3.2 Fauna

Our understanding of the original fauna species distribution within the coastal zone of the South East is determined from remnant vegetation communities, known habitat preferences for fauna species, fossil deposits and historical accounts. The fauna knowledge base has been severely limited by the clearance of vegetation and removal of habitat, with as little as 13% of the region's pre-European native vegetation remaining.

The arrival of Europeans to the South East saw the beginning of dramatic landscape modification through the development of townships, the drainage of many of the natural wetland systems and the extensive vegetation clearance for pastoral development (Aitkin 1983). These processes have significantly altered the distribution, abundance and status of native Australian fauna. Over half of the State's known mammal species at the time of European settlement were recorded in the South East of South Australia, with 16% restricted only to this region. Of these mammal species 30% have since become extinct (Croft et al. 1999). The wildlife were put under pressure by the loss of habitat, competition for resources and predation by introduced species including foxes, cats and rabbits (Croft et al. 1999). Those mammal species that have survived are those who inhabit mainly forests and swamp areas, as these land types have not been exploited completely, although they have been much reduced (Aitkin 1983).

The scale of habitat modification and loss is no more evident then for the regions wetlands. Prior to European colonisation, intermittent, seasonal and permanent wetlands covered approximately 55% of the Lower South East (Foulkes and Heard 2003, in Slater and Farrington 2010), however over the last 150 years artificial drainage across the South East has allowed vast areas of historically inundated wetland habitats to be dewatered and developed primarily for agriculture. This landscape scale alteration has left only ~6% of original wetlands (Bachmann 2002, Harding 2009, in Slater and Farrington 2010) with only 10% of these wetlands considered to still be intact (Harding 2007; in Slater and Farrington 2010). A reduction in groundwater elevation across much of the region is further threatening groundwater dependent ecosystems (Harding 2009; in Slater and Farrington 2010). In the lower South East, this artificial drainage network is now providing drought refuge for aquatic dependent fauna; namely freshwater fish and amphibians (Slater and Farrington 2010).

Most of the land within the Limestone Coast and Coorong coastal boundary is captured in the State's reserves system (51%). The dedication of some of these areas has been for the purpose of conserving particular species or environments. For example, Douglas Point Conservation Park was created to protect the threatened plant species, Sand Ixodia and also to protect food species for the Orange-bellied Parrot. Many other parks were set aside to protect and preserve the coastal environment of the South East, especially because of their importance to migratory waders and waterfowl; including Canunda National Park, Coorong National Park, Piccaninnie Ponds Conservation Park, Little Dip Conservation Park and Lake Frome Conservation Park.

Available records from the Department for Environment and Natural Resources and records from local observers indicate that there are currently 439 fauna species (native and non-native) found along the South East coast; comprising 273 birds, 69 mammals, 40 reptiles, 11 amphibians and 46 butterflies. Of these, 15 are listed under the *Environment, Protection and Biodiversity Conservation Act 1999* (EPBC Act) as critically endangered, endangered or vulnerable, and 38 as migratory. Under the *National Parks and Wildlife Act 1972* (NPW Act), 105 species are listed as endangered, vulnerable or rare.

They were considered to be chance sightings, or of dead individuals washed up from the sea (G. Carpenter pers. comm. 2009[*]). A total of 20 introduced fauna species have been recorded in the region.

The dataset used includes some records dating back to the early 1900's. This is both a limitation and a benefit. Changes to the landscape over this time may have impacted on the number and type of species present, resulting in the data indicating a species is present in an area where it no longer occurs. However, this historical data may be extremely useful in identifying changes in environmental conditions and species distribution over time.

The following section lists some of the threatened species and outlines the significant habitats within the South East coastal boundary for each group of fauna (birds, mammals, reptiles and amphibians), as well as the most abundant species. Butterflies are also included in an additional section, as a substitute for and representative of invertebrate abundance. A separate section follows, outlining five species chosen as focal species, where their importance and dependence on the coast is described. Lastly, species richness and current threats are discussed.

3.2.1 Birds

Combined records obtained from the Biological Survey Group data base (BDBSA), Atlas of Australian Birds, Birds SE, Australasian Wader Studies Group, and Friends of Shorebirds SE show 273 bird species have been documented within the Limestone Coast and Coorong coastal boundary. This includes records from local bird observers considered as valuable sightings. Appendix 9 lists all bird species, together with the cells where they have been recorded. Of particular importance to bird fauna in the region are the numerous water bodies, which provide important habitat for many of the species.

The following section focuses on State (endangered, vulnerable and rare) and Commonwealth EPBC (critically endangered, endangered and vulnerable) listed species. Birds are grouped by type (e.g. bushbird or waterbird), then by their habitat preference where appropriate. Guided by Graham Carpenter (DENR) and Maureen Christie (Friends of Shorebirds SE), some non-listed but important species were also included, such as migratory and resident waders and those bird species breeding along the South East coast. Some species were removed from the complete bird listing, despite being recorded occasionally within the South East. These were species which were only recorded on a few occasions and where their usual habitat is not found in this region. They were considered to be chance sightings, or of dead individuals washed up from the sea (mostly seabirds). Such species removed included: Shy Albatross, *Diomedea cauta*, Grey-headed Albatross, *Thalassarche chrysostoma* and Black-browed Albatross, *T. melanophris,* Southern-giant Petrel, *Macronectes giganteus*, Northern-giant Petrel, *M. halli*, Flesh-footed Shearwater, *Ardenna carneipes*, Pomarine Jaeger, *Stercorarius pomarinus*, Brown Goshawk, *Accipiter fasciatus*, Grey Goshawk, *A. novaehollandiae*, Macaroni Penguin (Royal Penguin), *Eudyptes chrysolophus*, Fiordland Penguin, *E. pachyrhynchus*, Fairy Prion, *Pachyptila turtur* and Broad-billed Prion, *P. vittate.*

[*] G. Carpenter pers. comm. 8 September 2009

Threatened bush birds

Coastal shrubland habitat

The Orange-bellied Parrot, *Neophema chrysogaster* (EPBC: CR; SA: E) is a coastal species, inhabiting coastal saltmarshes, coastal dune shrubs, beachfronts and occasionally introduced pastures (Ehmke et al. 2009). They have been sighted in all cells except SE11 (Guichen Bay). This migratory species travels from its breeding ground in south-west Tasmania to Victoria and the South East of South Australia in March-April each year. Sightings of these birds in South Australia have been in low numbers and in mostly beachfront and coastal dune vegetation; unlike in Victoria where it prefers saltmarsh habitat. Orange-bellied Parrots generally feed on Sea Rocket (*Cakile maritima**) and Bidgee-widgee (*Acaena novae–zelandiae*), which are present at Carpenter Rocks (SE5), a significant site for Orange-bellied Parrots. The rehabilitated Pick Swamp (SE1) has also had recent sightings of Orange-bellied Parrots feeding on Wireweed (*Polygonum aviculare**) (Birds Australia nd). Habitat assessments have confirmed the importance of weeds in the parrot's diet (Ehmke and Jones 2009). Orange-bellied Parrots have been known to roost in remnant patches of Silky Tea-tea (*Leptospermum lanigerum*), and in vegetated areas around Blackfellows Caves (SE 4) (Birds Australia nd). The Orange-bellied Parrot has been selected as a focal species for this project and is discussed further in Section 3.2.5.

Elegant Parrot, *Neophema elegans* (SA: R) has been found in Cells SE 1, 2, 3, 6, 7, 9, 10, 13, 15-17. Preferring coastal shrubland habitats including a variety of mallee or chenopod shrublands, heathlands, thickets and dunes, particularly *Eucalyptus gracilis* mallee. The Elegant Parrot is generally a terrestrial forager, feeding close to the ground on seeds, fruits and invertebrates, and nesting on or close to the ground.

In South Australia the Beautiful Firetail, *Stagonopleura bella* (SA:R) (Figure 3.16) lives in the swampy, grassy areas of the coast, around shrublands and forests composed of eucalypts, sheoaks, tea-tree and casuarinas (Croft et al. 1999; Australian Museum 2006). It has been recorded in all SE cells except SE12 and SE17. Foraging on or near the ground, they eat mainly grass seeds and the seeds of the casuarinas and tea tree (Croft et al. 1999; Australian Museum 2006).

Figure 3.16. Beautiful Firetail in heathy woodland near Blackford Drain. Photograph Chris Tzaros, Birds Australia.

Mallee/Low woodland habitat

Mallee Fowl, *Leipoa oCellata* (EPBC: V; SA: V) is a large mound builder recorded in Cells SE 15 to 17. They usually prefer to live in mallee eucalypt forest, with a high level of leaf litter from which the males build the mound where eggs are laid. Mallee Fowl are known to breed in Cells SE 15 and 16 (G. Carpenter pers. comm. 2009[*]) feeding mainly on seeds, herbs and insects. Fire regimes and the frequency and severity of drought are particularly influential to Mallee Fowl distribution, as they need a habitat with a long interval since fire to allow the leaf litter to build-up.

The Yellow-tailed Black-cockatoo, *Calyptorhynchus funereus* (SA: V), although not generally a coastal species, was recorded in many of the lower South East cells (SE Cells 1-5, 7, 9-13, 15). This species prefers a habitat composed of eucalypt woodland and pine plantations. They prefer to feed on seeds of native trees and pine cones, but also feed on the seeds of ground plants and some insects. Another bird with yellow features and not generally found on the coast is the Crested Shrike-tit, *Falcunculus frontatus* (SA: R) (Cells SE 1-5). This species is smaller than the Yellow-tailed Black-cockatoo but does inhabit the same vegetation. The Crested Shrike-tit generally feeds on insects, but will sometimes eat fruits and seeds.

Grassland habitat

Grassland species generally prefer areas dense with grassy species, which offer some protection and shelter from predators. The Brown Quail, *Coturnix ypsilophora* (SA: V) prefer to feed on seeds on the ground, green shoots and invertebrates. It also nests on the ground, under thick grasses creating a scrape in the ground, lined with grass (Australian Museum 2006). The Brown Quail is found in most South East coastal cells.

The Blue-winged Parrot, *Neophema chrysostoma* (SA: V) has been seen occasionally along most of the South East coast; recorded in all cells except SE 11, 12 and 14. They inhabit coastal and inland areas, preferring grasslands, grassy woodlands and wetlands. Blue-winged Parrot's diet consists mainly of seeds of grasses and herbaceous plants, but they require tree hollows or stumps in which to create a nest. As the feeding grounds of these parrots consist of grasslands, they can tolerate some clearing of vegetation, but not when their nest sites are removed (Australian Museum 2006).

Threatened wader species

Many wader species have been recorded along the South East coast (Table 3.6), especially in the Coorong (Cells SE 17, 16 and 15) and other important sites, such as Pelican Point (Cells SE 4 and 5, approximately 3 km south east of Carpenter Rocks) and Danger Point (Cells SE 1 and 2) (M. Christie pers. comm. 2009[†]). However, wader species are found in all South East coastal cells, whether they are resident or migratory species. Habitats preferred by waders include a combination of sheltered bays, estuaries, lagoons, mudflats, sandflats, spits, banks, near-coastal wetlands, saltmarsh, rocky coasts, rocky platforms, dunes and or reef environments and offshore islands, such as Baudin Rocks (Cell SE12) or man-made structures, such as Margaret Brock Reef (4 km off Cape Jaffa). Waders consume a range of food types, including: various annelids, crustaceans, fish, birds, worms, insects, tadpoles, crabs, polychaetes, spiders, eggs, carrion, bivalve molluscs, gastropods, shrimps, sea-cumbers, lizards, frogs and grasshoppers. Some species are known to also eat seeds, berries and plant material. The resident Banded Stilt (*Cladorhynchus leucocephalus*) is recorded to breed in the Coorong in low numbers, although it has been unsuccessful in recent years. The Australian Painted Snipe (*Rostratula australis*) is also known to breed in low numbers. Other wader species breeding along the South

[*] G. Carpenter pers. comm. 28 July 2009
[†] M. Christie pers. comm. 25 June 2009

East coast include: Sooty Oystercatcher (*Haematopus fuliginosus*) (Figure 3.17), Australian Pied Oystercatcher (*H. longirostris*), Black-winged Stilt (*H. himantopus*), Black-fronted Dotterel (*Elseyornis melanops*), Red-kneed Dotterel (*E. cinctus*) (Figure 3.19), Hooded Plover (*Thinornis rubricollis*) (Figure 3.18), Red-capped Plover (*Charadrius ruficapillus*) (Figure 3.20), Masked Lapwing (*Vanellus miles*), Banded Lapwing (*V. tricolour*) and Red-necked Avocet (*Recurvirostra novaehollandiae*) (G. Carpenter* and M. Christie† pers. comm. 2009).

Figure 3.17. Sooty Oystercatcher (*Haematopus fuliginosus*). Photograph P. Wainwright.

Figure 3.18. Hooded Plover (*Thinornis rubricollis*). Photograph P. Wainwright.

The Coorong, in addition to other South East sites including Lake Robe, Lake Eliza, Lake St. Clair, Lake George, Pt. MacDonnell, and Carpenter Rocks are exceptional sites for migratory shorebirds, where species aggregate in internationally and nationally significant numbers (Table 3.6). An area is deemed internationally important if it supports 1% of the East Asian-Australasian Flyway (EAAF) population of a species. A flyway is a geographic region that supports a group of migratory waterbirds that undertake an annual movement cycle (Bamford 2008). The Australian Government is currently considering a proposal to recognise sites that support 0.1% of a species in the EAAF as to define sites of 'national importance'. Sites of international and national importance, are significant conservation areas, and should be managed to conserve their unique values.

The Ramsar Convention is a global intergovernmental treaty on the conservation and wise use of wetlands. 'The Coorong, and Lakes Alexandrina and Albert' is the only Ramsar listed site included in the coastal boundary (in part). Proclaimed in November

* G. Carpenter pers. comm. 28 July 2009
† M. Christie pers. comm. 26 June 2009

1985, the Coorong was listed as an important breeding area for the Australia Pelican, Crested Tern and Fairy Tern (Ramsar 2009) and at that time supported nine shorebird species in internationally significant numbers. Since its proclamation, the site has suffered ecological stress because of extended drought, water regulations and the early impacts of climate change (DEWHA 2009a). An Ecological Character Description has been developed, as required by the Ramsar Convention (DEWHA 2009a). To date, no sites have ever been removed or de-listed from the List (Ramsar 2009).

The Australian Government has treaties with Japan, China and Korea (Japan-Australia Migratory Bird Agreement (JAMBA), China-Australia Migratory Bird Agreement (CAMBA) and the Republic of Korea- Australia Migratory Bird Agreement (ROKAMBA)) that protect and help preserve those species, habitats and areas where migratory birds congregate. Areas within the South East coastal zone support some of the species listed under the international agreements and accordingly need to be managed and protected.

Table 3.6. Threatened wader species present within the South East coastal zone.

Resident/ Migratory	Scientific name	Common name	Aust Status	SA Status
M	*Actitis hypoleucos*	Common Sandpiper	M	R
M	*Arenaria interpres*	Ruddy Turnstone	M	R
M	*Calidris acuminata*	Sharp-tailed Sandpiper	M	
M	*Calidris alba*	Sanderling	M	R
M	*Calidris canutus*	Red Knot	M	
M	*Calidris ferruginea*	Curlew Sandpiper	M	
M	*Calidris melanotos*	Pectoral Sandpiper	M	R
M	*Calidris minuta*	Little Stint	M	
M	*Calidris ruficollis*	Red-necked Stint	M	
M	*Calidris subminuta*	Long-toed Stint	M	R
M	*Calidris tenuirostris*	Great Knot	M	R
M	*Charadrius bicinctus*	Double-banded Plover		
M	*Charadrius leschenaultii*	Greater Sand Plover (Large Sand Plover)	M	R
M	*Charadrius mongolus*	Lesser Sand Plover (Mongolian Plover)	M	R
R	*Charadrius ruficapillus* ^	Red-capped Plover (Red-capped Dotterel)		
M	*Charadrius veredus*	Oriental plover	M	
R	*Cladorhynchus leucocephalus* ^	Banded Stilt		V
R	*Elseyornis melanops* ^	Black-fronted Dotterel (Black-fronted Plover)		
R	*Erythrogonys cinctus* ^	Red-kneed Dotterel		
M	*Gallinago hardwickii*	Latham's Snipe (Japanese Snipe)	M	R
R	*Haematopus fuliginosus* ^	Sooty Oystercatcher		R
R	*Haematopus longirostris* ^	Australian Pied Oystercatcher		R
R	*Himantopus himantopus* ^	Black-winged Stilt		
M	*Limicola falcinellus*	Broad-billed Sandpiper	M	

Resident/ Migratory	Scientific name	Common name	Aust Status	SA Status
M	*Limosa lapponica*	Bar-tailed Godwit	M	R
M	*Limosa limosa*	Black-tailed Godwit	M	R
M	*Numenius madagascariensis*	Eastern Curlew	M	V
M	*Numenius minutus*	Little Curlew	M	
M	*Numenius phaeopus*	Whimbrel	M	R
M	*Phalaropus fulicarius*	Grey Phalarope		
M	*Phalaropus lobatus*	Red-necked Phalarope	M	
M	*Philomachus pugnax*	Ruff	M	R
M	*Pluvialis fulva*	Pacific Golden Plover	M	R
M	*Pluvialis squatarola*	Grey Plover	M	
R	*Recurvirostra novaehollandiae* ^	Red-necked Avocet		
R	*Rostratula australis* ^	Australian painted Snipe	V	V
R	*Thinornis rubricollis* ^	Hooded Plover		V
M	*Tringa brevipes*	Grey-tailed Tattler	M	R
M	*Tringa glareola*	Wood Sandpiper	M	R
M	*Tringa nebularia*	Common Greenshank	M	
M	*Tringa stagnatilis*	Marsh Sandpiper	M	
R	*Vanellus miles* ^	Masked Lapwing		
R	*Vanellus tricolour* ^	Banded Lapwing		
M	*Xenus cinereus*	Terek Sandpiper	M	R

^ species breed along the South East coast
Note: species that are internationally significant are also nationally significant.

Figure 3.19. Red-kneed Dotterel. Photograph P. Wainwright.

Figure 3.20. Red-capped Plover. Photograph P. Wainwright.

Threatened waterbirds

For the purpose of this document, waterbirds are classified as those species that inhabit mainly freshwater, including coastal lakes and wetlands, lagoons, swamps, reservoirs and bays (Australian Museum 2006).

Three species of duck and one shoveler species are present along most of the South East coast: Musk Duck, *Biziura lobata* (SA: R) (Figure 3.21), Blue-billed Duck, *Oxyura australis* (SA: R), Freckled Duck, *Stictonetta naevosa* (SA: V) and Australasian Shoveler, *Anas rhynchotis* (SA: R). The Musk and Blue-billed Ducks both breed in the South East and

prefer large, deeper water bodies, where they feed on insects, crustaceans, fish and occasionally on the seeds of aquatic plants. The Freckled Duck has a more vegetative diet, consisting of algae, seeds and vegetation, and prefers less saline habitats like Lake Bonney (D. Mount pers. comm. 2009*). The Australasian Shoveler is a filter feeder, preferring small insects, crustaceans and plants in soft mud and water. The Australasian Shoveler also breeds in many of the cells along the South East.

Figure 3.21. Male Musk Duck (*Biziura lobata),* undertaking a mating display. Photograph P. Wainwright.

Egrets can occupy various habitats, from beaches, wetlands, rocky shores, tidal areas and exposed coral reefs to grasslands and woodlands with poor drainage and hence are a common sighting along the South East coast, especially in the lower South East. Four different species of egrets are found in the South East coastal zone. Although all the species have similar diets, consisting of fish, insects, amphibians, crustaceans, reptiles and occasionally small mammals, their method of foraging is slightly different; Cattle Egret, *Ardea ibis* (SA: R) catch their prey by lunging at it, or picking insects directly from and around cattle, whereas the Intermediate Egret, *A. intermedia* (SA: R), Eastern Reef Egret, *Egretta sacra* (SA: R) and Little Egret, *E. garzetta* (SA: R) stalk or ambush their prey. Only the Eastern Reef Egret is known to breed within the South East coastal boundary (G. Carpenter pers. comm. 2009†).

Other listed waterbirds present in the South East coastal zone include: Great Crested Grebe, *Podiceps cristatus* (SA: R) and Cape Barren Goose, *Cereopsis novaehollandiae* (SA: R), present in at least nine South East cells (Appendix 9). The Magpie Goose, *Anseranas semipalmate* (SA: E) and Brolga, *Grus rubicunda* (SA: V) were each present in two cells each, SE 1 and 4 and 1 and 13, respectively. The Brolga, along with the Australasian Bittern, *Botaurus poiciloptilus* (SA: V) and Australian Pelican, *Pelecanus conspicillatus* (Figure 3.22), are known to breed in the South East.

* D. Mount pers. comm. 19 November 2009

† G. Carpenter pers. comm. 28 July 2009

Figure 3.22. Australian Pelican (*Pelecanus conspicillatus)*. Photograph P. Wainwright.

Threatened seabirds

Twenty-two listed seabird species, in six families have been recorded along the South East coast, but some of these are not typically seen on the coast and so were removed, such as albatross and petrel species. Eleven tern species have been recorded on the South East coast, five of which have an Australian or South Australian status. Terns are usually found near the coast, while some species can also be found in wetlands and sheltered estuaries. Terns eat mostly fish, which are caught by plunging and stabbing, but they will also eat aquatic insects and crustaceans.

The Common Tern, *Sterna hirundo* (SA: R) is a migratory tern, while six other species breed in the South East coastal area or on offshore islands; the Crested Tern, *Thalasseus bergii* and Bridled Tern, *Onychoprion anaethetus* are known to breed on Baudin Rocks. Bridled Tern have previously also bred in Beachport, while the Little Tern, *S. albifrons* (SA: E), Fairy Tern, *S. nereis* (SA: E), Caspian Tern, *Hydroprogne caspia* and Whiskered Tern, *Childonias hybrida* breed at various locations along the South East coast. Terns are beach nesting birds, making scrapings in the sand. Their nests are particularly vulnerable to extreme weather (strong wind, high tides) and predation of eggs and chicks by foxes, dogs, cats, black rats, silver gulls, ravens and raptors (DEC 2009). The Fairy Tern has been selected as a Focal Species and is discussed in more detail in Section 3.2.5.

Another breeding seabird along the South East coast is the Short-tailed Shearwater (*Ardenna tenuirostris*), which breeds in Cell SE2. Baudin Rocks proves to be an important breeding site to more than the Crested Tern and Bridled Tern, with the Little Penguin (*Eudyptula minor*), Australasian Gannet (*Morus serrator*) and Black-faced Cormorant (*Phalacrocorax fuscescens*) also breeding there (G. Carpenter[*] and M. Christie pers. comm. 2009[†]). Black-faced Cormorants are also known to breed on the islets/rock stacks at Cape Northumberland and Carpenter Rocks (M. Christie pers. comm. 2009[‡]).

Threatened raptors

Two of the endangered (State) raptors present along the South East coastal zone are the White-bellied Sea-eagle, *Haliaeetus leucogaster* (recorded in all cells except SE 3, 8, 14 and

[*] G. Carpenter pers. comm. 8 September 2009
[†] M. Christie pers. comm. 25 June 2009
[‡] M. Christie pers. comm. 25 June 2009

16) and the Eastern Osprey, *Pandion cristatus* (present in Cells SE 1-6 ,10 and 11). Whilst the White-bellied Sea-eagle was recorded in most cells, it does not represent a resident or breeding individual; just that an individual was sighted. The White-bellied Sea-eagle prefers to hunt in open terrestrial habitats, inshore waters, islands, coral reefs, cays, bays, inlets, estuaries, mangroves and beaches, whereas Eastern Osprey hunt in larger patches of open water, and along the coast. Preferred prey items and nest sites also differ between the species, where the White-bellied Sea-eagle hunt for birds, fish, mammals, reptiles, crustaceans and carcasses of dead animals (carrion) and nests along cliffs, rock pinnacles, escarpments, tall trees. Eastern Osprey eat small terrestrial vertebrates, seabirds and crustaceans, while nesting in high positions, or surrounded by water, such as rocky headlands, stacks, cliffs and artificial platforms. The Peregrine Falcon, *Falco peregrinus* (SA: R), is found in Cells SE 1-7, 9-11, 15 and 17; wherever food items are available. This species also breeds throughout much of the lower South East coastal region (G. Carpenter pers. comm. 2009[*]).

Habitat conservation for birds

Common threats to all coastal birds include: vegetation clearance and alteration; increased agriculture, grazing and change of land use, which creates areas of non-native vegetation and clears / isolates patches of native habitat; drainage of wetlands and lake systems, drought and flooding altering the cycles and environmental flows of water needed for healthy saltmarshes and freshwater wetlands; disturbance and predation by foxes, cats and dogs, especially on those ground dwelling and foraging species; grazing pressure from rabbits and abundant native herbivores which reduces the quality of native vegetation (rabbits in particular limit the height of shrub growth and recovery following clearance or fire); and disturbance by recreational vehicles and trampling of vegetation which also threaten significant foraging sites for coastal bird species.

Shorebirds are threatened by wetland destruction and alteration, pollution, disturbance, predation and hunting. Good feeding conditions and safe roosting sites are important for breeding and changes to favourable conditions could also impact shorebird numbers (Priest et al. 2002). Because of their relatively sedentary nature, sometimes in large numbers, introduced predators (foxes, dogs and cats) and increased numbers of native predators (gulls, ravens) also have impacts on their population numbers (Maguire 2008; Priest et al. 2002). Vehicles are also threatening these birds, especially beach-nesting birds, by crushing nests and young chicks on the beach (Maguire 2008). Many wader species use shallow waters and reefs as feeding, nesting and roosting grounds (Hughes 2004). The loss of this (and other) habitat from pollution, storm damage, sea level rise and/or human recreation activities is also threatening these species (Paton et al. 2000; Cornelius 2001; Bamford et al. 2008; Hughes 2004; Maguire 2008). An increase in coastal development also threatens the sensitive and important habitats for waders (Priest et al. 2002).

Sea Wheat-grass (*Thinopyrum junceiforme*) and Marram Grass (*Ammophila arenaria*), both introduced dune grasses, may be threatening to waders and beach-nesting birds by changing the beach profile and reducing the available nesting habitat (Maguire 2008). Marram grass has a great sand-binding capability which is creating steeper foredunes (when combined with wind and wave erosion) while also competing with native grasses (Maguire 2008; Harvey et al. 2003). Steeper beaches make it harder for chicks to escape predators and high tides into the safety of the native vegetation of the foredune. Sea wheat-grass (*Thinopyrum junceiforme*) can also change the beach morphology by leaving

[*] G. Carpenter pers. comm. 28 July 2009

vertical root bound escarpments following erosion of the foredune by storms and high seas (Figure 3.23).

Figure 3.23. Erosion of a Sea Wheat-grass (*Thinopyrum junceiforme*) covered foredune. Photograph J. Quinn, DENR.

'A Practical guide for managing beach-nesting birds in Australia (2008)' has been written by G. Maguire. This extensive document outlines the threats, management options and monitoring techniques and guidelines for the conservation and protection of beach-nesting birds. Some of the suggested management tools include signage, fencing of nesting areas, chick shelters, nest relocation and habitat management, especially weed control. Predator control is also a suggested action and is currently being implemented through fox baiting in the South East (in 2009 and 2010), in conjunction with regular shorebird monitoring. Fencing of nest sites is also being trialled at a few sites around the Carpenters Rocks area (trials have only just started) and is recommended to continue. Another management option that should be considered for the benefit of beach-nesting birds is controlled access and development around key breeding areas, especially during breeding periods. The Coorong beach closure is an example of this. The monitoring of shorebirds is also important and has been occurring for many years. This should continue, to aid the understanding of populations and help identify trends in numbers.

3.2.2 Mammals

The Biological Database of South Australia (BDBSA) (including the state biological survey and South Australian Museum (SAM) records) show 69 mammal species have been documented within the South East coastal zone (including the extinct Toolache Wallaby) (Appendix 10). Personal observations from locals, the expert opinion of Dr. Catherine Kemper (Vertebrates, Mammalogy, SAM) and information from management plans increased the occurrence of some species across the South East coastal cells. Those areas that are harder to access (part of SE1) or far from settled areas (Cell SE 14 to 18) have been rarely surveyed and hence these areas have few records. Thirty one of the recorded mammal species are listed as threatened under the Commonwealth and/or State listings, of which 20 are marine mammals. Introduced species make up 14% (10) of the mammal species recorded in the coastal zone.

For the purposes of this study it is important to include the presence and distribution of marine mammals within the cells, partly because of their historical connection with the coast through whaling stations. Whaling operations are included as historical sites within cells and are of conservation value. Tourism impacts are evident where people are drawn to the coast by sightings of marine species which frequent the waters of the South East of South Australia.

Eight of the 69 mammal species present within the study area are listed as threatened under the EPBC Act. Only two of these species Southern Brown Bandicoot (*Isoodon obesulus obesulus*) and Grey-headed Fying-fox (*Pteropus poliocephalus*) are terrestrial, the remaining 6 are marine mammals. Of the state listed species, 20 are marine and 11 are terrestrial (Table 3.7). Toolache Wallaby (*Macropus greyi*) is the only recorded extinct species although two other species were found as subfossil records in Cell SE17; Brush-tailed Bettong (*Bettongia penicillata*) and Western Barred Bandicoot (*Perameles bougainville*).

Table 3.7. Mammal species recorded in the South East coastal zone with an Australian threatened status (EPBC Act) or State threatened status (NPW Act).

Scientific Name	Common Name	EPBC Status	SA Status
Antechinus flavipes	Yellow-footed Antechinus		V
Antechinus minimus	Swamp Antechinus		E
Arctocephalus pusillus	Australian Fur-seal		R
Arctocephalus tropicalis	Subantarctic Fur-seal	V	E
Balaenoptera musculus	Blue Whale	EN	E
Caperea marginata	Pygmy Right Whale		R
Eubalaena australis	Southern Right Whale	EN	V
Globicephala macrorhynchus	Short-finned Pilot Whale		R
Grampus griseus	Risso's Dolphin		R
Hydrurga leptonyx	Leopard Seal		R
Hyperoodon planifrons	Southern Bottlenose Whale		R
Isoodon obesulus obesulus	Southern Brown Bandicoot (SA mainland and KI ssp)	EN	V
Kogia breviceps	Pygmy Sperm Whale		R
Macropus greyi	Toolache Wallaby	EX	E
Macropus rufogriseus	Red-necked Wallaby		R
Megaptera novaeangliae	Humpback Whale	V	V
Mesoplodon bowdoini	Andrew's Beaked Whale		R
Mesoplodon grayi	Gray's Beaked (Scamperdown) Whale		R
Mesoplodon hectori	Hector's Beaked Whale		R
Mirounga leonina	Southern Elephant Seal	V	R
Neophoca cinerea	Australian Sea-lion	V	V
Perameles bougainville	Western Barred Bandicoot		E
Physeter macrocephalus	Sperm Whale		R
Pseudorca crassidens	False Killer Whale		R
Pteropus poliocephalus	Grey-headed Flying-fox	V	R
Rattus lutreolus	Swamp Rat		R
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat		R

Scientific Name	Common Name	EPBC Status	SA Status
Tasmacetus shepherdi	Sheperd's Beaked Whale		R
Trichosurus vulpecula	Common Brushtail Possum		R
Vombatus ursinus	Common Wombat		R
Wallabia bicolor	Swamp Wallaby		V

Terrestrial species

The Toolache Wallaby (*Macropus greyi*) was common in the South East of South Australia, and nearby areas of Victoria, at the time of European settlement (Robinson 1983). Now extinct, the Toolache Wallaby was hunted for sport and their skins. Rapid development of their habitat also contributed to their disappearance (Robinson 1983). The Toolache Wallaby preferred habitat consisting of grasslands on the edge of stringy bark heath, with gentle undulating ground creating swampy patches filled with Blackrush and Kangaroo Grass (Van Dyck and Strahan 2008). The Biological Database of South Australia has only five records of the Toolache Wallaby (in Cells SE 10 and 13), all captured by a South Australian Museum team on three occasions; two in 1891, one in 1915 and two in 1925. It has not been included in current species counts in this report.

Southern Brown Bandicoot (*Isoodon obesulus obesulus*) (Figure 3.24), nationally listed as endangered, State listed as vulnerable, was only present in one cell (Cell SE9), recorded in 1985. This species can be found in forest, woodland, shrub and heath communities and are known to have a fragmented distribution (Van Dyck and Strahan 2008).

Figure 3.24. Southern Brown Bandicoot (*Isoodon obesulus obesulus*). Photograph P. Canty, DENR.

The preferred habitat of the nationally (vulnerable) and State (rare) listed Grey-headed Flying-fox (*Pteropus poliocephalus*) is dense riparian vegetation, such as some of the shores of the coastal lakes in the South East. Loss of habitat threatens Grey-headed Flying-fox numbers (Van Dyck and Strahan 2008), but this is unlikely to be the reason they were only recorded in one cell (Cell SE13). The flying nature of this species makes them more difficult to catch and record than other terrestrial species and it is possible they are present in other areas of the coast and are yet to be recorded.

The Swamp Antechinus (*Antechinus minimus*) (SA: E) (Figures 3.35 and 3.36) is a small carnivorous marsupial that inhabits dense, wet shrublands, tussock grasslands and sedgelands. In the South East it prefers *Leptospermum lanigermum-Ghania* swamplands and feeds on insects which it digs for in the moist soils (Croft et al. 1999). Selected as a focal species for this study, the Swamp Antechinus is described further in Section 3.2.5. Potential habitat for the Swamp Antechinus is recorded in all cells except Cell SE3. Actual sightings are only recorded in Cells SE 1, 2, 5, 6, 7, 9 and 10.

Although the Common Brushtail Possum (*Trichosurus vulpecular*) (SA: R) (Figure 3.25) is often thought to be common, it is a species generally in decline in its natural habitat. This species is only recorded in two of the cells in the South East (Cells SE 9 and 10) but is assumed to inhabit others. Being one of the most widely distributed mammals in Australia, this species can occur in many habitats, but prefers dry eucalypt forests and woodlands (Van Dyck and Strahan 2008). Consuming a variety of plant material, this species is herbivorous and requires older trees with hollows, for shelter and denning (Van Dyck and Strahan 2008). The destruction of natural habitat and urbanisation has contributed to the Common Brushtail Possum commonly residing in the roofs of houses (Harper 2005). The presence of this species in urban environments is known, but not necessarily well documented[*].

Figure 3.25. Common Brushtail Possum (*Trichosurus vulpecular*). Photograph G. Jackway, DENR.

The Common Wombat (*Vombatus ursinus*) (SA: R) (Figure 3.26) is currently recorded in ten South East coastal cells (SE 2, 4- 7, 10, 11, 15, 16 and 17). The preferred habitat of the Common Wombat is present throughout much of the South East coast and this species is likely to be present in other cells; their main habitat includes temperate forests, open vegetation, woodland, coastal scrub, heathland and grassy flat areas (Van Dyck and Strahan 2008; C. Kemper pers. comm. 2009[†]). Wombats are mobile animals and are often forced to cross roads that dissect their habitat. Reducing speed limits or increasing signage around crucial areas of vegetation may help to reduce the numbers of Common Wombats being killed by vehicle strike.

Of the mammal species recorded, many of the most abundant are introduced species, including the cat (*Felis catus*), house mouse (*Mus musculus*), rabbit (*Oryctolagus cuniculus*), black rat (*Rattus rattus*) and fox (*Vulpes culpes*), which were all recorded in at least ten of the 17 SE cells. The more common native species, present in at least ten SE cells,

[*] To increase the knowledge and known range of the Common Brushtail Possum, sightings and dead individuals can be reported to the South Australian Museum (C. Kemper pers. comm. 2009). This information will aid the understanding and present range of this species

[†] C. Kemper pers. comm. 21 July 2009

include: the Western Grey Kangaroo (*Macropus fuliginosus*), Bush Rat (*R. fuscipes*) and Swamp Rat (*R. lutreolus*). It is possible the number and distribution of introduced species is more widely spread throughout the area because they are more commonly recognised and identified than native mammals. Introduced species are also generally more adaptive and likely to be present in and around those areas settled by humans and hence more likely to be recorded opportunistically.

Figure 3.26. The State listed Common Wombat (*Vombatus ursinus*). Photograph S. Jennings.

Marine species

Marine mammals also add to the conservation value of the South East, especially as many of the marine species are State or Commonwealth listed. The majority of the marine mammal records are from strandings of dead individuals, while others are of live animal sightings (Table 3.8). The South East part of the South Australian coast is more likely to have individuals wash-up on the beach because the coastline is open and exposed to the Southern Ocean. Dead individuals can be carried onto the South East coast by currents and wave action. The continental shelf is also narrower in this area compared to other parts of southern Australia, meaning that oceanic species, such as Blue Whale (*Balaenoptera musculus*) and Antarctic Minke Whale (*Balaenoptera bonaerensis*) can come closer to the land and hence have increased sightings (from the coast) (C. Kemper pers. comm. 2009[*]).

Table 3.8. Marine mammal species recorded along the South East coast*.

Scientific Name	Common Name	Common/ Vagrant	Type of record
Arctocephalus forsteri	New Zealand Fur-seal	Common	L, D
Arctocephalus pusillus	Australian Fur-seal	Common	L, D
Arctocephalus tropicalis	Subantarctic Fur-seal	Rare/Vagrant	D
Balaenoptera bonaerensis	Antarctic Minke Whale	Rare	D
Balaenoptera musculus	Blue Whale	Common	L, D
Caperea marginata	Pygmy Right Whale	Rare	D
Delphinus delphis	Common Dolphin	Common	D
Eubalaena australis	Southern Right Whale	Common	L, D

[*] C. Kemper pers. comm. 21 July 2009

Scientific Name	Common Name	Common/ Vagrant	Type of record
Globicephala macrorhynchus	Short-finned Pilot Whale	Vagrant	D
Globicephala melas	Long-finned Pilot Whale	Common	D
Grampus griseus	Risso's Dolphin	Rare	D
Hydrurga leptonyx	Leopard Seal	Vagrant	L
Hyperoodon planifrons	Southern Bottlenose Whale	Rare	D
Kogia breviceps	Pygmy Sperm Whale	Rare	D
Lobodon carcinophagus	Crabeater Seal	Vagrant	D
Megaptera novaeangliae	Humpback Whale	Common	L
Mesoplodon bowdoini	Andrew's Beaked Whale	Rare	D
Mesoplodon grayi	Gray's Beaked (Scamperdown) Whale	Rare	D
Mesoplodon hectori	Hector's Beaked Whale	Rare	D
Mesoplodon layardii	Straptooth Whale	Rare	D
Mirounga leonina	Southern Elephant Seal	Vagrant	L, D
Neophoca cinerea	Australian Sea-lion	Common	L, D
Ommatophoca rossii	Ross Seal	Vagrant	L, D
Orcinus orca	Killer Whale (Orca)	Common	L
Physeter macrocephalus	Sperm Whale	Common	D
Pseudorca crassidens	False Killer Whale	Rare	D
Tasmacetus shepherdi	Sheperd's Beaked Whale	Rare	D
Tursiops truncatus	Common Bottlenose Dolphin	Common	D
Ziphius cavirostris	Cuvier's Beaked Whale (Goosebeak whale)	Rare	D

*Species are listed as commonly seen, rarely seen or vagrant and the record as live (L) (sighting) or dead (D).

One of the most common marine mammals that frequent the South East coast is the Southern Right Whale (*Eubalaena australis*) (EPBC: EN; SA: V). Southern Right Whales feed in summer in the open Southern Ocean, and come close to the coast in winter. In Australia, they occur from Perth, WA to Sydney, NSW, including Tasmania (Banniser et al. 1996). Sightings along the South East coast occur mainly during the winter months, when females use shallow coastal waters for calving (Bannister et al. 1996). Their population structure suggests high juvenile and low adult mortality (Bannister et al. 1996). Southern Right Whales rarely strand in South Australia (Kemper and Ling 1991), with only one recorded specimen found in Cell SE 2, but they have been sighted off many SE cells.

Australian Sea-lion, *Neophoca cinerea* (EPBC: VU; SA: V), were recorded (dead or alive) in most of the cells along the South East coast. They are distributed from Kangaroo Island, South Australia, to the Houtman Abrolhos Islands in Western Australia (Gales *et al.* 1994) with vagrant individuals coming ashore in eastern Australia as far north as central New South Wales (Jefferson et al. 2008). The Australian Sea-lion is especially important as it is the only endemic seal species in Australia (McIntosh et al. 2006). The species was subject to intensive sealing in the 18th, 19th and early 20th centuries (Goldsworthy et al. 2009), but are mostly threatened today by disturbance to breeding colonies and interactions with fisheries (entanglement/by-catch) (Jefferson et al. 2008; Goldsworthy et

al. 2009). Sea level rise may also lead to the loss of some breeding colonies, as some of the smaller islands and shore platforms become submerged (Goldsworthy et al. 2009).

Bottlenose Dolphin (*Tursiops truncatus*) is a coastal, estuarine, pelagic and oceanic species, occurring in tropical to temperate waters (Van Dyck and Strahan 2008), found in the waters (alive) and beached (dead) in Cells SE 1-7, 9, 14, 15 and 16. Occurring in waters off all states of Australia, *Tursiops truncatus* has two subspecies in Australia, *T.t. truncatus* and *T.t. aduncus*. Only *T.t. truncatus* is found in the South East, as *T.t. aduncus* prefers shallow waters less than 10 m, such as those around Adelaide and the gulf waters of St. Vincent and Spencer Gulf (Banniser et al. 1996; Kemper 2008).

Some of the listed marine species are vagrant species; indicating they are visitors and probably don't live in the area (C. Kemper pers. comm. 2009[*]). Others are rarely seen or only occasionally. Several of the common species are seen on a more regular basis because they have haul-out sites or feeding areas nearby. Examples include New Zealand Fur-seal (*Arctocephalus forsteri*), Australian Fur-seal (*A. pusillus*), Australian Sea-lion (*Neophoca cinerea*) and Bottlenose Dolphin (*Tursiops truncatus*) and Common Dolphin (*Delphinus delphis*). the Southern Right Whale (*Eubalaena australis*) is a commonly seen species off the South East coast because it undertakes a yearly migration to southern Australia to calve.

Habitat conservation for mammals

Terrestrial

Three of the state listed terrestrial species are typically found in swampy areas, including Swamp Antechinus (*Antechinus minimus*), Swamp Rat (*Rattus lutreolus*) and Swamp Wallaby (*Wallabia bicolour*) (Figure 3.27). Other species found in the South East coastal region, such as the Yellow-footed Antechinus (*Antechinus flavipes*), Little Bent-wing Bat (*Miniopterus australis*) and the Grey-headed Flying-fox (*Pteropus poliocephalus)* can also occur in swampy, damp, riparian areas. The swampy areas of the South East have not been as highly modified as other areas (such as those areas more suitable to agriculture), and these areas have possibly acted as a refuge or safe-haven for these species, along with government reserves and Heritage agreements (Croft 1999). The biggest threat to these species is the loss and alteration of habitat; particularly the drainage of wet areas (such as areas around marshes, swamps and lakes). Habitat clearance and damage to vegetation by off road vehicles are also resulting in habitat loss and fragmentation. Weeds can also cause habitat changes by displacing native vegetation. Introduced animals such as cats and foxes also need to be controlled, to give these smaller mammals the best chance of survival.

[*] C. Kemper pers. comm. 21 July 2009

Figure 3.27. Swamp Wallaby, Canunda NP. Photograph G. Jackway, DENR.

Marine

Maintaining the quality of marine waters is critical to protect marine mammal species. Many of the common marine species, especially the fur-seals, sea lions and dolphins, feed on fish, squid, cuttlefish, octopus, sharks, rock lobster, other small crustaceans and penguins (McIntosh et al. 2006; Marlow 1975; Gales and Cheal 1992). Maintaining and improving the seagrasses around the coast will help ensure a suitable breeding ground and nursery for some of these food species (Bell and Pollard 1989; Howard et al. 1989). Entanglement and by-catch also threaten many species (Kemper 2008; Goldsworthy et al. 2009; Kemper et al. 2005).

Over a number of years since 1997 (except 2006), an annual litter survey was conducted at Long Beach (Guichen Bay) by the Robe Professional Fisherman's Association, in conjunction with SARDI Aquatic Sciences and a variety of community groups (Reef Watch nd). Rubbish levels have increased in most years (Eglinton et al. 2006) reinforcing the need to educate and promote correct rubbish disposal. Other activities in and around the water environment can also impact on marine and shore species including noise pollution, water pollution and human disturbance (tourism) (Bannister et al. 1996). These actions also need to be reduced and controlled to limit the impact to fauna species (Bannister et al. 1996). Disturbance is especially important to calving and migration routes of Southern Right Whale (*Eubalaena australis*) (Kemper 2008).

Baudin Rocks (part of Cell SE 12) is a rocky group of islands approximately 2.5 km seaward of Cape Thomas. The site provides an area for New Zealand and Australian Fur-seals and Australian Sea-lions to haul-out. Consisting of flat and uneven areas of rock and a small beach, Baudin Rocks is a suitable resting area for all three species (S. Goldsworthy pers. comm. 2009[*]). It is possible these marine mammals may become a more frequent sighting along the South East coast as population numbers increase and the island is unable to support any more individuals. Similarly sea level rise will reduce the area of the island available to resting individuals. Fur-seals and Sea-lions will generally avoid areas that are close to shore to avoid human contact, but in the event that they do move to the coast, it is important they are left undisturbed.

3.2.3 Reptiles and Amphibians

State Biological Survey and South Australian Museum (SAM) records show 40 reptile and 11 amphibian species have been documented within the study area. Personal observations from locals and the expert opinion of Dr. Mark Hutchinson (Herpetology,

[*] S. Goldsworthy pers. comm. 1 July 2009

SAM) and information from reserve management plans increased the record of occurrence of some species across the South East coastal cells. Mark Hutchinson also added three species not previously recorded in the area. These species can be confidently assumed to be present due to their preference of habitat and other known locations in the South East just outside the coastal boundary. Thirteen reptile and amphibian species are listed as threatened under the Australian Commonwealth (4) and/or State listings (12).

Threatened reptiles and amphibians

Two reptile and one amphibian species are recorded as vulnerable species under the EPBC Act (Australian status) (Table 3.9). Both the Striped Snake-lizard (*Delma impar*) and Green Turtle (*Chelonia mydas*) were each recorded in one cell; Cell SE5 and Cell SE13 respectively. The Southern Bell Frog (*Litoria reniformis*) was recorded in six cells (Cells SE 3, 11, 13, 15-17).

Table 3.9. Threatened reptile and amphibian species recorded within the coastal boundary.

Scientific name	Common Name	EPBC Status	SA Status	Species prefers cool, temperate conditions
Chelonia mydas	Green Turtle	V	V	
Delma impar	Striped Snake-lizard	V		
Dermochelys coriacea	Leathery Turtle	E	V	
Drysdalia coronoides	White-lipped Snake		R	Yes
Echiopsis curta	Bardick		R	
Lissolepis coventryi	Swamp Skink		E	Yes
Nannoscincus maccoyi	Salamander Skink		E	Yes
Pseudemoia rawlinsoni	Glossy grass Skink		V	Yes
Varanus rosenbergi	Heath Goanna		V	
Geocrinia laevis	Smooth Frog		R	Yes
Litoria raniformis	Southern Bell Frog	V	V	
Pseudophryne bibronii	Brown Toadlet		R	
Pseudophryne semimarmorata	Marbled Toadlet		V	Yes

Some of the State listed reptile (four) and amphibian (two) species prefer cool, temperate zoned habitats. The lower South East provides this preferable habitat, enabling the area to become a stronghold for the species (M. Hutchinson pers. comm. 2009[*]). Other non-threatened species that do well in the cooler areas of the South East are Lowland Copperhead (*Austrelaps superbus*), Southern Grass Skink (*Pseudemoia entrecasteauxii*) and Blotched Bluetounge (*Tiliqua nigrolutea*). This is reflected in their presence in the lower South East cells (Cells SE 1-11) (Appendix 11).

Although the Southern Water Skink (*Eulamprus tympanum*) has not been recorded within the coastal boundary (it was one of three species assumed to be there by expert Dr. Mark Hutchison, SAM), the lower South East region provides suitable habitat for the species (such as damp environments along streams and drains including wet schlerophyll forests, rocky areas and freshwater bodies), and it is found in the surrounding area (M.

[*] M. Hutchinson pers. comm. 7 June 2009

Hutchinson pers. comm. 2009*; BDBSA). The two other species not recorded in the South East coastal boundary but expected to be present, are Jacky Dragon (*Amphibolurus muricatus*) in the lower South East and Plague Skink (*Lampropholis delicata*) in the upper South East (M. Hutchinson pers. comm. 2009*; BDBSA). The Plague Skink is a small, brown skink that is not often found by accident. Concerted searching is needed to find this species (M. Hutchinson pers. comm. 2009*). The Jacky Dragon prefers coastal heathlands, dry sclerophyll forests and rocky ridges (Cogger 2000).

Three of the listed reptile species are only present in the lower South East of South Australia, the Striped Snake-lizard, *Delma impar* (EPBC: V), Salamander Skink, *Nannoscincus maccoyi* (SA: E) and Glossy Grass Skink, *Pseudemoia rawlinsoni* (SA: V) (Figure 3.28). All three species have a limited distribution, even outside South Australia. They are also found in parts of Victoria and south eastern New South Wales (Cogger 2000). Although Striped Snake-lizard is only found in Cell SE 5, it is possible it could be present in Cells SE 1-4, which also have similar habitats and environmental conditions and connect the current known distributions. The Salamander Skink is found in Cells SE 2 and 7 and the Glossy Grass Skink is present in Cells SE 5 and 7-9. The Striped Snake-lizard and Salamander Skink are usually found in grasslands, forests and woodlands under soil, logs, rocks and ground debris (Cogger 2000).

Figure 3.28. Glossy Grass Skink (*Pseudemoia rawlinsoni*). Photograph M. Hutchinson, SAM.

Green Turtle, *Chelonia mydas* (EPBC: V; SA: V) is only a visitor to coastal South East SA, with only one record of this species (Cell SE13) from 1972. This species generally occupies the tropical waters off the coasts of Western Australia, Northern Territory and Queensland and are not often seen or captured in southern Australia (Cogger 2000).

Distributed across a large area of south-east Australia, including Tasmania, is the Southern Bell Frog, *Litoria reniformis* (EPBC: VU; SA: V), present in Cells SE 3, 11, 13, 15-17. They are an aquatic, day-time active species, found in or around the edges of still or slow-flowing permanent water bodies such as lagoons, swamps, lakes, ponds and farm dams (DEWHA 2009b, Harley et al. 2005; Cogger 2000; Turner 2001). Areas of permanent fresh water surrounded by complex vegetation are ideal for breeding (DEWHA 2009b). Breeding occurs in summer, which is also the ideal time to listen for calls (Turner 2001). The Southern Bell Frog has been selected as a focal species and is described further in Section 3.2.5.

Common species of reptiles and amphibians

Of the 40 reptile species recorded, the most abundant include the following, present in ten or more cells each: Lowland Copperhead (*Austrelaps superbus*), Four-toed Earless Skink (*Hemiergis peronii*), Bougainville's Skink (*Lerista bougainvillii*), Eastern Tiger Snake (*Notechis scutatus*), Southern Grass Skink (*Pseudemoia entrecasteauxii*), Eastern Brown Snake

(*Pseudonaja textillis*) and Sleepy Lizard (*Tiliqua rugosa*). The more common amphibian species include: Common Froglet (*Crinia signifera*), Banjo Frog (*Limnodynastes dumerilii*), Striped Marsh Frog (*L. peronii*) and Brown Tree Frog (*Litoria ewingii*). These frog species generally have loud-voiced calls, and are active in spring. Less common species such as Brown Toadlet (*Pseudophryne bibronii*), Marbled Toadlet (*P. semimarmorata*) and Smooth Frog (*Geocrinia laevis*) have low-voiced calls and are more active in autumn, during their breeding period. Frog surveys usually take place in spring, and this could be one reason why the less common species are not recorded more often (M. Hutchinson pers. comm. 2009[*]).

Habitat conservation for reptiles and amphibians

Cool, temperate conditions, such as those of the lower South East, are important to numerous reptile and amphibian species in the Limestone Coast and Coorong region. If these wet areas (i.e. edges of lakes, swamps and marshes) are to remain a stronghold for certain species, they must be protected from misuse or destruction. Maintaining and improving water quality and the health of surrounding vegetation will help give these animals the best chance of survival. Increased protection and the expansion of suitable buffer land to reduce edge effects will also help to improve survival. Climate change is likely to alter the environment, but by providing as much habitat as possible, vulnerable species can best adapt.

Throughout the South East, remaining intermittent wetlands and the constructed drainage network are providing refuge and connectivity for water dependent reptiles and amphibians. A report by Slater and Farrington (2010) titled 'Lower South East Drainage Network Adaptive Management: Preliminary Scoping Study,' has provided an ecological value for drains in the lower SE, including some that discharge to the coast or in wetlands in the coastal zone. The report also provides recommendations to help conserve these refuge waterways. Further work on these refuges will be important given declining water quality and availability.

3.2.4 Butterflies

The most comprehensive study on butterflies of the South East was undertaken by Grund and Hunt in 2000. Information from this report and current information from Grund was used to outline the conservation of butterflies in the South East.

A total of 46 butterfly species were identified as present in the South East coastal zone, with 15 species in 4 families being of conservation significance or vulnerability in South Australia as identified by R. Grund (butterflies are not listed under State legislation). Only two species are introduced, but many are vagrant species. Appendix 12 details the cells where butterfly species are known to occur, or are possibly found.

The presence of larval food plants dictates the species of butterfly present in an area (Grund and Hunt 2000). The following section will outline those plants and habitat conservation for butterfly species of the Limestone Coast and Coorong region.

Threatened butterflies

Vulnerability listings have been compiled in consultation with R. Grund (2009). Two of the listed South Australian butterfly species present along the South East coast are listed as endangered, while five other species are suggested to be vulnerable and eight as rare. Icilius Hairstreak (*Jamenus icilius*) and Olane Azure (*Ogyris olane*), both of the Lycaedidae (Coppers and Blues) family, are endangered in the South East, but not in other areas of

[*] M. Hutchinson pers. comm. 7 June 2009

South Australia (Table 3.10). The following four species, Rayed Blue (*Candalides heathi heathi),* Icilius Hairstreak (*Jamenus icilius*), Two-spotted Line-blue (*Nacuduba bioCellata bioCellata*) and Wattle Blue (*Theclinesthes miskini miskini*), are known to be at the limits of their biological tolerance for cold and wet conditions. It is possible they may not be present, even if suitable habitat and host plants are present (R. Grund pers. comm. 2009*).

The Yellowish Sedge-skipper (*Hesperilla donnysa donnysa*) was thought to be extinct in the region, but was recently found near Southend by B. Haywood (R. Grund pers. comm. 2009†). This species and many others from the Hesperiidae (Skipper) family depend on tussock grassland and *Gahnia* wetlands (Figure 3.29), as indicated in Table 3.10. The grassland and wetland vegetation is also the preferred habitat of butterflies in the family Nymphalidae (brush-footed butterflies). Much of the lower South East is characterised by wet tussock grasslands and sedgelands, particularly Cells SE 1-10, while there are a few areas with similar habitat around Kingston SE and Cells SE 12 and 13. The Yellowish Sedge-skipper has been selected as a focal species and is described further in Section 3.2.5.

Figure 3.29. *Gahnia filum*. Photograph R. Sandercock.

Common species of butterflies

The two most common and widespread species in the South East are the Common Xenica (*Geitoneura klugii klugii*) and Common Brown (*Heteronympha merope merope*). Both these species have been, or are expected to be found in all SE cells, using native and introduced grasses as larval host plants (Grund and Hunt 2000). The following species are locally common, where they are common in the areas in which they are present, Cabbage White (*Pieris rapae rapae*), Two-spotted Line-blue (*Nacuduba bioCellata bioCellata*) and Bitter-bush Blue (*Theclinesthes albocincta*). The latter of these species is known to occur at various sites along the South East coast, whereas the Cabbage White and Two-spotted Line-blue have only confirmed sightings in the lower South East. As the name suggests, Bitter-bush Blue butterfly uses Bitterbush as a larval food plant; in particular *Adriana hookeri* (Mallee Bitterbush or Water Bush), *A. klotzschii* (Coast Bitterbush) and *A. quadripartita* (Rare Bitterbush) (Figure 3.30). The Bitterbush (flora species) is common throughout South Australia (BDBSA 2009), and is well represented in State reserves, with key populations in the South East. It responds well to disturbance and is a pioneer species (R. Sandercock pers. comm. 2009‡), which may account for its presence in the South East.

* R. Grund pers. comm. 9 August 2009
† R. Grund pers. comm. 29 July 2009
‡ R. Sandercock pers. comm. 27 November 2009

Figure 3.30. Male flowers of *Adriana quadripartita*. Photograph R. Sandercock.

The Symmomus Rush-skipper (*Trapezites symmomus soma*), is one of the South East specialist butterfly species, occupying Cells SE 1 and 2, and only known from five sites within the area. This species is especially unique, in that it only has one larval food plant, *Lomandra longifolia*.

Habitat conservation for butterflies

Larval food plants and their density control the presence of butterfly populations within an area. Butterfly numbers will therefore decrease with the loss of vegetation containing food plants (Grund and Hunt 2000). Butterfly diversity is also dictated by the condition and size of indigenous habitat and the history of fire and adjacent land practices (wetland drainage, pesticide use) (R. Grund pers. comm. 2009[*]).

The South East region contains a mixture of environments, with drier conditions in the west and wetter conditions in the east (Grund and Hunt 2000). The lower South East vegetation comprising forest, shrublands and swamps, is especially important as numerous butterfly species are found here and no where else in South Australia (e.g. Symmomus Rush-skipper, *Trapezites symmomus soma*). Wetlands of the lower South East, are important low lying areas associated with creeks, rivers, lakes, estuaries and springs. Sedges (Cyperaceae family), especially *Gahnia* species, are an important vegetation component of wetlands and are the dominant food plant for the Hesperillini Skippers and several brown butterflies (Grund 2007). Stringy bark forest reserves are important throughout the South East, because they act as corridors and aid butterfly dispersal and movement (Grund and Hunt 2000). Threats are especially high in the lower South East, with the drainage of swamps and wetlands and clearing and fragmentation of vegetation leading to the loss of flora and hence butterfly species (Grund and Hunt 2000). The majority of butterfly species found in and around wetlands are now threatened because of the extent of habitat alteration (Grund 2007). Preserving habitat in all areas of the coast is an important step in preventing further loss of butterfly species. Also, incorporating food plants of butterflies into re-vegetation and restoration projects will increase the suitable habitat area for butterflies (Grund and Hunt 2000). Land managers can also help conserve butterfly numbers by preventing or reducing the use of toxic sprays, especially via aerial spread, where toxins are damaging not only directly to butterflies but also to wetlands and surrounding vegetation (Grund and Hunt 2000).

[*] R. Grund pers. comm. 20 July 2009

Table 3.10. Threatened butterfly species present in the South East coastal zone as per Grund (pers. comm. 2009).

Species	Common name	Larval food plant	Vulnerability
Family ***HESPERIIDAE*** (Skippers)			
Anisynta cynone cynone	Mottled grass-skipper		V
Hesperilla cyrhsoticha cyclospila	Chrysotricha Sedge-skipper or Golden-haired Sedge-skipper	*Gahnia* species	V
Hesperilla donnysa donnysa (pale form flavescens)	Yellowish Sedge-skipper	*Gahnia filum* and *G. deusta*	E
Taractrocera papyria papyria	White-banded Grass-dart	Native and introduced grasses incl. *Cynodon dactylon** (couch), *Echinopogon* species (rough-bearded or hedgehog grasses), *Microlaena stipoides* (weeping rice-grass), *Pennisetum clandestinum** (kikuyu), *Phragmites australis* (common reed), *Poa* species	R
Trapezites symmomus soma	Symmomus Rush-skipper or Splendid Ochre	Sole food plant is *Lomandra longifolia*	V
Family ***PAPILIONISAE***			
Delias aganippe	Wood White	*Amyema, Exocarpos* and *Santalum sp*	R
Family ***NYMPHALIDAE*** (Brush-footed butterflies)			
Heteronympha cordace wilsoni	Bright-eyed Brown	Carex species and various wetland grasses	E
Oreixenica kershawi kanunda	Striped Xenica	*Poa* species. Original habitat is *Gahnia clarkei*	V
Oreixenica lathoniella herceus	Silver Xenica	*Microlaena stipoides* (weeping rice-grass), *Poa* species	V
Tisiphone abeona albifascia	Sword-grass Brown	*Gahnia clarkei*, *G. radula*, *G. sieberiana*	R
Family ***LYCAENIDAE*** (Coppers and Blues)			
Candalides heathi heathi	Rayed Blue	*Prostanthera* species (mintbushes), *Westringia* species, *Eremophila* species and *Derwentia* (*Parahebe*) species	R
Erina hyacinthina form josephina	Common Dusky-blue	*Cassytha pubescens*	R
Erina hyacinthina hyacinthina	Dusky Blue	*Cassytha pubescens*	R
Jamenus icilius	Icilius Hairstreak	*Acacia* species and *Senna* species	E in SE
Lucia limbaria	Small Copper	*Oxalis corniculata corniculata** (yellow wood-sorrel), *O. perennans* (native sorrel or creeping yellow oxalis)	R
Ogyris abrota	Dark-purple Azure	*Muellerina eucalyptoides* (creeping mistletoe)	R
Ogyris olane	Olane Azure	*Amyema miquelii, A. pendulum pendulum*	E in SE

3.2.5 Focal Species

Focal species are given weighting within this report because of their conservation status or significance within the coastal boundary. They may reflect a species typical of an area or vegetation type which the community can use to promote conservation. Focal species are important, as they can help to stimulate community involvement, participation and enthusiasm for the natural environment and lead to an increase in knowledge of the species. They may also help educate and promote the importance of retaining native vegetation and mitigation or management of the major threats to the native flora and fauna. Focal species are usually easily identified species, in the hope that their presence can be reported with reasonable confidence to relevant authorities. Two bird, one mammal, one reptile, one amphibian and one butterfly species have been selected as focal species with particular significance to the Limestone Coast and Coorong.

Orange-bellied Parrot

The Orange-bellied Parrot, *Neophema chrysogaster* (EPBC: CR; SA: E) is endemic to south-eastern Australia, and is rarely recorded in large numbers throughout its distribution (Figure 3.31). On the brink of extinction, the species survives as a single, small population that breeds in south-west Tasmania (in the Tasmanian Wilderness World Heritage Area) and migrates to coastal Victoria, South Australia and New South Wales during the non-breeding winter season. Beaches, dune frontages and adjacent dune systems and sheltered areas along rocky foreshores are the birds preferred habitat in South Australia. The Orange-bellied Parrot occurs within The Coorong and Lakes Alexandrina and Albert Wetland of International Importance (Ramsar) (Ehmke et al. 2009; Ehmke and Jones 2009; OBPRT 2006). The species habitat distribution is depicted in Figure 3.32).

Figure 3.31. Orange-bellied Parrot. Photograph C. Dickson.

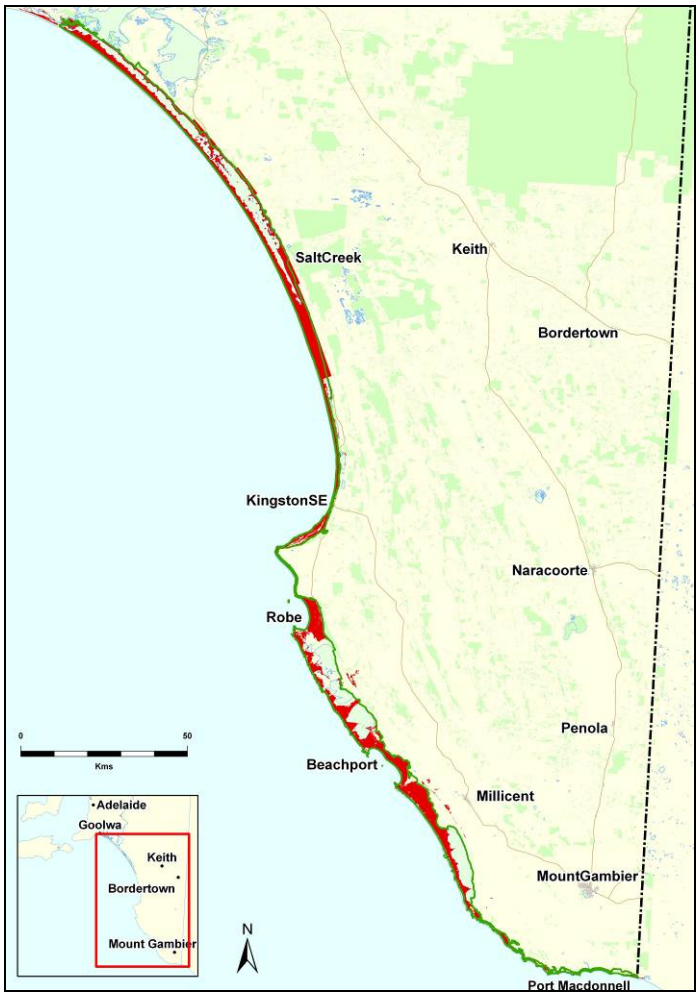

Figure 3.32. Habitat distribution of Orange-bellied Parrots.

Sea Rocket (*Cakile maritima**) and Bidgee-widgee (*Acaena novae–zelandiae*) are the common food plants of the Orange-bellied Parrot in the South East, but they will also occasionally feed on the seeds of other coastal plants and introduced grasses. Sea Rocket grows at the back of beaches and in the foredunes and is the food plant considered to be most favoured in South Australia (Croft et al. 1999).

The alteration and destruction of saltmarsh and coastal habitat for urban development and agriculture are the two main threats affecting Orange-bellied Parrots (Ehmke et al. 2009; Ehmke and Jones 2009; OBPRT 2006). These processes remove food sources, shelter and roost sites and patches of vegetation acting as corridors between neighbouring areas.

Invasive weeds also impact on Orange-bellied Parrots, by competing with their food sources and altering their foraging habitat. Dune stabilisers such as Marram Grass (*Ammophila arenaria**) and Pyp Grass (*Ehrharta villosa* var *maxima**) form a dense layer which prevent the germination and growth of native grasses; False Caper (*Euphorbia terracina**) is a primary coloniser on disturbed soils and Sea Spurge (*E. paralias**) compete with dune scrub vegetation (Ehmke and Jones 2009). These species out-compete native species and food plants in saltmarshes and dune systems. In the right areas, prescribed burning will restore Orange-bellied Parrot habitat by opening up inter-tussock spaces and encouraging preferred food plants to regenerate (OBPRT 2006).

Pest species such as the rabbit (*Oryctolagus cuniculus)* threaten the survival of the Orange-bellied Parrot by competing for food of both native and weed species. Although it has not been proven,

the high abundance of cats and foxes is also likely to have an impact on the numbers of birds, especially as they are generally a low shrub and ground dwelling species.

Recreational activities such as walking and vehicles on beaches, disturb Orange-bellied Parrots from carrying out their natural habits and also damage native vegetation used for food and shelter. Long-term disturbance at a site may cause the birds to abandon the area.

In 2006 the Commonwealth Government allocated funding for the 'Orange-bellied Parrot Habitat Restoration Project'. The project aimed to protect and enhance the foraging and roosting habitat for the Orange-bellied Parrot in South Australia through a range of on-ground management activities focused on private land, unallotted Crown land and the conservation reserve system. Guided by the 'Habitat Protection and Restoration Plan for the Orange-bellied Parrot in South Australia' a number of actions have been implemented including revegetation using roosting and food plants and vegetation monitoring at Blackfellows Caves, Pick Swamp, Piccaninnie Ponds Conservation Park and Canunda National Park; weed control (Pick Swamp); fencing (Pick Swamp and Canunda National Park) and on-going feral cat control (Canunda National Park). Community awareness campaigns for the conservation of the Orange-bellied Parrot were also established and included interpretative signage at Port MacDonnell, Carpenters Rocks, Beachport, Robe and Kingston SE and the creation of three working groups to coordinate an annual search for the species.

Although this project ended in June 2009, actions can still be taken to help the Orange-bellied Parrot and our understanding of this species. Radio tracking of individuals would provide a better indication of bird movement, especially during their migration. This could be linked with climate modelling, to investigate if changing climate is affecting migration. Smaller projects could also provide important information on this species, such as continual vegetation monitoring, to find out if the management options are working. Public awareness raising and media exposure may also aid the Orange-bellied parrot, by helping the community to 'bond' with the only known population of this critically endangered bird.

Fairy Tern

The Fairy Tern, *Sterna nereis* (SA: E) (Figure 3.34), is similar in appearance and behaviour to the Little Tern, *S. albifrons* (SA: E) however, the Fairy Tern has a slightly larger head with a larger white forehead area and has a more rounded profile, with a bulkier body and shorter, thicker, orange legs (Simpson and Day 2004). The Fairy Tern and Little Tern share very similar breeding habitats and sometimes breed together (Campbell and Christie 2009), resulting in hybrid birds. They are found on coastal beaches, inshore and offshore islands, sheltered inlets, estuaries and lagoons, and usually breed on sandy beaches (Australian Museum 2006). The Fairy Tern generally lays one or two eggs, directly onto the sand (BirdLife International 2008; Australian Museum 2006). It feeds almost entirely on fish and both species are present in low numbers in the South East (Australian Museum 2006; Campbell and Christie 2009). Figure 3.33 indicates the habitat distribution of Fairy Terns in the South East coastal zone.

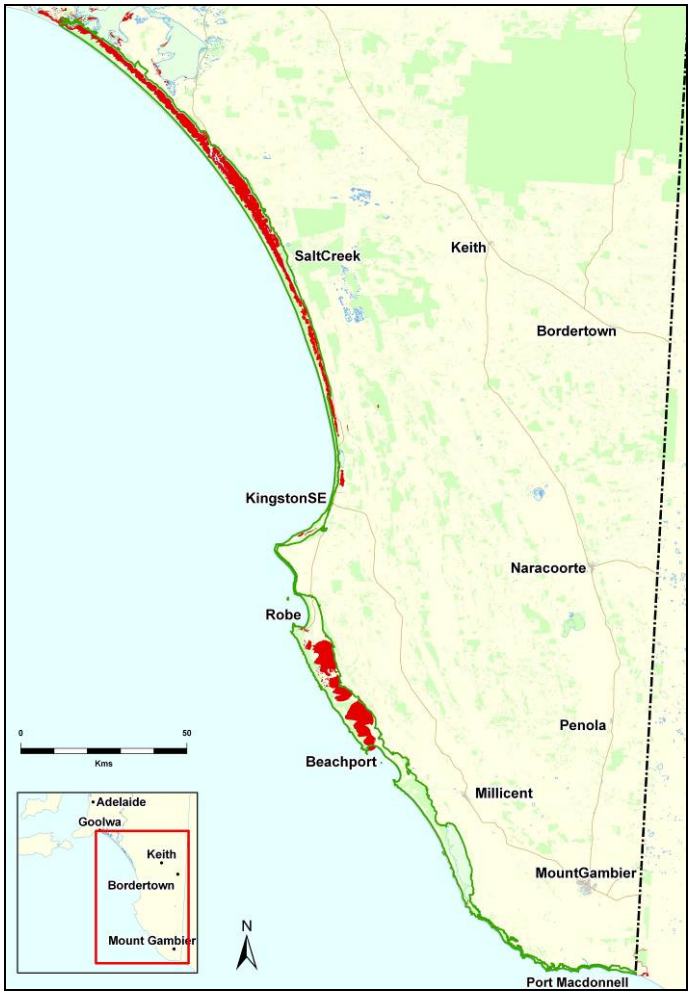

Figure 3.33. Habitat distribution of Fairy Tern.

Figure 3.34. Fairy Tern in flight. Photograph P. Wainwright.

Disturbance to nesting sites from natural causes (high tides and extreme weather, predators) and through human-related impacts (coastal development, recreation, pest plant and animals and sea level rise) threaten Fairy Terns. High tides and extreme weather wash away nests, eggs and sometimes chicks. In December 2008, two pairs of Fairy Terns attempted to breed at Danger Point (Carpenter Rocks). Both nests had two eggs present when discovered, but were later washed away by a high tide event (Campbell and Christie 2009). Strong winds can also bury the nests, causing adults to abandon the nest while extreme heat or cold can cause the eggs and chicks to perish quickly in the absence of parents (Maguire 2008). Extreme weather events can be devastating to local populations, putting a whole breeding season at risk (BirdLife International 2008). Native predators, such as ravens and gulls in addition to feral animals, such as foxes, cats and rats, prey upon the eggs, chicks and adults (Maguire 2008). Fairy Terns have been known to nest around Lake George (M. Christie pers. comm. 2009[23]) and up to 30 nests have been found at one time on Cowrie Island (at Beachport). Nests on Cowrie Island are known to be successful, containing chicks and fledglings (Paton nd).

Coastal development impacts on Fairy Terns by increasing disturbance to nesting areas (through increased access points and traffic), potentially altering the topography of the beach and possibly decreasing the area available for birds to nest (BirdLife International 2008; Maguire 2008). People, dogs and vehicles also directly destroy nests, or disturb the Fairy Terns and cause them to leave their nest or chick for periods of time. Habitat degradation through weed invasion also

[23] M. Christie pers. comm. 10 September 2009

threatens beach nesting birds, including the Fairy Tern. Some weeds bind the sand together, preventing the natural erosion and sand movement on the beach. Sea Wheat-grass (*Thinopyrum junceiforme*) is one such species. Marram Grass is another, that causes the dunes to become steeper, making it harder for chicks to escape predators, because they can not scale the dune to safety (Maguire 2008). Weeds also encroach onto the beach and decrease the amount of sand available for nesting (BirdLife International 2008).

Swamp Antechinus

The Swamp Antechinus (*Antechinus minimus*) (SA: E) (Figures 3.35 and 3.36) is a small, native marsupial occurring in the South East (Figure 3.37), with a sub-species present in Tasmania and the Bass Strait islands (Smith 1983). They are found in wet woodlands, heathland, tussock grassland and sedgeland and prefer areas with late successional vegetation (Van Dyck and Strahan 2008). Although the Swamp Antechinus is found in a variety of vegetation groups, the communities all generally have dense understorey vegetation (Wilson et al. 2001). The species has been captured in wet heath habitat dominated by dense Silky Tea-tree (*Leptospermum lanigerum*) and Cutting Grass (*Gahnia* species) in South Australia (Bachmann and van Weenen 2001). The Swamp Antechinus also prefer areas with a southerly aspect and gentle slope, near drainage lines and swamps (Van Dyck and Strahan 2008). Invertebrates dug from the topsoil and leaf litter compose much of the species diet (Van Dyck and Strahan 2008) and their nests are shallow burrows at ground level (SWIFT 2007; Menkhorst 2004). Their numbers fluctuate throughout the year, where males die off after breeding (in late winter, early spring) (Wilson et al. 1986; Van Dyck and Strahan 2008).

Figures 3.35 and 3.36. Swamp Antechinus (*Antechinus minimus*). Photographs J. Van Weenen, DENR.

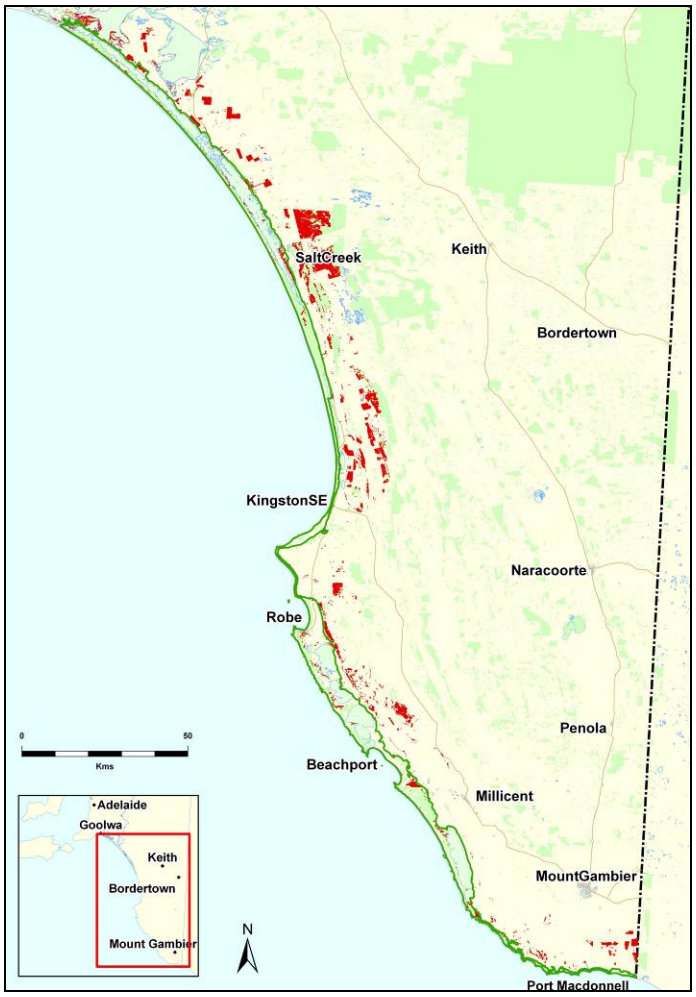

Figure 3.37. Habitat distribution of Swamp Antechinus.

The preferred habitat of *Leptospermum lanigerum* shrubland has been extensively cleared or modified through human disturbance. Habitat is altered by fragmentation, drainage of swamps and aquifers and fire frequency (Van Dyck and Strahan 2008; SWIFT 2007). The removal of habitat by clearance is especially damaging as the Swamp Antechinus prefers dense vegetation, which takes time to establish and thicken. Fragmentation of vegetation by roads and walking tracks can separate populations (Wilson et al. 2001) and prevent the mixing of genes for increased genetic fitness. The alteration of land through the drainage of swamps and aquifers occurs to make way for urbanisation and agriculture, once again removing, thinning and altering suitable habitat for the Swamp Antechinus (Bachmann and van Weenen 2001; SWIFT 2007). Dense vegetation also provides protection from feral animals, including foxes and cats. Introduced animals like the fox and cat not only prey upon Swamp Antechinus and reduce population numbers, but they may also deter or prevent Swamp Antechinus moving to other suitable areas (Bachmann and van Weenen 2001).

The Swamp Antechinus is a late successional species and is vulnerable to extinction at sites that are frequently burnt, as it takes many years to recolonise a site (Wilson 1994). Fire is used as a management tool for the protection of property and assets, through fuel reduction burning. The increased frequency of burning for these purposes is too short for the Swamp Antechinus and is detrimental to their population numbers (SWIFT 2007). Wildfire has been known to cause the extinction of the Swamp Antechinus population in the Otway Ranges in Victoria, where the inland site has not been recolonised (Wilson et al. 2001). Management of fire for the survival of the Swamp Antechinus would ensure fires do not occur often in the same area and are potentially

excluded from some areas, to ensure there is always suitable habitat for the species. Burning areas of vegetation in rotation would also allow for a diversity of plant species and vegetation types.

Actions can be taken to help stabilise and increase numbers of the Swamp Antechinus, including the protection and enhancement of its preferred habitat, a reduction in habitat fragmentation, feral animal control and improved fire management Small remnants of the *Leptospermum lanigerum* community are conserved in the region, with most occurring on private land subject to grazing pressure by cattle. Improving, protecting and revegetating patches of this habitat will help to increase the connectivity between these patches. Increasing connectivity helps the species distribution and mixing of genes between populations, thereby increasing the animals resilience to changes in the environment. In addition, the re-establishment of wetlands that are presently drained will help to increase the species range.

Swamp Skink

The Swamp Skink (*Lissolepis coventryia*, previously *Egernia coventryi*) (Figure 3.38), is found in densely vegetated freshwater swamps, drainage basins and the South East coastal regions of New South Wales, South Australia and Victoria (DEWHA 2009c; Robertson 1998). The species is on the western limit of its distribution in the Limestone Coast and Coorong region. Their preferred habitat consists of dense low-lying marshes, dominated by *Melaleuca ericifolia*, *Leptospermum lanigerum*, *Gahnia* species and other sedges, paperbark swamps, Tea-tree heathlands, low open woodland and saltmarshes (DEWHA 2009c; Cogger 2000; Robertson 1998) (Figure 3.39). Swamp Skinks are not usually distributed evenly throughout their preferred vegetation and they are generally sedentary, not moving far from initial capture sites (Robertson 1998). This species is active during the day and they give birth to fully developed, live young, unlike most other reptiles who lay eggs (DEWHA 2009c). It feeds on various insects, small snails, small crustaceans, flowers and fruits.

Figure 3.38. Swamp Skink (*Lissolepis coventryia*). Photograph M. Hutchinson, SAM.

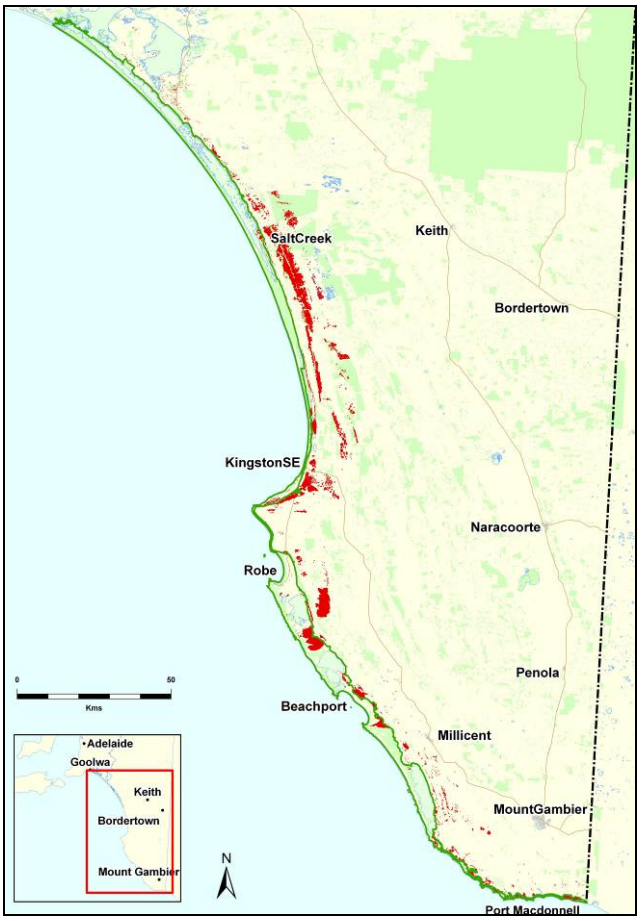

Figure 3.39. Habitat distribution of Swamp Skink.

As for the Swamp Antechinus, the preferred habitat in the South East has been extensively cleared for agriculture or impacted by drainage. The destruction of *Leptospermum langierum* communities has been described above and the loss of wetlands has similarly led to a decrease in suitable habitat. The loss and fragmentation of habitat reduces the opportunity for dispersal and recolonisation of Swamp Skink populations. Smaller population sizes create non-viable populations and may contribute to the loss of the species in the long term.

The drainage of wetlands and altered water regimes changes the preferred 'swampy conditions' of the Swamp Skink. Swampland areas that in the past probably supported populations of Swamp Skink have been drained and subsequently utilised for agricultural purposes and development (Robertson 1998). Changes to water regimes can occur from simple modifications such as track alteration, to larger alterations such as the creation of dams and watercourses. Any process or activity which threatens the integrity of the swampy vegetation is likely to impact on the Swamp Skink (Robertson 1998). Even pollutants which have the potential to alter swampy vegetation composition or structure may be a threat (Robertson 1998). In addition, numerous studies have found lizards in the diet of foxes and cats (Bayly 1978, Jones and Coman 1981, Kearney and Mirtschin 1992). Predation is therefore also likely to be a significant threat to Swamp Skink populations.

The effect of enhanced greenhouse climate scenarios was modelled by Bennett et al. (1991), who found that with a 3°C rise in temperature, the predicted bioclimate of the Swamp Skink reduced by between 70 and 89 percent of the populations which inhabit coastal/tidal areas in Victoria. Long-term drought conditions, also occurring as a result of climate change will also threaten this species, as swampy conditions may no longer remain cool and damp, but suffer from greater

evaporation and for longer periods of time, increasing the stress and survival of the Swamp Skink.

Currently there is no Action Plan for the Swamp Skink in South Australia. Considering the species has a fairly defined preferred habitat, it may be possible to undertake actions to protect and enhance its habitat requirements, while reducing habitat fragmentation, and disturbance. Actions taken to improve the habitat of Swamp Antechinus will also be of benefit to the Swamp Skink.

Southern Bell Frog

The preferred habitat of the Southern Bell Frog, *Litoria reniformis* (EPBC: V; SA: V) is in or around the edges of still or slow-flowing permanent water bodies such as lagoons, swamps, lakes, ponds and farm dams (Cogger 2000; DEWHA 2009b; Turner 2001). Their current known habitat distribution in the South East coastal zone is indicated in Figure 3.40. They are active during the day with ideal conditions for breeding being in areas of permanent fresh water surrounded by complex vegetation (DEWHA 2009b). The ideal time to listen for calls is during the summer breeding period (Turner 2001).

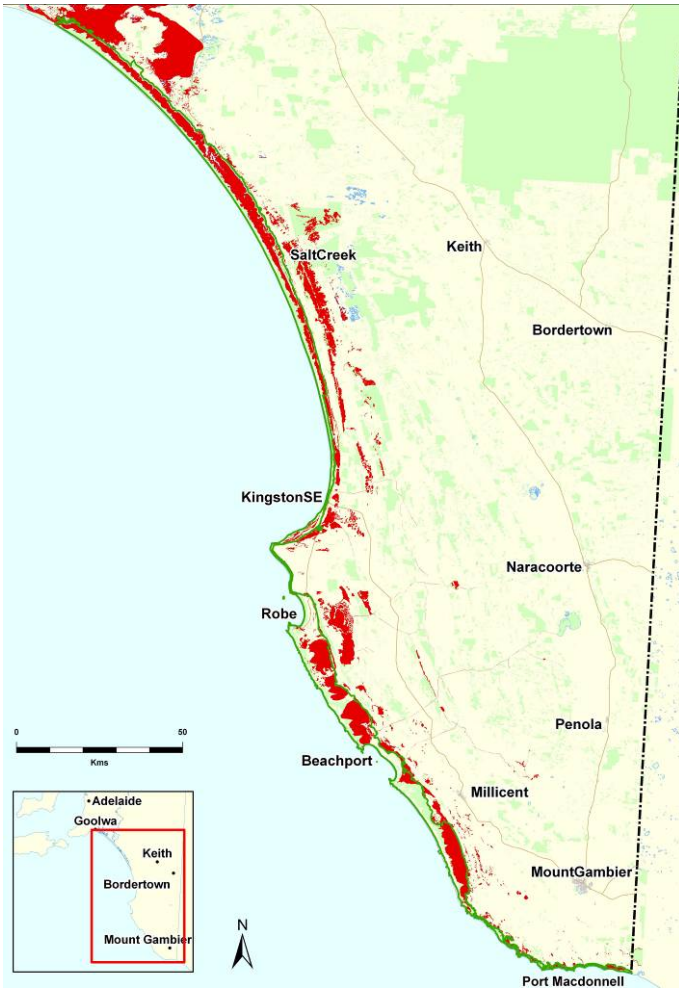

Figure 3.40. Habitat distribution of Southern Bell Frog.

Figure 3.41. Southern Bell Frog. Photograph S Slater, DENR.

The biggest threats to Southern Bell Frog are habitat loss, drainage of swamps, wetlands and floodplains, drought and pollution of water sources (Harley et al. 2005; DEWHA 2009b; DEC 2005; Frog Atlas nd). Southern Bell Frog prefer some vegetation around their water source,

where tadpoles and froglets can find protection, and where they can come to breed (DEC 2005; Frog Census nd). Wetlands, swamps and floodplains allow the movement of frogs between areas. When these areas are drained, it no longer provides the suitable, moist habitat needed for the Southern Bell Frog, and hence no movement or distribution of species can occur reducing the genetic fitness and the capability of frogs to escape unfavourable conditions. Long-term drought could also have the same negative effect as draining wetlands due to the land drying out (Frog Atlas nd). The presence of chemicals or pollutants in and around water sources is likely to affect the survival of frogs, because they are so sensitive to slight changes in water quality (Harley et al. 2005; Frog Census nd; Jansen and Healey 2003). Exotic fish, such as Mosquito Fish (*Gambusia holbrooki*) and Redfin (*Perca fluviatilis*), also threaten the survival of the Southern Bell Frog. Predatory fish prey upon tadpoles and directly kill individuals, reducing the population size (Harley et al. 2005). In other areas, the Chytrid fungus is detrimental to frog populations, but is yet to be identified in the South East (Harley et al. 2005).

A Regional Action Plan has been prepared for the Southern Bell Frog in the South East (Harley et al. 2005), which complements the National Recovery Plan for *Litoria reniformis* 2004-2008 (Clemann and Gillespie 2004). These plans outline the main actions for preventing the decline of the Southern Bell Frog which are to protect and enhance the wetland habitats where the species is known to occur, and then to identify other suitable conservation areas for the species. Enhancing the habitat may include fencing of wetland areas to exclude livestock. Enhancing the connectivity between water bodies will also help by facilitating movement between populations, and broadening the suitable habitat areas. Controlling predatory fish will increase the success of reproduction and replacement of old individuals, with fewer tadpoles being removed by predation. Other key actions recommended to aid the Southern Bell Frog population are long-term monitoring at all sites where the species is found and determination of whether the pathogen Chytrid fungus is present in populations in the South East. Community education and encouraging participation in recovery actions for the species will help raise the profile of the Southern Bell Frog and improve species identification and distribution mapping.

Yellowish Sedge-skipper

The Yellowish Sedge-skipper (*Hesperilla donnysa donnysa* form *flavescens* sometimes known as form *flavia* in South Australia) is an extreme colour form of *Hesperilla donnysa* (Donnysa Sedge-skipper) (Figures 3.42 and 3.43). The Yellowish Sedge-skipper is usually found on the coast, compared to the darker form (Grund 2002). The species found in the South East, form *flavescens*, relies mainly on the sedge species *Gahnia filum*, Thatching grass, for all its needs. It is used as food source and by the larvae to construct a shelter (Herbison-Evans and Crossley 2010; R. Grund pers. comm. 2009[24]), but *G. deusta* (Mallee Saw-sedge) may also be used by adult butterflies (Grund 2002). Thatching Grass is usually found in and around coastal and estuarine environments, while Mallee Saw-sedge prefers fresh water areas (Grund 2002).

Historically, Yellowish Sedge-skipper populations were present around the wetlands inland of the coastal beaches of Adelaide, through to Port Gawler, but due to urbanisation and clearance of suitable habitat it is now thought to be extinct (Grund 2002; Coleman and Coleman 2000). There was also a population on the Eyre Peninsula, but they have not been seen for many years. A known population occurs on the Yorke Peninsula and they have recently been rediscovered in the South East (Grund 2002; R. Grund pers. comm. 2009[24]). The Yellowish Sedge-skipper is known to be under extreme habitat pressure and is considered endangered (R. Grund pers. comm. 2009[25]), however the butterfly does not have any official conservation status in the State as invertebrates are not recognised under the *National Parks and Wildlife Act 1972*. The small

[24] R. Grund pers. comm. 9 August 2009

population size and limited available habitat restricts the Yellowish Sedge-skipper's chance of recovering (Coleman and Coleman 2000).

The Yellowish Sedge-skipper is a specialist butterfly which relies almost solely on *Gahnia filum* for survival, hence all threats to this plant species will also impact on butterfly survival. Much of the South East has suffered wetland drainage and land clearance, to make way for agriculture as described previously. The modification of wetlands has altered the conditions that were once suitable for *G. filum* and fragmented the vegetation into isolated remnants. This has discouraged the dispersal of the Yellowish Sedge-skipper (Coleman and Coleman 2000; Grund 2002; Sands and New 2002). Woody weeds including Boxthorn compete with the host *G. filum*, while smaller weedy grasses grow in dense clumps at the base of sedges, making it difficult for the female butterfly to deposit her eggs (New 1997; Coleman and Coleman 2000). Humans have further disturbed areas of *G. filum* through uncontrolled four-wheel drive and motor bike access to areas of sensitive wetland vegetation. Rabbits are also a threat to the Yellowish Sedge-skipper by eating the young growth and shoots of sedge species and uprooting and burrowing under mature plants (Coleman and Coleman 2000). Another possible threat that may directly impact the number of the Yellowish Sedge-skippers are those individuals taken by collectors, over-collecting, especially since the butterfly is a sedentary species. To prevent this becoming an issue, publishing site details of proven populations should be kept to a minimum (Coleman and Coleman 2000).

A report titled 'Local Recovery Plan for the Yellowish Sedge-skipper and Thatching Grass' was produced by Coleman and Coleman for the SA Urban Forest Biodiversity Program in 2000. This document focuses on the butterfly populations in and around Adelaide and the Yorke Peninsula. Many of the threats identified in the report are similar to those in the South East. Some of the actions suggested in the Coleman and Coleman (2000) report and by Grund (2007) include actively managing identified Yellowish Sedge-skipper populations by addressing habitat clearance and degradation issues; planting smaller patches of *Gahnia filum* between the larger sites, creating corridors facilitating greater distribution of Yellowish Sedge-skipper; educating the public and landholders on regional butterfly populations (not specific sites) and identification of habitats to help prevent further accidental destruction. Community involvement is also important in raising awareness of the butterfly, through promoting restoration and revegetation projects using native, butterfly-friendly plants.

Figure 3.42. Male Yellowish Sedge-skipper (*Hesperilla donnysa donnysa)* dark form delos (from the lower South East). Photograph R. Grund.

Figure 3.43. Female Yellowish Sedge-skipper. Photograph R. Grund.

3.2.6 Species Richness

Priority areas for conservation and management are often determined through the presence and/or abundance of individual species. These species often include those with a high conservation value or those that have been identified as a focal species, umbrella species or keystone species (eg Poiani et al. 2001, Simberloff 1997). Many of the species considered in this study, particularly birds, hold a conservation rating and therefore increase the value of the area and demonstrate the importance for conservation management. However, areas containing high and representative species richness of native wildlife (a diveristy of species) are also important and influence the value of an area for conservation. Managing natural areas for multiple common species has been identified as a more successful and cost efficient method for the long-term conservation of native wildlife (Scott et al. 1987). As a result, the number of species can also be used to indicate biodiversity and is used as an indicator for conservation-based outcomes (e.g. Atauri and Lucio 2001, Scott et al. 1987).

From the available data, four South East cells recorded the highest combined species richness for mammals, reptiles and amphibians (See fauna tables in Appendix 10, and 11 and Figure 3.44 below). These are Cells:

- SE 15 (Coorong, south end);
- SE 7 (Canunda National Park);
- SE 10 (Little Dip CP) and
- SE 17 (Coorong, Murray Mouth end).

Figure 3.44. Detailed species richness map.

(red and then orange being of highest conservation priority, through to blue the lowest.)

All four cells include NPWSA reserves: SE15 and SE17 the Coorong NP; SE7 Canunda NP and Lake Frome CP; and SE10 Little Dip CP and Lake Robe GR.

Considering bird species alone, Cell SE1 (Piccaninnie Ponds) had the highest species richness, followed by SE2 (Pt. MacDonnell), SE15 (southern end of the Coorong), SE3 (Cape Douglas), SE9 (Lake St. Clair Conservation Park, Beachport Conservation Park), SE4 (Blackfellows Caves), and SE5 (Carpenter Rocks).

Areas of the South East that contain relatively high numbers of fauna species also generally occur in regions with bigger and more diverse areas of remnant vegetation. This is especially indicative in the high bird species richness of Cell SE1, because it not only includes habitat suitable for shorebirds and seabirds, but also bushbirds such as quails, thornbills, cuckoo-shrikes, honeyeaters and robins in the recently rehabilitated Pick Swamp and adjacent vegetation. The remaining cells with high bird richness reflect those areas most suitable to shorebirds, such as the Coorong, coastal lakes, and rocky reefs and platforms, which are present at Danger Point (Cells SE1 and 2) and Pelican Point (Cell SE 4 and 5) at Carpenter Rocks. It must be noted that not all areas of the South East have been surveyed equally, so the species richness is likely to be skewed toward more highly surveyed areas.

Baudin Rocks (Cell SE12), a rocky group of islands off Cape Thomas, is worthy of an additional mention. The Bridled Tern has bred on Baudin Rocks in the recent past, but the rocks are also a key haul out site for New Zealand and Australian Fur-seals and the nationally vulnerable Australian Sea-lion. Baudin Rocks are an important conservation area, but do not have high species richness. Sites like this must still be identified and managed, as their loss could be detrimental to species that are dependent upon them.

Priority areas for more research/data collection

Although most of the South East coast has been surveyed or has fauna records, there are two cells that clearly lack information; SE14 (Long Beach, north of Cape Jaffa) and SE12 (Cape Jaffa). Cell SE14 includes approximately 15 km of coast, where the vegetation has been cleared for agriculture right up to the landward edge of the foredune, leaving only a thin strip of vegetation cover for fauna. Similarly, a thin strip of vegetation along the dunes is all that remains in Cell SE12 (which extends from Cape Jaffa, south to Boatswain Point); however this vegetation does connect with Guichen Bay Conservation Park. In both cases the lack of records may be a result of not having undertaken data collection or surveys, not a lack of individuals in the area; therefore these two cells should be priority areas for future fauna surveys. Cells with the oldest records are those that are either near the oldest settlements (e.g. Mount Gambier), or in areas where there is a feature of interest (e.g. Lake Bonney SE, Lake St. Clair, Lake George) or a reserve (or similar) that was proclaimed before the 1980's (e.g. Canunda National Park, Coorong National Park, Guichen Bay Conservation Park). These areas remain as places of interest and hence also have some of the newest records.

Lake Bonney SE is thought to be an important refuge for ducks and other waterbird species because it always contains water. More information on this site may confirm this and highlight its importance to other birds in the area, especially during dry years (M. Christie pers. comm. 2009[25]).

Priority areas for conservation and management

The lower South East is characterised by a cool, temperate climate, with forests, shrublands and coastal lakes and swampy areas. Many mammal, reptile, amphibian and butterfly species are

[25] M. Christie pers. comm. 10 September 2009

specialised or adapted to these temperate conditions and do not occur anywhere else in South Australia. In some cases the South East is a species stronghold (e.g. Swamp Antechinus and Swamp Skink). The conservation and protection of these fauna species is one of the main reasons why the lower South East must not be cleared any further and the remaining native vegetation conserved. In addition, the drainage or alteration of floodplains, wetlands and drains must be prevented.

Of particular conservation importance are the sedgelands around wetlands and swampy areas. Key habitat for numerous species as described previously, it is also critical to a particular butterfly, the Symmomus Rush-skipper (*Trapezites symmomus soma*). This butterfly is only known from five sites and is present in Cells SE1 (Piccaninnie Ponds) and SE2 (Pt. MacDonnell) (R. Grund, pers. comm. 2009[26]). It has a particularly restricted distribution as it only has one larval food plant, *Lomandra longifolia*.

Striped Xenica (*Oreixenica kershawi kanunda*) is another species only known from a few sites; around Pt. MacDonnell/Piccaninnie Ponds (Cells SE1 and 2) and Canunda National Park (Cells SE6 and 7). This butterfly's original habitat is *Gahnia clarkei*, but it has also been seen on *Poa* and *Tetrarrhena* species.

The Coorong system is another site of conservation significance in the South East. This is reflected in its identification as an Important Bird Area by BirdLife International (Dutson et al. 2009). Migratory bird species gather along the Coorong lakes in large numbers and it is home to other breeding resident species, including the Australian pelican, Crested Tern and Fairy Tern. The Coorong also provides habitat and feeding grounds for those species which prefer hypersaline conditions and feed on brine shrimp.

Figure 3.45. The Coorong mouth (left of picture), Coorong Channel and Bird Island (middle). Photograph Coast Protection Board 2008.

Lake George is an important asset to the South East having a unique ecosystem, being influenced by both marine and freshwater inflows. This site is an important over wintering site for Hooded Plovers, and other migratory species which travel from overseas. The fringing vegetation of

[26] R. Grund, pers. comm. 27 July 2009

woodland, samphire and mud flats, and unconsolidated dunes also provides habitat for many other fauna species. Like many other cells, this area is under threat from agricultural and recreational pressures, as well as erosion of the dunes by the wind. Conservation and protection of this unique environment will allow the lake to continue to support numerous species.

Another unique and important conservation area in the South East is Piccaninnie Ponds Conservation Park. This area is characterised by rising karst springs and is one of the few remaining freshwater ecosystems in South Australia (P. Wainwright pers. comm. 2009[27]). It is also one of the only conservation parks where the park boundary extends beyond the beach into the water. This area has a high impact beach and includes the largest remnant of coastal peat fan wetland in the bioregion. Piccaninnie Ponds supports approximately 20 migratory birds, some in internationally significant numbers and also breeding resident species including Hooded Plovers, Little Terns and Pied Oystercatchers. Piccaninnie Ponds and Pick Swamp are also important because they support numerous threatened bush bird species including Orange-bellied Parrot, Beautiful Firetail, Southern Emu-wren, Elegant Parrot and Blue-winged Parrot (M. Christie pers. comm. 2009[28]).

3.2.7 Current Threats

The Limestone Coast and Coorong coastal zone, with its once extensive woodland, shrubland, sedgeland and wetland habitats, once supported a more diverse range of native wildlife. Habitat clearance, fragmentation and degradation, wetland and swamp drainage, predation and competition from introduced species, development and human disturbances have lead to the loss of some species and continue to threaten the survival of native wildlife. The key threatening processes acting within the Limestone Coast and Coorong are highlighted in Table 3.11.

Table 3.11. Key threatening processes and their implications to native wildlife within the South East coastal zone.

Threat	Implications	Affects
Biological threats		
Degradation of habitat (e.g. loss of leaf litter, fallen timber, soil compaction, weed invasion)	Reduction in population size, change in ecosystem productivity, loss of food source (e.g. invertebrates), increase in animal pest species	All fauna
Competition between native species and introduced, domestic or abundant native species.	Spread of disease, reduced food source, competition for nesting and breeding areas, loss of native species	Mammals, birds
Predation by introduced species or abundant native species	Reduction in population size, loss of native species	Mammals, reptiles, birds, amphibians
Decline in prey availability e.g. loss of small native species	Reduction of natural recruitment rates, loss of native species	Reptiles, predatory birds (eg. raptors)
Insufficient information known about the biology, ecology and status of the species, especially the endangered and rare fauna	Loss of native species, inappropriate management decisions	All fauna
Hunting and over-harvesting	Loss of native species, reduction in population size	Mammals (marine and terrestrial), birds (raptors, ducks)

[27] P. Wainwright pers. comm. 8 September 2009
[28] M. Christie pers. comm. 9 September 2009

Threat	Implications	Affects
Climatic threats		
Sea level rise	Flooding, destruction of nests and inundation of shoreline habitats and offshore islands	Wader birds, bush birds, butterflies, marine mammals (e.g. Australian sea-lions and fur-seals)
Climate change / adverse weather	Drought and storms - loss of coastal habitat, increased salinity and water table levels, and changes in water temperature and quality - loss of species	All fauna
Resource use threats		
Land clearance and fragmentation	Reduction in population size, reduction in genetic diversity within a small population size, increase in animal pest and plant species, isolation	All fauna
Drainage of wetlands and lake systems	Loss of habitat, alteration of natural cycles and environmental flows, loss of native species, reduction in marine water quality	Reptiles, amphibians, butterflies, water dependent birds and mammals and marine mammals
Development	Loss of habitat including nesting, breeding and foraging areas (terrestrial and marine), loss of native species	All fauna
Recreation and tourism	Disturbance of nesting birds and sensitive species (flora and fauna)	Birds, particularly raptors and shorebirds, mammals
Human and off-road vehicle activity	Disturbance of nesting birds and sensitive species, destruction and fragmentation of native coastal habitat	All fauna, particularly birds, including shorebirds and raptors
Altered fire regimes	Loss of habitat, reduction in population size, reduction in genetic diversity within small populations, increase in animal pest and plant species, isolation	Mammals, reptiles and bush birds
Pollution e.g. oil spills, chemical contaminants, heavy metals, pesticide use and stormwater run-off	Reduction in water quality, sediment loading, loss of seagrass, loss of habitat, injury and death to marine species, loss of invertebrates as a food source and loss of butterfly species	All fauna – particularly marine mammals, water birds, waders and butterflies
Fishing	Entanglements from active fishing causing death and injury, loss of food source, disturbance of nesting and sensitive species	Marine mammals, sea and water birds
Mining and seismic survey activity	Loss of native species and habitat, disturbance to sensitive species (terrestrial and marine), increase in pest plant and animal species, isolation	All fauna

Habitat clearance, fragmentation and degradation

Although 51.1% (63649.5 ha) of the South East coastal boundary is covered by the State's reserve system (45.7% in National Parks, 4.2% in Conservation Parks, 0.2% in Conservation Reserves, 0.5% in Heritage Agreements, and 0.4% in Game Reserves), much of the remaining area has

been subjected to clearance of native vegetation, degradation of remnants and/or isolation of vegetation patches (fragmentation). These processes have resulted in the loss of woodlands, forests, shrublands, grasslands, mallee, and wetlands necessary to support the indigenous biodiversity of the region (Croft et al. 1999). Animals are directly affected by the loss of plant species important to them for habitat, shelter or food. This is especially important where specialist fauna species rely on a particular plant species, or type of environment.

Many of the parks in the reserves system were proclaimed to protect and conserve various habitat types typical of, or restricted to the area and may now provide a refuge for various species. However, it is important to recognise that the size of the patch of vegetation is not the only contributing factor to a species presence. Studies have shown that habitat fragmentation does not solely impact on fauna species such as reptiles, but that habitat structure and composition is just as important (Jellinek et al. 2004). For example, the structure of habitat, rather than the composition of vegetation, is the most important environmental characteristic to raptors (Olsen 1998). Hence, habitat destruction and alteration are the main threats to White-bellied Sea-eagles and Eastern Osprey (human disturbance to nests and nest sites is an increasing threat to these birds also).

While small patches may provide good habitat structure and composition, they are not able to support the numbers of individuals of each species as a larger patch. A reduced population size can therefore lead to a reduction in genetic diversity, and hence reduce species resilience to changes in the environment.

The ability of flora and fauna to adapt and persist in remnant vegetation is influenced by numerous factors, including the distance between patches. Interaction increases the genetic diversity and species survival. The density and fragmentation of vegetation is also important and determines the ease with which invasive flora and fauna penetrate into a patch. The greater the fragmentation the easier it is for foxes, cats, dogs and introduced plants to enter the remnant patch.

Some species are able to adapt to the changing environment by moving into urban areas, such as the Common Brushtail Possum (C. Kemper pers. comm. 2009[29]) and Marbled Gecko (Figure 3.46) (M. Hutchinson pers. comm. 2009[30]), while other species adapt to the changes in vegetation type and composition created by a disturbance (e.g. land clearance, degradation). Non-native species may provide habitat where native species have been removed. For example, the Orange-bellied Parrot use African Boxthorn as a roost site, and feed on weeds such as Sea Rocket (*Cakile maritima**) and Wireweed (*Polygonum aviculare**) where their preferred native species have been cleared (Ehmke 2009; Birds Australia nd). When considering the removal of non-native species, their use as shelter or a food source for fauna should be considered and substituted with native species that replace those habitats and characteristics.

[29] C. Kemper pers. comm. 21 July 2009
[30] M. Hutchinson pers. comm. 7 June 2009

Figure 3.46. The Marbled Gecko (right of picture). Photograph N. Rubbo.

Predation and competition

Introduced species are present in every Limestone Coast and Coorong cell and their impact on the environment varies. Pest animals include the fox, feral and domestic cat, domestic dog, the European rabbit, deer, cow, goat and non-indigenous bird species. Competition by rabbits and grazing stock and predation by fox in particular, are known to result in the loss of many native species.

Rabbits continue to be damaging across the region and compete for food with other native mammals and some grassbirds and prevent the re-generation of some plants. Preventing the regeneration of plants also impacts on those species which use the plants for protection and shelter. Foxes and cats directly kill native species, especially those species which live, nest or forage on or near the ground. Beach-nesting birds are especially vulnerable, with limited cover to hide or protect them. Ravens are also a threat to beach-nesting birds, especially Hooded Plovers and Little and Fairy Terns, by taking their eggs (M. Christie pers. comm. 2009[31]). The Kelp Gull from New Zealand is increasing in numbers, and they compete for food with the native Pacific Gull (M. Christie pers. comm. 2009[32]). Some bird species also contribute to the spread of invasive weeds such as Bridal Creeper (*Asparagus asparagoides*), Boxthorn (*Lycium ferocissimum*), Buckthorn (*Rhamnus alaternus*) and Mirror Bush (*Coprosma repens*).

The management of pest plants and animals is important to minimise the decline and loss of native fauna species. In 2009/10 a fox baiting program was undertaken along stretches of the South East coast to help control and monitor the effect foxes are having on shorebirds. Baiting occurred at various locations along the coast, four times a year, with shorebird monitoring carried out in conjunction as an indicator of success (R. Anderson pers. comm. 2009[32]).

Development and human disturbance, including draining of wetlands

Development and human disturbance have impacted both the terrestrial and marine environments. Urbanisation and development has brought fences and barriers, including roads. These barriers prevent the movement and migration of species, especially mammals and reptiles. Roads, especially those that have a cleared buffer either side, discourage the movement of some smaller mammals across the open, unprotected area, because of the increased threat of being seen

[31] M. Christie pers. comm. 26 June 2009
[32] R. Anderson pers. comm. 24 June 2009

by predators. Mammals and reptiles in particular have limited locomotion and are therefore less able to migrate if under threat, in comparison to birds.

Greater urbanisation and human visitation also impacts habitat through soil compaction. Soil compaction prevents or hampers burrowing species, such as frogs, reptiles and wombats. Compacted soils also generally have less vegetation cover and diversity that animals require for shelter or foraging.

Much of the human population of the South East is concentrated on the coast, which has negatively impacted on the number of seabirds (Copley 1996). The effect of disturbance on the nests of raptors and beach-nesting birds is well known; where nests and eggs are abandoned with increased disturbance. Tourism, four-wheel driving and other recreational activities along the coast are also likely to impact on the numbers of birds and other fauna, especially where habitat is destroyed or altered. To further protect these coastal species, the regulation and monitoring of off-road vehicles on beaches should allow for the protection of the intertidal zone in high conservation areas. Special attention needs to be made to the Conservation and National Parks boundaries, where in some cases their boundary stops at high tide and does not include the area most important to shorebirds and other coastal species; the intertidal zone. South Australian Marine Park boundaries include the areas to mean high water mark, and overlay some adjacent terrestrial park boundaries. Zoning of marine parks may allow for improved protection of sections of the beach and provide options for management.

Wetlands and swamps have been highlighted throughout the fauna section as critically important to a number of plants and animals in the South East. With a vast majority of the land now drained, remaining wetlands, lakes, springs and constructed drains in the region provide vital refuge for wildlife. The constructed drainage system has also led to detrimental impacts on the marine environment through increasing stormwater runoff and sediment, pollutant and nutrient loads discharging to the sea. For example, the loss of seagrasses in Rivoli Bay have been attributed to the drain discharges entering the northern and southern ends (SARDI 2006).

Waterbirds in particular have suffered from wetland and freshwater lake modification through drainage, increased salinity, grazing, clearing, infilling and burning. Development, especially along the coast, threatens other remaining habitats occupied by waterbirds including estuaries and inlets. Similarly, amphibians are severely threatened by altered aquatic environments. The draining and infilling of swamps and wetlands plus their adjoining watercourses removes critical movement corridors and refuge areas, and may threaten amphibian populations. Altering the natural drainage channels also changes the local environment's capacity to store/hold water, especially during heavy rain periods; which is an important characteristic of the land for frog species.

Seabirds and other marine animals are threatened by human disturbance. Activity threatens nesting birds and small populations. Competition for food sources by recreational and commercial fisheries is also occurring. Other impacts include habitat degradation through pollution, entanglement and by-catch causing injury or death, toxic spills including oil and other chemicals and the increasing presence of plastic debris and other litter (Copley 1996).

Climate Change

Climate change may effect the distribution, abundance and status of numerous species. The environment is likely to change as a result of varying temperature and rainfall and hence fauna species will have to alter their feeding habits and/or habitat in order to survive. Rehfisch et al (2004) found the distribution of fauna may also alter following changed season parameters, such as mean winter temperature and rainfall. Predictions from the CSIRO indicate that by 2070, the

temperature could increase by 1.8°C to 3.4°C (depending on emissions), with an increase in the frequency of hotter days over 35°C, and fewer frosts (CSIRO and Bureau of Meteorology 2007). In a low emissions scenario, there is expected to be about a 10% chance the temperature will rise by more than 2°C in most Australian coastal areas. Unlike temperature, annual rainfall is expected to decrease in the southern areas of Australia; decreases of around 7.5% less rain is estimated by 2070 (CSIRO and Bureau of Meteorology 2007). Considering the number of species that are 'swampy specialist' species (preferring a cool, damp environment), an increase in temperature and aridity as a result of climate change could have a significant impact on the fauna of the lower South East coast. It is possible some species could be lost from South Australia, considering the lower South East is their stronghold, including the Swamp Antechinus, Swamp Skink, White-lipped Snake, Glossy Grass Skink and Symmomus Rush-skipper.

As a result of climate change, sea levels are rising; with current projections indicating that sea levels could rise by up to 80 cm by the end of the century (CSIRO 2009). With rising sea levels, saltmarsh, intertidal reefs and swampy areas will become flooded with seawater. Naturally, these systems will retreat further inland over time, but with the creation of dune barriers and changes in land use, this can not always occur, resulting in the loss of preferable wader habitats. This not only puts resident waders at risk, but also those migratory species which travel long distances to the same area each year. Beach-nesting birds are also at risk with rising sea levels, as the area of beach available for nests decreases. Small islands and reefs will also suffer as they disappear under rising sea levels. The loss of small islands will create problems for fur seals and sea-lions, penguins and sea birds, as they loose their haul out and breeding sites. The acidity of oceans has increased significantly due to greater quantities of dissolved carbon dioxide, while salinity levels have decreased (CSIRO 2009). It is possible that changes in ocean water quality may also negatively affect marine and coast dependent fauna.