squirrel glider, each tree trap was mounted on a platform attached to a selected tree at a height of approximately three metres with the aid of a ladder. Tree traps were approximately 50 m apart and baited with standard peanut butter and rolled

oat mixture and candied honey wrapped in paper towel. The tree trunk above the trap was sprayed each day with a honey/water mixture via a spray bottle.

In order to target small terrestrial mammals, ground traps were set approximately 25 m apart along a route following the tree trap line. Traps were preferably positioned near obvious animal runways, fallen logs or suitable dense vegetation. Each Elliott trap was baited with standard peanut butter and rolled oat mixture.

In order to target medium sized terrestrial mammals such as the spotted-tailed quoll, brush-tailed phascogale and bandicoots, a cage trap was set at each end and the centre of each trap line. Cage traps were baited with a mixture of standard peanut butter bait and tuna based cat food. Raw chicken necks were added at Sites 3 and 4.

All traps were positioned so as to avoid the morning sun and were covered with a plastic bag to reduce the risk of exposure (due to rain) to any captured animal. Ground traps were either positioned within dense vegetation or covered with leaves or bark for shade. Bedding material, usually dry leaves gathered on site, was added to each Elliott trap.

All traps were inspected early each morning for captures, with captured animals either released immediately or kept until evening and then released at the point of capture.

Spotlight Survey (targeting the squirrel glider, brush-tailed phascogale, grey-headed flying-fox and spotted-tailed quoll)

Spotlighting was conducted twice at each survey site over the survey period. Transects along existing tracks were carried out on foot by two observers for a period of between 30 minutes to 1.25 hours using Makita 14-volt hand-held torches and 50-Watt Lightforce hand-held spotlights powered by 12-volt batteries. Both arboreal and terrestrial nocturnal animals were targeted during the spotlighting surveys and any fauna species positively identified either by sight or characteristic vocalisation were recorded.

Nocturnal Call Playback (targeting large forest owls, koala, squirrel glider and bush stone-curlew)

The playback of pre-recorded calls of threatened nocturnal species was carried out at each study site on two nights of the survey period. After an initial listening period of ten minutes, each call was played (amplified by the use of a loud hailer) for a total of five minutes, followed by a five minute listening period, with the last listening period followed by ten minutes of spotlighting. Any fauna responding to the call playback was identified either by characteristic call or direct observation using spotlights.

Ultrasonic Bat Call Detection (targeting insectivorous bats including threatened species)

During the survey period insectivorous bats were surveyed at all four study areas at a total of seventeen locations using Anabat CFZCAIM detectors to collect ultrasonic calls of insectivorous bat species within the area. The detectors were either hand-held or left in a stationary position during other survey activities (10 locations) or left in a stationary position overnight (7 locations).

Bats emit ultrasonic calls as a method of navigating and searching for food. These calls are often at a higher frequency than calls audible to the human ear. In order to make the calls audible, bat detectors convert the call to a lower frequency. These calls are recorded and later analysed with a computer package (Anabat), to identify the species recorded. Ultrasonic call detectors have proven

useful for recording species that are difficult to capture. However, owing to variations in call strength and frequency within and between species and the difficulty in identifying short or poor quality calls, the identity of species recorded by a bat detector cannot always be guaranteed. Some bats are difficult to detect due to their quiet calls (e.g. *Nyctophilus* sp., *Kerivoula papuensis*) and bats with extremely similar calls are sometimes difficult to differentiate (e.g. *Miniopterus schreibersii oceanensis* and *Vespadelus darlingtoni*). Therefore, bat detectors cannot always provide positive species identification.

Harp Trapping (targeting insectivorous bats including threatened species)

Harp trapping for insectivorous bats was carried out at each study site for at least two nights during the field survey period. Two harp traps were set up in the vicinity of each study site at the most appropriate locations. In order to maximise capture success, suitable harp trap sites were chosen along potential flyways (e.g. usually old vehicle tracks). All harp traps were inspected for captures early in the morning and also checked at night where possible. Captured bats were identified to species level and either released immediately or, if removed from the trap in the morning, kept in a cloth bag until the following evening.

Diurnal Bird Census

Surveys for diurnal birds were carried out on two occasions at each survey site over the survey period. Each bird survey was completed early in the morning by one observer for a period of 20 minutes. All birds positively identified either by direct visual observation or by their characteristic call during this period were recorded. Birds recorded outside of the timed survey were also recorded as such.

Diurnal Reptile Census

A reptile search was carried out at each of the study sites during the survey period. Each reptile survey was undertaken by one observer for a period of approximately 30 minutes to 2 hours when temperatures were suitable for reptile activity. All reptiles positively identified during this period were recorded.

Targeted Searches for Frogs

Targeted searches for frogs were carried out at night at any wet areas identified during other survey activities. Frog habitat was found at all sites except Site 1 and frog searches were undertaken by two people using head and hand held torches for approximately 30 minutes during the spotlight transects. All frogs positively identified either by direct visual observation or by their characteristic call were recorded.

Stag Watch

A ‘stag watch’ of hollow-bearing trees was carried out at each of the sites prior to the commencement of the call playback and spotlighting transects. The stag watch was undertaken by two observers (at different locations) for a period of approximately 30 minutes starting just after sunset, followed by a short period of spotlighting in the vicinity. Any faunal activity observed during that period was recorded, in particular any signs of owls, bats or arboreal mammals leaving or entering hollows.

Koala Scat Search

Although a systematic search for koala scats was not carried out, the ground around individual food trees, mainly the swamp mahogany (*Eucalyptus robusta*), encountered within the survey sites were searched for the presence of scats

Opportunistic Observations

All fauna opportunistically identified by site, footprint, diggings or scat while at each survey site were recorded

3.2 Survey Limitations

Field surveys for a large study area such as the WCL are inevitably based on targeted sampling of representative habitats within the study area, aimed at maximising the likelihood of detecting threatened fauna species. A number of limitations have been identified, most associated more generally with any short-term fauna survey.

For these surveys the weather conditions affected some of the survey results, particularly for the insectivorous bats and reptiles. Usually April is a satisfactory time to conduct surveys, however in 2008 the temperatures were cooler than normal and there were extended rain events, particularly in the middle of the month. Thus bat activity was found to be low during the survey period. The rain did increase frog activity, however most species recorded are those that are more active in the cooler months. Therefore a spring/summer survey could potentially record a different suite of species.

The timing of the survey in autumn meant that most migratory forest birds and waders had left the study area and therefore bird activity and species diversity was much reduced. Migratory or nomadic species such as the threatened swift parrot and regent honeyeater would only visit the study area on a seasonal basis (usually winter) and the availability of food resources (winter flowering eucalypts and paperbarks) is a key factor to the species visiting coastal habitats. Although the survey was conducted at the start of the possible arrival of the swift parrot from Tasmania, the availability of flowering trees and shrubs was generally low and therefore the chance of detection of both the swift parrot and regent honeyeater would have been low.

As a result of the open nature of much of the forest environment and motorbike/four wheel drive traffic on many of the major tracks, few good harp trap sites for insectivorous bats were found within the study area. In addition one of the CFZCAIM detectors malfunctioned during the first field trip. Despite these problems nine insectivorous bat species were recorded during the field surveys.

Some fauna species are difficult to detect using currently available survey methods due to their general nature, for example the brush-tailed phascogale is a renowned escapee from Elliott traps. A number of insectivorous bats such as the threatened eastern false pipistrelle and greater broad-nosed bat are difficult to identify using ultrasonic call analysis due to the similarity of their calls to other species. As a result of these limitations it is likely that some species that would be expected to occur would not have been detected.

Table 3. Summary of Weather Conditions

Date	Temperature (°C)		Cloud Cover (eights of sky)	Moon (quarters)	Wind	Rain
	Min	Max				
Week One						
07/04/08	12.7	22.7	1 (at 09:00)	0	Light-Mod	scattered light showers
08/04/08	15.1	22.0	7 (at 09:00)	0	Light-Mod	scattered light showers
09/04/08	14.6	23.0	7 (at 19:00)	1	Light – Mod (SE) (during call playback)	occasional light showers (during call playback & spotlighting)
10/04/08	11.8	22.9	0 (at 19:20)	1	0 (during call playback)	0 (during call playback & spotlighting)
11/04/08	11.3	23.1	1 (at 09:00)	1	Light	scattered light showers
Week Two						
28/04/08	11	18	0-2	1	Light-Mod	0
29/04/08	7	18	0-2	1	Light	0
30/04/08	5.5	20	0	1	0	0
01/05/08	7.7	17.6	0-7	0	0	0
02/05/08	12.4	22	0	0	0	0

N.B. Weather conditions sourced from field observations and the Bureau of Meteorology website (Williamstown Weather Station) http://www.bom.gov.au/climate/dwo/200804/html/IDCJDW2145.200804.shtml

3.3 Survey Results

Fauna Diversity

A total of 104 fauna species were identified during the field surveys (comprising 58 bird, 26 mammal, 8 frog and 12 reptile species). Six of the species recorded, common myna, horse, fox, dog, deer species and rabbit, are introduced. All fauna species recorded within the study area during the survey period are listed in **Appendix 2**. Survey trapping data and bat call analysis results tables are included as **Appendix 3**. A summary of the species recorded by taxonomic order and survey site is shown in **Table 4.** Best results were achieved at Sites 2 and 4, probably as a result of more habitat variation with both main vegetation communities sampled.

Table 4. Summary of Species Recorded at Survey Sites

Taxonomic Order	All Sites	Site 1	Site 2	Site 3	Site 4	Site 5	Lavis Lane (off site)
Amphibians	8	4	6	3	5	-	1
Birds	58	18	33	22	32	7	7
Mammals	26	12	18	11	15	-	1
Reptiles	12	5	6	4	3	-	3
Totals	**104**	**39**	**63**	**40**	**55**	**7**	**12**

Birds

Fifty-eight bird species were recorded during the survey period, most of them relatively common and widespread species expected to be found in the environs represented within the study area. The majority of species were recorded during specific diurnal bird surveys or opportunistically within the study area, with some nocturnal birds recorded during evening call playback and spotlight surveys. One threatened bird species listed as vulnerable in the TSC Act, the powerful owl (*Ninox strenua*), was recorded during the survey period. Only one migratory species listed in the EPBC Act, the white-bellied sea-eagle (*Haliaeetus leucogaster*) was recorded. This species is also listed in an international agreement (CAMBA) and the crested tern is listed in JAMBA. It is expected that a spring/summer survey would greatly increase the bird species diversity as summer migrants, including forest birds and waders, would be present.

Mammals

Twenty-six mammal species were identified during the survey period. An additional insectivorous bat species, (a freetail bat *Mormopterus* Sp 2 Adams et. al. 1988), was given a tentative (possible) identification based on ultrasonic call analysis. Four threatened mammal species were recorded, the eastern bent-wing bat, little bent-wing bat, squirrel glider and grey-headed flying fox. All are listed as vulnerable in the TSC Act and the grey-headed flying-fox is also listed as vulnerable in the federal EPBC Act.

Trapping within the study area yielded a high capture rate at Sites 3 and 4 with more than 50% capture success in the ground Elliott traps. However species diversity was low with all captures being the brown antechinus (*Antechinus stuartii*), apart from one squirrel glider (*Petaurus norfolcensis*) and two New Holland mice (*Pseudomys novaehollandiae*) at Site 4. Poor trapping results occurred at Site 1 with only three brown antechinus caught on the last morning. Site 2

produced slightly better results with 5 brown antechinus and a common brushtail possum caught on morning three. Therefore only four mammal species were captured using the live trapping transects and interestingly no bush rats (*Rattus fuscipes*) or swamp rats (*Rattus lutreolus*) were caught.

Five species of insectivorous bat were captured in harp traps, including the lesser long-eared bat (*Nyctophilus geoffroyi*) and Gould's long-eared bat (*N. gouldi*) (species that cannot be differentiated using ultrasonic call analysis) as well as the chocolate wattled bat (*Chalinolobus morio*), little forest bat (*Vespadelus vulturnus*) and the threatened little bent-wing bat (*Miniopterus australis*). In addition to those caught in harp traps, four species of insectivorous bat were given a definite or probable identification using ultrasonic call analysis. Detailed results of the ultrasonic bat call analysis are included in **Appendix 3.2**.

Spotlighting and call playback activities recorded the grey-headed flying fox and squirrel glider at all sites and common ringtail possum (*Pseudocheirus peregrinus*), common brushtail possum (*Trichosurus vulpecula*) and feathertail glider (*Acrobates pygmaeus*) at three sites (not Site 1). Macropods, either the swamp wallaby (*Wallabia bicolor*) or red-necked wallaby (*Macropus rufogriseus*), were recorded at all sites but were not always observed and bandicoots were only heard at Site 4.

Opportunistic sightings, generally digging, scats or footprints identified six species during the survey period. The echidna (*Tachyglossus aculeatus*) was recorded at three sites, bandicoot diggings at two sites and the remaining four species were all introduced species recorded at only one location.

Reptiles

Twelve reptile species were recorded during the survey period, all being relatively common and widespread species. As a result of the generally cool weather conditions, reptile activity would have been reduced, however despite this, most species were recorded actively foraging during the targeted searches. The most common species recorded were the garden skink (*Lampropholis guichenoti*) and copper-tailed skink (*Ctenotus taeniolatus*) recorded at all four main sites. The jacky dragon (*Amphibolurus muricatus*), striped skink (*Ctenotus robustus*) and grass skink (*Lampropholis delicata*) were recorded at two on the sites and the remaining species were only recorded from a single site. Two snake species were recorded, the diamond python (*Morelia spilota spilota*) was observed lying on a tree branch during spotlighting at Site 2 and the black-bellied swamp snake (*Hemiaspis signata*) was observed crossing Lavis Lane after dark. Several other common reptiles are expected to occur within the study area, including the bearded dragon (*Pogona barbata*) wall skink (*Cryptoblepharus virgatus*), eastern blue-tongue (*Tiliqua scincoides*), blind snake (*Ramphotyphlops* sp.), green tree-snake (*Dendrelaphis punctulata*), red-bellied black snake (*Pseudechis porphyriacus*) golden-crowned snake (*Cacophis squamulosus*) and eastern brown snake (*Pseudonaja textilis*). No threatened reptile species were recorded and none are expected to occur within the available habitat. However an unidentified weasel skink was observed at Site 1 but not caught and this could have been the dwarf weasel skink (*Saproscincus oriarus*) which is considered a regionally significant species.

Frogs

Eight species of frog were recorded within the survey period. Frogs were recorded during specific frog searches, evening spotlighting surveys or opportunistically within the study area. Most were recorded in pools of water following heavy rain at Sites 2 and 4. The most common species recorded were the brown toadlet (*Pseudophryne bibroni*) and common eastern toadlet (*Crinia*

signifera) which were recorded at all four sites. The brown-striped frog (*Lymnodynastes peronii*) and Jervis Bay tree frog (*Litoria jervisiensis*) were recorded at three sites with the remaining species only found at one or two sites. Additional species are expected to occur and be active during the spring and summer with Peron's tree frog (*Litoria peronii*), bleating tree frog (*Litoria dentata*), broad-palmed frog (*Litoria latopalmata*), green tree frog (*Litoria caerulea*) and a toadlet (*Uperoleia* sp.) most likely to occur. No threatened frog species were recorded during the survey period however habitat for the wallum froglet (*Crinia tinnula*) occurs where paperbark swamps are present behind the fore-dune.

Significant Fauna Species

Five threatened species, the squirrel glider, eastern bent-wing bat, little bent-wing bat, grey-headed flying-fox and powerful owl were positively identified within the study area during the survey period. All five species are listed as vulnerable on the TSC Act and the grey-headed flying-fox is also listed as vulnerable on the EBPC Act. The locations of threatened fauna species recorded during the field surveys are shown in **Figures 4a-d**.

The squirrel glider and grey-headed flying-fox were recorded at all four sites. The squirrel glider appears to be common and widespread throughout the whole of the study area, particularly in areas where hollow bearing trees are plentiful. The grey-headed flying-fox is expected to forage over the whole of the study area however no roost camps are known to occur. Known seasonal roost camps do occur in the local region at Moffat's Swamp Nature Reserve, Kooragang Nature Reserve and nearby Anna Bay, all well within the foraging range of this species.

The powerful owl was only recorded at Site 4 but could potentially forage and nest throughout the study area. Although not recorded during these surveys, the masked owl (*Tyto novaeholladiae*) has previously been recorded within or on the edge of the WCL (Ecotone 1997, 2002; ERM 2005) and therefore could potentially occur over much of the study area.

The eastern and little bent-wing bats are likely to forage throughout the study area however they are unlikely to roost there although nearby gun emplacements at Fern Bay and sea caves in rocky headlands near Anna Bay could be used. No maternity roosts for either species are known to occur in the locality. Tree roosting threatened bat species, the greater broad-nosed bat (*Scoteanax rueppellii*), east-coast freetail-bat (*Mormopterus norfolkensis*) and yellow-bellied sheathtail-bat (*Saccolaimus flaviventris*) have all been recorded within or near the WCL and therefore are expected to occur. The hoary wattled bat record mentioned in ERM 2005 is considered to be dubious as it is based on ultrasonic call and the location is well outside of the known distribution of the species. However, as the distribution of many bat species is poorly known, this species cannot be completely discounted.

The koala (*Phascolarctos cinereus*) has been previously recorded at several locations within or close to the WCL. Scats have been found in a swamp mahogany/paperbark swale east of Lavis Lane (Ecotone 2001). Similar habitat occurs within Sites 3 and 4 and the therefore the koala is expected to occur in the study area, particularly to the east of Lavis Lane.

The spotted-tailed quoll (*Dasyurus maculata*) and brush-tailed phascogale (*Phascogale tapoatafa*) have been recorded within the study locality (Wildlife Atlas records) and could potentially still occur within the WCL. Nest boxes erected as compensatory habitat by Energy Australia for the construction of transmission lines within the WCL recorded possible nest material of the brush-tailed phascogale in three boxes near Boyces Track (Hollow Log Homes, 2008).

The wallum froglet (*Crinia tinnula*) was not recorded during the current surveys however suitable habitat, poorly drained swamp mahogany/paperbark forest, was observed in the swales behind the fore-dunes

Another threatened species, the grey-crowned babbler (*Pomatostomus temporalis*), has previously been recorded by a single record in the WCL near Boyces Track. Although this distinctive bird was not recorded during the current surveys suitable habitats occur within the open forest/woodland. Seabirds, waders, oystercatchers and green turtle would occur only in the beach environments and the osprey and bush stone-curlew could occur within both beach and forest edge habitats.

Plate 7. Powerful Owl *Ninox strenua* (Photo: Narawan Williams)

Plate 8.Photographs of some of the Mammals Recorded during the Fauna Survey

NewHolland Mouse*Pseudomys novaehollandiae*

Brown Antechinus *Antechinus stuartii*

Squirrel Glider *Petaurus norfolcensis*

Feathertail Glider *Acrobates pygmaeus*

Lesser Long-eared Bat *Nyctophilus geoffroyi*

Little Bent-wing Bat *Miniopterus australis*

Plate 9. Photographs of some of the Amphibians and Reptiles Recorded during the Fauna Survey

Banjo Frog *Limnodynastes dumerilii*

Ornate Burrowing Frog *Limnodynastes ornatus*

Jervis Bat Tree Frog *Litoria jervisiensis*

Swamp Snake *Hemiaspis signata*

Copper-tailed Skink *Ctenotus taeniolatus*

Grass Sun-skink *Lampropholis guichenoti*

All photos Copyright Narawan Williams

4.0 KEY MANAGEMENT ISSUES IDENTIFIED FROM THE RESULTS OF THE SURVEY

Key Threatening Processes

During the surveys the following key threatening processes listed in Schedule 3 of the TSC Act were identified as posing potential management issues within the WCL.

a) High frequency of fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition.

Based on the habitat assessment carried out at the study sites, it was evident that fire has been a regular occurrence throughout the landscape, although the study sites chosen do not appear to have been burnt for about 5 years. The regular fires have probably had an affect on the flora species diversity, particularly in the shrub and ground layers where fire dependant species, such as bracken and blady grass, dominate. Fire also removes fallen timber and hollow bearing trees (both threatening processes) each time a fire event occurs. This loss of flora diversity and cover from fallen timber may be the reason why no bush rats were recorded during this survey. It would normally be expected that this species would be common throughout the available habitats.

b) Invasion of native plant communities by bitou bush and boneseed

Bitou bush was observed throughout the study area, particularly in disturbed land and on the edge of the forest, including the interface with the sand dunes. Control of this invasive weed is currently taking place

c) Invasion, establishment and spread of lantana Lantana camara L. sens. Lat

Lantana has the potential to occur throughout the study area, particularly in disturbed land and on the edge of the forest, including the interface with the sand dunes. The largest infestation noted was at Site 2 with some dense patches observed. Control of this invasive weed is currently taking place.

d) Predation by the European red fox Vulpes vulpes

Although only recorded at Site 1, foxes are likely to occur throughout the study area with easy access along the many tracks currently used by off road vehicles. Birds, reptiles and terrestrial small mammals, including bandicoots and the threatened brush-tailed phascogale are likely to be the major prey items for this predatory species. Arboreal mammals, particularly the common brushtail possum and common ringtail possum may also be taken if they come to ground. Predation on microbats has also been reported if access to a roost site is possible or if the exit point is close to the ground.

e) Predation by the feral cat Felis cattus

Although not recorded during the survey, feral cats are likely to occur throughout the study area with easy access along the many tracks currently used by off road vehicles. Birds, reptiles and small mammals, including bandicoots and arboreal species, such as the feathertail glider, squirrel glider and common ringtail possum, are likely to be the major prey items for this predatory species. The threatened brush-tailed phascogale is also known to be preyed on by domestic as well as feral cats.

f) Removal of dead wood and dead trees and *g) loss of hollow bearing trees*

Although legally not expected to be an issue within the WCL the removal of dead wood and dead trees could occur as a result of firewood collection by persons camping/fishing on the beach. As mentioned above frequent fire would also remove dead timber and hollow bearing trees.

Other Issues

Rubbish Dumping

The numerous vehicle tracks through the WCL increase the possibility of rubbish dumping occurring. Rubbish dumping does not appear to be a major problem in the areas observed during this survey and rubbish noted to occur appeared to have been there for some time. The main areas noted were within the Fern Bay section and near the powerline easement off Boyces Track. The recent closure of some of the tracks may help to control rubbish dumping but there could be an increase of dumping in areas with easy access, such as Boyces Track and the Lavis Lane entrance.

Off road vehicles

The WCL has been used by recreational vehicles for a long period of time. Fishermen accessing the beach with 4 wheel drives appear to do little damage, apart from adding to erosion along the existing access tracks. However, vehicles driving in the inter-tidal zone of the beach itself have been linked to reductions in the sub-sand flora and fauna (Schlacher and Thompson, in press) and this can be substantial in areas of heavy traffic. Recreational vehicles such as trail bikes, quad bikes and dune buggies have the potential to inflict damage to the dune vegetation and ephemeral wetlands thus causing erosion. Ground nesting birds, such as the masked lapwing, red-capped plover and endangered little tern, are also at risk of loosing their eggs to vehicle traffic if not protected.

Powerline Easements

A major powerline easement passes through the WCL and adjoining land from near Lavis Lane to Anna Bay. It is mainly situated along the northern boundary of the WCL between Lavis Lane and Bobs Farm, apart from a section near Boyces Track after which it follows Nelson Bay Road to the east. At Bobs Farm the easement travels through the WCL to Anna Bay. The width of the easement where it passes through bushland would prevent fauna such as the threatened squirrel glider from crossing the gap without going to ground. Nest box monitoring has shown that a substantial colony of squirrel gliders is known to occur along the edge of the powerline easement (Hollow Log Homes 2008) however it is not known if and how they cross the vegetation gap. The crossing of this gap by terrestrial and arboreal fauna would greatly increase the chance of predation by introduced and natural predators. Terrestrial and arboreal fauna movements to the west would also be hampered by the vegetation gap, particularly were it is combined with Nelson Bay Road, although the well vegetated and wide median strip would enable squirrel and sugar gliders to cross the road in some sections.

Cultural Significance

The WCL has special significance for the Worimi people. The cultural significance of fauna and specific species was not assessed as part of this study but may be addressed as part of a cultural association investigation. The significance of fauna as part of their culture, such as stories and totems; as well as resource use, for instance whether certain fauna species were favoured for harvesting in the area, are all potential areas that need further investigation in consultation and with the involvement of the local Worimi community.

5.0 CONCLUSIONS AND RECOMMENDATIONS

A vertebrate fauna survey of the Worimi Conservation lands has been undertaken in order to identify the fauna species assemblages within the WCL and record any significant species, including threatened species. As most of the previous studies were situated outside of or on the periphery of the WCL, a more detailed assessment of the fauna communities and habitat would assist in the future management for the WCL.

From the literature review a total of 270 fauna species (excluding marine mammals) have been recorded within the study locality (2 km from the centre line of the WCL). These consisted of 189 bird, forty-nine mammal, seventeen reptile and fifteen frog species. It should be pointed out that it is unlikely that all of these species would occur within the WCL as the search area provides a greater variety of habitats than those identified within the WCL.

Prior to the current survey a total of 135 species had been recorded within or very close to the WCL boundary. These consisted of eighty-seven bird, thirty-five mammal, six reptile and seven frog species. This represents about half of the total species recorded for the study locality based on the literature review. Of the fifty-four threatened species recorded within the locality, fourteen vulnerable listed species have been recorded within the boundaries of the WCL and four additional species have been recorded close to the boundary in continuous vegetation.

Following a desk top review of the study area, four major study sites were chosen in order to represent the two dominant forested habitats, the Coastal Sand Apple-Blackbutt Forest and the Swamp Mahogany-Paperbark Swamp Forest. A habitat assessment of each site was conducted in the field prior to setting traps in order to refine the location of each trap line.

A total of 102 fauna species were identified during the field surveys (comprising 58 bird, 26 mammal, 8 frog and 12 reptile species). Six of the species recorded, common myna, horse, fox, dog, deer species and rabbit, are introduced. Best results were achieved at Sites 2 and 4, probably as a result of more habitat variation with both main vegetation communities sampled. Five threatened species, the squirrel glider, eastern bent-wing bat, little bent-wing bat, grey-headed flying-fox and powerful owl were positively identified within the study area during the survey period. All five species are listed as vulnerable on the TSC Act and the grey-headed flying-fox is also listed as vulnerable on the EBPC Act. The squirrel glider and grey-headed flying-fox were recorded at all four sites and all five threatened species are expected or have the potential to use all of the forested habitats within the WCL. The timing of the survey in Autumn and un-seasonally cool weather resulted in an incomplete inventory of fauna species as summer migratory birds were absent, spring summer frogs were inactive and bat activity was lower than that normally expected.

Based on a combination of the results of the 2008 survey and the literature review, 159 fauna species have been recorded in the WCL consisting of 99 birds, 39 mammals, 12 reptiles and 9 amphibians.

The results of the survey and habitat assessment identified the potential for several key threatening processes, as listed in the NSW TSC Act, that need to be considered. Of most importance was high frequency of fire, predation by the European fox and feral cat, invasion of native plant communities by bitou bush, boneseed and lantana, loss of dead wood and dead trees by firewood collection and as a result of high intensity bushfires and the loss of hollow bearing trees, also as a result of high intensity bushfires. Other impacts not listed in the TSC Act include rubbish dumping and damage to dune vegetation and ground nesting birds resulting from the use of off road vehicles.

The flora and fauna of the WCL are undoubtedly an important part of the cultural heritage for the local Worimi people, although the full cultural significance is still to be determined.

In order to expand on the inventory of fauna species using the habitats within the WCL it is recommended that the following additional surveys be carried out:

- Summer bird survey along Stockton Beach for migratory waders, particularly noting any breeding sights of ground nesting birds.

- Summer survey for forest/woodland birds and bats, including mist netting for blossom bats if flowering trees and shrubs available.

- Spring frog survey after rain event, including ephemeral pools in open sand.

- Additional summer reptile surveys targeting the regionally significant dwarf weasel skink (*Saproscincus oriarus*), possibly by using pit fall traps.

In order to manage the identified key threatening processes the following is suggested:

- Continue the implementation of weed and feral animal control programs.

- Prepare a fire management plan in order to maintain fire intervals suitable for the vegetation type and any fauna species requirements. Such a plan is not always easy to implement as unwanted fires can be deliberately lit and the desired result is usually a mosaic of different aged patch burns in order to accommodate the habitat and specific fauna requirements. For example, a fire interval of about 10 years is usually recommended for Banksia species in order to allow for regeneration. On the other hand, wildfire can cause severe losses within koala populations and therefore a more regular control burn may be beneficial for the survival of this species.

- Sensitive areas such as the ephemeral wetlands and any identified nest sites for ground nesting birds within the dune system should be fenced to prevent vehicle access where necessary. Signage indicating the reason for fencing off an area could be used although this may encourage unwanted disturbance to the area.

- The collection of firewood would be difficult to control however the provision of firewood sourced from outside the WCL and located at specific beach camping locations could be considered. The lighting of fires within the forested part of the WCL should be discouraged in order to prevent unwanted bushfires however a complete ban on fires may result in a backlash to over regulation and encourage arson attacks.

Threats and recovery strategies for each of the local threatened species are given in the Species Profiles in **Appendix 5**.

6.0 REFERENCES

Adams, M., Reardon, T.R., Baverstock, P.R. & Watts, C.H.S., 1988. Electrophoretic resolution of species boundaries in Australian Microchiroptera. IV. The Molossidae (Chiroptera). *Australian Journal of Biological Science* 41: 315-326

DEC, 2004. *Threatened Biodiversity Survey and Assessment: Draft Guidelines for Developments and Activities*. Department of Environment and Conservation (NSW).

Ecotone Ecological Consultants 1994. *Bat survey of land proposed for sand extraction by Boral Resources (NSW) Pty Ltd at Fern Bay*. Report prepared for Resource Planning Pty Ltd

Ecotone Ecological Consultants 1995a. *Dual carriageway for Nelson Bay Road between Salt Ash and Bobs Farm, FIS for the proposed Stage 1 Construction at Salt Ash.* Report prepared for Port Stephens Council

Ecotone Ecological Consultants 1995b and 1997. *Dual carriageway for Nelson Bay Road between Salt Ash and Bobs Farm, assessment of impact on threatened species of the proposed stage 2 construction.* Reports prepared for Port Stephens Council

Ecotone Ecological Consultants 2001a. *Lower Hunter and Central Coast Regional Biodiversity Conservation Project, Module 1. Fauna Survey*. Report for LHCCREMS

Ecotone Ecological Consultants 2001b. *Flora and fauna survey and threatened species assessment, proposed subtransmission line upgrade to Tomaree Peninsula, Lavis Lane to Bobs Farm*. Southern, middle and northern section reports prepared for Energy Australia

ERM 2001. *REF for the Nelson Bay Road upgrade Bobs Farm to Anna Bay*. Report prepared for the NSW RTA and Port Stephens Council

ERM 2004. *Supplementary REF for modifications to the Nelson Bay Road upgrade.* Report prepared for NSW RTA (contains additional survey information from 2003)

ERM 2005a. *EIS for the Stockton Sandpit windblown sand extraction, Fern Bay.* Report prepared for Boral Resources (Country) Pty Ltd.

ERM 2005b. *SIS for the Fern Bay Estate Master Plan Study*. Report prepared for the Winton Property Group and CVC Limited.

Hollow Log Homes, 2008. Nelson Bay Nest Box Project – March 2008 Audit. Report prepared for Energy Australia.

Insite Planning Engineering Environmental 2007a. *Part 3A preliminary assessment for sand extraction at Lot 332 DP 753204, Jessie Road Anna Bay*. Report prepared for SS & LM Johnston

Insite Planning Engineering Environmental 2007b. *Preliminary assessment for sand extraction at Lot 4042 DP 1090633 and Lots 632 and 633 DP 609506, Nelson Bay Road Salt Ash*. Report prepared for ATB Morton Pty Ltd.

LHCCREMS 2003. *Extant Vegetation of the Lower Hunter and Central Coast. Revised Version.* Lower Hunter and Central Coast Regional Biodiversity Conservation Strategy.

Murray, M., Bell, S., Hoye, G. 2002. Flora ans Fauna Survey Guidelines: Lower Hunter and Central Coast Region 2002. Lower Hunter and Central Coast Regional Environmental Management Strategy, NSW.

Schlacher T.A. and Thompson L.M.C., in press. Vehicles versus conservation of invertebrates on sandy beaches: qualifying direct mortalities inflicted by off-road vehicles on ghost crabs. *Marine Biology* in press.

7.0 APPENDICES

Appendix 1.Total list of fauna species recorded within the Worimi Conservation Lands

Mammals

Common Name	Scientific Name
Black rat	*Rattus rattus* *
Brown antechinus	*Antechinus stuartii*
Brumby/Horse	*Equus caballus* *
Brush-tailed phascogale	***Phascogale tapoatafa***
Bush rat	*Rattus fuscipes*
Chocolate wattled bat	*Chalinolobus morio*
Common brushtail possum	*Trichosurus vulpecula*
Common ringtail possum	*Pseudocheirus peregrinus*
Common wombat	*Vombatus ursinus*
Deer sp.*	
Dog	*Canis familiaris* *
East-coast freetail-bat	***Mormopterus norfolkensis***
Eastern bent-wing bat	***Miniopterus schreibersii oceanensis***
Eastern broad-nosed bat	*Scotorepens orion*
Eastern forest bat	*Vespadelus pumilis*
Eastern grey kangaroo	*Macropus giganteus*
Feathertail glider	*Acrobates pygmaeus*
Fox	*Vulpes vulpes* *
Gould's long-eared bat	*Nyctophilus gouldi*
Gould's wattled bat	*Chalinolobus gouldii*
Greater broad-nosed bat	***Scoteanax rueppellii***
Grey-headed flying-fox	***Pteropus poliocephalus***
Koala	***Phascolarctos cinereus***
Lesser long-eared bat	*Nyctophilus geoffroyi*
Little bent-wing bat	***Miniopterus australis***
Little forest bat	*Vespadelus vulturnus*
Little red flying-fox	*Pteropus scapulatus*
Long-nosed bandicoot	*Perameles nasuta*
New Holland mouse	*Pseudomys novaehollandiae*
Northern brown bandicoot	*Isoodon macrourus*
Pygmy sperm whale	*Kogia breviceps*
Rabbit	*Oryctolagus cuniculus**
Red-necked wallaby	*Macropus rufogriseus*
Short-beaked echidna	*Tachyglossus aculeatus*
Squirrel glider	***Petaurus norfolcensis***
Sugar glider	*Petaurus breviceps*
Swamp rat	*Rattus lutreolus*
Swamp wallaby	*Wallabia bicolor*
White-striped freetail-bat	*Tadarida australis*

Reptiles

Common Name	Scientific Name
Copper-tailed skink	*Ctenotus taeniolatus*
Diamond python	*Morelia spilota spilota*
Garden skink	*Lampropholis guichenoti*
Grass skink	*Lampropholis delicata*
Green turtle	***Chelonia mydas***
Jacky lizard	*Amphibolurus muricatus*
Lace monitor	*Varanus varius*
Red-bellied black snake	*Pseudechis porphyriacus*
Robust ctenotus	*Ctenotus robustus*
South-eastern morethia skink	*Morethia boulengeri*
Southern rainbow-skink	*Carlia tetradactyla*
Weasel skink	*Saproscincus mustelina*

Frogs

Common Name	Scientific Name
Brown toadlet	*Pseudophryne bibronii*
Common eastern froglet	*Crinia signifera*
Eastern banjo frog	*Limnodynastes dumerilii*
Eastern dwarf tree frog	*Litoria fallax*
Jervis Bay tree frog	*Litoria jervisiensis*
Ornate burrowing frog	*Limnodynastes ornatus*
Peron's tree frog	*Litoria peronii*
Striped marsh frog	*Limnodynastes peronii*
Verreaux's tree frog	*Litoria verreauxii*

Birds

Common Name	Scientific Name
Australasian gannet	*Morus serrator*
Australian hobby	*Falco longipennis*
Australian magpie	*Gymnorhina tibicen*
Australian owlet-nightjar	*Aegotheles cristatus*
Australian pipit	*Anthus australis*
Australian raven	*Corvus coronoides*
Australian white ibis	*Threskiornis molucca*
Bar-shouldered dove	*Geopelia humeralis*
Black-faced cuckoo-shrike	*Coracina novaehollandiae*
Black-fronted dotterel	*Elseyornis melanops*
Black-shouldered kite	*Elanus axillaris*
Brown cuckoo-dove	*Macrophygia amboinensis*
Brown falcon	*Falco berigora*
Brown honeyeater	*Lichmera indistincta*
Brown thornbill	*Acanthiza pusilla*
Brown-headed honeyeater	*Melithreptus brevirostris*
Brush bronzewing	*Phaps elegans*
Channel-billed cuckoo	*Scythrops novaehollandiae*
Chestnut teal	*Anas castanea*
Common (Pacific) koel	*Eudynamys orientalis*
Common tern	*Sterna hirundo*
Crested pigeon	*Ocyphaps lophotes*
Crested shrike-tit	*Falcunculus frontatus*
Crested tern	*Sterna bergii*
Dollarbird	*Eurystomus orientalis*
Double-banded plover	*Charadrius bicinctus*
Dusky woodswallow	*Artamus cyanopterus*
Eastern rosella	*Platycercus eximius*
Eastern spinebill	*Acanthorhynchus tenuirostris*
Eastern whipbird	*Psophodes olivaceus*
Eastern yellow robin	*Eopsaltria australis*
Fan-tailed cuckoo	*Cacomantis flabelliformis*
Frigatebird sp.	*Fregata* sp.
Galah	*Eolophus roseicapillus*
Golden whistler	*Pachycephala pectoralis*
Golden-headed cisticola	*Cisticola exilis*
Grey butcherbird	*Cracticus torquatus*
Grey fantail	*Rhipidura fuliginosa*
Grey shrike-thrush	*Colluricincla harmonica*
Grey-crowned babbler	***Pomatostomus temporalis***
Laughing kookaburra	*Dacelo novaeguineae*
Lesser golden plover	*Pluvialis dominica*
Lewin's honeyeater	*Meliphaga lewinii*
Little grassbird	*Megalurus gramineus*

BIRDS - continued

Common Name	**Scientific Name**
Little penguin	*Eudyptula minor*
Little wattlebird	*Anthochaera chrysoptera*
Magpie-lark	*Grallina cyanoleuca*
Masked lapwing	*Vanellus miles*
Masked owl	***Tyto novaehollandiae***
Mistletoebird	*Dicaeum hirundinaceum*
Nankeen kestrel	*Falco cenchroides*
New Holland honeyeater	*Phylidonyris novaehollandiae*
Noisy friarbird	*Philemon corniculatus*
Noisy miner	*Manorina melanocephala*
Peregrine falcon	*Falco peregrinus*
Pheasant coucal	*Centropus phasianinus*
Pied cormorant	*Phalacrocorax varius*
Pied currawong	*Strepera graculina*
Pied oystercatcher	***Haematopus longirostris***
Powerful owl	***Ninox strenua***
Rainbow lorikeet	*Trichoglossus haematodus*
Red wattlebird	*Anthochaera carunculata*
Red-browed finch	*Neochmia temporalis*
Red-capped plover	*Charadrius ruficapillus*
Rufous whistler	*Pachycephala rufiventris*
Sacred kingfisher	*Todiramphus sanctus*
Sanderling	**Calidris alba**
Scaly-breasted lorikeet	*Trichoglossus chlorolepidotus*
Scarlet honeyeater	*Myzomela sanguinolenta*
Shining bronze-cuckoo	*Chalcites lucidus*
Short-tailed shearwater	*Puffinus tenuirostris*
Silver gull	*Larus novaehollandiae*
Silvereye	*Zosterops lateralis*
Southern boobook	*Ninox boobook*
Spangled drongo	*Dicrurus bracteatus*
Spotted pardalote	*Pardalotus punctatus*
Striated thornbill	*Acanthiza lineata*
Superb fairy-wren	*Malurus cyaneus*
Tawny frogmouth	*Podargus strigoides*
Terek sandpiper	***Xenus cinereus***
Varied sittella	*Daphoenositta chrysoptera*
Variegated fairy-wren	*Malurus lamberti*
Welcome swallow	*Hirundo neoxena*
Whistling kite	*Haliastur sphenurus*
White-bellied sea-eagle	*Haliaeetus leucogaster*
White-breasted woodswallow	*Artamus leucorynchus*
White-browed scrubwren	*Sericornis frontalis*
White-cheeked honeyeater	*Phylidonyris nigra*
White-fronted chat	*Epthianura albifrons*
White-throated gerygone	*Gerygone olivacea*
White-throated needletail	*Hirundapus caudacutus*
White-throated treecreeper	*Cormobates leucophaeus*
Willie wagtail	*Rhipidura leucophrys*
Yellow thornbill	*Acanthiza nana*
Yellow-faced honeyeater	*Lichenostomus chrysops*
Yellow-tailed black-cockatoo	*Calyptorhynchus funereus*
Lesser sand plover	***Charadrius mongolus***
Oriental plover	*Charadrius veredus*
Pacific golden plover	*Pluvialis fulva*

Notes:
* = introduced species
bold print = threatened species

Appendix 2. Combined Fauna Lists for the Study Area from the Literature Review and Survey Results

Notes:
* indicates introduced species (not native to the area)
Bold indicates a threatened species

Family / Scientific Name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Within WCL
MAMMALS																				
Family: *TACHYGLOSSIDAE*																				
Tachyglossus aculeatus	Short-beaked echidna	x	x				x											x	x	x
Family: *DASYURIDAE*																				
Dasyurus maculatus	**Spotted-tailed quoll**																	**x**		
Antechinus stuartii	Brown antechinus	x				x	x											x	x	x
Phascogale tapoatafa	**Brush-tailed phascogale**																	**x**		**x**
Sminthopsis murina	Common dunnart																	x		
Family: *PERAMELIDAE*																				
Isoodon macrourus	Northern brown bandicoot	x	x	x			x		x									x		x
Perameles nasuta	Long-nosed bandicoot		x				x		x									x		x
	Bandicoot sp.																		x	
Family: *PHASCOLARCTIDAE*																				
Phascolarctos cinereus	**Koala**					**x**	**x**			**x**								**x**		**x**
Family: *VOMBATIDAE*																				
Vombatus ursinus	Common wombat																	x		x
Family: *PETAURIDAE*																				
Petaurus breviceps	Sugar glider	x					x											x		x
Petaurus norfolcensis	**Squirrel glider**	**x**	**x**			**x**	**x**		**x**		**x**				**x**	**x**		**x**	**x**	**x**
Family: *PSEUDOCHEIRIDAE*																				
Pseudocheirus peregrinus	Common ringtail possum	x	x			x	x		x		x							x	x	x
Family: *ACROBATIDAE*																				
Acrobates pygmaeus	Feathertail glider									x								x	x	x
Family: *PHALANGERIDAE*																				
Trichosurus vulpecula	Common brushtail possum	x	x	x		x	x		x	x							x	x	x	x

Family / Scientific Name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Within WCL
MAMMALS - continued																				
Family: *MACROPODIDAE*																				
Macropus giganteus	Eastern grey kangaroo			x		x	x		x								x	x		x
Macropus rufogriseus	Red-necked wallaby	x	x	x		x	x		x									x	x	x
Wallabia bicolor	Swamp wallaby	x	x	x		x			x									x	x	x
Family: *PTEROPODIDAE*																				
Pteropus poliocephalus	**Grey-headed flying-fox**		**x**	**x**			**x**			**x**					**x**	**x**		**x**	**x**	**x**
Pteropus scapulatus	Little red flying-fox	x		x						x								x		x
Family: *EMBALLONURIDAE*																				
Saccolaimus flaviventris	**Yellow-bellied sheathtail bat**			**x**																
Family: *MOLOSSIDAE*																				
Mormopterus sp. 2 (Adams et al)	A freetail-bat		x	x				x		x								x		
Mormopterus norfolkensis	**East-coast freetail-bat**						**x**									**x**		**x**		**x**
Mormopterus sp.	Freetail-bat sp.						x							x						
Tadarida australis	White-striped freetail-bat	x	x	x		x												x	x	x
Family: *VESPERTILIONIDAE*																				
Miniopterus schreibersii oceanensis	**Eastern bent-wing bat**				**x**			**x**							**x**	**x**		**x**	**x**	**x**
Miniopterus australis	**Little bent-wing bat**				**x**				**x**						**x**	**x**		**x**	**x**	**x**
Nyctophilus geoffroyi	Lesser long-eared bat	x	x	x				x						x				x	x	x
Nyctophilus gouldi	Gould's long-eared bat	x	x				x	x				x						x	x	x
Nyctophilus sp.	Long-eared bat sp.					x													x	
Chalinolobus gouldii	Gould's wattled bat		x	x		x	x	x		x				x				x	x	x
Chalinolobus morio	Chocolate wattled bat									x								x	x	x
Chalinolobus nigrogriseus	**Hoary wattled bat**														**x?**					
Falsistrellus tasmaniensis	**Eastern false pipistrelle**																	**x**		
Myotis macropus	**Southern myotis**				**x**													**x**		
Scoteanax rueppellii	**Greater broad-nosed bat**		**x**	**x**						**x**				**x**	**x**	**x**		**x**		**x**
Scotorepens orion	Eastern broad-nosed bat		x			x		x										x		x
Vespadelus pumilis	Eastern forest bat					x	x			x									x	x
Vespadelus vulturnus	Little forest bat	x	x	x		x	x				x	x		x				x	x	x

Family / Scientific Name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Within WCL
MAMMALS - continued																				
Family: *MURIDAE*																				
Pseudomys novaehollandiae	New Holland mouse	x	x	x			x											x	x	x
Mus musculus *	House mouse		x															x		
Rattus fuscipes	Bush rat	x	x	x		x												x		x
Rattus lutreolus	Swamp rat		x	x			x											x		x
Rattus rattus *	Black rat	x	x				x											x		x
Family: *CANIDAE*																				
Canis familiaris *	Dog		x						x									x	x	x
Vulpes vulpes *	Fox		x															x	x	x
Family: *FELIDAE*																				
Felis catus *	Cat			x														x		
Family: *LEPORIDAE*																				
Oryctolagus cuniculus *	Rabbit		x							x								x	x[1]	x
Lepus capensis *	Brown hare		x															x		
Family: *EQUIDAE*																				
Equus caballus *	Brumby/Horse			x														x	x	x
Family: *SUIDAE*																				
Sus scrofa *	Pig																			
Family: *BOVIDAE*																				
Bos taurus *	European cattle																x	x		
Family: *CERVIDAE*																				
*	Deer sp.																		x	x
Family: *KOGIIDAE*																				
Kogia breviceps	Pygmy sperm whale											x								x
Family: *DELPHINIDAE*																				
Delphinus delphis	Common dolphin																	x		
Family: *BALAENOPTERIDAE*																				
Megaptera novaeangliae	**Humpback whale**																	**x**		

Family / Scientific Name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Within WCL
REPTILES																				
Family: *CHELONIIDAE*																				
Chelonia mydas	**Green turtle**																	**x**		**x**
Family: *AGAMIDAE*																				
Amphibolurus muricatus	Jacky lizard	x	x	x			x											x	x	x
Pogona barbata	Bearded dragon																	x		
Family: *VARANIDAE*																				
Varanus varius	Lace monitor	x	x				x											x		x
Family: *SCINCIDAE*																				
Carlia foliorum	Tree-base litter-skink		x																	
Carlia tetradactyla	Southern rainbow-skink																		x	x
Ctenotus robustus	Robust ctenotus		x	x			x											x	x	x
Ctenotus taeniolatus	Copper-tailed skink	x					x										x	x	x	x
Egernia major	Land mullet																	x		
Eulamprus quoyii	Eastern water skink																		x[1]	
Eulamprus tenuis	Barred-sided skink																		x[1]	
Lampropholis delicata	Grass skink	x	x			x	x			x							x	x	x	x
Lampropholis guichenoti	Garden skink	x					x											x	x	x
Morethia boulengeri	South-eastern morethia skink						x												x	x
Saproscincus mustelina	Weasel skink																		x	x
Tiliqua scincoides	Eastern blue-tongued lizard																	x		
Family: *BOIDAE*																				
Morelia spilota spilota	Diamond python																		x	x
Family: *COLUBRIDAE*																				
Dendrelaphis punctulata	Green tree snake		x																	
Family: *ELAPIDAE*																				
Demansia psammophis	Yellow-faced whip snake																	x		
Hemiaspis signata	Black-bellied swamp snake																		x[1]	
Pelamis platurus	Yellow-bellied seasnake																	x		
Pseudechis porphyriacus	Red-bellied black snake	x	x	x			x											x		x
Pseudonaja textilis	Eastern brown snake		x																	

Family / Scientific Name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Within WCL
AMPHIBIANS																				
Family: *MYOBATRACHIDAE*																				
Adelotus brevis	Tusked frog			x																
Crinia signifera	Common eastern froglet		x	x		x	x		x		x							x	x	x
Crinia tinnula	**Wallum froglet**														**x**			**x**		
Limnodynastes dumerilii	Eastern banjo frog	x					x											x	x	x
Limnodynastes ornatus	Ornate burrowing frog		x				x											x	x	x
Limnodynastes peronii	Striped marsh frog			x			x			x								x	x	x
Limnodynastes tasmaniensis	Spotted grass frog																	x		
Pseudophryne bibronii	Brown toadlet		x															x	x	x
Pseudophryne coriacea	Red-backed toadlet																	x		
Uperoleia laevigata	Red-groined toadlet																	x		
Family: *HYLIDAE*																				
Litoria caerulea	Green tree frog																	x		
Litoria dentata	Bleating tree frog						x											x		
Litoria fallax	Eastern dwarf tree frog		x	x						x							x	x	x	x
Litoria jervisiensis	Jervis Bay tree frog																		x	x
Litoria peronii	Peron's tree frog			x			x											x		x
Litoria verreauxii	Verreaux's tree frog		x	x							x							x	x[1]	x
BIRDS																				
Family: *PHASIANIDAE*																				
Pavo cristatus *	Indian peafowl												x						x[1]	
Family: *PHASIANIDAE*																				
Corturnix pectoralis	Stubble quail																	x		
Coturnix ypsilophora	Brown quail			x																
Coturnix sp.	Quail sp.					x														
Family: *ANATIDAE*																				
Cygnus atratus	Black swan																	x		
Chenonetta jubata	Australian wood duck			x									x							
Anas superciliosa	Pacific black duck																	x		
Anas castanea	Chestnut teal												x					x		x
Family: *SPHENISCIDAE*																				
Eudyptula minor	Little penguin																	x		x

Family / Scientific Name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Within WCL
BIRDS - continued																				
Family: *PROCELLARIIDAE*																				
Procellaria aequinoctialis	White-chinned petrel											x								
Pterodroma cookii	Cook's petrel											x								
Puffinus bulleri	Buller's shearwater											x								
Puffinus pacificus	Wedge-tailed shearwater												x							
Puffinus tenuirostris	Short-tailed shearwater												x					x		x
Pachyptila turtur	Fairy prion																	x		
Family: *DIOMEDEIDAE*																				
Thalassarche melanophris	**Black-browed albatross**												**x**							
Family: *ANHINGIDAE*																				
Anhinga melanogaster	Darter												x					x		
Family: *PHALACROCORACIDAE*																				
Phalacrocorax melanoleucos	Little pied cormorant												x					x		
Phalacrocorax varius	Pied cormorant																	x		x
Phalacrocorax sulcirostris	Little black cormorant																	x		
Phalacrocorax carbo	Great cormorant												x					x		
Family: *PELECANIDAE*																				
Pelecanus conspicillatus	Australian pelican												x					x		
Family: *SULIDAE*																				
Morus serrator	Australasian gannet												x					x	x	x
Family: *FREGATIDAE*																				
Fregata sp.	Frigatebird sp.						x													x
Family: *ARDEIDAE*																				
Egretta novaehollandiae	White-faced heron									x			x					x		
Egretta garzetta	Little egret												x					x		
Ardea pacifica	Pacific heron												x					x		
Ardea alba	Great egret												x					x		
Ardea intermedia	Intermediate egret																	x		
Ardea ibis	Cattle egret												x				x	x		
Nycticorax caledonicus	Rufous night heron																	x		
Butorides striatus	Striated heron												x					x		
Botaurus poiciloptilus	**Australasian bittern**																	**x**		

Family / Scientific Name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Within WCL
BIRDS - continued																				
Family: *THRESKIORNITHIDAE*																				
Threskiornis molucca	Australian white ibis												x					x		x
Threskiornis spinicollis	Straw-necked ibis												x					x	x	
Platalea regia	Royal spoonbill												x					x		
Family: *CICONIIDAE*																				
Ephippiorhynchus asiaticus	**Black-necked stork**																	**x**		
Family: *ACCIPITRIDAE*																				
Pandion haliaetus	**Osprey**																	**x**		
Elanus axillaris	Black-shouldered kite		x			x												x		x
Haliastur sphenurus	Whistling kite		x	x		x							x				x	x	x	x
Haliaeetus leucogaster	White-bellied sea-eagle		x	x		x							x					x	x	x
Accipiter novaehollandiae	Grey goshawk															x				
Aquila audax	Wedge-tailed eagle															x				
Hieraeetus morphnoides	Little eagle																	x		
Family: *FALCONIDAE*																				
Falco berigora	Brown falcon					x														x
Falco longipennis	Australian hobby												x					x	x	x
Falco peregrinus	Peregrine falcon												x							x
Falco cenchroides	Nankeen kestrel					x							x					x	x	x
Family: *RALLIDAE*																				
Porphyrio porphyrio	Purple swamphen																	x		
Gallinula tenebrosa	Dusky moorhen																	x		
Family: *SCOLOPACIDAE*																				
Arenaria interpres	Ruddy turnstone																	x		
Gallinago hardwickii	Latham's snipe																	x		
Limnodromus semipalmatus	Asian dowitcher																	x		
Limosa lapponica	Bar-tailed godwit												x					x		
Limosa limosa	**Black-tailed godwit**												**x**					**x**		
Numenius madagascariensis	Eastern curlew												x					x		
Numenius phaeopus	Whimbrel												x					x		
Tringa nebularia	Common greenshank												x					x		
Tringa stagnatilis	Marsh sandpiper												x					x		
Xenus cinereus	**Terek sandpiper**												**x**					**x**		**x**
Actitis hypoleucos	Common sandpiper												x					x		
Heteroscelus brevipes	Grey-tailed tattler												x					x		

Family / Scientific Name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Within WCL
BIRDS - continued																				
Calidris tenuirostris	**Great knot**												**x**					**x**		
Calidris canutus	Red knot												x					x		
Calidris alba	**Sanderling**												**x**					**x**		**x**
Calidris ruficollis	Red-necked stint												x					x		
Calidris acuminata	Sharp-tailed sandpiper																	x		
Calidris ferruginea	Curlew sandpiper												x					x		
Calidris melanotos	Pectoral sandpiper																	x		
Limicola falcinellus	**Broad-billed sandpiper**																	**x**		
Family: *BURHINIDAE*																				
Burhinus grallarius	**Bush stone-curlew**			**x**														**x**		
Family: *HAEMATOPODIDAE*																				
Haematopus longirostris	**Pied oystercatcher**												**x**					**x**		**x**
Haematopus fuliginosus	**Sooty oystercatcher**												**x**					**x**		
Family: *RECURVIROSTRIDAE*																				
Himantopus himantopus	Back-winged stilt												x					x		
Recurvirostra novaehollandiae	Red-necked avocet												x					x		
Family: *CHARADRIIDAE*																				
Pluvialis dominica	Lesser golden plover												x					x		x
Pluvialis fulva	Pacific golden plover																	x		x#
Charadrius bicinctus	Double-banded plover												x					x		x
Charadrius ruficapillus	Red-capped plover												x					x	x	x
Charadrius mongolus	**Lesser sand plover**																	**x**		**x#**
Charadrius veredus	Oriental plover																	x		x#
Elseyornis melanops	Black-fronted dotterel												x							x
Vanellus miles	Masked lapwing					x			x				x					x	x	x
Family: *STERCORCARIIDAE*																				
Stercorarius parasiticus	Arctic jaeger												x							
Family:*LARIDAE*																				
Larus dominicanus *	Kelp gull																	x		
Larus novaehollandiae	Silver gull												x					x	x	x
Sterna nilotica	Gull-billed tern												x					x		
Sterna caspia	Caspian tern																	x		
Sterna bergii	Crested tern												x					x	x	x
Sterna striata	White-fronted tern																	x		
Sterna hirundo	Common tern												x							x
Sterna albifrons	**Little tern**																	**x**		

Family / Scientific Name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Within WCL
BIRDS - continued																				
Chlidonias leucopterus	White-winged black tern																	x		
Family: *COLUMBIDAE*																				
Streptopelia chinensis *	Spotted turtle-dove			x						x			x					x		
Macrophygia amboinensis	Brown cuckoo-dove					x														x
Phaps elegans	Brush bronzewing		x															x		x
Ocyphaps lophotes	Crested pigeon	x				x							x				x	x	x	x
Geopelia placida	Peaceful dove		x	x																
Geopelia humeralis	Bar-shouldered dove		x														x	x	x	x
Columba livia *	Rock dove																	x		
Family: *CACATUIDAE*																				
Calyptorhynchus funereus	Yellow-tailed black-cockatoo		x			x							x					x	x	x
Eolophus roseicapillus	Galah					x			x				x				x	x		x
Cacatua galerita	Sulphur-crested cockatoo			x														x		
Family: *PSITTACIDAE*																				
Trichoglossus haematodus	Rainbow lorikeet			x						x			x					x	x	x
Trichoglossus chlorolepidotus	Scaly-breasted lorikeet			x									x				x		x	x
Alisterus scapularis	Australian king parrot			x																
Glossopsitta pusilla	Little lorikeet																x			
Platycercus eximius	Eastern rosella	x	x	x		x	x		x	x			x				x	x		x
Psephotus haematonotus	Red-rumped parrot																	x		
Family: *CUCULIDAE*																				
Cacomantis flabelliformis	Fan-tailed cuckoo		x			x			x				x				x	x	x	x
Chalcites lucidus	Shining bronze-cuckoo																	x	x	x
Eudynamys orientalis	Common (Pacific) koel		x										x					x		x
Scythrops novaehollandiae	Channel-billed cuckoo					x												x		x
Family: *CENTROPODIDAE*																				
Centropus phasianinus	Pheasant coucal					x							x						x[1]	x
Family: *STRIGIDAE*																				
Ninox strenua	**Powerful owl**	**x**		**x**		**x**									**x**			**x**	**x**	**x**
Ninox boobook	Southern boobook	x								x								x		x
Family: TYTONIDAE																				
Tyto novaehollandiae	**Masked owl**	**x**					**x**								**x**			**x**		**x**
Tyto capensis	**Grass owl**																	**x**		
Family: *PODARGIDAE*																				
Podargus strigoides	Tawny frogmouth	x	x	x		x	x		x	x								x		x

Family / Scientific Name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Within WCL
BIRDS - continued																				
Family: *AEGOTHELIDAE*																				
Aegotheles cristatus	Australian owlet-nightjar																	x	x	x
Family: *APODIDAE*																				
Hirundapus caudacutus	White-throated needletail		x										x					x		x
Apus pacificus	Fork-tailed swift																	x		
Family: *ALCEDINIDAE*																				
Dacelo novaeguineae	Laughing kookaburra	x	x	x		x	x		x				x				x	x	x	x
Todiramphus sanctus	Sacred kingfisher	x	x				x						x					x		x
Family: *CORACIIDAE*																				
Eurystomus orientalis	Dollarbird	x	x			x	x						x					x		x
Family: *CLIMACTERIDAE*																				
Cormobates leucophaeus	White-throated treecreeper	x	x	x			x											x	x	x
Family: *MALURIDAE*																				
Malurus cyaneus	Superb fairy-wren	x	x	x		x	x		x	x			x				x	x	x[1]	x
Malurus lamberti	Variegated fairy-wren	x	x	x		x	x						x					x	x	x
Stipiturus malachurus	Southern emu-wren																	x		
Family: *PARDALOTIDAE*																				
Pardalotus punctatus	Spotted pardalote		x	x						x							x	x		x
Sericornis frontalis	White-browed scrubwren		x				x										x	x	x	x
Smicrornis brevirostris	Weebill								x											
Gerygone levigaster	Mangrove gerygone												x					x		
Gerygone olivacea	White-throated gerygone		x				x			x								x		x
Acanthiza pusilla	Brown thornbill		x				x		x	x			x				x	x	x	x
Acanthiza chrysorrhoa	Yellow-rumped thornbill												x					x		
Acanthiza nana	Yellow thornbill	x				x												x	x	x
Acanthiza lineata	Striated thornbill					x	x											x		x
Family: *MELIPHAGIDAE*																				
Anthochaera carunculata	Red wattlebird	x							x	x			x					x	x	x
Anthochaera chrysoptera	Little wattlebird	x	x			x	x		x				x				x	x	x	x
Philemon corniculatus	Noisy friarbird	x	x				x						x				x	x	x	x
Entomyzon cyanotis	Blue-faced honeyeater												x							
Manorina melanocephala	Noisy miner	x		x		x			x	x			x					x	x	x
Meliphaga lewinii	Lewin's honeyeater			x		x			x								x	x	x	x
Lichenostomus chrysops	Yellow-faced honeyeater	x	x			x				x			x				x	x	x	x
Lichenostomus leucotis	White-eared honeyeater			x			x													
Melithreptus brevirostris	Brown-headed honeyeater																		x	x

Family / Scientific Name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Within WCL
BIRDS - continued																				
Lichmera indistincta	Brown honeyeater		x										x					x		x
Phylidonyris novaehollandiae	New Holland honeyeater			x		x													x	x
Phylidonyris nigra	White-cheeked honeyeater	x	x				x											x	x	x
Acanthorhynchus tenuirostris	Eastern spinebill	x	x			x	x		x	x		x	x				x	x	x	x
Myzomela sanguinolenta	Scarlet honeyeater	x																x	x	x
Epthianura albifrons	White-fronted chat												x					x		x
Family: *PETROICIDAE*																				
Microeca fascinans	Jacky winter								x											
Eopsaltria australis	Eastern yellow robin		x				x					x	x					x	x	x
Family: *POMATOSTOMIDAE*																				
Pomatostomus temporalis	**Grey-crowned babbler**																	**x**		**x**
Family: *PSOPHODIDAE*																				
Psophodes olivaceus	Eastern whipbird	x	x	x		x	x						x				x	x	x	x
Family: *NEOSITTIDAE*																				
Daphoenositta chrysoptera	Varied sittella																		x	x
Family: *PACHYCEPHALIDAE*																				
Falcunculus frontatus	Crested shrike-tit																		x	x
Pachycephala pectoralis	Golden whistler		x										x					x	x	x
Pachycephala rufiventris	Rufous whistler	x	x				x						x					x	x	x
Colluricincla harmonica	Grey shrike-thrush		x			x	x										x	x	x	x
Family: *DICRURIDAE*																				
Myiagra rubecula	Leaden flycatcher						x													
Myiagra cyanoleuca	Satin flycatcher	x																x		
Grallina cyanoleuca	Magpie-lark					x	x		x	x			x					x		x
Rhipidura rufifrons	Rufous fantail			x														x		
Rhipidura fuliginosa	Grey fantail	x	x	x			x			x			x				x	x	x	x
Rhipidura leucophrys	Willie wagtail	x					x			x			x					x	x	x
Dicrurus bracteatus	Spangled drongo												x					x	x	x
Family: *CAMPEPHAGIDAE*																				
Coracina novaehollandiae	Black-faced cuckoo-shrike	x	x	x		x	x		x	x			x				x	x	x	x
Coracina tenuirostris	Cicadabird						x													
Family: *ORIOLIDAE*																				
Sphecotheres viridis	Figbird												x							

Family / Scientific Name	Common Name	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	Within WCL
BIRDS - continued																				
Family: *ARTAMIDAE*																				
Artamus leucorynchus	White-breasted woodswallow		x															x		x
Artamus cyanopterus	Dusky woodswallow		x	x														x		x
Cracticus torquatus	Grey butcherbird	x	x	x		x			x	x			x				x	x	x	x
Cracticus nigrogularis	Pied butcherbird			x						x								x		
Gymnorhina tibicen	Australian magpie	x	x	x		x	x		x	x			x				x	x	x	x
Strepera graculina	Pied currawong	x	x	x		x	x		x	x			x					x		x
Family: *CORVIDAE*																				
Corvus coronoides	Australian raven	x	x			x	x		x				x				x	x	x	x
Family: *PTILONORHYNCHIDAE*																				
Ptilonorhynchus violaceus	Satin bowerbird																	x		
Family: *MOTACILLIDAE*																				
Anthus australis	Australian pipit												x					x		x
Family: *PASSERIDAE*																				
Passer domesticus *	House sparrow																	x		
Taeniopygia bichenovii	Double-barred finch																	x		
Neochmia temporalis	Red-browed finch		x	x		x	x		x			x							x	x
Family: *DICAEIDAE*																				
Dicaeum hirundinaceum	Mistletoebird		x	x														x	x	x
Family: *HIRUNDINIDAE*																				
Hirundo neoxena	Welcome swallow		x	x									x				x	x		x
Hirundo ariel	Fairy martin																	x		
Family: *SYLVIIDAE*																				
Megalurus timoriensis	Tawny grassbird																	x		
Megalurus gramineus	Little grassbird												x					x		x
Cisticola exilis	Golden-headed cisticola												x					x	x[1]	x
Family: *ZOSTEROPIDAE*																				
Zosterops lateralis	Silvereye	x	x	x		x	x			x			x				x	x	x	x
Family: *STURNIDAE*																				
Sturnus vulgaris *	Common starling		x										x					x		
Acridotheres tristis *	Common myna												x					x	x[1]	

Notes for Appendix 1:

[1] Recorded outside the Worimi Conservation Lands at Lavis Lane

recorded by Chris Herbert, Hunter Bird Observers Club (pers. comm.)

References:

A – Ecotone Ecological Consultants Pty Ltd, 1997. *A Dual Carriageway for Nelson Bay Road between Salt Ash and Bobs Farm. Assessment of Impact on Threatened Species of the Proposed Stage 2 Construction*. Report prepared for Port Stephens Council (Job No. 7058PSC)

B – Resource Planning, 1994. *Environmental Impact Statement for a Sand Extraction Operation on Boral Resources Freehold Property at Fern Bay near Newcastle, NSW*. Report prepared for Boral Resources Country Pty Ltd.

C – Anne Clements & Associates, 1992. *Flora and Fauna Report: part of the environmental assessment of Fern Bay, New South Wales*. Report prepared for Port Stephens Council.

D – Ecotone Ecological Consultants, 1995. *A Dual Carriageway for Nelson Bay Road between Salt Ash and Bobs Farm Fauna Impact Statement for the Proposed Stage 1 Construction at Salt Ash*. Report prepared for Port Stephens Council.

E – Ecotone Ecological Consultants Pty Ltd, 2001. *Flora and Fauna Survey and Threatened Species Assessment: Proposed Subtransmission Line Upgrade to Tomaree Peninsula (Northern Section – Nelson Bay Road, Bobs Farm to Anna Bay)*. Report prepared for Enerserve (Energy Australia).

F – Ecotone Ecological Consultants Pty Ltd, 2001. *Flora and Fauna Survey and Threatened Species Assessment: Proposed Subtransmission Line Upgrade to Tomaree Peninsula (Southern Section – Lavis Lane to Nelson Bay Road, Salt Ash)*. Report prepared for Enerserve (Energy Australia).

G – Ecotone Ecological Consultants Pty Ltd, 1994. *Bat Survey of Land Proposed for Sand Extraction by Boral Resources (NSW) Pty Ltd at Fern Bay*. Report prepared for Resource Planning Pty Ltd.

H – ERM, 2001. *Review of Environmental Factors: Nelson Bay Road Upgrade*. Report prepared for NSW Roads and Traffic Authority (RTA).

I – Ecotone Ecological Consultants Pty Ltd, 2007. *Flora and Fauna Impact Assessment: Proposed Childcare Centre & Mobile Home Village, Anna Bay*. Report prepared for Pacific Rim Accommodation Group.

J – Hunter & Central Coast REMS Data, 2001. Data supplied by NSW NPWS (Nelson Bay)

K – Australian Museum Specimen Register. Data supplied by NSW NPWS (Nelson Bay)

L – Birds Australia Atlas of Australian Birds 2. Data supplied by NSW NPWS (Nelson Bay)

M – Glen Hoye systematic bat survey data. Data supplied by NSW NPWS (Nelson Bay)

N – ERM, 2005. *Fern Bay Estate Master Plan Study: Fern Bay Estate Species Impact Statement*. Report prepared for Winten Property Group & Continental Venture Capital Limited

O – Insite Planning Engineering Environmental, 2007. *Preliminary Assessment Salt Ash: Lot 4042 DP 1090633, Lot 632 DP 609506 and Lot 633 DP 609506 Nelson Bay Road, Salt Ash*. Report prepared for ATB Morton Pty Ltd.

P – Harper Somers O'Sullivan Pty Ltd. *Flora and Fauna Assessment over land proposed for sand extraction at Janet Parade, Salt Ash*. Report prepared for Mr Steve Hufnagl, 10 Janet Parade, Salt Ash

Q – DECC, 2008. NSW NPWS Wildlife Atlas Records (Default Incidental Sightings) for the study area (within 2km of the centreline of Worimi Conservation Lands)

R – Ecotone Ecological Consultants Pty Ltd, 2008. Result of the current fauna field survey of the Worimi Conservation Lands (undertaken on behalf of DECC)

(NB: CSIRO Australian National Wildlife Collection not included as only one record of a spangled drongo)

Appendix 3. Fauna List for the Study Area and Survey Sites (this study)

Bold indicates a threatened species
[V] - Vulnerable, [E]– Endangered, [Mi]- Migratory
- Sighted offsite in edge of WCL (Rushland Road) at Site 1, Lavis Lane for Site 2
* indicates introduced / non-endemic species

Observation types:

O	observed	W	Heard	H	Hair, feathers or skin
F	tracks/scratchings	P	scat	E	Nest/roost
T	Trapped or netted	Y	Bone or teeth	Z	In raptor/owl pellet
K	Dead	X	In scat	R	Road kill
M	Miscellaneous	U	Ultrasonic call	d	Definite identification
p	Probable identification	J	JAMBA listed species	C	CAMBA listed species

Scientific name	Common name	Status TSC	Status EPBC	Site 1	Site 2	Site 3	Site 4	Site 5
AMPHIBIANS								
Limnodynastes dumerilii	Eastern banjo frog				3 (O)		1 (O)	
Limnodynastes peronii	Striped marsh frog			8 (O)	8 (O)		5+ (W)	
Limnodynastes ornatus	Ornate burrowing frog				9 (O)			
Pseodophryne bibroni	Brown toadlet			1 (O)	10 (W)	10 (W)	10 (W)	
Crinia signifera	Common eastern toadlet			3 (W)	5+ (O/W)	3+ (W)	10+ (W)	
Litoria fallax	Eastern dwarf tree frog			1 (W)				
Litoria jervisiensis	Jervis bay tree frog				10 (W)	1 (W)	10 (W)	
Litoria verreauxii	Verreaux's tree frog				1 (O)#			
BIRDS								
Morus serrator	Australasian gannet							3 (O)
Geopelia humeralis	Bar-shouldered dove				2 (O)	1 (W)	1 (W)	
Ocyphaps lophotes	Crested pigeon				1 (W)			
Sterna bergii	Crested tern		J					1 (O)
Larus novaehollandiae	Silver gull							19 (O)
Charadrius ruficapillus	Red-capped plover							11 (O)
Threskiornis spinicollis	Straw-necked ibis				10 (O)#			5 (O)
Haliaeetus leucogaster	White-bellied sea-eagle		Mi, C		1 (O)			
Haliastur sphenurus	Whistling kite				1 (O)			
Falco longipennis	Australian hobby						1 (O)	
Falco cenchroides	Nankeen kestrel					1 (O)		
Ninox strenua	**Powerful owl**	**V**					**1 (W)**	
Trichoglossus haematodus	Rainbow lorikeet			2 (W)	2 (W)	3 (O/W)	2 (W)	
Trichoglossus chlorolepidotus	Scaly-breasted lorikeet						1 (W)	
Calyptorhynchus funereus	Yellow-tailed black-cockatoo					1 (W)	1 (W)	
Aegotheles cristatus	Australian owlet-nightjar			1 (W)	1 (W)	1 (W)		
Dacelo novaeguineae	Laughing kookaburra			1 (O)				
Cacomantis flabelliformis	Fan-tailed cuckoo						1 (W)	
Chalcites lucidus	Shining bronze-cuckoo				1 (W)			
Centropus phasianinus	Pheasant coucal				1 (O)#			
Rhipidura fuliginosa	Grey fantail			1 (W)	3 (W)	1 (W)	1 (O/W)	
Rhipidura leucophrys	Willie wagtail				1 (O)#			1 (W)
Eopsaltria australis	Eastern yellow robin				1 (W)		2 (O/W)	

Scientific name	Common name	Status TSC	Status EPBC	Site 1	Site 2	Site 3	Site 4	Site 5
Pachycephala pectoralis	Golden whistler			3 (W)	1 (W)	1 (W)	3 (O/W)	
Pachycephala rufiventris	Rufous whistler				1 (W)			
Colluricincla harmonica	Grey shrike-thrush			1 (W)	3 (W)	2 (O/W)	2 (W)	
Falcunculus frontatus	Crested shrike-tit						1 (W)	
Psophodes olivaceus	Eastern whipbird			4 (W)	4 (W)		2 (W)	
Coracina novaehollandiae	Black-faced cuckoo-shrike				3 (O/W)	1 (W)	2 (O/W)	
Acanthiza nana	Yellow thornbill					5 (O)		
Acanthiza pusilla	Brown thornbill			2 (O/W)	4 (W)	2 (W)	2 (W)	
Sericornis frontalis	White-browed scrubwren			2 (O/W)	2 (W)	1 (W)	3 (O/W)	
Cisticola exilis	Golden-headed cisticola				1 (O)#			
Malurus cyaneus	Superb fairy-wren				5 (O)#			
Malurus lamberti	Variegated fairy-wren			2 (O/W)	3 (O/W)	1 (W)	5 (O/W)	
Daphoenositta chrysoptera	Varied sittella					2 (W)	2 (W)	
Cormobates leucophaeus	White-throated treecreeper				1 (O/W)		3 (O/W)	
Dicaeum hirundinaceum	Mistletoebird				1 (W)		1 (W)	
Zosterops lateralis	Silvereye			5+ (W)	8+ (O/W)	3 (W)	5+ (O/W)	
Melithreptus brevirostris	Brown-headed honeyeater				1 (W)		10+ (W)	
Myzomela sanguinolenta	Scarlet honeyeater						1 (W)	
Acanthorhynchus tenuirostris	Eastern spinebill			5 (W)	2 (W)	3 (O/W)	4 (O/W)	
Meliphaga lewinii	Lewin's honeyeater				2 (W)		1 (O)	
Lichenostomus chrysops	Yellow-faced honeyeater				4+ (W)	5+ (O/W)	10+ (O/W)	
Phylidonyris novaehollandiae	New Holland honeyeater			1 (W)		2 (W)		
Phylidonyris nigra	White-cheeked honeyeater			3 (W)	5+ (O/W)	5+ (O/W)	5+ (O/W)	
Manorina melanocephala	Noisy miner				1 (O/W)			
Anthochaera chrysoptera	Little wattlebird			3 (W)	7+ (W)	2 (W)	3 (O/W)	
Anthochaera carunculata	Red wattlebird			2 (W)	3+ (W)	1 (W)		
Philemon corniculatus	Noisy friarbird					5+ (O/W)	5+ (O/W)	
Neochmia temporalis	Red-browed finch				1 (W)		4 (O/W)	
Dicrurus bracteatus	Spangled drongo				1 (O)			
Cracticus torquatus	Grey butcherbird			1 (W)	4+ (O/W)		1 (W)	
Gymnorhina tibicen	Australian magpie				1 (O)			1 (O)
Corvus coronoides	Australian raven			1 (W)	2 (O/W)		1 (W)	
Acridotheres tristis *	Common myna				2 (O)#			
MAMMALS								
Tachyglossus aculeatus	Short-beaked echidna			1 (F)	1 (F)	1 (F)		
Antechinus stuartii	Brown antechinus			2 (T)	14 (T)	39 (T)	42 (T)	
Trichosurus vulpecula	Common brushtail possum				10 (O/W/T)	3 (O)	1 (O)	
Pseudocheirus peregrinus	Common ringtail possum			1 (E)	2 (O)	1 (O)	2 (O/E)	

Scientific name	Common name	Status TSC	Status EPBC	Site 1	Site 2	Site 3	Site 4	Site 5
Petaurus norfolcensis	**Squirrel glider**	**V**		**1 (O)**	**4 (O)**	**4 (O/W)**	**2 (T/O)**	
Acrobates pygmaeus	Feathertail glider				1 (O)	4 (O)	1 (O)	
Wallabia bicolor	Swamp wallaby				1+ W/P/F	1+ W/P/F	1 (F)	
Macropus rufogriseus	Red-necked wallaby			1(O)#	3 (O)			
Pteropus poliocephalus	**Grey-headed flying-fox**	**V**	**V**	**10+ (O/W)**	**10+ (O/W)**	**10+ (O/W)**	**5+ (W)**	
Tadarida australis	White-striped freetail bat			1 (W)	1+ (W)			
Nyctophilus gouldi	Gould's long-eared bat				3 (T)			
Nyctophilus geoffroyi	Lesser long-eared bat				2 (T)			
Miniopterus schreibersii oceanensis	**Eastern bent-wing bat**	**V**			**1 (Up)**			
Miniopterus australis	**Little bent-wing bat**	**V**			**1+ (T/Ud)**		**1+ (T)**	
Chalinolobus gouldii	Gould's wattled bat			1 (Up)	1+ (Up)			
Chalinolobus morio	Chocolate wattled bat			1 (Ud)	1+ T/Ud	1+ T/Up	1 (Up)	
Vespadelus pumilus	Eastern forest bat			1 (Up)				
Vespadelus vulturnus	Little forest bat			1 (Ud)	1+ T/Up	1 (T)	1 (Ud)	
Pseudomys novaehollandiae	New Holland mouse						2 (T)	
*Oryctolagus cuniculus**	Rabbit				1 (O)#			
*Equus caballus**	Horse						1 (F)	
*Canis familiaris**	Dog					1 (W)		
*Vulpes vulpes**	Fox			1 (P)				
	Bandicoot				1 (F)		1 (W/F)	
*	Deer						1 (F)	
Nyctophilus sp.	Long-eared bats			1+ (Ud)	1+ (Ud)		1+ (Ud)	
REPTILES								
Amphibolurus muricatus	Jacky lizard			2 (O)	1 (O)			
Carlia tetradactyla	Southern rainbow skink				1 (O)			
Ctenotus robustus	Robust ctenotus			2 (O)		1 (O)		
Ctenotus taeniolatus	Copper-tailed skink			1 (O)	1 (O)		1 (O)	
Lampropholis delicata	Grass skink				4 (O)		5 (O)	
Lampropholis guichenoti	Garden skink			3 (O)	35 (O)	5+ (O)	11 (O)	
Saproscincus Sp.	A weasel skink			1 (O)				
Morethia boulengeri	South-eastern morethia skink					1 (O)		
Eulamprus quoyii	Eastern water skink				1 (O)#			
Eulamprus tenuis	Barred-sided skink				1 (O)#			
Hemiaspis signata	Black-bellied swamp snake				1 (O)#			
Morelia spilota spilota	Diamond python				1 (O)			

Appendix 4. Details of Survey Results

All species that were opportunistically recorded are listed in **Appendix 2.**

Appendix 4.1 Elliott Trap Results

Site No.	Date	Trap No.	Trap size	Position / tree species	Species Captured	Sex
1	08/04/08		-	-	No captures	-
	09/04/08		-	-	No captures	-
	10/04/08		-	-	No captures	-
	11/04/08	15	A	ground	Brown antechinus *Antechinus stuartii*	F
		19	A	ground	Brown antechinus *Antechinus stuartii*	F
2	08/04/08	15	A	ground	Brown antechinus *Antechinus stuartii*	M
	09/04/08	5	A	ground	Brown antechinus *Antechinus stuartii*	M
		6	A	ground	Brown antechinus *Antechinus stuartii*	M
		18	A	ground	Brown antechinus *Antechinus stuartii*	M
		19	A	ground	Brown antechinus *Antechinus stuartii*	M
		21	A	ground	Brown antechinus *Antechinus stuartii*	M
	10/04/08	6	A	ground	Brown antechinus *Antechinus stuartii*	M
		8	A	ground	Brown antechinus *Antechinus stuartii*	F
		10	A	ground	Brown antechinus *Antechinus stuartii*	M
		15	A	ground	Brown antechinus *Antechinus stuartii*	M
		17	A	ground	Brown antechinus *Antechinus stuartii*	M
		20	Cage	ground	Common brushtail possum *Trichosurus vulpecula*	-
	11/04/08	8	A	ground	Brown antechinus *Antechinus stuartii*	F
		10	A	ground	Brown antechinus *Antechinus stuartii*	F
		17	A	ground	Brown antechinus *Antechinus stuartii*	F
3	29/04/08	1	A	ground	Brown antechinus *Antechinus stuartii*	F
		2	A	ground	Brown antechinus *Antechinus stuartii*	M
		8	A	ground	Brown antechinus *Antechinus stuartii*	F
		11	A	ground	Brown antechinus *Antechinus stuartii*	F
		18	A	ground	Brown antechinus *Antechinus stuartii*	M
		23	A	ground	Brown antechinus *Antechinus stuartii*	F
	30/04/08	1	A	ground	Brown antechinus *Antechinus stuartii*	M
		4	A	ground	Brown antechinus *Antechinus stuartii*	M
		6	A	ground	Brown antechinus *Antechinus stuartii*	M
		9	A	ground	Brown antechinus *Antechinus stuartii*	M
		14	A	ground	Brown antechinus *Antechinus stuartii*	M
		18	A	ground	Brown antechinus *Antechinus stuartii*	F
		23	A	ground	Brown antechinus *Antechinus stuartii*	M*
		23	B	tree	Brown antechinus *Antechinus stuartii*	M
	01/05/08	1	A	ground	Brown antechinus *Antechinus stuartii*	M
		3	A	ground	Brown antechinus *Antechinus stuartii*	M
		2	B	tree	Brown antechinus *Antechinus stuartii*	M
		4	A	ground	Brown antechinus *Antechinus stuartii*	M
		5	A	ground	Brown antechinus *Antechinus stuartii*	F
		6	A	ground	Brown antechinus *Antechinus stuartii*	M
		7	A	ground	Brown antechinus *Antechinus stuartii*	M
		9	A	ground	Brown antechinus *Antechinus stuartii*	M
		10	A	ground	Brown antechinus *Antechinus stuartii*	F
		12	A	ground	Brown antechinus *Antechinus stuartii*	F
		13	A	ground	Brown antechinus *Antechinus stuartii*	F
		22	A	ground	Brown antechinus *Antechinus stuartii*	F
		10	B	tree	Brown antechinus *Antechinus stuartii*	M
		24	A	ground	Brown antechinus *Antechinus stuartii*	F

Appendix 4.1 continued

Site No.	Date	Trap No.	Trap size	Position / tree species	Species Captured	Sex
	02/05/08	6	A	ground	Brown antechinus *Antechinus stuartii*	M
		7	A	ground	Brown antechinus *Antechinus stuartii*	M
		5	B	tree	Brown antechinus *Antechinus stuartii* (x2)	M/M
		10	A	ground	Brown antechinus *Antechinus stuartii*	M
		12	A	ground	Brown antechinus *Antechinus stuartii*	F
		13	A	ground	Brown antechinus *Antechinus stuartii*	M
		15	A	ground	Brown antechinus *Antechinus stuartii*	M
		10	B	tree	Brown antechinus *Antechinus stuartii* (x2)	M/F
4	29/04/08	3	A	ground	Brown antechinus *Antechinus stuartii*	M
		9	A	ground	New Holland mouse *Pseudomys novaehollandiae*	F
		16	A	ground	Brown antechinus *Antechinus stuartii*	F
		20	A	ground	Brown antechinus *Antechinus stuartii*	F
		22	A	ground	Brown antechinus *Antechinus stuartii*	M
	30/04/08	1	B	tree	Brown antechinus *Antechinus stuartii*	M
		4	A	ground	Brown antechinus *Antechinus stuartii*	M
		16	A	ground	Brown antechinus *Antechinus stuartii*	F
		18	A	ground	Brown antechinus *Antechinus stuartii*	F
		20	A	ground	Brown antechinus *Antechinus stuartii*	M
		10	B	tree	Brown antechinus *Antechinus stuartii*	F
		21	A	ground	Brown antechinus *Antechinus stuartii*	F
		22	A	ground	Brown antechinus *Antechinus stuartii*	M
		23	A	ground	Brown antechinus *Antechinus stuartii*	M
		25	A	ground	Brown antechinus *Antechinus stuartii*	F
	01/05/08	2	A	ground	Brown antechinus *Antechinus stuartii*	M
		3	A	ground	New Holland mouse *Pseudomys novaehollandiae*	M
		8	A	ground	Brown antechinus *Antechinus stuartii*	M
		9	A	ground	Brown antechinus *Antechinus stuartii*	M
		16	A	ground	Brown antechinus *Antechinus stuartii*	F
		18	A	ground	Brown antechinus *Antechinus stuartii*	M
		20	A	ground	Brown antechinus *Antechinus stuartii*	M
		10	B	tree	Brown antechinus *Antechinus stuartii*	M
		22	A	ground	Brown antechinus *Antechinus stuartii*	F
		23	A	ground	Brown antechinus *Antechinus stuartii*	F
		25	A	ground	Brown antechinus *Antechinus stuartii*	M
	02/05/08	1	A	ground	Brown antechinus *Antechinus stuartii*	M
		2	A	ground	Brown antechinus *Antechinus stuartii*	F
		3	A	ground	Brown antechinus *Antechinus stuartii*	F
		4	A	ground	Brown antechinus *Antechinus stuartii*	M
		8	A	ground	Brown antechinus *Antechinus stuartii*	M
		5	B	tree	Squirrel glider *Petaurus norfolcensis*	F
		11	A	ground	Brown antechinus *Antechinus stuartii*	F
		12	A	ground	Brown antechinus *Antechinus stuartii*	M
		13	A	ground	Brown antechinus *Antechinus stuartii*	F
		14	A	ground	Brown antechinus *Antechinus stuartii*	F
		15	A	ground	Brown antechinus *Antechinus stuartii*	M
		16	A	ground	Brown antechinus *Antechinus stuartii*	F
		18	A	ground	Brown antechinus *Antechinus stuartii*	F
		19	A	ground	Brown antechinus *Antechinus stuartii*	F
		20	A	ground	Brown antechinus *Antechinus stuartii*	M
		10	B	tree	Brown antechinus *Antechinus stuartii*	F
		22	A	ground	Brown antechinus *Antechinus stuartii*	M
		23	A	ground	Brown antechinus *Antechinus stuartii*	M
		24	A	ground	Brown antechinus *Antechinus stuartii*	M

* animal died

Appendix 4.2 Anabat Detector Results

Detector number/type of recording *	Date	Location	Species	Number of passes (D/Pr/P) *
Unit 3 Hand-held during spotlighting 18:45 – 21:30	08.04.08	Site 2	Chocolate wattled bat *Chalinolobus morio*	(3/1/1)
			Gould's wattled bat *Chalinolobus gouldii*	(3/1/0)
			Little bent-wing bat *Miniopterus australis*	(2/0/0)
			Little forest bat *Vespadelus vulturnus*	(0/1/0)
			Chocolate wattled bat *Chalinolobus morio* **or** eastern forest bat *Vespadelus pumilis*	(0/0/1)
			Chocolate wattled bat *Chalinolobus morio* **or** little forest bat *Vespadelus vulturnus*	(0/0/2)
			Chocolate wattled bat *Chalinolobus morio* **or** *Vespadelus sp.*	(0/0/3)
			Little forest bat *Vespadelus vulturnus* **or** eastern forest bat *Vespadelus pumilis*	(0/0/1)
Unit 2 Stationary 18:24 – 21:20 (394160E 6366636N)	09.04.08	Site 1	Little forest bat *Vespadelus vulturnus*	(3/1/0)
			Chocolate wattled bat *Chalinolobus morio*	(2/0/0)
			Nyctophilus sp.	(1/0/0)
			Gould's wattled bat *Chalinolobus gouldii*	(0/1/0)
			Eastern forest bat *Vespadelus pumilis*	(0/1/0)
			Little bent-wing bat *Miniopterus australis*	(0/0/1)
			Chocolate wattled bat *Chalinolobus morio* **or** eastern forest bat *Vespadelus pumilis*	(0/0/1)
			Chocolate wattled bat *Chalinolobus morio* **or** *Vespadelus sp.*	(0/0/1)
			Eastern bent-wing bat *Miniopterus schreibersii oceanensis* **or** large forest bat *Vespadelus darlingtoni*	(0/0/1)
Unit 3 Hand-held during spotlighting & call playback 18:00 – 21:00	09.04.08	Site 2	Little forest bat *Vespadelus vulturnus*	(1/1/1)
			Little bent-wing bat *Miniopterus australis*	(1/0/0)
			Nyctophilus sp.	(0/1/0)
			Chocolate wattled bat *Chalinolobus morio* **or** little forest bat *Vespadelus vulturnus*	(0/0/1)
Unit 3 Hand-held during stag watch, spotlighting & call playback 18:00 – 21:15	10.04.08	Site 2	**Little bent-wing bat *Miniopterus australis***	(2/0/0)
			Nyctophilus sp.	(1/1/0)
			Eastern bent-wing bat *Miniopterus schreibersii oceanensis*	(0/3/0)
			Little forest bat *Vespadelus vulturnus*	(0/1/0)
			A freetail-bat *Mormopterus* sp. 2 (Adams *et al* 1988)	(0/0/1)
			Chocolate wattled bat *Chalinolobus morio* **or** little forest bat *Vespadelus vulturnus*	(0/0/1)
			Chocolate wattled bat *Chalinolobus morio* **or** *Vespadelus sp.*	(0/0/1)
			Gould's wattled bat *Chalinolobus gouldii* **or** *Mormopterus sp.*	(0/0/1)
			Gould's wattled bat *Chalinolobus gouldii* **or** A freetail-bat *Mormopterus* sp. 2 (Adams *et al* 1988)	(0/0/1)
Unit 2 Hand-held 17:45 – 18:10	10.04.08	Site 2	Gould's wattled bat *Chalinolobus gouldii*	(2/0/0)
			Little forest bat *Vespadelus vulturnus*	(1/0/0)
			Chocolate wattled bat *Chalinolobus morio*	(0/1/1)
Unit 2 Hand-held 18:20 – 18:45	10.04.08	Site 2	Chocolate wattled bat *Chalinolobus morio*	(0/0/1)

Appendix 4.2 continued

Detector number/type of recording *	Date	Location	Species	Number of passes (D/Pr/P) *
Unit 2 Hand-held during spotlight & call playback, then stationary overnight at 388970E 6362834N 19:50 – 06:30	10.04.08	Site 1	White-striped freetail-bat *Tadarida australis*	(6/0/0)
			Eastern bent-wing bat *Miniopterus schreibersii oceanensis* **or** large forest bat *Vespadelus darlingtoni*	(0/0/1)
			Gould's wattled bat *Chalinolobus gouldii* **or** *Mormopterus sp.*	(0/0/1)
Unit 3 Hand-held during spotlight	11.04.08	Site 2	Little forest bat *Vespadelus vulturnus*	(1/0/0)
			Little forest bat *Vespadelus vulturnus* **or** chocolate wattled bat *Chalinolobus morio*	(0/0/1)
			Vespadelus sp. **or** chocolate wattled bat *Chalinolobus morio*	(0/0/2)
Unit 2 stationary overnight at 401623E 6369988N 17:15 – 06:30	28.04.08	Site 3	Chocolate wattled bat *Chalinolobus morio*	(0/1/0)
Unit 2 stationary during call playback at 401792E 6370299N 17:30 – 19:40	29.04.08	Site 3	Little forest bat *Vespadelus vulturnus* **or** chocolate wattled bat *Chalinolobus morio*	(0/0/1)
Unit 2 stationary overnight at 401819E 6370260N 19:40 – 06:30	29.04.08	Site 3	No calls	-
Unit 4 stationary overnight at 406769E 6372331N 17:45 – 06:30	28.04.08	Site 4	Gould's wattled bat *Chalinolobus gouldii*	(0/0/1)
			Chocolate wattled bat *Chalinolobus morio* **or** eastern forest bat *Vespadelus pumilis*	(0/0/1)
			Little forest bat *Vespadelus vulturnus* **or** chocolate wattled bat *Chalinolobus morio*	(0/0/1)
Unit 4 stationary overnight at 406813E 6372177N 17:30 – 06:30	29.04.08	Site 4	Equipment malfunction (no calls)	-
Unit 3 hand-held during spotlighting 17:45 – 21:30	29.04.08	Site 4	Chocolate wattled bat *Chalinolobus morio*	(0/2/4)
			A freetail-bat *Mormopterus* sp. 2 (Adams *et al* 1988)	(0/0/1)
			Little forest bat *Vespadelus vulturnus* **or** chocolate wattled bat *Chalinolobus morio*	(0/0/1)

Appendix 4.2 continued

Detector number/type of recording *	Date	Location	Species	Number of passes (D/Pr/P) *
Unit 3 stationary during call playback at 406811E 6372267N 17:40 – 20:00	01.05.08	Site 4	**Little bent-wing bat *Miniopterus australis***	(1/0/0)
			Nyctophilus sp.	(1/2/0)
			Chocolate wattled bat *Chalinolobus morio*	(0/2/0)
			Little forest bat *Vespadelus vulturnus* **or** chocolate wattled bat *Chalinolobus morio*	(0/0/1)
			Vespadelus sp. **or** chocolate wattled bat *Chalinolobus morio*	(0/0/1)
Unit 3 hand-held during spotlighting 20:00 – 21:15	01.05.08	Site 4	Chocolate wattled bat *Chalinolobus morio*	(0/2/0)
Unit 2 stationary overnight at 406819E 6372256N 17:30 – 06:30	01.05.08	Site 4	**Little bent-wing bat *Miniopterus australis***	(3/0/0)
			Little forest bat *Vespadelus vulturnus*	(1/2/1)
			Chocolate wattled bat *Chalinolobus morio*	(0/3/2)
			Vespadelus sp. **or** chocolate wattled bat *Chalinolobus morio*	(0/0/3)
			Little forest bat *Vespadelus vulturnus* **or** chocolate wattled bat *Chalinolobus morio*	(0/0/1)

* reliability of call D = definite; Pr = probable; Po = possible

Appendix 4.3 Harp Trapping Results

Harp Trap No.	Location	Date/Time	Species	Sex	Notes
1	Site 2 394443E 6366458N	08/04/08	No captures	-	-
		09/04/08	No captures	-	-
2	Site 2 394403E 6366301N	08/04/08	*Chalinolobus morio* *Vespadelus vulturnus* *Nyctophilus geoffroyi*	F M F	forearm 37.05mm forearm 28.5mm -
		09/04/08	*Nyctophilus geoffroyi*	F	possible recapture
		10/04/08	*Nyctophilus gouldi*	F	-
		11/04/08	*Miniopterus australis*	F	-
3	Site 1 388958E 6362841N	08/04/08	No captures	-	(trap not set for night of 08/04/08)
		10/04/08	No captures	-	-
4	Site 1 388854E 6362955N	08/04/08	No captures	-	(trap not set for night of 08/04/08)
		10/04/08	No captures	-	-
5	Site 2 394156E 6366636N	10/04/08	No captures	-	-
		11/04/08	*Nyctophilus gouldi* *Nyctophilus gouldi*	F M	- -
6	Site 3 401626E 6369997N	29/04/08	No captures	-	-
		30/04/08	No captures	-	-
		01/05/08	*Vespadelus vulturnus*	M	Adult
		02/05/08	No captures	-	-
7	Site 3 401870E 6370318N	30/04/08	No captures	-	-
		01/05/08	*Chalinolobus morio*	-	Adult
		02/05/08	No captures	-	-
8	Site 4 406898E 6372899N	30/04/08	No captures	-	-
		01/05/08	*Miniopterus australis*	-	Adult
		02/05/08	No captures	-	-
9	Site 4 406877E 6372453N	30/04/08	No captures	-	-
		01/05/08	No captures	-	-
		02/05/08	No captures	-	-

Appendix 4.4 Spotlighting Results

Site	Date / Time	Species Recorded	No.	Obs. Type	Notes
2	08/04/08 19:00 – 21:40	*Limnodynastes dumerilii*	4	O/W	-
		Grey-headed flying-fox	5+	O	-
		Limnodynastes ornatus	2	O	-
		Litoria jervisiensis	10+	O/W	-
		Common brushtail possum	1	O	-
		Common ringtail possum	2	O	-
		Crinia signifera	2	O	-
		Echidna	1	F	Footprints
		Pseudophryne bibroni	2	W	Inundated melaleuca swamp
		Limnodynastes peronii	2	O	-
1	09/04/08 20:20 – 21:40	*Limnodynastes peronii*	8	O	-
		Pseudophryne bibroni	1	O	-
		Grey-headed flying-fox	5+	O/W	Feeding on banksias (*B. serrata*)
2	09/04/08 20:15 – 21:44	Common brushtail possum	3	O/W	-
		Grey-headed flying-fox	10	O/W	Flying over & in flowering banksias
		Limnodynastes dumerilii	1	O	-
		Limnodynastes peronii	2	O	-
		Swamp wallaby	1	W/P	Scat & heard hopping away
		Litoria jervisiensis	3	W	-
		Limnodynastes ornatus	1	O	-
		Diamond python	1	O	On branch in *Angophora costata*
		Squirrel glider	1	O	In *Allocasuarina littoralis*
		Feathertail glider	1	O	In *Allocasuarina littoralis*
		Litoria fallax	1	W	-
1	10/04/08 19:45 – 21:35	Grey-headed flying-fox	10+	O	-
		Macropod sp.	1	W	-
		Tadarida australis	1	W	-
		Squirrel glider	1	O	-
		Owlet nightjar	1	W	-
2	10/04/08 18:30 – 21:10	Grey-headed flying-fox	5+	O/W	-
		Common brushtail possum	3	O	-
		Crinia signifera	2	W	-
		Squirrel glider	2	O	In flowering melaleuca
		Limnodynastes ornatus	5	O	-
		Tadarida australis	1	W	-
2	11/04/08 19:00 – 20:00	Squirrel glider	3	O	-
		Owlet nightjar	1	W	-
		Grey-headed flying-fox	5+	O/W	-
3	28/04/08 18:00 – 18:30	Grey-headed flying-fox	7	O/W	
		Pseudophryne bibroni	3+	W	
		Squirrel glider	2	O	
		Petaurus sp.	1	O	Did not get a good look at it
		Swamp wallaby	1	F	Footprints
3	28/04/08 18:00 – 19:15	Grey-headed flying-fox	7+	O/W	
		Common ringtail possum	1	O	
		Common brushtail possum	2	O	
		Pseudophryne bibroni	3+	W	
		Crinia signifera	3+	W	

Appendix 4.4 continued

Site	Date / Time	Species Recorded	No.	Obs. Type	Notes
3	29/04/08 19:45 – 21:15	Squirrel glider	1	O	In *Angophora costata*
		Owlet nightjar	1	W	
		Swamp wallaby	1	W	
		Feathertail glider	3	O	In flowering swamp mahoganies
		Grey-headed flying-fox	10+	O/W	Near tree trap 1
		Pseudophryne bibroni	5+	W	Near tree trap 1
		Common brushtail possum	1	O	
4	29/04/08 19:35 – 21:20	*Litoria jervisiensis*	5+	W	Frog search at pond (406916E 6372018N)
		Limnodynastes peronii	5+	W	
		Pseudophryne bibroni	10+	W	
		Crinia signifera	10+	W	
		Grey-headed flying-fox	1	W	
4	29/04/08 20:20 – 21:25	Grey-headed flying-fox	1	O	
		Common ringtail possum	2	O	1 adult & 1 juvenile
		Feathertail glider	1	O	
		Common brushtail possum	1	O	
4	01/05/08 18:00 – 18:30	*Litoria jervisiensis*	5+	W	Frog search at pond (406916E 6372018N)
		Crinia signifera	5+	W	
		Limnodynastes peronii	5+	W	
		Pseudophryne bibroni	5+	W	
		Squirrel glider	1	O	
		Grey-headed flying-fox	3+	O/W	
		Horse	1	F	Prints
4	01/05/08 20:15 – 21:15	Deer	1	F	Prints
		Bandicoot species	1	W	Heard moving but no call
		Limnodynastes dumerilii grayi	1	O	
		Macropod species	1	W	Probably swamp wallaby

Appendix 4.5 Call Playback Results

Site	Date / Time	Call Played	Species Recorded	No.	Obs. Type	Notes
Week One						
1	09/04/08 19:00 – 20:10	Initial listen	Grey-headed flying-fox	10+	O/W	feeding in banksias (*Banksia serrata*); heard throughout survey
		Squirrel glider	-	-	-	-
		Bush stone-curlew	Oystercatcher?	1	W	flying over (heading towards beach)
		Koala	*Crinia signifera*	2	W	-
			Pseudophryne bibroni	6	W	heard throughout survey
		Powerful owl	-	-	-	-
		Masked owl	-	-	-	-
		Barking owl	-	-	-	-
		Sooty owl	-	-	-	-
		Final listen & spotlight	-	-	-	-
2	09/04/08 18:15 – 20:00	Initial listen	*Limnodynastes ornatus*	1	O	within 30m
			Limnodynastes peronii	3	O/W	within 10m
		Squirrel glider	Grey-headed flying-fox	1	O/W	within 50m
		Bush stone-curlew	Grey-headed flying-fox	5+	W	within 200m
		Koala	*Crinia signifera*	5+	W	within 200m to south
		Yellow-bellied glider	*Pseudophryne bibroni*	5+	W	within 200m to south
		Powerful owl	-	-	-	-
		Masked owl	-	-	-	-
		Barking owl	-	-	-	-
		Sooty owl	-	-	-	-
		Grass owl	-	-	-	-
		Final listen & spotlight	-	-	-	-
1	10/04/08 20:10 – 21:20	Initial listen	Grey-headed flying-fox	5+	W	heard throughout survey
		Squirrel glider	-	-	-	-
		Bush stone-curlew	*Crinia signifera*	1	W	-
		Koala	-	-	-	-
		Powerful owl	-	-	-	-
		Masked owl	-	-	-	-
		Barking owl	Owlet nightjar	1	W	-
		Sooty owl	-	-	-	-
		Final listen & spotlight	-	-	-	-
2	10/04/08 19:20 – 20:40	Initial listen	*Litoria jervisiensis*	2	W	-
		Squirrel glider	*Crinia signifera*	2	W	-
		Bush stone-curlew	Grey-headed flying-fox	10+	O/W	heard throughout survey
			Owlet-nightjar	1	W	-
		Koala	-	-	-	-
		Powerful owl	Owlet-nightjar	1	W	-
			Common brushtail possum	2	W	-
		Masked owl	-	-	-	-
		Barking owl	-	-	-	-
		Sooty owl	*Tadarida australis*	1	W	-
		Grass owl	-	-	-	-
		Final listen & spotlight	-	-	-	-

Appendix 4.5 continued

Site	Date / Time	Call Played	Species Recorded	No.	Obs. Type	Notes
Week Two						
3	29/04/08	Initial listen	Grey-headed flying-fox	8+	O/W	within 100m; heard throughout survey
	18:00 – 19:40	Squirrel glider				
		Bush stone-curlew				
		Koala				
		Powerful owl	Squirrel glider	1	O/W	within 50m in flowering *Banksia serrata*
		Masked owl	*Litoria jervisiensis*	1	W	
		Barking owl				
		Sooty owl				
		Grass owl				
		Final listen & spotlight				
3	01/05/08	Initial listen	Grey-headed flying-fox	2+	W	heard throughout survey
			Pseudophryne bibroni	5+	W	heard throughout survey
	21:35 – 22:55	Squirrel glider				
		Bush stone-curlew				
		Koala				
		Powerful owl				
		Masked owl				
		Barking owl				
		Sooty owl				
		Final listen & spotlight	Feathertail glider	1	O	in flowering swamp mahogany
			Dog	1	W	
4	29/04/08	Initial listen				
		Squirrel glider				
	17:50 – 19:30	Bush stone-curlew				
		Koala				
		Powerful owl				
		Masked owl	Powerful owl	1	W	heard calling approximately 500m east of call playback site
		Barking owl	(Powerful owl still calling)			
		Sooty owl				
		Grass owl				
		Final listen & spotlight				
4	01/05/08	Initial listen	*Pseudophryne bibroni*	2+	W	heard throughout survey
			Grey-headed flying-fox	2+	W	heard throughout survey
	18:30 – 20:00	Squirrel glider				
		Bush stone-curlew				
		Koala	*Litoria jervisiensis*	2	W	
		Powerful owl				
		Masked owl				
		Barking owl				
		Sooty owl				
		Grass owl				
		Final listen & spotlight	Macropod species	1	W	

Appendix 4.6 Herpetofauna Survey Results

Date / Time	Location	Species	No.	Obs. Type	Micro-habitat	Notes
Week One						
09/04/08 10:40 – 11:40	Site 2	*Lampropholis guichenoti*	19	O	IL	Adult
		Lampropholis guichenoti	2	O	IL	Sub-adult
		Lampropholis guichenoti	6	O	IL	Juvenile
		Lampropholis guichenoti	3	O	OL	Adult
		Lampropholis guichenoti	2	O	OL	Juvenile
		Lampropholis delicata	1	O	IL	Adult
		Lampropholis delicata	1	O	IL	Sub-adult
		Lampropholis delicata	2	O	IL	Juvenile
11/04/08 11:30 – 12:30	Site 1	*Ctenotus taeniolatus*	1	O	IL	Sub-adult
		Lampropholis guichenoti	2	O	IL	Adult & juvenile
		Ctenotus robustus	1	O	IL	Sub-adult
		Amphibolurus muricatus	2	O	IL	Sub-adult & juvenile
Week Two						
29/04/08 11:00 – 11:30	Site 3	*Lampropholis guichenoti*	1	O	-	-
		Crinia signifera	1	W	-	-
		Pseudophryne bibroni	1	W	-	-
02/05/08 11:00 – 13:00	Site 4	*Lampropholis guichenoti*	11	O	-	-
		Lampropholis delicata	5	O	-	-
		Ctenotus taeniolatus	1	O	-	-

Appendix 4.7 Diurnal Bird Survey Results

Date / Time	Location	Species	No.	Obs. Type	Notes
Week One					
09/04/08 07:15 – 07:35	Site 1 (within 2ha survey area)	Eastern spinebill	3	W	*Banksia serrata* flowering
		Brown thornbill	1	W	-
		Golden whistler	3	W	-
		White-cheeked honeyeater	3	W	-
		White-browed scrubwren	2	W	-
		Silvereye	5+	W	-
		Eastern whipbird	2	W	-
		Little wattlebird	1	W	-
		Grey shrike-thrush	1	W	-
		Red wattlebird	1	W	-
	Site 1 (outside 2ha survey area)	Australian raven	1	W	-
		Grey butcherbird	1	W	-
		Rainbow lorikeet	2	W	-
		Eastern whipbird	2	W	-

Appendix 4.7 - continued

Date / Time	Location	Species	No.	Obs. Type	Notes
09/04/08 09:45 – 10:05	Site 2 (within 2ha survey area)	Mistletoebird	1	W	*B. serrata* & *B. integrifolia*;
		Silvereye	8	O/W	- noise from jets
		Eastern whipbird	2	W	-
		Red wattlebird	2	W	-
		Little wattlebird	7	O/W	Microhabitat code: HS
		White-browed scrubwren	1	W	-
		Lewin's honeyeater	2	W	-
		White-cheeked honeyeater	5+	O/W	Microhabitat code: HS
		Black-faced cuckoo-shrike	3	O/W	Microhabitat code: HS, FL
		Eastern spinebill	2	W	-
		Eastern yellow robin	1	W	-
		Grey fantail	3	W	-
		Brown thornbill	3	W	-
		Grey butcherbird	1	O	Microhabitat code: FL
		Grey shrike-thrush	1	W	-
	Site 2 (outside 2ha survey area)	Australian raven	2	O/W	Microhabitat code: AC
		Australian magpie	1	O	Microhabitat code: AC
		Eastern whipbird	2	W	-
10/04/08 10:00 – 10:20	Site 1 (within 2ha survey area)	Eastern spinebill	2	W	*B. serrata* flowering
		Little wattlebird	2	W	-
		Variegated fairy-wren	2	O/W	Microhabitat code: LS
		Brown thornbill	1	O	Microhabitat code: LS
		White-browed scrubwren	1	O/W	Microhabitat code: LS
	Site 1 (outside 2ha survey area)	Red wattlebird	1	W	-
		Eastern whipbird	2	W	-
10/04/08 08:30 – 08:50	Site 2 (within 2ha survey area)	Silvereye	6	W	Banksias flowering
		Little wattlebird	5	W	- noise from motorbikes
		Black-faced cuckoo-shrike	1	W	-
		Yellow-faced honeyeater	4	W	-
		White-cheeked honeyeater	5	W	-
		Grey butcherbird	2	W	-
		Eastern whipbird	2	W	-
		Grey fantail	2	W	-
		Golden whistler	1	W	-
		Grey shrike-thrush	2	W	-
		Brown thornbill	1	W	-
		Red wattlebird	2	W	-
		Variegated fairy-wren	1	W	-
		White-browed scrubwren	1	W	-
	Site 2 (outside 2ha survey area)	Eastern whipbird	2	W	-
		Grey butcherbird	2	W	-
		Red wattlebird	1	W	-

Appendix4.7 continued

Date / Time	Location	Species	No.	Obs. Type	*Notes*
Week Two					
29/04/08 10:05 – 10:25	Site 3 (within 2ha survey area)	Yellow-faced honeyeater	4	W	Swamp mahogany flowering
		Eastern spinebill	3	O/W	
		White-cheeked honeyeater	3	W	
		Noisy friarbird	3	O/W	
		Little wattlebird	1	W	
		Grey fantail	1	W	
		Rainbow lorikeet	1	O	
		Variegated fairy-wren	1	W	
		Golden whistler	1	W	
		Brown thornbill	2	W	
	Site 3 (outside 2ha survey area)	Noisy friarbird	2	W	
01/05/08 09:45 – 10:05	Site 3 (within 2ha survey area)	Bar-shouldered dove	1	W	Swamp mahogany flowering
		White-cheeked honeyeater	3	W	
		Noisy friarbird	5+	O/W	
		Eastern spinebill	2	W	
		Silvereye	3	W	
		Brown thornbill	1	W	
		Grey shrike-thrush	2	W	
		Little wattlebird	2	W	
		Red wattlebird	1	W	
		Golden whistler	1	W	
		Rainbow lorikeet	3	O/W	
		Yellow-faced honeyeater	2	W	
		White-browed scrub-wren	1	W	
	Site 3 (outside 2ha survey area)	Noisy friarbird	1	W	
29/04/08 07:30 – 07:50	Site 4 (within 2ha survey area)	Yellow-faced honeyeater	5	W	
		White-cheeked honeyeater	3	W	
		Grey butcherbird	1	W	
		White-browed scrub-wren	2	W	
		Golden whistler	2	W	
		Noisy friarbird	1	W	
		Eastern spinebill	2	W	
		Silvereye	4	W	
		Black-faced cuckoo-shrike	2	O/W	
		Grey fantail	1	O	
		White-throated treecreeper	1	O	

Appendix 4.7 continued

Date / Time	Location	Species	No.	Obs. Type	Notes
01/05/08 08:05 – 08:25	Site 4 (within 2ha survey area)	Silvereye	5+	O/W	Swamp mahogany flowering
		Noisy friarbird	3	O/W	
		White-cheeked honeyeater	5+	O/W	
		Eastern spinebill	4	O/W	
		Yellow-faced honeyeater	10+	O/W	
		Variegated fairy-wren	5	O/W	
		Mistletoebird	1	W	
		White-browed scrub-wren	3	O/W	
		Brown thornbill	2	W	
		Brown-headed honeyeater	10+	W	
		Golden whistler	3	O/W	
		Red-browed finch	4	O/W	
		Grey fantail	1	W	
		Fantail cuckoo	1	W	
		Easter whipbird	2	W	
		White-throated treecreeper	2	O/W	
		Grey shrike-thrush	1	W	
		Common ringtail possum	1	E	Drey
		Swamp wallaby	1	F	Prints
	Site 4 (outside 2ha survey area)	Noisy friarbird	2	W	
		Yellow-faced honeyeater	3	W	
		Bar-shouldered dove	1	W	
		White-throated treecreeper	1	W	
		Grey shrike-thrush	1	W	

Appendix 5. Profiles of Threatened Fauna Species recorded within or near the Worimi Conservation Lands

The following profiles are based on those available on the DECC website. Local information is based on the results of this survey, including the literature review, and the local knowledge of the species by the author of this report (Ray Williams).

MAMMALS

Squirrel Glider

Scientific name: *Petaurus norfolcensis*
Conservation status in NSW: Vulnerable

Distribution

This species is widely though sparsely distributed in the coast and ranges of eastern Australia, from northern Queensland to western Victoria. Coastal populations are absent south of Sydney.

Habitat and ecology

- Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.
- Prefers mixed species stands with a shrub or Acacia midstorey.
- Live in family groups of a single adult male one or more adult females and offspring.
- Require abundant tree hollows for refuge and nest sites.
- Diet varies seasonally and consists of Acacia gum, eucalypt sap, nectar, honeydew and manna, with invertebrates and pollen providing protein.

Regional information

The Squirrel Glider is known or predicted to occur in 17 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. A variety of habitats are utilised, including dry and wet sclerophyll forests, forested wetlands, grassy woodlands and heathlands.

Habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Trees with hollows > 5 cm diameter in eucalypt forests and woodlands
Foraging habitat	Forest or woodland with diverse understorey
Shelter/roosting/refuge habitat	n/a
Time of year species identifiable (if flora) or best detected (if fauna)	all year. Nocturnal

Local Information

The squirrel glider is locally common and widespread through the Port Stephens LGA. It is particularly common within the coastal forests including the Coastal Sand Apple-Blackbutt Forest and Swamp Mahogany-Paperbark Swamp Forest vegetation communities of the WCL. It is predicted that this species occurs within all forested parts of the WCL as it was recorded at all survey sites and during other surveys within or near the WCL boundaries. The monitoring of nest boxes erected by Energy Australia along the powerline easement within the WCL showed a high level of usage by gliders with 81 of 130 glider boxes showing signs of nest material and seven glider families identified (Hollow Log Homes, March 2008).

Threats

- Loss and fragmentation of habitat.
- Loss of hollow-bearing trees.
- Loss of flowering understorey and midstorey shrubs in forests.
- Individuals can get caught in barbed wire fences while gliding.
- Predation by foxes and cats if forced to travel on the ground as a result of habitat loss.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified five strategies to help recover the Squirrel Glider in New South Wales. These include habitat management (see below), the preparation of a recovery plan, surveys, mapping and habitat assessment.

What needs to be done to recover this species?

- Retain den trees and recruitment trees (future hollow-bearing trees).
- Retain food resources, particularly sap-feeding trees and understorey feed species such as Acacias and banksias.
- Replace top one or two strands of barbed wire on fences with regular wire in and adjacent to habitat.
- Retain and protect areas of habitat, particularly mature or oldgrowth forest containing hollow-bearing trees and sap-feeding trees.
- In urban and rural areas retain and rehabilitate habitat to maintain or increase the total area of habitat available, reduce edge effects, minimise foraging distances and increase the types of resources available.

References

- Davy S. (1984). Habitat preferences of arboreal marsupials within a coastal forest in southern NSW. Possums and Gliders (ed. A.P. Smith and I.D. Hume): 509-16. Surrey Beatty and Sons, Sydney.
- Menkhorst, P. and Knight, F. (2001). A Field Guide to the Mammals of Australia. Oxford Uni Press, Melbourne.
- Suckling G.C. 1995 Squirrel Glider in R Strahan (Ed.) The Mammals of Australia. Pp234-235. Reed Books, Chatswood.

Brush-tailed Phascogale

Scientific name: *Phascogale tapoatafa*
Conservation status in NSW: Vulnerable

Distribution

The Brush-tailed Phascogale has a patchy distribution around the coast of Australia. In NSW it is more frequently found in forest on the Great Dividing Range in the north-east and south-east of the State. There are also a few records from central NSW.

Habitat and ecology

- Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter.
- Also inhabit heath, swamps, rainforest and wet sclerophyll forest.
- Agile climber foraging preferentially in rough barked trees of 25 cm DBH or greater..
- Feeds mostly on arthropods but will also eat other invertebrates, nectar and sometimes small vertebrates.
- Females have exclusive territories of approximately 20 - 60 ha, while males have overlapping territories of up to 100 ha.
- Nest and shelter in tree hollows with entrances 2.5 - 4 cm wide and use many different hollows over a short time span.
- Mating occurs May - July; males die soon after the mating season whereas females can live for up to three years but generally only produce one litter.

Regional information

The brush-tailed phascogale is known to occur in 10 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. Most recent records are from north of the Hunter River. A variety of habitats are utilised, including dry and wet sclerophyll forests, forested and freshwater wetlands, grassy woodlands, grassland and rainforests.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Hollow trees or hollow stumps
Foraging habitat	Forages on trees
Shelter/roosting/refuge habitat	Hollow trees or hollow stumps
Time of year species identifiable (if flora) or best detected (if fauna)	All year

Local Information

The brush-tailed phascogale appears to be now rare in the Tillegerry Peninsula with only one DECC Wildlife Atlas record from within or near the WCL at Bobs Farm in 1986. Interestingly the nest box report for Energy Australia (Hollow Log Homes, 2008) reported shredded bark nest material in three boxes near Boyces Track and it was suggested that it may have been the work of the brush-tailed phascogale. There are some fairly recent records (2005) from the Tomago Sandbeds therefore this species could still well occur within WCL.

Threats

- Loss and fragmentation of habitat.
- Loss of hollow-bearing trees.
- Predation by foxes and cats.
- Competition for nesting hollows with the introduced honeybee.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified six strategies to help recover the brush-tailed phascogale in New South Wales. These include increased community awareness relating to cat control, habitat management with regards to predator control, fire and planning issues, monitoring known populations and research into the effect of hazard reduction fires on the species.

What needs to be done to recover this species?

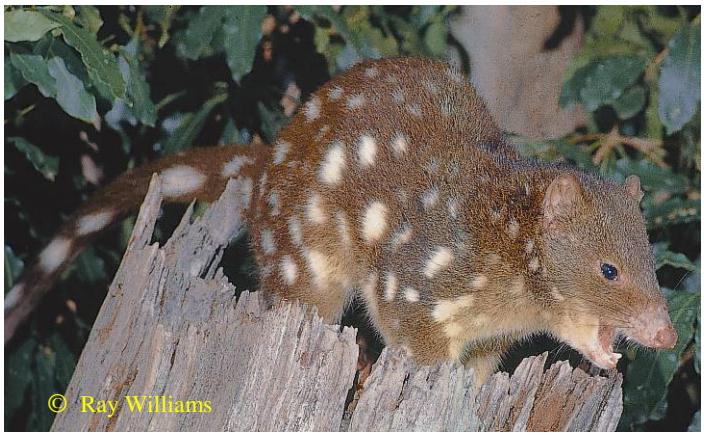
- Undertake fox and feral cat control.
- Provide nest boxes in areas where tree-hollows have been removed.
- Retain and protect habitat, particularly mature or oldgrowth forest containing hollow-bearing trees.
- Retain nest trees and recruitment trees (future hollow-bearing trees).

References

- Menkhorst P.W. (1995). Brush-tailed Phascogale in The Mammals of Victoria - Distribution, Ecology and Conservation. Oxford University Press, Australia.
- Menkhorst, P. and Knight, F. (2001). A Field Guide to the Mammals of Australia. Oxford Uni Press, Melbourne.
- Sodderquist T. (1995) Brush-tailed Phascogale, in Strahan, R.(ed.), The Australian Museum Complete Book of Australian Mammals. Angus & Robertson, Sydney.

Spotted-tailed Quoll

Scientific name: *Dasyurus maculatus*
Conservation status in NSW: Vulnerable
National conservation status: Endangered



Distribution

The range of the Spotted-tailed Quoll has contracted considerably since European settlement. It is now found on the east coast of NSW, Tasmania, eastern Victoria and north-eastern Queensland. Only in Tasmania is it still considered common.

Habitat and ecology

- Recorded across a range of habitat types, including rainforest, open forest, woodland, coastal heath and inland riparian forest, from the sub-alpine zone to the coastline.
- Individual animals use hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites.
- Mostly nocturnal, although will hunt during the day; spends most of the time on the ground, although also an excellent climber and may raid possum and glider dens and prey on roosting birds.
- Use 'latrine sites', often on flat rocks among boulder fields and rocky cliff-faces; these may be visited by a number of individuals; latrine sites can be recognised by the accumulation of the sometimes characteristic 'twisty-shaped' faeces deposited by animals.
- Consumes a variety of prey, including gliders, possums, small wallabies, rats, birds, bandicoots, rabbits and insects; also eats carrion and takes domestic fowl.
- Females occupy home ranges up to about 750 hectares and males up to 3500 hectares; usually traverse their ranges along densely vegetated creeklines.
- Average litter size is five; both sexes mature at about one year of age.

Regional Information

The spotted-tailed quoll is known to occur in 18 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. A variety of habitats are utilised, including dry and wet sclerophyll forests, forested wetlands, grassy woodlands, heathland and rainforests. The species is most likely to be found in the larger expanses of forest where it may be locally common, although in general it is rarely observed.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Hollow-bearing trees, fallen logs, burrows, small caves, rock crevices, boulder-fields and rocky-cliff faces
Foraging habitat	As per vegetation type
Shelter/roosting/refuge habitat	as per breeding habitat
Time of year species identifiable (if flora) or best detected (if fauna)	All year

Local Information

The spotted-tailed quoll is infrequently recorded within the locality and recent records are few in number. The most recent and nearest record found is from near Fenningham's Island just to the north of the WCL over the period 2004-06 (Wildlife Atlas). There are also several records from the Tomago Sandbeds, including near Salt Ash in 2001 (Ecotone 2001) as well as the Tilligerry Peninsula and Anna Bay. Therefore, the larger patches of bushland of the local region, including the WCL and Tomaree National Park, still have the potential to support populations of this secretive species.

Threats

- Loss, fragmentation and degradation of habitat.
- Accidental poisoning during wild dog and fox control programs. Deliberate poisoning, shooting and trapping may also be an issue.
- Competition with introduced predators such as cats and foxes.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified eleven strategies to help recover the spotted-tailed quoll in New South Wales. Most relevant to the local area are liaison with the local aboriginal community with regards to any conservation programs; increased community awareness and education relating to predation on poultry and the habitat requirements of the species; co-ordinate recovery and threat abatement programs; habitat management with regards to predator control, fire, protective road fencing and planning issues; monitoring known populations and research into the effect of identified impacts on the species.

What needs to be done to recover this species?

- Consult with DEC if Spotted-tailed Quolls are raiding poultry, rather than taking direct action.
- Undertake cat and fox control using poison-baiting techniques least likely to affect quolls.
- Consult with DEC if any poison baiting is to be conducted in and immediately adjacent to areas where Spotted-tailed Quolls are known or likely to occur.
- Retain and protect large, forested areas with hollow logs and rocky outcrops, particularly areas with thick understorey or dense vegetation along drainage lines.

References

- Edgar R. and Belcher C. (1995). Spotted-tailed Quoll (pp. 67-8) in Strahan, R. (ed.), The Australian Museum Complete Book of Australian Mammals. Angus & Robertson, Sydney.
- Menkhorst, P. and Knight, F. (2001). A Field Guide to the Mammals of Australia. Oxford Uni Press, Melbourne.

Koala

Scientific name: *Phascolarctos cinereus*
Conservation status in NSW: Vulnerable

Distribution
The Koala has a fragmented distribution throughout eastern Australia from north-east Queensland to the Eyre Peninsula in South Australia. In NSW it mainly occurs on the central and north coasts with some populations in the western region. It was historically abundant on the south coast of NSW, but now occurs in sparse and possibly disjunct populations. Koalas are also known from several sites on the southern tablelands.

Habitat and ecology

- Inhabit eucalypt woodlands and forests.
- Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species.
- Inactive for most of the day, feeding and moving mostly at night.
- Spend most of their time in trees, but will descend and traverse open ground to move between trees.
- Home range size varies with quality of habitat, ranging from less than two ha to several hundred hectares in size.
- Generally solitary, but have complex social hierarchies based on a dominant male with a territory overlapping several females and sub-ordinate males on the periphery.
- Females breed at two years of age and produce one young per year.

Regional Information

The koala is known to occur in 18 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. A variety of habitats are utilised, including dry and wet sclerophyll forests, forested wetlands, grassy woodlands and heathland. Although occurring over a wide area of the region and may be locally common, populations are scattered and the species is absent or very rare in many areas.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Eucalypt forests and woodlands
Foraging habitat	Eucalypt forests and woodlands
Shelter/roosting/refuge habitat	Eucalypt forests and woodlands
Time of year species identifiable (if flora) or best detected (if fauna)	all year

Local Information

The koala is widespread and locally common within Port Stephens LGA and it is the subject of the Port Stephens Comprehensive Koala Plan of Management (CKPoM). The koala was not recorded during the 2008 survey of the WCL however scattered records do occur, particularly east of Lavis Lane. The dominant vegetation type within the WCL, blackbutt/banksia woodland/forest is classed as supplementary koala habitat in the CKPoM and therefore koala populations are expected to be small, with individuals most likely to occur near the swales containing swamp mahogany/paperbark vegetation. There is some linkage between

the eastern end of the WCL and known habitat at Anna Bay across Gan Gan Road and through remnant trees between Nelson Bay Road and the sand dunes.

Recovery Strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified sixteen strategies to help recover the koala in New South Wales. The koala population in the Port Stephens LGA is the subject of a Comprehensive Koala Plan of Management (CKPoM) and therefore many of the priority actions have already been addressed. An additional action is the liaison with the local aboriginal community with regards to the cultural significance of the koala.

What needs to be done to recover this species?

- Undertake feral predator control.
- Apply low intensity, mosaic pattern fuel reduction burns in or adjacent to Koala habitat.
- Retain suitable habitat, especially areas dominated by preferred feed-tree species.
- Protect populations close to urban areas from attacks by domestic dogs.
- Identify road-kill blackspots and erect warning signs, reduce speed limits or provide safe crossing points to reduce Koala fatalities.
- Revegetate with suitable feed tree species and develop habitat corridors between populations.

References

- Martin R.W. and Handasyde K.A. (1995). Koala (pp. 196-8) in Strahan, R.(ed.), The Australian Museum Complete Book of Australian Mammals. Angus & Robertson, Sydney.
- Martin, R. & Handasyde, K. 1999. The Koala: natural history, conservation and management. University of New South Wales Press Ltd, Sydney.
- Menkhorst P.W. (1995). Koala (pp.85-8) in The Mammals of Victoria - Distribution, Ecology and Conservation. Oxford University Press, Australia.
- Menkhorst, P. and Knight, F. (2001). A Field Guide to the Mammals of Australia. Oxford Uni Press, Melbourne.
- NSW National Parks and Wildlife Service (2003) Draft Recovery Plan for the Koala (Phascolarctos cinereus). NSW NPWS, Sydney.
- Reed, P.C., Lunney, D. and Walker, P. 1990. A 1986-1987 survey of the koala Phascolarctos cinereus (Goldfuss) in New South Wales and an ecological interpretation of its distribution. In Biology of the Koala. Lee, A.K., Handasyde, K.A. and Sanson, G.D.

Grey-headed Flying-fox

Scientific name: *Pteropus poliocephalus*
Conservation status in NSW: Vulnerable
National conservation status: Vulnerable

Distribution
Grey-headed Flying-foxes are found within 200 km of the eastern coast of Australia, from Bundaberg in Queensland to Melbourne in Victoria.

Habitat and ecology

- Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.
- Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy.
- Individual camps may have tens of thousands of animals and are used for mating, birth and the rearing of young.
- Annual mating commences in January and a single young is born each October or November.
- Site fidelity to camps is high with some caps being used for over a century.
- Travel up to 50 km to forage.
- Feed on the nectar and pollen of native trees, in particular Eucalyptus, Melaleuca and Banksia, and fruits of rainforest trees and vines.
- Also forage in cultivated gardens and fruit crops and can inflict severe crop damage.

Regional Information

The grey-headed flying-fox is known to occur in 18 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. A variety of habitats are utilised as seasonal foraging habitat during the peak flowering or fruiting periods of trees and shrubs. Permanent or seasonal roost camps are scattered through the region with regular maternity camps known to occur at Blackbutt Reserve near Newcastle, Wingham near Taree, Singleton and Matcham on the Central Coast.

Habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Canopy trees associated with rainforest, or coastal scrub or riparian or estuarine communities and with sufficient forage resources available within 40km.
Foraging habitat	As per vegetation type
Shelter/roosting/refuge habitat	Patches of forest with canopy trees within 40 kilometres of forage resource. Or camps listed in the roosting database on the profiles.
Time of year species identifiable (if flora) or best detected (if fauna)	When forage habitat fruiting and/or flowering. Look in known camps.

Local Information

The grey-headed flying-fox is a common species within the local area and is expected to use the whole of the forested parts of the WCL as a foraging area, particularly during the flowering season of the eucalypts and banksias. No camp sites are known from within the WCL however temporary camps are known from Moffats Swamp Nature Reserve at Medowie, Fullerton Cove and also near Anna Bay to the north of Nelson Bay Road. The permanent camp at Blackbutt Reserve is also within flying range of the WCL.

Threats

- Loss of foraging habitat.
- Disturbance of roosting sites.
- Unregulated shooting.
- Electrocution on powerlines.
- Entanglement in crop protection netting.
- Entanglement in barbed wire fencing.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified ten strategies to help recover the grey-headed flying-fox in New South Wales. These include:

- Community liaison/awareness/ education with regards to the requirements of the species as well as the threats posed by barbed wire fencing and backyard fruit tree netting.
- Roost camp management, particularly where conflicts with the community occurs.
- Habitat management to enhance and sustain vegetation in key roost camps, for example maternity roosts.
- Habitat protection/restoration on private and public lands to increase and enhance foraging and roosting habitat.
- Monitor damage to fruit crops in the region.
- Research into a range of subjects including crop damage and protection, the effect of culling in orchards, breeding biology and ecology.
- Survey/mapping and habitat assessment to record areas of crop damage, map available foraging habitat and maintain the database of camp localities.

What needs to be done to recover this species?

- Protect roost sites, particularly avoid disturbance September through November.
- Identify and protect key foraging areas.
- Manage and enforce licensed shooting.
- Investigate and promote alternative non-lethal crop protection mechanisms.
- Identify powerline blackspots and implement measures to reduce deaths.

References

- Churchill, S. (1998) Australian Bats. New Holland, Sydney.
- Conder, P. (1994). With Wings on their Fingers. Angus and Robertson, Sydney.
- Hall, L. and Richards, G. (2000). Flying Foxes; fruit and blossom bats of Australia. UNSW Press, Sydney.
- NSW Scientific Committee (2001) Grey-headed flying fox - Vulnerable species determination - final. DEC (NSW), Sydney.
- Tidemann, C.R. (1995). Grey-headed Flying-fox *Pteropus poliocephalus* Temminck, 1925. In The Australian Museum Complete Book of Australian Mammals. Strahan, R. (ed.) Reed Books, Sydney.

Little Bent-wing bat

Scientific name: *Miniopterus australis*
Conservation status in NSW: Vulnerable

Distribution
Coastal north-eastern NSW and eastern Queensland.

Habitat and ecology

- Moist eucalypt forest, rainforest or dense coastal banksia scrub.
- Little Bentwing-bats roost in caves, tunnels and sometimes tree hollows during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats.
- They often share roosting sites with the Eastern Bentwing-bat and, in winter, the two species may form mixed clusters.
- In NSW the largest maternity colony is in close association with a large maternity colony of eastern bent-wing bats (*M. schreibersii oceanensis*) and appears to depend on the large colony to provide the high temperatures needed to rear its young.

Regional Information
The little bent-wing bat is known to occur in 10 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. A variety of habitats are utilised, including dry and wet sclerophyll forests, forested and freshwater wetlands, grassy woodlands, grassland, heathland and rainforests.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Caves
Foraging habitat	As per vegetation type
Shelter/roosting/refuge habitat	Caves, tunnels or tree hollows
Time of year species identifiable (if flora) or best detected (if fauna)	mid spring to mid autumn, although known to be active all year on the coast

Local Information

This species is commonly recorded in the local region and was recorded at Sites 2 and 4 in the WCL during this survey. It is expected to forage within most of the forested parts of the WCL. No roost sites have been identified within the WCL and the nearest known roost sites are in Balickera Tunnel near Grahamstown Dam, where up to 15,000 bats have been recorded and a sea cave at Yacaaba Head at the mouth of Port Stephens. Another roost may occur in sea caves near Anna Bay/Boat Harbour as little bent-wing bats have been recorded foraging at dusk in this area (Ecotone records).

Threats

- Disturbance of colonies, especially in nursery or hibernating caves may be catastrophic.
- Destruction of caves that provide seasonal or potential roosting sites.
- Changes to habitat, especially surrounding maternity caves.
- Use of pesticides.

Recovery Strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified eleven strategies to help recover the little bent-wing bat in New South Wales. However, as they revolve around the protection of roost sites, particularly maternity caves, none are relevant to the WCL.

What needs to be done to recover this species?

- Retain stands of native vegetation.
- Reduce use of pesticides.
- Protect known roosting and nursery sites and surrounding forest.
- Check with DEC before undertaking recreational caving activities.

References

- Churchill, S. (1998) Australian Bats. New Holland, Sydney.
- NPWS (2000). Threatened Species of the Lower North Coast of New South Wales. NPWS, Sydney.
- NPWS (2002). Threatened Species of the Upper North Coast of NSW: Fauna. NPWS, Coffs Harbour

Eastern Bentwing-bat

Scientific name: *Miniopterus schreibersii oceanensis*
Conservation status in NSW: Vulnerable

Distribution

Eastern bent-wing bats occur along the east coast and ranges of Australia.

Habitat and ecology

- Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other man-made structures.
- Form discrete populations centred on a maternity cave that is used annually in spring and summer for the birth and rearing of young.
- Maternity caves have very specific temperature and humidity regimes.
- At other times of the year, populations disperse within about 300 km range of maternity caves.
- Cold caves are used for hibernation in southern Australia.
- Breeding or roosting colonies can number from 100 to 150,000 individuals.
- Hunt in forested areas, catching moths and other flying insects above the tree tops.

Regional Information

The eastern bent-wing bat is known to occur in 15 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. A variety of habitats are utilised, including dry and wet sclerophyll forests, forested and freshwater wetlands, grassy woodlands, heathland and rainforests.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Caves
Foraging habitat	As per vegetation type
Shelter/roosting/refuge habitat	Roost in caves; will also use derelict mines, storm-water tunnels, buildings or other man-made structures.
Time of year species identifiable (if flora) or best detected (if fauna)	Hibernate from June to August at high altitudes. Active all year on the coast

Local Information

This species is commonly recorded in the local region and was recorded at Sites 2 in the WCL during this survey. It is expected to forage within most of the forested parts of the WCL. No roost sites have been identified within the WCL and the nearest known roost sites are in Balickera Tunnel near Grahamstown Dam, where up to 1,000 eastern bent-wing bats have been recorded and a sea cave at Yacaaba Head at the mouth of Port Stephens (Ecotone records).

Threats

- Damage to or disturbance of roosting caves, particularly during winter or breeding.
- Loss of foraging habitat.
- Application of pesticides in or adjacent to foraging areas.
- Predation by feral cats and foxes.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified ten strategies to help recover the eastern bent-wing bat in New South Wales. However, as they revolve around the protection of roost sites, particularly maternity caves, none are relevant to the WCL.

What needs to be done to recover this species?

- Control foxes and feral cats around roosting sites, particularly maternity caves.
- Retain native vegetation around roost sites, particularly within 300 m of maternity caves.
- Minimise the use of pesticides in foraging areas.
- Protect roosting sites from damage or disturbance.

References

- Churchill, S. (1998) Australian Bats. New Holland, Sydney.
- Dwyer, P.D. (1995., Common Bent-wing Bat in Strahan, R.(ed.), The Australian Museum Complete Book of Australian Mammals. Angus & Robertson, Sydney.

Greater Broad-nosed Bat

Scientific name: *Scoteanax rueppellii*
Conservation status in NSW: Vulnerable

Distribution

The greater broad-nosed bat is found mainly in the gullies and river systems that drain the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland. It extends to the coast over much of its range. In NSW it is widespread on the New England Tablelands, however does not occur at altitudes above 500 m.

Habitat and ecology

- Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest.
- Although this species usually roosts in tree hollows, it has also been found in buildings.
- Forages after sunset, flying slowly and directly along creek and river corridors at an altitude of 3 - 6 m.
- Open woodland habitat and dry open forest suits the direct flight of this species as it searches for beetles and other large, slow-flying insects; this species has been known to eat other bat species.
- Little is known of its reproductive cycle, however a single young is born in January; prior to birth, females congregate at maternity sites located in suitable trees, where they appear to exclude males during the birth and raising of the single young.

Regional Information

The greater broad-nosed bat is known to occur in 13 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. A variety of habitats are utilised, including dry and wet sclerophyll forests, forested wetlands, grassy woodlands, heathland and rainforests.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Likely to be as per roosting habitat
Foraging habitat	As per vegetation type
Shelter/roosting/refuge habitat	Live or dead hollow-bearing trees, under exfoliating bark, or buildings
Time of year species identifiable (if flora) or best detected (if fauna)	mid spring to mid autumn

Local Information

The greater broad-nosed bat appears to be uncommon within the local area but has been recorded close to the boundaries of the WCL. Much of the forested part of the WCL appears to be suitable as foraging and roosting habitat for this species, with hollow bearing trees commonly occurring, particularly east of Lavis Lane.

Threats

- Disturbance to roosting and summer breeding sites.
- Foraging habitats are being cleared for residential and agricultural developments, including clearing by residents within rural subdivisions.
- Loss of hollow-bearing trees.
- Pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individuals' fat stores.
- Changes to water regimes are likely to impact food resources, as is the use of pesticides and herbicides near waterways.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified six strategies to help recover the Greater Broad-nosed Bat in New South Wales. These include:

- Community liaison/awareness/ education with regards to the requirements of the species as well as the threats posed by the removal of large hollow bearing trees.
- Habitat management for the retention of hollow bearing trees through EIA guidelines, PVP assessments and other planning instruments.
- Habitat protection by promoting the conservation of high conservation lands such as old growth forest.
- Research into a range of subjects including habitat management, breeding biology and ecology.
- Survey/mapping and habitat assessment to identify land that has a high density of large hollow bearing trees.

What needs to be done to recover this species?

- Raise landowners' awareness of the presence of this species, and provide information on how their management actions will affect the species' survival.
- Actively encourage the conservation of the riparian vegetation and water quality of streams and rivers.
- DEC should be consulted when planning development/s to minimise impact/s on populations.
- Conduct searches for the species in suitable habitat in proposed development areas.
- Retain stands of native vegetation, especially those with hollow-bearing trees (including dead trees), and retain other structures containing bats.
- Retain a buffer of vegetation around roost sites in vegetated areas.
- Protect hollow-bearing trees for breeding sites, including those on farmland; younger mature trees should also be retained to provide replacements for the older trees as they die and fall over.
- Reduce the use of pesticides in the environment and enter known sites of this species and its potential habitat onto maps used for planned poison spraying activities.
- Encourage regeneration and replanting of local flora species to maintain bat foraging habitat.
- Assess the site's importance to the species' survival, including linkages provided between ecological resources across the broader landscape.

References

- Churchill, S. (1998) Australian Bats. New Holland, Sydney.
- Hoye, G.A and Richards, G.C. (1995). Greater Broad-nosed Bat. Pp 527-528. In: Strahan, R. Editor. The Australian Museum Complete Book of Australian Mammals. Angus and Robertson, Sydney.
- McKean, J.L. (1966). Some new distributional records of broad-nosed bats (Nycticeius spp.). Vic. Nat. 83:25-30.
- Menkhorst, P. and Knight, F. (2001). A Field Guide to the Mammals of Australia. Oxford Uni Press, Melbourne.
- Woodside, D.P. and Long, A. (1984). Observation on the feeding habits of the Greater Board-nosed Bat, *Nycticeius rueppellii* (Chiroptera: Vespertilionidae). Aust. Mammal. 7:121-129

East-coast Freetail-bat

Scientific name: *Mormopterus norfolkensis*
Conservation status in NSW: Vulnerable

Distribution

The east-coast freetail-bat is found along the east coast from south Queensland to southern NSW.

Habitat and ecology

- Occur in dry sclerophyll forest and woodland east of the Great Dividing Range.
- Roost mainly in tree hollows but will also roost under bark or in man-made structures.
- Often solitary but large colonies of up to 50 individuals have been reported.

Regional Information

The greater broad-nosed bat is known to occur in 11 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. A variety of habitats are utilised, including dry and wet sclerophyll forests, forested wetlands, grassy woodlands, grassland, heathland and rainforests. However, more open environments appear to be preferred (Ecotone records).

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Hollows in dead or alive trees, roofs of buildings
Foraging habitat	As per vegetation type
Shelter/roosting/refuge habitat	Roost in tree hollows; also use loose bark or man-made structures.
Time of year species identifiable (if flora) or best detected (if fauna)	all year

Local Information

The east-coast freetail bat appears to be uncommon within the local area but although not recorded during these latest surveys, it has previously been recorded within and close to the boundaries of the WCL. Much of the forested part of the WCL appears to be suitable as foraging and roosting habitat for this species, with hollow bearing trees commonly occurring, particularly east of Lavis Lane.

Threats

- Loss of hollow-bearing trees.
- Loss of foraging habitat.
- Application of pesticides in or adjacent to foraging areas.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified six strategies to help recover the Greater Broad-nosed Bat in New South Wales. These include:

- Community liaison/awareness/ education with regards to the requirements of the species as well as the threats posed by the removal of large hollow bearing trees.
- Habitat management for the retention of hollow bearing trees through EIA guidelines, PVP assessments and other planning instruments.
- Habitat protection by promoting the conservation of high conservation lands such as old growth forest.
- Research into a range of subjects including habitat management, breeding biology and ecology.
- Survey/mapping and habitat assessment to identify land that has a high density of large hollow bearing trees.

What needs to be done to recover this species?

- Retain hollow-bearing trees and provide for hollow tree recruitment.
- Retain foraging habitat.
- Minimise the use of pesticides in foraging areas.

References

- Allison, F.R. and Hoye, G.A. (1995). (pp. 484-5) Eastern Freetail-bat in The Australian Museum Complete Book of Australian Mammals. Strahan, R. (ed.). Reed Books, Sydney.
- Churchill, S. (1998) Australian Bats. New Holland, Sydney.
- Menkhorst, P. and Knight, F. (2001). A Field Guide to the Mammals of Australia. Oxford Uni Press, Melbourne.

BIRDS

Grey-crowned Babbler

Scientific name: *Pomatostomus temporalis temporalis*
Conservation status in NSW: Vulnerable

Distribution

The Grey-crowned Babbler is found throughout large parts of northern Australia and in south-eastern Australia. In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Hay. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. It may be extinct in the southern, central and New England tablelands.

Habitat and Ecology

- Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains.
- Flight is laborious so birds prefer to hop to the top of a tree and glide down to the next one. Birds are generally unable to cross large open areas.
- Live in family groups that consist of a breeding pair and young from previous breeding seasons. A group may consist of up to fifteen birds. All members of the family group remain close to each other when foraging. A soft 'chuck' call is made by all birds as a way of keeping in contact with other group members.
- Feed on invertebrates, either by foraging on the trunks and branches of eucalypts and other woodland trees or on the ground, digging and probing amongst litter and tussock grasses.
- Build and maintain several conspicuous, dome-shaped stick nests about the size of a football. A nest is used as a dormitory for roosting each night. Nests are usually located in shrubs or sapling eucalypts, although they may be built in the outermost leaves of low branches of large eucalypts. Nests are maintained year round, and old nests are often dismantled to build new ones.
- Breed between July and February. Usually two to three eggs are laid and incubated by the female. During incubation, the adult male and several helpers in the group may feed the female as she sits on the nest. Young birds are fed by all other members of the group.
- Territories range from one to fifty hectares (usually around ten hectares) and are defended all year. Territorial disputes with neighbouring groups are frequent and may last up to several hours, with much calling, chasing and occasional fighting.

Regional information

The grey-crowned babbler is known to occur in 11 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. A variety of habitats are utilised, including dry and wet grassy/shrubby sclerophyll forests, grassy woodlands and heathland.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
	As per vegetation type
Foraging habitat	As per vegetation type
Shelter/roosting/refuge habitat	As per vegetation type
Time of year species identifiable (if flora) or best detected (if fauna)	All year. Sedentary, but may be local movements in dry years. Gregarious, noisy and active. Move in small groups.

Local Information

The grey-crowned babbler appears to be rare in the local region with only one old record found for the study locality, within the WCL in the vicinity of Boyces Track in 1978. A group of up to five babblers have been observed on regular occasions at Medowie, approximately 10 kilometres from the WCL (Ray Williams pers. obs.). Whether this species still occurs within the WCL is unclear.

Threats

- Clearing of woodland remnants.
- Heavy grazing and removal of coarse, woody debris within woodland remnants.
- Nest predation by species such as ravens and butcherbirds may be an issue in some regions where populations are small and fragmented.

Recovery strategies

- Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified six strategies to help recover the grey-crowned babbler (eastern subspecies) in New South Wales. These include:
- Community liaison/awareness/ education with regards to conservation management assessments of grassy woodland habitat.
- Protocols and guidelines for the management and enhancement of habitat for woodland birds.
- Habitat management in public lands where the species is known to occur.
- Habitat rehabilitation/restoration and/or regeneration of key areas of habitat identified for protection.
- Research into the ecology of the species, particularly its resource and habitat requirements.
- Survey/mapping and habitat assessment to identify key breeding and foraging habitat and assess the current conservation status of the species.

What needs to be done to recover this species?

- Retain existing woodland vegetation.
- Retain dead timber on the ground in open woodland areas.
- Encourage regeneration of habitat by fencing remnant stands.
- Increase the size of existing remnants, planting trees and establishing buffer zones of unimproved uncultivated pasture around woodland remnants.

References

- Garnett, S. and Crowley, G. M. (2000). The Action Plan for Australian Birds. Published by Environment Australia. Canberra, ACT.
- Higgins, P. J. and Peter, J. M. (eds) (2002). 'Handbook of Australian, New Zealand and Antarctic Birds. Volume 6: Pardalotes to shrike-thrushes'. Oxford University Press, Melbourne.
- NSW Scientific Committee (2001) Grey-crowned babbler (eastern subspecies) - Vulnerable species determination - final. DEC (NSW), Sydney.
- Pizzey, G. and Knight, F. (2003). The Field Guide to the Birds of Australia 7th Edition. Menkhorst, P. (ed). HarperCollins.
- Reid, J. R. W. (1999). 'Threatened and declining birds in the New South Wales Sheep-Wheat Belt I: Diagnosis, characteristics and management'. Consultancy report to NSW National Parks and Wildlife Service. CSIRO Wildlife and Ecology, Canberra.
- Robinson, D. and Traill, B. J. (1996). Conserving woodland birds in the wheat and sheep belts of southern Australia. RAOU Conservation Statement No. 10. Birds Australia, Melbourne.
- Traill, B. J. and Duncan, S. (2000). 'Status of birds in the New South Wales Temperate woodlands region'. Consultancy report to the NSW National Parks and Wildlife Service. Australian Woodlands Conservancy, Chiltern, Victoria.

Powerful Owl

Scientific name: *Ninox strenua*
Conservation status in NSW: Vulnerable

Distribution

The Powerful Owl is endemic to eastern and south-eastern Australia, mainly on the coastal side of the Great Dividing Range from Mackay to south-western Victoria. In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered, mostly historical records on the western slopes and plains. Now uncommon throughout its range where it occurs at low densities.

Habitat and Ecology

- The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest.
- The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine Syncarpia glomulifera, Black She-oak Allocasuarina littoralis, Blackwood Acacia melanoxylon, Rough-barked Apple Angorphora floribunda, Cherry Ballart Exocarpus cupressiformis and a number of eucalypt species.
- The main prey items are medium-sized arboreal marsupials, particularly the Greater Glider, Common Ringtail Possum and Sugar Glider. There may be marked regional differences in the prey taken by Powerful Owls. For example in southern NSW, Ringtail Possum make up the bulk of prey in the lowland or coastal habitat. At higher elevations, such as the tableland forests, the Greater Glider may constitute almost all of the prey for a pair of Powerful Owls. Birds comprise about 10% of the diet, with flying foxes important in some areas. As most prey species require hollows and a shrub layer, these are important habitat components for the owl.
- Pairs of Powerful Owls are believed to have high fidelity to a small number of hollow-bearing nest trees and will defend a large home range of 400-1450 ha.
- Powerful Owls nest in large tree hollows (at least 0.5 m deep), in large eucalypts (diameter at breast height of 80-240 cm) that are at least 150 years old. During the breeding season, the male Powerful Owl roosts in a "grove" of up to 20-30 trees, situated within 100-200 metres of the nest tree where the female shelters.
- Powerful Owls are monogamous and mate for life. Nesting occurs from late autumn to mid-winter, but is slightly earlier in north-eastern NSW (late summer - mid autumn). Clutches consist of two dull white eggs and incubation lasts approximately 38 days.

Regional Information

The powerful owl is known to occur in 16 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. A variety of habitats are utilised, including dry and wet sclerophyll forests, grassy woodlands, heathland and rainforests.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Hollows >45 cm diameter that are 6 m or more above the ground in living or dead trees.
Foraging habitat	As per vegetation type
Shelter/roosting/refuge habitat	Groves of mid-canopy trees or tall shrubs in sheltered gullies.
Time of year species identifiable (if flora) or best detected (if fauna)	All year. Sedentary

Local Information

The powerful owl is often recorded during surveys in the local area however given the large home range and territory of each breeding pair, the population size is usually small and is dependant on the abundance of food (arboreal mammals). At least one breeding pair is likely to occur within the eastern part of the WCL as an individual was recorded in this area during the survey. It is predicted that a maximum of four pairs could be spread across the whole of the WCL.

Threats

- Historical loss and fragmentation of suitable forest and woodland habitat from land clearing for residential and agricultural development. This loss also affects the populations of arboreal prey species, particularly the Greater Glider which reduces food availability for the Powerful Owl.
- Inappropriate forest harvesting practices that have changed forest structure and removed old growth hollow-bearing trees. Loss of hollow-bearing trees reduces the availability of suitable nest sites and prey habitat.
- Can be extremely sensitive to disturbance around the nest site, particularly during pre-laying, laying and downy chick stages. Disturbance during the breeding period may affect breeding success.
- High frequency hazard reduction burning may also reduce the longevity of individuals by affecting prey availability.
- Road kills.
- Secondary poisoning.
- Predation of fledglings by foxes, dogs and cats.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified 10 strategies to help recover the Powerful Owl in New South Wales. These include:

- Aboriginal liaison to investigate the cultural and historic significance of the species.
- Community liaison/awareness/ education in order to actively manage large forest owls in Catchment Management Areas by producing guidelines for habitat protection, management and survey assessment. Identify research needs of the powerful owl.
- Conservation status review via threatened owl workshops.
- Habitat management through EIA consents and planning authorities by producing EIA guidelines to assist in impact assessments and use accurate large forest owl habitat information in the PVP Developer - threatened species tool and for Biobanking assessment methodologies.
- Habitat protection to encourage conservation of owl habitat on private land.
- Monitor the effectiveness of relevant concurrences and licence conditions post development and standardise regional monitoring protocols and sampling methodology by land tenure and disturbance history.
- A Recovery Plan has been approved for this species.

- Research into the use of logged versus unlogged forest by the powerful owl.
- Survey/mapping and habitat assessment to update and refine the existing powerful owl habitat models; carry out post logging surveys and calculate the extent of actual occupation within mapped modelled habitat and estimate the number of available territories in different land tenures.

What needs to be done to recover this species?

- Apply low-intensity, mosaic pattern fuel reduction regimes.
- Searches for the species should be conducted in suitable habitat in proposed development areas and proposed forest harvesting compartments.
- Retain at least a 200 metre buffer of native vegetation around known nesting sites.
- Retain large stands of native vegetation, especially those containing hollow-bearing trees.
- Protect riparian vegetation to preserve roosting areas.
- Protect hollow-bearing trees for nest sites. Younger recruitment trees should also be retained to replace older trees in the long-term.
- Minimise visits to nests and other disturbances, including surveys using call playback, when owls are breeding.
- Assess the importance of the site to the species' survival. Include the linkages the site provides for the species between ecological resources across the broader landscape.

References

- Debus, S.J.S. and Chafer, C.J. (1994). The Powerful Owl Ninox strenua in New South Wales. Australian Birds 28 supplement: S21-S38.
- Higgins, P.J. (ed), 1999. Handbook of Australian, New Zealand and Antarctic Birds. Volume 4. Oxford University Press.
- Kavanagh, R.P. (1988). The impact of predation by the Powerful Owl, Ninox strenua, on a population of the Greater Glider, Petauroides volans. Australian Journal of Ecology 13: 445-450.
- Kavanagh, R.P. (1992). Reply. The impact of predation by the Powerful Owl Ninox strenua on a population of the Greater Glider Petauroides volans. Australian Journal of Ecology 17: 469-472.
- Kavanagh, R.P. (2002). Comparative diets of the Powerful Owl (Ninox strenua), Sooty Owl (Tyto tenebricosa) and Masked Owl (Tyto novaehollandiae) in southeastern Australia. In Newton, I., Kavanagh, R., Olsen, J. and Taylor, I. (eds.). *Ecology and Conservation of Owls*, CSIRO Publishing.
- Kavanagh, R.P. and Stanton, M.A. (2002c). Response to habitat fragmentation by the Powerful Owl (Ninox strenua), Sooty Owl (Tyto tenebricosa) and Masked Owl (Tyto novaehollandiae) and other nocturnal fauna in southeastern Australia. In Newton, I., Kavanagh, R., Olsen, J. and Taylor, I. (eds.). *Ecology and Conservation of Owls*, CSIRO Publishing.
- NSW Department of Environment and Conservation (2005) Draft Recovery Plan for the Large Forest Owls: Powerful Owl Ninox strenua, Sooty Owl Tyto tenebricosa, Masked Owl Tyto novaehollandiae. NSW DEC, Sydney.
- Pavey, C.R. (1995). Food of the Powerful Owl Ninox strenua in suburban Brisbane, Queensland. Emu 95: 231-232.
- Pavey, C.R., Smyth, A.K. and Mathieson, M.T. (1994). The breeding season diet of the Powerful Owl Ninox strenua at Brisbane, Queensland. Emu 94: 278-284.
- Pizzey, G. and Knight, F. (2003). The Field Guide to the Birds of Australia 7th Edition. Menkhorst, P. (ed). HarperCollins.
- Robinson, D. and Traill, B. J. (1996). Conserving woodland birds in the wheat and sheep belts of southern Australia. RAOU Conservation Statement No. 10. Birds Australia, Melbourne.
- Soderquist, T.R., Lowe, K.W., Loyn, R.H., and Price, R. (2002). Habitat quality in Powerful Owl (Ninox strenua) territories in the Box-Ironbark forest of Victoria, Australia. In Newton, I., Kavanagh, R., Olsen, J. and Taylor, I. (eds.). Ecology and Conser

Masked owl

Scientific name: *Tyto novaehollandiae*
Conservation status in NSW: Vulnerable

Distribution
Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution.

Habitat and ecology

- Lives in dry eucalypt forests and woodlands from sea level to 1100 m.
- A forest owl, but often hunts along the edges of forests, including roadsides.
- The typical diet consists of tree-dwelling and ground mammals, especially rats.
- Pairs have a large home-range of 500 to 1000 hectares.
- Roosts and breeds in moist eucalypt forested gullies, using large tree hollows or sometimes caves for nesting.

Regional Information

The masked owl is known to occur in 14 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. A variety of habitats are utilised, including dry and wet sclerophyll forests, grassy woodlands and heathland.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	hollows in living and dead trees >40cm diameter, also crevices in cliffs or caves
Foraging habitat	As per vegetation type
Shelter/roosting/refuge habitat	Dense foliage in gullies or caves or recesses in cliffs.
Time of year species identifiable (if flora) or best detected (if fauna)	All year

Local Information

The masked owl has been infrequently recorded during surveys in the local region and although not recorded during this survey, records occur from near the WCL boundaries at Fern Bay, Fullerton Cove, Salt Ash and Anna Bay. The current status of this species is unclear, however it could potentially occur over much of the forested areas of the WCL, particularly where tall mature trees with large hollows are abundant.

Threats

- Loss of mature hollow-bearing trees and changes to forest and woodland structure, which leads to fewer such trees in the future.
- Clearing of habitat for grazing, agriculture, forestry or other development.
- A combination of grazing and regular burning is a threat, through the effects on the quality of ground cover for mammal prey, particularly in open, grassy forests.
- Secondary poisoning from rodenticides.
- Being hit by vehicles.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified 10 strategies to help recover the masked owl in New South Wales. These include:

- Aboriginal liaison to investigate the cultural and historic significance of the species.
- Community liaison/awareness/ education in order to actively manage large forest owls in Catchment Management Areas by producing guidelines for habitat protection, management and survey assessment. Identify research needs of the masked owl.
- Conservation status review via threatened owl workshops.
- Habitat management through EIA consents and planning authorities by producing EIA guidelines to assist in impact assessments and use accurate large forest owl habitat information in the PVP Developer - threatened species tool and for Biobanking assessment methodologies.
- Habitat protection to encourage conservation of owl habitat on private land.
- Monitor the effectiveness of relevant concurrences and licence conditions post development and standardise regional monitoring protocols and sampling methodology by land tenure and disturbance history.
- A Recovery Plan has been approved for this species.
- Research into the use of logged versus unlogged forest by the masked owl.
- Survey/mapping and habitat assessment to update and refine the existing masked owl habitat models; carry out post logging surveys and calculate the extent of actual occupation within mapped modelled habitat and estimate the number of available territories in different land tenures.

What needs to be done to recover this species?

- Drive carefully at night through forest areas.
- Retain and protect stands of native vegetation, especially those with hollow-bearing trees.
- Retain hollow-bearing trees as well as large, mature trees that will provide hollows in the future.
- Limit the use of pesticides used in suitable native habitat.

References

- Garnett, S. and Crowley, G. M. (2000). The Action Plan for Australian Birds. Published by Environment Australia. Canberra, ACT.
- Kavanagh, R. P. and Murray, M. (1996). Home range, habitat and behaviour of the Masked Owl Tyto novaehollandiae near Newcastle, New South Wales. Emu 96: 250-257.
- Newton, I., Kavanagh, R., Olson, J. and Taylor, I. (eds) (2002). Ecology and Conservation of Owls. CSIRO Publishing. Collingwood Victoria.
- NSW Department of Environment and Conservation (2005) Draft Recovery Plan for the Large Forest Owls: Powerful Owl Ninox strenua, Sooty Owl Tyto tenebricosa, Masked Owl Tyto novaehollandiae. NSW DEC, Sydney.

Pied Oystercatcher

Scientific name: *Haematopus longirostris*

Conservation status in NSW: Vulnerable

Distribution

The species is distributed around the entire Australian coastline, although it is most common in coastal Tasmania and parts of Victoria, such as Corner Inlet. In NSW the species is thinly scattered along the entire coast.

Habitat and ecology

- Favours intertidal flats of inlets and bays, open beaches and sandbanks.
- Forages on exposed sand, mud and rock at low tide, for molluscs, worms, crabs and small fish. The chisel-like bill is used to pry open or break into shells of oysters and other shellfish.
- Nests mostly on coastal or estuarine beaches although occasionally they use saltmarsh or grassy areas. Nests are shallow scrapes in sand above the high tide mark, often amongst seaweed, shells and small stones.
- Two to three eggs are laid between August and January. The female is the primary incubator and the young leave the nest within several days.

Regional Information

The pied oystercatcher is known to occur in 5 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. Habitats are limited to open marine environments such as shorelines dunes and saltmarsh.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Intertidal mudflats or sandbanks in large, marine embayments, or sandy, or ocean beaches or rocky shores.
Foraging habitat	above high water mark on beaches, or sandbars or margins of estuaries or lagoons.
Shelter/roosting/refuge habitat	On sandy beaches, or spits, or dunes, or islets in inlets, or lagoons or sheltered bays near mudflats
Time of year species identifiable (if flora) or best detected (if fauna)	All year

Local Information

The pied oystercatcher is regularly recorded along Stockton Beach, including the WCL**.**

Threats

- Disturbance to coastal feeding, nesting and roosting areas through beach-combing, fishing, dog-walking, horse-riding and 4WD vehicles.
- Predation of eggs and chicks by foxes, dogs, cats, Australian Ravens and raptors.
- Habitat destruction as a result of residential, agricultural and tourism developments.
- Hydrological changes to estuaries and similar water bodies causing modification or removal of important areas of suitable habitat.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified nine strategies to help recover the Pied Oystercatcher in New South Wales. The most relevant to WCL are:

- Community liaison/awareness/ education in order to co-ordinate a community based recovery and threat abatement program and appointing a regional shorebird recovery co-ordinator.
- Habitat management through fox control, native predator control at nest sites if required and nest site protection by the erection of fencing and signage
- Habitat protection by declaring nesting habitat as wildlife protection areas in a Companion Animal Management Plan and exclude uncontrolled dogs in the breeding season. Produce an estuary management plan to identify and protect nest sites.
- Monitor the distribution, population size and breeding success by annual surveys.
- Survey/mapping and habitat assessment in order to design a survey and monitoring program and to provide the result to the local Council.

What needs to be done to recover this species?

- Undertake fox, feral cat and Australian Raven control programs.
- Assess the appropriateness of dog and cat ownership in new subdivisions.
- Manage estuaries and the surrounding landscape to ensure the natural hydrological regimes are maintained.
- Install interpretive signs at major nesting sites.
- Protect and maintain known or potential habitat, including the implementation of protection zones around known habitat sites and sites of recent records.

References

- Hayman, P., Marchant, J. and Prater, T. (1986). Shorebirds. Helm Identification Guides. Christopher Helm, London.
- Marchant, S. and Higgins, P.J. (Eds) (1993). Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings. Oxford University Press, Melbourne.
- Pizzey, G. and Knight, F. (2003). The Field Guide to the Birds of Australia 7th Edition. Menkhorst, P. (ed). HarperCollins.
- Pringle, J.D. (1987) The Shorebirds of Australia, Angus and Robertson, Sydney.

Sooty oystercatcher

Scientific name: *Haematopus fuliginosus*
Conservation status in NSW: Vulnerable

Distribution
Sooty Oystercatchers are found around the entire Australian coast, including offshore islands, being most common in Bass Strait. Small numbers of the species are evenly distributed along the NSW coast. The availability of suitable nesting sites may limit populations.

Habitat and ecology
Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries.

- Forages on exposed rock or coral at low tide for foods such as limpets and mussels.
- Breeds in spring and summer, almost exclusively on offshore islands, and occasionally on isolated promontories. The nest is a shallow scrape on the ground, or small mounds of pebbles, shells or seaweed when nesting among rocks.

Regional information

The sooty oystercatcher is known to occur in 5 sub-regions of the Hunter/Central Rivers Catchment Management Region, including the Hunter sub-region. Habitats are limited to open marine environments such as shorelines with rocky headlands and outcrops.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Offshore islands or rock stacks, or remote headlands, or promontories, or rocky outcrops or steep, open beaches
Foraging habitat	Marine, coastal, usually within 50m of shore and prefer rocky intertidal shorelines or sandy beaches near intertidal mudflats.
Shelter/roosting/refuge habitat	Roost on offshore islands, or coral beaches, or banks or spits of sand, or shingle in sheltered bays or inlets.
Time of year species identifiable (if flora) or best detected (if fauna)	All year

Local Information

This species appears to be infrequently recorded in the local region, the closest record to the WCL being in the rocky beach environment of Birubi Beach at the eastern end of Stockton Beach. The sooty oystercatcher is less likely to frequent the sandy Stockton Beach and is not expected to breed in the WCL.

Threats

- Disturbance to coastal feeding, nesting and roosting areas through beach-combing, fishing, dog-walking, horse-riding and 4WD vehicles.
- Predation of eggs and chicks by foxes, dogs, cats, rats and raptors.
- Habitat destruction as a result of residential, agricultural and tourism developments.
- Hydrological changes to estuaries and similar water bodies causing modification or removal of important areas of suitable habitat.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified seven strategies to help recover the Sooty Oystercatcher in New South Wales. As this species mainly breeds on offshore islands, the most relevant to WCL are:

- Assess any threats to the species and determine recovery strategies if any key breeding sites occur.
- Community liaison/awareness/ education by promoting educational material
- Coordinate a community based recovery and threat abatement program by appointing a regional shorebird recovery co-ordinator.
- Survey/mapping and habitat assessment by conducting regular coordinated surveys of the coastline and off shore islands to determine the distribution and extent of breeding habitat.

What needs to be done to recover this species?

- Undertake fox, feral cat and rat control programs.
- Assess the appropriateness of dog and cat ownership in new subdivisions.
- Manage estuaries and the surrounding landscape to ensure the natural hydrological regimes are maintained.
- Install interpretive signs at major nesting sites.
- Protect and maintain known or potential habitat, including the implementation of protection zones around known habitat and breeding sites and sites of recent records.

References

- Hayman, P., Marchant, J. and Prater, T. (1986). Shorebirds. Helm Identification Guides. Christopher Helm, London.
- Marchant, S. and Higgins, P.J. (Eds) (1993). Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings. Oxford University Press, Melbourne.
- Pizzey, G. and Knight, F. (2003). The Field Guide to the Birds of Australia 7th Edition. Menkhorst, P. (ed). HarperCollins.
- Pringle, J.D. (1987) The Shorebirds of Australia, Angus and Robertson, Sydney.

Little tern

Scientific name: *Sterna albifrons*
Conservation status in NSW: Endangered


Keith Egan © DECC

Distribution

Migrating from eastern Asia, the Little Tern is found on the north, east and south-east Australian coasts, from Shark Bay in Western Australia to the Gulf of St Vincent in South Australia. In NSW, it arrives from September to November, occurring mainly north of Sydney, with smaller numbers found south to Victoria. It breeds in spring and summer along the entire east coast from Tasmania to northern Queensland, and is seen until May, with only occasional birds seen in winter months.

Habitat and ecology

- Almost exclusively coastal, preferring sheltered environments; however may occur several kilometres from the sea in harbours, inlets and rivers (with occasional offshore islands or coral cay records).
- Nests in small, scattered colonies in low dunes or on sandy beaches just above high tide mark near estuary mouths or adjacent to coastal lakes and islands.
- The nest is a scrape in the sand, which may be lined with shell grit, seaweed or small pebbles.
- Both parents incubate up to three well-camouflaged eggs for up to 22 days, aggressively defending the nest against intruders until the young fledge at 17 - 19 days.
- Often seen feeding in flocks, foraging for small fish, crustaceans, insects, annelids and molluscs by plunging in the shallow water of channels and estuaries, and in the surf on beaches, or skipping over the water surface with a swallow-like flight.

Regional Information

The little tern is known to occur in 5 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. Habitats are limited to open marine environments such as shorelines, dunes, oceans and more inland terrestrial saline environments.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Low dunes, or on sandy beaches just above the high tide mark, or near the mouths of estuaries or adjacent to coastal lakes, or islands.
Foraging habitat	Shallow waters of estuaries, or coastal lagoons or lakes.
Shelter/roosting/refuge habitat	Colony sites are bare or with sparse clumps of low vegetation. Usually roost on exposed sandspits, banks or bars within sheltered estuaries.
Time of year species identifiable (if flora) or best detected (if fauna)	Locally breeding population present September to March

Local Information

The little tern is frequently recorded in the local area, particularly in the vicinity of Stockton Bridge. It is expected that this species would forage and roost along the shoreline of Stockton Beach within the WCL, however it is unknown whether breeding occurs in the sand dunes. The little tern formerly nested at the Stockton Sandspit Shorebird Reserve where four pairs were last noted breeding in 1989 (Dick Cooper pers. com.). Hunter Bird Observers Club members have observed terns flying in the direction of Stockton Beach carrying fish however the location of any breeding site is unknown (Chris Herbert pers. com.). Therefore it is possible that a breeding site occurs in the sand dunes of Stockton Beach within the WCL.

Threats

- Coastal and inland habitat areas are being impacted by land clearing for residential, agricultural and tourism developments, by sand and rutile mining, and by waste disposal dumps.
- Hydrological changes to estuaries and similar waterbodies may modify or remove important areas of suitable habitat, or affect the availability of food.
- Potentially susceptible to pesticides and contamination of estuaries by oil-spills and heavy metals.
- Well-camouflaged eggs are at risk of accidental destruction.
- Nesting at flood-prone locations.
- Predation of eggs and chicks by foxes, dogs, cats, black rats, silver gulls, ravens and raptors.
- Disturbance to coastal feeding, nesting and roosting areas through beach-combing, fishing, dog-walking, horse-riding and 4WD vehicles; parents often leave the nest when approached, resulting in exposure of chicks or eggs.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified ten strategies to help recover the Little Tern in New South Wales. The most relevant to WCL, particularly if a breeding colony is discovered, are:

- Community liaison/awareness/ education by training a site warden to manage the nesting site and involve community interest groups to participate in survey, monitoring, protection and management of the nest site. Produce a field manual for management purposes.
- A Recovery Plan has been approved for this species.
- Habitat management through feral predator control (fox, cat and rats) at nest sites and nest site protection from human disturbance by the erection of fencing and signage.
- Habitat protection by acquirement of land with nesting site for addition into the reserve system.
- Habitat rehabilitation/restoration by the removal of encroaching vegetation.
- Monitoring by undertaking annual studies at individual breeding sites.
- Research – investigate the cultural history and significance to the local Aboriginal community and conduct banding studies in order to determine links to other breeding colonies.

What needs to be done to recover this species?

- Keep domestic dogs/cats indoors at night.
- Support local community groups acting as nesting site wardens.
- Undertake fox and feral cat control programs.
- Searches for the species should be conducted in suitable habitat in proposed development areas.
- DEC should be consulted when planning development/s to minimise impact/s on populations.
- Assess appropriateness of dog/cat ownership in new subdivisions.
- Manage estuaries and the surrounding landscape to ensure the natural hydrological regimes are maintained.
- Limit visitor movement through sites.
- Erect fences and interpretive signage to minimise human disturbance and advise how their behaviour can affect the threatened species' survival.
- Protect and maintain known or potential habitats, including implementation of protection zones around known habitat sites and sites of recent records.
- Flag beaches with lines of bunding or raise nests on sandbags to protect nesting birds in flood prone areas.
- Assess the site's importance to the species' survival, including linkages provided between ecological resources across the broader landscape.

References

- Higgins, P. and Davies, S. (eds.) (1996). Handbook of Australian, New Zealand and Antarctic Birds Volume 3: Snipe to Pigeons. Oxford University Press, Melbourne.
- Hill, R., Bamford, M., Rounsevell, D. and Vincent, J. (1988). Little Terns and Fairy Terns in Australia - an RAOU Conservation Statement. Royal Australian Ornithologists Union Report 53, Melbourne.
- Martindale, J. (1985). North Coast Little Tern Survey 1984-85. Unpublished Report, NSW NPWS.
- Morris, A.K., McGill, A.R. and Holmes, G. (1981). Handlist of Birds in New South Wales. NSW Field Ornithologists Club, Sydney.
- Murray, A. (1994). Little Tern. Australian Natural History 24(10):22-23
- NSW National Parks and Wildlife Service (2003) Little Tern (Sterna albifrons) Recovery Plan. NSW NPWS, Hurstville NSW.
- Owen, R. (1991). A Report on 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.
- Smith, P. (1990). The biology and management of the Little Tern Sterna albifrons in NSW. NPWS, Sydney.
- Smith, P. (1994). Management of the Little Tern Sterna albifrons Colony at Forster. Report to NSW NPWS, Hurstville.

Sanderling

Scientific name: *Calidris alba*
Conservation status in NSW: Vulnerable

Distribution

A regular summer migrant from Siberia and other Arctic breeding grounds to most of the Australian coastline. It is uncommon to locally common, arriving from September and leaving by May (some may overwinter in Australia). Sanderlings occur along the NSW coast, with occasional inland sightings.

Habitat and ecology

- Often found in coastal areas on low beaches of firm sand, near reefs and inlets, along tidal mudflats and bare open coastal lagoons; individuals are rarely recorded in near-coastal wetlands.
- Generally occurs in small flocks, however may associate freely with other waders.
- Individuals run behind receding waves, darting after insects, larvae and other small invertebrates in the sand, then dart back up the beach as each wave breaks.
- Also feeds on plants, seeds, worms, crustaceans, spiders, jellyfish and fish, foraging around rotting heaps of kelp, at the edges of shallow pools on sandspits and on nearby mudflats.
- Roosts on bare sand, behind clumps of beach-cast kelp or in coastal dunes.
- Breeding occurs in the Northern Hemisphere.

Regional Information

The sanderling is known to occur in 5 sub-regions of the Hunter/Central Rivers Catchment Management Region, including the Hunter sub-region. Habitats are limited to open marine environments such as shorelines, dunes, mangrove swamps and saltmarshes.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Breeds Northern Hemisphere
Foraging habitat	tidal mudflats, estuaries, coastal lagoons, inlets, or beaches
Shelter/roosting/refuge habitat	n/a
Time of year species identifiable (if flora) or best detected (if fauna)	Migratory - September to April

Local Information

The sanderling is not listed in the DECC Wildlife Atlas database for the study locality however there are records from Stockton Beach on the Birds Australia database and has been sighted by members of the Hunter Bird Observers Club (Chris Herbert pers. com.). As a summer visitor this species would not have been present on Stockton Beach during the current surveys however it is expected to occur within the WCL.

Threats

- Hydrological changes to estuaries and waterbodies may modify or remove important areas of suitable habitat.
- Disturbance to feeding and roosting sites.
- Pollution of estuaries and coastal areas.
- Tourism or agricultural developments reducing coastal and inland habitat areas.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified 5 priority actions to help recover the Sanderling in New South Wales. The most relevant to WCL are:

- Community liaison/awareness/ education in order to increase awareness by providing educational material.
- Habitat management through minimising human disturbance in key foraging areas.
- Monitor the distribution, population size by regular 2 yearly surveys (already being undertaken).
- Survey/mapping and habitat assessment in order to identify key foraging sites along the NSW coast.

What needs to be done to recover this species?

- Control dogs on beaches and in estuaries.
- Raise visitor awareness of the presence of this and other threatened shorebird species; provide information on how visitors' actions will affect the species' survival.
- Conduct searches for the species in suitable habitat in proposed development areas.
- Manage estuaries and the surrounding landscape to maintain the natural hydrological regimes.
- Protect coastal areas from pollution.
- Protect foraging and roosting areas from disturbance or inappropriate development.
- Protect and maintain known or potential habitat; implement protection zones around recent records.
- Assess the importance of sites to the species' survival, including linkages provided between ecological resources across the broader landscape.

References

- Ayers, D., Nash, S. and Baggett, K. (1996) Threatened Species of Western New South Wales. NSW NPWS, Sydney.
- Barker, R.D. and Vestjens, W.J.M. (1989). The Food of Australian Birds Volume 1: Non-Passerines. CSIRO Division of Wildlife and Ecology.
- Higgins, P. and Davies, S. (eds.) (1996). Handbook of Australian, New Zealand and Antarctic Birds Volume 3: Snipe to Pigeons. Oxford University Press, Melbourne.
- NPWS (2000). Threatened Species of the Lower North Coast of New South Wales. NPWS, Sydney.
- Pizzey, G. and Knight, F. (2003). The Field Guide to the Birds of Australia 7th Edition. Menkhorst, P. (ed). HarperCollins.
- Pringle, J.D. (1987) The Shorebirds of Australia, Angus and Robertson, Sydney.
- Smith, P. (1991). The Biology and Management of Waders in NSW. Species Management Report Number 9. NSW National Parks and Wildlife Service, Hurstville.

Great Knot

Scientific name: *Calidris tenuirostris*
Conservation status in NSW: Vulnerable

Distribution

In NSW, the species has been recorded at scattered sites along the coast to about Narooma. It has also been observed inland at Tullakool, Armidale, Gilgandra and Griffith.

Habitat and ecology

- Occurs within sheltered, coastal habitats containing large, intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons.
- Often recorded on sandy beaches with mudflats nearby, sandy spits and islets and sometimes on exposed reefs or rock platforms.
- Migrates to Australia from late August to early September, although juveniles may not arrive until October-November.
- Most birds return north in March and April, however some individuals may stay over winter in Australia.
- Forages for food by methodically thrusting its bill deep into the mud to search for invertebrates, such as bivalve molluscs, gastropods, polychaete worms and crustaceans.

Regional Information

The great knot is known to occur in 5 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. Habitats are limited to open aquatic environments such as shorelines, dunes, saline and freshwater wetlands, rivers, lakes and streams.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	n/a
Foraging habitat	tidal mudflats, estuaries, coastal lagoons, inlets, beaches or inland fresh water or salt lakes
Shelter/roosting/refuge habitat	in sheltered sites on spits, coastal dunes, salt flats, mangroves, tidal mudflats, estuaries, coastal lagoons, inlets, beaches or inland fresh water or salt lakes
Time of year species identifiable (if flora) or best detected (if fauna)	Migratory - September to March

Local Information

The great knot is regularly recorded in the Kooragang Wetlands however no records for the WCL has been found. As it appears to prefer sheltered foraging sites the great knot may only be an occasional visitor to Stockton Beach

Threats

- Hydrological changes to inland lakes may modify or remove important areas of suitable habitat for those individuals that overwinter in Australia.
- Tourism or agricultural developments that reduce coastal and inland habitat areas.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified five strategies to help recover the Great Knot in New South Wales. The most relevant to WCL are:

- Community liaison/awareness/ education in order to increase awareness by providing educational material.
- Habitat management through minimising human disturbance in key foraging areas.
- Monitor the distribution, population size by regular 2 yearly surveys (already being undertaken).
- Survey/mapping and habitat assessment in order to identify key foraging sites along the NSW coast.

What needs to be done to recover this species?

- Control dogs on beaches and in estuaries.
- Give way' to birds when walking, driving or riding on the beach.
- Protect coastal areas from pollution.
- Protect and maintain known or potential habitat; implement protection zones around recent records.

References

- Higgins, P. and Davies, S. (eds.) (1996). Handbook of Australian, New Zealand and Antarctic Birds Volume 3: Snipe to Pigeons. Oxford University Press, Melbourne.
- Schodde, R. and Tidemann, S. C. (1988). Complete Book of Australian Birds. Second Edition. Reader's Digest, Sydney.
- Smith, P. (1991). The Biology and Management of Waders in NSW. Species Management Report Number 9. NSW National Parks and Wildlife Service, Hurstville.

Greater Sand-plover

Scientific name: *Charadrius leschenaultii*
Conservation status in NSW: Vulnerable

Distribution

The Greater Sand Plover breeds in central Asia from Armenia to Mongolia, moving further south for winter. In Australia the species is commonly recorded in parties of 10-20 on the west coast, with the far northwest being the stronghold of the population. The species is apparently rare on the east coast, being found usually singly. In NSW, the species has been recorded between the northern rivers and the Illawarra, with most records coming from the Clarence and Richmond estuaries.

Habitat and ecology

- Almost entirely restricted to coastal areas in NSW, occurring mainly on sheltered sandy, shelly or muddy beaches or estuaries with large intertidal mudflats or sandbanks.
- Roosts during high tide on sandy beaches and rocky shores; begin foraging activity on wet ground at low tide, usually away from the edge of the water; individuals may forage and roost with other waders.
- Diet includes insects, crustaceans, polychaete worms and molluscs.
- Prey is detected visually by running a short distance, stopping to look, then running to collect the prey.

Regional Information

The greater sand plover is known to occur in 4 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. Habitats are usually limited to open marine environments such as shorelines, dunes, mangrove swamps and saltmarsh, although the use of secondary grassland habitat has also been recorded.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	n/a
Foraging habitat	intertidal sandflats or mud flats in estuaries or saltmarsh
Shelter/roosting/refuge habitat	beaches, sand spits or rocky shores
Time of year species identifiable (if flora) or best detected (if fauna)	September to March

Local Information

The greater sand plover is a rare visitor to the local region and is most likely to occur in the protected habitats of the Kooragang Wetlands than Stockton Beach. Therefore this species may not occur within the WCL.

Threats

- Loss and degradation of habitats as a result of residential, agricultural and tourism developments.
- Hydrological changes to estuaries and similar water bodies may modify or remove important areas of suitable habitat.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified three strategies to help recover the Greater Sand-plover in New South Wales. The most relevant to WCL are:

- Community liaison/awareness/ education in order to increase awareness by providing educational material.
- Habitat management through minimising human disturbance in key foraging areas.
- Survey/mapping and habitat assessment in order to identify key foraging sites along the NSW coast and monitor the distribution, population size by regular 2 yearly surveys (already being undertaken).

What needs to be done to recover this species?

- Raise visitor awareness about the presence of this and other threatened shorebird species; provide information on how their actions will affect the species' survival.
- Manage estuaries and the surrounding landscape to ensure natural hydrological regimes are maintained.
- Protect and maintain known or potential habitats, including the implementation of protection zones around known habitat sites and recent records.

References

- Hayman, P., Marchant, J. and Prater, T. (1986). Shorebirds. Helm Identification Guides. Christopher Helm, London.
- Marchant, S. and Higgins, P.J. (Eds) (1993). Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings. Oxford University Press, Melbourne.
- Pizzey, G. and Knight, F. (2003). The Field Guide to the Birds of Australia 7th Edition. Menkhorst, P. (ed). HarperCollins.
- Pringle, J.D. (1987) The Shorebirds of Australia, Angus and Robertson, Sydney.
- Smith, P. (1991). The Biology and Management of Waders in NSW. Species Management Report Number 9. NSW National Parks and Wildlife Service, Hurstville.
- Watkins, D. (1993). A National Plan for Shorebird Conservation in Australia. RAOU Report No. 90. Royal Australasian Ornithologists Union, Melbourne.

Lesser Sand-plover

Scientific name: *Charadrius mongolus*
Conservation status in NSW: Vulnerable

Distribution

The Lesser Sand Plover breeds in central and north eastern Asia, migrating further south for winter. In Australia the species is found around the entire coast but is most common in the Gulf of Carpentaria, and along the east coast of Queensland and northern NSW. Individuals are rarely recorded south of the Shoalhaven estuary, and there are few inland records.

Habitat and ecology

- Almost entirely coastal in NSW, favouring the beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats; occasionally occurs on sandy beaches, coral reefs and rock platforms.
- Highly gregarious, frequently seen in flocks exceeding 100 individuals; also often seen foraging and roosting with other wader species.
- Roosts during high tide on sandy beaches, spits and rocky shores; forage individually or in scattered flocks on wet ground at low tide, usually away from the water's edge.
- Diet includes insects, crustaceans, molluscs and marine worms.
- Prey is usually detected visually with the birds making short, quick runs, with abrupt stops to lunge at the ground or look for prey.

Regional Information

The lesser sand plover is known to occur in 4 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. Habitats are usually limited to open marine environments such as shorelines, dunes, mangrove swamps and saltmarsh, although the use of secondary grassland habitat has also been recorded.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	n/a
Foraging habitat	intertidal sandflats or mud flats in estuaries or saltmarsh
Shelter/roosting/refuge habitat	beaches, sand spits or rocky shores
Time of year species identifiable (if flora) or best detected (if fauna)	September to April

Local Information

The lesser sand-plover is a common summer visitor to the local region, particularly the Kooragang Wetlands. This species has also been recorded from Stockton Beach (Chris Herbert, pers. com.) and therefore it is expected to occur in the WCL.

Threats

- Loss and degradation of habitats as a result of residential, agricultural and tourism developments.
- Hydrological changes to estuaries and similar water bodies may modify or remove important areas of suitable habitat.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified three strategies to help recover the lesser sand-plover in New South Wales. The most relevant to WCL are:

- Community liaison/awareness/ education in order to increase awareness by providing educational material.
- Habitat management through minimising human disturbance in key foraging areas.
- Survey/mapping and habitat assessment in order to identify key foraging sites along the NSW coast and monitor the distribution, population size by regular 2 yearly surveys (already being undertaken).

What needs to be done to recover this species?

- Raise visitor awareness about the presence of this and other threatened shorebird species; provide information on how their actions will affect the species' survival.
- Manage estuaries and the surrounding landscape to ensure natural hydrological regimes are maintained.
- Protect and maintain known or potential habitats, including the implementation of protection zones around known habitat sites and recent records.

References

- Hayman, P., Marchant, J. and Prater, T. (1986). Shorebirds. Helm Identification Guides. Christopher Helm, London.
- Pizzey, G. and Knight, F. (2003). The Field Guide to the Birds of Australia 7th Edition. Menkhorst, P. (ed). HarperCollins.
- Pringle, J.D. (1987) The Shorebirds of Australia, Angus and Robertson, Sydney.
- Smith, P. (1991). The Biology and Management of Waders in NSW. Species Management Report Number 9. NSW National Parks and Wildlife Service, Hurstville.
- Watkins, D. (1993). A National Plan for Shorebird Conservation in Australia. RAOU Report No. 90. Royal Australasian Ornithologists Union, Melbourne.

Broad-billed Sandpiper

Scientific name: *Limicola falcinellus*
Conservation status in NSW: Vulnerable

Distribution
The eastern form of this species breeds in northern Siberia before migrating southwards in winter to Australia. In Australia, Broad-billed Sandpipers overwinter on the northern coast, particularly in the north-west, with birds located occasionally on the southern coast. In NSW, the main site for the species is the Hunter River estuary, with birds occasionally reaching the Shoalhaven estuary. There are few records for inland NSW.

Habitat and Ecology

- Broad-billed Sandpipers favour sheltered parts of the coast such as estuarine sandflats and mudflats, harbours, embayments, lagoons, saltmarshes and reefs as feeding and roosting habitat. Occasionally, individuals may be recorded in sewage farms or within shallow freshwater lagoons. Broad-billed Sandpipers roost on banks on sheltered sand, shell or shingle beaches.
- The species is an active forager, typically feeding by rapidly and repeatedly jabbing its bill into soft wet mud. Feeding also occurs while wading, often in water so deep that they have to submerge their heads and necks in order to probe the underlying mud. Their diet includes insects, crustaceans, molluscs, worms and seeds.
- Individuals are strongly migratory and only mildly gregarious when not breeding.
- Large flocks are seldom recorded and birds are often either encountered alone or feeding with other waders such as Red-necked Stints or Curlew Sandpipers.

Regional Information

The broad-billed sandpiper is known to occur in 4 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. Habitats are limited to open aquatic environments such as shorelines, dunes, saline and freshwater wetlands as well as non wetland water bodies, rivers, lakes and streams.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Breed in Northern Hemisphere.
Foraging habitat	Exposed flats of soft mud or wet sands at the edges of coastal or near coastal wetlands, or shallow water on muddy edges of ponds.
Shelter/roosting/refuge habitat	Banks on sheltered sand, or shell or shingle beaches.
Time of year species identifiable (if flora) or best detected (if fauna)	Migratory. September to March

Local Information

The broad-billed sandpiper has been recorded frequently from the Kooragang Wetlands but no records could be found for Stockton Beach. As this species appears to prefer more sheltered habitats it may not occur within the WCL.

Threats

- Coastal habitats are being impacted as land continues to be cleared for residential, agricultural and tourism developments.
- Hydrological changes to estuaries and similar water bodies may modify or remove important areas of suitable habitat.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified three strategies to help recover the Broad-billed Sandpiper in New South Wales. The most relevant to WCL are:

- Community liaison/awareness/ education in order to increase awareness by providing educational material.
- Habitat management through minimising human disturbance in key foraging areas.
- Survey/mapping and habitat assessment in order to identify key foraging sites along the NSW coast and monitor the distribution, population size by regular 2 yearly surveys (already being undertaken).

What needs to be done to recover this species?

- Raise visitor awareness about the presence of Broad-billed Sandpipers and other threatened shorebird species and provide information on how their actions will affect the species' survival.
- Searches for the species should be conducted in suitable habitat in proposed development areas. Assess the importance of the site to the species' survival. Include the linkages the site provides for the species between ecological resources across the broader landscape. NPWS should be consulted when planning development to minimise impact on populations.
- Manage estuaries and the surrounding landscape to ensure the natural hydrological regimes are maintained.
- Protect and maintain known or potential habitats, including the implementation of protection zones around known habitat sites and recent records.

References

- Hayman, P., Marchant, J. and Prater, T. (1986). Shorebirds. Helm Identification Guides. Christopher Helm, London.
- Marchant, S. and Higgins, P.J. (Eds) (1993). Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings. Oxford University Press, Melbourne.
- NPWS, Sydney. (2000). Broad-billed Sandpiper. Threatened species profile. NPWS, Sydney.
- Pizzey, G. and Knight, F. (2003). The Field Guide to the Birds of Australia 7th Edition. Menkhorst, P. (ed). HarperCollins.
- Pringle, J.D. (1987) The Shorebirds of Australia, Angus and Robertson, Sydney.
- Smith, P. (1991). The Biology and Management of Waders in NSW. Species Management Report Number 9. NSW National Parks and Wildlife Service, Hurstville.
- Watkins, D. (1993). A National Plan for Shorebird Conservation in Australia. RAOU Report No. 90. Royal Australasian Ornithologists Union, Melbourne.

Black-tailed Godwit

Scientific name: *Limosa limosa*
Conservation status in NSW: Vulnerable

Distribution

The black-tailed godwit is a migratory wading bird that breeds in Mongolia and Eastern Siberia (Palaearctic) and flies to Australia for the southern summer, arriving in August and leaving in March. In NSW, it is most frequently recorded at Kooragang Island (Hunter River estuary), with occasional records elsewhere along the north and south coast, and inland. Records in western NSW indicate that a regular inland passage is used by the species, as it may occur around any of the large lakes in the western areas during summer, when the muddy shores are exposed. The species has been recorded within the Murray-Darling Basin, on the western slopes of the Northern Tablelands and in the far north-western corner of the state.

Habitat and ecology

- Primarily a coastal species.
- Usually found in sheltered bays, estuaries and lagoons with large intertidal mudflats and/or sandflats.
- Further inland, it can also be found on mudflats and in water less than 10 cm deep, around muddy lakes and swamps.
- Individuals have been recorded in wet fields and sewerage treatment works.
- Forages for insects, crustaceans, molluscs, worms, larvae, spiders, fish eggs, frog eggs and tadpoles in soft mud or shallow water.
- Roosts and loafs on low banks of mud, sand and shell bars.
- Frequently recorded in mixed flocks with bar-tailed godwits.

Regional Information

The black-tailed godwit is known to occur in 5 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. Habitats are limited to open aquatic environments such as shorelines, dunes, saline and freshwater wetlands as well as non wetland water bodies, rivers, lakes and streams.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Breeds Northern Hemisphere
Foraging habitat	Wide, intertidal mud or sand-flats in soft mud or shallow water, or in shallow estuaries.
Shelter/roosting/refuge habitat	Low banks of mud, or sand or shell on bars, or islets or beaches in sheltered areas. Also sandflats behind mangroves.
Time of year species identifiable (if flora) or best detected (if fauna)	Migratory. September to April

Local Information

The black-tailed godwit has been recorded frequently from the Kooragang Wetlands but no records could be found for Stockton Beach. As this species appears to prefer more sheltered habitats it may not occur within the WCL.

Threats

- Hydrological changes to inland lakes and estuaries may modify or remove important areas of suitable habitat for individuals remaining in Australia over winter.
- Tourism, residential or agricultural developments reducing coastal and inland habitat areas.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified three strategies to help recover the Black-tailed Godwit in New South Wales. The most relevant to WCL are:

- Community liaison/awareness/ education in order to increase awareness by providing educational material.
- Habitat management through minimising human disturbance in key foraging areas.
- Survey/mapping and habitat assessment in order to identify key foraging sites along the NSW coast and monitor the distribution, population size by regular 2 yearly surveys (already being undertaken).

What needs to be done to recover this species?

- Raise visitor awareness about the presence of this and other threatened shorebird species; provide information on how visitors' actions will affect the species' survival.
- Searches for the species should be conducted in suitable habitat in proposed development areas in appropriate time of the year.
- Manage estuaries and inland water-bodies and the surrounding landscape, to ensure the natural hydrological regimes are maintained.
- Protect and maintain known or potential habitats; implement protection zones around known habitat sites and recent records.
- Assess the importance of sites to the species' survival; include the linkages the site provides for the species between ecological resources across the landscape.

References

- Hayman, P., Marchant, J. and Prater, T. (1986). Shorebirds. Helm Identification Guides. Christopher Helm, London.
- Kingsford, R. (1991). Australian Waterbirds, a field guide. Kangaroo Press, Sydney.
- Marchant, S. and Higgins, P.J. (Eds) (1993). Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings. Oxford University Press, Melbourne.
- Pizzey, G. and Knight, F. (2003). The Field Guide to the Birds of Australia 7th Edition. Menkhorst, P. (ed). HarperCollins.
- Schodde, R. and Tidemann, S. C. (1988). Complete Book of Australian Birds. Second Edition. Reader's Digest, Sydney.
- Smith, P. (1991). The Biology and Management of Waders in NSW. Species Management Report Number 9. NSW National Parks and Wildlife Service, Hurstville.
- Watkins, D. (1993). A National Plan for Shorebird Conservation in Australia. RAOU Report No. 90. Royal Australasian Ornithologists Union, Melbourne.

Terek Sandpiper

Scientific name: *Xenus cinereus*
Conservation status in NSW: Vulnerable


John Martindale © DEC

Distribution

A rare migrant to the eastern and southern Australian coasts, being most common in northern Australia, and extending its distribution south to the NSW coast in the east. The two main sites for the species in NSW are the Richmond River estuary and the Hunter River estuary. The latter has been identified as nationally and internationally important for the species.

Habitat and Ecology

- In Australia, has been recorded on coastal mudflats, lagoons, creeks and estuaries.
- Favours mudbanks and sandbanks located near mangroves, but may also be observed on rocky pools and reefs, and occasionally up to 10 km inland around brackish pools.
- Generally roosts communally amongst mangroves of dead trees, often with related wader species.
- Breaks up into smaller flocks or even solitary birds when feeding in open intertidal mudflats.
- The diet includes worms, crabs and other crustaceans, small shellfish and the adults and larvae of various flies, beetles and water-bugs.
- Feeding is undertaken by moving rapidly and erratically over soft, wet mud, pecking or probing at the surface.

Regional Information

The terek sandpiper is known to occur in 4 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. Habitats are limited to open aquatic environments such as shorelines, dunes, rocky islands, saline and freshwater wetlands as well as non wetland water bodies, rivers, lakes and streams.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	n/a
Foraging habitat	Estuarine tidal mudflats, or embayments, or harbours or lagoons, or coastal swamps, or dune lakes, or mangroves
Shelter/roosting/refuge habitat	n/a
Time of year species identifiable (if flora) or best detected (if fauna)	September to May.

Local Information

Although considered a rare visitor to eastern Australia there are over 500 records from the DECC Wildlife Atlas, mostly from the Hunter River estuary, which has been identified as being important for the species. One record falls within the WCL near Fern Bay however as this species appears to prefer more sheltered habitats it may only occur as an occasional visitor within the WCL.

Threats

- Clearing of habitat for residential, agricultural and tourism developments.
- Hydrological changes to estuaries and similar waterbodies may modify or remove important areas of suitable habitat.
- Disturbance of foraging and roosting sites by nearby development or recreational activities.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified three strategies to help recover the Terek Sandpiper in New South Wales. The most relevant to WCL are:

- Community liaison/awareness/ education in order to increase awareness by providing educational material.
- Habitat management through minimising human disturbance in key foraging areas.
- Survey/mapping and habitat assessment in order to identify key foraging sites along the NSW coast and monitor the distribution, population size by regular 2 yearly surveys (already being undertaken).

What needs to be done to recover this species?

- Raise visitor awareness about the presence of this and other threatened shorebird species and provide information on how their actions will affect its survival.
- Manage estuaries and the surrounding landscape to ensure the natural hydrological regimes are maintained.
- Protect and maintain known or potential habitats, including the implementation of protection zones around known habitat sites and recent records.
- Survey potential habitat to locate any new populations.

References

- Hayman, P., Marchant, J. and Prater, T. (1986). Shorebirds. Helm Identification Guides. Christopher Helm, London.
- Higgins, P. and Davies, S. (eds.) (1996). Handbook of Australian, New Zealand and Antarctic Birds Volume 3: Snipe to Pigeons. Oxford University Press, Melbourne.
- NPWS (2002). Threatened Species Information. E Terek Sandpiper. NPWS, Sydney.
- Pizzey, G. and Knight, F. (2003). The Field Guide to the Birds of Australia 7th Edition. Menkhorst, P. (ed). HarperCollins.
- Pringle, J.D. (1987) The Shorebirds of Australia, Angus and Robertson, Sydney.
- Smith, P. (1991). The Biology and Management of Waders in NSW. Species Management Report Number 9. NSW National Parks and Wildlife Service, Hurstville.

AMPHIBIANS

Wallum froglet

Scientific name: *Crinia tinnula*
Conservation status in NSW: Vulnerable

Distribution

Confined to coastal areas north from Sydney in NSW to Fraser Island in southern Queensland where suitable habitat occurs.

Habitat and ecology

This species is known to inhabit acid paperbark swamps in coastal wallum and heath growing on Quaternary sand (Cogger 1992; Ingram & MacDonald 1993). They do not tend to colonise permanent waterholes and avoid deep water sites. Payne & Wellington (1995) suggest that on the north coast of New South Wales the species is found in areas of low nutrient quaternary sands and deposited clays, which are periodically inundated. The main vegetation types include reeds, sedges and ferns, and in particular include the gramminoid clay heaths of *Themeda australis*, *Isachne globosa*, and *Hakea* sp. *A* and wet sedgelands of *Blechnum ambiguum*, *Hypolaena* sp. and *Callistemon pachyphyllus*.
Breeding is thought to take place in late winter, from about July to September as calling takes place from May through to September, although some calling has been heard at other times of the year (Cogger 1992; Robinson 1993).

Regional Information

The wallum froglet is known to occur in 4 sub-regions of the Hunter/Central Rivers Catchment Management Region including the Hunter sub-region. A variety of habitats are utilised in poorly drained pockets, including dry sclerophyll forests, forested and freshwater wetlands, grassy woodlands and heathland.

Important habitat requirements within region

Below is a list of the key habitat features for this species in this CMA:

Habitat	Details
Breeding habitat	Moist microhabitats in swamps, or wet or dry heaths, or sedge grasslands or swamps
Foraging habitat	Moist microhabitats in swamps, or wet or dry heaths, or sedge grasslands or swamps
Shelter/roosting/refuge habitat	Moist microhabitats in swamps, or wet or dry heaths, or sedge grasslands or swamps
Time of year species identifiable (if flora) or best detected (if fauna)	Calling: predominantly autumn but also in summer and winter after heavy rainfall

Local Information

The wallum froglet has been recorded at several locations within poorly drained swales of the Tomago Sandbeds. Therefore it is possible that this species occurs within the WCL although they were not identified in suitable habitat during the 2008 survey, despite the flooding of some swales producing ideal conditions for activity.

Threats

- Destruction and degradation of coastal wetlands as a result of roadworks, coastal developments and sandmining.
- Reduction of water quality and modification to acidity in coastal wetlands.
- Grazing and associated frequent burning of coastal wetlands.

Recovery strategies

Priority actions are the specific, practical things that must be done to recover a threatened species, population or ecological community. DECC has identified fourteen strategies to help recover the Wallum Froglet in New South Wales. Most relevant to the WCL are:

- Community liaison/awareness/ education in order to active management and protection of habitat, provide a fact sheet on acid frogs, organise survey and monitoring workshops and public displays.
- Conservation status review to justify whether the species should be included in the EPBC Act.
- Finalise the Recovery Plan for this species.
- Habitat management through feral animal control (plague minnow possibly relevant to WCL), fire management plan near habitat, weed control and avoid changes to drainage patterns and water quality, including pH levels.
- Habitat protection to encourage the conservation habitat on private and public land.
- Habitat rehabilitation/restoration/regeneration where habitat has been destroyed by grazing and sand mining.
- Monitoring to determine population trends and the response of the wallum froglet to threatening processes.
- Research into the effect of carrying out some of the above strategies.
- Survey/mapping and habitat assessment to identify potential and known habitat for the wallum froglet.
-

What needs to be done to recover this species?

- Protect swamps from fire during burning off activities.
- Retain wetland protection buffers in new coastal developments.
- Fence off swamps to prevent stock from grazing in these areas.
- Protect coastal wetland areas.

References

- Cogger, H.G., 1995. *Reptiles and Amphibians of Australia.* Reed Books, Sydney.
- Ingram G. J. & MacDonald, K. R. 1993, An Update on the Decline of Queensland's Frogs. pp. 297 - 303 in *Herpetology in Australia - A Diverse Discipline.* ed. D. Lunney & D. Ayers. Transactions of the Royal Zoological Society of New South Wales.
- Payne, R.J. & Wellington, R., 1995. *Flora and Fauna Survey - Munmorah State Recreation Area.*
- Robinson, M. 1993. A Field Guide to Frogs of Australia. Reed Books, Sydney.