

FLORA AND FAUNA OF THE MORUYA ESTUARY



Report prepared for: Moruya/Deua River Estuary Management Committee
Eurobodalla Shire Council

Report prepared by: Mike Crowley MEnvMgt BSc



October 2005

Mike Crowley
Environmental Planning & Assessment
22 Dell Parade Moruya Heads NSW 2537
(02) 44742677
crowley@ispdr.net.au

Executive Summary

This study researches, compiles and documents information about the fauna and flora of the Moruya River estuary and its immediate surrounds. It was undertaken to fill a knowledge gap as identified in the *Moruya River Estuary Data Compilation* report and provide detailed fauna and flora information for use in development of the Moruya Estuary Management Study and Plan. The study area includes the tidal reaches of the Moruya estuary from the Kiora Bridge to the mouth of the Moruya River, and the associated foreshore and riparian zone.

The study area was aerially photographed in February 2005 and all existing areas of native vegetation identified. Each area was surveyed. Surveys noted and described the main structural and floral components. These data were used to name each ecosystem as documented in the Southern Comprehensive Regional Assessment (CRA) of south-eastern NSW (1997-2000) that formed part of the Regional Forest Agreement (RFA) between the Commonwealth and State governments. Information regarding fauna in the study area was taken from the authors personal records compiled over the past 20 years.

Eight terrestrial ecosystems were identified within the study area. Three of these are listed in part 3 of schedule 1 of the NSW Threatened Species Conservation Act, 1995 as Endangered Ecological Communities, one has a preliminary determination as an Endangered Ecological Community and one is protected under section 205 of the NSW Fisheries Management Act, 1994 Regulation 227A. Most areas of native vegetation identified are remnants and in reasonable condition but all have been significantly disturbed mainly through a proliferation of tracks, camp fires, camping sites and weed infestations.

Sixteen frogs, 13 reptiles, 193 birds and 40 mammals have been recorded within or in close proximity to the study area. Twenty six fauna species are listed as threatened under the NSW Threatened Species Conservation Act, 1995 – 4 species are listed as endangered and 22 are listed as vulnerable. Twenty species of birds protected under international migratory bird agreements have been recorded in the study area. The habitat for most species is in a satisfactory condition but disturbance is beginning to have an impact. These disturbances include degradation of habitat, human disturbance and changes through natural processes.

It is recommended that

- All ecosystems in the study area are mapped to a standard that will enable such maps to be effectively used as a planning tool.
- Existing remnants be surveyed and prioritised and actions taken to restrict access, restore and rehabilitate these remnants.
- Riparian areas are assessed and where possible rehabilitation of river bank erosion, outside bank erosion and stock exclusion by fencing be carried out.
- The areas of habitat in the estuary used by wildlife for roosting, foraging and breeding are assessed and measures taken to restore and prevent further degradation.
- Areas of potential connectivity between in the study site and other areas of native vegetation are assessed to provide connection corridors, and migration routes for native fauna and flora.
- The lack of knowledge of aquatic species (fish, invertebrates and flora) is addressed.

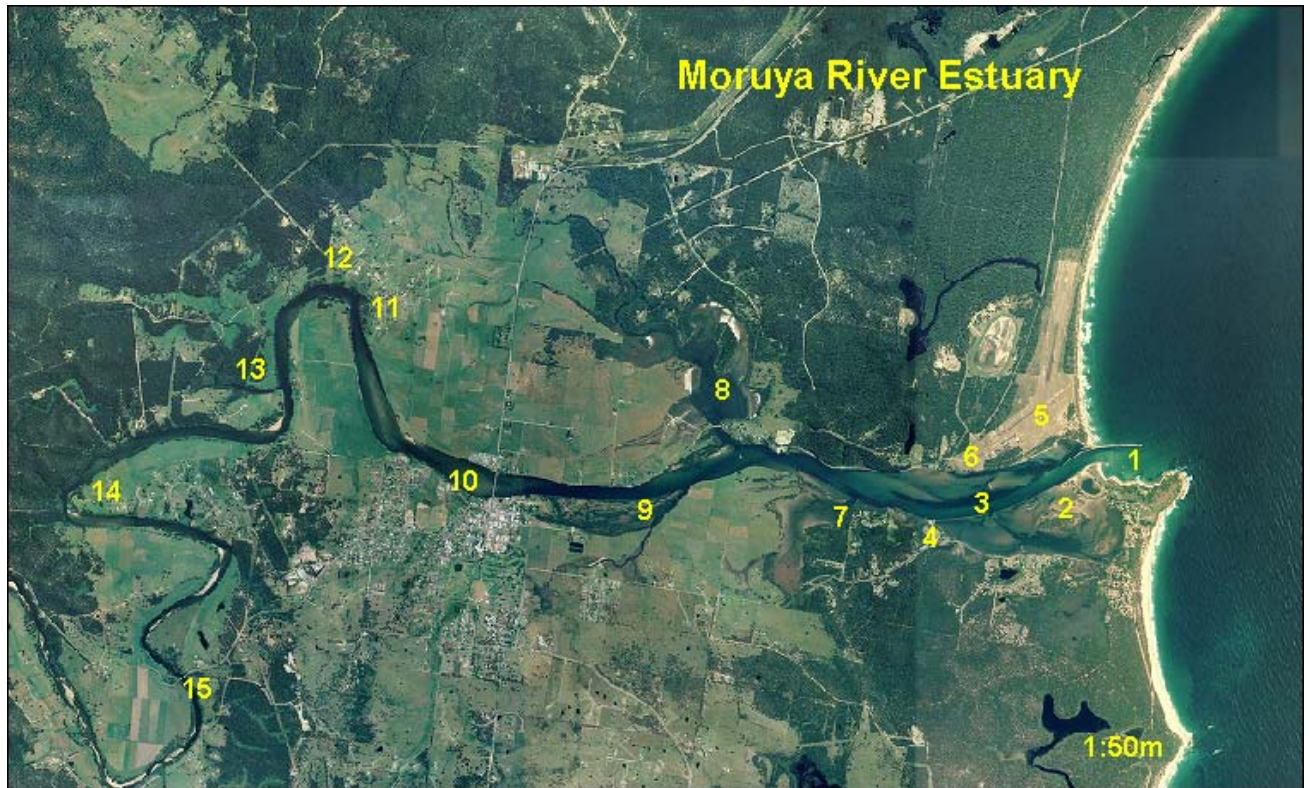
INDEX

Location Map.....	1
Introduction.....	2
Geology of the Moruya River.....	2
Ecologically Important Areas of the Moruya Estuary.....	3
PART 1 FLORA OF THE MORUYA RIVER.....	5
River Mouth to Malabar Lagoon.....	5
The Sand-dune vegetation at the mouth of the Moruya River.....	5
Quondolo Island.....	7
Gilmores Creek.....	8
Southern side of Breakwall.....	10
Native vegetation between the Airport and Brierley's Ramp.....	12
Vegetation between Preddy's Wharf and The Anchorage.....	13
The Anchorage.....	14
Vegetation between Brierley's Ramp and Malabar Lagoon.....	15
Malabar Lagoon.....	18
Malabar Lagoon to the Moruya Bridge.....	19
The Anchorage to Ryans Creek.....	19
Ryans Creek to Moruya Bridge.....	20
Malabar Lagoon entrance to Moruya Bridge.....	22
Moruya Bridge to Mogendoura Creek.....	24
Moruya Bridge to Glenduart.....	24
The Glenduart Cemetery.....	26
Glenduart to Mogendoura Creek.....	28
Mogendoura Creek.....	29
Mogendoura Creek to Kiora.....	30
Mogendoura Creek to Yarragee.....	30
Yarragee to Kiora Bridge.....	32
PART 2 FAUNA OF THE MORUYA RIVER.....	34
Frogs.....	34
Reptiles.....	38
Birds.....	41
Mammals.....	69
Recommendations.....	76
Bibliography.....	80
Appendices	
Appendix 1 Glossary of Plant Names.....	81
Appendix 2 Threatened Species.....	82
Appendix 3 Species protected by international migratory bird agreements.....	83

Acknowledgements

Many people have assisted me in the production of this report. I would like to particularly thank David Webb for his time and expertise in producing the aerial photography and many of the wildlife photographs, Dr. Petrus Heyligers and Dr. Peter Fullagar Honorary Fellows, CSIRO Sustainable Ecosystems for assistance in fieldwork and identification of species, Paula Pollock and Catherine Potter of Eurobodalla Shire Council for technical support, Forests NSW for access to flora and fauna records and members of the Eurobodalla Natural History Society for assistance in fieldwork.

Location Map



LEGEND

1. Moruya River Mouth
2. Quondolo Island
3. River Breakwall
4. Gilmores Creek
5. Moruya Airport
6. Brierley's Ramp
7. The Anchorage
8. Malabar Lagoon
9. Ryan's Creek
10. Moruya Bridge
11. Glenduart Cemetery
12. Glenduart
13. Mogendoura Creek
14. Yarragee
15. Kiora Bridge

Introduction

The study area covers the Moruya River from the river mouth to the Kiora bridge and 100m either side of the river. It also includes obvious branches of the river such as Gilmores Creek, Mogendoura Creek, The Anchorage, Ryans Creek and Malabar Lagoon.

For fauna I have used only records gathered by myself during the period 1985 to 2005 during which time I have conducted extensive formal and informal surveys of the study area. The only other records included are those that have historical interest such as records of Green and Golden Bell Frogs. These records come from voucher specimens and other equally reliable sources that can be authenticated. Where possible, photographs of threatened species have been included.

The flora survey has concentrated on the remnant riverside native vegetation and mangrove and saltmarsh communities that exist in the study area. The riverside vegetation, in the main, has been reduced to remnant patches due to clearing in the past. The mangrove and saltmarsh communities are dynamic and change from year to year. To produce an accurate historical record that will enable comparisons to be made of changes to the vegetation I have relied on aerial photography. Extensive aerial photographs of the study area were taken by me on 18 February 2005 and these photographs along with a broad description of the remnant floral communities are used to describe the vegetation.

Geology

The study area from the mouth of the Moruya River to the Kiora bridge traverses a number of different geological strata that have an influence on the soils and vegetation types that occur there. At the eastern side of the study area, at the mouth of the Moruya River, the geology consists of young Quarternary alluvials consisting of alluvial gravels, swamp deposits and sand dunes.

Between Newstead and the Anchorage on the southern side of the river and from Garlandtown to The Weir on the northern side of the river, two distinct geological formations occur. To the east the underlying rock is made up of Ordovician phyllites and shale, while to the west Silurian granite occurs. The contact zone is clearly visible in cuttings along North Head Road. These geological types have produced areas of slightly higher elevation where they occur.

To the west of this area, the river flows through very young alluvial deposits that are associated with the Moruya River floodplain.

In a few places around Yarragee and Kiora, the river makes contact again with Ordovician phyllites and shales producing some steep and slightly elevated terrain.

Ecologically Important Areas of the Moruya Estuary

A number of areas in the Moruya River estuary have been recognised for their ecological importance. Nationally, the Moruya River Estuary Saltmarshes – NSW119 have been listed as of national importance as ‘intertidal marshes; including saltmarshes, salt meadows, saltings, raised salt marshes, tidal brackish and freshwater marshes’. This national listing was made on the basis that the saltmarshes are:

‘a good example of a wetland type occurring within a biogeographic region of Australia’.

‘wetlands which play an important ecological or hydrological role in the natural functioning of a major wetland system/complex’. (Environment Australia, 2001).

This listing covers a number of areas within the Moruya estuary and includes Malabar Lagoon, The Anchorage, Ryans Creek, Gilmores Creek and the wetlands south of the breakwall at the mouth of the river.

New South Wales legislation also covers some areas of the estuary. Under State Environmental Planning Policy 14, (SEPP 14) coastal wetlands have been designated in a number of local governmental areas. The aim is to "ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the state (Coastal Council of NSW, 1985). A number of SEPP 14 wetlands occur in the Moruya estuary. They are:

- SEPPs 171, 172, 173, 174 and 176 which occur within the wetlands south of the breakwall at the mouth of the river.
- SEPP 175 – Gilmores Creek
- SEPP 177 – The Anchorage
- SEPP 178 – Ryans Creek
- SEPPs 179, 180 and 181 which occur in Malabar Lagoon.
- SEPP 178a – Mogendoura Creek

Mangroves are protected under section 205 of the NSW Fisheries Management Act, 1994 Regulation 227A.

Three ecological communities in the study area are listed in part 3 of schedule 1 of the NSW Threatened Species Conservation Act, 1995 as Endangered Ecological Communities. They are:

- Coastal Saltmarsh in the NSW North Coast, Sydney Basin and South-East Corner bioregions (Forest Ecosystem 186 – mudflats/saltmarshes).
- Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South-east Corner bioregions (Forest Ecosystem 25 – South Coast Swamp Forest Complex).

- Bega dry grass forest in the South East Corner bioregion (Forest Ecosystem 171 – Coastal Shrub/Grass Forest – *E. tereticornis*.)

One ecological community in the study area has been identified in a preliminary determination as an endangered ecological community in part 3 of schedule 1 of the NSW Threatened Species Conservation Act, 1995 as Endangered Ecological Communities. This community is:

- Bangalay sand forest of the Sydney Basin and South East Corner bioregion (Forest Ecosystem 28 – Coastal Sands Shrub/Fern Forest – *E. botryoides* / *Banksia serrata*.)

PART 1 FLORA OF THE MORUYA RIVER

River Mouth (1) to Malabar Lagoon (8)

Sand-dunes at the Mouth of the Moruya River.

Two species dominate the beachfront and adjacent sand dunes in the estuary – Spinifex *Spinifex sericeus* and European Sea Rocket, *Kakile maritima*. While only *K. maritima* was recorded during current surveys, the American Sea Rocket *Kakile edentula* had previously been recorded on this beach (per obs). Both species have spread widely beyond the beach front. Common Couch *Cynodon dactylon* is also widespread along with Coastal Pigface *Carpobrotus glaucescens*.

Only two species of trees occur in this area, and they are concentrated on the more sheltered southern and western side of the sand dunes. These species are Coastal Banksia *Banksia integrifolia* and Swamp Oak *Casuarina glauca*.

The most common shrubs in the hind dune area are Coastal Wattle *Acacia longifolia* var. *sophorae* and Coast Beard Heath *Leucopogon parviflorus*. A small number of Native Rosemary *Westringia fruticosa* are also in the area. These have been planted as part of vegetation stabilization schemes in the past.

The most common ground covers include Seaberry Saltbush *Rhagodia candolleana*, Matt Rush *Lomandra longifolia* the sedges Sea Rush *Juncus kraussii* and Knobby Clubrush *Isolepis nodosa*, New Zealand Spinach *Tetragonia tetragonoides* Australian Commelina *Commelina cyanea* and Orach *Atriplex hastata*. The most common grass is Salt Couch *Sporobolus virginicus* with Pricky Couch *Zoisia macrantha* and Common Couch also present.

The entire area is infested with the noxious weed Bitou Bush *Chrysanthemoides monilifera* and in many places the dead stumps and branches of this species are evident in bare patches that have resulted from their poisoning. There is vigorous re-growth of Bitou from seed and suckers throughout. Other weeds present are Black Nightshade *Solanum nigrum* and Fleabane *Conzia* sp.

This vegetation complex most closely resembles Forest Ecosystem 22 **Southern Coastal Hind Dune/ Headland Scrub** (NPWS, 2000). Disturbed patches also occur east of the Moruya airport, adjacent to the Moruya River.



Sand dune vegetation at the mouth of the Moruya River



Aerial view of beach-front vegetation at the mouth of the Moruya River

Quondolo Island



Quondolo Island

Quondolo Island, a part of Eurobodalla National Park, is very low, with some elevated areas of sand dune on the northern side of the island and some slightly elevated areas to the north-west. The two main canopy trees, Swamp Oak and Coastal Banksia occur in these higher parts. Coastal Banksia occurs mainly on the northern side of the island. The island was extensively burnt during the winter of 2001 and much of the under storey is made up of re-growth Swamp Oak and Coastal Banksia along with Coastal Wattle. There are some Sweet Pittosporum *Pittosporum undulatum* and Coastal Beard Heath scattered throughout.

The ground cover comprises a number of saltmarsh plants, including *Stipa stipoides*, Austral Seablight *Suaeda australis*, Beaded Glasswort *Sarcocornia quinqueflora*, Orach New Zealand Spinach, Seaberry Saltbush, Creeping Brookweed *Samolus repens* and Common Couch. Fleabane and Black Nightshade are common in areas that had been burnt. This vegetation complex most closely resembles the endangered ecological community **Forest Ecosystem 25 South Coast Swamp Forest Complex** (NPWS, 2000).

The periphery of the island and its tidal inlets are covered with two mangrove species, Grey Mangrove *Avicennia marina* and, to a lesser extent, River Mangrove *Aegriceras corniculatum*.

Gilmores Creek (4)

Gilmores Creek has a mixture of several vegetation types, typical of a tidally influenced inlet. There are extensive mangrove clumps, dominated by Grey Mangrove, with fewer numbers of River Mangrove. The vegetation type most closely resembles **Forest Ecosystem 185 Mangrove Estuarine Low Forest** (NPWS, 2000).

There are a few small areas where the mangroves merge into stands of Swamp Oak producing a vegetation community closely resembling the endangered ecological community **Forest Ecosystem 25: South Coast Swamp Forest complex – *Casuarina glauca*** (NPWS, 2000).

There are also extensive saltmarsh areas. The most common species are Austral Seabligh, Beaded Glasswort. Also present are Orach, Knotty Club Rush, Coastal Pigface and Swamp Weed *Selliera radicans*. This resembles the endangered ecological community **Forest Ecosystem 186 Mudflats/Saltmarshes** (NPWS, 2000). The area is listed as SEPP 14 wetland 175 (Coastal Council of NSW, 1985).

Towards the upper reaches of the creek the vegetation on both sides of the creek is Spotted Gum forest. The canopy in this forest is dominated by Spotted Gum *Corymbia maculata*, with Grey Ironbark *Eucalyptus paniculata* and a number of Stringybark species. The most common species in the understorey are Burrawangs *Macrozamia communis*, Black She-oak *Allocasuarina littoralis* and Geebung *Persoonia linearis*. The ground layer is dominated by Blady Grass *Imperata cylindrica*. The vegetation type most closely resembles **Forest Ecosystem 9: Coastal Lowland Cycad Dry Shrub Forest – *Corymbia maculata* / *Macrozamia communis*** (NPWS, 2000).



Gilmores Creek- View from bridge looking south-west



Aerial view of saltmarsh and mangroves at Gilmores Creek

Southern side of Breakwall (3)

The area on the southern side of the breakwall has extensive stands of Mangroves and saltmarsh. There is evidence that this area is gradually infilling with sediment. Aerial photographs of the estuary taken periodically over the last fifty years and other historic photographs indicate a gradual siltation of this area. The mangroves which occur in large stands, particularly in the south-east are of two species. The most common is the Grey Mangrove and there are scattered individuals of the River Mangrove. These mangroves also form a continuous stand along the southern border adjacent to South Heads Road. This ecosystem is **Forest Ecosystem 185: Mangrove Low Forest** (NPWS 2000). There is evidence that this ecosystem is increasing in some places.

The salt marsh that is dispersed through the mangroves comprises a number of species. The most common species are Austral Seabligh, Beaded Glasswort, Orach, Coastal Pigface, New Zealand Spinach, Seaberry Saltbush, European Sea Rocket, Native Sea Lavender *Limonium australe*, Sea Rush and Knobby Clubrush. Grasses include Salt Couch and Prickly Couch.

Several other species of note are *Chenopodium glaucum*, Nettle-leafed Goosefoot *Chenopodium murale*, Streaked Arrow Grass *Triglochin striatum*, Berry Saltbush *Einadia hastata*, Climbing Saltbush and *Einadia nutans ssp linifolia*. On the slightly higher sand ridges are Prickly Couch, Common Couch, Strand Sedge *Carex pumila* and *Stipa stipoides*. This ecosystem is the endangered ecological community **Non-forest Ecosystem 186: Mudflats / Saltmarshes** (NPWS 2000).

Scattered throughout are small stands of Swamp Oak which make up small amounts of the ecosystem most closely resembling the endangered ecological community **Forest Ecosystem 25: South Coast Swamp Forest complex – *Casuarina glauca*** (NPWS, 2000).

Substantial patches of these three ecosystems also occur on private property in tidal areas south of South Heads Road.

This area includes SEPP 14 wetlands 171, 172, 173, 174 and 176 (Coastal Council of NSW, 1985).



Southern side of breakwall showing mangrove and saltmarsh communities



Southern side of the Moruya estuary showing a continuous stand of mangroves

Airport (5) to Brierley's Ramp (6)

A remnant of native vegetation occurs on both sides of Bruce Cameron Drive between the airport and Brierley's boat ramp. The canopy is composed of two species, Coastal Mahogany, *E. botryoides* and Blackbutt, *E. pilularis*.

The understorey is dominated by Sweet Pittosporum, Burrawang, Tree Broom-heath, *Monotoca elliptica* and Coastal Wattle with lesser elements of Old Man Banksia, *B. serrata*, Coastal Banksia, Black Wattle, *A. mearnsii* and a few scattered Black She-oak.

The groundcover is composed mainly of Bracken *Pteridium esculentum* and Matt Rush, with a lesser element of Blady Grass. There are also substantial infestations of Bitou, and Kikuyu *Pennisetum clandestinum*. An area at the eastern end of this remnant has been recently cleared presumably because of its proximity to the flight path at Moruya airport.

The vegetation does not closely match any of the described vegetation types, but contains elements of the provisionally listed endangered ecological community **Forest Ecosystem 28: Coastal Sands Shrub/Fern Forest – *E. botryoides* / *Banksia serrata***



Remnant native vegetation between the airport and Brierleys ramp

Preddy's Wharf to The Anchorage (7)



Vegetation between Preddy's Wharf and The Anchorage

West of Preddy's Wharf, adjacent to the car park, the vegetation has been cleared and consists mostly of Kikuyu with small stands of Swamp Oak and a few River Mangroves on the shore. To the south, on private property, there are disturbed remnants of Spotted Gum forest resembling **Forest Ecosystem 9: Coastal Lowland Cycad Dry Shrub Forest – *Corymbia maculata* / *Macrozamia communis*** (NPWS, 2000).

On the eastern side of the embayment there is a large stand of mangroves, made up mainly of Grey Mangrove with scattered individuals of River Mangrove. This ecosystem is **Forest Ecosystem 185: Mangrove Low Forest** (NPWS 2000). On the higher areas of the shoreline a mixture of species occurs – mainly Salt Couch, Austral Seabligh, New Zealand Spinach, Knotty Clubrush, Creeping Brookweed, Seaberry Saltbush and Beaded Glasswort. The weed *Asparagus Fern* *Protasparagus aethiopicus* occurs in a few patches of in this area. A small ephemeral creek, approximately in the centre of the embayment is lined with Common Reed *Phragmites australis*.

On the western side mangroves are replaced by extensive saltmarsh flats. The most common species in this stand are Beaded Glasswort, Knotty Clubrush, Salt Couch, New Zealand Spinach and Sea Rush. Also present are Orach, Austral Sea Lavender, Austral Seabligh, Seaberry Saltbush and Creeping Brookweed. This ecosystem is the endangered ecological community **Non-forest Ecosystem 186: Mudflats / Saltmarshes** (NPWS 2000). A few Prickly Pear *Opuntia spp* occur on a small 'island' of Grey Mangrove and Swamp Oak in the north-east corner of this embayment.

The Anchorage



The Anchorage and its upper reaches

The anchorage and its upper reaches contain extensive areas of mangroves and saltmarsh which extend to the south beyond South Heads Road in a number of places. The saltmarsh is dominated by Beaded Glasswort with some Sea Rush, Streaked Arrow Grass, Austral Seabligh and Creeping Brookweed scattered throughout. Around the edges, a number of other species occur: New Zealand Spinach, Swamp Weed, Berry Saltbush, Seaberry Saltbush, Salt Couch and *Disphyma clavellatum*. This resembles the endangered ecological community **Forest Ecosystem 186 Mudflats/Saltmarshes** (NPWS, 2000). There are stands of Swamp Oak around the edges and along Louttit's Creek. This resembles the endangered ecological community **Forest Ecosystem 25: South Coast Swamp Forest complex – *Casuarina glauca*** (NPWS, 2000).

Grey Mangroves are very common with some scattered River Mangrove. This stand resembles **Forest Ecosystem 185 Mangrove Estuarine Low Forest** (NPWS, 2000).

The west and south of this area is surrounded by cleared agricultural land. Some Forest Red Gums stand in these cleared paddocks. On the east, adjacent to the Anchorage, the vegetation is partially cleared (due to small acreage development). The vegetation consists of a canopy of Spotted Gum, Grey Ironbark and some stringybark species. The understorey is sparse, mainly Burrawangs, Black Sheoak and Geebung. The groundcover is also sparse, mainly Blady Grass and some *Poa* species. This vegetation is **Forest Ecosystem 9: Coastal Lowland Cycad Dry Shrub Forest – *Corymbia maculata*/ *Macrozamia communis*** (NPWS, 2000).

Brierley's Ramp (6) to Malabar Lagoon (8)

On the north side of the river between Brierleys Ramp and The Weir the remaining native vegetation consists of **Forest Ecosystem 9: Coastal Lowland Cycad Dry Shrub Forest** – *Corymbia maculata*/ *Macrozamia communis* (NPWS, 2000) The area is steep with a number of incised gullies. The canopy is dominated by Spotted Gym, Grey Ironbark and a Stringybark species. The most common species in the understorey are Burrawangs, Black She-oak, Sweet Pittosporum, Cherry Ballart, *Exocarpos cupressiformis* and Prickly bearded-heath, *Leucopogon juniperinus*. The ground layer is dominated by Blady Grass *Imperata cylindrical*. There are significant infestations of the weed Bridal Creeper *Myrsiphillum asparagoides*.

The most common species in the incised gullies is Grey Myrtle, *Backhousia myrtifolia* with an understorey of Rough Treefern *Cyathea australis* and *Gahnia clerkei*.

In several places there are small tidal inlets that have been formed by the construction of North Head Road. The vegetation in these inlets is made up of Swamp Oak on the periphery with Grey Mangrove in the tidal areas. There are some saltmarsh species, mainly Beaded Glasswort, Austral Seabligh, Sea Rush, Creeping Brook Weed and New Zealand Spinach in these areas. There are also some patches of Swamp Weed.



Vegetation between Brierleys Ramp and The Weir on the north side of the river



Vegetation between Brierleys Ramp and The Weir showing a salt marsh inlet



Salt marsh inlet – North Head Road

The small neck of land between the granite quarry and the bridge at the Weir has been largely cleared of native vegetation and has been heavily disturbed. However, there are still some traces of the endangered ecological community **Forest Ecosystem 171: Coastal Shrub/Grass Forest – *E tereticornis***. Virtually all of the ground cover and understorey has been removed but a few Forest Red Gum *Eucalyptus tereticornis* remain in the paddocks.

Neck of land between the Granite Quarry and the bridge at The Weir



Malabar Lagoon (8)



Malabar Lagoon

Three communities occur on the lagoon, the endangered ecological community **Non-forest Ecosystem 186: Mudflats / Saltmarshes**, the endangered ecological community **Forest Ecosystem 25: South Coast Swamp Forest complex – *Casuarina glauca*** and **Forest Ecosystem 185: Mangrove Low Forest** (NPWS 2000) and includes SEPP 14 wetlands 179, 180 and 181.

There is evidence that all three communities fluctuate over time. There are areas of active increase as well as areas where the vegetation shows signs of senescence throughout the lagoon. Among other things, this is probably the result of fluctuations in seasonal temperatures, freshwater flows of the river and creeks that flow into the lagoon. There is also evidence of disturbance, particularly from cattle grazing and attempts to control salt water flows in the south-west corner through levees and artificial channels.

The most extensive areas are saltmarshes. They are made up almost entirely of Beaded Glasswort with small patches of Austral Seablight, Sea Rush and Knobby Clubrush. Around the 'shores' the most common species are Orach, Swamp Weed, Streaked Arrow Grass and New Zealand Spinach. Grasses include Salt Couch and Prickly Couch. There are small patches of Kikuyu throughout. The stands of mangroves are almost all Grey Mangrove with a few scattered individuals of River Mangrove. There are stands of Swamp Oak around the periphery and some larger stands on higher ground and the banks of creeks and man-made channels.

Malabar Lagoon (8) to the Moruya Bridge (10)

The Anchorage (7) to Ryans Creek (9)



The Anchorage to Ryans Creek

The native riverside vegetation between The Anchorage and Ryans Creek has been almost entirely cleared. Immediately west of The Anchorage some stands of Swamp Oak remain. These stands are associated with tidal channels that run west from the mouth of The Anchorage.

Further west, the vegetation is made up of exotic pasture species, mainly Kikuyu and clover species *Trifolium spp.* There are a few scattered Swamp Oak trees and African Boxthorn bushes on the bank and a few River Mangroves in the gaps between the granite boulders stabilising the bank. A few saltmarsh plants also occur here. These include Orach, Berry Saltbush, Beaded Glasswort, New Zealand Spinach and Austral Seabligh.

Ryans Creek (9) to Moruya Bridge (10)



Ryans Creek

An extensive area of native vegetation occurs in the vicinity of Ryans Creek, which includes SEPP wetland 178. The endangered ecological community **Non-forest Ecosystem 186: Mudflats / Saltmarshes** (NPWS, 2000) extends from the mouth of Ryans Creek to South Heads Road. As with the other saltmarshes on the river, the most common species are Beaded Glasswort, Austral Seabligh, Sea Rush, Knobby Clubrush, Orach, Swamp Weed, Streaked Arrow Grass and New Zealand Spinach. Grasses again include Salt Couch and Prickly Couch. In the main, this ecosystem occurs on grazing land and has been considerably disturbed.

Large stands of mangroves, **Forest Ecosystem 185: Mangrove Low Forest** (NPWS 2000) also occur here. While Grey Mangrove is the most common species, there are considerable numbers of River Mangrove, particularly near the mouth of the creek.

On the margins of the creek, the endangered ecological community **Forest Ecosystem 25: South Coast Swamp Forest complex – *Casuarina glauca*** (NPWS, 2000) also occurs.

The area between Ryans Creek and the Moruya Swimming Pool, formerly the Moruya Caravan Park and now known as the Moruya Riverside Park, has some remnant native vegetation, particularly in the eastern area of the reserve. The canopy is dominated by Swamp Oak, with some Black Wattle, Coastal Wattle, Mabel's Wattle *Acacia mabellae* and

Sweet Pittosporum. The understorey is virtually absent with only *Bursaria lasiophylla* and *Babingtonia plurifolia* being the only noticeable native species but there are a number of introduced species including Small-leaved Privet *Ligustrum sinense* and African Boxthorn *Lycium ferocissimum*. The groundcover is made up of a number of introduced and native grasses, including Kikuyu, Common Couch, Panic Grass *Erhrharta erecta* and Parramatta Grass *Sporobolus africanus*. This area has been heavily disturbed by grazing. The area is also infested with a number of common weeds including Serrated Tussock *Nassella thrichotoma* (G. Harding pers comm).

In the area previously occupied by the Moruya Caravan Park there are a number of introduced tree species.



Upper reaches of Ryans Creek showing saltmarsh

Malabar Lagoon entrance (8) to Moruya Bridge (10)



Native vegetation adjacent to the Moruya River at mouth of Malabar Lagoon

On the western banks of the entrance to Malabar Lagoon, adjacent to the Moruya River there is a stand of native vegetation. It consists mainly of Swamp Oak forest, the endangered ecological community **Forest Ecosystem 25: South Coast Swamp Forest complex – *Casuarina glauca*** (NPWS, 2000), with some stands of mangroves along the banks of the river and along the tidal channels that run through the Swamp Oak forest.

The canopy of the forest is made up entirely of Swamp Oak, with a few small patches of Black Wattle in areas that have previously been cleared for grazing. The understorey is absent and the groundcover is composed mainly of Kikuyu, Tall Speargrass *Stipa pubescens* and the weeds Wandering Jew *Transecantia albiflora* and Cape Ivy *Delairea odorata*. In areas close to the river, Prickly Couch is also present.

Along the tidal channels the most common mangrove is Grey Mangrove, with small numbers of River Mangrove. Other species present in the channels are Austral Sea Lavender, New Zealand Spinach, Orach, Austral Seabight, Creeping Brookweed, Beaded Glasswort, Seaberry Saltbush and Berry Saltbush.

Along the riverfront in this area both mangrove species are present as is Sea Couch, Sea Rush, Knobby Clubrush, Beaded Glasswort. The weeds Bitou Bush and African Boxthorn were also noted.



River bank at mouth of Malabar Lagoon showing vegetation remnant and mangrove channels.

The river bank west to the Moruya Bridge has been retained with granite. There are a few Swamp Oak and Black Wattle in this area. Several exotic species have been planted between North Head Drive and the river.

Moruya Bridge (10 to Mogendoura Creek (13)

Moruya Bridge (10) to Glenduart (12)



Moruya Bridge to Glenduart - view looking north-west from Moruya

On the southern bank of the river very little native vegetation remains. This native vegetation is mainly Swamp Oak which occurs as scattered individuals or small clumps and some very old Coastal Grey Box *Eucalyptus bosistoana* which overhang the river between the bridge and the hospital. The other species are exotics and include Norfolk Island Pine *Araucaria heterophylla*, Silky Oak *Grevillia robusta*, Peppercorn *Schinus areira* and some exotic eucalypts.

The sparse understorey, where present, consists of Sweet Pittosporum and Black Wattle. The groundcover species comprise Kikuyu, Tall Speargrass, Bracken Fern, small patches of Native Reed *Phragmites australis* and the weeds Wandering Jew and Cape Ivy.

Along the river, between the bridge and the hospital, Grey Mangroves are well established and appear to be spreading. Only two individuals of River Mangrove were located in this area. A few saltmarsh plants occur along the granite wall, including Orach, New Zealand Spinach and Berry Saltbush.

From the hospital to the bend opposite Glenduart the riverbank has been retained for only about 200 metres, after which there is active erosion. In this area there is an almost continuous line of Swamp Oak, interspersed with Black Wattle and Coastal Wattle. Small patches of Native Reed and Sweet Pittosporum also occur here. The groundcover consists

of pasture species mainly kikuyu. Also present are the weeds Cape Ivy, Rambling Dock, Fleabane and Common Verbena *Verbena bonariensis*.

There are Grey Mangroves scattered along the river in this area.



Moruya Bridge to Glenduart - view looking south-east from Glenduart

The northern bank of the river has been retained for some distance and has been fenced. There have been extensive plantings along the bank. The most common native species is Swamp Oak which occurs throughout. There is also some River Oak *Casuarina cunninghamiana* in this area. Because these two species hybridize readily there are likely to be hybrids in areas where they both occur. Black Wattle, Coastal Wattle and Coastal Grey Box are also present.

The understorey is mostly absent, but where present, consists mainly of the weed African Boxthorn and some Coastal Wattle. The groundcover away from the river is made up of pasture grasses - Kikuyu and Clover species. Near the river, Salt Couch, Prickly Couch, Kangaroo Grass *Themeda australis*, Knobby Club Rush, Tall Speargrass, Bracken Fern and Matt Rush are present. Weeds include Rambling Dock, Cape Ivy, Scotch Thistle *Cirsium vulgare*, Common Verbena, Prickly Pear and Fleabane.

On a sandbank opposite the hospital there a number of recently established Grey Mangroves less than one metre tall and several patches of saltmarsh plants. On the higher sand hummocks, Sea Couch and Beaded Glasswort are well established. Also present are Sea Rush, Knobby Club Rush, Native Reed, Orach, Austral Seabligh, Austral Sea Lavender and New Zealand Spinach.



Mangroves and eucalypts on bank of the Moruya River

The Glenduart Cemetery (11)

There is a small patch of remnant native vegetation on the north bank of the Moruya River in the vicinity of the Glenduart cemetery. This cemetery reserve and the surrounding area does not appear to have been previously grazed or cleared and contains a number of old and senescent trees. The canopy in this area is dominated by Forest Red Gum with a few other species including Blue-leafed Stringybark *Eucalyptus agglomerata*, Coastal Grey Box and Rough-barked Apple *Angophora floribunda*. The understorey is sparse with Cherry Ballart, Black Wattle, Black Sheoak, Sweet Pittosporum, Rough-fruited Pittosporum *Pittosporum revolutum* Native Blackthorn *Bursaria spinosa* and a few suppressed eucalypt species being the most noticeable elements. Kangaroo Grass is the most common ground cover species. This remnant most closely resembles the endangered ecological community **Forest Ecosystem 171: Coastal Shrub/Grass Forest – *E tereticornis***.



Remnant native vegetation – Glenduart cemetery.



River at Glenduart showing remnant vegetation (top left) at Glenduart cemetery.

Glenduart (12) to Mogendoura Creek (13)



Glenduart to Mogendoura Creek (Glenduart – foreground; Mogendoura Creek top right)



Typical river bank between Glenduart and Mogendoura Creek

The vegetation on both sides of the river between Glenduart and Mogendoura Creek is very similar to that from the Moruya Bridge to Glenduart. The land has been cleared for grazing and the river bank trees are Casuarinas (River Oak, Swamp Oak and their hybrids), Black Wattle and Mabel's Wattle. A few eucalypts are also present. There is no understorey and the ground cover is mainly kikuyu, with some bracken fern and Tall Speargrass. Rambling Dock, Cape Ivy and Common Verbena are also present.

In the river, young River Mangroves are scattered throughout, with Sea Rush, Knobby Clubrush and Native Reed also present.

Mogendoura Creek (13)

The banks on both sides of Mogendoura Creek have also been cleared. Trees present on the banks include both species of Casuarina and their hybrids, Black Wattle and Mabel's Wattle as well as a few Poplar trees, *Populus spp.* Some understorey exists, mainly in areas excluded from grazing and consist of juvenile wattles, casuarinas and some Privet *Ligustrum sinense*. The groundcover is mainly pasture grasses with Bracken Fern, Tall Speargrass and Knobby Clubrush. In the river there is River Mangrove. This species forms extensive stands and is **Forest Ecosystem 185: Mangrove Low Forest** (NPWS 2000). The wetlands in this area have been classified as SEPP 14 Wetland No 178a. On the landward side of these stands Sea Rush, Knobby Clubrush, Native Reed and Tall Speargrass are also present.



Bank of Mogendoura Creek showing extensive stands of River Mangrove.



Mogendoura Creek with mangroves clearly evident

Mogendoura Creek (13) to Kiora (15)

Mogendoura Creek (13) to Yarragee (14)

The vegetation in the cleared sections on both sides of the river is similar to the previously described section. On the eastern (Yarragee side) there is more evidence of weed infestation, notably Cape Ivy and Wild Tobacco. This is probably due to the fact that this side of the river is not grazed as heavily by cattle due to the fact that most of the land is small acreage rural residential rather than farm land. A section on the western bank consists of uncleared forest. This vegetation is similar to two forest types **Forest type 7 South Coastal Hinterland Shrub/Tussock Grass Dry Forest – *E. agglomerata* – *E. muelleriana*** and **Forest Type 10 Southern Coastal Lowlands Shrub/Grass Dry Forest – *E. globoidea* /*E. longifolia***. The two types appear to merge throughout with the canopy species of both types, White Stringybark *E. globoidea*, Woollybutt *E. longifolia*, Yellow Stringybark *E. muelleriana*, Blue-leafed Stringybark, Rough-barked Apple and Silver-topped Ash *E. sieberi* being present.

The understorey is dominated by Burrawangs, Geebung, Mock Olive *Notelaea venosa*, Black Sheoak and a number of Acacia species. The most common groundcover species are Wire Grass *Entolasia stricta*, Sword Grass *Lepidosperma laterale*, Blue Flax Lily *Dianella caerulea*, *Poa spp.* and Lomandra.



Mogendoura Creek to Yarragee showing uncleared forest on the western bank



Uncleared land on the western bank of the river at Yarragee

Yarragee (14) to Kiora (15)

In the main, the river in this section flows through cleared pasture. The main canopy species is River Oak which is found in a narrow and, in some places, scattered distribution along the bank. Other major species present on the bank are Black Wattle and Mabel's Wattle. In places (e.g. around the Kiora bridge) there are some willows, *Salix spp*, but these do not appear to be invasive. Except for a few scattered African Box-thorn weeds and some regrowth of River Oak and wattles, the understorey is absent.

The groundcover is mainly pasture grasses – kikuyu, clover and some common couch. Small clumps of Mat Rush and Tall Speargrass were noted in places. There are a number of Rough Treeferns in well shaded gullies.

Prominent weeds include Cape Ivy, Wandering Jew, Wild Tobacco *Solanum mautitianum*, Fleabane and Cobblers Peg *Bidens pilosa*.



Yarragee to Kiora (Yarragee top left; Kiora bottom right)



Typical riverside vegetation –Yarragee to Kiora

There is a small section of native vegetation on a small rocky cliff face on the south side of Yarragee. Species present in this area are Spotted Gum, White Stringybark, Cherry Ballart, Black Sheoak and Burrawang.



Native vegetation on cliff face to the south of Yarragee

PART 2 FAUNA

Amphibians

Order and nomenclature follows Cogger 2000

Because the study area is within the tidal limits of the Moruya River, no frog species occur in the river itself. However, there are a number of species that are found in permanent and ephemeral freshwater environments in the study area.

Common Eastern Froglet *Crinia signifera*

Probably the most common species in the study area present in all suitable locations. Calls throughout the year and one of the few species that call during winter.

Eastern Banjo Frog *Lymnodynastes dumerilii*

A large frog with distinct femoral glands. Occurs in most locations with permanent freshwater.



Lymnodynastes dumerilii

Newstead Pond 2003

Striped Marsh Frog *Lymnodynastes peronii*

A very common species throughout the study area. Often recorded away from water during wet weather. Egg masses often found in ephemeral ponds and puddles after rain.



Striped Marsh Frog *Lymnodynastes peronii*

Haswell's Frog *Paracrinia haswelli*

A common frog found throughout the study area in permanent freshwater.

Brown Toadlet *Pseudophryne bibronii*

Found throughout the study area in forest and heathland where it shelters under rocks, logs and leaf litter. Eggs are laid in burrows under leaf mould and hatch when burrows are flooded by rain.

Pseudophryne dendyi

As for *Pseudophryne bibronii*

Uperoleia laevigata

Found throughout the study area in forested habitats, usually in areas that are inundated by water after heavy rain. They can be easily identified by their prominent parotid glands.

Uperoleia tyleri

Occurs in almost identical habitat to *U. laevigata*, occurring in forested areas away from water. Most often found in areas inundated by water after heavy rain. This species can be identified by its prominent parotid glands and yellow groin and thigh patch.



U. tyleri

Tomakin 2004

Green and Golden Bell Frog *Litoria aurea*

Threatened species listed on Schedule 1 of the Threatened Species Conservation Act as Endangered. Previously a very common frog in the study area, but has undergone a dramatic decline throughout its range along the east coast. This large species was regularly recorded in freshwater wetlands such as Pedro Swamp, Newstead Reserve and wetlands adjacent to Ryans Creek up until the 1970s. It is now possibly extinct in Eurobodalla Shire.



Green and Golden Bell Frog

Bawley Point 2000

Blue Mountains Tree Frog *Litoria citropa*

This species occurs commonly in freshwater forest streams throughout the south coast. It is closely associated with two other species, the Leaf Green Tree Frog *Litoria Phyllochroa* and Leseur's Tree Frog *Litoria lesueuri*. These species are not known to occur in brackish water, which comprises most of the study area, but would almost certainly occur in most streams feeding into the Moruya River.

Bleating Tree Frog *Litoria dentata*

A common species around permanent or temporary freshwater throughout the study area. Very vocal during wet weather.

Brown Tree Frog *Litoria ewingii*

A common species around permanent or temporary freshwater throughout the study area.

Leseur's Tree Frog *Litoria lesueuri*

See Blue Mountains Tree Frog

Peron's Tree Frog, *Litoria peronii*

A common large frog throughout the study area near permanent or ephemeral freshwater. Calls during spring and summer.



Perons Tree Frog

Moruya 2004

Leaf Green Tree Frog *Litoria Phyllochroa*

See Blue Mountains Tree Frog

Verreaux's Tree Frog *Litoria verreauxii*

Found throughout the study area in areas with permanent or ephemeral freshwater. One of the few frogs that call during winter.

Reptiles

Order and nomenclature follows Swan et al 2004

Lace Monitor *Varanus varius*

Common throughout the entire study area, usually only encountered during spring and summer. Most often seen on the ground, foraging on carrion. When disturbed usually climbs the nearest tree.

Jacky Lizard *Amphibolurus muricatus*

Common throughout entire study area. Usually found in areas where sclerophyll forest meets the banks of the Moruya river. Also common in coastal hind-dunes at Moruya Heads.

Eastern Water Dragon *Physignathus lesueurii*

A common species throughout the study area, recorded in all months. These dragons are often seen along the margins of the Moruya estuary and its tributaries where they loaf on waterside rocks, accumulated flood debris, logs and tree branches overhanging water. Two sub-species are recognised – the nominate race *Physignathus lesueurii lesueurii* and *Physignathus lesueurii howittii* often referred to as the Gippsland Water Dragon. Only *Physignathus lesueurii howittii* occurs in the study area.



Male Water Dragon

Ryans Creek Moruya 2003

Red-throated Skink *Acritoscincus platynotum*

Uncommon. Usually found in leaf litter where sclerophyll forest meets the banks of the Moruya river.

Yellow-bellied Water Skink *Eulamprus heatwolei*

Very common throughout, usually recorded in accumulated high tide debris and flood debris. Often seen foraging close to water during the day.

Garden Sun-skink *Lampropholis delicata*

A very common species recorded throughout the study area; very active during the day.

Grass Sun-skink *Lampropholis guichenoti*

A very common species recorded throughout the study area; very active during the day.

Common Blue-tongued Lizard *Tiliqua scincoides*

A very common species recorded throughout the study area, usually in spring and summer.

Diamond Python *Morelia spilota*

Fairly common throughout the study area in all habitats. Most commonly seen basking on exposed rocks or sand during spring.



Diamond Python

Moruya Estuary 2002

White-lipped Snake *Drysdalia coronoides*

A small (c35cm) grayish snake with a distinct white upper lip. Fairly common throughout the study area, most commonly found under leaf litter, logs etc.

Mustard-bellied Snake *Drysdalia rhodogaster*

A small (c35cm) brown snake, with a distinct dark head, often with an orange brownish band on the nape of the neck. This species is sometimes mis-identified as a Copperhead Snake. Fairly common in leaf litter, under logs etc.; in spring it is often seen on exposed rocks and sand.

Red-bellied Black Snake *Pseudechis porphyriacus*

Most common snake in the study area. Found in all habitats, especially along the edges of freshwater wetlands. Most often encountered in spring and summer.

Long-necked Turtle *Chelodina longicollis*

The only turtle (usually referred to as a tortoise) that occurs in this area. Very common in freshwater wetlands adjacent to the Moruya River; does not occur in the river below the tidal limit. Most commonly seen when dispersing in late spring and early summer.

Reptiles not recorded in the study area, but known to occur in the surrounding district

Black Rock Skink, *Ergenia saxatilis*

Weasel Skink, *Saproscincus mustelinus*

Tiger Snake, *Notechis scutatus*

Common Brown Snake, *Pseudonaja textiles*

Small-eyed Snake, *Rhinoplocephalus nigrescens*

Birds

Nomenclature and order follows Christidis and Boles 1994

Black Swan *Cygnus atratus*

Very common resident present throughout the study area in all months. Large numbers occur in more sheltered area when moulting occurs in Autumn. Breeds in freshwater wetlands adjacent to the river.

Wood Duck *Chenonetta jubata*

Common breeding resident throughout the study area. Breeds in hollow trees adjacent to the river. Numbers have increased markedly over the past ten years.

Pacific Black Duck *Anas superciliosa*

Common breeding resident present in all months.

Australasian Shoveler *Anas rhynchotis*

Uncommon migrant usually found on freshwater wetlands adjacent to the river. Has been recorded in all months, but more common in winter.

Grey Teal *Anas gracilis*

Common breeding resident found in all habitats in the study area in all months.

Chestnut Teal *Anis castanea*

Very common breeding resident.

Hardhead *Aythya australis*

Occurs irregularly in small numbers on freshwater wetlands adjacent to the river. Recorded in all months.

Australasian Grebe *Tachybaptus novaehollandiae*

Common breeding resident species of freshwater wetlands; occasionally recorded in the river.

Hoary-headed grebe *Poliiocephalus poliocephalus*

Common breeding resident species of freshwater wetlands; occasionally recorded in the river.

Little Penguin *Eudyptula minor*

Common oceanic breeding resident. Occasionally recorded in the Moruya River adjacent to the river mouth.

Darter *Anhinga melanogaster*

Common breeding resident, present in small numbers throughout the study area.

Little Pied Cormorant *Phalacrocorax melanoleucos*

Very common breeding resident present in large numbers throughout the study area.

Pied Cormorant *Phalacrocorax varius*

Uncommon resident, present in small numbers throughout the year east of Preddy's Wharf on retaining wall and sand banks.

Little Black Cormorant *Phalacrocorax sulcirostris*

Very common resident present in large numbers throughout the study area. Often seen in large flocks when feeding on shoals of fish in estuary.

Great Cormorant *Phalacrocorax carbo*

Common resident throughout the study area on the coast, estuary, ponds and wetlands.

Australian Pelican *Pelicanus conspicillatus*

Common resident recorded mainly on larger expanses of water but also occurs on small wetlands and ponds. Present in all months.

White-faced Heron *Egretta novaehollandiae*

Common breeding resident found in all habitats in the study area. Present in all months.

Little Egret *Egretta garzetta*

Common resident, present in all months. Usually seen feeding on the muddy edges of the river, estuary and adjacent wetlands.

Eastern Reef Heron *Egretta sacra*

Uncommon. Individuals sometimes recorded on rocky outcrops at the mouth of the Moruya River.

White-necked Heron *Ardea pacifica*

Uncommon breeding resident, found in small numbers throughout study area, usually along creek banks and small freshwater wetlands.

Great Egret *Egretta alba*

Common resident found along the margins of the estuary, river banks and freshwater wetlands throughout the study area.

Intermediate Egret *Egretta intermedia*

Uncommon migrant to the study area. Has been recorded on margins of the estuary.

Cattle Egret *Ardea ibis*

Common winter migrant, arriving during March and departing in November. Numbers have gradually increased over the past twenty years. Usually seen foraging in association with cattle in agricultural land. Communally roosts at night in several areas along the Moruya River.

Striated Heron *Butorides striatus*

Uncommon resident, found in small numbers throughout the study area, usually at the water's edge on a falling tide.

Nankeen Night Heron *Nycticorax caledonicus*

Uncommon resident found throughout study area; usually observed roosting in small groups in *Casuarina glauca* during the day.

Australian White Ibis *Threskiornis molucca*

A common resident, present throughout the study area in all months.

Straw-necked Ibis *Threskiornis spinicollis*

Uncommon migrant, usually observed foraging in agricultural land adjacent to the river. Most common in winter.

Royal Spoonbill *Platalea regia*

Common resident, present throughout the year on the estuary, wetlands and river bank.

Yellow Spoonbill *Platalea flavipes*

Rare migrant, observed occasionally in association with Royal Spoonbills.

Osprey *Pandion haliaetus*

Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as Vulnerable. Uncommon non-breeding migrant recorded irregularly at the mouth of the Moruya River and the adjacent mudflats. Most records are in autumn and winter.



Osprey

Black-shouldered Kite *Elanus notatus*

Common breeding resident usually observed hovering over open ground in agricultural land adjacent to the river. Occurs in all months.

Square-tailed Kite *Lophoictinia isura*

Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as Vulnerable. Summer breeding migrant of forests in the area sometimes observed over forested areas adjacent to the river.



Square-tailed Kite

Mogo State Forest

Whistling Kite *Haliastur sphenurus*

Common breeding resident found throughout the study area in all months.

White-bellied Sea Eagle *Haliaeetus leucogaster*

Breeding resident with two permanently occupied territories in the study area. One pair occupies a territory east of the Moruya River bridge, the other in the Kiara area. Seen throughout the year over the river and estuary. Nesting sites probably vulnerable to clearing and development of forested areas adjacent to the river.



White-bellied Sea Eagle

Swamp Harrier *Circus approximans*

Common breeding resident found in all months, adjacent to the estuary, river side and wetlands in the study area.

Brown Goshawk *Accipiter fasciatus*

Common breeding resident in the study area, most often seen in areas of forest and thick vegetation adjacent to the river.

Grey Goshawk *Accipiter novaehollandiae*

Uncommon breeding resident; both grey and white phase birds have been recorded in the study area. Found in habitat similar to that of the Brown Goshawk.

Collared Sparrowhawk *Accipiter cirrhocephalus*

Uncommon breeding resident, recorded throughout the study area in all months.

Wedge-tailed Eagle *Aquila audax*

Breeding resident in the region, often seen soaring above the study area.

Little Eagle *Hieraetus morphnoides*

Uncommon resident of the region occasionally recorded in the study area.

Brown Falcon *Falco berigora*

Breeding resident of the region occasionally recorded in the study area.

Australian Hobby *Falco longipennis*

Breeding resident of the region occasionally recorded in the study area.

Peregrine Falcon *Falco perigrinus*

Breeding resident of the region occasionally recorded in the study area.

Australian Kestrel *Falco cenchroides*

Common breeding resident in the study area usually seen hovering over cleared land adjacent to the river. Males present in all months, females arrive in Spring for breeding and depart in the autumn. Nest in hollow paddock trees.

Buff-banded Rail *Gallirallus philippensis*

Uncommon resident in the study area; found along the margins of the estuary, river and adjacent wetlands.

Purple Swamphen *Porphyrio porphyrio*

Common breeding resident found in all freshwater wetlands in the study area as well as the more brackish areas of the Moruya river.

Dusky Moorhen *Gallinula tenebrosa*

Uncommon breeding resident, occurs only around freshwater ponds, dams etc in the study area.

Eurasian Coot *Fulica atra*

Common breeding resident, occurs only around freshwater ponds, dams etc in the study area.

Latham's Snipe *Gallinago hardwickii*

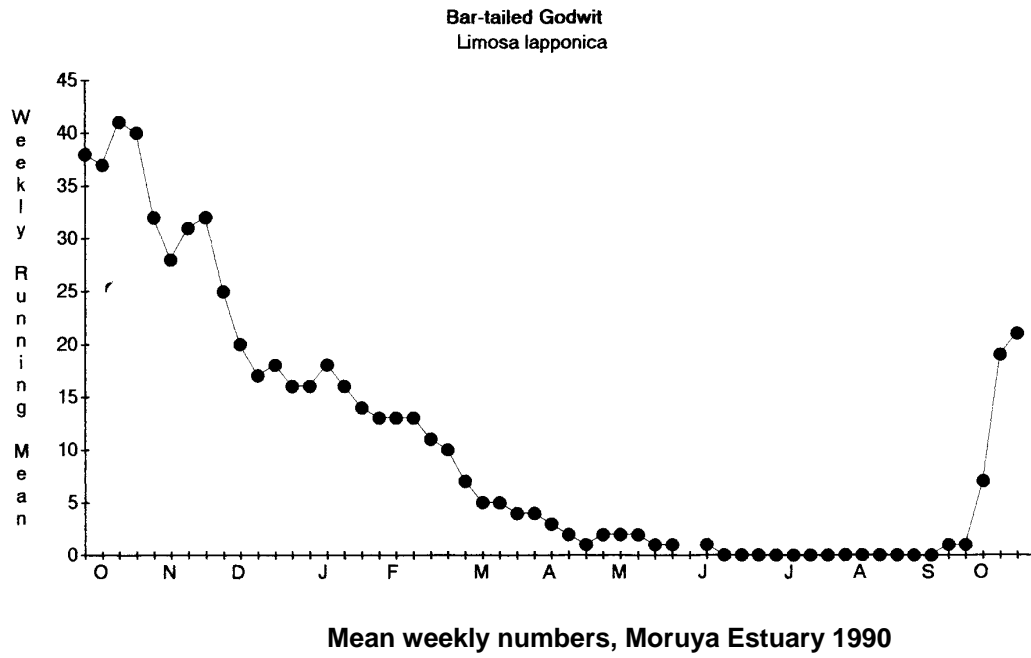
Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as Vulnerable. Also listed under the JAMBA Agreement. Regular non-breeding migrant to this area. Breeds in Japan and migrates to the east coast of Australia during the Austral spring and summer. Departs for breeding grounds in March/April. Found along the margins of freshwater swamps, wetlands and ponds in the study area.

Black-tailed Godwit *Limosa limosa*

Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as Vulnerable. Also listed under the JAMBA and CAMBA Agreement. A rare vagrant to the south coast, recorded once on the Moruya estuary on 11 March 1991. Has also been recorded at Tuross Lake and the Narooma Estuary.

Bar-tailed Godwit, *Limosa lapponica*

Listed under the JAMBA and CAMBA Agreements. A common spring/summer migrant, breeding in the high arctic of eastern Siberia and migrating to Australia in the Austral spring/summer, foraging in estuaries. In the Moruya estuary they are passage migrants, arriving in late September. Numbers dwindle throughout the summer and they depart again in late summer and autumn.

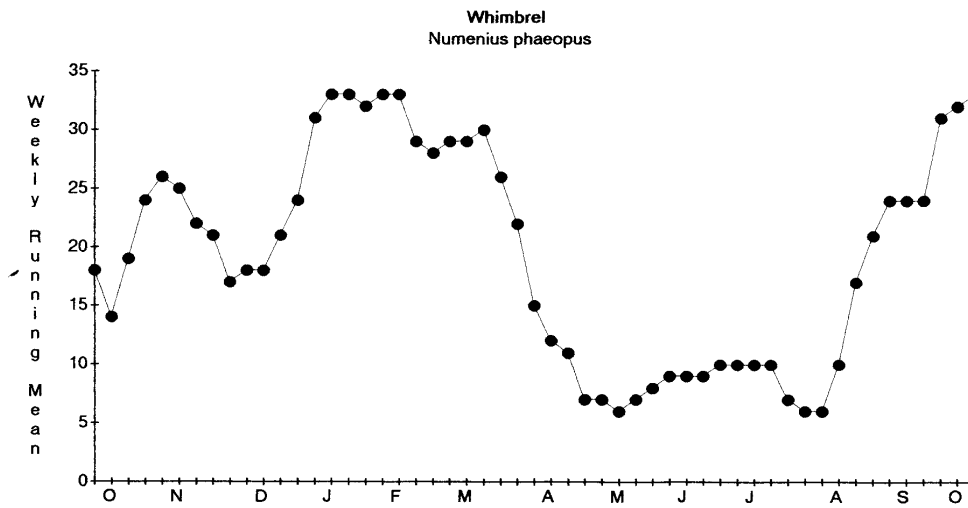


Bar-tailed Godwit

Moruya Estuary

Whimbrel *Numenius phaeopus*

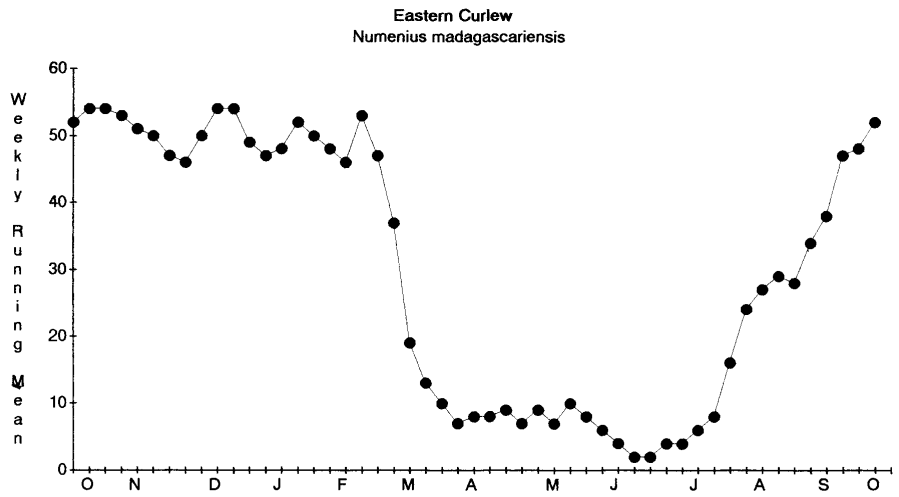
Listed under the JAMBA and CAMBA Agreements. A common spring/summer migrant, breeding across the high arctic of Iceland, Siberia and Alaska. Subspecies *Numenius phaeopus variegates* which breeds in eastern Siberia migrates to Australia in the Austral spring/summer. A common species on the Moruya estuary, arriving in September/October and departing in March/April. Small numbers remain on the estuary throughout the winter.



Mean weekly numbers, Moruya Estuary 1990

Eastern Curlew *Numenius madagascariensis*

Listed under the JAMBA and CAMBA Agreements. A common spring/summer migrant to eastern Australia, breeding in north-eastern Russia and China. Arrives on the Moruya estuary in late August and departs in late March. A common species throughout the spring and summer. Small numbers, usually juveniles, remain on the estuary throughout the winter.



Mean weekly numbers Moruya estuary 1990



Eastern Curlew

Common Greenshank *Tringa nebularia*

Listed under the JAMBA and CAMBA Agreements. An uncommon spring/summer passage migrant along the east coast. There are several scattered records of individual birds on the Moruya estuary.

Terek Sandpiper *Xenus cinereus*

Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as Vulnerable. Listed under the JAMBA and CAMBA Agreements. This species is a trans-equatorial migrant breeding across northern Russia and is a rare vagrant to the study area. The only record in this region is from the Moruya estuary on 21-27 October 2001.

Common Sandpiper *Actitis hypoleucos* Listed under the JAMBA and CAMBA Agreements. A trans-equatorial migrant that is a rare passage migrant on the south coast. There is one record for the Moruya estuary, on 15 February 2003.

Grey-tailed Tattler *Heteroscelus brevipes*

Listed under the JAMBA and CAMBA Agreements. A trans-equatorial migrant that breeds in Siberia and migrates to Australia in the Austral summer. This species is present in small numbers throughout the spring and summer on the Moruya estuary.



Grey-tailed Tattler

Moruya Estuary

Ruddy Turnstone *Arenaria interpres*

Listed under the JAMBA and CAMBA Agreements. A trans-equatorial migrant and uncommon bird of passage in this region. Recorded on the Moruya estuary as a passage migrant in most years, usually in September and October.

Great Knot *Calidris tenuirostris* Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as Vulnerable. Listed under the JAMBA and CAMBA Agreements. A trans-equatorial migrant uncommon in this region. Recorded on the Moruya estuary as a passage migrant in most years.

Red Knot *Calidris canutus*

Listed under the JAMBA and CAMBA Agreements. A trans-equatorial migrant occurring regularly on the Moruya estuary, most commonly in small groups in Spring. A few individuals have also been recorded in late summer on their northern migration.

Sanderling *Calidris alba*

Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as Vulnerable. Listed under the JAMBA and CAMBA Agreements. A trans-equatorial migrant and uncommon migrant in this region. Recorded only once on the Moruya estuary on 25 November 1990. This species has been recorded occasionally on other estuaries in the region.

Red-necked Stint *Calidris ruficollis*

Listed under the JAMBA and CAMBA Agreements. A trans-equatorial migrant and common bird of passage in this region. Recorded on the Moruya estuary as a passage migrant in most years, usually in parties of 5 – 10 and often associated with other migrant waders. Most common in Spring, but also recorded in some years in late summer.



Red-necked Stint

Moruya estuary.

Sharp-tailed Sandpiper *Calidris acuminata*

Listed under the JAMBA and CAMBA Agreements. A trans-equatorial migrant and uncommon bird of passage in this region. More common on the margin of freshwater wetlands, but has been recorded on the Moruya estuary once when two birds were observed on 10 October 1993.



Sharp-tailed Sandpiper

Brou Lake

Curlew Sandpiper *Calidris ferruginea*

Listed under the JAMBA and CAMBA Agreements. A trans-equatorial migrant and uncommon passage migrant in this region. Recorded on the Moruya estuary in small numbers in most years during spring.

Beach Stone-curlew *Esacus neglectus*

Threatened species listed on Schedule 1 of the Threatened Species Conservation Act as endangered. Only record for the shire of one individual on the Moruya estuary on 26 December 2002.



Beach Stone-curlew

Moruya estuary 2002

Pied Oystercatcher *Haematopus longirostris*

Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as Vulnerable. This species is a permanent breeding resident on the Moruya estuary with usually three but sometimes four pairs resident throughout the year. All pairs attempt breeding during the spring and summer with nests often located on the granite breakwall, the sandy margins of the river and islands. Once a nest was noted on the adjacent Moruya airfield. Pied Oystercatchers forage on the exposed sand flats of the estuary and sand islands of the river.



Pied Oystercatchers

Moruya Estuary

Sooty Oystercatcher *Haematopus fuliginosus*

Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as Vulnerable. This species is a permanent breeding resident in the region, but occurs mainly on rocky coastal outcrops and off-shore islands where it breeds. It occurs irregularly on the Moruya estuary.



Sooty Oystercatchers

Congo Point

Black-winged Stilt *Himantopus himantopus*

A rare vagrant to this region. One bird was recorded on the Moruya estuary on 25 August 1994.

Pacific Golden Plover *Pluvialis fulva*

Listed under the JAMBA and CAMBA Agreements. . A trans-equatorial migrant and regular bird of passage in this region. It is recorded almost every year as a bird of passage in September and October on the Moruya estuary.



Pacific Golden Plover

Tuross estuary

Grey Plover *Pluvialis squatarola*

Listed under the JAMBA and CAMBA Agreements. . A trans-equatorial migrant and regular bird of passage in this region. It is recorded almost every year as a bird of passage in September and October on the Moruya estuary.

Red-capped Plover *Charadrius ruficapillus*

A common breeding resident regularly recorded on the Moruya estuary. This species often nests on the beachfront and regularly forages on exposed sand flats in the estuary at low tide.



Red-capped Plover

Moruya estuary

Double-banded Plover *Charadrius bicinctus*

A trans-Tasman migrant that breeds in New Zealand and migrates to Australia to over-winter. They begin arriving in late February and reach maximum numbers during May-June. They arrive in non-breeding plumage and gradually attain breeding colours in late winter. They depart for their breeding grounds in late August and early September. They are regular winter residents on the mudflats and saltmarshes of the estuary.

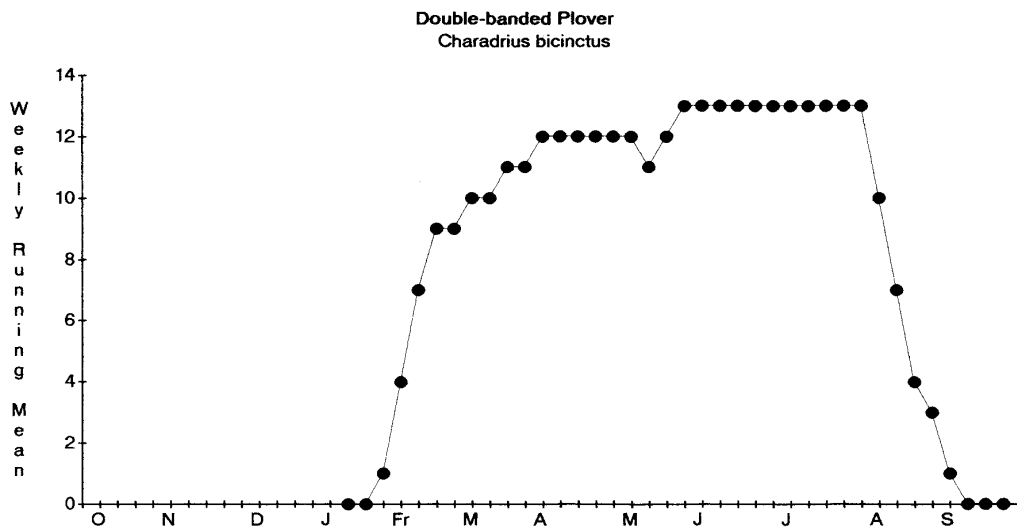


Figure 1 – Mean weekly numbers, Moruya Estuary 1990



Double-banded Plover (breeding plumage)

Moruya Estuary 2004

Lesser Sand Plover *Charadrius mongolus*

Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as Vulnerable. Listed under the JAMBA and CAMBA Agreements. A trans-equatorial migrant uncommon in this region. Has been recorded irregularly on the Moruya estuary, usually during spring as a passage migrant.

Greater Sand Plover *Charadrius leschenaultia*

Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as Vulnerable. Listed under the JAMBA and CAMBA Agreements. A trans-equatorial migrant uncommon in this region. Has been recorded irregularly on the Moruya estuary, usually during spring as a passage migrant.

Hooded Plover *Thinornis rubricollis*

Threatened species listed on Schedule 1 of the Threatened Species Conservation Act as endangered. A rare resident species that has bred on the beach front of the Moruya estuary. Has also been recorded foraging with unfledged young on the exposed sand in the estuary on the falling tide.



Hooded Plover

Congo Point

Masked Lapwing *Vanellus miles*

A common breeding resident present in all months throughout the study area.

Pacific Gull *Larus pacificus*

An uncommon vagrant that is irregularly recorded on the Moruya estuary. Most records are of immatures during autumn and spring.

Silver Gull *Larus novaehollandiae*

A common resident present in all months throughout the study area.

Caspian Tern *Sterna caspia*

An uncommon resident on the Moruya estuary recorded in small numbers in all months of the year.

Crested Tern, *Sterna bergii*

Common resident breeding on Montagu Island, present on the Moruya estuary in all months.

Little Tern *Sterna albifrons*

Threatened species listed on Schedule 1 of the Threatened Species Conservation Act as endangered. A summer breeding resident in the region. Small numbers occasionally occur over sand flats at Moruya estuary during spring. There are no records of breeding in the Moruya estuary.

Rock Dove *Columba livia*

A common breeding resident. A substantial population occurs in the vicinity of the Moruya bridge. Often observed in large numbers on sand islands adjacent to the bridge.

White-headed Pigeon *Columba leucomela*

A resident breeding species. Present in small numbers throughout the study area.

Spotted Turtle-dove *Streptopelia chinensis*

A resident breeding species. Present in small numbers throughout the study area.

Common Bronzewing *Phaps chalcoptera*

A common breeding resident in the region; occasionally observed in remnant bushland close to the river.

Crested Pigeon *Ocyphaps lophotes*.

A common breeding resident throughout the study area.

Peaceful Dove *Geopelia placida*

A common breeding resident in the region. Often seen and heard in suitable habitat in the study area.

Wonga Pigeon *Leucosarcia melanoleuca*

A common breeding resident in the region. Regularly recorded in forested area and adjacent open land within the study area.

Topknot Pigeon *Lopholaimus antarcticus*

An uncommon bird of passage, occasionally recorded in the study area.

Glossy Black-Cockatoo *Calyptorhynchus lathami*

Threatened species listed on Schedule 2 of the Threatened Species Conservation

Act as vulnerable. Occurs in forested areas, usually where stands of Black Sheoak *Allocasuarina littoralis* occur. Occasionally seen flying over the Moruya River and likely to be found in stands of Black Sheoak in forest close to the river.



Glossy Black-Cockatoo

Yellow-tailed Black-Cockatoo *Calyptorhynchus funereus*

Common and widespread resident throughout the study area.

Gang-Gang Cockatoo *Callocephalon fimbriatum*

Common resident seen in all months flying over the study area.

Galah *Eolophus roseicapillus*

Common breeding resident seen in all months.

Little Corella *Cacatua sanguinea*

Breeding resident; small flock of c30 present in Moruya in all months. Breeding recorded at Glenduart. Often seen in small flocks in other places in the study area.

Sulphur-crested Cockatoo *Cacatua galeria*

Common and widespread throughout the study area in all months.

Rainbow Lorikeet *Trichoglossis haematodus*

Common and widespread resident throughout the study area, particularly when eucalypts are in flower.

Musk Lorikeet *Glossopsitta concinna*

Common and widespread resident throughout the study area, particularly when eucalypts are in flower.

Little Lorikeet *Glossopsitta pusilla*

Moderately common and widespread resident throughout the study area, particularly when eucalypts are in flower.

Australian King Parrot *Alisterus scapularis*

Common and widespread resident throughout the study area; possibly more common in winter.

Crimson Rosella *Platycercus elegans*

Common breeding resident in forest and woodland throughout the study area.

Eastern Rosella *Platycercus eximius*

Common breeding resident throughout the study area. Usually found in more open farmland and cleared areas.

Swift Parrot *Lathamus discolor*

Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as vulnerable. Breeds in Tasmania and flies to the mainland in autumn/winter. An uncommon winter visitor that usually occurs when Spotted Gum is in flower and may be observed flying over the study area.

Pallid Cuckoo *Cuculus pallidus*

A spring/summer migrant recorded in all areas of the study area.

Brush Cuckoo *Cacomantis variolosus*

A spring/summer migrant usually recorded in forested areas. Has been recorded in the study area where eucalypt forest persists.

Fan-tailed Cuckoo *Cacomantis flabelliformis*

A spring/summer migrant that has been recorded in all months. Common throughout the study area.

Horsfields Bronze Cuckoo *Chalcites basalis*

A spring/summer migrant common throughout the study area.

Shining Bronze Cuckoo *Chalcites lucidus*

A spring/summer migrant common throughout the study area.

Pacific Koel *Eudynamis orientalis*

A spring/summer breeding resident becoming more common in recent years. Usually arrives in October and easily recognised by clear loud call, particularly at night.

Channel-billed Cuckoo *Scythrops novaehollandiae*

A spring/summer breeding resident arriving in the study area in October.

Powerful Owl *Ninox strenua*

Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as vulnerable. Permanent breeding resident in the surrounding region and probably present in forested areas of the study area.



Powerful Owl

Southern Boobook *Ninox boobook*

Permanent breeding resident. Common and widespread throughout the study area. Usually very vocal in spring.

Masked Owl *Tyto novaehollandiae*

Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as vulnerable. Permanent breeding resident in the surrounding region and probably present in forested areas of the study area. This species is often found on the ecotone between forested and cleared land.



Masked Owl

Barn Owl *Tyto alba*

An uncommon resident recorded once in Casuarinas at Ryans Creek in 1996 but probably underrecorded.

Tawny Frogmouth *Podargus strigoides*

Common breeding resident present in all months.

White-throated Needletail *Hirundapus caudicutus*

A regular summer migrant often seen in flocks hawking for insects, usually over the study area.

Azure Kingfisher *Alcedo azurea*

Very common breeding resident in the study area, usually observed perched on branches overhanging the river.

Laughing Kookaburra *Dacelo novaeguineae*

Common breeding resident throughout the study area.

Sacred Kingfisher *Toriramphus sanctus*

Common spring / summer breeding migrant found in all forested parts of the study area.

Dollarbird *Eurystomus orientalis*

Common spring / summer breeding migrant, usually arriving in October. Found throughout the study area.

Superb Lyrebird *Menura novaehollandiae*

A common resident species present in all months in forested parts of the study area.

White-throated Treecreeper *Climacteris erythroga*

Common and widespread breeding resident.

Superb Fairy-wren *Malurus cyaneus*

Common and widespread breeding resident.

Variegated Fairy-wren *Malurus lamberti*

Common and widespread breeding resident.

Spotted Pardalote *Pardalotus punctatus*

Common and widespread breeding resident.

White-browed Scrub-wren *Sericornis frontalis*

Common and widespread breeding resident.

Brown Gerygone *Gerygone mouki*

Common and widespread breeding resident usually found in moist forested gullies.

White-throated Gerygone *Gerygone olivacea*

A regular spring / summer breeding migrant usually found in forest and open woodland in the study area.

Brown Thornbill *Acanthiza pusilla*

Common and widespread breeding resident.

Yellow-rumped Thornbill *Acanthiza chrysorrhoa*

Common and widespread breeding resident.

Yellow Thornbill *Acanthiza nana*

Common and widespread breeding resident.

Striated Thornbill *Acanthiza lineata*

Common and widespread breeding resident.

Red Wattlebird *Anthochaera corniculata*

Common and widespread breeding resident.

Little Wattlebird *Anthochaera chrysoptera*

Common and widespread breeding resident; more commonly recorded towards the coast.

Noisy Friarbird *Philemon corniculatus*

Common and widespread spring / summer breeding resident. May occur throughout the year when winter-flowering eucalypts are in bloom.

Lewins Honeyeater *Meliphaga lewinii*

Common breeding resident recorded in all months in moister gullies and thicker vegetation of the study area.

Yellow-faced Honeyeater *Lichenostomus chrysops*

Common breeding resident present in all months throughout the study area.

White-eared Honeyeater *Lichenostomus leucotis*

Regularly recorded as an autumn/winter migrant. Recorded in all habitats in the study area.

Fuscus Honeyeater *Lichenostomus fuscus*

An uncommon autumn/winter migrant often recorded in flocks of other honeyeaters during northern migration between April and July.

Brown-headed Honeyeater *Melithreptus brevirostris*

An uncommon spring/summer migrant found mainly in open woodlands in the study area. Breeding has been recorded in this region.

White-naped Honeyeater *Melithreptus lunatus*

A common breeding resident present in all months in the study area.

Crescent Honeyeater *Phylidonyris phrrhoptera*

An uncommon breeding resident, more common in higher altitudes in the region. Has been recorded in the study area during winter.

New Holland Honeyeater *Phylidonyris novaehollandiae*

A common breeding resident recorded in all months. More common near the coast, but present throughout the study area.

Eastern Spinebill *Acanthorhynchus tenuirostris*

A common breeding resident widespread throughout the study area. Present in all months.

Scarlet Honeyeater *Myzomela sanguinolenta*

Has been recorded in the study area in all months. More common in spring/summer. Breeding has been noted in the region.

White-fronted Chat *Ephthianura albifrons*

Common in suitable habitat in the region, but rare in the study area. A few sparse records at Moruya Heads.

Jacky Winter *Microeca fascinans*

A common breeding resident in the study area recorded in all months. More conspicuous in winter when feeding in open habitats.

Scarlet Robin *Petroica multicolor*

Uncommon winter migrant to the study area.

Flame Robin *Petroica phoenicea*

Uncommon winter migrant to the study area.

Rose Robin *Petroica rosea*

Uncommon winter resident in the study area.

Eastern Yellow Robin *Eopsaltria australis*

A common breeding resident present in all months in areas of woodland and forest.

Eastern Whipbird *Psophodes olivaceus*

A common breeding resident present in all months in areas of woodland and forest.

Spotted Quail-thrush *Cinclosoma punctatum*

Breeding resident, found in drier forested parts of the study area.

Varied Sitella *Daphoenositta chrysoptera*

Uncommon breeding resident found in woodland and forest in the study area.

Crested Shrike-tit *Falcunculus frontalis*

Uncommon breeding resident recorded in woodland and forest in the study area.

Golden Whistler *Pachycephala pectoralis*

Common and widespread breeding species present in all months in the study area.

Rufous Whistler *Pachycephala rufiventris*

Common spring/summer breeding resident recorded in forest and woodland throughout the study area.

Grey Shrike-thrush *Colluricincla harmonica*

Common and widespread breeding species present in all months in the study area.

Black-faced Monarch *Monarcha melanophris*

Common spring/summer breeding resident recorded in forest and woodland throughout the study area.

Leaden Flycatcher *Myiagra rubecula*

Common spring/summer breeding resident recorded in forest and woodland throughout the study area.

Restless Flycatcher *Myiagra inquieta*

Common breeding resident more common in autumn/winter in the study area.

Magpie-lark *Grallina cyanoleuca*

A common and widespread breeding resident recorded in all months in the study area.

Rufous Fantail *Rhipidura rufifrons*

An uncommon spring/summer breeding migrant to the study area. Most often recorded in wet gullies but can occur in other areas particularly during migration.

Grey Fantail *Rhipidura fuliginosa*

A common breeding resident recorded in all months, but more numerous in spring/summer.

Willy Wagtail *Rhipidura leucophrys*

A common and widespread breeding resident recorded in all months in the study area.

Black-faced Cuckoo-shrike *Coracina novaehollandiae*

Common breeding resident present throughout the year in the study area.

Cicadabird *Coracina tenuirostris*

A spring/summer breeding migrant present in forested parts of the study area.

Olive-backed Oriole *Oriolus sagittatus*

A spring/summer breeding resident found in woodland and forests in the study area. A few have been recorded during the winter.

Figbird *Sphecotheres viridis*

A once rare but now regular spring/summer migrant to the study area. Evidence of breeding has been recorded in the area near the Moruya swimming pool and in the old caravan park (now Moruya Riverside Reserve). Possibly becoming more common.

Dusky Woodswallow *Artamus cyanopterus*

A common spring/summer migrant to the study area.

Grey Butcherbird *Cracticus torquatus*

Common breeding resident present throughout the year in the study area.

Australian Magpie *Gymnorhina tibicen*

Common breeding resident present throughout the year in the study area.

Pied Currawong *Strepera graculina*

Common breeding resident present throughout the year in the study area.

Grey Currawong *Strepera versicolor*

An uncommon non-breeding winter visitor to the study area.

Australian Raven *Corvus coronoides*

Common breeding resident present throughout the year in the study area.

White-winged Chough *Corcorax melanorhamphos*

An uncommon breeding resident present in woodland throughout the study area.

Satin Bowerbird *Ptilonorhynchus violaceus*

Common breeding resident present throughout the year in the study area.

Australian Pipit *Anthus novaehseelandiae*

Common breeding resident in open farmland and parkland throughout the study area.

House Sparrow *Passer domesticus

Common breeding species in residential areas in the study area.

Double Barred Finch *Taeniopygia bichenovii*

A now rare local resident previously recorded regularly in open farmland and parkland.

Red-browed Finch *Neochmia temporalis*

A common breeding resident throughout the study area.

European Goldfinch *Carduelis carduelis

Uncommon breeding resident in the study area.

Mistletoebird *Dicaeum hirundinaceum*

Common spring/summer breeding migrant found throughout the study area.

Welcome Swallow *Hirundo neoxena*

Common breeding resident present throughout the year in the study area.

Tree Martin *Hirundo nigricans*

Common spring/summer breeding migrant found throughout the study area.

Fairy Martin *Hirundo ariel*

Common spring/summer breeding migrant found throughout the study area.

Clamorous Reed-Warbler *Acrocephalus stentoreus*

Common spring/summer breeding migrant found throughout the study area.

Little Grassbird *Megalurus gramineus*

Rare resident found in areas of suitable habitat within the study area.

Golden-headed Cisticola *Cisticola exilis*

An uncommon resident found in areas of suitable habitat in the study area.

Silvereye *Zosterops lateralis*

Common breeding resident found throughout the study area.

Bassian Thrush *Zoothera dauma*

Uncommon resident usually found in forested areas of the study area.

Common Blackbird *Turdus merula

Common breeding resident present in all months in the study area.

Common Starling *Sturnus vulgaris

Common breeding resident present in all months in the study area.

Common Myna *Acridotheres tristis

An uncommon breeding resident present in all months. Numbers have increased steadily in the study area over the past five years.

* indicates introduced species

Mammals

Order and nomenclature follows Strahan, 1995

Terrestrial Mammals

Platypus *Ornithorhynchus anatinus*

Occurs in the upper parts of the Deua River, but unlikely to be found below the tidal limit, unless flushed by increased flow in the river during heavy rainfall.

Short-beaked Echidna *Tachyglossus aculeatus*

A common species throughout the study area.

Spot-tailed Quoll *Dasyurus maculatus*

An uncommon species that is irregularly recorded in the study area. **Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as vulnerable.**



Spot-tailed Quoll

Featherdale Wildlife Park

Agile Antechinus *Antechinus agilis*

Formerly the Brown Antechinus *Antechinus stuartii*. This species is very common throughout the study area.

Dusky Antechinus *Antechinus swainsonii*

A common species, more likely to be encountered in forest in the study area.

Long-nosed Bandicoot *Perameles nasuta*

Long-nosed bandicoots are common in coastal parts of the study area where sandy/loamy soils occur.

Common Wombat *Vombatus ursinus*

Rare in coastal areas, but becoming more common in the western parts of the study area, particularly in places where forest abuts cleared land.

Common Brush-tailed Possum *Trichosurus vulpecula*

A very common species throughout the study area.

Sugar Glider *Petaurus breviceps*

A common species throughout the study area in forested and semi-cleared areas.

Greater Glider *Perauroides volans*

Uncommon in the study area. Restricted to forested areas and occur in suitable patches of eucalypt forest.

Common Ring-tailed Possum *Pseudocheirus peregrinus*

A very common species throughout the study area.

Feather-tailed Glider *Acrobates pygmaeus*

A fairly common species usually found in forested areas.

Bottle-nosed Dolphin *Tursiops truncatus*

A pod of up to ten individuals resident in coastal adjacent waters. Groups are occasionally recorded in the Moruya river.

Yellow-bellied Glider *Petaurus australis*

While not recorded in the study area, this species is known to occur in the Broulee area and Moruya State Forest to the west of Kiora and has the potential to be found in suitable patches of habitat. This species is most often recognised by its distinctive call at night, or the characteristic incisions made in feed trees. **Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as vulnerable.**



Yellow-bellied Glider Feed Tree

Eastern Grey Kangaroo *Macropus giganteus*

A common species with an increasing population in the study area. Found in all types of habitat.



Eastern Grey Kangaroo

Moruya Heads

Red-necked Wallaby *Macropus rufogriseus*

A fairly common species in the study area usually found in forested areas or the ecotones between forest and cleared land.



Red-necked Wallaby

Potato Point

Bush Rat *Rattus fuscipes*

A very common species found in all areas of native vegetation in the study area.

Swamp Rat *Rattus lutreolus*

A common species that occurs in wetter areas of native vegetation in the study area.

Black Rat *Rattus rattus

A very common species, usually found near to houses, barns, sheds and other places occupied by humans.

House Mouse *Mus musculus*

A very common species, usually found near to houses, barns, sheds and other places occupied by humans.

Feral Dog*, Dingo and their hybrids *Canis familiaris*

Common throughout the study area. Most often found in areas of native vegetation adjacent to cleared agricultural land.

Red Fox *Vulpes vulpes

A very common introduced predator found in all areas of the study area.

Feral Cat *Felis catus

A very common introduced predator found in all areas of the study area.

European Rabbit, *Oryctolagus cuniculus

Common introduced species found in most habitats throughout the study area.

Bats

Two types of bats occur in the study area – Microchiropteran (insectivorous) bats and Megachiropteran (fructivorous) bats, commonly known as flying foxes. No surveys for these species have been carried out in the study area, but extensive surveys in surrounding forests by Forests NSW and various other biodiversity studies have recorded 16 species. All species rely on forested habitats for roosting and foraging and may be recorded foraging over the Moruya River and in the adjacent vegetation.

Microchiropteran Bats

Yellow-bellied Sheath-tailed Bat *Saccolaimus flaviventris*

An uncommon bat in the area, seldom recorded. Its rarity may be the result of its habit of foraging high above the tree canopy making it less likely to be captured for identification. **Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as vulnerable.**

White-striped Freetail-Bat *Nyctinomus australis*

A large uncommon bat that is rarely recorded. Its rarity may be the result of its habit of foraging high above the tree canopy making it less likely to be captured for identification.

Golden-tipped Bat *Kerivoula papuensis*

This species is restricted to areas of rainforest and wet sclerophyll gullies where it forages mainly on spiders. It is regularly captured in low numbers in forests surrounding the study area. **Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as vulnerable.**



Golden-tipped Bat

Moruya State Forest

Common Bent-winged Bat *Miniopterus schreibersii*

A species regularly recorded in forests adjacent to the study area. This species is an obligate cave dweller that relies on caves and disused mines for roosting. **Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as vulnerable.**



Common Bent-winged Bat

Bimbimbie Mine, Mogo

Lesser Long-eared Bat *Nyctophilus geoffroyi*

A common species throughout the region.

Gould's Long-eared Bat *Nyctophilus gouldi*

A common species throughout the region.

Gould's Wattled Bat *Chalinolobus gouldii*

A common species throughout the region.

Chocolate Wattled Bat *Chalinolobus morio*

One of the most common species in the region.

Eastern False Pipistrelle *Falsistrellus tasmaniensis*

An uncommon species, usually recorded at higher altitude in this region, There are some records from coastal areas. **Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as vulnerable.**

Large-footed Myotis *Myotis australis*

An uncommon species, usually recorded foraging over water and roosting in close proximity to water. **Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as vulnerable.** This species has large feet used for catching prey over water.



Myotis australis

Greater Broad-nosed Bat *Scoteanax ruppellii*

A large bat that is regularly recorded in the region. **Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as vulnerable.**

Eastern Broad-nosed Bat *Scotorepens orion*

An uncommon species that has been recorded in a number of different habitats in the region.

Large Forest Bat *Vespadellus darlingtoni*

A common species throughout the region.

Southern Forest Bat *Vespadellus regulus*

A common species throughout the region.

Little Forest Bat *Vespadellus vulturinus*

The smallest and probably most common species found in this area.

Megachiropteran Bats

Grey-headed Flying Fox *Pteropus poliocephalus*

A large and conspicuous flying fox that is regularly recorded in the study area. No permanent flying fox camps occur in the area, but when there are mass flowerings of eucalypts this species congregates in regularly used temporary camps. Very common in this area when conditions are right. **Threatened species listed on Schedule 2 of the Threatened Species Conservation Act as vulnerable.**



Grey-headed Flying Fox

* indicates introduced species

Recommendations

Mapping of Vegetation Communities

Existing vegetation maps of the study area indicate that many of the extant native vegetation communities are not mapped or are not correctly mapped. These include three ecosystems are listed as Endangered Ecological Communities in part 3 of schedule 1 of the NSW Threatened Species Conservation Act, 1995:

- Forest Ecosystem 25 South Coast Swamp Forest Complex
- Forest Ecosystem 186 Mudflats/Saltmarshes
- Bega dry grass forest in the South East Corner bioregion (Forest Ecosystem 171 – Coastal Shrub/Grass Forest – *E. tereticornis*).

and one ecological community that has been identified in a preliminary determination as an endangered ecological community:

- Bangalay sand forest of the Sydney Basin and South East Corner bioregion (Forest Ecosystem 28 – Coastal Sands Shrub/Fern Forest – *E. botryoides* / *Banksia serrata*).

Forest Ecosystem 185 Mangrove Estuarine Low Forest (NPWS, 2000) is protected under section 205 of the NSW Fisheries Management Act, 1994 Regulation 227A.

It is recommended that all identifiable ecosystems in the study area be mapped with particular emphasis on those communities that have been protected under legislation.

Fencing and restoration of River bank

In places the river bank has been fenced to restrict livestock access but in sections where this has not occurred there is active erosion or the potential for erosion to occur. It is recommended that the fencing off of all agricultural land adjacent to river banks be investigated.

The restoration of riverbank vegetation has also been carried out in some areas along the river. It is recommended that a survey to prioritise places most in need of restoration be carried out and followed up by the revegetation of such areas. This should be carried out using species native to the areas being re-vegetated.



Active bank erosion by livestock

Kiora

Protection of existing remnants of native vegetation

Most of the existing remnants of native vegetation on the riverbank have been degraded by human activities. The proliferation of vehicular tracks, illegal camping sites, camp fires and grazing has had a significant impact in a number of areas. The most important areas include:

- The riverbank between the airport and Brierleys Ramp).
- The Glenduart cemetery
- The river bank on the western side of the Malabar Lagoon entrance
- Moruya Riverside Park

Where possible, these remnants should be protected by restricting camping, fires and vehicular access and active restoration if necessary should be carried out.

Weeds

Several weeds species are present throughout the study area. It is recommended that their distribution and abundance be investigated and appropriate removal be carried out where necessary.

Mitigation of outside bend erosion

Some mitigation of outside bank erosion has taken place but this erosion is evident in several places. It is recommended that the study area be surveyed to identify and prioritise sites of active erosion so that mitigation measures can then be carried out where appropriate.



Outside bend erosion

Riverview Farm

Maintenance of Wader Habitat

The area used mostly by local and migratory waders is at the eastern end of the study area and includes the sand flats in the river east of the Anchorage and the tidal sand flats south of the river breakwall. South of the breakwall the proliferation of mangroves has become a problem in areas where they have invaded traditional roosting areas for migratory species. This has occurred in other estuaries in the state where steps have been taken to remove mangroves from sensitive areas. It is recommended that the removal of mangroves from the relevant sections of the estuary be investigated.



Wader roosting area - Moruya estuary

January 2001



Wader roosting area - Moruya estuary

February 2004

The tidal sand flats east of the Anchorage are the main feeding grounds for local and migratory waders, including three pairs of Pied Oystercatchers listed as Vulnerable under the Threatened Species Conservation Act, 1995. Human disturbance in this area has increased e.g. Jet Skis. The constant activity, noise and wash do not allow birds and their young to feed and roost in these critical areas. Steps such as banning Jet Ski from the Moruya estuary or restricting their activity to areas west of Brierley's Ramp may need to be taken. It is recommended that this be investigated.

Connectivity of riverside vegetation

It is recommended that all vegetation remnants in the study area be assessed for their potential to provide connectivity to other sections of native vegetation both along the river and to adjacent areas of forest. This would provide corridors, dispersal and migration routes for native wildlife in the area. Sections with high potential should then be planted with appropriate vegetation.

Aquatic Ecology

There is very little data available on the aquatic biology of the estuary. Apart from professional fish catch information there are no reliable studies of fish, invertebrate species, algae, the distribution and abundance of seagrasses etc. It is recommended that studies to address this lack of information be prioritised and implemented.

Bibliography

- Bridgewater, P.B., Celia Rosser and Anne De Corona . No Date. ***The Saltmarsh Plants of Southern Australia***. Monash University, Melbourne.
- Christidis, L and Boles, WE. 1994 ***The Taxonomy and Species of Birds of Australia and its Territories***. RAOU Monograph 2. RAOU, Melbourne.
- Coastal Council of NSW. 1985. ***Coastal Wetlands of New South Wales***. Coastal Council of NSW, Sydney.
- Cogger, H. 2000. ***Reptiles and Amphibians of Australia***. New Holland Publishers (Australia) Sydney.
- Costermans, L. 1998. ***Native Trees and Shrubs of South-eastern Australia***. Landsdowne Press, Sydney.
- Harden, G.J.(Ed.).1990. ***Flora of New South Wales - Volume 1***. University of NSW Press, Kensington,NSW.
- Harden, G.J.(Ed.).1991. ***Flora of New South Wales - Volume 2***. University of NSW Press, Kensington,NSW.
- Harden, G.J.(Ed.).1992. ***Flora of New South Wales - Volume 3***. University of NSW Press, Kensington,NSW.
- Harden, G.J.(Ed.).1993. ***Flora of New South Wales - Volume 4***. University of NSW Press, Kensington,NSW.
- Environment Australia. 2001. ***A Directory of Important Wetlands in Australia. Third Edition***. Environment Australia, Canberra.
- NPWS. 2000. ***Terrestrial Ecosystems of the Eurobodalla Local Government Area. Report of the Eurobodalla LGA Vegetation Mapping Project, derived from the Southern Comprehensive Regional Assessment (1997-2000)***. New South Wales National Parks and Wildlife Service, Hurstville NSW.
- Robinson, L. 1991. ***Field Guide to the Native Plants of Sydney***. Kangaroo Press, Sydney.
- Sainty, G. R. and S.W.L Jacobs. 1981. ***Waterplants of New South Wales***. Water Resources Commission of NSW.
- Strahan, R (Ed). 1995. ***The Mammals of Australia***. Reed Publications, Sydney.
- Swan, G; G. Shea & R. Sadlier. 2004. ***A Field Guide to the Reptiles of New South Wales***. New Holland Publishers (Australia) Sydney.

Appendix 1

Glossary of Plant Species

African Boxthorn, <i>Lycium ferocissimum</i>	Nettle-leaved Goosefoot <i>Chenopodium murale</i>
American Sea Rocket <i>Kakile edentula</i>	New Zealand Spinach <i>Tetragonia tetragonoides</i>
Asparagus Fern <i>Protasparagus aethiopicus</i>	Norfolk Island Pine <i>Araucaria heterophylla</i>
Australian Commelina, <i>Commelina cyanea</i>	Old Man Banksia <i>Banksia serrata</i>
Austral Seablight <i>Suaeda australis</i>	Orach, <i>Atriplex hastata</i>
<i>Babingtonia plurifolia</i>	Panic Grass, <i>Erhrharta erecta</i>
Beaded Glasswort <i>Sarcocornia quinqueflora</i>	Parramatta Grass <i>Sporobolus africanus</i> .
Berry Saltbush <i>Einadia nutans spp linifolia</i>	Peppercorn <i>Schinus areira</i>
Bitou Bush <i>Chrysanthemoides monillifera</i>	Prickly bearded-heath <i>Leucopogon juniperinus</i>
Blackbutt <i>Eucalyptus pilularis</i>	Pricky Couch <i>Zoisia macrantha</i>
Black Nightshade <i>Solanum nigrum</i>	Prickly Pear <i>Opuntia spp</i>
Black She-oak, <i>Allocasuarina littoralis</i>	Privet, <i>Ligustrum sinense</i>
Black Wattle, <i>Acacia mearnsii</i>	River Mangrove <i>Aegriceras corniculatum</i>
Blady Grass <i>Imperata cylindrical</i>	River Oak <i>Casuarina cunninghamiana</i>
Blue Flax Lily <i>Dianella caerulea</i>	Rough-barked Apple, <i>Angophora floribunda</i>
Blue-leaved Stringybark <i>Eucalyptus agglomerata</i>	Rough-fruited Pittosporum, <i>Pittosporum revolutum</i>
Bracken Fern <i>Pteridium esculentum</i>	Rough Treefern <i>Cyathea australis</i>
Bridal Creeper <i>Myrsiphillum asparagoides</i>	Salt Couch <i>Sporobolus virginicus</i>
Burrawang <i>Macrozamia communis</i>	Scotch Thistle <i>Cirsium vulgare</i>
Cape Ivy <i>Delairea odorata</i>	Seaberry Saltbush <i>Rhagodia candolleana</i> ,
<i>Chenopodium glaucum</i>	Sea Rush <i>Juncus kraussii</i>
Cherry Ballart, <i>Exocarpos cupressiformis</i>	Silver-topped Ash, <i>Eucalyptus sieberi</i>
Climbing Saltbush <i>Einadia nutans ssp linifolia</i>	Small-leaved Privet, <i>Ligustrum sinense</i>
Clover <i>Trifolium spp.</i>	Spinifex <i>Spinifex sericeus</i>
Coast Beard Heath <i>Leucopogon parvifoliflorus</i>	Spotted Gym <i>Corymbia maculata</i>
Coastal Banksia <i>Banksia integrifolia</i>	Stipa <i>Stipa stipoides</i>
Coastal Grey Box <i>Eucalyptus bosistoana</i>	Strand Sedge <i>Carex pumila</i>
Coastal Mahogany <i>E. botryoides</i>	Streaked Arrow Grass <i>Triglochin striatum</i>
Coastal Pigface <i>Carpobrotus glaucescens</i>	Swamp Oak <i>Casuarina glauca</i>
Coastal Wattle <i>Acacia longifolia var. sophorae</i>	Swamp Weed <i>Selliera radicans</i>
Cobblers Peg <i>Bidens pilosa</i>	Sword Grass <i>Lepidosperma laterale</i>
Common Couch <i>Cynodon dactylon</i>	Sweet Pittosporum <i>Pittosporum undulatum</i>
Common Reed <i>Phragmites australis</i>	Tall Speargrass <i>Stipa pubescens</i>
Common Verbena <i>Verbena bonariensis</i>	Tree Broom-heath <i>Monotoca elliptica</i>
Creeping Brookweed, <i>Samolus repens</i>	Wandering Jew <i>Transecantia albiflora</i>
<i>Disphyma clavellatum</i>	White Stringybark, <i>Eucalyptus globoidea</i>
European Sea Rocket <i>Kakile maritime</i>	Wild Tobacco, <i>Solanum mauritianum</i>
Fleabane, <i>Conyza spp.</i>	Wire Grass <i>Entolasia stricta</i>
Forest Red Gum <i>Eucalyptus tereticornis</i>	Woollybutt <i>Eucalyptus longifolia</i>
<i>Gahnia clerkei</i>	Yellow Stringybark <i>Eucalyptus muelleriana</i>
Geebung <i>Persoonia linearis</i>	
Grey Ironbark <i>Eucalyptus paniculata</i>	
Grey Mangrove <i>Avicennia marina</i>	
Grey Myrte <i>Backhousia myrtifolia</i>	
Kangaroo Grass <i>Themeda australis</i>	
Kikuyu <i>Pennisetum. clandestinum</i>	
Knobby Clubbrush <i>Isolepis nodosa</i>	
Mabel's Wattle <i>Acacia mabellae</i>	
Matt Rush <i>Lomandra longifolia</i>	
Mock Olive, <i>Notelaea venosa</i>	
Native Blackthorn <i>Bursaria spinosa</i>	
Native Reed <i>Phragmites australis</i>	
Native Rosemary <i>Westringia fruticosa</i>	
Native Sea Lavender <i>Limonium australe</i>	

Appendix 2 Threatened Fauna recorded in the Study Area

Schedule 1 – Endangered

Green and Golden Bell Frog	<i>Litoria aurea</i>
Beach Stone Curlew	<i>Esacus neglectus</i>
Hooded Plover	<i>Thinornis rubricollis</i>
Little Tern	<i>Sterna albifrons</i>

Schedule 2 – Vulnerable

Osprey	<i>Pandion haliaetus</i>
Square-tailed Kite	<i>Lophoictinia isura</i>
Latham's Snipe	<i>Gallinago hardwickii</i>
Black-tailed Godwit	<i>Limosa limosa</i>
Terek Sandpiper	<i>Xenus cinereus</i>
Great Knot	<i>Calidris tenuirostris</i>
Sanderling	<i>Calidris alba</i>
Pied Oystercatcher	<i>Haematopus longirostris</i>
Sooty Oystercatcher	<i>Haematopus fuliginosus</i>
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>
Swift Parrot	<i>Lathamus discolor</i>
Powerful Owl	<i>Ninox strenua</i>
Masked Owl	<i>Tyto novaehollandiae</i>
Spot-tailed Quoll	<i>Dasyurus maculatus</i>
Yellow-bellied Glider	<i>Petaurus australis</i>
Yellow-bellied Sheath-tailed Bat	<i>Saccolaimus flaviventris</i>
Golden-tipped Bat	<i>Kerivoula papuensis</i>
Common Bent-winged Bat	<i>Miniopterus schreibersii</i>
Eastern False Pipistrelle	<i>Falsistrellus tasmaniensis</i>
Large-footed Myotis	<i>Myotis australis</i>
Greater Broad-nosed Bat	<i>Scoteanax ruppellii</i>
Grey-headed Flying Fox	<i>Pteropus poliocephalus</i>

Appendix 3

Species recorded in the study area protected by the:

China Australia Migratory Bird Agreement (CAMBA)
Japan Australia Migratory Bird Agreement (JAMBA) that have been.

Species		JAMBA	CAMBA
Latham's Snipe	<i>Gallinago hardwickii</i>	•	
Black-tailed Godwit	<i>Limosa limosa</i>	•	•
Bar-tailed Godwit	<i>Limosa lapponica</i>	•	•
Whimbrel	<i>Numenius phaeopus</i>	•	•
Eastern Curlew	<i>Numenius madagascariensis</i>	•	•
Common Greenshank	<i>Tringa nebularia</i>	•	•
Terek Sandpiper	<i>Xenus cinereus</i>	•	•
Common Sandpiper	<i>Actitis hypoleucos</i>	•	•
Grey-tailed Tattler	<i>Heteroscelus brevipes</i>	•	•
Ruddy Turnstone	<i>Arenaria interpres</i>	•	•
Great Knot	<i>Calidris tenuirostris</i>	•	•
Red Knot	<i>Calidris canutus</i>	•	•
Sanderling	<i>Calidris alba</i>	•	•
Red-necked Stint	<i>Calidris ruficollis</i>	•	•
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	•	•
Curlew Sandpiper	<i>Calidris ferruginea</i>	•	•
Pacific Golden Plover	<i>Pluvialis fulva</i>	•	•
Grey Plover	<i>Pluvialis squatarola</i>	•	•
Mongolian Plover	<i>Charadrius mongolus</i>	•	•
Great Sand Plover	<i>Charadrius leschenaulti</i>	•	•