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Literature review of the ecology of birds of The Coorong, Lakes Alexandrina and Albert Ramsar wetlands

Department for Environment and Heritage

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1.1 Introduction

Ongoing drought in the Murray-Darling Basin, together with the effects of river regulation and over allocation of water resources, have resulted in historically low inflows to the Coorong and Lakes Alexandrina and Albert Ramsar site over the last three years. Over this period water levels in Lakes Alexandrina and Albert (the Lower Lakes) have as a consequence reached historically low levels, the salinity of the Coorong Lagoons has risen to historically high levels and the Murray estuary has contracted to a very small remnant of its previous area. Looking forward, predictions suggest that this pattern will continue.

Low flows from the River Murray have threatened much of the ecological character of the Ramsar site. Low water levels within the Lower Lakes have resulted in the exposure of extensive areas of acid sulfate soils, and disconnected the lakes from their fringing vegetation, with a range of associated threats to the Lower Lakes ecosystem. Rising salinity in the Lower Lakes is threatening a number of freshwater flora and fauna species and allowing more estuarine adapted species to establish, suggesting a marked change to ecological character. Rising salinity within the Coorong has caused marked changes to the ecosystem in the north and south lagoons. Loss of freshwater flow and connectivity between the Lower Lakes and the Murray estuary threatens much of the estuary's ecological character.

In this context Ecological Associates Pty Ltd was engaged by the Department for Environment and Heritage (DEH) to review the literature on the ecology and life history of the bird species of the Coorong, and Lakes Alexandrina and Albert Ramsar site.

These data will be used to develop life-history and conceptual models for use in population risk assessment matrices on management scenarios related to the potential acidification or salinisation of the Lakes Alexandrina and Albert ecosystem and other management actions yet to be defined. The information is required to inform management decisions for water security projects in the Coorong and Lower Lakes.

1.2 Scope of Work

This project will bring together the known information on the waterbird species associated with the Ramsar Site. The predominant focus will be on waterbirds, but terrestrial avian species that form a component of the sites Ecological Character Description (ECD) or are of National Environmental Significance (NES) under the Environment Protection and Biodiversity Conservation (EPBC) Act will be included.

To enable determination of possible effects of water quality change on bird species in the Coorong and Lower Lakes the project needs to:

1. detail life-history and habitat use for birds of the Lower Lakes and Coorong to aid the development of models;

2. develop functional groupings for bird species of the region;

3. review waterbird population trends across the Ramsar site

4. document known saline habitat use and acidity tolerance for the various bird species from the region and where possible functional groupings based on available literature;

5. ascertain the potential impacts to the various bird communities of acidification or salinisation of the Ramsar site:

6. identify knowledge gaps (that may be further investigated in subsequent research) for bird species adversely impacted by proposed options;

7. outline impacts on state/nationally threatened and protected bird species; and

8. outline the biological impacts on important bird species or functional groupings of the region.

1.3 Background to the Project

The Coorong and Lakes Alexandrina and Albert were designated as a Wetland of International Importance under the Ramsar Convention on Wetlands in 1985 (Phillips and Muller 2006). A wide range of bird species contributes to the Ramsar status of the site, meeting five of the biodiversity criteria (2, 3, 4, 5, and 6) needed to qualify as a wetland of international importance (Phillips and Muller 2006). The wetland system has also been designated as an ‘icon site’ by the Murray-Darling Basin Authority (MDBA) and is referred to in this context as the Lower Lakes, Coorong and Murray Mouth Icon Site (MDBC 2006). Within Australia Watkins (1993) ranked the Coorong as the seventh most important site for waders in Australia and the second most important in South Australia.

The Coorong, and Lakes Alexandrina and Albert Ramsar site consists of a complex of wetlands at the mouth of the River Murray: the Lower Lakes (Lakes Alexandrina and Albert), the Coorong lagoons and estuary, the Ephemeral Lakes, and fringing wetlands consisting of a complex of 22 wetland types.

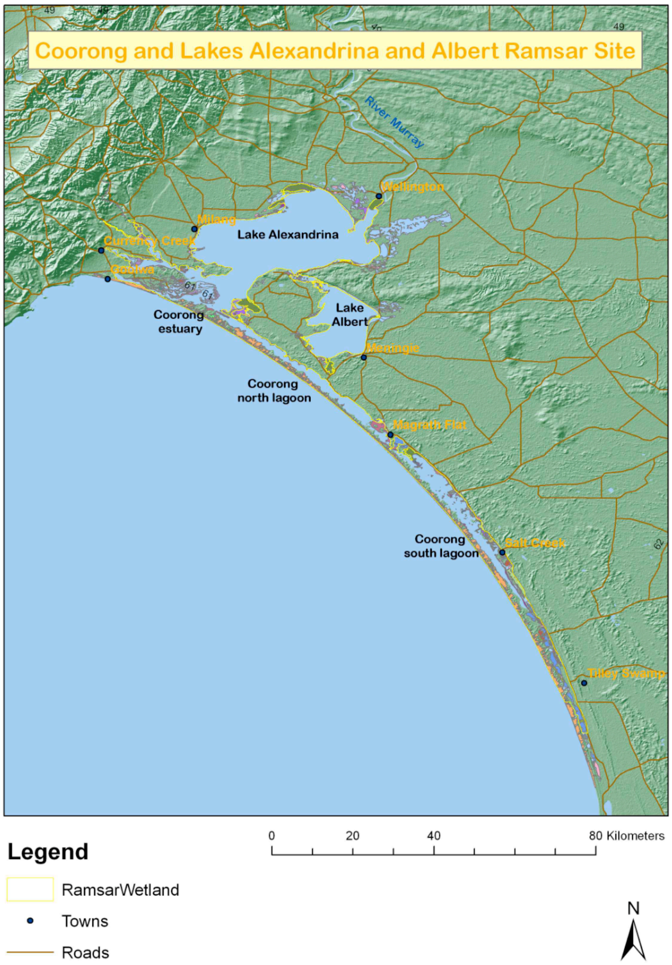

Figure 1: Coorong and Lakes Alexandrina and Albert locality map

The Ramsar wetland complex has been subject to a continuum of change since regulation of the River Murray and other tributaries began over 100 years ago. It is in this context of ongoing change and its implications for the regions ecology that this literature review of the ecology and life history of the bird species of the Ramsar site must be bedded.

Each wetland element within the Ramsar site has a unique ecological character that is evolving subject to an array of ongoing changes to key levers that operate within the system. A brief background to each wetland and the types of habitat it provides is important in understanding the complexity of habitat use by waterbirds.

The Lower Lakes

The Lower Lakes (Lakes Alexandrina and Albert) are isolated from the Murray Mouth and Coorong by a system of five barrages (Goolwa, Mundoo, Boundary Creek, Ewe and Tauwitchere), constructed between 1914 and 1940. The barrages were designed to exclude seawater from the Lower Lakes and to regulate lake water levels. Two fishways have been installed on Tauwitchere barrage and one on Goolwa barrage to enable fish movement between the Lower Lakes and the Murray Mouth/Coorong.

Lake Alexandrina

The River Murray discharges directly to Lake Alexandrina just downstream of the town of Wellington. The lake is broad and shallow (mean depth 2.86 m, maximum depth 4.05 m), well-mixed, freshwater, regulated waterbody, with a surface area of 660 km^2 and volume of 1,660 GL at full supply level (FSL). In addition to the River Murray, five streams from the eastern Mount Lofty Ranges also discharge into Lake Alexandrina and although their combined annual discharge, somewhat in excess of 100 GL (Phillips and Muller 2006), is a minor proportion of total inflows, it is ecologically important, particularly for native fish (Wedderburn and Hammer 2003).

After barrage construction, Lake Alexandrina developed an ecological character very different from its historical condition. Lake Alexandrina is now predominantly a freshwater system with no estuarine element. Analysis of sediment cores from Lake Alexandrina show marine water did not dominate over the last 2000 years, suggesting the lake was freshwater (Fluin et al. 2007). In the period prior to European settlement the lake may have been periodically brackish in its lower half, but was predominantly fresh, with river water discharging to the sea and keeping the Murray mouth open. Saltwater intrusions into the lake environment were not common until after 1900 when significant water resource development commenced in the River Murray system (Sim and Muller 2004). After 1900 short-lived intrusions of saltwater would occur during periods of low river flow, resulting in a lower lake level, however it appears that only small areas of the lakes, around the mouth and channels, were affected.

Prior to European settlement the Lake Alexandrina wetland complex would have offered a mosaic of variable fresh, brackish, saline and hypersaline fringing wetland systems. Freshwater, submerged aquatic plant communities were extensive in the lake system up until European settlement (Sim and Muller 2004).

The lake is now highly regulated by barrages, and through upstream water manipulation, particularly at Lock 1. It is typically maintained at FSL between 0.75 and 0.85 m AHD. The lake levels vary with season through flooding and drying events, and with wind direction or seiching, exposing and inundating the lake margin, on a seasonal and short-term irregular basis. Lake Alexandrina is typically a freshwater system, with salinity usually varying between 400 and 1,500 EC (Phillips and Muller 2006).

As a consequence of barrage construction and maintenance of relatively stable water levels, the lake habitat heterogeneity has been reduced, with the extent of fringing and emergent vegetation significantly contracted in extent when compared with historical values.

The lake supports a complex fringing vegetation and an array of sand and mud islands, providing important habitat to a variety of bird species (Seaman 2003). In the present drought, and as a consequence of the associated record low flow into the lake and low lake levels, much of this fringing habitat has been disconnected from the lake shoreline for an extended period.

Lake Albert

Lake Albert (16,800 ha) extends from the south-eastern shore of Lake Alexandrina through a narrow channel (Narrung Narrows). Lake Albert is a local inland terminus of the River Murray; only receiving inflows from Lake Alexandrina, and when connected its levels rise and fall in accord. The lake is broad and shallow (maximum depth -1.7 m AHD), and acts as a sink for salt and sediment for all inflows. The lake is consequently more saline than Lake Alexandrina, with salinities typically in the range 1,300 to 2,300 EC (Phillips and Muller 2006).

The lake supports a complex and extensive fringing vegetation and an array of sand and mud islands, providing important habitat to a variety of bird species (Seaman 2003). In the present drought, and as a consequence of the concomitant record low flow into the lake and historic low lake levels, much of this fringing habitat has been disconnected from the lake shoreline for an extended period. A shallow and saline aquifer discharges into the lake during periods of low water levels, creating seasonal and permanent salt-water marshes in depressions or swales around the lakes edge (Phillips and Muller 2006).

Prior to European settlement, Lake Albert supported extensive submerged aquatic plant beds and diverse emergent fringing vegetation communities (Sim and Muller 2004).

The Coorong

The Coorong is a 140 km long coastal lagoon complex, separated from the Southern Ocean by a narrow coastal dune barrier, the Younghusband Peninsula. The lagoons are up to 5 km wide and are typically shallow, with a maximum depth of around 3 m. Its area ranges from 150 km2 to almost 240 km2, depending on the amount of inflow from the River Murray or the sea (Lothian and Williams 1988).

The Coorong can be divided into three distinct regions based on different salinity and flow patterns – the Murray Estuary (from the Goolwa Barrage, to Pelican Point), North Lagoon and South Lagoon:

- *Murray Estuary.* From the Murray mouth to Pelican Point a diurnal tidal prism is evident. The Murray Estuary includes the area around the Murray Mouth from the Goolwa barrage to Pelican Point and includes the Goolwa, Coorong and Mundoo channels, which are separated from Lake Alexandrina by the Goolwa, Boundary Creek, Mundoo, Ewe and Tauwitchere Barrages. The area is naturally estuarine, but salinity levels fluctuate widely when there is flow across the barrages.

When flow ceases a salinity gradient from seawater at the mouth to hypersaline conditions in the northern Lagoon develops.

- *North Lagoon.* The North Lagoon is characterised by similar conditions as the Murray Estuary (Dittmann et al. 2006), with barrage releases controlling salinity. The salinity gradient increases southwards along the North Lagoon, which extends from Pelican Point to Parnka Point, where it reduces to a 100 m wide section separating it from the South Lagoon.
- *South Lagoon.* South of Parnka Point, the South Lagoon extends past Salt Creek where it ultimately becomes a series of hypersaline ephemeral lagoons south of the Coorong. The South Lagoon varies from estuarine to hypersaline.

The Murray mouth and estuary is microtidal. Elsewhere in the Coorong water level is determined to varying extents by wind, sea level, evaporation and water release over the barrages. Within the body of the North Lagoon, at weather timescales (10 days or less), water level variations are caused in similar measure by the wind, which tilts the water level one way or another depending on wind direction, and by sea level variations (Webster 2007). In the South Lagoon, water level fluctuations at weather timescales are mostly caused by the wind. The impact of diurnal tidal changes decreases from about 20% of ocean tides at the Murray mouth to trivial at Pelican Point.

Importantly, seasonal changes in sea level cause long-term changes in water depth in the Coorong beyond the tidal zone (Webster 2007). The depth of the Mouth channel and of the channel connecting the North and South Lagoons limits the extent of the sea level influence. When sea level (and water level in the North Lagoon) drops below approximately 0 m (AHD) in summer, water flow through the Parnka Point channel is not able to replenish evaporative losses in the South Lagoon resulting in a further level drop and increased salinity. Water level in both lagoons rises later in the year with the seasonal rise in sea level in autumn. Because of shallow depth and gently sloping beds, this water movement exposes and inundates extensive areas of mudflats, but with a strong seasonal fluctuation in extent. The distances between shoreline and waterline can consequently vary markedly throughout most of the Coorong lagoon and estuary (Dittmann et al. 2006).

The salinity of the Coorong increases with distance from the mouth, changing from estuarine in the Murray Estuary, influenced by freshwater flows over the barrages, to hypersaline in the South Lagoon. Ultimately, the salinity levels in the system are determined by the balance between 'forward' transport of salt in the flow required to replace evaporation (transport towards the southeast) and the 'backward' mixing of salt by oscillating currents induced by the wind, barrage flows and sea level changes (Webster 2007). Much of the ecological character of the Coorong and the habitat provided for bird species is dependent on the pattern and degree of salinisation in the lagoons and estuary. The patterns and level of salinity in the Coorong are believed to have changed markedly over the last 100 years.

Barrage flows influence the salinity dynamics in the Coorong in at least three important ways (Webster 2007):

- periods of elevated barrage flows deepen the Mouth channel and connection to the sea, which in turn allows more active mixing along the length of the Coorong;
- by freshening the water at the northern end of the North Lagoon (compared to sea water), the water that flows along the Coorong to replace evaporative losses has a lower salinity; and

- when the barrages flow, the water level in the whole system tends to increase and water is pushed along the Coorong.

It is believed that the Coorong is more saline now than prior to river regulation (Geddes and Hall 1990). Gell and Haynes (2005) found the Coorong is now a much more closed system than in the past. They postulate that in the past marine input from the Murray mouth, and groundwater and freshwater input from the south-east of South Australia, maintained a variable, but clear water system, mostly in a salinity range between 5,000-35,000 mg/L. Before European settlement the Northern Lagoon of the Coorong was dominated by tidal input of marine water. Marine flushing also strongly influenced the Southern Lagoon but less frequently or to a lesser extent. They concluded that in the 300 years before European settlement the Coorong was not directly influenced by flows from the River Murray. Importantly, as discussed above, flows over the barrages indirectly influence salinity in the Coorong, by freshening the water that flows along the Coorong to replace evaporative losses (Webster 2007). The northern end of the southern lagoon occasionally experienced hypersaline conditions in the 300 years before European settlement.

The presence of the barrages between Lake Alexandrina and the Coorong, and the historically low flows into Lake Alexandrina has resulted in infrequent flows of freshwater into the Coorong from the lake.

While there is evidence that the water regime and salinity of the Coorong Southern Lagoon is influenced by discharge from the River Murray (Geddes 1987), several authors suggest freshwater inflows from the south east occurred historically via Salt Creek (England 1993, Phillips and Muller 2006) and, more contentiously, via the ephemeral saline lakes at the southern extent of the system (England 1993). In the southern lagoon the presence in sediment layers of diatom and ostracod taxa preferring salinity levels ~ 5,000 mg/L suggests regular freshwater input in the past (Gell and Haynes 2005). This source is likely to have been from the south east of South Australia. There is also evidence of the historical presence of aquatic species in the Coorong Southern Lagoon that are currently absent and that are intolerant of the high salinities now present (Geddes and Butler 1984).

Since European settlement, but mostly since 1940, the Coorong has been impacted by increased accumulation, or input, of fine, exogenous sediments (Gell and Haynes 2005). This is likely to have increased turbidity and reduced light availability within its waters.

Declining ecosystem health of the Coorong since the 1970’s has been well documented. Declines in biological productivity and ecological complexity have occurred in association with increasing salinity. The Coorong Southern Lagoon has become increasingly saline, with salinities now greater than at any time in the 6,000-year history of the wetland (Phillips and Muller 2006). Concentrations of 83,200 to 243,000 mg/L (approximately 7 times seawater conductivity) now occur in summer (MDBC 2006). Salinities of this magnitude exceed the tolerances of much of the native biota. Consequently there have been dramatic declines in the abundance and species composition of many organisms including aquatic plants, invertebrates and fish.

Presently, in addition to local runoff and rainfall, the Coorong normally receives freshwater inflows at its northern extremity from the River Murray, groundwater inputs along its length, and inflows into the South Lagoon from the Upper South East Drainage Scheme via Salt Creek.

Historically water also flowed from the lower southeast of South Australia via the ephemeral lakes and along interdune corridors. The construction of a complex of drains in the lower southeast and the loss of this water to the sea has had unknown impacts on the ecological character of the Coorong. Reduced River Murray flows may also have contributed, however River Murray inflows do not guarantee a reduction in the salinity of the Coorong Southern Lagoon (Geddes and Butler 1984, Geddes 1987).

The Ephemeral Lakes

Extending in a southerly direction from Salt Creek, the permanent southern lagoon of the Coorong grades through an annually dry section to a chain of shallow ephemeral salt lakes. These Ephemeral Lakes constitute a distinct and relatively highly productive ecological system from the Coorong South Lagoon (Nicolson 1993). They provide significant and diverse waterbird habitat.

The Ephemeral Lakes provide a diverse range of habitat types both spatially and temporally (Nicolson 1993). The lakes vary in such factors as:

- hydrology: being filled to differing extents either by rainfall or when the unconfined aquifer rises above the lakebeds in winter, consequent to local aquifer recharge. Underlying fresh and saline groundwaters control the salinity and chemical composition of the lakes;
- salinity: marked seasonal changes in salinity are evident in lakes, and these salinity levels vary among lakes;
- depth: during winter and spring the lakes fill to a depth that varies between 0.4 to 1.0 m;
- vegetation: the lakes contain a diverse range of aquatic (e.g. *Ruppia*, *Lamprothamnion*), emergent and fringing vegetation
- faunal communities: a diverse range of aquatic macroscopic invertebrates comprise the most significant faunal biomass, with seasonal patterns in abundance of individual species;
- waterbird communities: many of the lakes are devoid of aquatic vertebrates, providing highly productive feeding areas for waterbirds that forage on invertebrates

The Murray Mouth

The Murray mouth has migrated over 1.6 km west along the coast since the 1830s and up to 6 km over the past 3,000 years and is naturally a geomorphologically highly dynamic area (MDBC 2005). In pre-European times the Murray Mouth would have been almost permanently open, with mouth closure only an occasional possibility (MDBC 2005).

The release of water from the barrages maintains an open mouth and counteracts the effects of longshore drift. Modelling suggests releases from the barrages of 2,000 ML/day, released as a continuous flow, are required to maintain an open mouth (Phillips and Muller 2006). Flows of less than this volume dominate the flow regime under MDBA's 'cap' conditions. River regulation in the Murray-Darling Basin has caused a 73% reduction in median annual discharge from the Murray Mouth (Phillips and Muller 2006). Without adequate flows the mouth closes due to sand deposition. The Murray Mouth closed for the only time in recorded history in 1981 (MDBC 2005). Earth moving equipment was used at this time to re-open the mouth. Flows from the mid 1980's throughout the 1990's were adequate to maintain an open mouth without dredging. However, dredging to prevent mouth closure recommenced in October 2002 (A. Morse, MDBA, *pers. com.* 3/3/2009) and has been maintained almost continuously to the present due to low inflows to the lower River Murray.

Long-term closure of the Murray Mouth would exacerbate the deterioration of the Coorong's ecosystem, with outcomes including increased salinity, reduced diadromous fish populations and habitat deterioration for migratory waders (Brookes et al. 2002).

Fringing Wetlands

Two groups of fringing wetlands within the Ramsar site have been distinguished with regards provision of habitat for birds:

- Tributary freshwater wetlands. Tributary wetlands associated with three eastern Mount Lofty Range streams (Finniss River, Tookayerta Creek and Currency Creek) constituting a significant part of the Fleurieu Peninsula swamps a critically endangered ecological community under the Commonwealth EPBC Act. Three major types of swamps have been identified (largely based on geomorphology) as spring-fed, floodplains and reedlands (Littlely 1998); and
- Saline groundwater fed wetlands, comprising salinas, samphire, salt marshes, *Gahnia* sedgelands and *Melaleuca halmaturorum* shrublands fringing the lakes.

2.1 Introduction

The focus of this literature review is on birds dependent on habitat provided by wetlands within the Coorong and Lakes Alexandrina and Albert Ramsar site. Waterbirds constitute a fundamental component of this system, requiring foraging, refuge and breeding habitat. In addition many terrestrial bird species, particularly insectivores, are also reliant on wetland productivity. In the long-term at least, abundant and diverse native bird populations are indicative of wetland health, as birds require both sufficient food resources and nesting habitat, which generally equate to a healthy wetland (Reid and Brooks 2000).

Access to suitable habitat is essential for the survival and successful reproduction of all species, ultimately determining their distribution and abundance. The scientific literature contains many examples of species that have declined when the amount of habitat suitable for them has been reduced (Lindenmayer and Fischer 2006). The resources and conditions present in an area that a given species occupies, and where it survives and reproduces constitute habitat (Hall et al. 1997). What constitutes suitable habitat is species-specific, and consequently all changes to habitat affect species in species-specific ways. In defining an organism's habitat the physical and biological characteristics of an area are being related to the presence of that species.

An ideal habitat description for a species presents an analysis of the critical factors determining distribution and the suitability of particular sites, taking into account (Marchant and Higgins 1990):

- needs for different purposes (e.g. feeding, breeding, roosting);
- dynamics of the temporal use of habitat (e.g. daily, seasonally); and
- the effects of alteration of habitat.

Unfortunately by these criteria there are few bird species for which a comprehensive description of habitat can be applied (Marchant and Higgins 1990).

Many waterbird species have a high level of plasticity in foraging habitat they will use. Consequently, observed habitat use does not always reflect an individual species preferred habitat. Habitat selection is a hierarchical process involving a series of innate and learned behavioural decisions made by an animal about what habitat it should use at different scales of the environment (Hutto 1985, Hall et al. 1997). Habitat quality is not always correlated with the density of a species in an area (Van Horne 1983), and while broad scale habitat elements may be present in an area, important microhabitat components may be absent. In the absence of significant environmental variability individuals may also settle randomly (Orians and Wittenberger 1991).

During dispersal an organism must recognise a habitat appropriate for occupancy. Within this habitat it may choose to remain within one area, constituting its home range. On a day-to-day basis, only particular components or microhabitats within this area may be used.

A component of habitat is the "habitat type", or more appropriately the "vegetation type", which refers only to the type of vegetation association in an area (Hall *et al.* 1997). For many waterbirds the vegetation is an important component of a species habitat, providing critical elements of microhabitat upon which species' rely. For these reasons the vegetation types and associated landforms found within the region are described below. This provides an important context for the subsequent discussion on waterbird habitat.

2.2 Vegetation Types

The wetlands of the Coorong and Lakes Alexandrina and Albert contain a wide variety of water dependent vegetation types that vary in association with the type of landscape feature and the nature and timing of inundation, and in turn provide a variety of habitat elements used by different bird species.

The types of foraging, refuge and roosting microhabitats found in association with each combination of landscape feature and water dependent habitat component are outlined in Table 1, and discussed in detail below.

Table 1: Water dependent vegetation types and associated microhabitats available to birds in the Coorong and Lakes Alexandrina and Albert Ramsar site

Landscape Features	Inundation Pattern		
	Deep Water (>0.3 m)	Periodically Inundated	Flood Zone / Supratidal
Lake	Open water or bare ground when exposed by low lake levels	A band of locally patchy but occasionally extensive reed beds of *Phragmites australis*, *Typha* sp. and *Schoenoplectus validus*. Extensive shoreline areas are actively eroded and have little or no vegetation.	Localised and occasionally extensive complexes of salt marshes with salt pans, samphire communities, *Gahnia* sp. sedgelands and *Melaleuca halmaturorum*.
Estuary	Little information. Possibly localised beds of *Ruppia megacarpa* and brown and filamentous algae	Extensive mudflats and sandflats. Little macrophyte vegetation.	Generally a narrow fringe of samphire communities. More complex communities including salt tolerant sedges and rushes are present where a channel discharges to the estuary from Hindmarsh Island.
Lagoon	Beds of submerged aquatic macrophytes including *Ruppia megacarpa*, *R. tuberosa*, *Lamprothamnimum* sp and *Lepliaena* sp, these species and associated habitat have declined dramatically in extent since the 1980's.	Extensive mudflats and sandflats. Plants and fragments (e.g. propagules such as seeds and turions) of *Ruppia* sp. and other submerged aquatic plants may be exposed by low water levels. Samphire communities and reed beds of *Phragmites australia* and other reeds are present in local areas.	A variety of plant communities are present. Freshwater soaks at the base of the coastal dunes support a mixture of salt-tolerant and freshwater reeds, sedges and rushes. Communities of *Gahnia* sp. and *Melaleuca halmaturorum* are present extensively on the landward shore. Numerous salt marshes with samphire vegetation are present at the fringes of the lagoon.
Freshwater Spring-fed Swamp	Extensive beds of soft-leaved submerged macrophytes including *Myriophyllum* spp., *Potamogeton* spp. and *Chara* spp.	Dense stands of emergent macrophytes including *Phragmites australis*, *Typha* sp. and *Bolboschoenus medianus* and *Juncus pallidus*.	Shrublands of *Acacia retinodes* and *Melaleuca continentale*.

Lakes are extensive areas of open water present relative to surface water, with the water not obviously flowing. Lakes Alexandrina and Albert are representative of this landscape element. An estuary is a transition zone between the freshwater and marine environment, and subject to tidal influence. The estuary, as used here, refers to the region between the Lake Alexandrina barrages, the Murray mouth and Pelican Point. A lagoon is a salt-water lake parted from the sea by a sandbank. The north and south lagoons of the Coorong are representative of this landscape element. Freshwater, spring-fed swamps refer to the region including the Goolwa Channel and the swamps associated with the mouths of Finniss River, Tookayerta Creek and Currency Creek.

Lake Environment

Deep Water

Lakes Alexandrina and Albert are open water bodies which support little or no macrophyte vegetation beyond a depth of approximately 0.5 m. It is likely that high turbidity, water movement, carp and excessive depth all contribute to an unfavourable environment for submerged, floating-leaved and emergent macrophytes.

A community of submerged and floating-leaved plants can develop in sheltered environments such as the fringes of Dog Lake, Tolderol and some other enclosed backwaters on the lake fringes such as the channels of Hindmarsh Island. Species typically include *Myriophyllum* spp., *Potamogeton* spp., *Valisneria americana, Chara* sp. and *Triglochin procerum.*

Periodically Exposed / Inundated Zone

At or near the full supply level of the lake, beds of emergent macrophytes, particularly *Phragmites australis, Typha sp.* and *Schoenoplectus validus* may be present. This vegetation can be extensive in sheltered shorelines with a low-gradient lakebed. Significant fringing reedbeds are present at:

- Milang Shores; and
- Tolderol.

Reed beds are generally absent from the lakeshore in areas exposed to erosion. Lakeshore erosion is a significant problem in the lower lakes where wave action has undercut exposed banks. Erosion has been promoted by cattle access to the shoreline and contributes to sediment loads in the lake and poor lakeshore habitat (Seaman 2003, Phillips and Muller 2006).

Low lake levels can expose the lakebed immediately below the reed beds. Vegetation is normally absent from these areas, but if low levels persist they will become colonised by aquatic herbland species such as *Cotula coronopifolia, Agrostis avenacea* and *Hordeum marinum*.

Supratidal / Flood Zone

Salt marsh complexes surround the lakes above the normal operating level. A shallow saline aquifer contributes to waterlogging and high soil salinities in nearby low-lying areas, which provides conditions for salt marsh development. Salt marshes may extend inland from the lake as a continuation of lakeshore plant communities or may be present as isolated wetlands and shallow lakes.

In winter, groundwater discharge and rainfall create waterlogged conditions or shallow flooding, while in summer the salt marshes are generally dry. They typically support a halophytic plant community of herbs and forbs, which includes *Haloscarcia* spp., *Suaeda australis*, *Mimulus repens, Samolus repens* and *Distichlis distichophylla*. Lignum (*Muehlenbeckia florulenta*) may be present. Salt marshes subject to regular inundation by freshwater (such as Milang Shores) may also support sedges and rushes such as *Bolboschoenus caldwellii, Schoenoplectus pungens* and *Juncus kraussii*.

It is likely that prior to settlement, communities of *Melaleuca halmaturorum* and *Gahnia* spp. fringed and possibly connected the saltmarshes surrounding the lakes.

Salt marsh communities are present at:

- Waltowa Swamp;
- Poltalloch;
- Teringie;
- Narrung;
- Loveday Bay; and
- Milang Shores.

Significant remnants of *Gahnia filum* sedgeland are present at Clayton Wetland and remnants of *Melaleuca halmaturorum* are present on Hindmarsh Island.

Estuary Environment

Deep Water

Little information has been found on the deep-water vegetation of the estuary environment specifically. The North Lagoon of the Coorong, which is continuous with this area, has supported extensive beds of *Ruppia megacarpa.* Phillips and Muller (2006) report that *R. megacarpa* has increasingly appeared in the estuary since the 1980s, possibly due to the stabilisation of salinities and water levels associated with narrowing of the estuary entrance and reduced barrage outflows.

The algae *Gracilaria* sp., *Entermorpha* sp. and *Rhizoconium* sp. have been recorded in the North Lagoon and Murray Mouth.

Periodically Exposed / Inundated Zone

The water regime of the estuary is dominated by tidal fluctuation on which river flow peaks are superimposed. The periodically exposed fringe of the estuary does not support macrophyte vegetation and comprises mainly base sand and mud flats.

Supratidal / Flood Zone

Salt marsh communities are present at the fringes of the estuary. They mainly comprise low shrublands of samphire species but may become more complex where there is a freshwater influence. Freshwater in a range of deep (>1 m) and shallow water can provide habitat for species such as *Ruppia megacarpa,* *Paspalum distichum, Bolboschoenus caldwellii, Typha* sp., *Phragmites australis* and *Juncus kraussii.* A complex of these communities is present where a tidal channel from Hindmarsh Island enters the estuary. *Melaleuca halmaturorum* is also present as an overstorey where it has been planted along the Goolwa Channel.

Lagoon Environment

Deep Water

Ruppia megacarpa is a submerged, salt-tolerant perennial species, which grows in permanently inundated habitats to an average depth of 0.6 m. It tolerates brief exposure but relies on seed to recolonise areas subject to prolonged exposure. Beds of *Ruppia megacarpa* in the Coorong North Lagoon have been extensive and are important for the physical habitat and food sources for fish and macroinvertebrates associated with them.

Ruppia tuberosa is more tolerant of high salinities than *R. megacarpa* and has been the dominant species in the South Lagoon of the Coorong. It is an annual species and grows at depths of 0.3 to 0.9 m.

Other submerged aquatic plants present were *Lamprothamnium* and *Lepilaena*. Both of these species have been lost from the Coorong in recent years and *Ruppia* spp. has declined substantially. Historically, submerged aquatic plants in the Coorong have formed dense, extensive beds.

Periodically Exposed / Inundated Zone

The periodically exposed fringes of the Coorong are unfavourable for submerged aquatic macrophytes. However, living plants and fragments are frequently found in this area either because water levels have fallen or because plant material has accumulated near the shore through wind and wave action. The shoreline otherwise provides bare-mud habitat, rocky substrate, or localised communities of samphire and *Phragmites australis, Juncus kraussii* and *Bolboschoenus caldwellii.*

Supratidal / Flood Zone

The Coorong lagoons are fringed by salt-tolerant species growing in a range of groundwater environments. In more saline areas saltpan samphire communities are found. Areas with a low-salinity groundwater influence can support extensive tall shrublands of *Gahnia* sp. and *Melaleuca halmaturorum*. Freshwater soaks at the base of the coastal dunes support mixtures of species associated with fresh and salt-water environments including *Juncus spp., Schoenoplectus pungens, Cyperus gymnocaulos, Samolus repens, Apium prostratum* and *Sporobolous virginicus.*

Freshwater Spring-fed Swamps

Deep Water

The three main tributaries from the eastern slopes of the Mount Lofty Ranges are the Finniss River, Currency Creek and Tookayerta Creek. Each of these provides deep, permanent freshwater habitat, which supports beds of submerged aquatic plants. Key species include *Myriophyllum* spp., *Ceratophyllum demersum, Potamogeton* spp. *Nitella* sp. and *Chara* sp. These species tend to be excluded from depths of less than 0.5 m by emergent macrophytes and extend to depths of 1 to 1.5 m after which they are replaced by open water.

Periodically Exposed / Inundated Zone

The edges of the tributaries support extensive, dense beds of emergent macrophytes. Dominant species include *Phragmites australis, Typha* sp., *Schoenoplectus validus* and *Bolboschoenus medianus*. Submerged macrophytes such as *Myriophyllum* sp. may be present at the base of these plants.

Supratidal / Flood Zone

The tributaries are strongly influenced by fresh groundwater discharge, which provides waterlogged conditions above the normal limit of water fluctuations. Reed beds can extend outside the range of inundation, but shrub species become increasingly dominant. Key species include *Acacia retinodes* and *Melaleuca continentale.*

2.3 Waterbird foraging habitat

Wetlands often support species of waterbird that have diverse physical adaptations to feed on a wide variety of food types, with the composition and abundance of waterbird communities on a wetland often reflecting the availability of food (Kingsford and Porter 1994, McDougall and Timms 2001). The feeding behaviour of waders is closely associated with their bill size and shape. Generally short-billed species are 'pickers', mostly taking food items from the substrate surface (e.g. plovers), while those with long bills feed by probing deeply into substrates (e.g. curlews). Those with medium length straight bills are often generalists, able to feed by picking or probing. In addition there are a number of specialist feeder with bills adapted to either their favourite food (e.g. oystercatcher) or their primary feeding technique (e.g. spoonbills). Importantly all waterbirds are plastic in their feeding behaviours and will take foods other than those for which they are best adapted, if the opportunity arises, or if conditions do not allow their usual feeding methods (Chandler 2009). Wader distributions and densities often reflect the availability of food species, which is a function of prey species abundance and the ability of birds to access prey. The latter is a function of physical foraging habitat availability such as preferred water depths of substrate types. Habitat use can be influenced by the proximity of roost sites, water quality especially salinity, the availability of preferred habitat, and the need for refuge.

Waterbird foraging habitat within the Coorong and Lakes Alexandrina and Albert Ramsar site broadly consists of: deep water; shallow water (0-30 cm deep); areas inundated during tidal flows and with wind seiche; and supratidal or flood zones. Within each of the wetland types the pattern of inundation and associated substrates provide 33 broad microhabitat foraging types for waterbirds across the study site (Table 2).

Table 2: Waterbird foraging habitat within the Coorong and Lakes Alexandrina and Albert Ramsar site

<table>
<tr><th rowspan="4">Landscape Feature</th><th colspan="4">Water Dependent Habitat Components (vary in spatial extent and temporal duration of inundation)</th></tr>
<tr><th rowspan="2">Deep Water
(> 0.3 m)</th><th colspan="3">Periodically exposed / inundated zone</th></tr>
<tr><th>Shallow water
(< 0.3 m)</th><th>Intertidal / Seiche zone</th><th>Supratidal / Flood zone</th></tr>
<tr><th colspan="4">Waterbird microhabitat types</th></tr>
<tr><td>Lake</td><td>• Water column and substrate</td><td>• Reed beds
• Mudflats and sandflats</td><td>• Reed beds
• Mudflats and sandflats
• Rocky substrate
• Water edge</td><td>• Fringing vegetation
• Saltmarsh</td></tr>
<tr><td>Estuary</td><td>• Water column, substrate and aquatic vegetation</td><td>• Mudflats and sandflats</td><td>• Mudflats and sandflats
• Water edge</td><td>• Saltmarsh</td></tr>
<tr><td>Lagoon</td><td>• Water column, substrate and aquatic vegetation</td><td>• Mudflats and sandflats
• Aquatic vegetation
• Algae beds
• Reed beds</td><td>• Mudflats and sandflats
• Exposed aquatic vegetation
• Reed beds
• Exposed algal beds
• Rocky substrate
• Water edge</td><td>• Saltmarsh
• Fringing vegetation
• Mudflats and sandflats
• Reed beds</td></tr>
<tr><td>Freshwater Spring-fed Swamp</td><td>• Aquatic vegetation</td><td>• Reed beds</td><td>• Reed beds</td><td>• Fringing Vegetation</td></tr>
</table>

Deep water

In permanent or long-term waterbodies algae, epiphytes, macroinvertebrates, zooplankton, and fish found through the water column and in the vegetation beds together constitute a complex food web supporting a variety of birds (Paracuellos 2006).

Most wading birds use water up to 30 cm deep, generally walking on the substrate as they forage. Other species, and some of the waders, forage in deeper water either for similar food sources found on or near the surface, or for alternative food sources in the deeper water column and on the substrate.

A range of waterbird feeding guilds use deep, open, water particularly diving waterbirds (Broome and Jarman 1983). Deep diving ducks such as the Hardhead and Blue-billed Duck feed on emergent and submergent plants, and insects and fish, and the Musk Duck feed mainly on insects but will also eat large numbers of freshwater mussels, snails, crayfish and frogs. Fish-eating (piscivorous) birds may catch fish on the surface (e.g. Terns such as the Whiskered Tern), or may dive to catch fish and a range of invertebrates such as yabbies (e.g. Darter, and grebes and cormorants). Grazing waterfowl such as the Black Swan will upend and use their long neck to browse on plant material in deep water. While larger birds will use deeper water in which to forage, they generally prefer shallow water when food is available (Gawlik 2002), as it is more profitable, using less energy to forage (Lovvorn 1994).

Factors like water turbidity have implications for the diversity and abundance of food resources available in deeper water, with highly turbid water limiting the primary productivity of a lake to the upper parts of the water column or the fringes of the lake.

Shallow water (<30 cm deep)

Waterbirds that wade, predominantly forage in water up to a maximum depth of approximately 30 cm. The water depth used by the different waterbird species when foraging is strongly linked with neck and leg length (Baker 1979, Zeffer et al. 2003), dictating where a particular species will have the most success in foraging. Worldwide the greatest diversity and abundance of foraging waterbirds is found in water depths of between 10 and 20 cm (Isola et al. 2000, Taft et al. 2002). Natural or artificial waterbodies that offer an array of water depths and vegetation associations tend to have rich communities of invertebrates, and carry higher numbers of species and individuals of waterbirds (Broome and Jarman 1983). Piscivores feed on fish in shallow water in preference to those in deeper water (Gawlik 2002). The density of prey at which the birds will stop searching increases with increasing depth being almost twice as high at 28 cm as it is at 10 cm (Gawlik 2002).

In the Coorong, Paton and Rogers (Brookes et al. 2009), found that foraging performance in the three most abundant *Calidris* species (Sharp-tailed Sandpiper, Red-necked Stint, and Curlew Sandpiper) declined rapidly with slight (2-3 cm) increases in water depth, and also with small shifts (<10 m) above the waterline, indicating their narrow niche in association with very shallow water.

Intertidal / Seiche Zones

The substrate exposed and inundated through tidal movement particularly in the shallow gently sloping bed of water bodies provides important foraging habitat for a wide variety of waterbird species. Some species forage in the shallow receding or encroaching water, other species forage on the recently exposed sand or mud flats, and some forage at the moving interface of water over substrate as the tide encroaches and recedes. In the Coorong encroaching water in tidal systems tends to provide poor foraging habitat for migratory birds, with most birds tending to forage on outgoing tides (Daniel Rogers DEH, Pers. Comm. 07/08/2009).

The state of the tidal cycle alters the area of habitat available for foraging waders and also affects prey behaviour and substrate penetrability, which in turn affects the harvestability of prey (Esselink and Zwarts 1989). A mud bank exposed for too long may dry out affecting the penetrability of the sediments and the depth of the prey. Substrate type (e.g. mud, sand, rock) can also affect the density of harvestable prey by affecting the preys behaviour, for example by changing the depth to which they bury themselves, making them more or less susceptible to predation (Esselink and Zwarts 1989). Rolston and Dittman (2009) found macrobenthic fauna abundances decreased significantly at high mudflat exposures in the Murray Mouth region, and at high and medium exposures in the North Lagoon region from December 2006 – March 2007.

In tidal environments most wader species segregate themselves in intertidal habitat according to preferences for sedimentary penetrability and water depth, as waders prefer to feed in shallow water or wet substrate.

Most wader species in Australia feed on intertidal mudflats at falling and low tide, irrespective of whether this occurs during the day or night (Geering et al. 2007). At rising and high tide many species generally spend time roosting in flocks above the high water mark. As the tide recedes they move onto adjacent intertidal mud and sand flats to feed (Geering et al. 2007).

The force of wind moving over water can cause a surge of water, which can inundate the lee shore of a waterbody. The exposure and inundation of the substrate and vegetation along a shore by this process with change in wind direction, or by seiching (a short-period oscillation in an enclosed or semi-enclosed body of water), provides an important foraging habitat for many waterbird species. In large, long, gently-sloping waterbodies like the Coorong lagoons, such water movement can inundate and expose large areas of mud and sand flats, fringing vegetation, and even aquatic vegetation, providing important foraging habitat for a wide variety of waterbird species.

The wind also serves to concentrate food sources on the leeward side of a waterbody, with significant implications for the waterbird feeding efficiency. Waterbirds are known to favour leeward shores when foraging on such food sources as *Ruppia* turions and seeds, and Brine Shrimp.

Mud and Sand Flats

The shores of the Murray estuary, Coorong Lagoons and Lower Lakes are fringed towards the subtidal by sand and mud flats of several metres to hundreds of metres in width. A community of invertebrate macrofauna is found living within and on these flats, providing the basis of a complex and productive foodweb under normal conditions. These extensive mudflats and shallow waters are particularly important for waders (Paton 2000). The tides, seasonal and annual changes in water level, and changes with flooding regime and wind direction, rainfall and evaporation result in patterns of inundation and exposure that vary the accessibility and extent of this habitat available to waders (Brookes et al. 2009). An average water level of 0.12 m AHD is predicted to result in the largest average mudflat area (Brookes et al. 2009).

There have been marked and ongoing changes to the composition, distribution and abundance of the macrobenthic community over the last decade. Recent studies of the benthic fauna diversity and productivity along the Coorong and the Murray estuary have shown that while the mudflat macrofaunal diversity and biomass are relatively low, individual densities are high (Dittmann et al. 2006). In 2006 the benthos community structure varied between the estuary and the South Lagoon, being dominated by amphipods and polychaetes near the Murray mouth, and insects in the South Lagoon and Lake Alexandrina (Dittmann et al. 2006). More recently, Rolston and Dittman (2009) found that adult and juvenile macrobenthic diversity and abundance were greatest in the Murray Mouth region before decreasing in the North Lagoon. Greatest abundance of both adult and juvenile macrobenthos fauna occurred at Pelican Point, which was also distinct from other sites in terms of sediment grain size. In December 2006, only insect larvae were present in the South Lagoon. No taxa were present in the South Lagoon in January and March 2007. In 2006 and 2007 distinct adult and juvenile macrobenthic communities were present in the Murray mouth, North Lagoon and South Lagoon, and these did not change significantly with time (Rolston and Dittman 2009). Macrobenthic abundances in the Murray mouth region were dominated by Polychaeta (particularly *Capitella* spp.), Amphipoda and the micro-bivalve *Arthritica helmsi* (Rolston and Dittman 2009).

The Southern Ephemeral Lakes support a salt lake invertebrate community that is unusually diverse and distinct from that of the marine lagoonal community of the Coorong Southern Lagoon (De Deckker and Geddes 1980). Examples include a species of polychaete worm with the highly unusual ability to tolerate wetland drying (Hutchings et al. 1981) and two species of the Australian endemic fairy shrimp genus *Parartemia* (De Deckker and Geddes 1980).

Following reduced water levels in the Coorong, mud and sandflats have been exposed for longer periods of time, resulting in more solid surfaces (Dittmann et al. 2006), affecting the habitat selection and foraging success of waders, as pack depth and prey density depend on the penetrability of the sediment. Dittmann et al. (2006) concluded that in the Coorong, only the moister sediments near the water line are suitable for foraging by waders, with low prey densities being found in this area. Constriction of foraging habitat area has implications for the abundance of foraging birds in the area.

Supratidal / Flood Zones

Shallow flooding of wetlands provides critical and highly productive habitat for more waterbird species (Colwell and Taft 2000), and is the basis of many waterbird reproductive events.

In the areas subject to flooding and inundation, exposure and drying of wetland sediments during summer and autumn facilitates a suite of biotic and abiotic processes in seasonal wetlands that do not occur in permanently inundated sediments. Subsequent shallow inundation of mudflats during winter and spring facilitates ecosystem productivity and replenishes mudflat resources. The cycle of growth and decay and thus greater availability of nutrients in the water column (Baldwin and Mitchell 2000), resulting from regular inundation and exposure of vegetation along these margins, is the basis of a complex food web that provides food to the vertebrates that forage in, on and around the water (Baxter et al. 2005), and is the basis of breeding events in many species of fish and waterbirds (Crome 1988, Junk et al. 1989, Scott 1997). Crome (1988) found that breeding for a wide variety of waterbird species in Australia only followed a rise in water level if the wetland had been completely dried out before hand. This is not true for all waterbird species, with Pacific Herons and Yellow-billed Spoonbills favouring sites that have not dried out before reflooding (Briggs et al. 1997).

As wetlands dry out during summer, mudflat and sandflat exposure ensures resources within are available to waterbirds. During this drying phase algal abundance increases, species composition changes, and biotic interactions such as predation and competition increase (Gawne and Scholz 2006). With shallower water the fish community becomes more susceptible to avian predation.

Water bodies that are permanent, or ephemeral systems that lose their drying phase, have been shown to support a lower density and diversity of birds, decline in invertebrate productivity, increase in abundance of introduced fish, and increase the anaerobic decomposition of organic matter (Crome 1988, Kingston et al. 2004, Gawne and Scholz 2006). Turbidity can also be affected, with consequences for euphotic depth and primary productivity. For wetland ecosystems that have evolved in response to seasonal drying, permanent inundation would likely lead to ecological degradation and displacement by an alternative community of flora and fauna.

Emergent and Fringing Vegetation

The presence of a healthy macrophyte community within and fringing a wetland is important to a distinct subgroup of waterbirds, as they may be either a direct or indirect food source, and / or provide an essential refuge or roosting site. For this group of waterbirds use of an area is associated more with the structural and cover pattern of the vegetation emergent from the wetland and around its fringe, and the actual plant species present are generally not important.

For a complex bird community to exist in an area, the foraging habitat requirements are diverse, requiring a mosaic of shallow gently sloping margins as well as deep water and reed beds. Abundance of macroinvertebrates is usually positively correlated with macrophyte abundance and diversity (Boulton and Brock 1991, Hargeby et al. 1994, Safran et al. 2000). In wetlands, total and breeding waterbird species richness have been shown to increase with percent cover of emergent vegetation (Hargeby et al. 1994, VanRees-Siewert and Dinsmore 1996, Safran et al. 2000, Fairbairn and Dinsmore 2001).

Fringing wetland vegetation provides important foraging, refuge and roosting habitat for a range of specialist and generalist waterbird species within the Lower Lakes and Coorong. Record low flows into the Lower Lakes and Coorong have resulted in low water levels within these systems and a disconnection between their water-dependent fringing and emergent vegetation and the shoreline. Such a disconnection markedly reduces the diversity of habitat types available to the waterbirds and lowers the wetland productivity, with significant negative implications for the diversity of species and populations that the wetland can support.

Saltmarsh

Saltmarsh is of direct importance to many avian species by providing habitat in which individuals can breed, feed and roost (Saintilan 2009). This vegetation community is dominant over parts of the study area. Samphire shrublands occur around the periphery of relatively saline seasonal and permanent wetlands. Dominant species include *Halosarcia* spp. and *Sarcocornia* spp.. Samphire vegetation tolerates, but does not require, inundation (Wilson 1999).

Saltmarsh can act as a drought refuge for Australian breeding waders and many migratory waders will roost and feed in saltmarsh (Spencer et al. 2009). In Australia little is known of wader use of saltmarsh habitats, but it has been documented as important habitat for several shorebird species in Africa, Europe and North America (Spencer et al. 2009). Species that commonly feed in saltmarsh in Australia include: Curlew Sandpiper, Marsh Sandpiper, Red-necked Stint, Australian White Ibis, Straw-necked Ibis, Cattle Egret, Black Swan, Chestnut Teal, Australian Shelduck, Sharp-tailed Sandpiper, Masked Lapwing, Red-capped Plover, Black-tailed Godwit, Common Greenshank, Eastern Curlew, Latham Snipe, and Pacific Golden Plover (Spencer et al. 2009). The nationally critically endangered Orange-bellied Parrot (*Neophema chrysogaster*), which frequents wetlands in the study area, feeds on the fruit of *Sarcocornia quinqueflora* (Croft et al. 1999).

In broad terms four major foraging 'habitat types' can be defined for Orange-bellied Parrots in SA (Ehmke et al. 2009): Beachfront / dune scrub, Saltmarsh, Introduced Pasture and Irrigated Crop. Saltmarsh habitat in SA ranges from consistently inundated wet saltmarshes to predominantly dry saltmarshes that are only rarely inundated. In general it is the more consistently inundated saltmarshes that constitute the best habitat for Orange-bellied Parrots (Ehmke et al. 2009). Most consistently inundated saltmarshes are associated with intertidal environments, while those fringing ‘inland’ lakes (i.e. water-bodies not connected to the sea) are generally inundated only ephemerally.

Aquatic Vegetation

Ruppia tuberosa provides a major contribution of primary production to the Coorong ecosystem, that is accessible to higher organisms, as well as physical habitat important for juvenile fish (Phillips and Muller 2006). It used to occur predominantly in the Coorong Southern Lagoon (Phillips and Muller 2006). *Ruppia tuberosa,* as of early 2009, was effectively absent from the South Lagoon, but appeared to be slowly increasing in distribution and abundance in the North Lagoon (Rogers and Paton 2009). Within the systems in which *R. tuberosa* dominates there are no species that have an equivalent role. It has a particular role in ecosystem stability, providing critical habitat and food sources, which form the basis of a low-complexity food web sustaining a diversity of high trophic level organisms (Thompson and Starzomski 2007). Although not a “keystone species” in the strictest sense (Power et al. 1996), *R. tuberosa* does exert a strong effect on biodiversity (Duffy et al. 2007), by virtue of its large biomass and trophic position, because of the complex microhabitat array it provides for other species, and because of the diversity or waterbirds known or suspected to feed on it.

The primary source of organic content in the mudflats of the Coorong Southern Lagoon is exposed, decaying *R. tuberosa* (MDBC 2006). Thus, maintenance of this asset is directly dependent upon maintenance of ‘*R. tuberosa* colonisation and reproduction’. The organic content of mudflats provides resources for mudflat invertebrates, which in turn are a food source for migratory waders and Australian waders.

Submerged vegetation in the Lower Lakes is now restricted to inshore areas, whereas these species were once widely spread throughout the lakes’ basins (Ganf 2000, Sim and Muller 2004). Submerged freshwater aquatic vegetation plant communities occur in fresh/brackish wetlands with open water. Typical species include *Potamogeton* spp., *Myriophyllum* spp., *Triglochin* spp., *Crassula helmsii* and *Villarsia reniformis*. In addition to the significance of the plant community, this vegetation provides important structural habitat for a number of freshwater fish species (Hammer 2002). It can occur in both permanent and seasonal wetlands and drains.

Chara spp. is a benthic aquatic alga with a plant-like habit that forms extensive, essentially monocultural beds in some semi-permanent wetlands. This species serves a similar ecological role as freshwater aquatic vegetation, such as providing habitats for fish and macroinvertebrates, but often survives in saline environments where other plants are absent. An increase in *Chara* spp. biomass in a lake in the Netherlands was strongly correlated with an increase in the abundance of herbivorous waterbirds (Noordhuis et al. 2002), illustrating the likely importance of *Chara* spp. to the productivity of higher trophic levels and in supporting wildlife populations. *Chara* spp. beds may act as nutrient sinks in wetlands (Kufel and Kufel 2002), thus helping to control nutrient concentrations in the water column and maintaining ecosystem stability. Research indicates *Chara* recovers well following disturbance (eg. wetland drying, increased water depth) due to a persistent oospore bank (Harwell and Havens 2003).

These beds of aquatic vegetation are the basis of a complex food chain, providing forage for waterbirds through a complex of interactions.

High abiogenic turbidity, with low light penetration in Lake Alexandrina (Geddes 1984a) and Lake Albert limits macrophyte growth to the lake perimeter. These factors have a large influence on the lakes ecology. Algal growth provides primary production across the large areas of open water, with a relatively low level of productivity. The high turbidity is postulated to limit algal diversity and promote the occurrence of large species of zooplankton, with a high zooplankton biomass (Geddes 1984b).

2.4 Waterbird Roost Sites

Waterbirds need to rest, particularly when not feeding. When roosting (sleeping) or loafing they seek out sites, generally specific to their species, where they can conserve energy, and minimise risks such as predation. Such sites generally provide specific habitat structures that provide shelter from sun or wind, or such factors as uninterrupted views to maximise the chance of detecting potential predators. Many species will gather together in large, often multispecies, flocks when roosting.

Waders will seek out roosting sites when they do not have to feed or when inclement weather or high tides make their feeding grounds unavailable (Chandler 2009).

Many of the habitat specialists such as Rails maintain a strong association with dense fringing and emergent habitat for refuge and roosting. For many of these species a close association of foraging and roost sites is essential to ongoing use of a habitat.

Close proximity to a good quality, high-tide roost site can be an overriding factor determining the distribution of feeding waders on intertidal flats, with energy reserves able to be conserved by minimising the flight distance between roosting and feeding areas (Geering et al. 2007).

The lack of appropriate roosting site may minimise or limit the use of an area for a species. For example the presence of suitable roosting habitat close to foraging grounds is believed to be important for Orange-bellied Parrots (Ehmke et al. 2009).

2.5 Waterbird Drought and Summer Refuge

Refuges are habitats or environmental factors that convey spatial and temporal resistance and/or resilience to biotic communities impacted by biophysical disturbance (Sedell et al. 1990). They may be considered part of an environmental continuum, being places (or times) where the negative effects of disturbance are lower than in the surrounding area (or time) (Lancaster and Belyea 1997). Organisms require refuge from both biotic (eg predation) and abiotic (eg drought) disturbance. Refuges exist at a range of spatial and temporal scales: from the smallest (eg microhabitat) to the largest (eg drainage basin) spatial scale, and may be required across a range of temporal scales from minutes to years (Magoulick and Kobza 2003). Consequently the nature of a refuge varies among species, being dependent on the species adaptations, habitat requirements, spatial and temporal scale and the nature of the disturbance.

The more permanent wetland elements throughout the Ramsar site provide important summer and drought refuge for a wide variety of Australian bird species, with seasonal migrations to the wetlands from regions across large parts of Australia as inland habitat dries out on a seasonal basis or as a consequence of drought. The habitat values provided for these species by the Ramsar site wetlands relate to sustaining the individuals within the population, rather than providing for the higher order demands of non breeding migratory species or species reliant on the region for breeding.

2.6 Waterbird Breeding Habitat

Waterbird breeding, with the exception of colonial breeding events, are typically difficult to observe and quantify, and data on when and where they occur are consequently not always easy to obtain. Colonial waterbirds breed in large numbers and are more frequently recorded than the solitary breeding species. Wetland habitat conditions that result in colonial waterbird breeding also provide suitable habitat for other waterbird species such as ducks, and waders. Consequently an analysis of where colonial breeding occurs is a good surrogate for quantifying overall waterbird breeding.

Within Australia the Murray-Darling Basin is responsible for 55.9% of all colonial waterbird-breeding records on a basin-by-basin basis (Brandis *et al.* 2009). Brandis *et al.* (2009) found that there are 470 records of colonial waterbird breeding in the Murray-Darling Basin from 1899 to 2008, with breeding recorded in 115 unique wetlands. Of these wetlands the Coorong and Lower Lakes wetland complex ranked 5th in the total number of breeding events, with 34 known events in the 110 year period, making it one of the most important waterbird breeding sites in Australia. Key breeding sites within the region include: islands within the south lagoons of the Coorong, islands within Salt Lagoon, Tucker's Swamp, reed beds such as those at Pomanda Point, Snake Island, Currency Creek Game reserve, and habitat associated with Tolderol and Mosquito Points.

Relatively few waterbirds breed in the Coorong. Colonies of Crested Terns, Fairy Terns, Caspian Terns, Silver Gulls and Australian Pelicans previously regularly bred on islands in the South lagoon during the summer months (Paton et al. 2009b), in the last decade only Crested Terns now breed in significant numbers. In the early twentieth century significant numbers of Black Swans and small colonies of Pied Cormorants also bred on these islands. The Lower Lakes are more important as breeding areas. The Lower Lakes have, prior to the 1980's, been significant sites for the breeding of: Black Swans; Pacific Black Duck, Musk and Ducks (Paton et al. 2009b). They were also breeding sites for small to moderate numbers of Grey Teal, Chestnut Teal, Australasian Shovellers, Australian Wood Duck, Hardheads, Australian Shelduck, Blue-billed Ducks, Pink-eared Ducks, Purple Swamp Hen, Australian Spotted Crake, Black-winged Stilt and Red-kneed Dotterel (Paton et al. 2009b). There is also one record of the threatened Painted Snipe breeding at Tuckers swamp in January 1980 (Paton et al. 2009b). A range of colonial breeding waterbirds such as cormorants (Great, Little Black, Little Pied, and Pied), ibis (Glossy, Australian White and Straw-necked), spoonbills (Royal and Yellow-billed), and egrets (Great) also bred in the Lower Lakes prior to the 1970's, but declined dramatically for unknown reasons in the 1970's, possibly associated with the arrival of carp (Paton et al. 2009b).

These breeding events are necessarily associated with long-term (3 to 10 month) flood events and the high levels of associated wetland productivity. Flood events in the lower River Murray are now much altered and reduced in volume. Instead of small floods or spates flowing downriver and filling wetlands on the floodplain in about seven years out of ten, there are now low or no flow through the barrages in most summers and a shift in the timing and duration of flood events (Brandis *et al.* 2009). These changes in flow present a significant risk to waterbirds throughout the Coorong and Lakes Alexandrina and Albert Ramsar site through long-term loss of breeding habitat.

Because waterbirds are highly mobile and capable of responding to flood events on Murray-Darling Basin wide or continent wide basis, the consequences of reduced breeding success in the Coorong and Lower Lakes can only really be assessed in the context of the breeding success within Australia. Results of long-term monitoring show that waterbird communities have declined over the last 25 years across eastern Australia to less than 13% of numbers recorded in 1984 (Brandis *et al.* 2009). Declines in reproductive success are a critical component of these drops in population.

2.7 Waterbird Water Quality Tolerance

Both abiotic factors and biotic processes control the dynamics of wetlands as natural systems. A specific lake provides an abiotic framework made up of all its physical and chemical characteristics (e.g. lake morphology, sediment characteristics, nutrient concentrations, light availability, oxygen concentration, pH and temperature). The organisms able to survive and reproduce within this abiotic framework affect each other through biotic interactions such as predation and competition for resources. Anthropogenic induced disturbances such as salinisation, eutrophication and acidification may drastically alter the lakes abiotic environment. In consequence, the niche of organisms may fall outside that framework and they will become extinct from that specific system.

Changes to the Coorong and Lower Lakes Ramsar site arising as a consequence of the historically low flows may have strong effects on the biodiversity of the system or its elements. The potential impacts on waterbirds of changes in salinity, algal blooms and acidification are discussed below.

2.7.1 The Role of Wetland Salinity in Water Bird Habitat Use

The role of wetland salinity in waterbird habitat use is complex, being determined by interplay between each bird species physiological and behavioural responses at one level, and saline induced changes to the community and environment in which they live at a higher level. Ionic concentration of the wetland water affects a range of chemical and physical processes within the water, but also loss of critical microhabitat components or food sources through saline induced community changes, which can impact a species independently of their own salinity tolerance.

Salinity Definition

Salinity can be measured by its Electrical Conductivity (EC), which is expressed in micro Siemens per centimetre (μS/cm), commonly termed "EC Units". Due to the fact that EC varies with temperature, values are "corrected" to the EC at 25°C.

With regards waterbird use of saline water bodies quantitative salinity values or ranges are rarely given within the literature. Consequently, when referring to habitat use within this review only three broad categories of wetland salinity are used (Table 3): freshwater; saline; and hypersaline.

Table 3: Typical salinised water electrical conductivity (EC) measures (µS/cm, based on Suttar 1990).

Water type	Electrical conductivity (µS/cm)	Terminology used in this review (µS/cm)
Deionised water	0.5 - 3	Freshwater
Pure rainwater	< 15	(0 – 4,800)
Freshwater (Potable)	0 – 2,500	
Brackish water	1,600 – 4,800	
Saline water	> 4,800	Saline
Seawater (marine)	51,500	(4,800 – 58,332)
Estuarine	11,667 – 58,332	
Hypermarine	58,332 – 116,665	Hypersaline
Hypersaline	> 116,665	(> 58,332)

Bird Physiological Responses to Increasing Wetland Salinity

The salinity of water that a bird ingests generally changes as they encounter different salinities in their search for food. Animals that feed on marine invertebrates may have very high salt ingestion levels since body fluids of this type of prey are generally isotonic to the surrounding seawater (Hildebrandt 2001).

Osmoregulation in birds is the product of a series of highly integrated and complex interactions among the gut, kidneys, hindgut, salt glands and supporting organs (Hughes 2003). On average bird kidneys are able to concentrate their final kidney urine output up to twice the osmotic concentration of their blood (Hughes 2003). In turn, the hindgut is able to reabsorb water from urine, but cannot excrete salts. Consequently, birds are only able to drink seawater or ingest salty food because of the presence of nasal salt glands, which is able to secret hypersaline solutions. This organ is present in nearly all birds (Technau 1936), but is fully developed only in those species that are potentially or frequently exposed to drinking sea of brackish water (Hildebrandt 2001).

Nasal glands of marine birds are usually fully developed at very early stages of their lives. But, in non-marine birds, it is only with prolonged osmotic stress that quiescent salt glands are activated, resulting in rapid nasal gland growth and ultimately the secretion of hypertonic sodium chloride solution from the nasal glands (Hildebrandt 2001). This high level of physiological plasticity enables waterbirds to adapt to changing saline levels either within wetlands, or as they move among wetlands. Despite detailed knowledge of the process of avian osmoregulation, the environmental salinity tolerance of individual species in the wild is poorly known. The effects of immediate changes in habitat salinity or changes associated with adaptation to different but sustained osmotic changes have received little attention in wild birds (Hughes 2003).

Behavioural adaptations mean that despite these limiting physiological adaptations many waterbirds can continue to forage in wetlands with salinities beyond these limits where they can fly to distant sources of freshwater (Gawlik 2002).

Salinity Induced Changes to Habitat Structure, Complexity and Composition and the Implications for Waterbirds

Salinity is the overriding factor determining the productivity and species composition of plant communities in wetlands, with characteristic communities associated with surface water salinity tolerances (Ganf 2000). Marked changes in salinity thus change the structure, complexity and composition of habitat types associated with a wetland. With the changes to habitat are concomitant changes to the microhabitats, foraging habitat and refuges available to waterbirds. Marked changes in salinity consequently affect which waterbird species can persist within a habitat.

Saltlakes hold a comparatively low diversity of biota compared with freshwater lakes. Fish and frogs are seldom found in saltlakes, and the numbers of macrophyte and invertebrate species is generally low. The vegetation that provides the microhabitat with which most species are associated (trees, shrubs, sedges and rushes) is generally unable to persist in waterbodies with high salinity levels. Within the Lower Lakes the keystone submerged aquatic species *Myriophyllum*, to thrive and recruit, require soil fully inundated with freshwater (< 5000 EC) (Jason Nicol SARDI, *Pers. Comm.* 18/09/2009). Recent high salinity levels in the Goolwa Channel region have removed this species and the associated food web from the region. The loss of *Ruppia tuberosa* from the Coorong Southern Lagoon due to extreme hypersaline conditions (Rogers and Paton 2009) has removed a complex of trophic sources for many waterbirds and changed the waterbird species makeup.

Despite differences in fauna diversity and habitat complexity between salt and freshwater lakes, this does not translate into lower productivity in saline lakes. Saline lakes can be highly productive environments.

Increasing salinity does not necessarily cause a decline in water bird abundance but may result in a decline in waterbird species diversity, especially in hypersaline environments. Salinity differences between wetlands can favour some waterbird species over others, resulting in changes to species composition. Differences in waterbird diversity between salt lakes and adjacent freshwater lakes may be marked, with the bird community composition and abundance attributable to food resource rather than the wetland salinity (Kingsford and Porter 1994).

A comparison of two nearby and similarly sized lakes (one saline, one fresh) in se Queensland found the salt lake had more than 10 times the waterbird population (mainly ducks, herbivores, and wading birds) than the freshwater lake (mainly piscivores and large waders), with larger numbers of planktonic invertebrates and more macrophyte vegetation in the salt lake than in the freshwater lake, while the freshwater lake contained fish and shrimp populations (Kingsford and Porter 1994). Within this overall trend, piscivores and large wading birds were on average 290 ± 140 times more abundant on the freshwater lake. The salt lake had lower species diversity than the freshwater lake. Kingsford and Porter (1994) postulated that the lower turbidity in the saline wetland – resulting from the physical effect of salinity on clay particles – allowed greater light penetration, resulting in higher primary productivity and in turn higher invertebrate abundances to support the larger waterbird populations.

A meta-study in Western Australia found wetland salinity was an important determinant of waterbird use (Halse et al. 1993). Halse *et al.* (1993) found more positive associations for waterbirds with brackish than with fresh or saline wetlands and few waterbird species occurred in hypersaline wetlands. Of the 61 waterbird species recorded in the study, only the Hooded Plover showed a significant positive association with hypersaline conditions, but many species were associated with brackish or saline, rather than fresh, wetlands. In contrast to the findings of Kingsford and Porter (1994), Halse *et al.* found that the wetlands that supported the highest number of species also supported the highest number of waterbirds and the most breeding species. Typical wetlands in this group were moderately large, brackish and permanent, and contained fringing trees or shrubs. They were characteristically alkaline in September, with moderately high (0.36 ± 0.09 mg L^{-1}) phosphorus levels.

Very high salinity levels have been shown to decrease food availability and diversity for waterbirds in the Coorong (Rolston and Dittman 2009). Experimental translocations of macroinvertebrate fauna in sediment from areas of high salinity to low salinity, and from areas of high mudflat exposure to low exposure led to an increase in macrobenthic species diversity and abundance (Rolston and Dittman 2009). The converse was true for the reciprocal translocations. Macrobenthic invertebrates were unable to survive in exposed sediment for one week without inundation.

2.7.2 Acidity and Low pH

As a consequence of long-term inundation due to regulation in the River Murray and the Lower Lakes there has been significant accumulation of sulfidic material in sub-aqueous and margin soils – referred to as acid sulfate soils – of Lakes Alexandrina and Albert, and the Goolwa channel. If left undisturbed and covered with water, sulfidic material poses little or no threat (Fitzpatrick *et al.* 2009). However, when sulfuric material is exposed to the air, the sulfides react with oxygen to form sulfuric acid. Across the two lakes, if water levels drop to -1.5 m AHD, approximately 32,000 ha of acid sulfate soils would be exposed (Fitzpatrick *et al.* 2008).

Acid sulfate soils are those soils containing iron sulfide minerals (Fitzpatrick *et al.* 2009). These soils may either contain sulfuric acid (sulfuric material), or have the potential to form sulfuric acid (sulfidic material), or cause de-oxygenation (monosulfidic material), or release contaminants when the sulfide materials are exposed to oxygen in the air. Acid sulfate soils form naturally when sulfate in the water is converted to sulfide by bacteria. These sulfides react with metals, especially iron (Fe), to form sulfidic materials (typically pyrite: FeS_2) in subaqueous acid sulfate soil or sediments in the wetlands. When these sulfuric materials are subsequently covered in water, significant amounts of sulfuric acid can be released.

As a consequence of low inflows into the Lower Lakes large areas of acid sulfate soils have been exposed across the lakebeds. Subsequent rainfall and flow to these exposed sediments will release sulfuric acid, if the buffering capacity of the water is overcome, the pH will lower, and toxic quantities of iron, aluminium and other metals may be released into the water column.

In the field it is difficult to interpret data on acid stress for wildlife as any population decline may be caused by the concentration of hydrogen ions (i.e. pH), or by some associated factors such as lack of chemical nutrients, or the presence of toxic heavy metal ions.

If water within the lower lakes acidifies there are significant implications for waterbirds. Birds exposed to low pH water bodies will be affected both through direct exposure, with the potential for significant injury or death of the bird, and through loss of significant food web components upon which they rely.

Bird Physiological Responses to Decreasing Wetland pH

Minimal literature exists on the physiological effects of acid solutions on bird life. The following discussion draws generalisations with regards to birds based on known impacts on humans and other animals, principally laboratory species.

When determining the potential effect of an acid solution, the severity is directly related to the acid type, its concentration, pH and contact time. Acids with higher concentrations, also having lower pH values, are regarded as more corrosive irritants (Plumlee 2004).

Birds landing on an acidified waterbody will initially be exposed to the acid on their skin and feathers for which it is corrosive, an irritant, and a permeator, and via exposed mucus membranes such as the eyes, and through inhalation into the lungs. Corrosive effects are described as a coagulation-type necrosis, which can cause destruction of surface epithelium and submucosa (Plumlee 2004). Where the birds interact with strong acids exposure is usually brief, as it incurs immediate pain.

Eye contact with acid causes corneal ulceration, intense pain and blepharospasm (spasmodic winking caused by the involuntary contraction of an eyelid muscle). Even diluted sulfuric acid can irritate the skin and mucous membranes and cause irreparable damage to the cornea, resulting in blindness (Dowsett 1998). In strongly acidic solutions brief exposure can cause rapid blindness. Only with immediate and ongoing flushing of the eye with water can further damage be minimised. Blinded birds can be expected to die on, or around, the acidified water body and are generally taken by predators or scavengers.

Inhaling acid mists, vapours, or aerosols can cause severe irritation and corrosive damage to the lungs (CCOHS 1998). The lethal concentration of sulfuric acid aerosols is known to vary for different animal species studied (ScienceLab 2008). For example, the lowest concentration of sulfuric acid vapour known to have resulted in death in rats is 383 mg/m^3, while mice and guinea pigs are considerably more susceptible (ATSDR 1998). In humans the health effects of short-term exposure (< 15 minutes) to sulfuric acid vapour have been described (Table 4).

Table 4: Aerosol, mist and gaseous sulfuric acid exposure levels and associated health impact on humans in acute (< 15 minutes) exposure situations (TDSHS 2005)

Concentration (mg/m^3)	Health Effects
<1.0	No acute effects expected
1.0-2.0	Eye, nose, and throat irritation expected
2.0-5.0	Severe eye, nose, and throat irritation, burning sensation, cough, labored breathing, shortness of breath.
>5.0	Inhalation may result in pulmonary edema. Symptoms may be delayed and may not become apparent until a few hours after exposure. Medical observation is needed.
>15	Immediately dangerous to life and health.

Where a bird lands on acidified water and immerses it head, it may be distressed and injured or blinded by the initial contact. If the bird drinks the water, or starts to preen or feed and ingests the acidified water, then the consequences can be severe. Sulfuric acid may cause nausea and vomiting if ingested, and there may be permanent damage to the digestive tract (Dowsett 1998). Sulfuric acid causes gastrointestinal tract (GI) burns, and may cause perforation of the stomach, GI bleeding, edema of the glottis, necrosis and scarring, and sudden circulatory collapse (similar to acute inhalation) (ScienceLab 2008). It may also cause systemic toxicity with acidosis (ScienceLab 2008).

Low pH within the body has significant biochemical and physiological implications for a bird. Amongst other things it:

- affects the binding of amino acid and the formation of proteins;
- modifies protein structure, particularly the active site of enzymes, which inactivates or slow their function;
- significantly affects the facilitated movement of ions and molecules across membranes; and
- affects the ability of haemoglobin to bind and release oxygen.

Longer-term exposure to sulfuric acid may cause damage to the following organs: kidneys, lungs, heart, cardiovascular system, upper respiratory tract, eyes, teeth (ScienceLab 2008). Long-term chronic effects have been demonstrated in humans and laboratory animals. These include (ScienceLab 2008):

- Mutagenicity: Cytogenetic Analysis: Hamster, ovary = 4mmol/L; and
- Reproductive effects: May cause adverse reproductive effects based on animal data. Developmental abnormalities (musculoskeletal) in rabbits at a dose of 20 mg/m^3 for 7 hrs. (RTECS).

The prognosis for minor exposures to acids is good, as long as intervention is rapid and care can be given to the animal (Plumlee 2004). Bird species vary in their response to acid exposure. Whiskered Terns are known to be highly susceptible, being known to dive into acidified waters, take off and immediately collapse back into the water. Conversely, the Spotless Crake normally occurs in acidic (pH<6), fresh, heavily vegetated swamps in southwest Western Australia (Marchant and Higgins 1993).

In the mining sector across the world resolving the impact of tailing dam acidity on wildlife, and in particular waterbirds, is an ongoing challenge. But, in this field of research, there are virtually no publications available in the scientific literature. Acidity was blamed for 40 verified migrating bird deaths on a tailings dam at the Phelps Dodge Tyronne Copper Mine in New Mexico (http://www.azstarnet.com/sn/preps/33709.php 27 February 2005), and in Montana (1995), 342 migrating Snow Geese were found dead in a flooded pit at a copper mine, again blamed on acidity. (http://www.epa.gov/fedrgstr/EPA-WASTE/2003/August/Day-27/f21866.htm 27 February 2005).

pH Induced Changes to Wetland Communities and the Implications for Waterbirds

When pH in a waterbody reaches values lower than 6, changes in wetland communities are detected (Brönmark and Hansson 2002). At values of 5-6, the algal species diversity and biomass decrease considerably, leading to higher water transparency; a characteristic feature of acidified lakes (Stenson *et al.* 1993).

Some types of plants and animals are able to tolerate acidic waters. Others, however, are acid-sensitive and will be lost as the pH declines, resulting in a concomitant decline in fauna diversity (Brönmark and Hansson 2002). Increasing concentrations of hydrogen ions and metals directly impact on reproduction and survival of both algae and invertebrates (Stenson *et al.* 1993).

Most freshwater fish appear to be indifferent to pH within the range of approximately 10.5 to 5.5, but for maximum productivity the pH value should generally be between 6.5 and 8.5 (Fromm 1980). As water flows through exposed acid soils in a wetland, heavy metals such as aluminium are released from the soil into the waterbody along with the acid. So, as pH in a lake decreases, aluminium levels for example increase. Mobilisation of metals in acidified lakes and increasing exposure to organisms have been shown to be as important as the high hydrogen-ion activity as a factor affecting reproduction and survival among fishes and invertebrates (Stenson *et al.* 1993). Progressively higher acid levels cause a cascade of effects that harm or kill individual fish, reduce fish population numbers, completely eliminate fish species from a waterbody, and decrease biodiversity (Stenson *et al.* 1993). In cases of severe acid stress (below pH = 5.0) fish death due to hypoxia may result due to such factors as the alteration of gill membranes and coagulation of gill mucus (Fromm 1980). Information on more chronic effects of acidity on growth rate and body size is ambiguous, and requires further investigation (Fromm 1980).

Generally, the young of most fish species are more sensitive to environmental conditions than adults. The 'no effect' level of pH depression for successful reproduction in fish is around 6.5 (Fromm 1980). Exposure of fish to low pH significantly reduces reproductive success and impacts on development; at pH 5, most fish eggs cannot hatch (Fromm 1980).

The plants and animals living within an ecosystem are highly interdependent. Not all animal groups can tolerate the same amount of acid and consequently even though a species may have a high tolerance to acidity its persistence in a habitat may be limited by other species. Frogs, for example, may tolerate relatively high levels of acidity, but if they eat insects like the mayfly, which have a low tolerance to acidity, they may be affected as pH falls because part of their food supply may disappear.

Because of these connections between the many fish, plants, and other organisms living in an aquatic ecosystem, marked changes in pH or heavy metal levels affect biodiversity as well. A direct reduction in biodiversity may have dramatic effects on ecosystem functioning as the numbers and composition of species determine which organismal traits are present and influence ecosystem processes. Experimental studies have shown that plant productivity as well as dynamic variables such as community variability and resilience increase with species richness (Tilman 1999). Thus, as lakes become more acidic, not only do the numbers and types of taxon that live in these waters decrease, but the health of the remaining populations and the community may decline disproportionately.

Acidification of a waterbody impacts on birds at all trophic levels. The combined effect of changes to the ecosystem may be a reduction in the carrying capacity and diversity of waterbird species that are able to persist in the wetland environment. Further, loss of species in higher trophic levels may in turn have strong repercussion down the food chain (Brönmark *et al.* 1997).

2.7.3 pH, Salinity and Waterbird Breeding

Within Australia only one study has been found that assessed the impact of salinity and pH on waterbird breeding. In southwestern Australia a complex of wetlands between Esperance, Albany and Northampton with wide ranging pH and salinity were surveyed for waterbird use (Goodsell 1990). Goodsell (1990) collected an extensive data set that allowed him to correlate waterbird breeding with salinity and pH, on 67 wetlands of the 293 wetland sites surveyed. In the study wetland pH varied between 2.4 and 10.4 and salinities varied from 0.55 to 430.0 g L^{-1}. These data provide some insight into the potential impact of rising salinity and acidification (i.e. lowering pH) on waterbirds and breeding.

Broods (i.e. adults plus young) were recorded for 39 species of waterbirds (608 records). The mean salinity of the 271 waters used by broods was less than that of the 546 waters not used by broods. Of all the records of brood use, 90% were from water with salinities less than 15.3 g L^{-1}. Only the Grey Teal, Australian Shelduck, Black Swan, and Red-necked Avocet were recorded to breed in hypersaline waters. But, of these, only the Red-necked Avocet bred on average in waters with salinities above that of seawater.

Of the 33 species with more than two water quality data points, 9 (Australasian Grebe, Wood Duck, Great Egret, Freckled Duck, Great Cormorant, Rufous Night Heron, Great Crested Grebe, Darter, and Pacific Heron) were never recorded with a brood in waters with a pH < 7, suggesting no tolerance of acidic waters. A further 20 (61%) were never recorded with a brood in waters with a pH > 6, suggesting some tolerance of slightly acidic waters.

Brood use of wetlands decreased at high salinities and increased with pH at low to medium salinities. Of all the records of wetlands used by broods, only 9% occurred in waters with a pH < 7. Where breeding did occur in acidic wetlands (55 records), 80% of the records were in fresh water. The Straw-necked Ibis, Sacred Ibis and Little Bittern were tolerant of slightly acidic waters on average, but only where the waters were fresh. Only the Red-necked Avocet was tolerant of, and able to breed in association with, highly acidic waters. It could tolerate these high acidities in combination with hypersalinity.

Overall very few waterbird species in the study could breed in acidic waters and this intolerance of acidic waters was exacerbated by salinity.

High salinity levels and extremes of pH also jeopardise the success of vegetation, thus pH together with salinity may also influence the success of waterbird broods by affecting the availability of vegetation that provides nesting habitats (Goodsell 1990).

2.7.4 The Impact of Algal Blooms

Algal bloom outbreaks within the Lower Lakes have the potential to impact on waterbirds. They have occurred regularly in Lake Alexandrina in the past. Between 1975 and 1978 the green algae *Planctonema lauterbornii* generally accounted for more than 95% of the algal cells under conditions of low average irradiance in the mixed water column in Lake Alexandrina (Geddes 1984a). During this period Geddes postulated that low light availability, as a consequence of high turbidity, precluded diatoms and blue-green algae. But, blooms of blue-green algae were recorded in 1965-1967 (*Nodularis*, *Gomphosphaeria*, and *Hormidium*) and 1972-1973 (*Anabaena*, *Nodularia*, *Oscillatoria*), during years of low flow and possibly low turbidity. These blooms are not a recent phenomenon as Lake Alexandrina was the site of the first record of a toxic bloom of blue-green algae (*Nodularis spumigena*) recorded in Australia (Francis 1878). Plankton biomass between 1975 and 1978 typically peaked around December, with annual highs of 70, 46.7 and 71.9 mg Chlorophyll *a* m^{-3} (Geddes 1984a).

Low inflows, changes to nutrient levels and warmer water temperatures as a consequence of low lake levels may increase the likelihood of wide spread algal blooms in the Lower Lakes.

Harmful algal bloom (HAB) toxins can change the strength of consumer-prey interactions by altering the foraging behaviour of foraging shorebirds on rocky and sandy shores (Kvitek and Bretz 2005). Kvitek and Bretz (2005) have shown that shorebirds are able to detect and avoid consumption of lethal amounts of paralytic shellfish poisoning toxin (PSPT), and that the movement of HAB toxins through the marine food web can alter upper-level trophic interactions. Changes in the foraging behaviour and diet of five common northern California shorebirds (Black Oystercatchers, godwits, sanderlings, whimbrels, and willets) correlated with the predicted seasonal variation in PSPT concentrations in their two major invertebrate prey species: sea mussels *Mytilus californianus*; and sand crabs *Emerita analoga*. In rocky habitats, when mussel PSPT concentrations exceeded 150 mu g saxitoxin (STX) eq 100 g^{-1}, oystercatchers increased their consumption of smaller, non-PSPT-accumulating prey (limpets, primarily *Lottia* spp.), as well as their discard rate of captured mussel tissue. In sandy habitats, when sand crab PSPT concentrations exceeded 150 to 200 mu g STX eq 100 g^{-1}, shorebird abundance decreased, while their rejection rate of sand crab prey increased.

2.8 Terrestrial Bird Habitat

Energetic and nutrient flux between wetland and terrestrial food webs is important to the productivity and diversity of both aquatic and terrestrial ecosystems.

During and subsequent to a flood the related increase in primary productivity across a floodplain, and in wetlands, is the basis of a complex terrestrially based food web. Inundated overstorey provides foraging, refuge and breeding habitat for terrestrial fauna species. Following water recession the subsequent growth of understorey provides forage for herbivores again contributing significant productivity to the terrestrially based food web. Many species that forage in the region will move to the area for refuge and breeding. Heterogeneity in lowland floodplain macrohabitat has been shown to significantly increase local avian biodiversity (Parkinson 2002).

In addition to the increased productivity of the floodplain and fringing vegetation subsequent to inundation, there is ultimately an additional faunal-mediated transfer of energy and resources from the aquatic environments to the adjacent terrestrial environments, increasing the productivity of those terrestrial environments (Ballinger and Lake 2006). The emergence of adult insects from the water contributes significantly to riparian consumers such as insectivorous birds (Baxter et al. 2005). Densities and diversity of non-aquatic woodland bird species, for example, have been shown to increase significantly with the presence of wetlands in woodlands when compared with equivalent woodland habitat without wetlands (Parkinson et al. 2002, Ballinger and Lake 2006). This exchange may influence ecosystem productivity at the landscape scale (Ballinger and Lake 2006), bringing about breeding activity and population growth across a suite of terrestrial faunal species.

The fauna community associated with a floodplain and riparian zone, and wetlands is therefore complex and diverse, with a large number of species that make use of the area in differing ways and which are reliant upon inundation of the floodplain and wetlands and the presence of healthy floodplain and riparian vegetation as the basis of the community. The ecological impact of reduced floodplain inundation, as a result of river regulation, may have been significantly underestimated (Ballinger and Lake 2006).

At the Coorong and Lakes Alexandrina and Albert Ramsar site changes to the extent and nature of movement of energy and nutrients from the wetlands to the surrounding terrestrial landscape will significantly impact on the productivity of linked terrestrial fauna communities.

3.1 Overview of Species

The Biological Data Base of South Australia (BDBSA) records 307 bird species within 1 km of the Coorong and Lakes Alexandrina and Albert Ramsar site (Appendix A), 108 of which (Table 5) merit a significant conservation rating or are protected under one of the migratory bird agreements with Japan (Japan Australia Migratory Bird Agreement (JAMBA)), China (China Australia Migratory Bird Agreement (CAMBA)), or the Republic of Korea (Republic of Korea Australia Migratory Bird Agreement (RoKAMBA)) and so protected under the EPBC Act. Ten species have a national conservation rating:

- critically endangered (CR): Orange-bellied Parrot;
- endangered (EN): Southern Emu-wren, Osprey, Swift Parrot; and
- vulnerable (VU): Shy Albatross, Grey-headed Albatross, Wandering Albatross, Malleefowl, Red-lored Whistler, and Soft-plumaged Petrel.

Four of these taxa (Shy Albatross, Grey-headed Albatross, Wandering Albatross, and Soft-plumaged Petrel) use predominantly marine pelagic habitat and are seldom seen inshore. The habitat provided by the Coorong and Lower Lakes is unlikely to be of significance to these species and they will not be considered further in this review. The Mallee Fowl, Red-lored Whistler and Swift Parrot are terrestrial species with little or no connectivity with the wetlands in this study. The Orange-bellied Parrot, Southern Emu-Wren and Eastern Osprey all utilize various wetland-based habitat within the study area and are discussed in detail below.

Within South Australia nine species are classified as endangered (7 wetland dependent, 2 terrestrial), 22 as vulnerable (8 wetland dependent, 7 marine pelagic, and 7 terrestrial) and 55 as rare (35 wetland dependent, 20 terrestrial). Migratory bird agreements list 38 species under JAMBA, 40 species under CAMBA and 39 species under RoKAMBA.

Table 5: Bird species of conservation significance recorded within the Coorong and Lakes Alexandrina and Albert Ramsar site (with 1 km buffer) Source: BDBSA 15/01/2009.

FAMILY *Genus species*	Common Name	Conservation Significance[1]	Wetland Dependant[2]
ACANTHIZIDAE			
Hylacola cauta (Calamanthus cautus)	Shy Heathwren (Shy Hylacola)	r	n
Dasyornis broadbenti	Rufous Bristlebird	r	y
ACCIPITRIDAE			
Elanus scriptus	Letter-winged Kite	r	n
Haliaeetus leucogaster	White-bellied Sea-Eagle	e C	y
Pandion cristatus (haliaetus)	Eastern Osprey	EN e	y
ANATIDAE			
Anas rhynchotis	Australasian Shoveler	r	y
Cereopsis novaehollandiae	Cape Barren Goose	r	y
Biziura lobata	Musk Duck	r	y
Oxyura australis	Blue-billed Duck	r	y
Stictonetta naevosa	Freckled Duck	v	y
ANHINGIDAE			

FAMILY *Genus species*	Common Name	Conservation Significance[1]	Wetland Dependant[2]
Anhinga novaehollandiae (melanogaster)	Australasian Darter	r	y
APODIDAE			
Apus pacificus	Fork-tailed Swift	J C	n
ARDEIDAE			
Ardea modesta (alba)	Eastern Great Egret, (White Egret)	J C	y
Ardea ibis	Cattle Egret	r J C	y
Ardea intermedia	Intermediate Egret	r	y
Botaurus poiciloptilus	Australasian Bittern	v	y
Egretta garzetta	Little Egret	r	y
Ixobrychus dubius (minutus)	Australian Little Bittern	e	y
BURHINIDAE			
Burhinus grallarius	Bush Stone-curlew	r	n
CACATUIDAE			
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	v	n
CAMPEPHAGIDAE			
Coracina papuensis	White-bellied Cuckoo-shrike	r	n
CHARADRIIDAE			
Charadrius leschenaultii	Greater Sand Plover	r Ro J C	y
Charadrius mongolus	Lesser Sand Plover	r Ro J C	y
Charadrius veredus	Oriental Plover	Ro	y
Pluvialis fulva	Pacific Golden Plover	r Ro	y
Pluvialis squatarola	Grey Plover	Ro J C	y
Thinornis rubricollis	Hooded Plover	v	y
DICRURIDAE			
Myiagra inquieta	Restless Flycatcher	r	n
DIOMEDEIDAE			
Diomedea cauta	Shy Albatross	VU (ssp) v	m
Diomedea chlororhynchos	Yellow-nosed Albatross	ssp carteri v ssp chlororhynchos v	m
Diomedea chrysostoma	Grey-headed Albatross	VU v	m
Diomedea exulans	Wandering Albatross	VU v	m
Diomedea melanophris ssp *impavida*	Black-browed Albatross	v	m
ESTRILDIDAE			
Stagonopleura bella	Beautiful Firetail	r	n
Stagonopleura guttata	Diamond Firetail	v	n
FALCONIDAE			
Falco hypoleucos	Grey Falcon	r	n
Falco peregrinus	Peregrine Falcon	r	n
HAEMATOPODIDAE			
Haematopus fuliginosus	Sooty Oystercatcher	r	y
Haematopus longirostris	Pied Oystercatcher	r	y
LARIDAE			
Chlidonias leucopterus	White-winged Black Tern	J C	y
Hydroprogne (Sterna) caspia	Caspian Tern	C	y
Larus dominicanus	Kelp Gull	r	y
Stercocarius antarcticus (Catharacta skua) ssp *lonnbergi*	Brown Skua	v	m
Stercorarius parasiticus	Arctic Jaeger, (Arctic Skua)	Ro J	m
Sterna hirundo	Common Tern	r Ro J C	y
Sternula (Sterna) albifrons	Little Tern	e Ro J C	y
Sternula (Sterna) nereis	Fairy Tern	e	y
Thalasseus (Sterna) bergii	Crested Tern	J	y

FAMILY *Genus species*	Common Name	Conservation Significance[1]	Wetland Dependant[2]
MALURIDAE			
Stipiturus malachurus intermedius	Southern Emu-wren (Mt Lofty Ranges ssp)	EN e	y
MEGAPODIIDAE			
Leipoa ocellata	Malleefowl	VU v	n
MELIPHAGIDAE			
Epthianura crocea	Yellow Chat	e	n
Lichenostomus cratitius ssp *occidentalis*	Purple-gaped Honeyeater	r	n
Melithreptus gularis ssp *laetior*	Black-chinned Honeyeater	r	n
Plectorhyncha lanceolata	Striped Honeyeater	r	n
MOTACILLIDAE			
Motacilla flava	Yellow Wagtail	Ro J C	y
MUSCICAPIDAE			
Zoothera lunulata	Bassian Thrush	r Ro J C	n
OTIDIDAE			
Ardeotis australis	Australian Bustard	v	n
PACHYCEPHALIDAE			
Falcunculus frontatus	Crested Shrike-tit	r	n
Pachycephala rufogularis	Red-lored Whistler	VU r	n
PETROICIDAE			
Melanodryas cucullata ssp *cucullata*	Hooded Robin	r	n
Microeca fascinans ssp *fascinans*	Jacky Winter	r	n
Petroica boodang (multicolor) ssp *boodang*	Scarlet Robin	r	n
Petroica phoenicea	Flame Robin	v	n
PHASIANIDAE			
Coturnix ypsilophora	Brown Quail	v	n
PODICIPEDIDAE			
Podiceps cristatus	Great Crested Grebe	r	y
POMATOSTOMIDAE			
Pomatostomus temporalis	Grey-crowned Babbler		n
PROCELLARIIDAE			
Ardenna (Puffinus) carneipes	Fleshy-footed Shearwater	r Ro J	m
Ardenna (Puffinus) tenuirostris	Short-tailed Shearwater	Ro J	m
Macronectes giganteus	Southern Giant-Petrel	v	m
Pterodroma mollis	Soft-plumaged Petrel	VU	m
PSITTACIDAE			
Lathamus discolor	Swift Parrot	EN e	n
Neophema chrysogaster	Orange-bellied Parrot	CR e	y
Neophema chrysostoma	Blue-winged Parrot	v	n
Neophema elegans	Elegant Parrot	r	n
Neophema petrophila	Rock Parrot	r	y
RALLIDAE			
Porzana tabuensis	Spotless Crake	r	y
Lewinia (Rallus) pectoralis	Lewin's Rail	v	y
ROSTRATULIDAE			
Rostratula australis (benghalensis)	Australian Painted Snipe	v C	y
SCOLOPACIDAE			
Actitis hypoleucos	Common Sandpiper	r Ro C	y
Arenaria interpres	Ruddy Turnstone	r Ro J C	y
Calidris acuminata	Sharp-tailed Sandpiper	Ro J C	y
Calidris alba	Sanderling	r Ro J C	y
Calidris canutus	Red Knot	Ro J C	y

FAMILY *Genus species*	Common Name	Conservation Significance[1]	Wetland Dependant[2]
Calidris ferruginea	Curlew Sandpiper	Ro J C	y
Calidris melanotos	Pectoral Sandpiper	r Ro J	y
Calidris minuta	Little Stint	Ro	y
Calidris ruficollis	Red-necked Stint	Ro J C	y
Calidris subminuta	Long-toed Stint	r Ro J C	y
Calidris tenuirostris	Great Knot	r Ro J C	y
Gallinago hardwickii	Latham's Snipe	r Ro J C	y
Limicola falcinellus	Broad-billed Sandpiper	Ro J C	y
Limosa lapponica	Bar-tailed Godwit	r Ro J C	y
Limosa limosa	Black-tailed Godwit	r Ro J C	y
Numenius madagascariensis	Eastern Curlew	v Ro J C	y
Numenius minutus	Little Curlew	Ro J C	y
Numenius phaeopus	Whimbrel	r Ro J C	y
Phalaropus fulicarius (fulicaria)	Grey Phalarope	C	y
Phalaropus lobatus	Red-necked Phalarope	Ro J C	y
Philomachus pugnax	Ruff	r Ro J C	y
Tringa (Heteroscelus) brevipes	Grey-tailed Tattler	r Ro J C	y
Tringa glareola	Wood Sandpiper	r Ro J C	y
Tringa nebularia	Common Greenshank	Ro J C	y
Tringa stagnatilis	Marsh Sandpiper	Ro J C	y
Tringa totanus	Common Redshank	Ro C	y
Xenus cinereus	Terek Sandpiper	r Ro J C	y
STRIGIDAE			
Ninox connivens	Barking Owl	r	n
SYLVIIDAE			
Acrocephalus australis	Australian Reed Warbler, (Clamorous Reed-Warbler)	Ro C	y
Cladorhynchus leucocephalu	Banded Stilt	v	y
THRESKIORNITHIDAE			
Plegadis falcinellus	Glossy Ibis	r C	y
TURNICIDAE			
Turnix varius (varia)	Painted Button-quail	r	n

1. **Environmental Protection and Biodiversity Conservation Act (EPBC) Status** Australian Conservation Status Codes

EX Extinct: there is no reasonable doubt that the last member of the species has died.

EW Extinct in the Wild: known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.

CR Critically Endangered: facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.

EN Endangered: facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

VU Vulnerable: facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

J Japanese Australian Migratory Bird Agreement (JAMBA)

C Chinese Australian Migratory Bird Agreement (CAMBA)

Ro Republic of Korea Australian Migratory Bird Agreement (ROKAMBA)

SA Status South Australian Conservation Status Codes**.** Codes based on the current listing of species under Schedules of the National Parks and Wildlife Act 1972. Schedule 7, 8, and 9. Reviewed 21/02/2008

e Endangered: (Schedule 7) in danger of becoming extinct in the wild.

v Vulnerable: (Schedule 8) at risk from potential or long-term threats, which could cause the species to become endangered in the future.

r Rare: (Schedule 9) low overall frequency of occurrence (may be locally common with a very restricted distribution or may be scattered sparsely over a wider area). Not currently exposed to significant threats, but warrants monitoring and protective measures to prevent reduction of population sizes.

2. **y = wetland dependant, n = no direct wetland dependence, m = marine**

3.2 Wetland Dependent Bird Species' Habitat Requirements

Of the 307 bird species recorded within 1 km of the Coorong and Lakes Alexandrina and Albert Ramsar site, 119 utilise wetland habitats directly. Twenty-three species are predominantly marine and pelagic in habitat use, being unlikely to use habitats within the study site to a significant degree. It is not known to what extent near-shore pelagic species rely on marine productivity associated with River Murray flows. As the study site is probably only of importance as a temporary refuge for these species during extreme weather events, they are not considered any further in this review. The remaining 165 species are predominantly terrestrial in habitat use and unlikely to depend directly on inundated wetland habitat as a principal component of their habitat requirements. These terrestrial species may benefit from wetland productivity, either directly through increased food availability emergent from the wetlands, or indirectly through increased productivity at lower trophic levels in their food web.

For each of the 119 designated wetland dependent species a literature search was carried out to determine known habitat requirements (Appendix B). For each species, habitat use is described in general, and known specific habitat types identified, particularly in relationship to the habitat types available in the Coorong and Lower Lakes. The known diversity of microhabitats used in relation to foraging, roosting and breeding is outlined. Annual, seasonal, and lifetime movement patterns are outlined, where known. Finally, to clarify the foraging needs of each species the diversity of foraging behaviours and known food types are outlined in detail.

Four temporal patterns in wetland dependent species' habitat use are evident:

1. summer non-breeding migrant foraging habitat, for Australian and international migrants;
2. summer or drought refuge habitat for species that use inland ephemeral wetlands for foraging and breeding;
3. perennial habitat for resident species; and
4. ephemeral / seasonal breeding habitat for species that breed in association with flood events and / or with favourable seasonal conditions.

Using foraging microhabitat, foraging behaviour, and principal food sources, five broad guilds were identified:

1. waterbirds which forage in association with the intertidal, wind affected and seiche zone across a range of substrates, all of which are reliant upon a temporal variation in inundation and exposure, or forage along shorelines. Maintenance of the food web upon which these species are reliant depends on water quality and flow regimes. These species are predominantly migratory and Australian waders;
2. piscivores / carnivores that forage in deep or shallow water using a variety of feeding techniques, but reliant upon a diverse and productive ecosystem to maintain their food source;
3. habitat specialists that maintain a strong association with dense fringing and emergent habitat for foraging, refuge and roosting requirements. These species are predominantly from the family Rallidae;

4. herbivores that forage predominantly on vegetation in association with wetland fringes (predominantly wildfowl); and
5. generalists and scavengers that forage on a range of plant and / or invertebrate material in the water column in a wide variety of habitats near to shore or in open water (predominantly wildfowl).

Wetland dependent bird species within the Coorong and Lower Lakes have been assigned to one of these guilds (Table 6).

Table 6: Broad waterbird foraging guilds and associated species

Foraging Guild	Species
1. Waterbirds that forage in shallow water and along the water edge in association with the intertidal, wind affected and seiche zone taking mostly invertebrates	Wood Sandpiper, Sharp-tailed Sandpiper, Curlew Sandpiper, Common Sandpiper, Pectoral Sandpiper, Terek Sandpiper, Broadbilled Sandpiper, Little Stint, Red-necked Stint, Long-toed Stint, Latham's Snipe, Ruff, Wood Sandpiper, Common Greenshank, Marsh Sandpiper, Common Redshank, Double-banded Plover, Great Sand Plover, Lesser Sand Plover, Red-capped Plover, Black-fronted Dotterel, Red-kneed Dotterel, Banded Stilt, Black-winged Stilt, Pied Stilt, Pacific Golden Plover, Grey plover, Red-necked Avocet, Painted Snipe, Hooded Plover, Long-toed Stint, Ruddy Turnstone, Red Knot, Great Knot, Grey-tailed Tattler, Bar-tailed Godwit, Black-tailed Godwit, Eastern Curlew, Little Curlew Whimbrel, Red-necked Phalarope, Grey Phalarope, Glossy Ibis, Oriental Plover, Sooty Oystercatcher, Pied Oystercatcher, Pink-eared Duck, Freckled Duck, Sanderling, Beach Stone Curlew, Australasian Shoveller.
2. Piscivores / carnivores that forage in deep or shallow water	Whiskered Terns, White-winged Black Tern, Australasian Gannet, Australian Pelican, Great Cormorant, Little Pied Cormorant, Little Black Cormorant, Pied Cormorant, Crested Tern, Caspian Tern, Common Tern, Gull-billed Tern, Little Tern, Fairy Tern, Whiskered Tern, White-winged Black Tern, Sooty Tern, White-fronted Tern, White-bellied Sea-eagle, Eastern Osprey, Swamp Harrier, Darter, Great Crested Grebe, Hoary-headed Grebe, Australasian Grebe, Eastern Great Egret, Intermediate Egret, White-necked Heron, Little Egret, White-faced heron, Nankeen Night Heron, Royal Spoonbill, Yellow-billed Spoonbill, Australian White Ibis, Straw-necked Ibis, Musk Duck, Black-faced Cormorant.
3. Habitat specialists that forage in association with fringing and emergent habitat	Eurasian Coot, Dusky Moorhen, Buff-banded Rail, Purple Swamphen, Australian Spotted Crake, Spotless Crake, Baillon's Crake, Lewin's Rail, Australasian Bittern, Little Bittern, Masked Lapwing, Australian Painted Snipe, Latham's Snipe, Australian Reed Warbler, Eurasian Coot, Black-tailed Native-hen, Orange-bellied Parrot, Rock Parrot, Southern Emu-wren, Little Grass-bird, Australian Pratincole.
4. Herbivores	Chestnut Teal, Grey Teal, Hardhead, Cape Barren Goose, Australian Wood Duck, Black Swan, Blue-billed Duck, Pacific Black Duck.
5. Generalists / Scavengers	Australian Shelduck, Silver Gull, Kelp Gull, Pacific Gull.

3.3 Potential waterbird use of habitat types in the Coorong and Lakes Alexandrina and Albert Ramsar site

Recorded habitat use by water dependent bird species (Appendix B) was used to populate a habitat matrix of critical habitats within the Coorong and Lakes Alexandrina and Albert Ramsar site (Appendix C). For ease of interpretation the table was split into the five broad foraging guilds identified in Section 3.2. Within each of four general landscape scale habitat types (lake, lagoon, estuary, and fresh groundwater shallow swamp), the foraging habitats identified above (i.e. deep water (> 30 cm), shallow water (< 30 cm), intratidal / seiche zone, shoreline, and supratidal / flood zone), were divided into subsections based on substrate type present (i.e. emergent / fringing vegetation, mudflats and sandflats, floated and rooted leaved aquatic vegetation, algae, and rocky substrate). This subdivision of foraging habitats resulted in 33 relatively discrete microhabitat categories appropriate to the wide range of waterbird foraging behaviours and specialisations. Finally each species potential use of each microhabitat type was indicated under three water quality scenarios (fresh, saline, or hypersaline). Bird species salinity tolerance was inferred from recorded use of these habitats in the literature (see Appendix B).

The majority of waterbirds are highly plastic in their use of foraging habitat within the Coorong and Lakes Alexandrina and Albert Ramsar site. The diversity of microhabitats in which each of the waterbird species are capable of foraging allows them to accommodate substantive changes to the ecological character of the wetlands, as long as the overall wetland productivity is maintained, and the species are still able to consume the alternative prey. The use of a range of habitat types may also reflect the necessary complementarity of these habitats for species and indicate the need for all of the habitats to support a species.

With hypersalinisation, primary productivity has not declined dramatically in the South Lagoon, but now takes the form of phytoplankton, that feed carbon through the food chain almost exclusively through brine shrimp. The change in bird community within this system has arisen through changes in the food web that aren't necessarily related to primary productivity. From the perspective of pelican breeding, productivity has crashed, through large declines in the abundance of the fish community on which they forage (Rogers and Paton 2008).

The way in which both habitat 'quality' and 'productivity' decline with the ongoing change in salinity are unknown. Thresholds are likely to exist that mean habitat can be lost very quickly with small incremental changes; the ability of birds to accommodate substantive changes will depend on how close to these thresholds a wetland moves. Where wetland productivity is reduced the populations of each bird species can be anticipated to decline proportionately.

Nearly all waterbird species recorded forage within fresh or brackish to saline water, but only a small proportion are recorded using hypersaline water bodies on an uncommon to regular basis. These changes in species composition do not necessarily relate directly to salinity, but may be more associated with changes to the primary productivity and food web structure established by a salinity / water level regime (in the Coorong). There may also be changes to the physical habitats in parallel with but not caused by the salinity regime eg the area around the Murray mouth, which has a marine-estuarine salinity gradient, has a grain size that varies between coarse sands and river alluvia that is depending on flow, which favours certain bird species such as the Whimbrel.

There are a number of specialist marine species (as previously discussed, see Section 3.1, e.g. Sooty Oystercatcher), some that can tolerate only minor increases in salinity (e.g. Australasian Bittern, Whiskered Tern, Yellow-billed Spoonbill), and some that rarely use freshwater swamps (e.g. Red Knot).

Paton *et al.* (2009) were able to identify indicator species in association with specific regions of the Coorong. The Murray estuary was significantly associated with 14 species (Little Pied Cormorant, Black Swan, Pacific Black Duck, Musk Duck, White-faced Heron, Australian White Ibis, Common Greenshank, Curlew Sandpiper, Pied Oystercatcher, Masked Lapwing, Black-winged Stilt, Caspian Tern and Sharp-tailed sandpiper), confirming the distinct species-rich nature of the estuary. The hypersaline region within the Southern Lagoon was best represented by three piscivorous species (Australian Pelican, Fairy Tern, Crested Tern), all of which are known to nest within the region. The Northern Lagoon was significantly associated with seven species (Chestnut Teal, Australian Shelduck, Red-necked Stint, Red-capped Plover, Little Black Cormorant, Pied Cormorant and Great Cormorant). The Red-necked Stint, the most common species recorded in the Coorong, was a significant indicator species for the region immediately north of Parnka Point.

The shift north in distribution and abundance of waterbird communities recorded by Paton *et al.* (2009) and others is attributed to changes in the distribution and abundance of key food resources, such as benthic macroinvertebrates and aquatic vegetation, associated with the hyper-salinisation of the Southern Lagoon. A potential impact of this shift is an increase in flight distance between nesting sites and foraging sites for species that breed on the Coorong and Lower Lakes. It has been shown in a heron species that those birds foraging far from a colony site rear smaller broods than locally foraging birds (Simpson et al. 1987). The best breeding sites for Fairy Tern and Australian Pelican in the South Lagoon (rocky islands), but their primary food source (fish) are now only in the North Lagoon/Estuary. The increased energetic and time costs of movement between forage and breeding grounds could as a consequence impact negatively on the populations of these species.

Waterbird roost requirements within the Coorong and Lakes Alexandrina and Albert Ramsar site (Appendix B) include:

- dense emergent vegetation e.g. reed beds;
- rocks, logs, stumps near shoreline;
- branches of trees and shrubs in fringing vegetation;
- vegetation on islands;
- floating on deep water;
- mudbanks, sandbanks or rocky areas along beaches and on spits;
- saltmarsh, samphire, sedges, lignum or short fringing vegetation such as grass;
- coastal dunes;
- open shoreline; and
- shallow pools.

Of these roost types, the recent and ongoing decline in saltmarsh habitat quality is of greatest significance to the waterbirds.

3.4 Habitat Requirements for Terrestrial Bird Species of Conservation Significance

Of the 167 terrestrial species recorded in association with the perimeter of the Coorong and Lakes Alexandrina and Albert Ramsar site, 32 species merit a significant conservation rating (Table 5). The habitat requirements of these terrestrial species are varied (Table 7) and do not directly involve wetland elements, although the wetlands will contribute to resource requirements including prey, forage, shelter and nesting material for a number of the species.

Table 7: Habitat requirements of terrestrial bird species of conservation significance recorded within one kilometre of the Coorong and Lakes Alexandrina and Albert Ramsar site boundary

Scientific name	Common Name	Relevant Habitat Requirements
Apus pacificus	Fork-tailed Swift	Low to very high airspace over almost any habitat (Morcombe 2003). Non-breeding summer migrant, which seldom lands in Australia (Frith 1979).
Ardeotis australis	Australian Bustard	Grasslands, especially tussock grasses like speargrass, arid scrub with saltbush and bluebush, open dry woodlands of mulga, mallee and heath. Extreme southern end of distribution (Morcombe 2003).
Burhinus grallarius	Bush Stone-Curlew	Inhabits woodlands with a grassy understorey. There are no records outside of reserves in the South Australian Murray Darling Basin (Kahrimanis et al. 2001)
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	Diverse range of habitats used: Eucalypt forests, woodlands and rainforests in coastal, inland and alpine areas. Feed largely on seeds of native trees and shrubs, pine plantations are also worked for pine seeds and wood boring insects (Morcombe 2003).
Coracina papuensis	White-bellied Cuckoo-shrike	Eucalypt forests and woodlands, also mangroves and river side tree belts (Morcombe 2003). Extreme south western edge of distribution.
Corcorax melanorhamphos	White-winged Chough	Eucalypt woodlands and the drier, more open forests where there is abundant litter across relatively open ground (Morcombe 2003).
Coturnix ypsilophora	Brown Quail	The population in SA is at one end of an Australian coastal distribution. Prefers damp rank vegetation along margins of creeks and swamps in grasslands, crops, heaths, grassy and spinifex woodlands. (Morcombe 2003). Has suffered loss of habitat due to drainage and clearance.
Elanus scriptus	Letter-winged Kite	Highly disperse with some individuals moving into this habitat in productive years in inland regions.
Epthianura crocea	Yellow Chat	Southern end of range enters extreme NW corner of SA. Usual habitat not found in southern 2/3rd of SA. Sighting is unusual for this area.
Hylacola cauta (*Calamanthus cautus*)	Shy Heathwren (Shy Hylacola)	Mallee and coastal thickets with dense low cover, or grass tussocks on sandplain (Morcombe 2003).
Falco hypoleucos	Grey Falcon	Usually in lightly timbered country, especially stony plains and lightly timbered acacia scrublands across most of Australia (Morcombe 2003).
Falco peregrinus	Peregrine Falcon	Diverse habitat use across most of Australia.
Falcunculus frontatus	Crested Shrike-tit	Open forests, woodlands, mallee, riverside and watercourse trees, stands of cypress pines, and banksia woodlands (Morcombe 2003).
Lathamus discolor	Swift Parrot	Forests and woodlands with flowering trees (Morcombe 2003). Extreme western edge of autumn / winter migratory range.
Leipoa ocellata	Malleefowl	Favoured habitat is shrublands and low woodlands dominated by mallee, native pine (*Callitris*) woodlands, acacia shrublands, broombush (*Melaleuca uncinata*) vegetation and coastal heathlands. To build mounds, the birds need a sandy substrate with leaf litter (Frith, 1962). Predicted Malleefowl habitat does not lie within the project footprint (Kahrimanis et al. 2001).

Scientific name	Common Name	Relevant Habitat Requirements
Lichenostomus cratitius	Purple-gaped Honeyeater	Mallee open woodlands with shrubby understorey, broombrush, heathlands (Morcombe 2003).
Melanodryas cucullata	Hooded Robin	Drier and arid regions in open woodland of eucalypt, casuarina, pine, mallee, mulga, open banksia heathlands of inland and drier parts of the coast, semi-cleared farmland (Morcombe 2003).
Melithreptus gularis	Black-chinned Honeyeater	Forests, woodland of eucalypts, paperbarks, tree-lined watercourses of arid regions (Morcombe 2003). Ssp *gularis* has an eastern Australian distribution and is probably the subspecies recorded at the proposed pipeline site. Ssp *laetior* is found in northern Australia and unlikely to be present at the site. Southern limit of distribution along east coast just into south eastern SA.
Microeca fascinans	Jacky Winter	Open woodlands, mallee, mulga, cleared land with trees and stumps across most of Australia (Morcombe 2003). Ssp *fascinans* east and southern coast of Australia to Yorke peninsula, where grades into ssp *barcoo*.
Myiagra inquieta	Restless Flycatcher	Open forests, woodlands, and farmlands (Morcombe 2003)..
Neophema chrysostoma	Blue-winged Parrot	Forests and alpine to grasslands, mulga, saltbush, and coastal dunes (Morcombe 2003).
Neophema elegans	Elegant Parrot	Woodlands, lightly timbered grasslands, partly cleared farmlands, margins of clearings in heavy forests, tree-lined water courses, mallee, mulga (Morcombe 2003).
Ninox connivens	Barking Owl	Open country with stands of trees, tree-lined watercourses (Morcombe 2003). Study area is to the west of likely range.
Pachycephala rufogularis	Red-lored Whistler	Dense low broombush or mallee heath, native pine and stringybark-banksia heath with groundcover of shrubs and spinifex (Morcombe 2003). Present range in Southern Australia: Ninety-Mile Desert, Billiatt Conservation Park (CP), Danggali CP, Bookmark Biosphere Reserve, along Murray R. and northern Eyre Peninsula. Breed where mallee eucalypts, 5-8 m tall, form an open canopy over a moderately dense and diverse but patchy shrub layer (Woinarski, 1987, Mathew et al., 1996). Birds dispersing in the non- breeding season can occupy a variety of other woodland habitats (Hackett and Hackett, 1986). Study site is to the south and west of likely range and predicted habitat (Kahrimanis et al. 2001).
Petroica multicolor	Scarlet Robin	Forests and woodlands. Heavier vegetation when breeding, more open and cleared in autumn and winter (Morcombe 2003). Ssp *cambelli* occurs west of the Eyre Peninsula, ssp *boobang* has a SE distribution and is likely the ssp present at the site.
Petroica phoenicea	Flame Robin	In summer eucalypt forests and woodland. In winter open woodlands, and farmlands (Morcombe 2003).
Plectorhyncha lanceolata	Striped Honeyeater	Drier open forests, woodlands, mallee, mulga, also heathlands and mangroves (Morcombe 2003). Found along River Murray corridor with *Eucalyptus largiflorins* to Murray Bridge, and in mallee. Requires areas of habitat greater than 200 ha for one pair (Kahrimanis et al. 2001).
Pomatostomus temporalis	Grey Crowned Babbler	Open forests, woodlands, with grassy groundcover and sparse shrubbery (Morcombe 2003).
Stagonopleura bella	Beautiful Firetail	Damp or swampy grassy spots in gullies, low-lying flats, woodland with dense, low undergrowth, dense thickets along creeks and rivers, and coastal heaths. Need water nearby (Morcombe 2003).

Scientific name	Common Name	Relevant Habitat Requirements
Stagonopleura guttata	Diamond Firetail	Localities with grassy groundcover underneath open forests, woodland, mallee, acacia scrublands and timber belts along water courses and roadside cover (Morcombe 2003). This species has declined over most of its historical range across south eastern and eastern Australia in both extent and density and is considered to be near-threatened nationally (Garnett and Crowley 2000). In South Australia, a significant reduction in distribution was recorded between 1974-1975 and 1984-1985 (Paton et al. 1994). This decline has continued and Diamond Firetails are now rarely reported in the western, central and southern Mount Lofty Ranges (Paton et al. 2004). Declines have also been recorded in the Strathalbyn area on the eastern side of the ranges (Eckert 2000).
Turnix varia	Painted Button-quail	Open forests and woodlands including banksia woodland and mallee. Prefers stony ridges, abundant leaf litter but sparse grasses (Morcombe 2003).
Zoothera lunulata	Bassian Thrush	Eucalypt forests and woodlands with dense canopy and thick litter layer (Morcombe 2003).

3.5 Population Dynamics Within the Coorong and Lakes Alexandrina and Albert Ramsar Site

Since 1985, on an irregular basis, and since 2000, on an annual basis, there has been a relatively systematic attempt to survey the abundance and diversity of waterbirds across four key regions (Lake Alexandrina, Lake Albert, the Coorong Lagoons, and the Estuary) of the Ramsar site (Appendix D).

These data must be interpreted with caution. Measuring waterbird abundance is fraught with challenges as their populations undergo large inter-annual fluctuations, which become more marked on large spatial scales. Factors such as severe weather, rainfall patterns, disturbance, hunting pressure, and changes in food supply can markedly influence the movement of birds and their abundance. The Coorong and Lakes Alexandrina and Albert Ramsar site is a dynamic system, subject to extreme fluctuations in both waterbird species richness and abundance, as a consequence of spatial and temporal variation in rainfall, inflow and surface water at the local, regional and national scale. Many elements of the wetland complex are essentially seasonal in nature. Such changes impact on the habitat available to water bird species and which of them are able to forage or breed. The migratory shorebird community is also subject to a variety of factors outside of Australia that impact on survivorship.

The sensitivity of waterbirds birds to hydrological change in the short-term is unclear. High mobility allows birds to exploit resources from both local and distant waterbodies. The presence or absence of birds within a given wetland may, therefore, depend upon conditions hundreds of kilometres away, rather than the condition of the wetland under consideration, this is further confounded by the high level of behavioural complexity that allows them to change responses to changing hydrological conditions (Reid and Brooks 2000). It is unlikely that birds will be useful indicators of short-term changes in wetland ecosystems in response to hydrological management, but they may prove to be valuable indicators of wetland ecosystem changes over longer periods.

To determine when a significant change to ecological character takes place, within this context, it is necessary to systematically collect and rigorously analyse data to determine if they have significantly departed from established objective thresholds.

Bird abundance and diversity can be expected to vary markedly at the study site, as the highly mobile species using the wetlands immigrate and emigrate on a daily, irregular, seasonal and annual basis. The population size of a species will fluctuate under natural variation in environmental conditions across Australia, from one season to the next. So that these normal fluctuations are not misinterpreted as significant declines or increases in a population it is necessary to account for the way in which a population is likely to change naturally. Known natural fluctuation should be understood before single annual survey events can be interpreted with a known level of confidence. This is particularly true for less abundant species. We need to understand ecological acceptable thresholds for change from a population dynamics perspective for a particular bird species, and we need to better understand these populations / systems to know what these thresholds are. Data collection to support the development of conceptual models needs to be undertaken. Because of the extremely high mobility that many waterbird species are capable of, this is not simply limited to determining populations within the region, but must include an understanding of what is happening to populations of each species nationally and, where appropriate, internationally.

With the above cautionary note, total wader numbers in the Coorong have been highly variable over the last 27 years. Startling from an estimated high of 234,543 in 1982 to a low in 2001 of 48,000 (20.5%), with a subsequent upturn in 2002 to 103,000 and variation in numbers around these levels for three years before returning to a moderately high level, 167,872 in 2006. A record low count in 2007 of 38,056 birds was followed by a return to 1982 levels in 2008 with a population estimate of 287,313. These numbers mask a change in the number of species using the site and a shift in the relative proportion of each species population present. Importantly, Banded Stilts and Red-necked Avocets combined contributed 261,424 birds to the total in 2008. Essentially the number of migrant waders has been at record lows since 2007, with counts of 28,785 in 2007 and 25,889 in 2008 (Wainwright and Christie 2008).

Absolute waterbird counts for Lake Alexandrina and Lake Albert are only available for the last seven years. Results from Lake Alexandrina confirm that the overall numbers of birds observed were generally higher than for other regions in the Coorong and Lower Lakes up until 2007, but since then there has been a pronounced reduction in overall bird numbers (Letch 2009b). At Lake Albert the number of waterbirds was generally lower than for other regions in the Coorong and Lower Lakes Survey. Again the number of birds observed has declined markedly since 2007 (Letch 2009a). As with Lake Alexandrina the principle driver of this overall decline in numbers was the marked drop in the Eurasian Coot *Fulica atra* population. At both of the Lower Lakes most species show strong spatial heterogeneity in distribution, but a marked shift in preferred sites between years is evident (Letch 2009b, a).

Detailed discussion on shifts in spatial patterns and changes in populations of specific species are available for the Coorong estuary (Letch 2009c), Lake Alexandrina (Letch 2009b) and Lake Albert (Letch 2009a). Without data on a range of potential causative factors that may vary spatially and temporally no valid comments can be made on species specific factors potentially driving these changes in habitat use. The evaluation of faunal resource preference and use is a complex component of modern ecological research requiring specifically designed protocols (Johnson 1980).

Available data were used to classify each of the species recorded within the study site into one of seven estimates of apparent trends in population in the medium term (approximately 24 years; Table 8):

- Decline: where the recent trend shows a decline in abundance in the order of a factor of 10 or greater, and there is no evidence of such a decline in population having occurred previously;
- Increase: where the recent trend shows an increase in abundance in the order of a factor of 10 or greater, and there is no evidence of this increase in population having occurred previously;
- Stable: Minor variations in abundance apparent, but around a long-term central value;
- Variable: changes in abundance, often cyclical, are evident over an extended period;
- Uncommon: Only low counts (usually less than 50) ever recorded;
- Rare / not recorded: counts of less than five recorded on an irregular basis, or species never recorded in a survey; and
- No data: Typically applied to highly cryptic species for, example members of the Rallidae family, where general surveys are unlikely to detect their presence, or data is not available, or yet to be obtained for that species.

A large number of waterbird species previously recorded within the study site were only rarely or never observed during the surveys (Table 8: Coorong lagoons 48, Murray estuary 44, Lake Alexandrina 50, and Lake Albert 65). These species are typically relatively easy to observe if they are present in the study site. Consequently, they can be excluded from any further consideration, with regards impact by future management scenarios.

In the Coorong lagoons (13) and estuaries (10) a small number of species have shown relatively stable populations in the medium term, but in the Lower Lakes very few species have maintained stable populations (Alexandrina 4, Albert 1). There is only a relatively small number of species that are uncommon in the study area (Table 8: Coorong lagoons 11, Murray estuary 4, Lake Alexandrina 5, and Lake Albert 1).

Species showing a variable pattern in abundance were a relatively large and important component of the study area (Table 8: Coorong lagoons 11, Murray estuary 25, Lake Alexandrina 6, and Lake Albert 10). More intensive and well designed monitoring programs would be required to determine the factors that drive these populations in the medium term. These programs need to be based on a better understanding on how the system operates, and the birds interact with the system.

Of importance is the large number of species that have shown a marked decline (Table 8), with Lakes Alexandrina and Albert having markedly more species in decline than observed at either the Coorong lagoons or the Murray estuary. Conversely only a limited number of species were showing a medium-term and marked increase in numbers (Table 8), with three species at the Coorong lagoons, six at the Murray estuary, and six at Lake Albert. No species showed such a trend at Lake Alexandrina. Such relatively large changes in abundance for so many species across all four of the major wetlands in the study site indicate a significant change to the ecological character of these wetlands. Of major concern is the relatively large number of species in the Lower Lakes for which a marked decline in abundance over the short to medium term is apparent.

Table 8: Apparent population trends based on survey data review (Appendix D) for the Coorong north and south lagoons, the Coorong estuary, Lake Alexandrina and Lake Albert

Apparent Population Trends	Coorong (north and south lagoons)	Murray Estuary	Lake Alexandrina	Lake Albert
Decline	Eastern Great Egret Sharp-tailed Sandpiper Curlew Sandpiper Red-necked Stint Red-capped Plover Black Swan Australian Pelican Little Black Cormorant Hoary-headed Grebe Red-necked Avocet Fairy Tern **Count: 11**	Australasian Shoveler Hardhead Whiskered Tern Black Swan Red-kneed Dotterel Eurasian Coot Pink-eared Duck Little Black Cormorant Glossy Ibis Great Crested Grebe Hoary-headed Grebe Red-necked Avocet Caspian Tern **Count: 13**	Chestnut Teal Grey Teal Australasian Shoveler Pacific Black Duck Darter Hardhead Sharp-tailed Sandpiper Curlew Sandpiper Cape Barren Goose Australian Wood Duck Whiskered Tern Banded Stilt Black Swan Red-kneed Dotterel Eurasian Coot Black-winged Stilt Pink-eared Duck Australian Pelican Great Cormorant Black-faced Cormorant Little Pied Cormorant Little Black Cormorant Pied Cormorant Glossy Ibis Great Crested Grebe Hoary-headed Grebe Purple Swamphen Red-necked Avocet Crested Tern Caspian Tern Freckled Duck Australian Shelduck Australian White Ibis Straw-necked Ibis Common Greenshank Masked Lapwing Banded Lapwing **Count: 37**	Chestnut Teal Australasian Shoveler Pacific Black Duck Eastern Great Egret Hardhead Whiskered Tern Black Swan Eurasian Coot Silver Gull Pink-eared Duck Great Cormorant Little Pied Cormorant Great Crested Grebe Hoary-headed Grebe Purple Swamphen Crested Tern Caspian Tern Freckled Duck Australian White Ibis Straw-necked Ibis **Count: 20**
Increase	Chestnut Teal Banded Stilt Bar-tailed Godwit **Count: 3**	Red-capped Plover White-faced Heron Black-winged Stilt Royal Spoonbill Common Greenshank Marsh Sandpiper **Count: 6**	**Count: 0**	Sharp-tailed Sandpiper Curlew Sandpiper Red-necked Stint Red-capped Plover Yellow-billed Spoonbill Royal Spoonbill **Count: 6**

Apparent Population Trends	Coorong (north and south lagoons)	Murray Estuary	Lake Alexandrina	Lake Albert
Stable	Pacific Black Duck Whiskered Tern White-faced Heron Pied Oystercatcher Black-winged Stilt Silver Gull Black-faced Cormorant Pied Cormorant Crested Tern Australian Shelduck Australian White Ibis Common Greenshank Masked Lapwing **Count: 13**	Pacific Gull Bar-tailed Godwit Eastern Curlew Pied Cormorant Pacific Golden Plover Crested Tern Australian Shelduck Australian White Ibis Straw-necked Ibis Masked Lapwing **Count: 10**	Red-capped Plover Silver Gull Yellow-billed Spoonbill Royal Spoonbill **Count: 4**	Australian Shelduck **Count: 1**
Variable	Grey Teal Australasian Shoveler Musk Duck Cape Barren Goose Black-tailed Godwit Pink-eared Duck Australasian Gannet Great Cormorant Little Pied Cormorant Royal Spoonbill Pacific Golden Plover Great Crested Grebe Caspian Tern Straw-necked Ibis Marsh Sandpiper **Count: 15**	Chestnut Teal Grey Teal Pacific Black Duck Darter Eastern Great Egret Musk Duck Sharp-tailed Sandpiper Sanderling Curlew Sandpiper Red-necked Stint Cape Barren Goose Lesser Sand Plover Banded Stilt Little Egret Black-tailed Native-hen Sooty Oystercatcher Pied Oystercatcher Silver Gull Black-tailed Godwit Australian Pelican Great Cormorant Black-faced Cormorant Little Pied Cormorant Fairy Tern Australasian Grebe **Count: 25**	Eastern Great Egret Cattle Egret Red-necked Stint White-faced Heron Black-tailed Native-hen Marsh Sandpiper **Count: 6**	Grey Teal Banded Stilt Red-kneed Dotterel Black-winged Stilt Australian Pelican Little Black Cormorant Pied Cormorant Red-necked Avocet Marsh Sandpiper Masked Lapwing **Count: 10**
Uncommon	Hardhead Great Knot Black-fronted Dotterel Red-kneed Dotterel Eurasian Coot Black-tailed Native-hen Sooty Oystercatcher Orange-bellied Parrot Eastern Curlew Grey Plover Hooded Plover **Count: 11**	Orange-bellied Parrot Yellow-billed Spoonbill Gull-billed Tern Freckled Duck **Count: 4**	Black-fronted Dotterel Black-tailed Godwit Orange-bellied Parrot Gull-billed Tern Australasian Grebe **Count: 5**	Common Greenshank **Count: 1**

Apparent Population Trends	Coorong (north and south lagoons)	Murray Estuary	Lake Alexandrina	Lake Albert
Rare / not recorded	Common Sandpiper Darter Cattle Egret Intermediate Egret White-necked Heron Ruddy Turnstone Red Knot Pectoral Sandpiper Little Stint Long-toed Stint Greater Sand Plover Lesser Sand Plover Oriental Plover Australian Wood Duck White-winged Black Tern Little Egret Beach Stone-curlew Dusky Moorhen Oriental Pratincole Grey-tailed Tattler Kelp Gull Pacific Gull Broad-billed Sandpiper Yellow Wagtail Little Curlew Whimbrel Nankeen Night Heron Blue-billed Duck Grey Phalarope Red-necked Phalarope Ruff Yellow-billed Spoonbill Glossy Ibis Purple Swamphen Little Tern Sooty Tern Common Tern Gull-billed Tern Arctic Tern White-fronted Tern Freckled Duck Australian Pratincole Australasian Grebe Lesser Yellowlegs Wood Sandpiper Common Redshank Banded Lapwing Terek Sandpiper **Count: 48**	Common Sandpiper Cattle Egret Intermediate Egret White-necked Heron Ruddy Turnstone Red Knot Pectoral Sandpiper Little Stint Long-toed Stint Great Knot Greater Sand Plover Oriental Plover Australian Wood Duck White-winged Black Tern Black-fronted Dotterel Beach Stone-curlew Dusky Moorhen Oriental Pratincole Grey-tailed Tattler Kelp Gull Broad-billed Sandpiper Australasian Gannet Yellow Wagtail Little Curlew Whimbrel Nankeen Night Heron Blue-billed Duck Grey Phalarope Red-necked Phalarope Ruff Grey Plover Purple Swamphen Little Tern Sooty Tern Common Tern Arctic Tern White-fronted Tern Australian Pratincole Hooded Plover Lesser Yellowlegs Wood Sandpiper Common Redshank Banded Lapwing Terek Sandpiper **Count: 44**	Common Sandpiper Intermediate Egret White-necked Heron Ruddy Turnstone Musk Duck Sanderling Red Knot Pectoral Sandpiper Little Stint Long-toed Stint Great Knot Greater Sand Plover Lesser Sand Plover Oriental Plover White-winged Black Tern Little Egret Beach Stone-curlew Dusky Moorhen Oriental Pratincole Sooty Oystercatcher Pied Oystercatcher Grey-tailed Tattler Kelp Gull Pacific Gull Broad-billed Sandpiper Bar-tailed Godwit Australasian Gannet Yellow Wagtail Eastern Curlew Little Curlew Whimbrel Nankeen Night Heron Blue-billed Duck Grey Phalarope Red-necked Phalarope Ruff Pacific Golden Plover Grey Plover Little Tern Sooty Tern Common Tern Fairy Tern Arctic Tern White-fronted Tern Australian Pratincole Hooded Plover Lesser Yellowlegs Wood Sandpiper Common Redshank Terek Sandpiper **Count: 50**	Common Sandpiper Darter Cattle Egret Intermediate Egret White-necked Heron Ruddy Turnstone Musk Duck Sanderling Red Knot Pectoral Sandpiper Little Stint Long-toed Stint Great Knot Cape Barren Goose Greater Sand Plover Lesser Sand Plover Oriental Plover Australian Wood Duck White-winged Black Tern Little Egret White-faced Heron Black-fronted Dotterel Beach Stone-curlew Pin-tailed Snip Dusky Moorhen Black-tailed Native-hen Oriental Pratincole Sooty Oystercatcher Pied Oystercatcher Grey-tailed Tattler Kelp Gull Pacific Gull Broad-billed Sandpiper Bar-tailed Godwit Black-tailed Godwit Australasian Gannet Yellow Wagtail Orange-bellied Parrot Eastern Curlew Little Curlew Whimbrel Nankeen Night Heron Blue-billed Duck Black-faced Cormorant Grey Phalarope Red-necked Phalarope Ruff Glossy Ibis Pacific Golden Plover Grey Plover Little Tern Sooty Tern Common Tern Fairy Tern Gull-billed Tern Arctic Tern White-fronted Tern Australian Pratincole Australasian Grebe Hooded Plover Lesser Yellowlegs Wood Sandpiper Common Redshank Banded Lapwing Terek Sandpiper **Count: 65**

Apparent Population Trends	Coorong (north and south lagoons)	Murray Estuary	Lake Alexandrina	Lake Albert
No data	Australian Reed Warbler, Australasian Bittern Swamp Harrier Latham's Snipe Pin-tailed Snip Buff-banded Rail White-bellied Sea-Eagle Little Bittern Little Grassbird Rock Parrot Osprey Australian Spotted Crake Baillon's Crake Spotless Crake Lewin's Rail Painted Snipe **Count: 16**	Australian Reed Warbler, Australasian Bittern Swamp Harrier Latham's Snipe Pin-tailed Snip Buff-banded Rail White-bellied Sea-Eagle Little Bittern Little Grassbird Rock Parrot Osprey Australian Spotted Crake Baillon's Crake Spotless Crake Lewin's Rail Painted Snipe **Count: 16**	Australian Reed Warbler, Australasian Bittern Swamp Harrier Latham's Snipe Pin-tailed Snip Buff-banded Rail White-bellied Sea-Eagle Little Bittern Little Grassbird Rock Parrot Osprey Australian Spotted Crake Baillon's Crake Spotless Crake Lewin's Rail Painted Snipe **Count: 16**	Australian Reed Warbler, Australasian Bittern Swamp Harrier Latham's Snipe Buff-banded Rail White-bellied Sea-Eagle Little Bittern Little Grassbird Rock Parrot Osprey Australian Spotted Crake Baillon's Crake Spotless Crake Lewin's Rail Painted Snipe **Count: 15**

Analysis of the waterbird community abundance data within the Coorong during the period 2000-2007 showed a strong geographic gradient, with the structure of the waterbird community changing consistently from the north to south (Gosbell and Grear 2005, Paton et al. 2009). Paton *et al.* (2009) found variation in community structure between three distinct bird clusters (southern lagoon and southern end of the northern lagoon, the northern lagoon, and the estuary) is greater than variation in community structure between years within these regions. This analysis contrasts with a longer-term comparison (1985 c.f. 2000-2007), which showed that a high spatial diversity for waterbirds within the South Lagoon in 1985 was no longer present, and significantly distinct from, the diversity present in the period 2000-2007.

Recent wader monitoring on the Eyre Peninsula, (where local site-based environmental impacts to waders are minor in comparison with the Coorong), has shown comparatively minor decreases in wader populations, relative to those seen on the Coorong (Paul Wainwright DEH, Pers. Comm. 01/07/2009). But, population trends in the Gulf Saint Vincent, Victoria and Tasmania show a similar decline for most species (Ken Gosbell, AWSG, Pers. Comm. 10/09/2009). This suggests the relatively large declines in migratory wader populations observed at the Coorong may be due to significant changes in biological productivity and food sources at the Coorong, as well as declines in fly-way populations to Australia.

A National and International Perspective

Worldwide, shorebird populations have undergone considerable declines (CHASM 2004). Internationally of the 237 shorebird populations for which trend data are available, 52% are in decline and only 8% are increasing (Wetlands International 2006). Declines in migratory populations can at least be partially attributed to developments destroying staging sites along their flyways to and from Australia (Rogers et al. 2006).

Across the eastern 1/3rd of Australia long-term surveys (1983-2006) indicate that migratory shorebirds have declined by 73%, and Australian resident shorebirds by 81% (Nebel et al. 2008). Loss of wetlands due to river regulation was identified as a significant contributor to this drastic decline of shorebirds in Australia.

Gosbell and Clemens (2006) found evidence of declines in Bar-tailed Godwits, Curlew Sandpipers, Eastern Curlew and Sharp-tailed Sandpiper across Australia. Of these species there is strong evidence of a marked decline in the Curlew Sandpiper. This species is not a generalist, and for that reason, it is very susceptible to habitat loss or declining habitat quality/food resources.

Terrestrial Species Directly Affected by Change to Ecological Character

For many of the terrestrial species that may benefit from fauna mediated energetic and nutrient production in the wetlands to the terrestrial environment the impact of recent change in ecological character is not easily measured, nor is it easily distinguished from the consequences of the associated drought. But, there is strong evidence that Orange-bellied Parrots and other *Neophema* species have decreased markedly in numbers in association with the hydrological degradation in the Coorong, with Orange-bellied Parrots not recorded in the South Coorong Lagoon since 2005 (Ehmke 2009). Large-scale dieback of the saltmarsh is evident in many places and there is a reduction in the extent that constitutes suitable habitat for Orange-bellied Parrots (Glenn Ehmke Birds Australia Pers. Comm. 24/08/2009).

This report presents a hierarchical classification of bird habitat requirements in the Lower Lakes and Coorong based on the four principal landscape features (Lakes, estuary, lagoon and tributary wetland), the main vegetation types and water regimes in each, and the microhabitats within these zones. At the most detailed level the classification is complex, and reflects the diverse specialised habitat requirements and habitat features available at the site. However, based as it is on detailed and specific observations of the birds and lake habitats, it provides a tool to predict the ecological consequences of change in bird habitat on bird abundance and diversity.

There are virtually no objective, qualitative data on the potential impacts of hypersalinisation or acidification on nearly all of the waterbird species that utilise the site. Our knowledge of waterbird tolerances of hypersaline environments is based on correlative presence / absence data. The complex of physiological, behavioural and ecological factors underlying these observed patterns is not understood. Any attempt to interpret those data obtained through a substantial monitoring effort over the last eight years is confounded by a lack of understanding of factors and threats affecting bird movements and populations on a regional, continental and global scale.

Given the scarcity of data on the wide range of factors and interactions that may influence waterbirds, their high trophic levels in the food web, and their behavioural plasticity, it is not possible to make specific predictions on the impact of ongoing changes for each bird species. The marked changes to the system that have arisen through record low flows have reduced the ecosystems resilience, with many bird species no longer able to use their optimal habitat, reduced abundance recorded for many waterbird species and increased abundance in some others, and with limited or no breeding events recorded for an extended period.

The ecology of the Coorong and Lakes Alexandrina and Albert Ramsar site is under extreme threat. The most ecologically beneficial solution to the current threats is the delivery of large volumes of freshwater from the River Murray to restore the annual flooding and drying cycle and salinity gradients to which the ecosystem is adapted.

4.1 Knowledge Gaps

Knowledge gaps in our understanding of waterbirds and their use of wetlands occur at all scales: global; continental; regional; and at the wetland scale (Brandis *et al.* 2009). Key knowledge gaps include:

- the impacts of global issues such as climate change, wetland loss (Brandis *et al.* 2009), loss of flyway feeding habitat, and the interaction of small scale change across multiple factors on global waterbird populations are poorly understood – need large scale surveys and monitoring projects;
- at the continental scale the impact of wetland loss and decline in wetland health on resident species and migratory species is poorly understood (Brandis *et al.* 2009) – need large scale surveys and monitoring projects;
- our understanding of the way in which waterbirds use a wetland mosaic, both regionally and within a wetland complex is poor (Brandis *et al.* 2009), this is particularly true of the Coorong and Lakes Alexandrina and Albert Ramsar site – need extensive marking / tagging programs for

waterbirds and formalised tracking and survey programs to monitor daily, seasonal and annual movement patterns and movement patterns in response to flood events;

- a lack of data on habitat usage by waterbirds based on resource availability within the Coorong and Lower Lakes – need carefully designed research protocols (e.g. Johnson 1980) to compare usage and availability data. Requires a synergy between those collecting and analysing invertebrate distribution and abundance data and those collecting and analysing waterbird distribution and abundance data;
- waterbird breeding triggers are poorly understood (Brandis *et al.* 2009). The recent immediate response of Ibis and Magpie Geese to the flooding of Bool and Hacks Lagoons in the lower southeast of South Australia, and breeding within a week of the first water entering the system (G Kerr, *Pers. Obs.*) is unprecedented in the literature. Our understanding of breeding triggers for colonial nesting species is poor – need flow manipulation experiments at the wetland patch scale to allow key triggers to be identified. Triggers can be expected to vary between species and importantly between wetlands (Brandis *et al.* 2009);
- our understanding of fundamental waterbird life history characteristics is poor. This means that the cumulative effects of environmental impacts on waterbird population viability and recruitment ability cannot be determined – need broad scale, long-term mark-recapture programs across species to determine all aspects of life history and population structure including such factors as: life span, breeding age, parental experience, juvenile survival, peak reproductive age, and reproductive senescence;
- a lack of understanding about how regional wetland productivity affects juvenile dispersal and survival after a successful reproductive event. Where artificial watering triggers a reproductive response and successful breeding occurs within a region otherwise in drought, do the dispersing young survive to contribute to successive generations? Do artificial watering events need to be planned in a regional context? – need extensive marking / tagging programs and for juvenile waterbirds and formalised tracking and survey programs to monitor subsequent movement patterns and survivorship after the juveniles depart from their natal site;
- the impact of environmental factors other than hydrology on waterbirds (Brandis *et al.* 2009). Factors include climate change, pest species, change to benthic invertebrate, zooplankton and phytoplankton community structure, change in fish community structure, clearing, grazing, and avian disease – need to collect baseline data and then conduct manipulative controlled experiments;
- the role of regional context in determining waterbird response to flooding events. Artificial flooding events do not necessarily occur within a context that would allow waterbirds to expect an imminent flood and do not necessarily provide the appropriate physiological and behavioural cues needed to initiate such behaviours as waterbird movement towards the flooded wetland and stimulate the appropriate breeding behaviours – need to collect contextual data on artificial watering of wetlands and correlate with waterbird response across the region;
- limited ability to predict waterbird responses to habitat variables. Current understanding of waterbird responses is based on overseas studies, or limited to specific wetlands in Australia.

General responses are known but quantitative relationships have not been developed. This necessitates an adaptive management framework, incorporating new knowledge to manage waterbirds – need development of quantitative relationships between species and wetland habitat through detailed studies of habitat use and manipulative experiments (Brandis *et al.* 2009);

- a limited ability to identify critical thresholds for such factors as salinity, acidity, toxicity of heavy metals and bioaccumulation potential, and toxicity and food chain transmission associated with blue green algal blooms for each waterbird species. Identification of trigger points for each species and associated habitat types that result in management actions to redress the threat – need detailed knowledge for each waterbird species of their behavioural ecology and physiological ecology through directed research;
- little knowledge is available on how a change in wetland productivity and associated terrestrial energetic and nutrient flux, or the loss of flood associated wetland productivity within the Coorong and Lower Lakes, impacts on regional terrestrial fauna population dynamics – need spatial studies on changes in such factors as foraging behaviour and reproductive success of terrestrial fauna in association with regional flow characteristic and wetland productivity;
- no knowledge of population dynamics and spatial distribution of waterbirds that use habitats other than the open mudflat and water regions in the Coorong and Lower Lakes. There are no data available on cryptic waterbird species and species that use dense habitats such as reed beds. – need directed surveys, designed to locate specific species, utilising such techniques as playback surveys and remote voice recording surveys;
- no knowledge of population dynamics and spatial distribution of waterbirds in the ephemeral lakes system of the Coorong - need to extend existing waterbird survey program to the ephemeral lakes;
- little knowledge on impact of low flows and extended periods without floods on the extensive saltmarsh system and associated fauna in the Coorong and Lower Lakes – vegetation surveys need to be extended to the salt marsh habitats. Need to assess salt marsh productivity over the long term. Need to investigate importance of saltmarshes to regional fauna; and
- it is not known to what extent near-shore pelagic species rely on marine productivity associated with River Murray flows.

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Appendix A: Bird Species List (BDBSA)

This list of bird species recorded within 1 km of the perimeter of the Coorong and Lower Lakes Ramsar site is sourced from the Biological Database of South Australia (BDBSA).

The BDBSA is comprised of an integrated collection of corporate databases, which meet Department for Environment and Heritage (DEH) standards for data quality, integrity and maintenance. In addition to DEH biological data the BDBSA also includes data from partner organisations.

DEH Partner Datasets: Birds Australia (http://www.birdsaustralia.com.au/); Atlas records for SA - 1996 to 2002; Birds SA (http://www.birdssa.asn.au/); Birds SA field trips database - supplied mid 2005, supplementary load September 2007; Birds SA Journal records – supplied 2007; Birds SA Parks Data - supplied mid 2005; Birds SA Member Personal Records – supplied 2007; Threatened Birds of the South East - supplied through Birds SA September 2006; Southern Fleurieu Bird Watchers - supplied through Birds SA February 2007; Australasian Wader Study Group (http://www.awsg.org.au/) supplied 2005; SA Museum (http://www.samuseum.sa.gov.au/page/default.asp?site=1); Bird data Loaded May 2005; Victorian Department of Sustainability and Environment (http://www.dse.vic.gov.au/); and New South Wales Government Department of Environment and Climate Change (http://www.environment.nsw.gov.au/).

Where subspecies of a particular species merit different conservation ratings, only those subspecies recorded at the study site are included in the table.

Where a scientific name has recently been changed, the current name is followed by the previous synonymy in parentheses.

FAMILY *Genus species*	Common Name	Conservation Significance[1]
ACANTHIZIDAE		
Acanthiza apicalis	Inland Thornbill	
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	
Acanthiza iredalei	Slender-billed Thornbill	
Acanthiza lineata	Striated Thornbill	
Acanthiza nana	Yellow Thornbill	
Acanthiza pusilla	Brown Thornbill	
Acanthiza reguloides	Buff-rumped Thornbill	
Aphelocephala leucopsis	Southern Whiteface	
Calamanthus campestris	Rufous Fieldwren	
Calamanthus fuliginosus	Striated Fieldwren	
Dasyornis broadbenti	Rufous Bristlebird	r
Hylacola (Calamanthus) cautus	Shy Heathwren (Shy Hylacola)	r
Pyrrholaemus brunneus	Redthroat	
Sericornis frontalis	White-browed Scrubwren	
Smicrornis brevirostris	Weebill	
ACCIPITRIDAE		
Accipiter cirrocephalus (cirrhocephalus)	Collared Sparrowhawk	
Accipiter fasciatus	Brown Goshawk	
Aquila audax	Wedge-tailed Eagle	
Circus approximans	Swamp Harrier	
Circus assimilis	Spotted Harrier	
Elanus axillaris	Black-shouldered Kite	
Elanus scriptus	Letter-winged Kite	r
Haliaeetus leucogaster	White-bellied Sea-Eagle	e C
Haliastur sphenurus	Whistling Kite	
Hieraaetus morphnoides	Little Eagle	
Milvus migrans	Black Kite	
Pandion cristatus (haliaetus)	Eastern Osprey	EN e
AEGOTHELIDAE		
Aegotheles cristatus	Australian Owlet-nightjar	
ALAUDIDAE		
Alauda arvensis	Eurasian Skylark	
Mirafra javanica	Horsfield's Bushlark	
ALCEDINIDAE		
Dacelo novaeguineae	Laughing Kookaburra	
Tachybaptus novaehollandia	Australasian Grebe, (Little Grebe)	
Todiramphus pyrrhopygia	Red-backed Kingfisher	
Todiramphus sanctus	Sacred Kingfisher	
ANATIDAE		
Anas castanea	Chestnut Teal	
Anas gracilis	Grey Teal	
Anas platyrhynchos	Mallard	
Anas rhynchotis	Australasian Shoveler	r
Aythya australis	Hardhead (White-eyed Duck)	
Chenonetta jubata	Australian Wood Duck, (Maned Duck)	
Cereopsis novaehollandiae	Cape Barren Goose	r
Cygnus atratus	Black Swan	
Biziura lobata	Musk Duck	r
Oxyura australis	Blue-billed Duck	r
Stictonetta naevosa	Freckled Duck	v
Tadorna tadornoides	Australian Shelduck	
ANHINGIDAE		
Anhinga novaehollandiae	Darter	r

FAMILY *Genus species*	Common Name	Conservation Significance[1]
(melanogaster)		
APODIDAE		
Apus pacificus	Fork-tailed Swift	J C
ARDEIDAE		
Ardea modesta (alba)	Eastern Great Egret, (White Egret)	J C
Ardea ibis	Cattle Egret	r J C
Ardea intermedia	Intermediate Egret	r
Ardea pacifica	White-necked Heron	
Botaurus poiciloptilus	Australasian Bittern	v
Egretta garzetta	Little Egret	r
Egretta novaehollandiae	White-faced Heron	
Ixobrychus dubius (minutus)	Little Bittern	e
Nycticorax caledonicus	Nankeen Night Heron	
ARTAMIDAE		
Artamus cinereus	Black-faced Woodswallow	
Artamus cyanopterus	Dusky Woodswallow	
Artamus personatus	Masked Woodswallow	
Artamus superciliosus	White-browed Woodswallow	
Cracticus torquatus	Grey Butcherbird	
Cracticus (Gymnorhina) tibicen	Australian Magpie	
Strepera versicolor	Grey Currawong	
BURHINIDAE		
Burhinus grallarius	Bush Stone-curlew	r
CACATUIDAE		
Cacatua galerita	Sulphur-crested Cockatoo	
Cacatua sanguinea	Little Corella	
Calyptorhynchus funereus	Yellow-tailed Black-Cockatoo	v
Eolophus (Cacatua) roseicapilla	Galah	
Nymphicus hollandicus	Cockatiel	
CAMPEPHAGIDAE		
Coracina novaehollandiae	Black-faced Cuckoo-shrike	
Coracina papuensis	White-bellied Cuckoo-shrike	r
Lalage sueurii (tricolor)	White-winged Triller	
CAPRIMULGIDAE		
Eurostopodus argus	Spotted Nightjar	
CASUARIIDAE		
Dromaius novaehollandiae	Emu	
CHARADRIIDAE		
Charadrius australis	Inland Dotterel	
Charadrius bicinctus	Double-banded Plover	
Charadrius leschenaultii	Greater Sand Plover	r Ro J C
Charadrius mongolus	Lesser Sand Plover	r Ro J C
Charadrius ruficapillus	Red-capped Plover	
Charadrius veredus	Oriental Plover	Ro
Elseyornis melanops	Black-fronted Dotterel	
Erythrogonys cinctus	Red-kneed Dotterel	
Pluvialis fulva	Pacific Golden Plover	r Ro
Pluvialis squatarola	Grey Plover	Ro J C
Thinornis rubricollis	Hooded Plover	v
Vanellus miles	Masked Lapwing	
Vanellus tricolor	Banded Lapwing	
COLUMBIDAE		
Columba livia	Rock Dove	
Geopelia striata (placida)	Peaceful Dove	
Ocyphaps lophotes	Crested Pigeon	
Phaps chalcoptera	Common Bronzewing	

FAMILY *Genus species*	Common Name	Conservation Significance[1]
Phaps elegans	Brush Bronzewing	
Streptopelia chinensis	Spotted Turtle-dove	
CORACIIDAE		
Eurystomus orientalis	Dollarbird	
CORVIDAE		
Corvus coronoides	Australian Raven	
Corvus mellori	Little Raven	
CUCULIDAE		
Cacomantis flabelliformis	Fan-tailed Cuckoo	
Cacomantis (Cuculus) pallidus	Pallid Cuckoo	
Chalcites (Chrysococcyx) basalis	Horsfield's Bronze-cuckoo	
Chalcites (Chrysococcyx) lucidus	Shining Bronze-Cuckoo	
Chalcites (Chrysococcyx) osculans	Black-eared Cuckoo	
DICAEIDAE		
Dicaeum hirundinaceum	Mistletoebird	
DICRURIDAE		
Grallina cyanoleuca	Magpie-lark	
Monarcha melanopsis	Black-faced Monarch	
Myiagra inquieta	Restless Flycatcher	r
Rhipidura albiscapa	Grey Fantail	
Rhipidura leucophrys	Willie Wagtail	
DIOMEDEIDAE		
Diomedea cauta	Shy Albatross	VU ssp carteri v
Diomedea chlororhynchos	Yellow-nosed Albatross	ssp chlororhynchos v
Diomedea chrysostoma	Grey-headed Albatross	VU v
Diomedea exulans	Wandering Albatross	VU v
Diomedea melanophris	Black-browed Albatross	ssp impavida v
ESTRILDIDAE		
Neochmia temporalis	Red-browed Finch	
Stagonopleura bella	Beautiful Firetail	r
Stagonopleura guttata	Diamond Firetail	v
Taeniopygia guttata	Zebra Finch	
FALCONIDAE		
Falco berigora	Brown Falcon	
Falco cenchroides	Nankeen Kestrel	
Falco hypoleucos	Grey Falcon	r
Falco longipennis	Australian Hobby	
Falco peregrinus	Peregrine Falcon	r
Falco subniger	Black Falcon	
FRINGILLIDAE		
Carduelis carduelis	European Goldfinch	
Carduelis chloris	European Greenfinch	
GLAREOLIDAE		
Glareola maldivarum	Oriental Pratincole	
Stiltia isabella	Australian Pratincole	
HAEMATOPODIDAE		
Haematopus fuliginosus	Sooty Oystercatcher	r
Haematopus longirostris	Pied Oystercatcher	r
HIRUNDINIDAE		
Cheramoeca leucosternus	White-backed Swallow	
Hirundo neoxena	Welcome Swallow	
Petrochelidon ariel	Fairy Martin	
Petrochelidon nigricans	Tree Martin	

FAMILY *Genus species*	Common Name	Conservation Significance[1]
LARIDAE		
Chroicocephalus (Larus) novaehollandiae	Silver Gull	
Chlidonias hybrida (hybridus)	Whiskered Tern	
Chlidonias leucopterus	White-winged Black Tern	J C
Gelochelidon (Sterna) nilotica	Gull-billed Tern	
Hydroprogne (Sterna) caspia	Caspian Tern	C
Larus dominicanus	Kelp Gull	r
Larus pacificus	Pacific Gull	
Onychoprion (Sterna) fuscata	Sooty Tern	
Stercorarius parasiticus	Arctic Jaeger, (Arctic Skua)	Ro J
Stercorarius antarticus (Catharacta skua)	Brown Skua	ssp lonnbergi v
Sterna hirundo	Common Tern	r Ro J C
Sterna paradisaea	Arctic Tern	
Sterna striata	White-fronted Tern	
Sternula (Sterna) albifrons	Little Tern	e Ro J C
Sternula (Sterna) nereis	Fairy Tern	e
Thalasseus (Sterna) bergii	Crested Tern	J
MALURIDAE		
Malurus cyaneus	Superb Fairy-wren	
Malurus lamberti	Variegated Fairy-wren	
Malurus splendens	Splendid Fairy-wren	
Stipiturus malachurus intermedius	Southern Emu-wren (Mt Lofty Ranges ssp)	EN e
MEGAPODIIDAE		
Leipoa ocellata	Malleefowl	VU v
MELIPHAGIDAE		
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	
Acanthorhynchus tenuirostr	Eastern Spinebill	
Anthochaera carunculata	Red Wattlebird	
Anthochaera chrysoptera	Little Wattlebird	
Epthianura albifrons	White-fronted Chat	
Epthianura aurifrons	Orange Chat	
Epthianura crocea	Yellow Chat	e
Gliciphila melanops	Tawny-crowned Honeyeater	
Lichenostomus chrysops	Yellow-faced Honeyeater	
Lichenostomus cratitius	Purple-gaped Honeyeater	ssp occidentalis r
Lichenostomus leucotis	White-eared Honeyeater	
Lichenostomus ornatus	Yellow-plumed Honeyeater	
Lichenostomus penicillatus	White-plumed Honeyeater	
Lichenostomus virescens	Singing Honeyeater	
Manorina melanocephala	Noisy Miner	
Melithreptus brevirostris	Brown-headed Honeyeater	
Melithreptus gularis	Black-chinned Honeyeater	ssp laetior r
Melithreptus lunatus	White-naped Honeyeater	
Phylidonyris novaehollandi	New Holland Honeyeater	
Phylidonyris pyrrhopterus (pyrrhoptera)	Crescent Honeyeater	
Plectorhyncha lanceolata	Striped Honeyeater	r
Purnella (Phylidonyris) albifrons	White-fronted Honeyeater	
MEROPIDAE		
Merops ornatus	Rainbow Bee-eater	
MOTACILLIDAE		
Anthus novaeseelandiae	Richard's Pipit	
Motacilla flava	Yellow Wagtail	Ro J C

FAMILY *Genus species*	Common Name	Conservation Significance[1]
MURIDAE		
Poliocephalus poliocephalu	Hoary-headed Grebe	
Recurvirostra novaeholland	Red-necked Avocet	
MUSCICAPIDAE		
Turdus merula	Eurasian Blackbird	
Zoothera lunulata	Bassian Thrush	r Ro J C
NEOSITTIDAE		
Daphoenositta chrysoptera	Varied Sittella	
OTIDIDAE		
Ardeotis australis	Australian Bustard	v
PACHYCEPHALIDAE		
Colluricincla harmonica	Grey Shrike-thrush	
Falcunculus frontatus	Crested Shrike-tit	r
Pachycephala pectoralis	Golden Whistler	
Pachycephala rufiventris	Rufous Whistler	
Pachycephala rufogularis	Red-lored Whistler	VU r
PARDALOTIDAE		
Pardalotus punctatus	Spotted Pardalote	
Pardalotus striatus	Striated Pardalote	
PASSERIDAE		
Passer domesticus	House Sparrow	
PELECANIDAE		
Pelecanus conspicillatus	Australian Pelican	
PERAMELIDAE		
Malacorhynchus membranaceu	Pink-eared Duck	
PETROICIDAE		
Drymodes brunneopygia	Southern Scrub-robin	
Eopsaltria australis	Eastern Yellow Robin	
Melanodryas cucullata	Hooded Robin	ssp cucullata r
Microeca fascinans	Jacky Winter	ssp fascinans r
Petroica boodang (multicolor)	Scarlet Robin	ssp boodang r
Petroica goodenovii	Red-capped Robin	
Petroica phoenicea	Flame Robin	v
Petroica rodinogaster	Pink Robin	
Petroica rosea	Rose Robin	
PHALACROCORACIDAE		
Phalacrocorax carbo	Great Cormorant	
Phalacrocorax fuscescens	Black-faced Cormorant	
Phalacrocorax melanoleucos	Little Pied Cormorant	
Phalacrocorax sulcirostris	Little Black Cormorant	
Phalacrocorax varius	Pied Cormorant	
PHASIANIDAE		
Coturnix pectoralis	Stubble Quail	
Coturnix ypsilophora	Brown Quail	v
PODARGIDAE		
Podargus strigoides	Tawny Frogmouth	
PODICIPEDIDAE		
Podiceps cristatus	Great Crested Grebe	r
POMATOSTOMIDAE		
Pomatostomus superciliosus	White-browed Babbler	
Pomatostomus temporalis	Grey-crowned Babbler	
PROCELLARIIDAE		
Ardenna (Puffinus) carneipes	Fleshy-footed Shearwater	r Ro J
Ardenna (Puffinus) tenuirostris	Short-tailed Shearwater	Ro J
Fulmarus glacialoides	Southern Fulmar	
Halobaena caerulea	Blue Petrel	

FAMILY *Genus species*	Common Name	Conservation Significance[1]
Lugensa brevirostris	Kerguelen Petrel	
Macronectes giganteus	Southern Giant-Petrel	v
Pachyptila belcheri	Slender-billed Prion	
Pachyptila desolata	Antarctic Prion	
Pachyptila turtur	Fairy Prion	
Pachyptila vittata	Broad-billed Prion	
Pelecanoides urinatrix	Common Diving-Petrel	
Pterodroma inexpectata	Mottled Petrel	
Pterodroma lessonii	White-headed Petrel	
Pterodroma mollis	Soft-plumaged Petrel	VU
Puffinus gavia	Fluttering Shearwater	
Thalassoica antarctica	Antarctic Petrel	
PSITTACIDAE		
Barnardius zonarius	Australian Ringneck, (Ring-necked Parrot)	
Glossopsitta concinna	Musk Lorikeet	
Glossopsitta porphyrocepha	Purple-crowned Lorikeet	
Lathamus discolor	Swift Parrot	EN e
Melopsittacus undulatus	Budgerigar	
Neophema chrysogaster	Orange-bellied Parrot	CR e
Neophema chrysostoma	Blue-winged Parrot	v
Neophema elegans	Elegant Parrot	r
Neophema petrophila	Rock Parrot	r
Northiella haematogaster	Blue Bonnet	
Platycercus elegans	Crimson Rosella	
Platycercus eximius	Eastern Rosella	
Psephotus haematonotus	Red-rumped Parrot	
Psephotus varius	Mulga Parrot	
Trichoglossus haematodus	Rainbow Lorikeet	
RALLIDAE		
Fulica atra	Eurasian Coot	
Gallinula tenebrosa	Dusky Moorhen	
Gallirallus philippensis	Buff-banded Rail	
Lewinia (Rallus) pectoralis	Lewin's Rail	v
Porphyrio porphyrio	Purple Swamphen	
Porzana fluminea	Australian Spotted Crake	
Porzana pusilla	Baillon's Crake	
Porzana tabuensis	Spotless Crake	r
Tribonyx (Gallinula) ventralis	Black-tailed Native-hen	
RECURVIROSTRIDAE		
Himantopus himantopus	Black-winged Stilt	
ROSTRATULIDAE		
Rostratula australis (benghalensis)	Painted Snipe	v C
SCOLOPACIDAE		
Actitis hypoleucos	Common Sandpiper	r Ro C
Arenaria interpres	Ruddy Turnstone	r Ro J C
Calidris acuminata	Sharp-tailed Sandpiper	Ro J C
Calidris alba	Sanderling	r Ro J C
Calidris canutus	Red Knot	Ro J C
Calidris ferruginea	Curlew Sandpiper	Ro J C
Calidris melanotos	Pectoral Sandpiper	r Ro J
Calidris minuta	Little Stint	Ro
Calidris ruficollis	Red-necked Stint	Ro J C
Calidris subminuta	Long-toed Stint	r Ro J C
Calidris tenuirostris	Great Knot	r Ro J C
Gallinago hardwickii	Latham's Snipe	r Ro J C
Limicola falcinellus	Broad-billed Sandpiper	Ro J C

FAMILY *Genus species*	Common Name	Conservation Significance[1]
Philomachus pugnax	Ruff	r Ro J C
Phalaropus fulicarius (fulicaria)	Grey Phalarope	C
Phalaropus lobatus	Red-necked Phalarope	Ro J C
Limosa lapponica	Bar-tailed Godwit	r Ro J C
Limosa limosa	Black-tailed Godwit	r Ro J C
Numenius madagascariensis	Eastern Curlew	v Ro J C
Numenius minutus	Little Curlew	Ro J C
Numenius phaeopus	Whimbrel	r Ro J C
Tringa (Heteroscelus) brevipes	Grey-tailed Tattler	r Ro J C
Tringa flavipes	Lesser Yellowlegs	
Tringa glareola	Wood Sandpiper	r Ro J C
Tringa nebularia	Common Greenshank	Ro J C
Tringa stagnatilis	Marsh Sandpiper	Ro J C
Tringa totanus	Common Redshank	Ro C
Xenus cinereus	Terek Sandpiper	r Ro J C
SPHENISCIDAE		
Eudyptes chrysocome	Rockhopper Penguin	
Eudyptes pachyrhynchus	Fiordland Penguin	
Eudyptula minor	Little Penguin	
STRIGIDAE		
Ninox connivens	Barking Owl	r
Ninox novaeseelandiae	Southern Boobook	
STURNIDAE		
Sturnus vulgaris	Common Starling	
SULIDAE		
Morus serrator	Australasian Gannet	
SYLVIIDAE		
Acrocephalus australis	Australian Reed Warbler, (Clamorous Reed-Warbler)	Ro C
Cisticola exilis	Golden-headed Cisticola	
Cladorhynchus leucocephalu	Banded Stilt	v
Cincloramphus cruralis	Brown Songlark	
Cincloramphus mathewsi	Rufous Songlark	
Megalurus gramineus	Little Grassbird	
THRESKIORNITHIDAE		
Platalea flavipes	Yellow-billed Spoonbill	
Platalea regia	Royal Spoonbill	
Plegadis falcinellus	Glossy Ibis	r C
Threskiornis molucca	Australian White Ibis	
Threskiornis spinicollis	Straw-necked Ibis	
TURNICIDAE		
Turnix varius (varia)	Painted Button-quail	r
Turnix velox	Little Button-quail	
TYTONIDAE		
Tyto javanica (alba)	Barn Owl	
ZOSTEROPIDAE		
Zosterops lateralis	Silvereye	

1. **Environmental Protection and Biodiversity Conservation Act (EPBC) Status** Australian Conservation Status Codes

EX Extinct: there is no reasonable doubt that the last member of the species has died.

EW Extinct in the Wild: known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.

CR Critically Endangered: facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.

EN Endangered: facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.

VU Vulnerable: facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

J Japanese Australian Migratory Bird Agreement (JAMBA)

C Chinese Australian Migratory Bird Agreement (CAMBA)
Ro Republic of Korea Australian Migratory Bird Agreement (ROKAMBA)

SA Status South Australian Conservation Status Codes
Codes based on the current listing of species under Schedules of the National Parks and Wildlife Act 1972. Schedule 7, 8, and 9. Reviewed 21/02/2008
e Endangered: (Schedule 7) in danger of becoming extinct in the wild.
v Vulnerable: (Schedule 8) at risk from potential or long-term threats, which could cause the species to become endangered in the future.
r Rare: (Schedule 9) low overall frequency of occurrence (may be locally common with a very restricted distribution or may be scattered sparsely over a wider area). Not currently exposed to significant threats, but warrants monitoring and protective measures to prevent reduction of population sizes.

Appendix B: Review of Waterbird Habitat Use

For each of the 119 designated wetland dependent species a literature search was carried out to determine known habitat requirements (Appendix B). For each species, habitat use is described in general, and known specific habitat types identified, particularly in relationship to the habitat types available in the Coorong and Lower Lakes. The known diversity of microhabitats used in relation to foraging, roosting and breeding is outlined. Annual, seasonal, and lifetime movement patterns are outlined, where known. Finally, to clarify the foraging needs of each species the diversity of foraging behaviours and known food types are outlined in detail.

All data sources are cited. Numbers in parentheses (e.g. (1)) refer to full reference citations in the reference section beneath this table.

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Acrocephalus australis	Australian Reed Warbler, (Clamorous Reed-Warbler)	Typically in dense, low, aquatic or riparian vegetation (*1*).	Aquatic or riparian vegetation, mainly reeds, rushes, sedges, and other vegetation with similar vertical structure, in and around nearly any type of fresh, brackish or saline wetlands, including creeks, rivers, billabongs, estuaries, swamps, lagoons, and lakes. Primarily inhabit dense rushland, sedgeland and grassland. In SA found in paperbarks around brackish teatree lagoons (*1*).	Little known. Forage mainly in dense aquatic or riparian vegetation, making observations difficult. Forage in vegetation, mainly rushes, reeds, sedges and grass, on bare ground or mud or next to reeds, or up to 30 m above ground in trees. Usually forage on or near ground (*1*).	In dense reed beds	Partially migratory, but full range of movement not clear. Largely migratory in se Australia. Leaving breeding sites Feb to Apr, and returning Aug to Sep, although some remain in winter. Apparently moving NW away from se Australia in winter (*1*).	Glean arthropods from tree trunks and branches, floating debris and reeds, also chase and sally after insects in flight, usually over water (*1*).	Arthropods, mainly insects (diverse range of terrestrial taxa) and spiders, also molluscs and occasionally seeds (*1*).		Endemic to Australia. Breed early Sep to early Mar. Typically in dense low aquatic or riparian vegetation, in and round nearly any type pf fresh, brackish or saline wetland (*1*).
Actitis hypoleucos	Common Sandpiper	Wide range of coastal or inland wetlands, with varying levels of salinity (*2*).	Mainly muddy margins or rocky shores of wetlands, often around estuaries and deltas of streams, also around lakes, pools, billabongs, reservoirs, dams and claypans. Don't favour large coastal mudflats (*2*).	Generally forage in shallow water and on bare soft mud at edge of wetlands, often where obstacles project from substrate. Sometimes venture into grassy areas adjoining wetlands (*2*).	Almost always roost on rocks or in roots or branches of vegetation, sometimes rest on mud (*2*).	Non-breeding migrant - arrive Aust July (Northern Aust). Depart SA Feb to May, most leave Australia Mar – Apr (*2*).	Diurnal. Picking and stabbing combined with stalking and creeping. Adopt low creeping posture to snatch low flying insects, may dart forward to secure sitting prey. Rarely probes (*2*).	Carnivorous: Molluscs (bivalves), crustaceans (amphipods, crabs), and wide variety of insects (*2*).	Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	Breed Europe and Asia
Anas castanea	Chestnut Teal	Inhabit terrestrial wetlands and estuarine habitats, mainly in coastal regions of se and sw Australia	Tolerate high salinity waters. Regularly on saline habitats, estuaries, inlets, mangrove swamps, saltpans, salt lakes, coastal lagoons, salt fields, tidal mudflats, saltmarshes, and lower river reaches. Often use large coastal wetlands as refuges in summer and during drought. Other records in many wetland habitat types with or without emergent vegetation (***4***).	Aquatic. Feed particularly along edges of wetlands or over sand or mudflats, in shallows with aquatic or emergent plant growth **(*4*)**.	Roost and nest above waterline often in places partly or entirely surrounded by water **(*4*)**.	Presumably migratory between breeding area and non-breeding refuges. In breeding season disperse on small and large wetlands, in non-breeding period, gather on large bodies of water (***4***).	Crepuscular and nocturnal. When swimming feed by dabbling and probing on water edge, upending in shallow, pecking at surface matter or stripping seeds from plants. More usually feed at edge of water in front of rising tide water, dabbling on recently covered flats and pecking seeds from surface.	Predominantly vegetable **(*5*)**. Seeds and insects with some vegetable material and mollusca (molluscs, bivalves, gastropods, chitons), polychaetes, and crustaceans (copepods, amphipods, cladocerans, isopods, crabs), in more littoral habitats, and spiders, insects (***4***).	South Lagoon of Coorong: *Lamprothamnium* tubers 57%, *Ruppia* tubers 40%, *Lepilaena* seeds 0.5% **(*6*)**. Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	Endemic to Australia. Breed mostly in tree hollows mainly in coastal regions, on islands or shores in swamps, lakes, billabongs, coastal lagoons and mangroves. Sometimes ground nest. Breeding period extended and not easily defined. The Coorong: laying from mid-Aug, or earlier to Dec **(*4*)**.

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Anas gracilis	Grey Teal	Widespread on terrestrial wetlands, sheltered estuarine and marine waters, occasionally on farm dams in grasslands (***4***).	Particularly characteristic of large shallow productive inland wetlands. Prefer open or discontinuously, rather than densely, wooded wetlands. Saline or hypersaline wetlands may at times support large part of population. Coastal waters used as a non-breeding refuge during dry season or drought. Also occur on saltmarshes, saltpans, saltfields, and tidal reaches of rivers (***4***).	Mainly aquatic, feeding in shallow open water < 1 m deep, or in flooded marginal vegetation, occasionally in deep water, especially where floating aquatic vegetation, also out of water on exposed shores and mudflats, damp grass, pastures or crops. Respond rapidly to flooding on inland alluvial plains, following edge of spreading waters (***4***).	Roost or loaf communally, often haul out on logs etc, or along shore. Most loafing diurnal also at night when not feeding	Highly dispersive from breeding sites and responding to climatic changes with movements over great distances. Regular movements to se Australia as inland water bodies dry out (***4***).	Both diurnal and nocturnal, but most probably crepuscular. Food obtained by up-ending, dabbling at water surface, dredging mud at water's edge and by stripping seeds from emergent vegetation (***4***).	Predominantly vegetable (***5***). Mostly seeds of aquatic plants, but dietary analyses using gizzard samples probably biased against animal matter. Animals include: molluscs (gastropods, bivalves), polychaetes, crustaceans (cladocerans, ostracods, isopods, amphipods, copepods), insects (diverse aquatic taxa) (***4***).	South Lagoon of Coorong: *Lamprothamnium* tubers 41%, *Ruppia* tubers 50%, *Lepilaena* seeds 6% (***6***). Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Australia and New Zealand. Opportunistic breeders inland on large shallow floodwaters, a few birds nest in or beside other wetlands (swamps, dams, lakes, saltmarsh). Nest solitarily, most commonly in tree hollows. Most commonly lay eggs between Jun and Feb.
Anas platyrhynchos	Mallard	Limited to where seasonal conditions approach those in northern hemisphere range. Terrestrial wetlands, grasslands and croplands and sheltered estuarine and marine habitats(***4***).	Urban lakes, ponds, farm dams, also any fresh water close to human habitation (***4***).	Prefer still shallow waters with abundant submerged, floating or emergent plants. Hardly any area of water too small (***4***).		Introduced to Australia, natural range Holarctic (***4***).	Feeds by filtering at surface of still, shallow, water., sometimes stirring mud by paddling feet (***4***).			

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Anas rhynchotis	Australasian Shoveler	Aquatic, mainly on Temperate Zone terrestrial wetlands and occasionally sheltered estuarine and inshore waters (***4***).	Prefer large deep permanent wetlands, with fringe of vegetation and area of open water, where conditions stable and aquatic flora abundant. But, seen on most types of wetlands and may be found on floodwaters. Prefer freshwater, but may occur in high numbers in brackish or saline lakes, saltpans, coastal lagoons, estuaries and sheltered inshore waters, especially when salinity reduced by freshwater run-off (***4***).	Bill specialised for filter feeding limits foraging to aquatic habitats on open water or soft mud in fertile wetlands with abundant prey. Numerous on swamps where small seasonal fluctuations in water-level promote development of rich littoral flora and fauna. Foraging usually restricted to depth that can be reached by upending (*c*. 0.3 m), but recorded diving in greater depths (***4***).	Rest in day on mudbanks, in dense cover or floating on deep water. Loaf in water during day (***4***).	Dispersive but poorly known. In wetter areas possibly philopatric to nesting site. Otherwise distribution and size of population correlated with conditions in the Murray-Darling Basin and se SA. No seasonal pattern of abundance anywhere in its range (***4***).	Crepuscular and nocturnal. Food obtained by dabbling in mud or at surface where lamellae on spatulate bill used to filter food from water. Filter while swimming. Occasionally upend to feed on bottom, chase prey across surface, and dive. May feed in V formation (***4***).	Mostly animal matter (***5***), though some contents of gizzard dominated by residual hard seeds. Include: Molluscs (bivalves, gastropods), crustaceans (ostracods, cladocerans, copepods), aquatic insects and plant seeds (***4***).		Endemic to Australia and New Zealand. Breed in grassy sites near freshwater wetlands, both temporary and permanent. (***4***)
Anas superciliosa	Pacific Black Duck	Catholic in choice of habitat and found in all types of fresh and salt water from pools to open sea, however most characteristic of rather deep permanent swamps with dense vegetation (***4***).	On temperate and tropical terrestrial wetlands and sheltered estuarine and marine waters. Use aquatic and terrestrial habitats. Prefer shallow productive wetlands of low salinity where areas of open water interspersed with ample vegetation cover. Broad habitat tolerance. Generally less common on saline habitats, although use may increase in dry season or in drought. Regular on saltpans or estuaries, and occasional or in low numbers on coastal lagoons, saltmarshes, and tidal parts of creeks or rivers (***4***).	Feed in shallow or deep water, often among aquatic or marginal vegetation, or out of water by wetland shores, exposed mudflats or pastures, especially where moist or flooded, rarely on dry ground (***4***).	Loaf either on water or onshore, often using low perches (***4***).	Dispersive from inland areas in summer, but largely sedentary on permanent water or in well-watered regions (***4***).	Mainly nocturnal, but will feed during the day. Food obtained by dabbling at surface, up-ending to reach submerged food and grazing, seed heads often being swallowed whole. Also recorded diving in shallow water and flocks recorded herding shrimp into shallows (***4***).	Mostly plant material (***5***). Particularly seed of aquatic and waterside vegetation, though animal matter, particularly aquatic insects and crustaceans (copepods, ostracods, shrimps, freshwater crayfish, probably underestimated in gizzard samples), also molluscs (bivalves, gastropods), spiders (***4***).	Infrequently recorded partially foraging on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Australia and New Zealand. Breed throughout range. Catholic in choice of site: away from water, or in, or beside any wetland. Breed seasonally, typically Jun to Dec (***4***).

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Anhinga novaehollandiae (melanogaster)	Darter	Wide distribution on terrestrial wetlands and in sheltered coastal waters (***4***).	Inhabits lakes, reservoirs, rivers, pools, billabongs, swamps, and estuaries. Most common on permanent waterbodies with extensive open water at least 0.5 m deep, such as lakes estuaries and large rivers. Occasionally at sea, also feeds in deeper parts of other wetlands, shallow vegetated edges of large lakes and semi-permanent and seasonal freshwater swamps (***4***).	Forage in smooth and sheltered waters. Dive well. Capture benthic fish, but can also take prey from middle and surface water layers (***4***).	Fringing or projecting tree trunks, branches, stumps or posts required for perching and to dry wings (***4***).	Poorly known. Adults and juveniles apparently dispersive when not breeding, sometimes over long distances (*c.* 2000 km), but almost entire population contracts to breeding areas during summer (***4***).	Food captured by diving under water in depths > 60 cm. Feed by stalking fish underwater. Fish stabbed in lower flanks by tips of partly opened bill (***4***).	Carnivorous. Mostly fish, some insects and other aquatic animals such as tortoises, occasionally take vegetable matter (***4***).		Africa, southern Asia, Australia, Papua New Guinea. Nesting, solitary or in loose colonies with other tree nesting waterbirds Nest in trees or tall bushes growing in or over water. If water levels fall during breeding, birds may move to deeper water. Breeding season: Nov to early months of year. (***4***).
Ardea modesta (alba)	Eastern Great Egret, (White Egret)	Terrestrial wetlands, estuarine and littoral habitats, and moist grasslands	Inland use a variety of habitats, prefer permanent water bodies on flood plains, shallow or deep permanent lakes, either open or vegetated with shrubs or trees, semi-permanent swamps will tall emergent vegetation. Regularly use saline habitats: Estuaries mudflats mainly in summer-autumn or drought refuges (***4***).	Forage by wading in open shallow water (up to 0.3 m deep) (***4***).	Roost in trees at night in or near wetlands. In tidal areas, roosting is determined by tidal cycles (***4***).	Dispersive, though some seasonal movements regular, possibly migratory and sometimes irruptive into NZ (***4***).	Diurnal. Hunt usually by standing and waiting for prey, usually by walking slowly, then lunge to snatch prey from water. When catching small passerines sway head from side to side before lunging. Also plunge onto fish from air, snatching them while flying or entering water (***4***).	Aquatic animals, principally fish but also frogs, insects (Odonata, aquatic insects, crickets, flies) and small birds. Also freshwater snails, shrimps, crayfish, snakes. Fish > 12 cm handled with difficulty (***4***).	Sometimes recorded foraging on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Southern and eastern Asia and Australasia. Breed in wetlands with fringing or flooded trees, or other tall vegetation in which nests are built. Active breeding recorded Nov-Jan in SA. Records of breeding in Lake Alexandrina (***4***).
Ardea ibis	Cattle Egret	Tropical and temperate grasslands, wooded lands and terrestrial wetlands, uncommon in arid and semi-arid regions.	Predominantly low lying grasslands. Wetlands used are mainly shallow, open and fresh. They include meadows, swamps with low emergent vegetation and abundant aquatic flora, and shallow open water in deep swamps, occasionally use swamps with tall emergent vegetation. Use of saline habitats is rare (***4***).	Regularly forage away from water on low-lying grasslands, improved pastures and croplands. Density high on moist, low-lying, poorly drained pasture, especially near hollows and ditches and where tussock of long grass present (***4***).	Roost in trees or among ground vegetation in or near lakes or swamps (***4***).	Partial migrant. Birds in non-breeding parts of range sometimes staying to breed extending range. First reported in SA in Adelaide 1948 (***4***).	Diurnal. On ground, usually follow large herbivores, snapping up disturbed insects or worms forced to surface. Take ectoparasites of cattle. Will feed independent of cattle in flocks (***4***).	Mostly grasshoppers in breeding season with smaller numbers of other insects, particularly cicadas, centipedes, spiders, cattle ticks, frogs, lizards, and a few mammals (***4***).		Originally Africa, sw Europe, southern Asia, but has now expanded to all continents except Antarctica. In Australia nest in dense woodland in or beside swamps, rivers or pools. Breed Oct to Mar in Qld. Recorded breeding in Salt lagoon Lake Alexandrina in SA in Nov 1971 (***4***).

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Ardea intermedia	Intermediate Egret	On terrestrial wetlands, wet grasslands and rarely, in sheltered coastal habitats	Usually seen on billabongs, pools, swamps, and watercourses on floodplains, with short or tall emergent vegetation of grasses, herbs, sedges, reeds or rushes and abundant aquatic fauna. Also in swamps, or on shallow margins of large lakes vegetated with shrubs, open fresh water or moist pasture. Occasionally in saline habitats: estuarine mangrove swamps, saltmarsh, inter tidal flats and tidal reaches of creeks (***4***).	Prefer to forage in still fresh water < 80 mm deep, among dense aquatic and emergent vegetation, but also in deep water by walking on matted vegetation or diving for fish near surface (***4***).	Roost in trees fringing wetlands communally at night (***4***).	Poorly known, apparently sedentary in some areas, but large seasonal variations in populations suggest much dispersion in others, possible migration (***4***).	Diurnal. Hunt in water either by standing and waiting for prey, gleaning, peering or foot-stirring. Seen to hover briefly and dive vertically onto fish like terns (***4***).	Carnivorous. Aquatic animals, principally fish but also frogs, with lizards and grasshoppers main food in drier habitats, and snakes. Also insects (***4***).		Africa, southern Asia, Australasia. Assumed to breed widely throughout regular range on mainland, but little information. Nests colonially in trees standing in or near water, in freshwater swamps, inlands or in mangrove forests along coast. Victoria active nests Nov to Jan. No breeding records in SA (***4***).
Ardea pacifica	White-necked Heron	Widespread in terrestrial wetlands, grasslands and, less often, in estuarine habitats. Less common in arid interior although use permanent or ephemeral water when available (***4***)	Mainly freshwater. Strongly opportunistic, readily use floodwaters, artificial water bodies and small transient waters. Prefer shallow swamps, pools, watercourses and flooded land sparsely vegetated with grasses, herbs or sedges, grassland, open lakes and reservoirs, and deep rush dominated (*Eleocharis*) swamps. Rarely use saline habitats: estuarine mudflats, bare saltpans, shallows of saline lakes (***4***).	Forage in shallow water (< 70 mm deep), or wet grassland over soft substrate. Able to forage in deep, steeply banked water bodies (***4***).	Often roost in trees	Dispersive, sometimes irruptive. Populations increase rapidly on ephemeral wetlands then forced to coast as swamps dry (***4***).	Most food taken after standing and waiting before seizing, but will also stalk prey, glean from foliage and plunge from perch (***4***).	Mainly small aquatic and terrestrial animals, rarely fish. No detailed studies. Molluscs (freshwater mussels), crustaceans (shrimp, freshwater crayfish), spiders, insects (wide variety of taxa), fish, frogs, lizards, ducklings, young water rat, mice and carrion (***4***)		Breeding endemic to mainland Australia. Colonial breeders. Breed in freshwater wetlands (rivers, lakes, swamps) with flooded or fringing trees, in which nests are built. Occasionally nests in trees in cleared paddocks near waterbodies. Breed early Aug to Feb/Mar (***4***).
Arenaria interpres	Ruddy Turnstone	Mainly coastal (*2*).	On exposed rock or platforms and shelves, often with shallow tidal pools and rocky, shingle or gravel beaches, also on sand coral or shell beaches occasionally in estuaries, harbours, bays and coastal lagoons, among low saltmarsh or on exposed areas of seagrass and mudflats, may occur on pebble strewn shores of saltlakes near coast (*2*).	Mainly between supralittoral and lower littoral zones of foreshore, from strand-line to wave-zone. Also forage on exposed rocky platforms and mudflats, occasionally among low vegetation in saltmarsh, on exposed beds of seagrass, and sometimes in grassy areas above tideline (*2*).	Roost or loaf on beaches, above tideline, among rocks, shells, beachcast seaweed, also on rocky islets among grassy tussocks, and on mudflats and sandflats (*2*).	Non-breeding migrant - arrive Aust Sep (Eastern Aust), arrive SA Nov-Dec. Depart SA mid-Mar (*2*).	Diurnal and nocturnal. Feed busily by probing, pecking and prying into crevices, using bills to flip over stones, shells, seaweed and other objects, often digs large holes in sandy areas (*2*).	Carnivorous: insects, worms, crustaceans (barnacles), molluscs (gastropods, bivalves), sandhoppers, spiders, occasionally eggs and carrion (*2*).	In some years recorded foraging primarily on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Breed coasts of Europe, Asia and North America

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Aythya australis	Hardhead (White-eyed Duck)	On terrestrial wetlands and occasionally sheltered estuarine and inshore waters	Almost entirely aquatic, preferring large deep fresh waters with abundant aquatic vegetation, particularly deep swamps and lakes. In some areas favoured wetlands have little emergent vegetation, in others, where waters have tall emergent vegetation or shrubs. Birds avoid dense cover. Uncommon on saline wetlands, occasional records from coastal lagoons and salt lakes (***4***).	On permanent freshwater lakes and swamps mainly in deep open water. Rarely on land except when breeding (***4***)	Often congregate in large flocks on water when loafing during day, but will haul out and stand on sandbanks or other low perches (***4***).	Dispersive and irruptive after good years. Main concentrations in the Murray-Darling basin and sw Australia, and widespread dispersal reported after dry years inland (***4***).	Most food obtained by diving. Swim up to 40 m underwater using feet (***4***).	Mostly plant material (***5***). Mixture of aquatic plants (diverse variety of taxa, including *Ruppia*) and animals, particularly mussels and freshwater shellfish (***4***).	In some years recorded foraging primarily on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Endemic to Australia. Very poorly known. Breed in densely vegetated freshwater wetlands, either permanent waters or deep floodwaters. Time of breeding probably much influenced by wet conditions and occurrence of flooding. Probably August to December (***4***).
Biziura lobata	Musk Duck	On terrestrial wetlands, estuarine habitats and sheltered inshore waters. Typically large, well-established water bodies, open or well vegetated, fresh or saline (***4***).	Almost entirely aquatic, preferring deep waters of large permanent swamps, lakes and estuaries, where conditions stable and aquatic flora abundant (***4***).	Wetlands with both dense marginal vegetation and large expanses of water suitable all year, less numerous on shallow or small waters. Winter flocks prefer deep exposed waters far from shore (***4***).	Lone birds seen sleeping motionless in water at night (***4***).	On permanent water adults apparently sedentary, but adults breeding on ephemeral water dispersive. Regularly congregate in flocks on open waters, including coastal inlets, late summer, autumn and winter. Flocks thought to consist largely of juveniles (***4***).	Obtain food largely by diving in deep water to at least 6 m, also take food from surface and peck at overhanging vegetation. Feed at any time of day, nocturnal feeding not recorded. Will peck at water-surface for insects (***4***).	Mostly animal (***5***). Mainly aquatic invertebrates such as water beetles, water boatmen, freshwater crayfish, water snails, freshwater mussels, with a few fish, and even ducklings, supplemented with a wide variety of plant material, including *Ruppia*. Also annelids and molluscs (***4***).		Endemic to southern Australia. Breeding not well known with no detailed study. When breeding dispersed on deep freshwater swamps, lakes, billabongs and rivers. Dense vegetation provides nesting cover, but may be widespread or patchy. Nearby open water needed for feeding and display. Breed Aug to Nov (***4***).
Botaurus poiciloptilus	Australasian Bittern	Terrestrial wetlands and occasionally, estuarine habitats.	Favours permanent freshwater wetlands with tall dense vegetation dominated by sedges, rush, reeds or cutting grass, growing over muddy or peaty substrate. Brackish water tolerated in estuaries and tidal wetlands, where birds inhabit beds of rushes or reeds in saltmarsh, especially near mouths of creeks or freshwater seepage (***4***).	Forage in still shallow water up to 0.3 m deep, often at edges of pools or waterways, or from platform or mat of vegetation over deep water (***4***).		Probably sedentary in permanent habitat, but possible regular short-distance movements among wetlands (***4, 7***).	Predominantly nocturnal, crepuscular, but also diurnal at times. Stalk with great stealth through shallow water, or remain absolutely still, before lunging for prey	Medium-sized aquatic animals including eels, frogs and freshwater crayfish (***4***)		Australia and New Zealand. Breed in deep, densely vegetated freshwater swamps and pools, building nests in deep cover over shallow water. In rushland avoid densest areas. Breed Oct-Feb (***4***).

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Calidris acuminata	Sharp-tailed Sandpiper	Wide variety of Coastal and inland wetlands. Prefer muddy edges of shallow, fresh or brackish wetlands, with emergent sedges, grass, saltmarsh or other low vegetation (*2*).	Lagoons, swamps, lakes and pools near coast, dams, waterholes, soaks, saltpans and hypersaline saltlakes inland. Use flooded paddocks, sedgelands and other ephemeral wetlands, but leave when dry. Occasionally use intertidal mudflats in sheltered bays, inlets, estuaries or seashores, mainly after ephemeral terrestrial wetlands have dried out (*2*).	Feed mostly at edge of water on mudflats and wetlands or intertidal mudflats, either on bare wet mud or sand, in wet areas of algal mat, or in shallow water, also among inundated vegetation of saltmarsh, grass or sedges. Often in hypersaline environments. Also feed o4n paddocks of short grass, well away from water but damp from recent rain (*2*).	Edge of wetlands, on wet open mud or sand, or in short sparse vegetation, such as grass or saltmarsh. Occasionally on stony shores or on rocks in water (*2*).	Non-breeding migrant - arrive Aust mid-Aug (Northern Aust) to Dec-Jan (SA). Depart SA mid-Feb, most leave Australia by end of Mar (*2*).	Mainly pecks and jabs at substrate, with rapid shallow probing (*2*).	Omnivores: Seeds (*Ruppia*, Chenopods, Fabaceae, Polygonacea) worms, molluscs (Gastropods, bivalves), crustaceans (ostracods) and insects (wide variety). Also eats Annelids, polychaetes, and Nereidae (*2*).	Recorded foraging on food chains based on the *Ruppia tuberosa* system in southern Coorong ***(3)***	Breeds NE Siberia
Calidris alba	Sanderling	Almost always on coast in non-breeding periods	Mostly open sandy beaches exposed to open sea-swell, also on exposed sandbars and spits, and shingle banks. Less often on more sheltered sandy shorelines of estuaries, inlets and harbours. Rarely near coastal wetlands e.g. lagoons, hypersaline lakes, saltponds, and samphire flats (*2*).	Forage along sandy beaches and exposed sandbars at edge of water on wave-washed zone, sometimes among heaps of rotting kelp, or along edges of shallow pools on sandspits and nearby mudflats (*2*).	Bare sand behind clumps of beachcast kelp or in coastal dunes. Also on rocky reefs and ledges. In Coorong roost on the sheltered shores (*2*).	Non-breeding migrant - arrive Aust Sep (Northern Aust) to Oct (SA). Depart Australia Mar – Apr (*2*).	Diurnal and nocturnal Run-pause-probe foraging. Robust bill allows probing in hard ground and sand. Sewing machine action. May probe among rotting kelp, glean, lunge quickly from side to side and skim food from surface of shallow water while running (*2*).	Omnivorous: plants, seeds, worms, crustaceans, spiders, insects, occasionally medusae, fish and larger molluscs and crustaceans taken as carrion (*2*).	Recorded foraging in some years partially on food chains based on the *Ruppia tuberosa* system in southern Coorong ***(3)***	Breed on scattered localities from N America to N Russia and islands in Artic Ocean
Calidris canutus	Red Knot	Coastal	Mainly intertidal mudflats, sand flats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours. Occasionally on sandy ocean beaches or rock platforms. Occasionally on terrestrial saline wetlands near coast, but rarely freshwater swamp (*2*).	Usually forage in soft substrate near edge of water on intertidal mudflats or sandflats exposed by low tide. At high tide may feed on nearby lakes etc. May forage on beds of eelgrass on tidal sandflats and on thick algal mats in shallow water (*2*).	Sandy beaches spits and islets, and mudflats, also in shallow saline ponds at saltworks (*2*).	Non-breeding migrant – arrive Aust end Aug (Northern Aust) to end Sep (SA). Depart SA late Mar to late Apr, depart Australia late Mar – end Apr (*2*).	Diurnal and nocturnal. Activity regulated by tide. Follow receding edge of tide. Locate prey mostly by touch. Feed mainly by probing vertically into substrate, glean from surface, plough with bill, or sewing machine action (*2*).	Omnivorous: worms, polychaetes, bivalves, gastropods, crustaceans and echinoderms (*2*).		Breeds North America, Russia, Greenland, Spitzbergen, and Alaska

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Calidris ferruginea	Curlew Sandpiper	In non-breeding season favour estuarine mudflats and muddy edges of freshwater and brackish wetlands, both coastal and inland (*2*).	Mainly intertidal mudflats in sheltered coastal area, such as estuaries, bays, inlets and lagoons, also round non-tidal swamps, lakes and lagoons near coast. Less often recorded inland around ephemeral and permanent wetlands with bare edges of mud or sand. Occasionally round floodwaters (*2*).	Forage on mudflats and nearby shallow water. In non-tidal wetlands usually wade, mostly in water 15-30 mm, but up to 60 mm. Also forage further out or on mud or sand covered by a film of water. At high tide, feed among low sparse emergent vegetation, such as saltmarsh, sometimes in flooded paddocks or inundated saltflats (*2*).	Generally on bare dry shingle, shell or sand beaches, sandspits and islets in, or around, coastal or near coastal lagoons and other wetlands, occasionally in dunes during very high tides and sometimes in saltmarsh (*2*).	Non-breeding migrant – arrive Aust mid Aug (Northern Aust) in SA late Aug-Sep. Depart SA late Mar to Apr, depart Australia Mar – end Apr (*2*).	Diurnal and nocturnal. Usually forage in water near shore or on bare wet mud at edge of wetlands. Also probe in shallow water, jab at edge of water where water film remains on sand, glean from mud from surface of water, or in drier areas above edge of water. May wade up to belly and will feed by swimming and picking food from water surface (*2*).	Omnivorous. Mainly invertebrates: worms, Annelids (polychaetes), Neridae, molluscs (bivalves, gastropods), crustaceans (amphipods, crabs), and insects (Coleoptera, Dytiscidae, Diptera, Scarabaeidae, Lepidoptera). Also seeds (*Ruppia*)	South Lagoon of Coorong: *Ruppia* seeds, fish (hardyhead), Coleoptera (*Clivina* sp, Staphylinidae) **(*6*)**. Recorded foraging partially on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	High Arctic of N Siberia
Calidris melanotos	Pectoral Sandpiper	A wide variety of freshwater and brackish wetlands, both coastal and inland	Shallow fresh to saline wetlands, usually coastal or near-coastal, but occasionally inland. Includes coastal lagoons, estuaries, bays, swamps, lakes, inundated grassland, saltmarshes, river pools, creeks and floodplains. Wetlands often have open fringing mudflats, and low emergent or fringing vegetation, such as grass or samphire (*2*).	Forages in shallow water or soft mud at edges of, or on low islets in, wetlands, often close to low fringing or emergent vegetation (*2*).		Uncommon non-breeding migrant – arrive Aust Sep-Oct (Northern Aust) Depart SA Mar(?), depart Australia Mar – May (*2*).	Slowly walk on grass fringing water or in very shallow water. Rarely seen on open mudflats. Probe with rapid strokes, probe repeatedly in small area, and will glean.	Omnivorous. Algae, seeds, crustacean, arachnids and insects (Hemiptera, Coleoptera, Dytiscidae)		Arctic
Calidris minuta	Little Stint	Mainly Coastal preferring estuarine mudflats, but also a wide variety of freshwater, brackish and saline wetlands (*2*).	Mudflats and occasionally sandflats or islets of sheltered coastal estuaries, islets and embayments, round mudflats of near-coastal terrestrial wetlands, including shallow freshwater lakes, lagoons and shallow pools (*2*).	Forage on mudflats, in wet mud near edge of water, in shallow water or round shallow pools or channels, also on sandy margins and islets (*2*).	Roost on muddy shore (*2*).	Non-breeding vagrant	Feed actively picking from surface in wet mud near edge of water, probe and occasionally wade (*2*).			N Scandinavia and Russia

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Calidris ruficollis	Red-necked Stint	Mainly Coastal preferring estuarine mudflats, but also a wide variety of freshwater, brackish and saline wetlands (*2*).	Sheltered inlets, bays, lagoons, and estuaries with intertidal mudflats, often near spits, islets and banks, sometimes on protected sandy shores, occasionally on exposed or open beaches, sometimes on stony or rocky shores. Also occur on saltmarsh, ephemeral or permanent shallow wetlands near coast or inland (*2*).	Mostly on bare wet mud on intertidal mudflats or sandflats, or in very shallow water, mostly in areas with film of surface water, close to the edge of water, also less often in very shallow water near to edge of water. During high tide may forage in non-tidal wetlands. May also forage in samphire (*2*).	Roosts on sheltered beaches, spits, banks and islets, of sand, mud, coral or shingle, often in saltmarsh or other vegetation (*2*).	Non-breeding migrant – arrive Aust late Aug (Northern Aust) to late Aug – Nov (SA). Depart SA Feb-Mar, depart Australia Mar – Apr (*2*).	Forage by constantly and rapidly jabbing and probing with bill into soft mud for small invertebrates, also glean from plants in saltmarsh, water and surface substrate. Usually feed for entire period mudflat is exposed (*2*).	Omnivorous: Seeds (Ruppia, Fabacea, Polygonaceae, Boraginacea), Molluscs (gastropods, bivalves), Annelids (polychaetes), Orbiniidae, Pomatiopsidae, Crustaceans (Amphipods), Insects (Diptera, Hemiptera, Coleoptera, Scarabaeidae) (*2*).	South Lagoon of Coorong: *Ruppia* seeds *Ruppia* turions, Coleoptera (*Clivina* sp, Staphylinidae) North Lagoon of Coorong: Nematoda, and unidentified insect material **(*6*)**. Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	NE Siberia and N and W Alaska
Calidris subminuta	Long-toed Stint	Prefer muddy or vegetated edges of coastal and near-coastal freshwater and brackish wetlands.	A variety of terrestrial wetlands. Prefer shallow freshwater or brackish wetlands such as lakes, swamps, streams, river floodplains, and lagoons with areas of muddy shoreline, and growths of short grasses, weeds, sedges, low or floating aquatic vegetation, reeds and rushes and occasionally samphire. Often on muddy fringes of drying ephemeral lakes but also edge of permanent wetlands (*2*).	Forage on wet mud or in shallow water, often among short grass, weeds and other vegetation on islets or around edge of wetlands. Occasionally feed on open water, well away from shore, especially in drying ephemeral wetlands. Recorded foraging in shallow around edge of flooded samphire (*2*).	Usually roost or loaf in sparse vegetation at edge of wetland, and on damp mud in or near shallow water (*2*).	Non-breeding migrant – arrive Aust Aug (Northern Aust) to Sep – Dec (SA). Depart SA Mar-Apr, depart Australia Mar – May (*2*).	Mainly feed on freshwaters, in shallow water on floating weed or algae, or in low vegetation. Glean from surface of mud and water, sometimes probe or turn head to flick over debris. Possibly defend feeding territory in non-breeding period (*2*).	Poorly known. Omnivorous: Seeds, molluscs, crustaceans and insects (*2*).		Siberia

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Calidris tenuirostris	Great Knot	Sheltered coastal habitats Sandy or muddy estuaries and coasts with large tidal mudflats (*2*).	Large intertidal mudflats or sandflats, including inlets, bays, harbours, estuaries and lagoons, also ocean beaches. Often on sandy beaches with mudflats nearby. Occasionally on swamps near coast, saltlakes and non-tidal lagoons. Rarely on inland lakes or swamps (*2*).	Forage on intertidal flats, in soft mud or sand, usually in shallow water, often at edge of water as tide recedes. Occasionally forage on ocean beaches (*2*).	Sheltered sites on spits, banks, islets or beaches, often at edge of water or in shallow water, also in coastal dunes and salt flats among mangroves (*2*).	Non-breeding migrant – arrive Aust late Aug-early Sep (Northern Aust) to Oct – Nov (SA). Depart SA late Feb, depart Australia late Mar (*2*).	Nocturnal and diurnal. Feed mainly on intertidal mudflats rapidly and repeatedly jabbing bill into mud. Probe one spot at a time with several deep jabs. Often feed along edge of tide and sometimes in shallow water. Glean from surface, peck at mud with open bill, probe mud with bill (*2*).	Carnivorous: mainly bivalves, also Molluscs (gastropods, bivalves), Annelids (polychaetes), worms, Crustaceans (decapod crabs, shrimp) Echinoderms and Holothurians (sea cucumber), Sarcodina (foraminifera). Also said to eat seeds berries and insects on breeding grounds (*2*).	In some years recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong ***(3)***	NE Siberia
Cereopsis novaehollandiae	Cape Barren Goose	Grasslands and terrestrial wetlands on southern off-shore islands and adjacent mainland	Congregate on grasslands and pastures with short green grass. Occasionally feed on intertidal mudflats (***4***).	Mainly terrestrial grazing on short green herbage, including grass, pasture, cereal and other crops, particularly pastures that are flat, but occasionally entering water to graze on edges of wetlands or seashore (***4***).	Roost in sheltered parts of breeding areas and on beaches, mudflats, lake edges, sandbars and islets in wetlands, and offshore islands. Records from saltmarshes may refer to roosting birds (***4***).	Partial migrant. Birds from islands that dry out during summer move to pasture on adjacent mainland or larger islands, but others largely resident. In SA all birds leave offshore islands and move to adjacent mainland areas near Lakes Alexandrina and Albert and Eyre Peninsula, in summer/ autumn (***4***).	Diurnal. Graze using tip of bill and backward pulling motion of head to shear herbage (***4***).	Mostly green herbage including pasture grasses and legumes (***4***).		Endemic to southern Australia. Breed on offshore islands in Bass Straight and off South Australia. Breeding period May to Nov (***4***).

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Charadrius bicinctus	Double-banded Plover	Littoral, estuarine and fresh or saline terrestrial wetlands, also saltmarsh, grassland and pasture **(*8*)**.	Braided rivers, beaches, bays and inlets, margins of fresh or saline terrestrial wetlands, including lakes, lagoons, swamps, shallow estuaries and lacustrine rive mouths, short open salt marshes, sometimes associated with coastal lagoons and inland saltlakes Seagrass beds especially *Zostera*, which when exposed at low tide remain heavily saturated **(*8*)**.	Forage on vegetated shingle beds, closely cropped pasture, tilled soil and mudflat. Open wet sand, saltmarsh, shoreline at edge of water,	Roost on bare open areas or among vegetation **(*8*)**.	Partly migratory and dispersive from breeding sites in New Zealand. Non-breeding summer migrant to Australia. Widespread in coastal regions in SA. Depart breeding grounds Oct-Dec, return Aug-early Sep. High site fidelity on wintering grounds **(*8*)**.	Diurnal and nocturnal. Generalist with straight, medium-sized bill enabling pecking and probing for a variety of prey. Visual location of prey. Use foot-trembling in damp habitats **(*8*)**.	Molluscs, insects, crustaceans and spiders, sometimes seeds and fruits. In Australia: molluscs (gastropods), crustaceans (isopods, crabs) and insects **(*8*)**.		Breed in New Zealand Aug to Dec **(*8*)**.
Charadrius leschenaultii	Greater Sand Plover	Coastal in non-breeding season, foraging on sandy beaches and intertidal mudflats **(*8*)**.	Coastal in littoral and estuarine habitats. Mainly on sheltered sandy, shelly or muddy beaches with large intertidal mudflats and sandbanks, sandy estuarine lagoons, also on inshore reefs and rock platforms. Occasionally near-coastal saltlakes (including marginal saltmarsh) and brackish swamps. Rarely on shallow freshwater wetlands **(*8*)**.	Feed on surface of wet mud or sand of open intertidal flats rather than in shallow water. Occasionally on sand in estuarine lagoons. Shores of lakes and rivers **(*8*)**.	Usually on sand-spits and banks on beaches and tidal lagoons **(*8*)**.	Non-breeding summer migrant but recorded in all months in Australia. Birds remaining in Australia are mostly first and second year birds. Arrive Australia mid Aug to Sep, depart Mar-Apr **(*8*)**.	Feed in typical stop-run-peck manner, gleaning and probing in loose flocks. Will wade up to belly, occasionally putting head under water. Recorded foot-trembling in mud and sand to disturb prey **(*8*)**.	Molluscs (gastropods), worms, crustaceans (shrimps, crabs), insects (variety of aquatic and terrestrial taxa) and, occasionally lizards **(*8*)**.		Breed southern Siberia **(*8*)**.
Charadrius mongolus	Lesser Sand Plover	In non-breeding season usually coastal, in littoral and estuarine environments, rarely inland around terrestrial wetlands **(*8*)**.	Beaches of sheltered bays, harbours and estuaries with large intertidal sandflats or mudflats, occasionally sandy ocean beaches, rocky outcrops, sometimes in short saltmarsh. Near-coastal saltpans, brackish swamps **(*8*)**.	Feed mostly on freshly exposed intertidal mudflats and mudflats of estuaries, beaches or, rarely, around inland lakes. Rarely feed at edge of water **(*8*)**.	Roost on beaches, banks, spits and bars of sand or shells on beaches or in estuarine lagoons next to feeding grounds **(*8*)**.	Non-breeding summer migrant. Arrive north Australia Aug-Oct, move down east coast with maximum numbers in most areas in Dec, depart Mar-Apr **(*8*)**.	Typical run-stop-peck manner of *Charadrius* plovers, also stalk worms in holes. Locate prey by sight. Observed shaking feet in sand and mud to disturb prey **(*8*)**.	Molluscs (gastropods), worms, crustaceans (crabs) and insects **(*8*)**.		Scattered breeding in central and ne. Asia **(*8*)**.

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Charadrius ruficapillus	Red-capped Plover	Variety of coastal habitats, especially shelly or sandy beaches with muddy or sandy flats nearby (***8***).	Littoral, estuarine and terrestrial wetlands. Prefer saline and brackish waters, but tolerate varying salinities from fresh to hypersaline. Prefer inland saltlakes, with wide open bare mudflats sparsely vegetated on margins, also on other inland water. Including brackish and freshwater lakes. In coastal areas prefer saline wetlands behind coast including saltmarsh and saltpans, also inlets, estuaries and lagoons (***8***).	Feed on sandflats or mudflats, along shores and margins of estuaries, lagoons and lakes, recorded feeding on dry mat of *Ruppia maritima*. Also forage away from water in non-tidal saline habitat Forage on sandy beaches, lakesides, stream banks, saltmarshes, and pastures (***8***).	On coast, loafing and roosting recorded on sandy beaches or spits, sometimes among beach cast debris, may shelter in sand-dunes on windy days (***8***).	Poorly known. Move between coast and inland wetlands, also between inland wetlands, apparently in response to availability of suitable wetlands. No large-scale seasonal pattern apparent. High numbers often occur at coastal sites in summer, when little surface water inland. At lakes and marshes generally summer-autumn peak with low numbers in winter-spring (***8***).	Typical run-stop-peck manner of *Charadrius* plovers.. Locate prey by sight. Seldom wade and not reported foot-trembling (***8***).	Annelids, molluscs (gastropods), small crustaceans (ostracods, isopods, amphipods, and small crabs), diverse range of insect taxa, and some vegetation (***8***).	South Lagoon of Coorong: *Ruppia* seeds, unidentified plant material Coleoptera (*Clivina* sp) (***6***). Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Endemic to Australia. On coast, breeding is seasonal, with birds dispersing to breed Aug-Jan. Inland breeding in response to rainfall and flooding. Breed in simple pairs on ground in a diverse range of sites. Including brackish or freshwater lagoons, generally near water (***8***).
Charadrius veredus	Oriental Plover	Generally inland, open grasslands in arid and semi-arid zones, less often in estuarine or littoral environments	With regards wetlands: bare sand, rocky, or muddy margins of terrestrial wetlands, estuarine mudflats and sandbanks, ocean beaches. Vagrant in saltmarsh (***8***).	On wetlands forage on mudflats, and on kelp on beaches (***8***).	Roost or loaf on soft deep wet mud and shallow (<1 cm) water of beaches and tidal mudflats (***8***).	Non-breeding summer migrant. Arrive northern Australia Sep to Nov, SA small numbers coastally Dec-Feb. depart Feb-Apr. Straggler in SA (***8***).	Typical run-stop-peck manner of plovers. Glean prey from mudflats, beaches, kelp beds, bare ground and pasture (***8***).	Insectivorous (***8***).		Breed western Mongolia.

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Chenonetta jubata	Australian Wood Duck, (Maned Duck)	Widespread in grasslands, wooded lands and terrestrial wetlands, particularly better-watered parts of inland in mixed farming and gazing areas (***4***).	Particularly associated with small wetlands systems. After breeding gathers beside large open lakes, particularly reservoirs, where congregate on grassy banks and seldom on water. Largely confined to freshwater, but occasional records from coastal saltmarsh and lower reaches of rivers (***4***).	Forage in short grass or herbage, mainly on land, but also in shallow water at edges of wetlands. Activities centre on wetlands that provide open banks or wide beaches for loafing near feeding grounds. Prefer grasslands and pastures, especially short green growth such as clover, but not long coarse growth (***4***).	Generally roost near water (***4***).	Highly dispersive in ephemeral habitat, movement localised in better-watered areas. Post-breeding pairs with young congregate at flocking sites by May, but earlier in dry years, usually disperse to breeding sites Jul-Aug. Heavy rain may act as a proximate stimulus for dispersal inland (***4***).	Feed both day and night. Most food obtained by grazing on land. Also take insects on land and water by rushing at them, or picking them from the water surface. In water feeding zone is restricted to, or just above, surface, rarely upend (***4***).	'Entirely' vegetable (***5***). Grass, clover and other green herbage. Grain and insects when green vegetation unavailable (***4***).		Endemic to Australia. Breeding associated with freshwater wetlands, although nest may be placed some distance from water, in lightly or densely timbered areas, where tree holes provide nest-sites. Breed in simple pairs, solitary. Breed typically Jul to Oct, but can nest all year (***4***).
Chlidonias hybrida (hybridus)	Whiskered Tern	Terrestrial wetlands in permanent swamps or floodwaters (*2*).	Prefer shallow terrestrial freshwater wetlands, either permanent or ephemeral, including lakes, swamps, billabongs, river pool, reservoir, large dam, flooded saltmarsh and farms, often around floodwaters. Usually in wetlands with much submerged and emergent vegetation on margins, including grass, sedges, reeds and rushes. Rarely on saline wetlands (*2*).	Terrestrial wetlands in permanent swamps or floodwaters with vegetated margins or emergent aquatic plants, including grasses, sedges, reeds, and rushes. Forage aerially or feed from surface of water, just below water surface and glean from emergent vegetation, rarely feed on hypersaline lakes (*2*).	In wetlands on muddy spits and banks, among dense reeds, also perch on branches of dead trees etc. During breeding roost on floating nest platform (*2*).	Migratory and dispersive. Africa, Europe, Asia, Australia. Scattered in most regions of mainland Australia. Disperse mid Dec-mid Jan. Most abundant in Summer in S Australia. Dispersive in Australia during breeding period. Move N in none-breeding period (*2*).	Diurnal. Forage aerially over wetlands and over farmland. Fly upwind, low over water, with rapid returns to start downwind. Plunge into water, skim water surface, and hawk (*2*).	Carnivorous. Mainly aquatic invertebrates, then invertebrates of floating and emergent vegetation: Insects, crustaceans, fish and other small vertebrates such as frogs, occasionally seeds, centipedes, spiders, and young waterbirds (*2*).	Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Breed in temporarily flooded terrestrial wetlands and other inundated flats, in water up to 1 m deep. Usually among inundated vegetation. Floating nests attached to vegetation on small islets or submerged bushes. Colonial nesting in large loose colonies (Dec to Mar) (*2*).

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Chlidonias leucopterus	White-winged Black Tern	Mostly coastal or subcoastal fresh or saline wetlands	Frequent tidal wetlands such as harbours, bays, estuaries ns lagoons and their associated flats. Also terrestrial wetlands including swamps, lakes, billabongs, rivers, floodplains and reservoirs (*2*).	In non-breeding areas mainly forage on coastal estuaries and freshwater wetlands and associated vegetation (*2*).	Usually roost or loaf on ground at edges of wetlands, including sand and mudflats, beaches, spits, banks, islets and rocks, occasionally in reeds or low vegetation (*2*).	Non-breeding migrant – arrive Aust Aug-Sep (Northern Aust) to Sep-Oct (SA). Depart SA Apr-May, depart Australia Apr-May (*2*).	Mainly aerially over water or muddy or sandy edges of wetlands, also adjacent land. Beat steadily into wind. Food usually taken from low over water or ground, or from water surface, less often from ground. Hawk and skim water surface. Very rarely dive into water. Often hawk over wetland vegetation (e.g. reeds and rushes, saltmarsh). May also glean insects (*2*).	Carnivorous. Insects (Orthoptera, Coleoptera, Hydrophilidae, Curculionidae, Formicidiae), spiders, fish, skinks (*2*).		Eastern Europe, Russia and China
Chroicocephalus (Larus) novaehollandiae	Silver Gull	Inhabit a wide variety of coastal habitats and inland wetlands (*2*).	In Australia: coasts, ocean beaches, sheltered embayments, harbours, inlets and estuaries, lakes, terrestrial wetlands and agricultural regions. At sea, usually inshore (*2*).	On land, feed from ground where attracted to sites of human refuses. Feed in agricultural land where forages behind machinery. When feeding on intertidal beaches, forage on sand or in clumps of beach cast seaweed. Sometimes forages in shallow water (<5 cm deep), sometimes in moist sand after waves recede, on wet mudflats or reef exposed at low tide. Forages at seas close inshore and around breakers (*2*).	Roost and loaf on sandy intertidal beaches, mudflats, exposed banks of sand and mud and spits, round margins of wetlands and floodwaters, either on dry ground or in shallow water up to 5 cm deep (*2*).	Movements vary: partly migratory, partly dispersive, partly resident and partly sedentary.	Mainly diurnal, when food abundant may forage at night. Use a wide variety of foraging methods: hawking; feed on ground, feed in or over water dipping, skimming, surface feeding, foot paddling, or will dive up to 30 cm below the surface. Will swim on saltlakes taking brine shrimp from just below the surface. Will take eggs and young, scavenge, will feed in associations hunting cooperatively over water and is a kleptoparasite (*2*).	Opportunistic scavengers, semi-commensal on human domestic and industrial organic waste, some are pelagic planktivores, will take a highly diverse range of food types (*2*).	Recorded foraging on food chains based on the *Ruppia tuberosa* system in southern Coorong ***(3)***	Australia and New Zealand. Breeding Jul-Mar at coastal sites in SA. Nests on a diverse range of sites from offshore islands to inland wetlands (*2*).

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Circus approximans	Swamp Harrier	Terrestrial wetlands and open country, mainly well watered SE and SW shallow (***8***).	Mainly confined to wetlands, fresh or salt, often deep swamps with tall emergent vegetation of rush, reeds or sedge (*Phragmites, Typha, Scirpus, Eleocharis, Juncus*, and *Baumea*) and areas of open water. Other habitats include shallow open swamps, saltmarsh and saltpans. Uncommon over marine waters, recorded in coastal dunes (***8***).	Usually search for prey by slow-quartering < 9 m above water surface or ground. Soaring unusual (***8***).	Usually perch low, on posts, stumps, low vegetation. Trees little used. Roost in vegetation in wetlands, tall dense grass or crops (***8***).	Partly migratory. Breeding populations in se migrate north in late summer and autumn and return during late winter and spring. Irregular movements recorded in some near-coastal areas in eastern Australia, mat be dispersive following heavy inland rains (***8***).	Diurnal. Most common method of attack is hover and drop, and occasionally attack from perch. Take prey from water surface, but do not fully submerge. Active on ground, sometimes wade into shallow water, and scavenge, capture prey and feed on land. Hunt over swamps in dune swales and within vegetation where it is sparse or patchy. Often harry swimming waterbirds. Long legs help to catch prey in tall vegetation. Stoop to catch fish. (***8***).	Take small mammals, birds and eggs, large insects, frogs, fish and reptiles (***8***).		Australasia and sw Pacific. Nest in deep swamps with extensive beds of tall reeds or rush, particularly *Phragmites* and *Typha* in which nests are built near or on water, on a raised mound of sticks, grass, reed stems. Breed late Sep to early Dec (***8***).
Cladorhynchus leucocephalus	Banded Stilt	Mainly saline or hypersaline waters of inland and coast, typically large open and shallow (***8***).	In coastal and near-coastal areas large congregations occur at flooded ephemeral saltlakes. Large numbers may also occur in marine wetlands, such as lagoons, inlets, estuaries, sheltered bays, and intertidal flats, especially where evaporation increases salinity of water. Occasionally recorded on lower salinity waters (***8***).	Forages in water of salinity 40 to 145 ‰. Forage by wading in shallows or swimming in deeper water. Rarely drink at freshwater pools (***8***).	Roost or loaf on banks, bars, shores, islands or spits of sand, shell-grit or soil, or in shallow water in saltlakes, salt ponds or lagoons (***8***).	Little known. Dispersive. Movements complex and often erratic, in response to availability of feeding and breeding habitat across the range. Populations coastal and near coastal when arid inlands dry, returning inland to breed after rain or flooding (***8***).	Diurnal. Dependent on availability of prey in ephemeral saltlakes. Forage by pecking, probing and scything in saltlakes, either by wading in shallow water or by swimming often some distance from shore (***8***).	Mainly crustaceans, including branchiopods and ostracods, also molluscs, insects, vegetation, seeds, and roots (***8***).	Brine shrimp. Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Endemic to Australia. Mainly in south and centre. Breed in arid inland at large shallow ephemeral saltlakes inundated by rain or floodwater. Nest on low islands or spits (1 – 1.5 m above water), beside shallow water (10 – 60 cm). Breeding is entirely dependent on suitable conditions in association with heavy rain (***8***).

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Cygnus atratus	Black Swan	Widespread in temperate and tropical terrestrial wetlands, sheltered estuarine and maritime habitats (***4***).	Prefer large permanent waters, avoid those where fast flow, strong wave-action or turbidity prevent establishment of aquatic vegetation, or that are so overgrown or small that take-off is difficult. Terrestrial habitat used when flooded or moist. Shallow freshwater swamps, deep swamps vegetated with tall emergents, fresh meadows, lakes and reservoirs. Range of salinities tolerated from fresh to hypersaline. Common on large salt lakes, coastal lagoons, estuaries, tidal mudflats, saltmarshes (***4***).	Feed in shallow or deep open water, on wetland margins, exposed mudflats, or ashore, wherever floating or submerged aquatic plants, emergent vegetation or soft terrestrial herbage can be reached. Salinity tolerance limited by threshold of tolerance of aquatic food plants like *Ruppia* (***4***).		Adults sedentary in permanently suitable habitat, but young and adults from ephemeral habitats move far and often. Congregates on permanent water during drought (***4***).	Food mainly taken while swimming, either at surface or from bottom, up-ending in deep water to reach depths down to 1 m. Occasionally stand in shallow water while feeding from bottom or water surface, or graze on land.	Almost entirely herbivorous, usually taking leaves and shoots of aquatic plants. Plants include: *Vallisneria*, *Potamogeton*, *Typha*, *Azolla*, *Chara*, and *Ruppia*. Require freshwater. When malting at The Coorong, congregate around freshwater soaks (***4***).	Recorded foraging on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Endemic to Australia. Breeding not well known in wild. Breed in simple pairs, solitary on small (< 2 ha) waters, and on larger waters with fringe of aquatic plants or with constant water level in winter-spring, or in large (10^3) colonies on larger lakes and swamps with fluctuating water levels and abundant food. May nest throughout year (***4***).
Egretta garzetta	Little Egret	In terrestrial wetlands and estuarine and littoral habitats.	Saline wetlands much used in Australia. Prefer intertidal mudflats, mangrove lined estuaries and tidal reaches of water courses, saltpans and saltmarsh. Also use shallow coastal lagoons and salt lakes, and beaches. Also use shallow open areas in freshwater swamps with short or tall emergent vegetation, open lakes and reservoirs(***4***).	Forage mainly in shallow open water (0.1- 0.15 m), also on shores or exposed flats or banks, particularly in areas with soft substrate, abundant aquatic vegetation and little or no emergent vegetation. Able to use deep water where flying birds take fish from surface (***4***).	Roost in trees, on banks, or occasionally artificial structures. In tidal habitats, roosting determined by tidal cycles (***4***).	Movements poorly understood, probably most movements over short distances, but dispersive when necessary. Range has evidently expanded, with first record on River Murray in 1939, and first record in SA during 1952 (***4***).	Active feeder with diverse range of feeding methods. Stands erect and searches for prey, then pursue, will wing-flick on open water, foot stirs to dislodge prey from beneath debris or vegetation, will plunge for fish from air, and hover (***4***).	Aquatic animals, principally fish, but also frogs and insects. Also crustaceans including crayfish and shrimps (***4***).	Regularly recorded foraging on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Africa, Europe, southern Asia, Australia, Papua New Guinea. breed in fresh, brackish or saline wetlands vegetated with trees, in which nests are built. Along coasts, regularly in mangrove forests, inland in swamps or freshwater lakes. Records of breeding at Lake Alexandrina in 1967 (***4***).

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Egretta novaehollandiae	White-faced Heron	Widespread in tropical and temperate littoral and estuarine habitats, and inland wetlands and grass lands.	In all shallow, fresh and marine wetlands, particularly intertidal mudflats, also grasslands. Saline habitat much used. On estuarine mudflats all shallow microhabitats used. Also inhabit saltmarshes and saline and hypersaline lakes. Seasonal variation in habitat with coastal wetlands such as estuaries used as summer/ autumn refuges (***4***).	Forage in open areas over soft or firm substrate, in shallow water (< 0.1 m), on shores or exposed surfaces in wetlands, also regularly away from wetlands on moist or dry surfaces (***4***).	Roost in trees, mangroves, on rocky headlands or beside wetlands. Communal or solitary (***4***).	Poorly understood. Appear to be locally nomadic with regular short distance movements and a few longer distances. Move to coastal estuaries or margins of large inland lakes during summer after breeding, movement to fresh waters and pastures with rainfall in winter-spring (***4***).	Diurnal. Food taken by standing and waiting, gleaning, walking slowly with stealthy approach, scanning, walking quickly, wing flicking and foot-raking. Generally solitary (***4***).	Wide range of aquatic invertebrates and vertebrates. Includes: crustaceans (amphipods, isopods, decapods, notostracans, crabs and shrimps), insects (diverse variety or aquatic and terrestrial taxa), molluscs, cephalopods, spiders, fish, frogs and plant seeds and leaves (***4***).	Regularly recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Australia, New Zealand and Pacific Islands. Breeding badly known, with no detailed studies. Breed in fresh or saline wetlands with fringing or flooded trees, in which nests are built, also use shrubs. Breeds solitarily. Breeding Aug/Oct to Jan/Mar (***4***).
Elseyornis melanops	Black-fronted Dotterel	Terrestrial freshwater wetlands, sometimes brackish, and less often, saline wetlands (***8***).	Margins of terrestrial wetlands, particularly fresh shallow ones with muddy bottoms and margins. Occasionally brackish wetlands, sometimes round waters of high salinity. Very rarely around estuarine or littoral habitats. Avoid densely vegetated areas. May inhabit margins of wetlands with little fringing or emergent vegetation (***8***).	Generally forage on soft fine wet deposits of silt or mud, usually at edge of water, but also occasionally in shallow water. Sometimes on open mudflats with sparse low vegetation, near gravely shorelines of lakes. Occasionally forage in sand or shingle at edge of water, especially where rotting algae stranded (***8***).	Roost along rivers, among saltmarsh, and on piles of dredged shells and mud beside ponds (***8***).	Poorly known in Australia. Mainly sedentary, many remain on or near breeding site (***8***).	Diurnal. Feed in typical walk- or run-stop-peck behaviour of *Charadrius* plovers, also tap and peck, probe into mud to a depth of about 1/3rd length of bill, and glean (***8***).	Molluscs (gastropods, freshwater snails), Annelids (oligochaetes, earthworms) crustaceans (ostracods, isopods, wood slaters), arachnids (mites) and insects (diverse range of aquatic and terrestrial taxa), occasionally seeds (***8***).		Widespread throughout Australasia (except New Guinea). Usually breed on open stony ground. Often on banks beside shallow creeks, rivers, lakes and lagoons. Breed Australia Sep to Feb (***8***).
Erythrogonys cinctus	Red-kneed Dotterel	Margins of terrestrial or permanent terrestrial freshwater wetlands, particularly those inundated by rain or floodwaters (***8***).	Wetlands usually with exposed margins and bottom of soft fine mud or clay, or less often, sand. Water usually shallow and turbid. Often found in open areas among scattered fringing or emergent vegetation (including saltmarsh). Rarely at brackish or saline wetlands, seen on saline swamps, saltlakes, saltmarsh and coastal dune-lakes (***8***).	Forage along muddy margins on shore, or wading in shallow water (1-1.5 cm). Quite aquatic, occasionally swim in deeper water, observed in water at least 30 cm deep. Do not feed on dry land (***8***).	Recorded resting under shade of bushes and floating and resting on water (***8***).	Probably in response to availability of fresh water. Move to coastal areas when inland areas dry. Move to inland areas after wet season or flooding replenishes wetlands. Concentrate on SA coast mainly in summer (***8***).	Diurnal. Glean and probe surface and subsurface of wet mud and, less often, sand, or wade up to belly in shallow water (1-1.5 cm). Swim placing head under water to take prey, do not feed on dry ground and avoid pebbly substrates. Tremble feet in soft substrate to disturb prey (***8***).	Seeds, molluscs (bivalves, gastropods, freshwater snails), annelids, spiders and insects (diverse range of aquatic and terrestrial taxa) (***8***).		Nest at freshwater wetlands, on shores or small islets, often where dense or dead shrubs conceal nests. Usually breed Aug to Dec-Jan. breed in simple pairs with often many pairs in same locality or in colonies (***8***).

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Fulica atra	Eurasian Coot	Terrestrial, estuarine and, rarely, marine wetlands (***8***).	Prefer shallow, permanent or ephemeral wetlands with a high diversity of submerged or emergent aquatic vegetation, often with open and deeper water (> 2 m) for diving. Fresh to saline and sometimes hypersaline, mesotrophic or eutrophic. Swamps, lakes, lagoons, saltpans, freshwater meadows, grass and reed swamps. Occasionally in estuaries (***8***).	Forage in open, deep or shallow water in wetlands, especially where submerged aquatic vegetation occurs, on floating mats of aquatic vegetation, in grassy areas next to wetlands (***8***).	Roost, loaf or shelter among dense, emergent vegetation, in large open areas of water, on grassy margins of wetlands, on mats of floating vegetation (***8***).	Dispersive. No apparent large-scale seasonal pattern of movements. In Australia numbers can change suddenly possibly in response to weather conditions (***8***).	Diurnal. Feed in water and on land. Scrape algae off submerged stems, etc, pick food of water surface while swimming, feed among vegetation, break off young emergent plant shoots and soft white bases, upend in depths up to 40 cm, occasionally immersing whole body, and diving. Graze on land. Fish in flocks up to 100 (***8***).	Almost entirely herbivorous (aquatic vegetation, seeds, grass), but aquatic insects, molluscs, crustaceans and occasionally eggs recorded (***8***).	Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	From Atlantic, through Europe, northern Africa, southern Asia, and Australasia. Breed in permanent or ephemeral wetlands, including floodwaters, among or at edge of floating or dense emergent aquatic vegetation or other emergent vegetation such as weeds, shrubs or trees, sometimes on islands in wetlands. Breed Aug to Feb in southern Australia (***8***).
Gallinago hardwickii	Latham's Snipe	Variety of permanent and ephemeral wetlands. Prefer open freshwater wetlands with cover nearby, especially freshwater meadows, seasonal and semi-permanent freshwater swamps and open freshwaters. Occasionally in saline or brackish habitat (*2*).	Occupy any vegetation around wetlands, including tussock grasslands, sedges, lignum, reeds and rushes, coastal heath and tea-tree scrub woodlands. Readily use modified of artificial habitats including variety of agricultural land (*2*).	Feed on soft mud or in shallow water at edges of wetlands either in open or on bare mud between vegetation (*2*)	During day on ground in vegetation near feeding area usually beside or under clumps of vegetation. (*2*)	Non-breeding migrant - arrive Aust July (Northern Aust) to Sept-Oct (SA). Depart SE by end of Feb, most leave Australia by end of April (*2*).	Crepuscular. Probe soft ground with sensitive flexible tip of bill (*2*)	Omnivorous; seeds and other plant material, earthworms spiders and insects, occasionally molluscs, isopods and centipedes (*2*).		Jun to Jul in northern Japan

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Gallinula tenebrosa	Dusky Moorhen	Permanent or ephemeral terrestrial and coastal wetlands, usually fresh, but sometimes brackish to saline, including swamps, creeks, rivers, lagoons, estuaries, and billabongs (***8***).	Require open water, margins of wetlands often vegetated with emergent or floating vegetation, such as reeds, rushes, grass, waterweed and algae. Seldom far from edge of wetland, often occur on short-grassed surrounds, and herbfields and terrestrial vegetation. Uncommon on saline and ephemeral wetlands (***8***).	Forage in open shallow water (to at least 30 cm deep), among floating vegetation or in open water of wetlands, usually within 100 m of cover. Also on adjacent land, often in grass or herbfields near water. Rarely feed among tall terrestrial vegetation (***8***).	Roost or loaf among reedbeds (often construct platforms of trampled vegetation), on fallen logs or stumps projecting from vegetation, or in trees at wetland margins (***8***).	Little known. Sedentary or dispersive, possibly partly migratory, though reporting rates do not suggest regular long-distance movements (***8***).	Diurnal. Feed in water and on land. Food taken from up to 30 cm below surface. Glean and pack at ground or low vegetation. Prefer feeding in shallow water where there is much vegetation. Sometimes run after insects. While swimming glean from surface and will upend. Do not dive (***8***).	Vegetable matter, seeds, fruit, molluscs, insects, spiders, carrion and faeces. (***8***).	In many years recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Indonesia, New Guinea and Australia. Breed on ground or over water in fringing vegetation. Can breed Aug-Mar, but mainly Sep-Oct (***8***).
Gallirallus philippensis	Buff-banded Rail	Permanent and ephemeral, fresh and saline, terrestrial, estuarine and littoral wetlands, swamps, marshes, lakes, coastal lagoons, saltmarsh, and tidal mudflats (***8***).	Usually among dense vegetation including overgrown grass, rushes, reeds, sedges and other rank vegetation, in or bordering many types of wetlands, estuaries and beaches (***8***).	Forage around vegetated margins of wetlands on mud among or next to tall grass, reeds, rushes and samphire, also on grassy banks or flats next to wetlands, mudflats, among stranded or rotting seagrass in coastal lagoons (***8***).	Roost, loaf or shelter among thick, tall clumps of concealing vegetation such as grass, reeds, rushes or shrubs (***8***).	Not well known. Resident and dispersive, possibly migratory. In southern Australia generally considered a spring-summer visitor. Suggested that birds in southern Australia move in response to availability of water (***8***).	Recorded feeding at all times of day and night, but mostly crepuscular. Feed on ground, usually solitary. Probe and peck in mud, shallow water and on beaches, occasionally in pasture. Capture live prey by stabbing with slightly open bill. Glean for seeds and scavenge strand-line. Drink fresh water (***8***).	Mostly crustaceans, molluscs, worms, insects, sometimes young plants, seeds, and other vegetable matter, fruits, frogs, eggs, carrion and refuse (***8***).		SE Asia, New Guinea, Australia, and New Zealand. Often breed around wetlands or in pasture or crops among dense clumps of grass, rushes, sedges, samphire or shrubs like *Melaleuca*. On islands may nest in trees and hollows, under logs and rocks, on sand or among grass. Breed Aug to Feb (***8***).

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Gelochelidon (Sterna) nilotica	Gull-billed Tern	Inhabit coastal and inland wetlands, coasts and estuaries, croplands and grasslands (*2*).	Prefer shallow, often ephemeral, terrestrial wetlands, fresh or saline, especially lakes, swamps and lagoons, particularly those with mudflats, sometimes on inundated ground, including saltpans, claypans and saltmarsh, or watercourses and associated floodplains. Also occur in sheltered coastal embayments, estuaries and river deltas with tidal sandflats, mudflats or beaches (*2*).	Forage on terrestrial wetlands and, occasionally, sheltered coasts. Food taken from surface of water or from surface of exposed mud or sand at, or near, edge of water (*2*).	Usually roost or loaf at edges of wetlands, mainly on exposed muddy or sandy banks, flats, bars, spits or islets, which are bare or have low vegetation, such as saltmarsh (*2*).	Nomadic and migratory in the Australasian region. Subspecies *macrotarsa* is only taxa in SA, highly dispersive and breeds in Australia. Apparently with regular movement to northern Australia in winter and to southern Australia in summer (*2*).	Generally diurnal, but recorded feeding at night. Three methods of foraging: hawking, dipping (take items from surface), and rarely plunging into water (*2*).	Carnivorous. Insects (Orthoptera, Gryllidae, Acridae, Hemiptera, Coleoptera, lepidoptera, Diptera, Hymenoptera, Formicidae), Annelids, Crustaceans (decapods, crayfish, prawns, crabs), Arthropods (centipedes), fish and small vertebrates especially mice and skinks, occasionally young water birds (*2*).	In one years recorded foraging partially on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	Breeds at scattered sites in N and S America, Europe, Africa, Asia and Australia. Not well known in Australia. Breed on large, often ephemeral, inland lakes and swamps, on local exposed islands, banks, spits of dry mud, sand or occasionally, rocks. Either bare or vegetated with sparse dry grass, reeds and rushes or scattered samphire. Mostly Sep to Jan (*2*).
Glareola maldivarum	Oriental Pratincole	Open country, often near water, usually in lowlands (*2*).	Usually occur on plains, floodplains or grassland with little or no emergent vegetation, on grassy flats and mudflats. Occur near terrestrial wetlands formed by rain, on margins or near billabongs, lakes, creeks and sometimes in small numbers at lagoons, beaches, mudflats and islands (*2*).	Normally hawk over wetlands	Loaf near water during heat of day, roost in areas with no or low vegetation (e.g. samphire), such as claypans	Non-breeding migrant to Australia, where dispersive - arrive Aust late Oct (Northern Aust) Most leave Australia by end of April. Move towards areas of recent rainfall and disperse soon after (*2*).	Hawk for swarming insects. Glean on ground (*2*).	Insectivorous		SE Asia
Haematopus fuliginosus	Sooty Oystercatcher	Strictly marine coastal, usually within 50 m of shore **(*8*)**.	In southern Australia, most common on rocky shores, cliffs, headlands, wavecut platforms. Sometimes in sandy habitats especially beaches with rocky sections, near rocky promontories, or with mudflats nearby, also sheltered estuarine sandflats or sandbanks **(*8*)**.	Prefer rocky intertidal shorelines with little foliose algae. Often feed on rocky areas or sandy beaches near intertidal mudflats **(*8*)**.	Roost on offshore islands, included associated reefs or wave cut platforms, on isolated rocks, on coral beach, on banks or spits of sand or shingle in sheltered bays or inlets **(*8*)**.	Mostly resident, maintaining territories throughout year. Most leave breeding grounds in Apr after moulting, and are absent from islands to at least Oct.	Diurnal and nocturnal. Six basic feeding movements: Stab prey, prise mussels apart, lever prey, hammer prey with tip of bill, scissor mandibles, and stich substrate with continual rapid pecking as they move along. Readily wade belly deep in water, rarely swim **(*8*)**.	Molluscs, crustaceans, polychaetes, ascidians, echinoderms and small fish **(*8*)**.	In one year recorded foraging partially on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	Endemic to Australia. Breed on offshore islands and rock stacks, often close to rocky coasts **(*8*)**.

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Haematopus longirostris	Pied Oystercatcher	Rarely recorded away from shoreline (***8***).	Coastal preferring intertidal mudflats and sandbanks in large marine embayments, also sandy beaches. Less common along rocky or shingle coastlines (***8***).	Forage on exposed sand, mud and rock. On large flats or wide beaches may be far from edge of water. Vic Oct '92: 56% edge of water, 20% on sand or open ocean beach, 7% among seaweed, 7% in water, 7% on rock and 3% in saltmarsh. Feed extensively in wash-zone of ocean beach on ebb and flow tide (***8***).	Mainly roost on sandy beaches, spits dunes, and small islets in sheltered bays, lagoons, inlets, especially if mudflats nearby, also sandy ocean beaches (***8***).	Not well known. Some breeding pairs sedentary, seasonal movement by part of population along coast and between mainland and offshore islands. Flocking after breeding and dispersal to breeding area apparent in some areas. Non breeding season (Jan-Aug) form conspicuous flocks at many sites (***8***).	Diurnal and nocturnal. Mostly forage at low water. Peck and jab in soft substrate. Hammer prey with bill, insert bill tip through gape of shell and then open mandibles, remove visceral mass with scissoring action (***8***).	Molluscs, worms, crabs and small fish. Echinoderms, annelids (earthworms, polychaetes, sandworms), molluscs (gastropods, pulmonata, small bivalves, mussels, pipi, cockles) crustaceans (prawns, crabs), Insects (***8***).	Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Australia and some New Guinea islands. Nest on areas of sand above high water mark on beaches, sandbars, and margins of estuaries and lagoons. Also within or beside saltmarsh, samphire and mudflats. Breed Sep to Dec (***8***).
Haliaeetus leucogaster	White-bellied Sea-Eagle	Maritime habitats, terrestrial wetlands and coastal lands of tropical and temperate Australia, ranging far inland over large rivers and wetlands (***8***).	Prefer large open terrestrial wetlands, particularly deep freshwater swamps, lakes, reservoirs and billabongs. Also shallow freshwater swamps, meadows, deep channels, coastal lagoons, saltmarsh, and ephemeral wetlands inland when filled by floodwaters. Nature of shoreline or emergent vegetation apparently unimportant, providing open water remains (***8***).	Hunt over large open tracts of water, particularly in maritime habitats and open terrestrial habitats (***8***).	Perch and roost in trees, and on tree stumps, reefs and beaches (***8***).	Resident, established pairs mostly sedentary. immature and some adults dispersive. Birds occupying territories on inland waterbodies possibly ore dispersive than birds along coast, forced to move as water disappears (***8***).	Search for prey and carrion from perch or on wing. Patrol up to 60 m above water. Take live prey from on or near surface of water, plunging to at least 40 cm depth (***8***).	Carnivorous, opportunistic. Birds, reptiles, fish, mammals, crustaceans, echinoderms and carrion		From west India east to s China, se Asia and Australasia. Breed on coast and offshore islands, and inland beside large rivers, lakes and swamps, usually in tall trees in or near water but also on cliffs, rock pinnacles and escarpments. Breed Jun to Sep in southern Australia (***8***).

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Himantopus himantopus	Black-winged Stilt	Prefer shallow open freshwater wetlands, especially those with dense growth of short grass or similar emergent vegetation (***8***).	Occur on most types of wetlands, including lakes, lagoons, saltmarsh and closed tidal wetlands. Prefer freshwater, but also occur on brackish and saline waters, such as coastal lagoons and flooded saltpans, and occasionally hypersaline waters, such as saltlakes (up to 145 ‰). Also on intertidal mudflats or sandflats in sheltered tidal inlets including estuaries and river deltas (***8***).	Forage in shallow water or saturated mud in fresh or non-tidal saline waters, often close to emergent vegetation. Occasionally on wet flats or along margins of deep channels in tidal estuaries. Rarely on beaches (***8***).	Roost in shallow water or on banks or islets in sheltered wetlands, on sandflats in estuaries. Roost or feed at high tide, feed at low tide (***8***).	Apparently dispersive in Australia. Movements correlated with seasonal and annual fluctuations in rainfall and availability of wetlands. Birds in Victoria apparently move north in winter (***8***).	Diurnal and nocturnal. In estuarine habitats follow tidal cycles. Forage in water up to belly, on damp pasture, among floating debris and on tidal mudflats. Nine feed methods: peck from surfaces, plunge head into water, snatch flying insects, bill-pursuit on water surface, filtering in mud and weeds, probe bill in substrate, scythe bill through water, laterally probe under substrate, and rake bill through fine shingle (***8***).	Aquatic and terrestrial invertebrates. Molluscs, crustaceans, insects, small fish and occasionally seeds.	South Lagoon of Coorong: *Ruppia* seeds, *Ruppia* turions, fish (hardyhead), Coleoptera (*Clivina* sp, Anthicidae, Staphylinidae, *Sitona* sp, *Apion* sp), Formicida, Arachnid (spider) (***6***). In all years recorded foraging partially on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Cosmopolitan. Breed Australasia and Africa. Breed usually in colonies, on islets or hummocks surrounded by shallow fresh, brackish or saline water. Breed in swamps, streams, rivers, flooded saltmarsh and in mangroves. Breed on ground, but also on loose platform, generally Aug to Dec, but also if conditions suitable (***8***).
Hydroprogne (Sterna) caspia	Caspian Tern	Inhabit a wide variety of coastal habitats, especially estuaries and sandy beaches, and inland wetlands, especially large lakes and rivers (*2*).	Mostly sheltered coastal embayments, including harbours, lagoons, inlets, bays, estuaries, and river deltas, usually with sandy or muddy margins. Also on near-coastal or inland terrestrial wetlands, either fresh or saline, especially lakes (including ephemeral lakes), waterholes, reservoirs, rivers and creeks (*2*).	Usually forage in open wetlands, including lakes and rivers, often preferring sheltered shallow waters near margin, also in open coastal waters. Prefer wetlands with clear water to those with muddy turbid water, rarely in choppy or deep water. In coastal inlets may prefer to forage in tidal channels, or over submerged mudbanks (*2*).	Generally roost or loaf on bare exposed sand or shell spit, banks or shores of coasts, lakes, estuaries, coastal lagoons and inlets. Usually near, but not in, water, rarely in shallows (*2*).	Poorly known in Australasia. Partly resident, partly dispersive and, possibly partly migratory (*2*).	Diurnal. Usually feed by shallow plunging (*2*).	Carnivorous. Almost entirely fish, and crustaceans (decapods, Alpheidae, Penaeidae) (*2*).	In some years recorded foraging partially on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Breed at widely scattered sites in North America, Europe, Africa, Asia and Australasia. Breed on low islands, cays, spits, banks, ridges and beaches of sand or shell, may be in open or among low and sparse vegetation. Recorded breeding in The Coorong. Breed Aug or Sep to Jan (*2*).

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Ixobrychus minutus	Little Bittern	Terrestrial wetlands and, occasionally, estuarine and littoral habitats	Skulk in thick reed beds, flooded shrubland, other dense vegetation mainly in freshwater swamps, marshes or at edge of wetlands, or other fresh waters and occasionally slow moving rivers. Particularly in beds or patches of tall sedge, reeds, or rush (e.g. *Scirpus*, *Phragmites*, *Baumea*, *Typha*, *Juncus*), often > 1.5 m high. Tolerate brackish-saline waters in *Juncus dominated* swamps and wooded margins of coastal lagoons **(*4*)**.	Forage in shallow water or from supporting emergent or aquatic vegetation over deep water **(*4*)**.	Usually roost among dense aquatic vegetation **(*4*)**.	Probably migratory. Most reported sightings throughout continent Aug-Apr, although outside breeding season hard to find. Most leave southeast SA by Mar. Movement through northern Australia may occur from mid-summer. Regarded as winter visitors to southern Papua New Guinea. Return to SA in late August **(*4*)**.	Mainly crepuscular and nocturnal. Food may be taken by standing and waiting at edge of water or perched on emergent vegetation, occasionally jabbing bill at water, or by stealth stalking. May raid nests of reed dwelling birds **(*4*)**.	Mainly small aquatic invertebrates. Recorded taking crustaceans, shrimps, prawns, freshwater crayfish, aquatic insects, fish and frogs **(*4*)**.		Eurasia, Africa and Australia. Breed mainly inland in eastern Australia. Nest in densely vegetated freshwater wetlands, invariably over water, in sedge, reeds or rush, either in pure stands or interspersed in wooded thickets. Breed in solitary simple pairs, in SA recorded laying eggs 2-25 Dec **(*4*)**.
Larus dominicanus	Kelp Gull	Antarctic to subtropical zones, with seas-surface temperatures ranging from 0^{o} to 23^{o} C. In Australia almost exclusively coastal (*2*).	Mostly occur in sheltered parts of coast such as harbours, bays, inlets and estuaries, sandy or rocky beaches, mudflats and banks, and rock platforms. Generally in greater numbers on estuaries rather than nearby beaches (*2*).	Forage on land or in water, rarely in air. Mostly forage on coasts, in either inshore waters or intertidal zone (*2*).	Roost on islands and rock stacks, beaches and estuaries, farmland and playing fields (*2*)	Have become established in Australia since the 1940's. Dispersive, extent varying between colonies. In many parts of Australia resident all year. Have a high fidelity to breeding area (*2*).	Mainly diurnal. Mainly feed from sublittoral to supralittoral zone, in shallow water or scavenging on beach cast food. Pick food from water to depth 0.7 m (*2*).	Carnivorous, generally predators and scavengers, opportunistic. Diet includes molluscs, fish and crustaceans. Diet depends on the availability of prey (*2*).		Circumaustral. Breed on all southern continents.

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Larus pacificus	Pacific Gull	Sandy, or less often, rocky coasts (*2*).	Prefer rocky and sandy beaches, estuaries, bays, harbours and offshore islands (*2*).	Usually forage along coast between high water mark and shallow (< 200 mm) water, on sandy beaches, exposed mudflats and mudbanks. Often on exposed rocky platforms and reefs. Sometimes feed in inshore waters (*2*).	Often roost or loaf in elevated situation, on natural vantage points, such as rocky headlands or artificial structures. Also on sandy beaches, intertidal mudflats and exposed mudbanks	Poorly known. Partly resident and partly dispersive. Move to near-coastal wetlands a or farmland in bad weather (*2*).	Diurnal and nocturnal. Typically patrol tideline in search of prey. Will actively hawk other bird species. Use bill to tear molluscs from substrate. Foot-tremble to disturb prey in loose substrate. Drop gastropods, echinoids and other objects from air to break them	Carnivorous, predator and scavenger. Molluscs, echinoids, fish, birds, and other marine animals, carrion and tide-line wrack (*2*).		Endemic to SA. Breed offshore on rocky islets and rock stacks, usually on raised areas such as ridges and cliffs
Lewinia (Rallus) pectoralis	Lewin's Rail	Densely vegetated, fresh, brackish or saline wetlands, usually with areas of standing water. Favour permanent wetlands but often use ephemeral ones. Swamps, marshes, lakes, small pools, swampy or tidal creeks and streams, saltmarshes, coastal lagoons and estuaries (***8***).	Wetlands used when they have dense fringing or emergent, long or tussocky grass, reeds, rushes, sedges or bracken, occasionally in thickets of other wetland shrubs, such as *Melaleuca* (***8***).	Forage in soft mud or shallow water (< 5 cm) at edges of wetlands, in small pools and channels, usually remaining close to, or in, dense vegetation, such as samphire, but occasionally in open (***8***).	No details (***8***).	Virtually unknown. Sightings rare and observations difficult. May be partly migratory. Some apparently resident or sedentary. A summer visitor in SA with no records Jun-Aug (***8***).	Crepuscular, sometimes diurnal. Feeds solitarily on dry ground, soft soil, mud, reed beds and shallow water by pecking, probing and drilling holes in substrate. In shallow water will sometimes submerge head. only leave cover briefly, exceptionally up to 20 min (***8***).	Molluscs, earthworms, arthropods, especially insects and crustaceans, occasionally frogs and eggs of birds (***8***).		New Guinea, Flores and south eastern Australia. Breeds in swamps and marshes with low dense concealing vegetation, such as sedges, rushes, samphire. breed Aug to Jan in shallow cup or saucer shaped structure in dense cover woven out of rushes or dead grass stems (***8***).

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Limicola falcinellus	Broad-billed Sandpiper	Sheltered parts of coasts (*2*).	Estuaries, harbours, embayments, lagoons, also lagoons, creeks, swamps and lake near coast (*2*).	Large soft intertidal mudflats, or wet sand at edges of coastal and near-coastal wetlands. Also feed in shallow water on muddy edges of ponds (*2*).	On banks on sheltered sand, shell or shingle beaches (*2*).	Non-breeding migrant - arrive Aust late Oct (Northern Aust) to Nov (SA). Depart SE Mar - May, most leave Australia mid April (*2*).	Feed on wet mud and in shallow water, rapidly and repeatedly probing substrate with bill, sometimes immerses head completely (*2*).	Omnivorous: worms, polychaetes, molluscs, crustaceans, insects, seeds and occasionally rootlets and other vegetation (*2*).		
Limosa lapponica	Bar-tailed Godwit	Mainly coastal (*2*).	Largely intertidal sandflats, spits and banks, and less often mudflats, estuaries, inlets, coastal lagoons and bays, often around beds of seagrass and sometimes in nearby saltmarsh (*2*)	Prefer exposed sandy substrates on intertidal flats, banks and beaches; also soft mud often with beds of eelgrass or other seagrasses (*2*).	Sandy beaches, bars and spits; near coastal saltmarshes; and at edge of water in sheltered bays (*2*).	Non-breeding migrant - arrive Aust Aug (Northern Aust) to late Aug-Nov (SA). Depart SE Feb - Apr, most leave Australia first week April (*2*).	Diurnal or nocturnal: varies with tide and time of year. Usually forage near edge of water or in shallow water (probe in mud often in water up to 15 cm deep), mainly in tidal estuaries and harbours. Shallow sewing machine and mowing action (*2*).	Mainly carnivorous: annelids, polychaetes, spionidae, oligochaetes, molluscs, crustaceans (crabs), insects and some plant material (*2*).		Jun to Jul in north eastern Siberia
Limosa limosa	Black-tailed Godwit	Mainly coastal, usually in sheltered bays, estuaries and lagoons. Also near coastal wetlands that are shallow and sparsely vegetated (*2*)	Large intertidal mudflats or sandflats, saltmarsh, saltflats, river pools, swamps, lagoons and floodplains (*2*)	Mainly forage on wide intertidal mudflats (often open and unvegetated) or sandflats, occasionally in shallow estuaries (*2*)	Roost and loaf on low banks of mud, sand or shell, bars, islets and beaches in sheltered areas, also on saltflats (*2*)	Non-breeding migrant - arrive Aust late Aug (Northern Aust) to Nov-Dec (SA). Depart SE Feb - Apr, most leave Australia by mid April (*2*).	Diurnal and Nocturnal. Often wade up to belly in water. Locate food by touch and site. Probe substrate shallow and rapid then suddenly deep to pull out prey. Also glean from ground and vegetation (*2*)	Omnivorous. Invertebrates (molluscs, bivalves, insects) and occasionally seeds; extralimitally, annelids, crustaceans, arachnids, fish eggs and spawn and tadpoles. Seeds and berries on migration (*2*)		May to Jul in north east Siberia and Europe

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Malacorhynchus membranaceus	Pink-eared Duck	Widespread on terrestrial wetlands, with stronghold in inland plains, regularly reaching coast only when mean annual rainfall < 400 mm (***4***).	Almost entirely aquatic. Typically associated with shallow inland wetlands and floodwaters. During dry inland conditions large groups may gather on deep swamps, lakes, and billabongs where food is scarce. Generally uncommon in saline habitats, although many recorded in some brackish or saltlakes, rare on saltpans, saltmarsh flats and coastal lagoons. May be found on estuaries during drought (***4***).	Prefer shallow stagnant turbid water with abundant aquatic fauna and so concentrate in large sheets of floodwater covering shrubby alluvial plains. Gather on warm receding water, clear fast moving recent floodwaters not used. Bill specialised for filter feeding, limits foraging to water and soft mud. Usually feeding away from shore (***4***).	Roost in flocks on edge of water or on low branches over water. Rest on water in mixed species flocks (***4***).	Highly dispersive from inland Australia. Movements related to availability of water. Seasonality of rainfall however gives some regularity to movement. Dry weather inland often causes irruptions to coast, particularly when drought follows flooding. Wet weather inland followed by evacuation of coastal regions (***4***).	Most food taken by filtering through lamellae on side of bill. Feeding occurs while standing in shallow water, or when swimming with heads submerged up to the eyes. Rarely up-end. Birds feed in one of three ways: solitarily, in parallel, or by spinning or 'vortexing' in pairs (***4***).	Mostly invertebrates, particularly chironomid larvae, though take seeds. Animals include: molluscs (gastropods), crustaceans (ostracods, copepods, cladocerans, clam shrimps), rotifers, insects (Diverse range of aquatic taxa) (***4***).	When present recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Endemic to Australia. Huge breeding concentrations form inland on shallow turbid floodwaters over shrubby alluvial plains. Nest on any available surface over water. Breeding stimulated by wetland drying and refilling, usually freshwater, but in WA uses saline water. No precise breeding season. May breed at any time of year when conditions suitable, usually following winter rains (***4***).
Megalurus gramineus	Little Grassbird	Typically in dense vegetation in and on margins of wetlands, either fresh or saline, and some ephemeral (*1*).	Swamps, lakes, saltmarshes, estuaries, creeks and rivers. Mainly in rushlands and sedgelands (e.g. *Typha, Juncus, Phragmites, Baumea, Eleocharis, Bolboschoenus and Gahnia)*, rank grasslands, wet to damp shrublands (commonly in lignum swamps, also in samphire and chenopod shrublands) (*1*).	Forage on ground and in low vegetation such as rushes, dense grass and lignum (*1*).	No information	Poorly known. Widely described as resident or sedentary. Probably local movements, but no evidence of migration (*1*).	Foraging behaviour virtually unknown. Move around reeds quietly almost mouse like while foraging (*1*).	Invertebrates, mainly insects (diverse range of terrestrial taxa), also small molluscs, spiders and rarely seeds (*1*).		Endemic to Australia. Breed early Sep to Jan. Usually over water, low and well concealed in centre of wetland plant, usually in clumps of rushes, reeds, etc (*1*).
Morus serrator	Australasian Gannet	Marine, mostly within limits of continental shelf (***4***).	In South Australia, frequent inshore waters, including gulfs and water around islands, off rocky coasts and sandy beaches. Enter bays, harbours and estuaries (***4***).	Feed in shallow (<5 m depth) or deep water (up to 180 m) waters of coastal shelf, with most fishing observed close inshore (< 5 km from coast) (***4***).	Roost mostly near breeding colonies, and occasionally mainland, presumably at sea at other times (***4***).	Migratory / dispersive, adults leave breeding sites for 3-4 months annually, though movement non-directional. Immatures travel 1000's kilometres N or W during the 3-4 yr pre-breeding period (***4***).	Diurnal, but with no daily pattern of feeding activity. Food usually caught by deep-plunging from up to 20 m and also surface-plunging from 1-2 m. Surface plunging usually adopted in water < 3 m deep (***4***).	Largely small fish, occasionally cephalopods (***4***).		Australia and New Zealand. Colonial nesters usually on steep, small rocky islands and stacks near mainland. Breed broadly from Jul to Feb (***4***).

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Motacilla flava	Yellow Wagtail	Wide range of habitats in non-breeding range. Usually in open areas with low vegetation (*1*)	In Australia recorded in a variety of moist, muddy or grassy habitats, including edges of wetlands (e.g. swamps lakes, freshwater lagoons) (*1*)			Non-breeding summer migrant. Vagrant to southern Australia (*1*)		Primarily terrestrial and aquatic vertebrates (*1*)		Breed Africa, Europe, Asia. Vagrant to southern Australia. (*1*)
Neophema chrysogaster	Orange-bellied Parrot	Occupy a variety of coastal and near-coastal habitats, especially buttongrass plains in breeding area in sw Tas, and saltmarsh at wintering sites in Vic and SA (***9***).	On mainland Australia: Mostly within 3 km of coast. In SA: mostly on beaches and coastal dunes, but also sometimes at edges of estuaries and coastal lagoons (***9***).	Mostly feed among colonising plants, especially searocket *Cakile maritima* on beaches above high-tide mark, also in *Sarcocornia*-dominated saltmarsh. Sometimes recorded in pasture and open grassy paddocks, in heath vegetation or very rarely cultivated crops (***9***).	On mainland roosts in dense clumps and thickets of coastal shrubs, usually less than 1 km from feeding sites (***9***).	Non-breeding migrant to SA and Vic from breeding grounds in sw Tas. Spend non-breeding period on mainland between Gippsland Vic and The Coorong SA. Protracted departure from Tas adults leave late Feb to early Mar. Normally arrive se SA Apr to May, with max in Jun. Rapid return: gone by Sep in SA (***9***).	Feed mostly on ground, sometimes in shrubs. In SA feed during early to mid-morning and mid to late afternoon, with long periods of inactivity during the middle of the day. In Vic take as many seeds as possible from one spot before walking or flying to another spot *c.* 5 m away (***9***).	Almost exclusively seeds and fruit, mainly of sedges and salt-tolerant coastal and saltmarsh plants, occasionally feed on flowers and stems. During wintering period includes: *helianthus annuus, Cakile maritima, Atriplex hastate, Chenopdium glaucum, Sarcocornia quinquiflora, Sclerostegia arbuscula, frankenia pauciflora* (***9***).		Endemic to se Australia. Nest in hollows in mature *Eucalyptus* trees (***9***).

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Neophema petrophila	Rock Parrot	In SA confined to coastal regions, seldom more than a few hundred metres from coast, although occasionally move further inland along estuaries **(*9*)**.	On mainland inhabit sand-dunes, sandy beaches, and rocky areas, often around cliffs or headlands, and saltmarsh and sometimes other swampy areas, usually within a few hundred metres of shore **(*9*)**.	Feed among rocks or in tidal flats and beaches, among low plants such as samphire, pigface, groundsel *Senecio*, *Nitraria*, saltbush and sea rocket, growing along or above high water mark, sometimes foraging among plants as they are exposed by receding tide, also among seeding rushes near shore, and in saltmarshes at edge of salt lakes **(*9*)**.	No information on roosting habitat, often perch in low shrubs or on rocks **(*9*)**.	Resident. Most or all breeding occurs on islands. Resident on at least some islands and no migration recorded. However, pronounced post-breeding dispersal to some islands and recorded > 160 km from known nesting islands. In SA move freely between inshore islands and mainland. May disperse e and s along coast from breeding areas in Eyre Peninsula Dec to Aug but mostly Jan to Mar **(*9*)**.	Feed in morning and late afternoon. Mostly feed on ground, sometimes in low shrubs **(*9*)**.	Seeds and fruits of a wide variety of grasses and rushes, shrubs and halophytic plants in coastal habitats **(*9*)**.		Endemic to southern Australia. Breed Aug-Sep to Dec on small offshore islands **(*9*)**.
Numenius madagascariensis	Eastern Curlew	Sheltered coasts (*2*).	Estuaries, embayments, harbours, inlets, and coastal lagoons with large intertidal mudflats or sandflats, often with beds of seagrass. Often recorded among saltmarsh, and on mudflats fringed by mangroves (*2*).	Mainly soft sheltered intertidal sandflats or mudflats, open and without vegetation or covered with seagrass, often near mangroves. Also on saltflats and in saltmarsh; rock pools; and ocean beach near tideline (*2*).	Sandy spits and islets, dry sand on beach near high water mark. Also among coastal vegetation including low salt marsh and mangroves (*2*).	Non-breeding migrant - arrive Aust July (Northern Aust) to Nov (SA). Depart: most leave Australia late Feb to late Mar (*2*).	Diurnal and nocturnal (poorly known). On sandbanks find burrows of crabs by sight during day or moonlight and by touch when probing in poor light. (*2*).	Carnivorous: Mainly crabs and small molluscs, also insects. (*2*).		Russia and NE China

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Numenius minutus	Little Curlew	Coastal and inland grasslands and black soil plains of N Australia near freshwater swamps and pools or flooded ground	Short, dry grasslands and sedgelands, including dry floodplains and blacksoil plains, which have scattered shallow freshwater pools. Occasionally in open woodland with grassy or burnt understorey, and in dry saltmarshes. Also coastal swamps and on sheltered coasts on mudflats or sandflats of estuaries or beaches (*2*).	Mostly feed in dry grassland or sedgeland, generally in grass < 20 cm tall. Sometimes forage in grassland around pools, riverbeds and water filled tidal channels, occasionally in shallow water at edges of billabongs, among emergent grasses. Also on flooded claypans and floodplains inundated by spring or king tides (*2*).	Congregate to loaf and roost on exposed margins of shallow (< 30 cm) freshwater pools in sparsely grassed floodplain during hottest times of day, occasionally on mudflats when nearby grasslands are unburnt	Non-breeding migrant dispersive in Australia - arrive Aust mid-late Sep (Northern Aust). Depart: most leave Australia first two weeks of April (*2*).	Thrust bills to base into soft ground around roots of grass to take small beetles. Forage in flocks that move across dry grass (*2*).	Omnivorous. Mainly insects, also arachnids, seeds (Poaceae, Fabaceae) and berries (*2*).		Siberia
Numenius phaeopus	Whimbrel	Mainly coastal, on tidal and estuarine mudflats, particularly those with mangroves (*2*).	Intertidal mudflats of sheltered coasts, harbours, lagoons, estuaries, and river deltas. Prefer mudflats with mangroves, but also occur on open unvegetated mudflats. Occasionally on sandy beaches or sand with scattered exposed rocks. Infrequently saline or brackish lakes near coast, saltflats with saltmarsh (*2*).	Forage on intertidal mudflats, and along muddy banks of estuaries and in coastal lagoons, either in open unvegetated areas or among mangroves. Sometimes also on sandy beaches or among rocks (*2*).	Often roost in branches of mangroves round mudflats and in estuaries, occasionally in tall coastal trees. Also on ground on muddy sandy or rocky beaches and rocky islets (*2*).	Non-breeding migrant - arrive Aust Aug-Sep (Northern Aust). Depart: most leave Australia mid-late April (*2*).	Diurnal and nocturnal. Use both visual and non-visual cues to locate prey. On reef flats probe among percolation holes, on beaches, feed at low tide, running in quick bursts and catching prey away from water. Take crabs by probing burrows with bill. In Victoria prefer mud flats with *Zostera* cover, followed by areas of sand and mud and bare mudflats and platforms (*2*).	In non-breeding areas mainly carnivorous, taking annelids (polychaetes), crustaceans (shrimps, crabs), and, rarely, fish and birds. Scavenger of beach cast invertebrates (*2*).		Breeds N and W Alaska

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Nycticorax caledonicus	Nankeen Night Heron	Littoral and estuarine habitats and terrestrial wetlands and grasslands.	Inland prefer permanent waterbodies on floodplains, especially those with woody edges, and swamps with tall emergents. Occur in saline habitats less often, but birds regularly found on mangrove-lined coasts, estuaries, tidal reaches of water courses, and saltmarshes ***(4)***.	Forage over soft or firm substrate, in still or slow moving shallow water, on exposed shores, banks and flats in wetlands, or in swampy vegetation, banks and flats in wetlands, or in swampy vegetation, often where sheltered by tall emergent or ground vegetation, and near trees used for roosting. Can forage in deep water by plunging, either from perches or from aerial sallies ***(4)***.	Daylight roosts in dense cover. Usually in leafy trees close to or away from water, in reeds or other waterside vegetation. Roosting sites of birds breeding on treeless islands probably dense low shrubs ***(4)***.	Poorly understood, generally considered nomadic, depending on availability of food, but some birds probably sedentary in favourable habitat. In general a northern movement of at least part of southern population in winter. Some dispersive movement from drying swamps in Murray-Darling river system.	Mainly nocturnal. Usually stand and wait in erect or crouched posture or walk slowly. Also drop from up to 2 m onto aquatic prey. Feed alone or in large flocks	Mostly aquatic animals, principally fish but also frogs, freshwater crayfish and insects (diverse range of aquatic and terrestrial taxa). But an opportunist that takes any suitable pray when available including newly hatched sea-turtles, nestlings, house mice and human refuse. Also molluscs, freshwater mussels, centipedes, spiders, and crabs ***(4)***.		Indonesian islands, Australia, New Guinea, and New Zealand. Nest in dense cover of trees or shrubs in saline or fresh wetlands. Also breed in treeless offshore islands on ground among shrubs. Breed colonially, usually in central parts of swamps and flooded areas. Breeding broadly in spring and summer, but probably more influenced by rainfall, flooding and water conditions ***(4)***.
Onychoprion (Sterna) fuscata	Sooty Tern	Offshore and pelargic zones of tropical waters, almost never inshore unless forced there by bad weather (*2*).				Rare vagrant in SA				

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Oxyura australis	Blue-billed Duck	Almost entirely aquatic. In winter congregate in large flocks on large clear lakes. For most of the year, confined to deep, densely vegetated swamps (***4***).	On terrestrial wetlands in temperate se and sw parts of continent. Prefer deep water in large, permanent wetlands where condition stable and aquatic flora abundant (***4***).	Secretive, feeding in open water within or beside tall dense vegetation, prefer to stay far from shore if dense cover available in central parts of wetland, Gatherings form on large fresh open lakes and swamps particularly in winter, but in some areas persisting through summer. Saline wetlands and lakes may support large numbers particularly in winter, when salinity is reduced. Do not occur in marine waters	Rarely seen on land. Preen in water. Usually roost in open water or in small concealed bays, not out of water or in thick vegetation (***4***).	Short-distance movements between breeding swamps and overwintering lakes with some long distance dispersal in exceptional years. Migration in populations. Leave breeding swamps Apr-May and return Jul-Aug. In years of low rainfall may remain on breeding swamps throughout the year (***4***).	Dive in deep water to strain mud with sweeping action of head and bill. Filter-feed on surface with similar action. Also take food from surface and pack at overhanging vegetation, stripping seeds with bill. Probably mostly feed during daylight (***4***).	Seeds and leaves of a wide variety of freshwater plants with large numbers of midge, caddisfly and dragonfly larvae. Animals include molluscs (bivalves, gastropods,), crustaceans (copepods, cladocerans), mites, and insects (wide variety of aquatic taxa) (***4***).		Endemic to southern Australia. When breeding dispersed on deep fresh swamps and lakes, densely vegetated throughout or around margins, where rushes or sedges provide soft vegetation for nest building. Breed Sep to Feb (***4***).
Pandion cristatus (haliaetus)	Eastern Osprey	Usually of coasts and estuaries, penetrating inland along rivers. Littoral habitats, terrestrial wetlands and coastal lands of tropical and temperate Australia (***8***).	Extensive sheets of clear open water, fresh, brackish or saline. Predominantly coastal, using variety of marine and littoral habitats including bays, estuaries, beaches and inshore waters. Terrestrial wetlands used mainly near coast including wide rivers, and large lakes (***8***).	Open water (***8***).	May roost on nest, roost and loaf on dead trees, artificial structures, cliffs and rocks (***8***).	Mostly sedentary. Forage over wider area during non-breeding season, returning to same site in successive years. Some dispersal evident during autumn (***8***).	Diurnal, sometimes feed by moonlight. Mostly search by slow soaring, often repeatedly quartering the same area of water, but occasionally sit and wait on waterside perch (***8***).	Mostly fish although small terrestrial vertebrates, seabirds and crustacea also recorded (***8***).		Cosmopolitan. Breed mainly on coasts and islands, near ocean or large waterbody for fishing, in open position for access and visibility. Often in prominent position on rocky headland, stacks, cliffs or in tall dead trees or on artificial platforms. Nest Jul to Sep in southern Australia (***8***).

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Pelecanus conspicillatus	Australian Pelican	Terrestrial wetlands, estuarine and marine, and arid zone ephemeral wetlands (***4***).	Mainly found on waterbodies with large sheets of open water, free of dense aquatic vegetation. Particularly open estuarine waters, saltpans, lakes and coastal lagoons. Nature of fringing vegetation unimportant. Frequent pools in saltmarshes. Also use deep open waters and channels in swamps and lakes vegetated with tall emergents, shrubs or trees. Saline habitat much used (below *c*. 130 ‰) (***4***).	Can use water where depth, low temperature, exposure, or fluctuating turbidity and salinity limit food supply and inhibit use by other waterbirds. Gather at receding floodwaters or seasonal wetlands to feed on trapped fish (***4***).	Require stretches of open shoreline with bare ground or patchy or short vegetation available for loafing (***4***).	Dispersive, numbers in inland Australia varying with inland rainfall (***4***).	Mainly diurnal, but nocturnal with moonlight. Feed alone or in groups. When alone plunges head into water, or scoop prey from shallow water. In flocks drive fish into shallow water (***4***).	Probably mostly fish, but an eclectic carnivore and scavenger taking anything from insects and small crustaceans to ducks and small dogs (***4***).	Regularly recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Australia, Papua New Guinea, Indonesia and Fiji. Breed colonially on low secluded sandy islands, islets or shores, or among low or patchy vegetation. Need undisturbed site with abundant and assured food supply for 3 months for successful colonial breeding. Breed in The Coorong and Lake Alexandrina (***4***).
Phalacrocorax carbo	Great Cormorant	Widespread in terrestrial wetlands and coastal waters (***4***).	Occur inland on lakes, reservoirs, swamps, rivers, pools and billabongs. Associated with large sheets of open water, favouring deep permanent lakes, major rivers or open water in deep marshes. Less common on small waterbodies. Along coasts abundant in estuaries and deep coastal lagoons. Birds unaffected by fluctuations in salinity and turbidity and nature of shoreline vegetation unimportant (***4***).	Forage underwater in sheltered marine and inland waters, favouring estuaries, deep open lakes and lagoons (***4***).	Require trunks, branches, post or islands, in or by water, for perching (***4***).	Nomadic with wide dispersal following successful inland breeding (***4***).	Forage underwater, by pursuit-diving using wings and feet for propulsion, for fish and arthropods. Small prey swallowed underwater (***4***).	Predominantly fish in most habitats, in freshwater occasionally takes large numbers of crustaceans or insects, some amphibians (***4***).	Sometimes recorded foraging partially on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Almost cosmopolitan. In Australia breed mainly in the Murray darling Basin. Breed in colonies. Nest in trees, bushes or reeds, in or near water in lakes, swamps, rivers, billabongs, temporary floodwaters, estuaries and shallow coastal lagoons (***4***).
Phalacrocorax fuscescens	Black-faced Cormorant	Marine and estuarine.	Sheltered marine gulf, bays and inlets (***4***).	Feed in inshore waters, in shallow water or over reefs, seldom enter inlets and bays (***4***).	Roost on islands, offshore rocks, sandbanks (***4***).	Largely sedentary with some dispersal of juveniles (***4***).	Food taken by plunge diving to depths of up to 12 m (***4***).	Small coastal fish (***4***).	Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Australia. Breeding throughout range, sometimes in large colonies (***4***).

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Phalacrocorax melanoleucos	Little Pied Cormorant	Terrestrial wetlands and sheltered coastal waters	Inland use various natural and artificial wetlands, Along coast use deep lagoons and sheltered estuaries, bays and harbours, remaining in sight of land. Also found in saltfields, saltmarshes and shallow coastal lagoons **(*4*)**.	Forage in marine and inland waters, often in small ponds and streams. Feed in open water, but able to use smaller wetlands and smaller areas of open water in vegetated wetlands than other species of cormorant. On large lakes feed in shallow margins where crustaceans most abundant **(*4*)**.	Roost and nest in trees and bushes near water. Perch on trees, stumps, posts, banks of channels and artificial structures **(*4*)**.	Dispersive with some moving overseas **(*4*)**.	Prey caught in succession of brief dives often in circle or zig-zag pattern **(*4*)**.	Mostly freshwater crayfish and other crustaceans, with smaller numbers of fish, particularly carp and perch, and insects **(*4*)**.		Australia, New Zealand. Poorly known. Breed in colonies in a variety of small and large vegetated wetlands, mainly freshwater, on trees and bushes in or near water. Breeding colony Salt Lagoon Island, Lake Alexandrina SA. Nesting Aug?-Nov?, but records for May in SA **(*4*)**.
Phalacrocorax sulcirostris	Little Black Cormorant	Widespread in wetlands and sheltered coastal waters **(*4*)**.	On Australian mainland most common in inland waters, on estuaries and brackish waters **(*4*)**.	Forage in many sorts of inland waters and marine inlets **(*4*)**.	Perch on trees, stumps, posts, banks of channels and artificial structures **(*4*)**.	Dispersive in Australia. Movement of large numbers occurs after drought following wet periods inland. Dispersal to coast and probably overseas **(*4*)**.	Diurnal. Most prey caught by pursuit diving using feet for propulsion. Feed mainly in open waters > 1 m deep. Feed singly or in cooperative groups **(*4*)**.	Mostly fish with small numbers of freshwater crayfish and other crustaceans, insects **(*4*)**.	Sometimes recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	Australia, New Zealand, Indonesia, New Guinea. Widespread in suitable wetlands throughout range. Breed in vegetated swamps and lakes, mainly freshwater, favour flooded trees well away from land in remote parts of large wetlands. Breeding colony Salt Lagoon Island, Lake Alexandrina SA **(*4*)**.
Phalacrocorax varius	Pied Cormorant	Mainly marine, in eastern Australia inhabit terrestrial wetlands and coastal waters **(*4*)**.	Associated with large sheets of open water, particularly permanent freshwater lakes and reservoirs, and open freshwater in deep freshwater marshes. Along coast abundant in estuaries, also occur in coastal lagoons. Birds unaffected by fluctuations in salinity and turbidity and nature of shoreline vegetation unimportant **(*4*)**.	Forage underwater in sheltered marine and inland waters, favouring large permanent open waters and estuaries **(*4*)**.	Require trunks, branches, posts or islands, in or by water, for perching. Roost in trees near water, or on cliffs, offshore rocks, and sandspits **(*4*)**.	Largely sedentary, but some juvenile dispersal **(*4*)**.	Diurnal. All food caught by pursuit diving. Inland **(*4*)**.	Mostly fish with a few crustaceans (prawns, shrimps, crabs) **(*4*)**.	Recorded foraging partially on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	Australia and New Zealand. Breed coastally on rocky or sandy islands offshore or in bays, or in estuaries or tidal creeks, in trees or matted bushes able to support nests. Breeding colony Salt Lagoon Island, Lake Alexandrina SA **(*4*)**.

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Phalaropus fulicarius (fulicaria)	Grey Phalarope	Usually pelagic in non-breeding period found mainly in plankton-rich upwellings of tropical and subtropical seas. At other times, and especially when storm blown, found on a wide variety of coastal and inland wetlands (*2*).	In Australia mostly on shallow lagoons or inundated depressions with open brackish or saline water, generally surrounded by low saltmarsh or grass, with exposed mud at edges (*2*).			Non-breeding vagrant in Australia. Most Australian records between June and July. All populations move east from breeding grounds and then south east across the Atlantic or Pacific Oceans (*2*).	Feeds by picking from the surface water while swimming, may also feed by walking at water edge **(*10*)**			High Arctic
Phalaropus lobatus	Red-necked Phalarope	Usually pelagic in non-breeding period, infrequently recorded on coasts and shallow near coastal wetlands (*2*).	In Australia mainly shallow, fresh brackish or saline near coastal wetlands, usually with muddy edges, including lakes, lagoons, swamps, estuaries, pools and ponds.	Mainly forage from surface of water, either open and unvegetated, or among floating or emergent aquatic vegetation, such as algae and waterweed. Mostly in shallows or occasionally in small shallow pools, rarely along muddy edges or on soft mud spits (*2*).	Roost or loaf in shallow pools or on clay, mud or sand at edges of wetlands or on small islets (*2*).	Non-breeding summer migrant vagrant in Australia. Most Australian records between mid-Oct and early-April (*2*).	Usually take invertebrates on open water, rarely, on mudflats. Swim or wade on water. Spin anticlockwise, occasionally fluttering and pecking at the water. When wading in soft mud or shallow pools take food with single sharp jab (*2*).	No Australasian studies. Mainly invertebrates: floating organisms and aquatic insects (*2*).	When present recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	Arctic, sub-Arctic, North America, Europe and Russia
Philomachus pugnax	Ruff	Generally fresh, brackish or saline wetlands with exposed mudflats at edges (*2*).	Usually terrestrial wetlands, including lakes swamps, pools, lagoons, tidal rivers, swampy fields and floodlands, occasionally on sheltered coasts, in harbours, estuaries and on seashores. Wetlands sometimes surrounded by dense vegetation, including grass sedges, saltmarsh and weeds (*2*).	Mainly on exposed mudflats, in shallow water, or occasionally on dry mud. Also among dry waterside plants (*2*).	Mainly roost among short vegetation (*2*).	Rare non-breeding migrant - arrive Aust Sep. depart Apr (*2*).	Omnivorous in Australia, insectivorous on breeding grounds. Diurnal and nocturnal. Probe and peck in water, on dry land and among dead vegetation at edge of water. May wade up to belly and swim (*2*).	Extralimital: moss and plant fibre, seeds, annelids, molluscs, crustaceans, spiders, insects, fish and amphibians (*2*).		N Europe and Russia

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Platalea flavipes	Yellow-billed Spoonbill	Terrestrial wetlands, wet grasslands, and rarely sheltered marine habitats (***4***).	Mainly inland at fresh or brackish wetlands with sparse or low vegetation. Prefer shallow swamps with abundant aquatic flora, pools, watercourse, billabongs, also on pastures flooded by rain or irrigation, shallow parts of lakes or deeper swamps, either in open water or among emergent vegetation. Rarely coastal at estuaries (***4***).	Structure of bill limits feeding to shallow water < 0.4 m deep over substrate of sand, mud or clay. Birds forage in open water or near aquatic or emergent vegetation or submerged logs that shelter prey. Coastal forage on intertidal mudflats, or on open saltpans, swamps and meadows vegetated with saltmarsh (***4***).	Outside breeding season unknown, probably in trees (***4***).	Little known. Probably no regular seasonal movement in southern Australia (***4***).	Nocturnal and Diurnal. Feed in shallow wetlands with soft substrates. Take food from on or above substrate. Five methods of feeding: Moving forward slowly while slow sweeping of open bill in water; dragging of bill in shallow water; intensive search; probing of waterplant bases and logs; and grabbing with tip of bill (***4***).	Carnivorous. Mainly aquatic insects, particularly backswimmers, with small numbers of freshwater crayfish, fresh water shrimp and fish (***4***). Generally smaller slower prey than Royal Spoonbill.		Endemic to Australia. Breed mainly in southern part of range, usually inland at freshwater wetlands vegetated with trees, lignum or reeds, in which nests are built. Usual breeding season probably Oct to Apr. Large numbers recorded breeding in Lake Alexandrina in 1970 (***4***).
Platalea regia	Royal Spoonbill	Terrestrial wetlands, sheltered marine habitats and wet grasslands, permanent and ephemeral wetlands used in arid interior. Prefer large areas of water. Many habitats used: fresh or saline, permanent or ephemeral, open or vegetated (***4***).	Favoured coastal habitats include estuaries and inlets, less common in open coastal lagoons, unvegetated saltpans and saline swamps. Inland prefer freshwater wetlands, including swamps with semi-aquatic herbs or tall emergent vegetation, in deeper lakes and swamps use shallow margins, and also feed on open water (***4***).	Structure of bill limits feeding to shallow water < 0.4 m deep over substrate of sand, mud or clay. Birds often feed among aquatic or emergent vegetation or submerged logs that shelter prey. Coastal forage on intertidal mudflats covered with seagrass (***4***).	Outside breeding season in trees near feeding area. Roost anywhere when not feeding. Rest and loaf in water near feeding area (***4***).	Sedentary at most coastal sites in Australia with movement inland fluctuating with conditions (***4***).	Nocturnal and Diurnal. Take food from on or above substrate. Five methods of feeding: Slow sweeping of open bill in water; Intensive search; dragging of bill in shallow water; Probing of waterplant bases and logs; and grabbing with tip of bill (***4***).	In fresh water mainly fish, on tidal flats shrimps, also takes other crustaceans (freshwater crayfish), aquatic insects (wide variety of taxa) and molluscs (***4***).	Sometimes recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Probably throughout range in Australia and New Zealand. Colonies nest over or near water, usually in trees, shrubs or reeds. Freshwater wetlands used for breeding, but birds nest also in brackish or saline habitats. Usual breeding season probably Aug to Mar in Australia (***4***).

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Plegadis falcinellus	Glossy Ibis	Terrestrial wetlands and occasionally wet grasslands and sheltered marine habitats	Prefer freshwater wetlands inland, in particular permanent or ephemeral water bodies on floodplains and shallow swamps with abundant aquatic fauna. Also on shores or shallow margins of large lakes or deeper swamps, in open water or among tall emergent vegetation. Uncommon on coast but occasional on estuaries (***4***).	Forage in shallow water over soft substrate or on grassy or muddy verges of wetlands, preferring those providing a variety of water depths (***4***).	Roost in dead or living trees, in or near, water (***4***).	Migratory in at least part of range but movements erratic. Marked N-S movements in eastern Australia, with birds breeding in S during summer and moving N in winter (***4***).	Probe for food mainly in shallows and on land. Food taken in tip of curved bill while probing soft sediments, or taken from surface or from seed panicles of standing grass (***4***).	Mostly aquatic invertebrates (freshwater snails, freshwater mussels, freshwater crayfish), arachnids (spiders, mites) and insects (crickets, grasshoppers, waterboatmen, waterbugs, water beetles, chafers, weevils,and beetles), frogs (***4***).		Widespread from e North America, to w Palaearctic, to Africa, Asia and Australia. Breed usually in fresh or brackish wetlands (swamps, lakes, watercourses, floodwaters), vegetated with reeds, rush, shrubs or trees, in which nests are built. Less often in saline wetlands. Breeding records at lake Alexandrina (1964) (***4***).
Pluvialis fulva	Pacific Golden Plover	Mainly coastal, occurring in estuaries, intertidal mudflats, rocky reefs, beaches and saltmarshes, occasionally far inland (***8***).	Sandy, muddy or rocky shores, estuaries and lagoons, reefs, saltmarsh, and short grass in paddocks and crops, usually coastal. Often-on beaches and mudflats, also sandflats, in estuaries and lagoons. Terrestrial subcoastal wetlands such as fresh, brackish or saline lakes, billabongs and swamps usually with muddy margins and often with submerged vegetation or short emergent grass. Also on saltmarsh (***8***).	Feed on mudflats, saltmarsh, in wave wash, among tide wrack on beaches and in pasture (***8***)	Roost near feeding areas, on sandy beaches and spits, and rocky points, islets and exposed reefs, sometimes under shrubs and trees at top of beach, among vegetation in backing dunes, among beach cast seaweed, also on low saltmarsh (***8***)	Non-breeding summer migrant to Australia. Arrive in Australia Sep-Nov, moving down east coast and across inland routes reaching se SA in Oct-Nov. Leave Australia mid-Feb to May. Small numbers of birds remain in non-breeding range throughout the southern winter (***8***).	Diurnal and nocturnal. Glean and probe for prey in substrate. Run, take short pauses, and then peck. Rarely enter water (***8***).	Molluscs (gastropods, freshwater snails), annelids (polychaetes), insects (variety of terrestrial taxa), crustaceans (small crustaceans and crabs), spiders and occasionally seeds, leaves, lizards, bird's eggs and small fish (***8***).	Once recorded foraging partially on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Breed west Alaska and northern Siberia.

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Pluvialis squatarola	Grey Plover	Almost entirely coastal, but occasionally recorded on inland wetlands **(*8*)**	Mainly on marine shores, inlets, estuaries and lagoons where there are nearby large tidal mudflats or sandflats. Away from coast on margins of saltlakes and saltpans, occasionally near-coastal and inland freshwater or brackish lakes, swamps, lagoons and dams **(*8*)**.	Forage on intertidal mudflats, beaches and occasionally pasture **(*8*)**.	Roost or loaf on unvegetated sandbanks or spits or beaches and in lagoons and estuaries, occasionally muddy margins of estuaries or reservoirs **(*8*)**.	Non-breeding summer migrant. Arrive in Australia early Sep, reaching maximum numbers in southern Australia in Dec. Depart SA in Mar, leave Australia mid-Apr **(*8*)**.	Mainly diurnal. Glean and probe for prey on substrate. Feed in typical stop-start plover fashion. Enter water often. Prey located mainly by sight **(*8*)**.	Molluscs (gastropods, periwinkles), insects (terrestrial taxa), crustaceans (crabs), annelids (polychaetes), and occasionally vegetation and seeds **(*8*)**.		Breed in tundras N of 65° N.
Podiceps cristatus	Great Crested Grebe	When breeding usually on large, deep, open, freshwater water bodies (rivers swamps lakes lagoons) Non-breeding concentrations form on large saline lakes, estuaries and bays, particularly in winter **(*11*)**.	Breeding: Large (> 1000 ha) open freshwater-brackish lakes. Non-breeding: permanent saline (perhaps < 30‰) wetlands: lakes, coastal lagoons, and inlets with *Ruppia maritima*, *Zostera* algae, with sandy or rocky shoreline, or with fringing *Juncus maritima* mangroves or saltmarsh. Also on open water in deep freshwater marshes without emergent vegetation, and with sparse fringing vegetation of sedges, rushes, *Triglochin* on permanent open freshwater deeper than 1 m **(*11*)**.	Grebes tolerate waves of < 0.7 m and visibility underwater of > 0.2 m. Depth of dives: ♀ mean 3.4 m, max 10.2 m and mean 10.2 m from shore; ♂ mean 2.4 m, and mean 13.1 m from shore **(*11*)**.	Rarely on land, when gait awkward **(*11*)**.	Local movement between non-breeding winter flocks and more dispersed breeding sites. Move mostly at night from one water body to another **(*11*)**.	Majority of foraging during dives. Rarely feeding on surface and picking insects from marginal vegetation **(*11*)**.	Mostly fish, mainly by diving in clear water. Also aquatic insects, shrimps, and crustaceans **(*11*)**.	Sometimes recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	Europe, Africa, Asia, Australasia. Breed Oct to Feb in simple pairs on inland lakes and larger waters, usually well dispersed, but sometime concentrated in loose colonies. Normally build a mound or platform of dead waterplants or weeds on or near vegetated margins of large lakes 2-10 m from shore, in depths of 1-2 m **(*11*)**.

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Poliocephalus poliocephalus	Hoary-headed Grebe	Terrestrial to estuarine wetlands of much variety throughout temperate and tropical Australia. Apparently prefer large water bodies, permanent or semi-permanent, but also frequent small waters and temporary waters after flooding. (***11***).	Typically found well away from shoreline on large open waters, estuarine, brackish or freshwater. Common at times on brackish to saline coastal, estuarine and even marine waters. Include: Open water in deep freshwater marshes, natural lakes shallow turbid floodwater swamps, saltpans, lagoons, saline and hypersaline lakes and coastal inlets. Coastal wetlands particularly in winter. In se, s and sw of Australia frequent waters of all sorts and sizes. Probably prefer large (100-500 m wide) sheets of open water 0.5 to 3.0 m deep, with submerged vegetation. Avoid water covered by dense weeds (***11***).	Sharp divisions between dense weed and open deeps water leads to concentrations, particularly submerged plants such as *Ruppia* and *Vallisneria*. If small invertebrates plentiful, clarity of water rather unimportant. Social behaviour may help to find concentrations of food in muddy water. If underwater habitat suitable feed without regard to distance from shore or cover (***11***).	For roosting prefer to be near grassy banks, low sedges, scattered lignum, flooded trees or shrubs, or areas where submergents reach surface (***11***).	Poorly known. Highly dispersive in drier parts of range, some regular movements in coastal areas. Long-distance dispersal suggested by recent arrival in NZ. In se Australia flocks of hundreds or thousands assemble in bays and estuaries during winter (***11***).	Diurnal. Forage largely (±90%) by deep diving. Move slowly with rear elevated and feet waving vigorously, pecking incessantly towards waterweeds or sediment. Feeds less on surface than other grebes (***11***).	Chiefly aquatic arthropods (diverse range of aquatic insect taxa) obtained largely by deep diving. Also freshwater snails, crustaceans (ostracods, decapods, yabbies), fish and amphibians (***11***).	Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Australasia. Prefer to breed in permanent waters or climax stages of semi-permanent floodwaters with open marsh and swamp vegetation and widespread waterweed. Colonies among scattered sedges, reeds, swampmarsh vegetation, *Triglochin*, *Eragrostris* or lignum. No detailed studies. Breed Sep to Dec. Usually in shallow well offshore in small floating platform of waterweeds loosely attached to submergents (***11***).
Porphyrio porphyrio	Purple Swamphen	Terrestrial wetlands and adjacent grasslands, also estuarine and littoral wetlands. Usually 0-370 m above sea level (***8***).	Usually on fresh or brackish water, sometimes at saline, eutrophic and turbid wetlands, permanent, semi-permanent, seasonal and ephemeral. aquatic vegetation round fringes of wetland, and terrestrial vegetation consists of many sorts of sedges, rushes, reeds, shrubs and trees, usually dense (***8***).	Feed on ground and in water in swamps, damp pastures and grasslands. Move out into adjacent wet pasture and sward to graze (***8***)	During much of day keep to denser reed beds where climb, wade through or roost in vegetation over water	Some dispersive movements, possibly partly migratory, some territories maintained year round (***8***).	Diurnal. Graze clover and pasture, pull out monocotyledon tillers or nip them off at base. Glean insects and seeds. Dig for subterranean rhizomes ad roots of clovers and grasses. Will immerse head and swim to get new growth. Does not dive (***8***).	Mainly aquatic vegetation, also seeds, fruits, insects, frogs, lizards, fish, young birds, eggs and small mammals (***8***).		Africa, southern and south east Asia, and Australasia. Communal. Monogamous, polygamous and promiscuous. In reeds in swamps, dams, usually in water but occasionally in isolated tussocks to about 180 m from water. Build nest on platform of beaten-down reds or rushes. Breed in southern Australia Sep to Dec (***8***)

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Porzana fluminea	Australian Spotted Crake	Well-vegetated margins of permanent or ephemeral terrestrial and maritime wetlands. Often in saline, including tidal, wetlands, but also in brackish and fresh wetlands (***8***).	Usually among dense vegetation such as samphire, lignum, canegrass, bluebush, saltbush, reeds and rushes and rank grass or dense thickets of *Callistemon* or *Melaleuca*, or floating water-ribbon. May occur some distance from water (***8***).	Mainly forage at margins of wetlands in shallow (< 5 cm) water or on mud or peat near or among reeds, rushes, saltmarsh, grass or other shrubs, also among floating water-ribbon (***8***).	Roost among dense vegetation (***8***).	Unknown, possibly dispersive. Possibly irruptive as suddenly appear and depart. No seasonal movement suggested. Abundant after floods and heavy rains (***8***).	Diurnal, particularly early and late in day. Feed on ground. Glean and probe on mudflats and in reed beds. Wade in shallow water and swim, probing lunging under water and at emergent vegetation. Often submerge whole head (***8***).	Seeds, molluscs (gastropods, fresh water snails), insects (variety of terrestrial and aquatic taxa), crustaceans (ostracods) and spiders (***8***).		Endemic to Australia. Breed in clumps of dense vegetation in swamps and other inundated wetlands. Breed Aug to Jan, SA mid-Aug to late-Nov (***8***).
Porzana pusilla	Baillon's Crake	Vegetated, permanent to ephemeral terrestrial and coastal wetlands. Waters usually fresh or brackish, also saline (***8***).	Wetlands usually have dense vegetation, often with abundant floating plants, but also occur in open waters with clumped vegetation. Occasionally on saltmarsh, few records in acidic wetlands (***8***).	Forage on mud in and next to reeds and other fringing vegetation. Also feed while wading in either clear water or water covered with *Azolla* and other floating vegetation to a depth of about 3 cm (***8***).	Roost or loaf on floating vegetation or perched just above water on branches of trees or stumps (***8***)	Probably migratory, but little hard evidence and no knowledge of details. Generally disappear from southern part of Australian range Apr-Sep (***8***).	Diurnal. Glean among floating vegetation, saltmarsh, freshwater reeds, mudflats, and shallow water, occasionally wading up to level of body. swim well and reported to dive for food	Mostly aquatic insects, also seeds, snails, crustaceans, and some small vertebrates (***8***).		Africa, Europe, Asia and Australasia. Breed in thick vegetation in shallow water, usually within 20 m of edge of swamp. Nest is a shallow cup or platform with or without a hood, constructed out of dry rushes, grass or water-weed. Breed Sep to mid-Jan in SA (***8***).

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Porzana tabuensis	Spotless Crake	Permanent or ephemeral, terrestrial and littoral wetlands, usually with continuous blocks of tall emergent reeds, sedges or other vegetation. Rivers, tidal creeks and lagoons, lakes, inundated depressions, and salt marsh Also in agricultural areas, heathy flats and coastal scrub (***8***).	In dense vegetation around margins of freshwater swamps, and in well vegetated saltmarsh. Prefer wetlands with flowing water, but avoid deeper, swifter sections. Occur in saline, brackish or fresh water (salinity 0.7-2.45 g/l and pH 6.9-8.2. Only crake normally occurring in acidic (pH<6), fresh, heavily vegetated swamps in sw WA (***8***).	Often remains within deep cover when foraging. Usually forage in mud or shallow water, either in the open or beside concealing vegetation, at margins of wetlands. Prefer to feed at base of reeds, rather than in sedges and rushes (***8***).	In dense vegetation	Unknown, secretive, with biased reporting rates. Fewer records in south in winter claimed to suggest migration (***8***).	Crepuscular. Usually feed on ground. Glean on mudflats, in reed beds, shallow water, tideline and driftline of rivers. Also swim readily. Scratch in litter with feet and turn over litter with bill. Able to survive without fresh water (***8***)	Seeds, fruit, shoots of grasses and aquatic plants, adult and larval insects, molluscs, crustaceans, spiders and carrion (***8***).		Philippines, through Indonesia and Australasia. Usually breed in large, unbroken stands of dense, tall emergents such as reeds, rushes, sedges, grass tussocks and stands of dense shrubs, e.g. *Melaleuca*, growing near water of swamps. Breed Aug-Sep to Nov-Dec (***8***).
Recurvirostra novaehollandiae	Red-necked Avocet	Variety of wetland habitats but generally shallow ephemeral inland wetlands. Prefer saline waters (***8***).	Flooded salt lakes, especially when salinity has been increased by evaporation. Occur in fresh to hypersaline (up to 146 ‰) wetlands. Also use other wetlands, inland and coastal, often ephemeral, including lagoons, shallow swamps, and margins of rivers and estuaries. From near-coastal habitats, birds may move to nearby intertidal mudflats or shallow tidal water in sheltered or estuarine areas (***8***).	Typically feed in shallow water, on soft mud, wadding up to belly (***8***).	Roost on low bare islands or banks near water, in shallow water, or sometimes among low vegetation (***8***).	Not well known. Dispersive, in response to rainfall and changing water levels. No apparent seasonal or regular movements, although at some sites apparently move inland in winter and to the coast in summer. Apparent seasonality affected by change in suitability of wetland, drought or flood.	Diurnal. Wade in shallow water, rapidly sweeping through water and soft mud with long upturned bill slightly opened, close to bottom. Apparently rely on touch to locate prey. Will place head and neck underwater, and even upend, still using scything motion. Swim readily, glean insects from surface of water (***8***).	Insects, crustaceans, occasionally seeds and vegetation. No detailed studies. Animals include: annelids, molluscs, crustaceans (branchiopods, brine shrimps, anostraca), aquatic insects, and fish (***8***).	South Lagoon of Coorong: fish (hardyhead), Coleoptera (*Clivina* sp, Staphylinidae, *Sitona* sp, *Apion* sp), Formicida, Arachnid (spider) North Lagoon of Coorong: *Ruppia* seeds, unidentified plant material, fish Dipteran larvae, Nematoda (***6***). Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Endemic to Australia. Mainly breed at inland saltlakes, on low islands or banks beside shallow water. Lake may be newly flooded or with receding waters. Nest may be on bare ground or among low vegetation. Breed in simple pairs, individually or in colonies. Breed Aug to Dec (***8***).

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Rostratula australis (benghalensis)	Australian Painted Snipe	Terrestrial shallow freshwater (occasionally brackish) wetlands, ephemeral and permanent. lakes, swamps, claypans, inundated or waterlogged grassland or saltmarsh **(*8*)**.	Wetlands with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire, often with scattered clumps of lignum, canegrass or *Melaleuca* **(*8*)**.	Usually on ground or in shallow water. Generally remain in dense cover when feeding, though may forage over nearby mudflats and other open areas such as grassland **(*8*)**.	Sit quietly under cover of grass, reeds or other dense cover during day **(*8*)**.	Unknown. Possibly dispersive or migratory in Australia. Irregular and infrequent occurrence and breeding in some areas. Dispersive movements attributed to local conditions **(*8*)**.	Mainly crepuscular and nocturnal. Feed deliberately in skulking rail-like manner. Glean from edge of water and from mudflats. Probe in soft ground and scythe with bill in shallow water **(*8*)**.	Vegetation, seeds, insects, worms and molluscs, crustaceans and other invertebrates. Animals include: annelids (oligochaetes), molluscs (gastropods, freshwater snails), myriapods (centipedes), and aquatic insects **(*8*)**.		Africa, south and south east Asia, and Australia. Female polyandrous. Nest among tall rank tussocks of grass, reeds, rushes or samphire, frequently on small, muddy islands or mounds surrounded by shallow fresh water, sometimes on shores of swamps. In southern Australia breed Aug to Feb **(*8*)**.
Sterna hirundo	Common Tern	Marine, pelagic and coastal (*2*).	Often in near coastal waters, both on ocean beaches and in sheltered waters, such as bays, harbours and estuaries. Occasionally recorded in coastal and near-coastal wetlands, either saline or freshwater, including lagoons, rivers, lakes, and swamps, sometimes in mangroves or saltmarsh (*2*).	Forage in marine environments, close to shore, including sheltered embayments. Also forage in near-coastal terrestrial wetlands, including estuaries, rivers and swamps (*2*).	Roost or loaf on unvegetated intertidal sandy ocean beaches, shores of estuaries or lagoons, and sandbars (*2*).	Non-breeding migrant. Arrive Aust Aug (Northern Aust). Depart most leave Australia Apr. Uncommon in SA (*2*)	Crepuscular. Feed by surface or shallow plunging, also feed by dipping, taking prey from, or just below, water. Glean from ground (*2*)	Poorly known in this region. Carnivorous. Mainly fish, occasionally insects and crustaceans (*2*)	In one year recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	North America, Europe and Asia.

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Gelochelidon (Sterna) nilotica	Gull-billed Tern	Inhabit coastal and inland wetlands, coasts and estuaries, croplands and grasslands (*2*).	Prefer shallow, often ephemeral, terrestrial wetlands, fresh or saline, especially lakes, swamps and lagoons, particularly those with mudflats, sometimes on inundated ground, including saltpans, claypans and saltmarsh, or watercourses and associated floodplains. Also occur in sheltered coastal embayments, estuaries and river deltas with tidal sandflats, mudflats or beaches (*2*).	Forage on terrestrial wetlands and, occasionally, sheltered coasts. Food taken from surface of water or from surface of exposed mud or sand at, or near, edge of water (*2*).	Usually roost or loaf at edges of wetlands, mainly on exposed muddy or sandy banks, flats, bars, spits or islets, which are bare or have low vegetation, such as saltmarsh (*2*).	Nomadic and migratory in the Australasian region. Subspecies *macrotarsa* is only taxa in SA, highly dispersive and breeds in Australia. Apparently with regular movement to northern Australia in winter and to southern Australia in summer (*2*).	Generally diurnal, but recorded feeding at night. Three methods of foraging: hawking, dipping (take items from surface), and rarely plunging into water (*2*).	Carnivorous. Insects (Orthoptera, Gryllidae, Acridae, Hemiptera, Coleoptera, lepidoptera, Diptera, Hymenoptera, Formicidae), Annelids, Crustaceans (decapods, crayfish, prawns, crabs), Arthropods (centipedes), fish and small vertebrates especially mice and skinks, occasionally young water birds (*2*).	In one year recorded foraging partially on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	Breeds at scattered sites in N and S America, Europe, Africa, Asia and Australia. Not well known in Australia. Breed on large, often ephemeral, inland lakes and swamps, on local exposed islands, banks, spits of dry mud, sand or occasionally, rocks. Either bare or vegetated with sparse dry grass, reeds and rushes or scattered samphire. Mostly Sep to Jan (*2*).
Sterna paradisaea	Arctic Tern	During non-breeding periods, mainly frequents edges of Antarctic pack ice and nearby icebergs (*2*).	In Australia, mostly recorded resting on estuarine beaches and spits. On migration, rest at seas, perching on kelp, logs or flotsam (*2*).			Migratory. Move from Holarctic to non-breeding areas in Antarctic pack ice and back. Regularly in small numbers in Australasian waters, mainly east coast. Mostly recorded during periods of passage. Southern passage mainly Aug to Sep, northern passage Mar to Apr (*2*).	Diurnal. Fly upwind in search of prey and hover before plunging (*2*).	Carnivorous. Mainly fish, crustaceans and insects (*2*).		Breed Holarctic

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Sterna striata	White-fronted Tern	Marine, inhabiting coasts and offshore waters	Coastal seas and exposed rocky coasts, often with islands or stacks, and sandy beaches of sheltered coasts, including bays, harbours, estuaries and lagoons, especially those with banks, spits of flats of sand or shingle. Less often in sheltered environments in Australia (*2*).	Mainly forage offshore in Australia. Forage from surface or just below surface, in turbulent breaking water in or just beyond surf zone, and < 3 km from shore. Occasionally in harbours and coves, in river systems, mainly estuaries (*2*).	Roost or loaf on sandy beaches without wide mudflats, or on spits and bars or peninsulas of sand, shells or shingle (*2*).	Dispersive, possibly partly migratory. Disperse to seas around New Zealand after breeding. Generally arrive SE Australia in May-Jun, depart Jun-Oct (*2*).	Diurnal. Forage mainly by surface or shallow plunging, also feed occasionally by dipping (*2*).	Carnivorous. Mostly fish (*2*).		Most breed New Zealand., some in Bass Straight.
Sternula (Sterna) albifrons	Little Tern	Sheltered coastal environments (*2*).	Lagoons, estuaries, river mouth and deltas, lakes, bays, harbours and inlets, also on sandy ocean beaches (wide and flat or gently sloping) (*2*).	Forage in shallow water of estuaries, coastal lagoons and lakes, usually over channels next to spits and banks. Occasionally forage along coasts, especially around bars off entrances to rivers and lagoons. On rising tides during floods forage in estuary at interface between incoming seawater and muddy lakewater (*2*).	Usually roost or loaf on exposed sand-spits, banks and bars within sheltered estuarine or coastal environments, often at or near edge of water, in shallows or along tideline. Also on sandy shores of lakes and ocean beaches. Prefer sheltered sand-spits surrounded by narrow shallow channels in lakes (*2*).	Migratory. Three separate populations of one subspecies in Australia. East and north Australian populations breed, Asian population is a non-breeding summer migrant. E Aust population birds move north to Java, Lesser Sundas etc, but range not understood (*2*).	Mainly diurnal. Feed by plunging in shallow water of channels and estuaries, and in surf on beaches. On lakes dive and glean items from surface (*2*).	Carnivorous. Mainly small fish, but also crustaceans, insects, annelids and molluscs (*2*).		Europe, Asia and Australasia. Three subspecies one of which breeds in Australia (northeastern and eastern populations) eastern Australian population occasionally breed in SA. Breed spring and summer on sandspits, banks, ridges or islets in sheltered coastal environments, usually within 150 m of tideline. Nest usually a shallow scrape in sand (*2*).

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Sternula (Sterna) nereis	Fairy Tern	More sheltered coasts, on mainland and inshore and offshore islands (*2*).	In embayments, such as harbours, inlets, bays, estuaries and lagoons, and on ocean beaches, rarely out of site of land. Also fresh or saline near-coastal terrestrial wetlands, including lakes and salt ponds. Mostly associated with sandy beaches with spits and banks (*2*).	Forage in shallow water (> 10 cm) of sheltered coasts, embayments and estuaries. Usually close inshore, often near shoreline, over submerged banks or adjacent shallow channels. May forage between and around islands or at sea just beyond breaking waves. Also in coastal lagoons and near-coastal lakes (*2*).	Generally roost or loaf on sheltered sandy beaches and other exposed sandy features, including spits, banks and bars, also sandy islets (*2*).	Partly migratory (poorly known). SA population appear <u>not</u> to move regularly. Appear to move to non-breeding areas of gulf and lakes at Murray mouth (*2*).	Catch fish by plunging in shallow water (*2*).	Almost entirely fish, also plant material, crustaceans and gastropods (*2*).	Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	Australia, New Zealand and New Caledonia. Sep to Mar in southern Australia. Nest above high-water mark on sheltered beaches, spits, bars, banks and ridges, usually of sand but also of shell grit or coral. Either on mainland or on inshore islands and often within estuaries and embankments (*2*).
Stictonetta naevosa	Freckled Duck	Temperate areas of se and sw Australia, where found on terrestrial wetlands. During dry season or drought, birds move off ephemeral breeding swamps, and occupy permanent open waters in breeding and non-breeding ranges. <u>Not</u> recorded in marine or estuarine habitats **(*4*)**.	Prefer fresh densely vegetated waters, particularly floodwater swamps and creeks vegetated with lignum or canegrass. In coastal regions, prefer swamps and lakes with dense thickets of *Melaleuca*, *Casuarina*, or *Leptospermum*. In dry periods move to lakes and reservoirs > 100 ha in area and with salinities up to 34 ‰**(*4*)** Unlike breeding wetlands, many have little emergent or aquatic vegetation, and where fringing cover occurs it is avoided **(*4*)**.	Aquatic habitat, especially shallow productive waters or soft mud at wetland edges **(*4*)**.	Commonly found dayloafing in groups, most often on exposed mudflats, sandspits or headlands, sometimes among dense cover or standing on emergent post or snags. Less often remains as raft in water **(*4*)**.	Dispersive from principal breeding areas including northern SA. In wet years largely sedentary but in dry seasons disperse widely, with most populations in se Australia, moving towards coastal se Australia. Numbers and distribution apparently correlated with inland rainfall**(*4*)**.	Typically nocturnal, crepuscular at feeding areas. Specialised filter feeder. Feed by filtering and dabbling. Wade in shallow water (<5 cm deep) taking most food by bottom filtering, often from very shallow water or soft mud. Also surface filtering when swimming, peck and sweep up floating food, nibble at algae covered logs and other partly submerged objects and upend freely. Will strip seeds from grass heads. Never feed by diving **(*4*)**.	Omnivorous. Gut analyses misleading in suggesting that diet is mostly seeds and vegetative part of aquatic plants including: Ranunculus, Chenopodiaceae, Fabaceae, Convolvulaceae, Boraginaceae, Potamogetonaceae, *Ruppia*, Cyperaceae, and *Chara*. Take a wide variety of animals including: crustaceans (cladocerans, copepods, ostracods), insects (mayfly nymphs, odonatans, bugs, flies and chironomids) **(*4*)**.		Endemic to se and sw Australia. Breeding not well known. Nest-sites well spaced, usually solitary in Lignum. Breeding season is broadly from Jun to Dec **(*4*)**.

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Stiltia isabella	Australian Pratincole	Mainly arid interior on open grasslands, gibber, and claypans (2).	Open plains, also sparsely wooded plains and tussock grassland, and gibber, usually in arid or semi-arid rainfall zones. Sometimes around margins of wetlands (require drinking water) (*2*).	Feed on ground		Migratory. In spring and summer, generally move to southern parts of range to breed returning to northern parts to winter. Many movement dispersive especially in response to rainfall (*2*).	Crepuscular. Forage on ground, stalk prey, also jump or fly small distances into air to catch prey, occasionally hawk (*2*).	Insectivorous. Insects, spiders and centipedes, plant material possibly ingested incidentally		Australia. Need scattered shrubs to breed, normally not around wetlands. Generally Oct-Dec (*2*).
Stipiturus malachurus intermedius	Southern Emu-wren (Mt Lofty Ranges ssp)	Mostly low dense vegetation	Ssp *intermedius* is confined to a few scattered sub-populations on Fleurieu Peninsula: around Deep Creek, Parawa, Myponga, Mt Compass, Nangkita and Finniss. Habitat is characterised by dense vegetation up to 1 m high **(*12*)**. The Southern Emu-wren (Fleurieu Peninsula) mainly occurs in two broad habitat types: freshwater swamp (e.g. wet heathland, sedgeland, reedland) and dry heathland **(*12, 13*)**.	Forage on or near ground in or below dense vegetation including shrubs and grasses **(*14*)**.		Poorly known. Considered resident or sedentary. No large scale seasonal movements recorded. Able to colonise or recolonise ephemeral habitats **(*14*)**.	Forage by creeping, hopping and running like mice through dense low shrubs and across ground, occasionally sally to catch flying insects **(*14*)**.	Almost entirely insectivorous, rarely take seeds. Larvae and adults of a range of terrestrial insects **(*14*)**.		Endemic to Mount Lofty Ranges SA. Nest well concealed close to ground, in dense shrubs or tussocks of grass, sedges, or rushes **(*14*)**.

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Tachybaptus novaehollandiae	Australasian Grebe, (Little Grebe)	Wetlands of all sorts, in varying terrain, mainly freshwater. Unusual in brackish or saline waters (***11***).	Found on all sorts of rather shallow freshwaters from small dams to larger lakes and marshes, tending to be mostly near shore and in fringing vegetation rather than in open water, also less likely on brackish and saline waters. Probably prefer rather small open waters with some cover of tall aquatics and banks with herbs or scrub and fairly deep permanent clear water (***11***).	Typically feed where gradient of bottom is steep, near steep banks, and at edges of reed beds with patchy emergents, clumps of submergents, submerged logs, and carpets of *Azolla* or coarse floating vegetation. On open lakes, found away from banks, normally where there are snags, logs, protruding trunks, gradients of depth and edges of dense reed beds (***11***).	Only accidental on land (***11***).	Poorly known. Possibly migratory in n, resident in e and sw, dispersive inland. No evidence of regular long-distance movement in se or sw of Australia, although regular flocking in autumn and winter. Movements must be extensive as indicated by recent colonization of NZ (***11***).	Feeding methods vary more than in most other grebes and include: diving (55% obs, probably two different types of feeding dives), swimming with head and neck immersed and turning rhythmically from side to side, floating in one position, peering through carpets of surface vegetation, stealing in crouched pose upon insects perched on floating vegetation, snatching insects from substrate. Feed intensely during morning and evening twilight (***11***).	Fish, snails and wide variety of aquatic arthropods. Suggested preference for free swimming prey (***11***).	Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Australasia. Depend for breeding on fringes or patches of emergent vegetation for anchoring and concealing nests, usually on fertile, permanent and semi-permanent wetlands, preferring mosaic of cover and open water. Breeding poorly known. Breeds in simple pairs, territorially, main breeding period Sep to Dec (***11***).
Tadorna tadornoides	Australian Shelduck	Equally at home in terrestrial and aquatic habitats. Found in grasslands and croplands, terrestrial wetlands, estuarine waters, and occasionally wooded grasslands. Tolerate high salinity, but need freshwater for drinking (***4***).	Particularly favour large lakes, large shallow swamps on alluvial plains and open parts of deep freshwater swamps, greatest densities on waters near rich dryland feeding grounds, with short grass, pasture, grain or seed crops. Common on estuarine mudflats, salt lakes and coastal lagoons Also tidal and inland rivers, saltmarsh, rush dominated swamp or sheltered inshore waters (***4***).	Feed by grazing at water margins and by upending in water, but on water feed only where bottom can be reached from surface (***4***).	By day rest in loose groups on muddy margins or far out in water (***4***).	Most of population migratory between dispersed breeding sites and moulting places, with birds being philopatric to nest sites. Gather for moult in summer on large permanent waterbodies with open aspect, on fresh or saline lakes, reservoirs and estuaries. Moult sites Oct to Feb (***4***).	Crepuscular. Employ many feeding techniques such as grazing, surface dabbling, upending in shallow water, paddling, sifting biotic ooze, combing shorelines and other opportunistic behaviour. Able to drink highly saline water (***4***).	Poorly known, but appears to be a diverse range of vegetation and invertebrates. Animals include: molluscs, mussels, crustaceans, cladocerans, and insects. Plants include: *Medicago, Trifolium, Vallisneria, Potamogeton*, Cyperaceae, Poaceae, Chlorophyta and *Chara* (***4***).	South Lagoon of Coorong: *Lamprothamnium* tubers 78%, *Ruppia* tubers 13%, *Ruppia* foliage 6%, *Lepilaena* seeds 1% (***6***). Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Endemic to Australia. Breed throughout range, usually in hollow trees, but in places in crevices on island shores and beneath shrubs in saltmarsh. Breed Jun to Nov (***4***).

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Thalasseus (Sterna) bergii	Crested Tern	Coastal, normally inshore, except around offshore breeding islands	Exposed ocean beaches or sheltered embayments, such as bays, harbours, inlets, estuaries and lagoons. Often on offshore islands, regularly in pelagic waters, occasionally on coastal saline lakes (*2*).	Mainly in inshore waters, and often close to beaches and shores of islands. Also in estuaries and sheltered inlets, sometimes in shallow water over submerged beds of seagrass (*2*).	Usually roost or loaf on bare flat sandy areas, either near edge of water in exposed intertidal zones, or above high water mark on beaches, banks, spits, shoals, islets, and cays, also in estuaries and tidal lagoons (*2*).	Poorly known. Throughout range, considered resident, dispersive and partly migratory (*2*).	Diurnal. Mainly feed by plunging. Feed from surface of sea to approximately 1 m deep (*2*).	Carnivorous. Mainly fish, occasionally prawns and squid (*2*).	Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	Widespread and scattered on islands off east and south coasts. Breed on islands, cays, and banks of sand, shells, coral or rock. Breed in The Coorong (> 1200 chicks 1970-71) (*2*).
Thinornis rubricollis	Hooded Plover	Coasts and coastal and inland saltlakes	In se Australia prefer sandy ocean beaches. Occasionally on tidal bays and estuaries. Regularly use near-coastal saline and freshwater lakes and lagoons, often with saltmarsh. In SA regularly recorded on ephemeral hypersaline lagoons and lakes in summer, autumn and winter (not surveyed in spring) **(*8*)**.	In coastal lagoons and saltlakes in SA, in summer foraged mostly on dry substrate, occasionally on damp substrate at edge of water, by winter as water level rose mainly foraged on damp substrate and in shallow water **(*8*)**.	On coastal lakes, roost along edges	Poorly known. Evidence of seasonal flocking in se Australia, appear to breed on inland saltlakes, moving in non-breeding season to costal lakes.	Diurnal and nocturnal. Forage on beaches especially in wave wash zone, lagoons and saltpans. Feed in run-stop-peck manner typical of *Charadrius* plovers, both gleaning and probing **(*8*)**.	Annelids (polychaetes), molluscs (bivalves, gastropods), crustaceans (amphipods, crabs), insects, turions and seeds. Plants include *Ruppia tuberosa* **(*8*)**.	Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong **(*3*)**	Endemic to southern Australia. Recorded breeding in salt lakes of The Coorong. Breed on sandy ocean beaches strewn with seacast seaweed, in narrow strip between high-water mark and base of dunes. Breed Aug to Jan in SA, predominantly Oct-Nov **(*8*)**.

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Threskiornis molucca	Australian White Ibis	Inhabit wetlands of almost any sort. Terrestrial wetlands, sheltered marine habitats and grasslands (***4***).	In inland prefer shallow swamps with abundant aquatic flora and open freshwater. Wet grasslands or agricultural land used mainly when prey abundant. Also freshwater meadows, swamps with tall emergent vegetation and shallow parts of larger lakes or deeper swamps. Saline habitat regularly used: estuaries (mainly intertidal mudflats) and saltmarsh, coastal lagoons and beaches (***4***)	Prefer feeding in shallow water over soft substrate or on muddy flats and shores, also away from wetlands in moist grasslands, often in open areas or where vegetation is sparse (***4***).	Nocturnal roosts in trees on seashore or over water in freshwater marshes, near rivers (***4***).	Adults sedentary in south east Australia.	Walk slowly using long curved bill to probe substrate or to peck food from surface of both land and shallow water. Visual predator, but most food detected by mechanoreceptors in tip of bill (***4***).	Carnivorous. Small usually aquatic animals including fish, frogs, crustaceans (diverse range of taxa including freshwater crayfish, isopods, shrimp, crabs), insects (diverse range of taxa), molluscs including freshwater mussels, spiders, earthworms, and occasionally snakes, also take carrions (***4***).		Australia and New Guinea. Breed in fresh, brackish or saline wetlands vegetated with reeds, shrubs, or trees, in which nests are built. Suggested that coastal breeding is stimulated by seasonal rise in water levels, but inland associated with drying wetting cycles. Breeding recorded at Lake Alexandrina 1964. Breed Sep-Jan (***4***).
Threskiornis spinicollis	Straw-necked Ibis	Wet or dry land in grassland or cultivated land, also in shallows or around margins of wetlands, mainly freshwater (***4***).	Mainly distributed away from coast. Prefer pasture and cultivated land where land is wet. Grasslands, cultivated land, terrestrial wetlands (meadows, shallow swamps with semi-aquatic herbs, abundant aquatic vegetation and tall emergent vegetation) and rarely, sheltered marine habitats. Saline habitat regularly used: estuarine mudflats and saltmarsh, coastal dunes and beaches (***4***).	Feed in damp or dry grasslands often away from wetlands, or in aquatic shallows < 0.25 m deep, where vegetation short or patchy enough for unimpeded movement (***4***).	Nocturnal communal roosts in trees (***4***).	Partially migrant with some birds probably sedentary near breeding sites, other regularly travel long distances either seasonally or as local conditions vary. Two major migratory trends: seasonal N-S movement between se (spring-summers) and n (autumn-winter) Australia; and regular movement between coastal refuges and inland breeding sites (***4***).	Long curved bill used for probing spider holes and crevices in soil, tussocks of grass and sedges or into shallow water. Food probably detected more by sight than touch (***4***).	Carnivorous. Wide range of small animals depending on habitat but including: frogs, crustaceans (diverse range of taxa including freshwater crayfish, isopods, shrimp, crabs), fish, insects (diverse range of taxa), molluscs (including freshwater snails, mussels, bivalves, gastropods), spiders, reptiles (lizards, snakes), rats, mice (***4***).		Australia and New Guinea. Breeding widespread in Australia. Breed communally in fresh, brackish or saline wetlands, vegetated with reeds, shrubs or trees in which nests are built. May nest on ground on islands or wetland margins. In eastern Australia breeding conditions usually created with flooding, but permanent wetlands with stable waters also used. Breed Aug-Dec in south (***4***).

SPECIES ***Genus species***	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Tribonyx ventralis	Black-tailed Native-hen	Opportunistic. Permanent or ephemeral terrestrial wetlands in low rainfall areas. In almost any open dry area close to water and cover (***8***).	Though favour fresh or brackish water, often on shallow and more saline drying ephemeral wetlands. May occur on coastal flats, among samphire and coastal scrub (***8***).	Forage at waters edge or on open ground near wetlands. Grassy or muddy margins of water holes, lakes, swamps, river and creeks, also green or dry pastures or crops (***8***).		Dispersive and highly irruptive. May make regular seasonal movement. In Victoria reporting rates increase in spring and summer and decrease in (***8***).	Diurnal. Feed in water and on ground. Glean from ground and surface of water. Feed gregariously or in pairs, alternately running and stopping in order to disturb insects. Submerge head and shoulders in water (***8***).	Seeds, plant material and insects (***8***).	Recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Endemic to Australia. Breeding poorly known. Usually breed near water, in swamps, round waterholes, dams. Lakes or river flats. Often among clumps of dense or rank vegetation. Usually breed Aug to Dec (***8***).
Tringa brevipes	Grey-tailed Tattler	Wide variety of coastal habitats and waterways (*2*).	Sheltered coasts with reefs and rock platforms or intertidal mudflats. Intertidal rocky, coral or stony reefs, platforms and islets. Also on intertidal mudflats in embayments, estuaries, and coastal lagoons, especially fringed with mangroves. Occasionally around near coastal wetlands (*2*).	Usually forage in shallow (*c*. 2 cm) water, on hard intertidal substrates. Also on exposed intertidal mudflats, especially with mangroves and possibly seagrass nearby. Occasionally on intertidal sandflats, round banks of seaweed or protruding rocks (*2*).	Usually roosts in branches of mangroves, or rarely in dense stands of other shrubs. Where mangroves are not present roosts on rocks, and on beaches and reefs rarely on bare sandy beaches (*2*).	Non-breeding migrant - arrive Aust late Aug-early Sep (Northern Aust) to Sept-Nov (SA). Depart SE by Mar-Apr, most leave Australia by early-mid April (*2*).	Diurnal. Locate prey by sight or by probing rocky shores, reef crests, areas of reef rubble, and along edge of water of beaches and mudflats Crabs possibly more important food source before migration, chase amphipods out of water (*2*).	Carnivorous. Polychaetes, molluscs, crustaceans (amphipods, isopods, crabs), insects and occasionally fish (*2*).		Siberia
Tringa flavipes	Lesser Yellowlegs	Coastal and inland wetlands usually with emergent vegetation Fresh to hypersaline (*2*).	Grassy ponds and marshes, shores of shallow open lakes, lagoons and pools,, coastal estuaries and mudflats, sheltered bays, inundated pastures and rivers (*2*).	Mudflats in shallow water up to belly, in salt ponds and among small fringing halophytic plants (*2*).	Edge of lakes and in field with other waders (*2*).	Non-breeding vagrant - arrive Aust ? Depart Australia Mar (*2*).	Probe mud or sand, seize invertebrates waving bill through water.	Take aquatic insects, range of small invertebrates, tadpoles and frogs, small fish		North America

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Tringa glareola	Wood Sandpiper	Well-vegetated shallow freshwater wetlands. Fresh water to brackish (*2*).	Swamps, billabongs, lakes, pools, typically with emergent, aquatic plants or grass, and dominated by taller fringing vegetation (dense stands of low to tall rushes, reeds, and shrubs). Also frequent inundated grassland, short herbage or wooded floodplain where floodwaters are temporary or receding. More rarely brackish wetlands or dry stunted saltmarsh (*2*).	Forage on moist or dry mud at edges of wetlands or in shallows, either along shores, among scattered aquatic vegetation, or in clear shallow water (*2*).	Recorded loafing on low, grassy hillock in flooded meadow (*2*).	Non-breeding migrant - arrive Aust Aug (Northern Aust). Depart SE Mar - Apr, most leave Australia Mar-Apr (*2*).	Wade in shallow fresh water, often up to belly, gleaning prey from surface of water, probe sometimes with head and neck submerged, and sweep bill from side to side under water (*2*).	Carnivorous: Insects (Orthoptera, Hemiptera, Coleoptera, Diptera, Coelopidae, Hymenoptera, and Formicidae) and Molluscs (*2*).		Eurasia
Tringa nebularia	Common Greenshank	Wide variety of inland wetlands and sheltered coastal habitats, of varying salinity (*2*).	Typically with large mudflats, and saltmarsh, mangroves or seagrass, including embayments, harbours, river estuaries, deltas and lagoons. Frequent permanent or ephemeral terrestrial wetlands including swamps, lakes and saltflats (*2*).	At edge of wetlands, in soft mud on mudflats, in channels or in shallows round edge of water (*2*).	Roost and loaf round wetlands, in shallow pools and puddles, or slightly elevated on rocks, sandbanks or small muddy islands (*2*).	Non-breeding migrant - arrive Aust Aug (Northern Aust) to Oct-Nov (SA). Depart SE Mar - Apr, most leave Australia in April (*2*).	Diurnal and nocturnal, finding prey mainly by sight, but also by touch. Wade in shallow water, pursue insects on water surface and in air, fish taken by dash and lunge technique, swim, up-end, foot tremble in mud and raise small stones (*2*).	Carnivorous: molluscs, crustaceans, insects, occasionally fish (*Galaxias*) and frogs. Molluscs: gastropods; bivalves; Crustaceans: cladocerans; ostracods; malocostracans: shrimps; Insects: Hemiptera: Corixidae; Notonectidae; Coleoptera: Carabidae; Dytiscidae; Diptera; Hymenoptera: Formicidae (*2*).	Recorded foraging partially on food chains based on the *Ruppia tuberosa* system in southern Coorong ***(3)***	Palaeoartic
Tringa stagnatilis	Marsh Sandpiper	Permanent or ephemeral wetlands or varying salinity (fresh to brackish, and recorded at saltwater habitats), avoid open beaches (*2*).	Swamps, lagoons, billabongs, saltpans, saltmarshes, estuaries, pools or inundated floodplains and intertidal mudflats (*2*).	Shallow water at edge of wetland, may wade far from shore. Probe wet mud of mudflats or among marshy vegetation (*2*).	Recorded roosting or loafing on tidal mudflats, near saltmarsh and around inland swamps (*2*).	Non-breeding migrant - arrive Aust Sep (Northern Aust) to Sep-Dec (SA). Depart Australia Mar-Apr (*2*).	Usually feed in shallow water, often wading deeper than level of tarsus. Generally pick at surface of water or mud, may glean from vegetation, rarely lunge and grab prey, recorded scything and probing (*2*).	Carnivorous: Insects and Molluscs, plant material has been found in stomachs of birds in Australia (*2*).	In one year recorded foraging predominantly on food chains based on the *Ruppia tuberosa* system in southern Coorong ***(3)***	E Europe, S Siberia and N China.

SPECIES *Genus species*	Common Name	Habitat - General	Habitat types	Microhabitat - Foraging	Microhabitat - Roosts	Movement	Foraging Behaviour	Food General	Food CLL	Microhabitat – Breeding
Tringa totanus	Common Redshank	Sheltered coastal wetlands (*2*).	Bays, rivers, estuaries, lagoons, inlets, saltmarsh with bare open flats and banks of mud or sand. Also around salt lakes and freshwater lagoons (*2*).	Open mudflats with samphire and tidal pools. Shallow water, on wet bare mud or sand, or on algal deposits, round edges of wetlands. May be near rocks or samphire (*2*).	Small elevated areas, such as estuarine sandbars and muddy islets surrounded by water (*2*).	Non-breeding migrant - arrive Aust Sep (Northern Aust) to Sep-Dec (SA). Depart Australia Feb - Mar (*2*).	Diurnal and nocturnal, with time of feeding, diet and method varying with season. Locate prey by sight in daylight and touch at night. Brisk walk stopping every few steps to peck, probe infrequently and often wade (*2*).	Carnivorous: worms, molluscs, crustaceans, spiders and insects, also recorded taking fish and tadpoles (*2*).		N Temperate Eurasia
Vanellus miles	Masked Lapwing	Wide range of natural and modified open habitats usually near water (***8***).	Prefer short-grassed areas, often at margins of shallow, fresh or saline terrestrial wetlands including permanent or temporary swamps, marshes, lakes, receding floodwaters, saltmarshes, lagoons. Also in sheltered coastal areas, such as intertidal mudflats, estuaries, river deltas, coastal lagoons, sheltered embayments and muddy, sandy or rocky beaches (***8***).	Forage on ground in short grass, bare areas of gravel or mud, or sparsely grassed areas. Usually forage in wet pasture and grassland, but will feed on mudflats, on beaches and in shallow water (***8***).	Roost on ground in short grass, bare areas of gravel or mud, or sparsely grassed areas (***8***).	Resident. Adults tend to remain in general area from year to year. In Australia flocks will form in winter and autumn, but origins of birds in flocks is unknown (***8***).	Diurnal, although often heard flying at night. Stalk, run and peck pray, glean and probe. Walk or run, lunge and stab at prey. Seeds and leaves said to be eaten when insects are scarce in dry or cold weather (***8***).	Molluscs (gastropods, bivalves), annelids (oligochaetes), centipedes, millipedes, insects (diverse range of taxa), crustaceans (isopods), and occasionally seeds, leaves and frogs (***8***).	Recorded foraging partially on food chains based on the *Ruppia tuberosa* system in southern Coorong (***3***)	Australasia. Nest on ground in short (< 12 cm) grass or bare, stony or sealed ground, often near water. Breed late Jul to early-Dec in southern Australia (***8***).
Xenus cinereus	Terek Sandpiper	Coastal (*2*).	Mostly marine intertidal mudflats in sheltered estuaries, embayments, harbours and lagoons (*2*).	In open on soft wet intertidal mudflats, especially near mangroves and occasionally in samphire. On exposed rock platforms forage in lower littoral zone, but in rocky areas will use the supralittoral zone where a film of water covers the sand. Seldom near edge of water. (*2*).	Prefer to roost in or among mangroves. Elsewhere may roost with other waders on flat shores, on muddy spits, islets or banks, sometimes on sandy and pebbly beaches (*2*).	Non-breeding migrant - arrive Aust Aug (Northern Aust) to Sep-Nov (SA). Depart Australia Apr – mid May (*2*). First year birds remain during breeding season (*2*).	Forage on beach at high tide on stranded seaweed and at low tide along edge of water or in lower littoral zone on bare rock (*2*). Glean from surface of mud or in water, chase prey along sand or in water	Carnivorous: Crustaceans (amphipods, crabs) and Insects (Coleoptera and Diptera), also extralimitally seeds, molluscs and arachnids (*2*).		Eurasia

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Appendix C: Predicted Waterbird Microhabitat Use at the Study Site

Recorded habitat use by water dependent bird species (Appendix B) was used to populate this habitat matrix of critical habitats within the Coorong and Lakes Alexandrina and Albert Ramsar site.

For ease of interpretation the table was split into the five broad foraging guilds identified in Section 3.2. Within each of four general landscape scale habitat types (lake, lagoon, estuary, and fresh groundwater shallow swamp), the foraging habitats identified above (i.e. deep water (> 30 cm), shallow water (< 30 cm), intratidal / seiche zone, shoreline, and supratidal / flood zone), were divided into subsections based on substrate type present (i.e. emergent / fringing vegetation, mudflats and sandflats, floated and rooted leaved aquatic vegetation, algae, and rocky substrate). This subdivision of foraging habitats resulted in 33 relatively discrete microhabitat categories appropriate to the wide range of waterbird foraging behaviours and specialisations.

Finally each species potential use of each microhabitat type was indicated under three water quality scenarios (fresh, saline, or hypersaline). Bird species salinity tolerance was inferred from recorded use of these habitats in the literature (see Appendix B) and from recent survey data (Appendix D).

Foraging Guild	Species	Common Name	Fresh																Saline																													Hypersaline																	
			Lake								Estuary				Shallow swamps fed by fresh groundwater				Lake									Estuary					Lagoon															Lake						Estuary	Lagoon										
			Deep water > 30 cm	Shallow water <30 cm		Seiche zone				Flood zone	Deep water > 30 cm	Shallow water < 30 cm	Intertidal - Variable Shoreline		Deep water > 30 cm	Shallow water < 30 cm	Seiche zone	Flood zone	Deep water > 30 cm	Shallow water <30 cm		Seiche zone				Flood zone		Deep water > 30 cm	Shallow water < 30 cm	Intertidal - Variable Shoreline		Supratidal	Deep water > 30 cm	Shallow water < 30 cm				Intertidal / seiche zone - Variable Shoreline						Supratidal / flood zone				Deep water > 30 cm	Shallow water < 30 cm	Seiche zone			Flood Zone	Deep water > 30 cm	Deep water > 30 cm	Shallow water < 30 cm			Intertidal / seiche zone - Variable Shoreline				Supratidal / flood zone		
				Reed Beds	Mudflats and sandflats	Reed Beds	Mudflats and sandflats	Rocky substrate	Water edge	Reed Beds		Mudflats and sandflats	Mudflats and sandflats	Water edge	Aquatic vegetation	Reed Beds	Reed Beds	Fringing vegetation		Reed Beds	Mudflats and sandflats	Reed Beds	Mudflats and sandflats	Rocky substrate	Water edge	Reed Beds	Saltmarsh		Mudflats and sandflats	Mudflats and sandflats	Water edge	Saltmarsh		Reed Beds	Mudflats and sandflats	Aquatic vegetation	Algal beds	Reed Beds	Mudflats and sandflats	Water edge	Exposed aquatic vegetation	Exposed algal beds	Rocky substrate	Saltmarsh	Fringing vegetation	Mudflats and sandflats	Reed Beds		Mudflats and sandflats	Mudflats and sandflats	Rocky substrate	Water edge	Saltmarsh			Reed Beds	Mudflats and sandflats	Algal beds	Mudflats and sandflats	Water edge	Exposed algal beds	Rocky substrate	Saltmarsh	Fringing vegetation	Mudflats and sandflats
fringing / emergent habitat	*Acrocephalus australis*	Australian Reed Warbler, (Clamorous Reed-Warbler)		•		•				•						•	•			•		•				•								•				•									•								•									
fringing / emergent habitat	*Dasyornis broadbenti*	Rufous Bristlebird																																																															
fringing / emergent habitat	*Fulica atra*	Eurasian Coot	•	•							•				•	•			•	•								•					•	•		•	•											•	•					•	•	•		•							
fringing / emergent habitat	*Gallinula tenebrosa*	Dusky Moorhen		•	•	•	•			•		•	•			•	•	•		•	•	•	•			•			•	•				•	•	•		•	•								•																		
fringing / emergent habitat	*Gallinula ventralis*	Black-tailed Native-hen			•	•	•		•	•																																																		
fringing / emergent habitat	*Gallirallus philippensis*	Buff-banded Rail				•	•			•			•				•	•				•	•			•	•			•		•						•	•					•	•	•	•																		
fringing / emergent habitat	*Ixobrychus minutus*	Little Bittern		•		•				•						•	•	•		•		•				•							•				•							•		•																			
fringing / emergent habitat	*Lewinia (Rallus) pectoralis*	Lewin's Rail		•	•	•	•			•		•	•			•	•	•		•	•	•	•			•	•		•	•	•	•		•	•			•	•					•	•	•	•																		
fringing / emergent habitat	*Megalurus gramineus*	Little Grassbird		•		•				•						•	•			•		•				•							•				•									•																		
fringing / emergent habitat	*Porphyrio porphyrio*	Purple Swamphen		•	•	•	•			•		•	•			•	•	•		•	•	•	•			•			•	•				•	•	•		•	•						•	•	•																		
fringing / emergent habitat	*Porzana fluminea*	Australian Spotted Crake		•	•	•	•		•	•		•	•	•		•	•	•		•	•	•	•		•	•	•		•	•	•	•		•	•			•	•	•	•			•	•	•	•		•	•		•	•				•	•		•	•			•	•	•
fringing / emergent habitat	*Porzana pusilla*	Baillon's Crake		•	•	•	•		•	•		•	•	•		•	•	•		•	•	•	•		•	•	•		•	•	•	•		•	•	•	•	•	•	•	•	•		•	•	•	•																	
fringing / emergent habitat	*Porzana tabuensis*	Spotless Crake		•	•	•	•		•	•		•	•	•	•	•	•			•	•	•	•		•	•	•		•	•	•	•		•	•	•		•	•	•				•		•	•																	
generalist / scavanger	*Chroicocephalus (Larus)*	Silver Gull			•		•	•	•			•	•	•							•		•	•	•		•		•	•	•	•			•	•	•		•	•	•	•	•	•	•	•			•	•	•	•	•				•	•	•	•	•	•	•		
generalist / scavanger	*Larus dominicanus*	Kelp Gull										•	•	•						•										•	•	•				•				•	•	•	•	•						•	•	•	•		•	•	•	•	•	•	•	•	•			
generalist / scavanger	*Larus pacificus*	Pacific Gull																				•		•	•	•				•	•	•				•				•	•			•			•				•	•	•	•						•		•	•		•			•
generalist / scavanger	*Tadorna tadornoides*	Australian Shelduck			•		•		•			•	•	•				•				•		•		•		•		•	•	•	•			•	•	•		•	•	•	•				•			•	•		•					•	•	•	•	•			•	•
herbivore	*Anas castanea*	Chestnut Teal		•	•	•	•		•	•		•	•	•		•	•	•		•	•	•	•		•	•	•		•	•	•	•		•	•	•		•	•	•				•	•	•	•		•	•		•	•				•	•		•	•			•	•	•
herbivore	*Anas gracilis*	Grey Teal	•	•	•	•	•			•	•	•	•		•	•	•	•	•	•	•	•	•			•	•	•	•	•		•	•	•	•	•	•	•	•					•	•	•	•	•	•	•			•	•	•	•	•	•	•	•	•		•		•	•	•
herbivore	*Anas superciliosa*	Pacific Black Duck	•	•	•	•	•			•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	?	?	?		?		?	?		?								
herbivore	*Aythya australis*	Hardhead (White-eyed Duck)	•								•				•				•									•					•																																
herbivore	*Cereopsis novaehollandiae*	Cape Barren Goose													•			•																•					•																								
herbivore	*Chenonetta jubata*	Australian Wood Duck, (Maned Duck)				•	•		•									•																																														
herbivore	*Cygnus atratus*	Black Swan	•		•		•				•	•	•	•	•				•		•		•		•		•	•	•	•		•	•	•	•	•		•		•	•		•		•		•	•	•			•	•	•		•		•	•	•		•		•		•
herbivore	*Limicola falcinellus*	Broad-billed Sandpiper					•						•											•							•								•							•																			
herbivore	*Neophema chrysogaster*	Orange-bellied Parrot																									•					•												•																				
herbivore	*Neophema petrophila*	Rock Parrot																									•					•												•	•	•							•										•	•	•
herbivore	*Oxyura australis*	Blue-billed Duck	•								•				•				•									•					•																																
insectivore	*Stipiturus malachurus intermedius*	Southern Emu-wren (Mt Lofty Ranges ssp)														•	•																																															
insectivore	*Vanellus tricolor*	Banded Lapwing																																																															
piscivore / carnivore	*Anhinga melanogaster*	Darter	•								•				•				•									•					•															•						•	•										
piscivore / carnivore	*Biziura lobata*	Musk Duck	•								•				•				•									•					•															•						•	•										
piscivore / carnivore	*Botaurus poiciloptilus*	Australasian Bittern		•	•	•			•	•		•	•		•	•	•	•		•	•	•	•		•	•	•		•	•	•	•		•	•			•	•	•				•	•	•	•																		
piscivore / carnivore	*Chlidonias hybrida (hybridus)*	Whiskered Tern	•	•	•	•	•			•					•	•	•	•	•																																														
piscivore / carnivore	*Chlidonias leucopterus*	White-winged Black Tern	•		•		•				•	•	•		•				•		•		•					•	•	•			•		•				•																										
piscivore / carnivore	*Circus approximans*	Swamp Harrier	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•		•	•	•
piscivore / carnivore	*Egretta garzetta*	Little Egret	•		•						•	•			•				•		•						•	•	•			•	•		•	•	•							•				•	•				•	•	•		•	•		•		•		
piscivore / carnivore	*Egretta novaehollandiae*	White-faced Heron		•	•	•	•		•	•		•	•	•		•	•	•		•	•	•	•		•	•	•		•	•	•	•		•	•	•	•	•	•	•	•	•		•	•	•	•		•	•		•	•				•	•	•	•	•	•		•	•	•
piscivore / carnivore	*Gelochelidon (Sterna) nilotica*	Gull-billed Tern	•		•		•		•		•	•	•	•	•				•		•		•		•		•	•	•	•	•	•	•	•	•				•	•				•		•		•	•	•		•	•	•	•		•						•		•
piscivore / carnivore	*Haliaeetus leucogaster*	White-bellied Sea-Eagle	•		•		•				•	•			•				•		•		•				•	•	•	•				•		•				•					•		•		•	•	•			•	•	•						•		
piscivore / carnivore	*Hydroprogne (Sterna) caspia*	Caspian Tern	•		•						•	•			•				•		•							•	•				•		•													•	•					•	•										
piscivore / carnivore	*Morus serrator*	Australasian Gannet									•																		•					•															•						•	•										
piscivore / carnivore	*Nycticorax caledonicus*	Nankeen Night Heron	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•		•	•	•	•																		
piscivore / carnivore	*Onychoprion (Sterna) fuscata*	Sooty Tern																																																															
piscivore / carnivore	*Pandion cristatus (haliaetus)*	Eastern Osprey	•								•				•				•									•					•															•						•	•										
piscivore / carnivore	*Pelecanus conspicillatus*	Australian Pelican	•		•		•				•	•			•				•		•		•					•	•	•			•		•	•			•									•	•	•				•	•		•	•							
piscivore / carnivore	*Phalacrocorax carbo*	Great Cormorant	•								•								•									•					•															•						•	•										
piscivore / carnivore	*Phalacrocorax fuscescens*	Black-faced Cormorant																	•									•					•															•						•											
piscivore / carnivore	*Phalacrocorax melanoleucos*	Little Pied Cormorant	•		•		•				•				•				•		•							•					•															•						•	•										
piscivore / carnivore	*Phalacrocorax sulcirostris*	Little Black Cormorant	•								•				•				•									•					•															•						•	•										
piscivore / carnivore	*Phalacrocorax varius*	Pied Cormorant	•								•				•				•									•					•															•						•	•										
piscivore / carnivore	*Platalea flavipes*	Yellow-billed Spoonbill		•	•	•	•			•		•	•			•	•	•																																													
piscivore / carnivore	*Platalea regia*	Royal Spoonbill		•	•							•				•				•	•						•		•				•	•	•	•													•							•	•	•					•		
piscivore / carnivore	*Plegadis falcinellus*	Glossy Ibis		•	•	•	•					•	•			•	•			•	•	•	•						•	•	•																																			
piscivore / carnivore	*Podiceps cristatus*	Great Crested Grebe	•								•								•									•					•																														
piscivore / carnivore	*Poliocephalus poliocephalus*	Hoary-headed Grebe	•								•				•				•									•					•															•						•	•										
piscivore / carnivore	*Sterna hirundo*	Common Tern	•		•						•	•			•				•		•							•	•				•		•													•	•					•	•										
piscivore / carnivore	*Sterna paradisaea*	Arctic Tern									•																	•																							•											
piscivore / carnivore	*Sterna striata*	White-fronted Tern									•		•																•					•																														
piscivore / carnivore	*Sternula (Sterna) albifrons*	Little Tern			•							•								•								•						•																														
piscivore / carnivore	*Sternula (Sterna) nereis*	Fairy Tern			•							•								•								•						•															•								•								
piscivore / carnivore	*Tachybaptus novaehollandiae*	Australasian Grebe, (Little Grebe)	•	•		•				•	•				•	•	•		?	?		?				?		?					?	?		?		?																							
piscivore / carnivore	*Thalasseus (Sterna) bergii*	Crested Tern	•		•						•	•			•				•		•							•	•				•		•	•												•	•					•	•										
piscivore / carnivore	*Threskiornis molucca*	Australian White Ibis			•		•		•			•	•	•				•			•		•		•		•		•	•	•	•			•				•	•	•			•	•	•																			
piscivore / carnivore	*Threskiornis spinicollis*	Straw-necked Ibis		•		•										•		•			•		•				•	•					•		•		•	•	•			•			•	•		•						•		•		•			•		•	•	
shallow / edge water	*Actitis hypoleucos*	Common Sandpiper			•		•	•	•			•	•	•							•		•	•	•		•		•	•	•				•				•	•			•			•			•	•	•	•					•		•	•		•			•
shallow / edge water	*Anas rhynchotis*	Australasian Shoveler			•		•					•				•				•		•						•					•	•	•		•																										
shallow / edge water	*Ardea ibis*	Cattle Egret														•	•	•																																												
shallow / edge water	*Ardea intermedia*	Intermediate Egret	•	•	•						•	•			•	•			•	•	•						•	•	•			•	•	•	•	•	•							•	•		•																			
shallow / edge water	*Ardea modesta (alba)*	Eastern Great Egret, (White Egret)			•		•					•									•								•						•	•																													
shallow / edge water	*Ardea pacifica*	White-necked Heron		•	•					•		•	•			•	•	•		•	•	•	•			•	•			•	•		•																																	
shallow / edge water	*Arenaria interpres*	Ruddy Turnstone											•																•		•							•		•	•	•	•		•				•	•		•								•		•	•	•		•
shallow / edge water	*Calidris acuminata*	Sharp-tailed Sandpiper			•		•		•													•		•		•		•		•	•	•	•			•	•	•		•	•	•	•		•	•	•			•	•		•	•				•	•	•	•	•		•	•	
shallow / edge water	*Calidris alba*	Sanderling											•	•									•		•		•			•	•	•							•	•		•		•					•		•	•						•	•	•		•		
shallow / edge water	*Calidris canutus*	Red Knot																													•	•									•	•	•	•																					•	•				•
shallow / edge water	*Calidris ferruginea*	Curlew Sandpiper			•		•		•			•	•	•							•		•		•				•	•	•				•				•	•						•			•	•		•					•		•	•					•
shallow / edge water	*Calidris melanotos*	Pectoral Sandpiper		•	•	•	•			•		•	•			•	•	•		•	•	•	•			•			•	•				•	•			•	•						•	•	•																		
shallow / edge water	*Calidris minuta*	Little Stint			•		•		•			•	•	•							•		•						•	•	•				•				•	•																										
shallow / edge water	*Calidris ruficollis*	Red-necked Stint			•				•			•		•							•				•		•		•		•	•			•					•				•					•			•	•				•			•			•		
shallow / edge water	*Calidris subminuta*	Long-toed Stint	•	•	•	•	•					•	•			•		•				•		•																																											
shallow / edge water	*Calidris tenuirostris*	Great Knot											?	?								•		•						•	•								•	•						•						•						•	•					
shallow / edge water	*Charadrius bicinctus*	Double-banded Plover					•		•				•	•						•		•		•			•	•	•							•	•				•		•				•		•	•						•	•			•		•
shallow / edge water	*Charadrius leschenaultii*	Greater Sand Plover																			•		•	•			•		•	•		•				•				•				•	•																							
shallow / edge water	*Charadrius mongolus*	Lesser Sand Plover																												•	•	•							•	•			•	•		•															•	•		•	•		•
shallow / edge water	*Charadrius ruficapillus*	Red-capped Plover											•										•				•			•		•							•		•	•	•	•	•	•					•			•						•		•		•	•	•
shallow / edge water	*Charadrius veredus*	Oriental Plover					•	•	•			•	•									•		•	•					•	•						•		•		•				•			•																			
shallow / edge water	*Cladorhynchus leucocephalus*	Banded Stilt																	•		•							•	•	•				•		•				•									•	•					•	•		•								
shallow / edge water	*Elseyornis melanops*	Black-fronted Dotterel			•		•		•			•	•	•							•		•		•		•		•	•	•	•				•				•	•	•	•		•		•																		
shallow / edge water	*Erythrogonys cinctus*	Red-kneed Dotterel		•	•	•	•		•	•		•	•	•		•	•	•		•	•	•	•		•		•			•	•	•			•	•	•		•	•	•	•			•	•	•	•		•	•		•	•				•	•		•	•			•	•	•
shallow / edge water	*Esacus neglectus*	Beach Stone-curlew																																																															
shallow / edge water	*Gallinago hardwickii*	Latham's Snipe		•	•	•	•									•	•	•		•	•	•	•			•																																						
shallow / edge water	*Glareola maldivarum*	Oriental Pratincole					•					•						•				•							•							•							•																			
shallow / edge water	*Haematopus fuliginosus*	Sooty Oystercatcher											•	•													•	•								•	•		•	•														•	•	•	•			
shallow / edge water	*Haematopus longirostris*	Pied Oystercatcher											•														•										•				•			•				•	•					•		•			•			•
shallow / edge water	*Heteroscelus brevipes*	Grey-tailed Tattler																																																															
shallow / edge water	*Himantopus himantopus*	Black-winged Stilt		•	•		•		•			•	•	•						•	•	•	•		•	•	•		•	•	•	•		•	•				•	•				•	•	•			•	•		•	•				•	•		•	•			•		•
shallow / edge water	*Limosa lapponica*	Bar-tailed Godwit																					•				•			•		•							•		•	•		•		•				•			•				•		•		•		•		•
shallow / edge water	*Limosa limosa*	Black-tailed Godwit										•	•	•						•		•		•		•		•	•	•	•			•				•	•				•		•			•	•		•	•				•		•	•			•		•
shallow / edge water	*Malacorhynchus membranaceus*	Pink-eared Duck	•		•						•	•			•				•		•		•				•	•	•				•		•				•																										
shallow / edge water	*Motacilla flava*	Yellow Wagtail		•	•	•	•		•							•	•	•																																													
shallow / edge water	*Numenius madagascariensis*	Eastern Curlew					•						•										•				•			•		•							•					•						•			•						•				•		
shallow / edge water	*Numenius minutus*	Little Curlew					•						•					•				•				•			•		•							•					•	•	•																			
shallow / edge water	*Numenius phaeopus*	Whimbrel											•																•		•							•					•		•																					
shallow / edge water	*Phalaropus fulicaria*	Grey Phalarope																			•															•																													
shallow / edge water	*Phalaropus lobatus*	Red-necked Phalarope		•	•		•		•			•		•						•	•				•				•		•			•	•	•	•			•									•			•				•	•		•					
shallow / edge water	*Philomachus pugnax*	Ruff			•		•					•	•					•					•				•		•	•		•			•				•					•	•	•			•	•			•				•		•				•	•	•
shallow / edge water	*Pluvialis fulva*	Pacific Golden Plover					•	•	•			•	•	•								•	•	•		•			•	•	•							•	•	•	•	•	•	•	•				•	•	•	•				•	•	•	•	•	•	•	•	•
shallow / edge water	*Pluvialis squatarola*	Grey Plover										•	•																•	•		•			•				•					•						•	•			•				•		•				•		
shallow / edge water	*Recurvirostra novaehollandiae*	Red-necked Avocet			•							•				•				•								•						•																•								•								
shallow / edge water	*Rostratula australis (benghalensis)*	Australian Painted Snipe		•	•	•	•			•																																																				
shallow / edge water	*Stictonetta naevosa*	Freckled Duck	•	•	•	•	•								•	•	•	•	•	•	•	•	•											•	•	•			•	•																										
shallow / edge water	*Stiltia isabella*	Australian Pratincole																																																															
shallow / edge water	*Thinornis rubricollis*	Hooded Plover					•		•				•	•									•		•		•			•	•	•							•	•				•		•			•			•	•				•		•	•			•		•
shallow / edge water	*Tringa flavipes*	Lesser Yellowlegs			•		•		•			•	•	•							•		•		•				•	•	•				•				•	•					•	•			•	•		•				•		•	•				•	•
shallow / edge water	*Tringa glareola*	Wood Sandpiper		•	•	•	•		•							•	•																																														
shallow / edge water	*Tringa nebularia*	Common Greenshank			•		•		•			•	•	•							•		•		•		•		•	•	•	•			•				•	•				•		•			•	•		•	•				•		•	•			•		•
shallow / edge water	*Tringa stagnatilis*	Marsh Sandpiper		•	•	•	•									•				•	•	•	•				•		•	•		•			•	•	•	•	•	•					•	•	•	•			•	•			•				•	•		•				•	•	•
shallow / edge water	*Tringa totanus*	Common Redshank			•		•		•			•	•	•							•		•		•		•		•	•	•	•			•				•	•				•		•			•	•		•	•				•		•	•			•		•
shallow / edge water	*Vanellus miles*	Masked Lapwing					•	•	•				•					•					•	•						•							•				•							•	•							•			•		•	•
shallow / edge water	*Xenus cinereus*	Terek Sandpiper										•	•														•	•		•			•		•		•				•	•		•			•	•	•		•				•		•			•	•		•
	Count	120	31	36	60	33	58	6	33	25	31	57	55	32	31	37	30	33	33	30	60	27	58	7	32	23	45	33	57	63	38	47	33	29	59	28	20	23	64	36	21	18	13	46	28	50	22	23	38	38	9	26	31	25	23	13	38	15	37	27	17	11	33	16	31

Appendix D: Waterbird Population Survey Data

For each of the 119 designated wetland dependent species a literature search was carried out to determine known populations. Since 1985, on an irregular basis, and since 2000, on an annual basis, there has been a relatively systematic attempt to survey the abundance and diversity of waterbirds across four key regions (Lake Alexandrina, Lake Albert, the Coorong Lagoons, and the Estuary) of the Ramsar site. This table summarises each data set and categorises the trends evident within each data set.

All data sources are cited. Numbers in parentheses (e.g. (1)) refer to full reference citations in the reference section beneath this table.

Populations within the table highlighted in red have undergone a noticeable decline in numbers for that species in the medium term. Those populations highlighted in green have undergone a noticeable increase in numbers for that species in the medium term. Where populations have either remained relatively stable, varied in a cyclical manner, or showed no apparent trend there is no highlight.

SPECIES ***Genus species***	**Common Name**	**Population trends - World**	**Population trends - Coorong**	**Population trends - Estuary**	**Population trends – Lake Alexandrina**	**Population trends – Lake Albert**
Acrocephalus australis	Australian Reed Warbler, (Clamorous Reed-Warbler)					
Actitis hypoleucos	Common Sandpiper	Total Australia 1993 c. 3,000. SA: (*1*).	Total counts Coorong 81, 82, 87, 93, 00-08: Max 13 ('81) Min 0 ('00, '04, '08) – No trend (*2*). 2000 - 2005: range 1 ('01) - 3 ('02). Trend: rare (*3*).	1982,'87, '94, '99-'01: range 0 ('82, '00, '01) - 3 ('99). Trend: Low count, no trend (*4*). 2002-Jun 2009 range 1 ('07 & '08) - 5 ('05 & '06). Trend: Low count, no trend (*5*).	2003-Jun 2009 not recorded (*6*).	2003-Jun 2009 not recorded (*7*).
Anas castanea	Chestnut Teal	Surveys of mainland Australia (1983) c. 21,000 (*8*).	Coorong South Lagoon 1985: 660, 2000-2007 range 430-10,147. Change in abundance between '85 and mean '00 –'07: 522.8% increase (*9*). 2000 - 2005: range 7,149 ('01) - 21,228 ('02). Trend: increase and then decrease (*3*)	2002-Jun 2009 range 965 ('09) - 3,486 ('03). Trend: variable (*5*).	2003-Jun 2009 range 8 ('08) - 127 ('04). Trend: decline (*6*).	2003-Jun 2009 range 21 ('08) - 829 ('03). Trend: marked decline (*7*).
Anas gracilis	Grey Teal	No estimates of total population. Australian indices of relative abundance from annual surveys in about 12% of land area of E Australia (1983-88) minimum 61,236, maximum 1,081,287 (*8*).	Coorong South Lagoon 1985: 59,113, 2000-2007 range 2,446-24,460. Change in abundance between '85 and mean '00 –'07: 85.2% decline (*9*). 2000 - 2005: range 10,811 ('00) - 39,510 ('02). Trend: increase and then decrease (*3*).	2002-Jun 2009 range 16,776 ('07) - 61,162 ('06). Trend: variable (*5*).	2003-Jun 2009 range 712 ('09) – 24,553 ('04). Trend: marked decline (*6*).	2003-Jun 2009 range 2,632 ('05) – 8,623 ('04). Trend: variable (*7*).
Anas platyrhynchos	Mallard	Feral		2005 39, Trend: insufficient data (*5*)		
Anas rhynchotis	Australasian Shoveler	No estimates of total population. Australian indices of relative abundance from annual surveys in about 12% of land area of eastern Australia (1983-88) minimum 2,089, maximum 22,391 (*8*).	2000 - 2005: range 0 ('01) - 203 ('03). Trend: variable (*3*).	2002-Jun 2009 range 58 ('09) – 1,707 ('06). Trend: variable, recent count very low (*5*).	2003-Jun 2009 range 60 ('08) – 1,834 ('04). Trend: marked decline last three years (*6*).	2003-Jun 2009 range 54 ('09) - 919 ('04). Trend: decline (*7*).
Anas superciliosa	Pacific Black Duck	No estimates of total population. Australian indices of relative abundance from annual surveys in about 12% of land area of eastern Australia (1983-88) minimum 10,052, maximum 163,492 (*8*).	2000 - 2005: range 59 ('02) – 433 ('00). Trend: stable (*3*).	2002-Jun 2009 range 664 ('02) – 6,134 ('07). Trend: increase then decline (*5*).	2003-Jun 2009 range 226 ('09) – 3,168 ('04). Trend: marked decline to 7% over 5 years (*6*).	2003-Jun 2009 range 290 ('09) – 2,786 ('03). Trend: decline to 10% over 6 years (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Anhinga melanogaster	Darter	No estimates of total population. Australian indices of relative abundance from annual surveys in about 12% of land area of E Australia (1983-88) minimum 173, maximum 1,251 (*8*).	2000 - 2005: 3 ('05). Trend: rare (*3*).	2002-Jun 2009 range 2 ('02) – 63 ('05). Trend: increase then decline (*5*).	2003-Jun 2009 range 4 ('08) – 108 ('05). Trend: marked decline to 4% over 5 years (*6*).	2003-Jun 2009 range 0 ('04, '07, '08) – 9 ('05). Trend: very low counts (*7*).
Ardea modesta (alba)	Eastern Great Egret, (White Egret)		2000 - 2005: range 8 ('04, '05) - 145 ('02). Trend: recent decline (*3*).	2002-Jun 2009 range 98 ('02) – 508 ('06). Trend: increase then decline (*5*).	2003-Jun 2009 range 55 ('09) – 311 ('04). Trend: variable (*6*).	2003-Jun 2009 range 13 ('09) – 127 ('04). Trend: decline to 10% over 6 years (*7*).
Ardea ibis	Cattle Egret		2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 range 13 ('08) – 116 ('06). Trend: increase then decline (*6*).	2003-Jun 2009 range 0 (all except '07) – 2 ('07). Trend: rare (*7*).
Ardea intermedia	Intermediate Egret		2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*)	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Ardea pacifica	White-necked Heron		2000 - 2005: not recorded (*3*).	2004 count = 1. Trend: rare (*5*).	2004 count = 2. Trend: rare (*6*).	2003-Jun 2009 Not recorded (*7*).
Arenaria interpres	Ruddy Turnstone	Total Australia 1993 c. 14,000. SA: (*1*).	Total counts Coorong 81, 82, 87, 00-08: Max 3 ('06) Min 0 ('81, '87, '01, '04, '08). No trend (*2*). 2000 - 2005: 4 ('00) - 1 ('02). Trend: rare (*3*).	1982,'87, '94, '99-'01: 1('94). Trend: Low count, no trend (*4*). 2002-Jun 2009 range 3 ('02) – 6 ('06). Trend: rare (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Aythya australis	Hardhead (White-eyed Duck)	No estimates of total population. Australian indices of relative abundance from annual surveys in about 12% of land area of E Australia (1983-88) minimum 2,707, maximum 480,267 (*8*).	2000 - 2005: range 0 ('00. '01, '05) - 108 ('03). Trend: episodic, uncommon (*3*).	2002-Jun 2009 range 8 ('08) – 1,793 ('02). Trend: extreme decline (*5*).	2003-Jun 2009 range 0 ('08, '09) – 1,136 ('04). Trend: extreme decline (*6*).	2003-Jun 2009 range 0 ('09) – 1,519 ('04). Trend: extreme decline (*7*).
Biziura lobata	Musk Duck	No estimates of total population. Australian indices of relative abundance from annual surveys in about 12% of land area of E Australia (1983-88) minimum <80, maximum 355 (*8*).	2000 - 2005: range 66 ('01) - 441 ('04). Trend: decrease and then increase (*3*).	2002-Jun 2009 range 768 ('02) – 4,629 ('06). Trend: increase then decline (*5*).	2003-Jun 2009 range 0 ('05, '06, '07) – 3 ('03). Trend: rare (*6*).	2003-Jun 2009 range 0 ('08) – 11 ('07). Trend: rare (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Botaurus poiciloptilus	Australasian Bittern	Within South Australia the population is estimated to be less than 10,000 mature individuals, with evidence of a continuing decline, and no subpopulation estimated to contain more than 1000 mature individuals (*10*)	2000 - 2005: not recorded (*3*).	2004 and '07 count = 1. Trend: rare (*5*).	2004 count = 2, 03 and '06 count = 1. Trend: rare (*6*).	2004 count = 1. Trend: rare (*7*).
Calidris acuminata	Sharp-tailed Sandpiper	Total Australia 1993 c. 166,000. SA: (*1*).	Max or average counts 1981 -85: Coorong 55,700 (*1*). Total counts Coorong 81, 82, 87, 93, 00-08: Max 55,739 ('82) Min 3,848 ('07) – variable over survey period (*2*). Coorong South Lagoon 1985 6,013, 2000-2007 range 188-4,202. Change in abundance between '85 and mean '00 –'07: 63.1% decline (*9*). 2000 - 2005: range 4,399 ('01) – 17,473 ('03). Trend: variable (*3*).	1982,'87, '94, '99-'01: range 1,276 ('99) - 5463 ('00). Trend: stable (*4*). 2002-Jun 2009 range 5,378 ('02) – 13,502 ('08). Trend: variable (*5*).	2003-Jun 2009 range 40 ('09) – 10,696('05). Trend: extreme decline (*6*).	2003-Jun 2009 range 46 ('06) – 1,289 ('09). Trend: 5X increase over 6 years (*7*).
Calidris alba	Sanderling	Total Australia 1993 c. 8,000. SA: (*1*).	Max or average counts 1981-85: Coorong 930 (*1*). Total counts Coorong 81, 82, 87, 93, 00-08: Max 930 ('93) Min 10 ('02) – No trend, variable (*2*). 2000 - 2005: range 0 ('00, '01, '05) - 289 ('03). Trend: increase and then decrease to zero (*3*).	1982,'87, '94, '99-'01: range 0 ('99) - 512 ('00). Trend: variable (*4*). 2002-Jun 2009 range 0 ('02) – 1,405 ('04). Trend: increase then decline (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Calidris canutus	Red Knot	Total Australia 1993 c. 153,000. SA: (*1*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 100 ('93) Min 0 ('87, '01, '08) – Trend: low numbers '01 to '08 (*2*). 2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: 80 ('00). Trend: not present in most years (*4*). 2002 and '07 count = 1. Trend: rare (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Calidris ferruginea	Curlew Sandpiper	Total Australia 1993 c. 188,000. SA: (*1*).	Max or average counts 1981-85: Coorong 40,000 (*1*). Total counts Coorong '81, '82, '87, '93 '00-'08: Max 40,000 ('93) Min 2,171 ('07) – Trend: decline (*2*). Coorong South Lagoon 1985: 9,449, 2000-2007 range 7-3,198. Change in abundance between '85 and mean '00 –'07: 94.2% decline (*9*). 2000 - 2005: range 1,830 ('04) – 8,157 ('00). Trend: decreasing (*3*).	1982,'87, '94, '99-'01: range 1,437 ('99) – 6,124 ('87). Trend: variable (*4*). 2002-Jun 2009 range 582 ('05) – 3,185 ('08). Trend: variable, long-term decline in maximums (*5*).	2003-Jun 2009 range 22 ('08) – 257 ('05). Trend: decline to 10% (*6*).	2003-Jun 2009 range 0 ('03-'06) – 80 ('09). Trend: expanded range? Increase (*7*).
Calidris melanotos	Pectoral Sandpiper	Regular visitor in small number to Australia. In summer surveys 1981-85: a total of 123 were recorded, 32 in SA (*1*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 1 ('82) Min 0 ('81, '87, '00, '01, '02 '08) – Trend: consistently low (*2*). 2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Calidris minuta	Little Stint	Vagrant	2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Calidris ruficollis	Red-necked Stint	Total Australia 1993 c. 353,000. SA: (*1*).	Max or average counts 1981-85: Coorong 63,800. Total counts Coorong '81, '82, '87, '93 '00-'08: Max 63,800 ('93) Min 12,288 ('08) – Trend: Medium-term decline, five-fold decline since early '90's (*2*). Coorong South Lagoon 1985 29,020, 2000-2007 range 1,591-22,453. Change in abundance between '85 and mean '00 –'07: 68.3% decline (*9*). 2000 - 2005: range 23,606 ('05) – 43,300 ('03). Trend: increase and then decrease (*3*).	1982,'87, '94, '99-'01: range 2,589 ('99) – 24,363 ('87). Trend: decline (*4*). 2002-Jun 2009 range 4201 ('02) – 24,048 ('09). Trend: variable (*5*). Highly variable in the medium term.	2003-Jun 2009 range 800 ('06) – 10,453 ('04). Trend: variable (*6*).	2003-Jun 2009 range 0 ('03-'06) – 4,478 ('08). Trend: marked increase (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Calidris subminuta	Long-toed Stint	Regular visitor in small numbers. Australian population is mainly found on west coast of WA, where all counts > 40 come from. SA: Most records from Coorong (*1*).	2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2002-Jun 2009: 2008 count = 6. Trend: rare (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Calidris tenuirostris	Great Knot	One of the most abundant shorebirds in Australia, although considered rare, endangered or uncommon until 1970's. Total Australia 1993 c. 270,000. SA: (*1*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 5 ('93) Min 0 ('87, '01) – Trend: Uncommon (*2*). 2000 - 2005: range 0 ('00) - 441 ('04). Trend: generally uncommon (*3*).	1982,'87, '94, '99-'01: 1 ('00) Rare (*4*). 2003-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Cereopsis novaehollandiae	Cape Barren Goose	Total population (1990) *c.* 17,000, SA *c.* 10,000 birds.	2000 - 2005: range 15 ('02) - 402 ('03). Trend: variable (*3*).	2002-Jun 2009 range 498 ('05) – 1,565 ('06). Trend: variable (*5*).	2003-Jun 2009 range 226 ('09) – 3,168 ('04). Trend: decline to 7% over 5 years (*6*).	2003-Jun 2009 range 96 ('03) – 655 ('06). Trend: increase then decrease (*7*).
Charadrius bicinctus	Double-banded Plover	Total population at least 12,450 (*c.* 5,600 in Australia) (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 150 ('93) Min 0 ('81, '82, '00, '01, '08) – Trend: Generally rare (*2*). 2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: 7 ('99) Rare (*4*). 2002-Jun 2009 range 0 ('02, '07) – 225 ('09). Trend: increase (*5*).	2003-Jun 2009 range 0 ('07) – 230 ('04). Trend: large decline over 5 years (*6*).	2003-Jun 2009 range 0 ('04-'06, '09) – 42 ('08). Trend: rare (*7*).
Charadrius leschenaultii	Greater Sand Plover	Australian population estimated *c.* 74,000 (*11*).	2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01 (*4*). 2003-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Charadrius mongolus	Lesser Sand Plover	Australian population estimated at 20,000 (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 2 ('02), 1 ('08) Min 0 (all other years) – Trend: Rare (*2*). 2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2002-Jun 2009 range 0 ('02, '03, '07-'09) – 40 ('04). Trend: variable (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Charadrius ruficapillus	Red-capped Plover	Australian population *c.* 95,000 (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 5,700 ('93) Min 737 ('07) – Trend: Medium-term decline, five-fold decline since early '90's (*2*). Coorong South Lagoon 1985 2,158, 2000-2007 range 206-1,038. Change in abundance between '85 and mean '00 –'07: 75.2% decline (*9*). 2000 - 2005: range 474 ('05) – 1,638 ('01). Trend: variable (*3*).	1982,'87, '94, '99-'01: range 79 ('87) - 356 ('99). Trend: variable, stable (*4*). 2002-Jun 2009 range 28 ('02) – 1,051 ('09). Trend: large (38X) increase (*5*).	2003-Jun 2009 range 125 ('05) – 286 ('07). Trend: relatively stable (*6*).	2003-Jun 2009 range 0 ('06) – 266 ('08). Trend: recent marked increase (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Charadrius veredus	Oriental Plover	Australian population estimated *c.* 40,000 (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 18 ('81) Min 0 (all other years) – Trend: rare (*2*). 2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2003-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Chenonetta jubata	Australian Wood Duck, (Maned Duck)	No estimates of total population. Australian indices of relative abundance from annual surveys in about 12% of land area of E Australia (1983-88) minimum 12,050, maximum 109,553 (*8*).	2000 - 2005: range 0 ('02-'05) - 11 ('00). Trend: rare, not recorded in last 4 years (*3*).	2002-Jun 2009 range 0 ('02, '05,'06, '08, '09) – 8 ('04). Trend: rare (*5*).	2003-Jun 2009 range 0 ('08, '09) – 202 ('04). Trend: marked decline to zero (*6*).	2003-Jun 2009 range 0 ('03, '09) – 34 ('08). Trend: rare variable (*7*).
Chlidonias hybridus	Whiskered Tern	Australian indices of relative abundance (1985-1994) minimum 1,346, maximum 32,571 (*1*).	Coorong South Lagoon '98: 2,656, 2000-2007 range: 334-2,847. Change in abundance between '85 and mean '00 –'07: 58.7% decline (*9*). 2000 - 2005: range 3,163 ('02) – 4,660 ('00). Trend: stable (*3*).	2002-Jun 2009 range 570 ('09) – 14,275 ('04). Trend: very large decline (*5*).	2003-Jun 2009 range 401 ('09) – 12,165 ('04). Trend: very large decline (*6*).	2003-Jun 2009 range 96 ('09) – 3,025 ('04). Trend: very large decline (*7*).
Chlidonias leucopterus	White-winged Black Tern	Mainly found on north coasts in Australia, where sometimes recorded in large numbers e.g. 1982 15,000 (*1*). Small but regular visitor to SA.	2000 - 2005: not recorded (*3*).	2002-Jun 2009: 2006 count = 1. Trend: rare (*5*).	2003-Jun 2009 range 0 ('08, '09) – 11 ('04). Trend: rare - decline (*6*). First record 1964 Lake Alexandrina 12,	2003-Jun 2009 Not recorded (*7*).
Circus approximans	Swamp Harrier					
Cladorhynchus leucocephalus	Banded Stilt	Total population *c.* 206,000 (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 261,229 ('08) Min 9,106 ('07) – Trend: Highly variable (*2*). Coorong South Lagoon 1985 6,208, 2000-2007 range 1,297-64,250. Change in abundance between '85 and mean '00 –'07: 258.5% increase (*9*). 2000 - 2005: range 2,354 ('00) – 32,305 ('05). Trend: 15 X increase (*3*).	1982,'87, '94, '99-'01: range 0 ('87, '00) - 500 ('94). Trend: variable (*4*). 2002-Jun 2009 range 0 ('07, '09) – 306 ('03). Trend: decline to zero (*5*). Highly variable among years	2003-Jun 2009 range 401 ('09) – 12,165 ('04). Trend: large decline (*6*).	2003-Jun 2009 range 0 ('05-'09) – 39 ('04). Trend: small decline to zero (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Cygnus atratus	Black Swan	Australian indices of relative abundance from annual surveys in about 12% of land area of E Australia (1983-88) minimum 13,827, maximum 156,843 (*8*).	Coorong South Lagoon 1985: 676, 2000-2007 range 68-526. Change in abundance between '85 and mean '00 –'07: 59.3% decline (*9*). 2000 - 2005: range 706 ('05) – 3,488 ('03). Trend: increase and recent decrease to 20% (*3*).	2002-Jun 2009 range 3,286 ('09) – 28,111 ('06). Trend: decline to 12% over 3 years (*5*).	2003-Jun 2009 range 204 ('09) – 6,317 ('04). Trend decline to 3% over 5 years (*6*).	2003-Jun 2009 range 273 ('09) – 4,489 ('04). Trend: decline to 6% over 5 years (*7*).
Dasyornis broadbenti	Rufous Bristlebird					
Egretta garzetta	Little Egret		2000 - 2005: range 3 ('02, '05) - 34 ('01). Trend: uncommon (*3*).	2002-Jun 2009 range 9 ('02) – 114 ('06). Trend: Increase then decrease (*5*).	2003-Jun 2009. 2007 = 1. Trend: rare (*6*).	2003-Jun 2009 range 0 ('05-'09) – 9 ('04). Trend: rare (*7*).
Egretta novaehollandiae	White-faced Heron		Coorong South Lagoon 1985: 128, 2000-2007 range 15-75. Change in abundance between '85 and mean '00 –'07: 69.4% decline (*9*). 2000 - 2005: range 89 ('04) - 212 ('01). Trend: stable (*3*).	2002-Jun 2009 range 64 ('02) – 962 ('06). Trend X 15 increase (*5*).	2003-Jun 2009 range 33 ('09) – 330 ('04). Trend: X10 increase then decrease to original size (*6*).	2003-Jun 2009 range 11 ('08) – 45 ('04). Trend: rare – stable (*7*).
Elseyornis melanops	Black-fronted Dotterel	Range has expanded recently. Total population *c.* 17,000 (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 15 ('93) Min 0 ('81, '87, '00, '01). Trend: Uncommon (*2*). 2000 - 2005: not recorded (*3*).	2002-Jun 2009. 2009 = 1. Trend: rare (*5*).	2003-Jun 2009 range 0 ('03, '07, '08) – 60 ('09). Trend: rare with recent X 10 increase (*6*).	2003-Jun 2009. 2003 = 6. Trend: rare (*7*).
Erythrogonys cinctus	Red-kneed Dotterel	Australian population *c.* 26,000 (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 18 ('04) Min 0 ('87, '00, '01) – Trend: Uncommon (*2*). 2000 - 2005: range 0 ('00-'02) - 28 ('03). Trend: absent, then uncommon since 2003 (*3*).	2002-Jun 2009 range 14 ('09) – 181 ('04). Trend: initial increase, then decline over five years (*5*).	2003-Jun 2009 range 0 ('07,'09) – 101 ('05). Trend: initial increase, then decline over five years to zero (*6*).	2003-Jun 2009 range 0 ('06, '08, '09) – 68 ('07). Trend: variable with decline to zero (*7*).
Esacus neglectus	Beach Stone-curlew		2000 - 2005: not recorded (*3*).	2002-Jun 2009. 2008 = 6. Trend: rare (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Fulica atra	Eurasian Coot	No estimates of total population. Australian indices of relative abundance from annual surveys in about 12% of land area of E Australia (1983-88) minimum 2,755, maximum 263,266. Populations stable, but characterised by large changes in abundance (*11*).	2000 - 2005: range 33 ('01) - 275 ('00). Trend: periods of higher abundance amid low background (*3*).	2002-Jun 2009 range 0 ('09) – 16,478 ('03). Trend: extreme decline over six years to zero (*5*).	2003-Jun 2009 range 0 ('09) – 38,855 ('05). Trend: extreme decline over six years to zero (*6*).	2003-Jun 2009 range 0 ('09) – 16,626 ('04). Trend: extreme decline over five years to zero (*7*).
Gallinago hardwickii	Latham's Snipe	Total Breeding population 1986 c. 37,000. Australia 1983 c. 15,000(*1*)	2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Gallinago hardwickii	Pin-tailed Snipe		2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*5*).	2003-Jun 2009 2006 = 40. Trend: rare (*6*).
Gallinula tenebrosa	Dusky Moorhen		2000 - 2005: range 0 ('00, '03 – '05) - 3 ('02). Trend: rare (*3*).	2002-Jun 2009 2004 = 1. Trend: rare (*5*).	2003-Jun 2009 range 0 ('09) – 40 ('05). Trend: Rare with small peak in '04 & '05 (*5*).	2003-Jun 2009 range 0 ('03, '05, '07-'09) – 2 ('04). Trend: Rare (*6*).
Gallinula ventralis	Black-tailed Native-hen	No estimates of total population. Australian indices of relative abundance from annual surveys in about 12% of land area of E Australia (1983-88) minimum 2,222 ('88), maximum 25,424 ('84). Populations stable, but characterised by large changes in abundance (*11*).	2000 - 2005: range 0 ('01, '05) - 76 ('02). Trend: variable, uncommon (*3*).	2002-Jun 2009 range 0 ('09) – 103 ('07). Trend: highly variable (*5*).	2003-Jun 2009 range 0 ('06, '09) – 168 ('04). Trend: highly variable (*5*).	2003-Jun 2009 range 0 ('03, '05, '06, '08 & '09) – 31 ('07). Trend: Rare and variable (*6*).
Gallirallus philippensis	Buff-banded Rail		2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Glareola maldivarum	Oriental Pratincole	Total Australia 1993 c. 60,000. Birds mainly occur away from coast in N Australia, infrequent visitor to SA (*1*).	2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Haematopus fuliginosus	Sooty Oystercatcher	Total population estimated *c.* 4,000 (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 24 ('02) Min 0 ('81, '82) – Trend: A small but persistent population appears to have established since the early 80's (*2*). 2000 - 2005: range 0 ('01) - 29 ('02). Trend: uncommon (*3*).	1982,'87, '94, '99-'01: range 0 ('82) - 100 ('94). Trend: variable (*4*). 2002-Jun 2009 range 13 ('02) – 136 ('05). Trend: variable (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Haematopus longirostris	Pied Oystercatcher	Australian population *c.* 10,000 (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 630 ('93) Min 9 ('01) – Trend: Variable, but relatively stable (*2*). Coorong South Lagoon 1985: 142, 2000-2007 range 15-113. Change in abundance between '85 and mean '00 –'07: 58.0% decline (*9*). 2000 - 2005: range 115 ('00) - 216 ('03). Trend: stable (*3*).	1982,'87, '94, '99-'01: range 25 ('87) - 170 ('82). Trend: variable (*4*). 2002-Jun 2009 range 115 ('02) – 1,824 ('06). Trend: increase then decline (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Haliaeetus leucogaster	White-bellied Sea-Eagle					
Heteroscelus brevipes	Grey-tailed Tattler	Total Australia 1993 c. 36,000. SA: uncommon (*1*).	2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2002-Jun 2009 2004-'06 = 1. Trend: rare (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Himantopus himantopus	Black-winged Stilt	Australian population *c.* 266,000 (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 991 ('82) Min 132 ('07) – Trend: Variable, but stable (*2*). Coorong South Lagoon 1985: 32, 2000-2007 range 14-505. Change in abundance between '85 and mean '00 –'07: 353.9% increase (*9*). 2000 - 2005: range 258 ('01) - 696 ('03). Trend: stable (*3*).	1982,'87, '94, '99-'01: range 0 ('99) - 319 ('82). Trend: variable (*4*). 2002-Jun 2009 range 393 ('02) – 2,387 ('08). Trend: variable but stable (*5*). Long-term increase	2003-Jun 2009 range 67 ('09) – 1,553 ('05). Trend: decline to 4% over last 5 years (*5*).	2003-Jun 2009 range 9 ('06) – 669 ('07). Trend: variable (*6*).
Ixobrychus minutus	Little Bittern	No data	2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Larus dominicanus	Kelp Gull		2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Larus novaehollandiae	Silver Gull	Australian indices of relative abundance from annual surveys in about 12% of land area of E Australia (1983-88) minimum 3,804, maximum 49,359 deep (*1*).	Coorong South Lagoon 1985 4,090, 2000-2007 range 1,077-8,445. Change in abundance between '85 and mean '00 –'07: 30.8% decline (*9*). 2000 - 2005: range 5,218 ('04) – 10,418 ('01). Trend: stable (*3*).	2002-Jun 2009 range 3555 ('02) – 24,006 ('06). Trend: variable - factor of 7 increase then decline (*5*).	2003-Jun 2009 range 891 ('09) – 2,050 ('04). Trend: stable (*5*).	2003-Jun 2009 range 460 ('09) – 4,232 ('07). Trend: rapid decline to 10% (*6*).
Larus pacificus	Pacific Gull	At least 1,100 pairs in eastern Australia. Evidence of decline in areas around Australia (*1*).	2000 - 2005: 1 ('01), 7 ('02). Trend: rare (*3*).	2002-Jun 2009 range 2 ('02) – 42 ('08). Trend: stable (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Limicola falcinellus	Broad-billed Sandpiper	Total Australia 1993 c. 8,000. SA: small numbers (*1*).	Not recorded in Coorong (*2*). 2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Limosa lapponica	Bar-tailed Godwit	Total Australia 1993 c. 165,000. SA: rarely recorded in SE (*1*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 150 ('08) Min 0 ('82, '01, '02) – Trend: marked increase in last four years (*2*). 2000 - 2005: range 0 ('03, '04) - 32 ('05). Trend: rare (*3*).	1982,'87, '94, '99-'01: range 0 ('82, '94, '01) - 8 ('00). Trend: rare (*4*). 2002-Jun 2009 range 62 ('08) – 641 ('06). Trend: variable - stable (*5*).	2003-Jun 2009 2005 = 1. Trend: rare (*5*).	2003-Jun 2009 Not recorded (*6*).
Limosa limosa	Black-tailed Godwit	Total breeding population 1993 c. 81,000. Australia 1986-91 summer totals 285 - 2950 (*1*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 210 ('00) Min 0 ('02) – Trend: High variability among years since '02 (*2*). 2000 - 2005: range 0 ('05) - 140 ('00). Trend: variable (*3*).	1982,'87, '94, '99-'01: range 0 ('99) - 210 ('00). Trend: variable (*4*). 2002-Jun 2009 range 12 ('02) – 408 ('04). Trend: variable - stable (*5*).	2003-Jun 2009 range 0 ('06 – '09) – 56 ('04). Trend: uncommon, not present last four years (*5*).	2003-Jun 2009 2007 = 4. Trend: rare (*6*).
Malacorhynchus membranaceus	Pink-eared Duck	Australian indices of relative abundance from annual surveys in about 12% of land area of E Australia (1983-88) minimum 12,071, maximum 121,003 (*8*).	Coorong South Lagoon 1985: not recoded, 2000-2007 range 0-749 (*9*). 2000 - 2005: 54 ('03). Trend: episodic (*3*).	2002-Jun 2009 range 0 ('09) – 537 ('02). Trend: rapid decline to zero (*5*).	2003-Jun 2009 range 0 ('08, '09) – 761 ('02). Trend: rapid decline to zero (*5*).	2003-Jun 2009 range 1 ('08) – 145 ('03). Trend: decline (*6*).
Megalurus gramineus	Little Grassbird					
Morus serrator	Australasian Gannet	Total population in 1980-81 estimated 52,664 pairs, 6,660 in Australia, 46,004 in NZ. Population status believed to be stable (*8*).	2000 - 2005: range 66 ('01) - 441 ('04). Trend: decrease and then increase (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Motacilla flava	Yellow Wagtail					
Neophema chrysogaster	Orange-bellied Parrot					
Neophema petrophila	Rock Parrot					

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Numenius madagascariensis	Eastern Curlew	Numbers have fallen significantly in some areas of SA, but unclear if populations have declined or there has been a change in non-breeding range (*1*). Total Breeding population 1993 < 20,000. Australia 1993 totals c. 19,000 (*1*).	In N Coorong common from 1930 to 1967-68, 15 in 1981, 22 in 1982 (*1*). Reclamation of land, construction of barrages and stabilization of water levels as destroyed feeding habitat (*1*). Total counts Coorong '81, '82, '87, '93 '00-'08: Max 29 ('07) Min 2 ('02, '03) – Trend: Uncommon (*2*). 2000 - 2005: range 1 ('00,'01) - 57 ('02). Trend: variable (*3*).	1982,'87, '94, '99-'01: range 3 ('87) - 15 ('82, '99, '00). Trend: variable but uncommon (*4*). 2002-Jun 2009 range 13 ('02) – 151 ('06). Trend: variable but stable (*5*).	2003-Jun 2009 Not recorded (*6*). Lake Alexandrina formerly widespread in small numbers between 1920-1940, rare since 1960 (*1*).	2003-Jun 2009 Not recorded (*7*). Lake Albert formerly widespread in small numbers between 1920-1940, rare since 1960 (*1*).
Numenius minutus	Little Curlew	Vagrant in SA. Widespread N of 20-21° S. Total Australia 1993 c. 180,000 (*1*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Not recorded (*2*). 2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Numenius phaeopus	Whimbrel	Total Australia 1993 10,000 (*1*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Not recorded (*2*). 2000 - 2005: 1 ('02). Trend: rare (*3*).	1982,'87, '94, '99-'01: 3 ('99) & 1 ('00). Trend: rare (*4*). 2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Nycticorax caledonicus	Nankeen Night Heron		2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Oxyura australis	Blue-billed Duck	Annual indices of abundance record only small numbers, but considered an underestimate because of shy and retiring habits and preference for dense vegetation (*8*).	2000 - 2005: 1 ('03). Trend: rare (*3*).	2002-Jun 2009 range 0 ('02, '06 - '09) – 5 ('03). Trend: rare (*5*).	2003-Jun 2009 2006 = 6, '. Trend: rare (*6*).	2003-Jun 2009. '02 = 4, '06 = 8. Trend: rare (*7*).
Pandion haliaetus	Osprey					
Pelecanus conspicillatus	Australian Pelican		Coorong South Lagoon 1985 6,045, 2000-2007 range 394-2,600. Change in abundance between '85 and mean '00 –'07: 77.3% decline (*9*). 2000 - 2005: range 2,293 ('05) – 5,649 ('01). Trend: decline (*3*).	2002-Jun 2009 range 1,720 ('09) – 11,551 ('06). Trend: five-fold increase and then decline (*5*).	2003-Jun 2009 range 1,191 ('09) – 6,819 ('04). Trend: five-fold decline over last five years (*6*).	2003-Jun 2009 range 660 ('06) – 3,008 ('08). Trend: variable (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Phalacrocorax carbo	Great Cormorant	Australian indices of relative abundance from annual surveys in about 12% of land are of E Australia (1983-88) minimum 1,745, maximum 6,949 (*8*).	2000 - 2005: range 266 ('03) – 1,860 ('02). Trend: five-fold increase and then decrease (*3*).	2002-Jun 2009 range 948 ('02) – 5,715 ('06). Trend: five-fold increase and then decline (*5*).	2003-Jun 2009 range 382 ('09) – 16,443 ('04). Trend: rapid decline to 2% over last five years (*6*).	2003-Jun 2009 range 10 ('09) – 3,929 ('04). Trend: rapid decline to 0.2% over last five years (*7*).
Phalacrocorax fuscescens	Black-faced Cormorant	Endemic to Australia, confined to south Australian coasts (*8*).	Coorong South Lagoon 1985 84, 2000-2007 range 0-132. Change in abundance between '85 and mean '00 –'07: 40.6% decline (*9*). 2000 - 2005: range 59 ('04) – 218 ('05). Trend: stable (*3*).	2002-Jun 2009 range 0 ('02) – 279 ('05). Trend: increase and then stable (*5*).	2003-Jun 2009 range 0 ('04-'05,'07-'09) – 77 ('03). Trend: rapid decline now absent (*6*).	2003-Jun 2009 Not recorded (*7*).
Phalacrocorax melanoleucos	Little Pied Cormorant	Australian indices of relative abundance from annual surveys in about 12% of land are of e Australia (1983-88) minimum 196, maximum 2,228 (*8*).	2000 - 2005: range 189 ('03) – 779 ('00). Trend: variable (*3*).	2002-Jun 2009 range 1,363 ('09) – 5,677 ('06). Trend: 2X increase and then decline (*5*).	2003-Jun 2009 range 23 ('08) – 354 ('04). Trend: Decline to 10% (*6*).	2003-Jun 2009 range 0 ('08, '09) – 196 ('03). Trend: Decline to zero (*7*).
Phalacrocorax sulcirostris	Little Black Cormorant	Australian indices of relative abundance from annual surveys in about 12% of land are of E Australia (1983-88) minimum 1,653, maximum 24,062 (*8*).	Coorong South Lagoon 1985 1,190, 2000-2007 range 0-430. Change in abundance between '85 and mean '00 –'07: 93.9% decline (*9*). 2000 - 2005: range 295 ('00) – 2,934 ('01). Trend: ten-fold increase and five-fold decrease (*3*).	2002-Jun 2009 range 13 ('09) – 4,731 ('03). Trend: increase and then decline to 0.3% (*5*).	2003-Jun 2009 range 12 ('09) – 3,026 ('05). Trend: increase and then decline to 0.4% (*6*).	2003-Jun 2009 range 0 ('08) – 732 ('06). Trend: variable, decline to zero, and then increase (*7*).
Phalacrocorax varius	Pied Cormorant		2000 - 2005: range 130 ('00) – 485 ('01). Trend: variable, stable (*3*).	2002-Jun 2009 range 168 ('02) – 1,852 ('03). Trend: variable, stable (*5*).	2003-Jun 2009 range 8 ('09) – 3,939 ('04). Trend: increase and then decline to 0.2% (*6*).	2003-Jun 2009 range 791 ('09) – 3,979 ('03). Trend: variable (*7*).
Phalaropus fulicaria	Grey Phalarope	SA Vagrant	2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Phalaropus lobatus	Red-necked Phalarope	SA Vagrant	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 3 ('87) Min 0 ('81, '82, '00, '01, '08) – Trend: Rare (*2*). 2000 - 2005: 1 ('05). Trend: rare (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Philomachus pugnax	Ruff	Rare but regular visitor. Total Australia: 1981-91 max in one year = 8 (*1*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 1 ('00) Only year recorded – Trend: Rare (*2*). 2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Platalea flavipes	Yellow-billed Spoonbill	Australia: Indices of relative abundance in annual wetland surveys in *c.* 12% of land area of e Australia 1983-88: 1,482 minimum, 8,785 maximum (*8*).	2000 - 2005: not recorded (*3*).	2002-Jun 2009 range 11 ('09) – 90 ('02). Trend: uncommon, stable (*5*).	2003-Jun 2009 range 112 ('07) – 296 ('04). Trend: stable (*6*).	2003-Jun 2009 range 2 ('06) – 65 ('09). Trend: recent increase (*7*).
Platalea regia	Royal Spoonbill	Australia: Indices of relative abundance in annual wetland surveys in *c.* 12% of land area of e Australia 1983-88: 70 minimum, 727 maximum (*8*).	2000 - 2005: range 9 ('05) – 161 ('01). Trend: X 15 increase and then decrease (*3*).	2002-Jun 2009 range 105 ('02) – 1,037 ('08). Trend: X10 increase in abundance over six years (*5*).	2003-Jun 2009 range 96 ('09) – 244 ('04). Trend: variable, stable (*6*).	2003-Jun 2009 range 22 ('05) – 323 ('09). Trend: X15 increase in last 4 years (*7*).
Plegadis falcinellus	Glossy Ibis	Australia: Indices of relative abundance in annual wetland surveys in *c.* 12% of land area of e Australia 1983-88: 855 minimum, 17,156 maximum (*8*).	2000 - 2005: not recorded (*3*).	2002-Jun 2009 2002 = 115. Trend: not recorded since 2002 (*5*).	2003-Jun 2009 range 0 ('08 & '09) – 268 ('05). Trend: not recorded since 2007 (*6*).	2003-Jun 2009 Not recorded (*7*).
Pluvialis fulva	Pacific Golden Plover	Australian population *c.* 9,000 (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 290 ('93) Min 30 ('04) – Trend: Variable but possible medium-term decline(*2*). 2000 - 2005: range 6 ('04) – 85 ('05). Trend: variable (*3*).	1982,'87, '94, '99-'01: range 31 ('94) - 214 ('82). Trend: variable (*4*). 2002-Jun 2009 range 16 ('02) – 118 ('06). Trend: increase then decline (*5*). Medium-term variable but stable.	2003-Jun 2009 range 0 ('05, '06, '08 & '09) – 14 ('04). Trend: not recorded since 2007 (*6*).	2003-Jun 2009 Not recorded (*7*).
Pluvialis squatarola	Grey Plover	Australian population *c.* 12,000 (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 12 ('00) Min 0 ('82, '87, '01) – Trend: Uncommon (*2*). 2000 - 2005: 4 ('02, '05). Trend: rare (*3*).	1982,'87, '94, '99-'01: 9 ('00) Trend: rare (*4*). 2002-Jun 2009 range 0 ('02-'06) – 9 ('08). Trend: recorded last three years (*5*).	2003-Jun 2009 2007 = 13. Trend: rare (*6*).	2003-Jun 2009 Not recorded (*7*).
Podiceps cristatus	Great Crested Grebe		Coorong South Lagoon 1985 263, 2000-2007 range 0-94. Change in abundance between '85 and mean '00 –'07: 92.6% decline (*9*). 2000 - 2005: range 62 ('01) – 543 ('05). Trend: variable (*3*).	2002-Jun 2009 range 25 ('09) – 1,186 ('03). Trend: decline to 2% over last 5 years (*5*).	2003-Jun 2009 range 5 ('09) – 2,719 ('05). Trend: decline to 0.2% over last 4 years (*6*).	2003-Jun 2009 range 2 ('09) – 473 ('04). Trend: decline to 0.4% over last 5 years (*7*).

SPECIES ***Genus species***	**Common Name**	**Population trends - World**	**Population trends - Coorong**	**Population trends - Estuary**	**Population trends – Lake Alexandrina**	**Population trends – Lake Albert**
Poliocephalus poliocephalus	Hoary-headed Grebe		Coorong South Lagoon 1985 16,766, 2000-2007 range 50-8,141. Change in abundance between '85 and mean '00 –'07: 85.0% decline (*9*). 2000 - 2005: range 2,324 ('03) – 8,461 ('0). Trend: four-fold decline (*3*).	2002-Jun 2009 range 359 ('09) – 5,159 ('03). Trend: decline to 7% over last 6 years (*5*).	2003-Jun 2009 range 0 ('07-'09) – 103 ('03). Trend: decline to zero and no recovery in last 3 years (*6*).	2003-Jun 2009 range 0 ('08-'09) – 135 ('05). Trend: decline to zero and no recovery in last 2 years (*7*).
Porphyrio porphyrio	Purple Swamphen	Australia: Indices of relative abundance in annual wetland surveys in *c.* 12% of land area of e Australia 1983-88: 296 minimum, 7,149 maximum (*11*).	2000 - 2005: 1 ('04). Trend: rare (*3*).	2002-Jun 2009 range 0 ('09) – 160 ('07). Trend: rare with increase in '07 (*5*).	2003-Jun 2009 range 4 ('09) – 504 ('04). Trend: sudden large decline last year (*6*).	2003-Jun 2009 range 16 ('09) – 955 ('07). Trend: sudden large decline last year (*7*).
Porzana fluminea	Australian Spotted Crake		2000 - 2005: range 0 ('02, '04) – 3 ('03). Trend: rarely observed (*3*).	2002-Jun 2009 range 0 ('05, '06, '08, '09) – 3 ('03, '07). Trend: rare (*5*).	2003-Jun 2009 range 0 ('03,'06, '07, '09) – 9 ('04). Trend: rare (*6*).	2003-Jun 2009 range 0 ('04,'06, '08, '09) – 2 ('05). Trend: rare (*7*).
Porzana pusilla	Baillon's Crake	Status not known (*11*).	2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 2007 = 1. Trend: rare (*6*).	2003-Jun 2009 Not recorded (*7*).
Porzana tabuensis	Spotless Crake	Probably plentiful in many areas but overlooked because shy (*11*).	2000 - 2005: not recorded (*3*).	2002-Jun 2009 2009 = 1. Trend: rare (*5*).	2003-Jun 2009 range 0 ('04,'08, '09) – 4 ('05, '07). Trend: rare (*6*).	2003-Jun 2009 range 0 ('04,'06-'09) – 2 ('05). Trend: rare (*7*).
Rallus pectoralis	Lewin's Rail		2000 - 2005: not recorded (*3*).	2002-Jun 2009 2003 = 2, '07 = 1. Trend: rare (*5*).	2003-Jun 2009 2005 = 1, '07 = 2. Trend: rare (*6*).	2003-Jun 2009 Not recorded (*7*).
Recurvirostra novaehollandiae	Red-necked Avocet	Total population estimated *c.* 107,000 (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 5,687 ('04) Min 93 ('00) – Trend: Recent decline, 10 to 20 fold decrease in last two years (*2*). Coorong South Lagoon 1985:7,210, 2000-2007 range 104-4,864. Change in abundance between '85 and mean '00 –'07: 74.8% decline (*9*). 2000 - 2005: range 163 ('00) – 6,030 ('05). Trend: large increase (*3*).	1982,'87, '94, '99-'01: range 0 ('00) - 444 ('82). Trend: variable (*4*). 2002-Jun 2009 range 7 ('09) – 10,387 ('03). Trend: marked decline to 0.06% over 6 years (*5*).	2003-Jun 2009 range 0 ('07, '09) – 2,092 ('05). Trend: marked decline to zero over 4 years (*6*).	2003-Jun 2009 range 0 ('06) – 89 ('08). Trend: variable (*7*).
Rostratula benghalensis	Painted Snipe	Australian population estimated at *c.* 1,500 (*11*).	2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Sterna albifrons	Little Tern	East Australian population 1989 breeding population 310-319 pairs. Populations in parts of Australian range have declined.	Uncommon in SA, where recorded from Coorong among others. Have bred on island in The Coorong (*1*). 2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*). Recorded from Lake Alexandrina among others. (*1*).	2003-Jun 2009 Not recorded (*7*).
Sterna bergii	Crested Tern	No estimates of abundance (*1*).	Coorong South Lagoon 1985: 6,687, 2000-2007 range 877-8,186. Change in abundance between '85 and mean '00 –'07: 50.7% decline (*9*). 2000 - 2005: range 1,300 ('03) – 5,638 ('05). Trend: variable, stable (*3*).	2002-Jun 2009 range 2,498 ('02) – 9,086 ('06). Trend: stable (*5*).	2003-Jun 2009 range 224 ('09) – 4,797 ('05). Trend: marked decline to 4% over 4 years (*6*).	2003-Jun 2009 range 16 ('09) – 4,232 ('07). Trend: marked decline to 11% over 2 years (*7*).
Sterna caspia	Caspian Tern	Australia: Indices of relative abundance in annual wetland surveys in *c*. 12% of land area 1983-94: 85 minimum, 2320 maximum (*1*).	Coorong South Lagoon 1985 329, 2000-2007 range 0-345. Change in abundance between '85 and mean '00 –'07: 75.7% decline (*9*). 2000 - 2005: range 227 ('04) – 1,362 ('01). Trend: variable (*3*).	2002-Jun 2009 range 308 ('09) – 3,711 ('06). Trend: marked decline to 8% over 3 years (*5*).	2003-Jun 2009 range 91 ('09) – 1,916 ('04). Trend: marked decline to 5% over 5 years (*6*).	2003-Jun 2009 range 11 ('08) – 176 ('04). Trend: decline to 8% over 5 years (*7*).
Sterna fuscata	Sooty Tern	Rare Vagrant in SA	2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Sterna hirundo	Common Tern		2000 - 2005: range 0 ('01) – 4 ('00). Trend: rare (*3*).	2002-Jun 2009 2007 = 2. Trend: rare (*5*).	2003-Jun 2009 2003 = 7, '04 = 5. Trend: rare (*6*).	2003-Jun 2009 Not recorded (*7*).
Sterna nereis	Fairy Tern	Total population estimated at *c*. 2000 breeding pairs. SA 100's of pairs (*1*).	Coorong South Lagoon 1985: 1,330, 2000-2007 range 6-586. Change in abundance between '85 and mean '00 –'07: 82.0% decline (*9*). 2000 - 2005: range 175 ('04) – 687 ('01). Trend: variable (*3*).	2002-Jun 2009 range 149 ('02) – 821 ('06). Trend: increase then decline (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 2003 = 1, '04 = 1. Trend: rare (*7*).
Sterna nilotica	Gull-billed Tern	Australia: Indices of relative abundance in annual wetland surveys in c. 12% of land area 1983-94: 40-80 minimum, 4690 maximum.	Irregular visitor S of 34° S in SA. No breeding records in CLL (*1*). 2000 - 2005: range 0 ('00, '01, '05) – 17 ('03). Trend: rare (*3*).	2002-Jun 2009 range 0 ('02) – 33 ('06). Trend: uncommon - stable (*5*).	2003-Jun 2009 range 0 ('08) – 8 ('04). Trend: uncommon - stable (*6*).	2003-Jun 2009 2003 = 1. Trend: rare (*7*).
Sterna paradisaea	Arctic Tern	SA Irregular visitor (*1*).	2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Sterna striata	White-fronted Tern	NZ breeding population estimated between 100,000 and 1,000,000 (*1*). Irregularly recorded in SA.	2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Stictonetta naevosa	Freckled Duck	Australia: Indices of relative abundance in annual wetland surveys in *c.* 12% of land area of eastern Australia 1983-88: 64 minimum, 4,119 maximum (*8*).	2000 - 2005: not recorded (*3*).	2002-Jun 2009 range 0 ('02, '06, '07, '09) – 35 ('05). Trend: uncommon, irregular (*5*).	2003-Jun 2009 range 0 ('08, '09) – 429 ('06). Trend: decline to zero and no recovery in last 2 years (*6*).	2003-Jun 2009 range 0 ('08, '09) – 456 ('03). Trend: decline to zero and no recovery in last 2 years (*7*).
Stiltia isabella	Australian Pratincole	Total Australia 1993 *c.* 60,000 (*1*).	2000 - 2005: not recorded (*3*).	2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 range 0 ('04, '06, '08, '09) – 7 ('03). Trend: rare(*6*).	2003-Jun 2009 Not recorded (*7*).
Stipiturus malachurus intermedius	Southern Emu-wren (Mt Lofty Ranges ssp)					
Tachybaptus novaehollandiae	Australasian Grebe, (Little Grebe)		2000 - 2005: 3 ('01) 4 ('02). Trend: rare (*3*).	2002-Jun 2009 range 0 ('02, '08, '09) – 84 ('06). Trend: increase from zero then decline back to zero (*5*).	2003-Jun 2009 range 0 ('07, '08) – 31 ('06). Trend: variable, uncommon (*6*).	2003-Jun 2009 2006 = 4. Trend: rare (*7*).
Tadorna tadornoides	Australian Shelduck	Australia: Indices of relative abundance in annual wetland surveys in *c.* 12% of land area of eastern Australia 1983-88: 4,145 minimum, 108,507 maximum (*8*).	Coorong South Lagoon 1985 6,059, 2000-2007 range 1,339-6,242. Change in abundance between '85 and mean '00 –'07: 45.7% decline (*9*). 2000 - 2005: range 2,738 ('02) – 8,581 ('01). Trend: stable (*3*).	2002-Jun 2009 range 1,170 ('02) – 6,081 ('06). Trend: stable (*5*).	2003-Jun 2009 range 1,812 ('09) – 13,647 ('03). Trend: stable, then sudden decline to 13% over last 2 years (*6*).	2003-Jun 2009 range 5,031 ('06) – 9,325 ('04). Trend: stable (*7*).
Thinornis rubricollis	Hooded Plover	Total population estimated at *c.* 5,000. In se Australia, now found at lower densities in parts of range still occupied. In 1987 surveys of entire coast indicated total population of 321-540 birds. Four surveys in 1982-83 between the Murray mouth and Vic border counted < 200 birds. 1988-90 170, 158, and 90 birds (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 23 ('06) Min 0 ('81, '82) – Trend: a small but stable population established (*2*). 2000 - 2005: range 8 ('00) – 29 ('04). Trend: uncommon stable (*3*).	1982,'87, '94, '99-'01: 1 ('01). Trend: rare (*4*). 2002-Jun 2009 2005 = 3. Trend: rare (*5*).	2003-Jun 2009 2004 = 5. Trend: rare (*6*).	2003-Jun 2009 Not recorded (*7*).

SPECIES ***Genus species***	**Common Name**	**Population trends - World**	**Population trends - Coorong**	**Population trends - Estuary**	**Population trends – Lake Alexandrina**	**Population trends – Lake Albert**
Threskiornis molucca	Australian White Ibis	Australia: Indices of relative abundance in annual wetland surveys in c. 12% of land area in eastern Australia 1983-88: 3,327 minimum, 24,406 maximum. Estimated at 39,100 adults breeding in 16 Victorian colonies in 1979 (*8*).	2000 - 2005: range 129 ('04) – 625 ('01). Trend: variable, stable (*3*).	2002-Jun 2009 range 248 ('02) – 2,695 ('06). Trend: stable (*5*).	2003-Jun 2009 range 22 ('09) – 938 ('04). Trend: stable, then sudden decline to 2% over last 3 years (*6*).	2003-Jun 2009 range 43 ('09) – 262 ('04). Trend: stable, then decline to 16% over last 2 years (*7*).
Threskiornis spinicollis	Straw-necked Ibis	Australia: Indices of relative abundance in annual wetland surveys in c. 12% of land area in eastern Australia 1983-88: 6,690 minimum, 55,025 maximum. Estimated at 76,000 adults breeding in Victorian colonies in 1979 (*8*).	Coorong South Lagoon 1985: 150, 2000-2007 range 0-1. Change in abundance between '85 and mean '00 –'07: 99.9% decline (*9*). 2000 - 2005: range 14 ('01) – 111 ('05). Trend: variable (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2002-Jun 2009 range 51 ('06) – 188 ('04). Trend: stable (*5*).	2003-Jun 2009 range 0 ('09) – 4,407 ('04). Trend: decline to zero (*6*).	2003-Jun 2009 range 0 ('09) – 286 ('04). Trend: decline to zero (*7*).
Tringa flavipes	Lesser Yellowlegs	Vagrant	2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).
Tringa glareola	Wood Sandpiper	Total Australia 1993 c. 6,000 (*1*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Not recorded (*2*). 2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 range 0 ('08, '09) – 43 ('04). Trend: uncommon then decline to zero (*6*).	2003-Jun 2009 Not recorded (*7*).
Tringa nebularia	Common Greenshank	Total Australia 1993 c. 20,000 (*1*).	Coorong 1981-85 720 (*1*). Total counts Coorong '81, '82, '87, '93 '00-'08: Max 720 ('93) Min 305 ('01) – Trend: Variable but relatively stable (*2*). Coorong South Lagoon 1985 313, 2000-2007 range 16-103. Change in abundance between '85 and mean '00 –'07: 80.1% decline (*9*). 2000 - 2005: range 417 ('01) – 591 ('02). Trend: stable (*3*).	1982,'87, '94, '99-'01: range 160 ('94) - 376 ('99). Trend: stable (*4*). 2002-Jun 2009 range 337 ('02) – 2,521 ('07). Trend: stable (*5*). Long-term increase by factor of 10.	2003-Jun 2009 range 15 ('09) – 159 ('04). Trend: decline to 10% (*6*).	2003-Jun 2009 range 2 ('05) – 20 ('03). Trend: stable-uncommon (*7*).

SPECIES *Genus species*	Common Name	Population trends - World	Population trends - Coorong	Population trends - Estuary	Population trends – Lake Alexandrina	Population trends – Lake Albert
Tringa stagnatilis	Marsh Sandpiper	Total Australia 1993 c. 9,000 (*1*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 68 ('02) Min 0 ('81, '00, '01) – Trend: Low counts with intermittent peaks (*2*). 2000 - 2005: range 0 ('00, '02) – 12 ('04). Trend: Low counts with intermittent peaks (*3*).	1982,'87, '94, '99-'01: 1 ('87), 2 ('94), 4 ('99). Trend: rare (*4*). 2002-Jun 2009 range 4 ('05) – 390 ('08). Trend: variable (*5*). Medium term increase	2003-Jun 2009 range 7 ('08) – 259 ('04). Trend: variable (*6*).	2003-Jun 2009 range 0 ('05, '06) – 62 ('09). Trend: variable (*7*).
Tringa totanus	Common Redshank	Vagrant to SA	Total counts Coorong '81, '82, '87, '93 '00-'08: No recorded (*2*). 2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: not recorded (*4*). 2002-Jun 2009 Not recorded (*5*).	2003-Jun 2009 2005 = 3. Trend: rare (*6*).	2003-Jun 2009 Not recorded (*7*).
Vanellus miles	Masked Lapwing	Total population estimated *c.* 287,000 of which Australian population *c.* 258,000 (*11*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 978 ('82) Min 233 ('00) – Trend: Stable at half the count in early '90's and '80's (*2*). Coorong South Lagoon 1985: 323, 2000-2007 range 86-262. Change in abundance between '85 and mean '00 –'07: 49.8% decline (*9*). 2000 - 2005: range 373 ('04) – 764 ('01). Trend: stable (*3*).	1982,'87, '94, '99-'01: range 103 ('00) - 344 ('990). Trend: stable (*4*). 2002-Jun 2009 range 222 ('02) – 850 ('06). Trend: stable (*5*).	2003-Jun 2009 range 173 ('09) – 2,603 ('04). Trend: decline to 7% over last 5 years (*6*).	2003-Jun 2009 range 234 ('09) – 874 ('07). Trend: variable (*7*).
Vanellus tricolor	Banded Lapwing		2000 - 2005: 2 ('05). Trend: rare (*3*).	2002-Jun 2009 2002 = 4, '06 = 4. Trend: rare (*5*).	2003-Jun 2009 range 0 ('09) – 385 ('08). Trend: stable until this year (*6*).	2003-Jun 2009 2008 = 15. Trend: rare (*7*).
Xenus cinereus	Terek Sandpiper	Total Australia 1993 c. 18,000 (*1*).	Total counts Coorong '81, '82, '87, '93 '00-'08: Max 1 ('02, '08) Min 0 (all other years) – Trend: Rare (*2*). 2000 - 2005: not recorded (*3*).	1982,'87, '94, '99-'01: 5 ('99) - 3 ('01). Trend: rare (*4*). 2002-Jun 2009 2004 = 2, '05 = 1. Trend: rare (*5*).	2003-Jun 2009 Not recorded (*6*).	2003-Jun 2009 Not recorded (*7*).

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