

**A Waterbird Census of Selected Wetlands along the Coastal
Margins of the Esperance District, Feb-Mar 2003.**

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SUMMARY

Waterbird surveys were conducted in the period January – March 2003 at 23 wetlands in the Western Australian Department of Conservation and Land Management (CALM) District of Esperance. The sites were restricted to estuaries and other coastal wetlands containing water to determine waterbird usage as drought refuges.

A punt and 6 wheel amphibious vehicle were used to access areas that could not be efficiently traversed by foot. A telescope and binoculars were used to identify species and count their numbers. Evidence of past breeding efforts was recorded along with water levels, conductivities and pH.

Forty-seven species were recorded from the 23 wetlands with a total of 34,548 birds present. All species of ducks that have occurred along the south coast in previous surveys were recorded in this survey. Musk Duck was the most abundant species, with 4,049 recorded. Black Swan, Australian Shelduck, Eurasian Coot and Grey Teal all had totals over 3,000.

Musk Duck and Great Crested Grebe were in greater abundance than in any survey of the same lakes in the 1980s and early 1990s. Counts of these and another seven species, most notably Freckled Duck and Hardhead, were very high compared with earlier counts across the entire south-west of the State. There can be no doubt that Esperance coast lakes were functioning as important drought refuges during summer-autumn 2003.

Mortijinup lakes supported the highest numbers of species with 29 recorded. Lakes with 20 or more species were Stokes Inlet, Windabout Lake and Ewens Lake. The Pacific Black Duck was the most widespread species, occurring at 16 of the 23 sites. Australian Shelduck, Common Greenshank and Grey Teal each occurred at 15 sites. Round Lake and Windabout Lake contained 70 and 164 Freckled Duck respectively. This species is uncommon to rare in south-western Australia. Only six lakes contained Hooded Plovers with Station Lake containing the highest number of 48. Four lakes were nearly dry and yielded low numbers of waterbirds.

Mortijinup lakes also supported the highest numbers of individuals with 7,345 recorded. The next highest was Windabout with 4,675. Lake Warden also supported over 4,000 birds. Other lakes with more than 2,000 birds were Wheatfield, Round Lake and Stokes Inlet. The Lake Warden Nature Reserve wetlands contained 12,315 individuals. The Mullet Lake Nature Reserve wetlands contained 4,087 individuals.

Twelve JAMBA/CAMBA-listed species were recorded, although not in high numbers. The most abundant (c. 2,800) was the Red-necked Stint, a migrant with its breeding grounds in eastern Siberia. The next most abundant was the Common Greenshank (150 birds). Many of the wetlands known for wading species were dry and therefore not visited. Due to time restrictions, only one survey could be undertaken at most sites. Repeat surveys would have increased the species diversity recorded, particularly of shorebirds.

Key wetlands known to be important for waterbirds and considered by CALM to possibly be under threat continue to support significant numbers and species diversity. Hooded Plover numbers were lower than in some previous surveys, but further work in wetlands to the north may have revealed greater numbers. Heavy rainfall in the middle of the survey period noticeably reduced waterbird numbers on the coastal lakes and estuaries.

The results of this study emphasise the importance of Nature Reserves and National Parks in the Esperance District for the maintenance of waterbird populations in conditions of widespread drought. The great majority (93%) of birds counted were on conservation lands.

Further survey work on the less-studied wetlands such as Round Lake, Mortijinup Lakes, Lake Nambarup, Exchange Road Swamp and the northern end of Stokes Inlet would be beneficial in determining their comparative importance within the region.

INTRODUCTION

Background

The Esperance District of the Department of Conservation and Land Management (CALM) provided funding for a waterbird census of permanent coastal wetlands during late summer 2003. The survey was conducted by the senior author, Senior Technical Officer Alan Clarke (AC), who was seconded to the District (on a 50% Science Division / 50% District Duties basis) from the Department's Woodvale Research Centre, Perth, for the three months January - March 2003.

This census was identified as the primary research activity to be undertaken by AC while based in the District. The survey would be undertaken at a time of widespread drought conditions across much of Australia. Permanent wetlands of the Esperance District (and other coastal areas) could be expected to provide refuge for large numbers of waterbirds of many species. Conditions such as this could be expected to occur only once or twice every few decades. It would be a significant event and an opportunity not to be missed.

Wetland selection and adoption of survey methodology was a collaborative effort between Esperance District staff, AC, and Principal Research Scientist Jim Lane (JL). The District perspective was that the work would assist in further defining the biological importance of south coast wetlands, and in the assessment of impacts of catchment land use on waterbird habitat values. The census could also provide information concerning habitat use by migratory shorebirds and other species of special significance under state and national policies and legislation.

This report provides information on an individual wetland basis, highlighting the most significant data collected during the project, together with references to previous work. Data are also presented in more detail in a number of tables.

Census Area

The 23 wetlands surveyed were within an area up to 20 kilometers inland from the south coast stretching from Munglinup, 100km west of the town of Esperance, to Thomas River, 100km east of Esperance. Beaumont Nature Reserve 20km northeast of Condingup was also included.

Selection of Wetlands

The survey effort was concentrated on 'permanent' wetlands of the Esperance District, that is, wetlands that retain water even during times of drought. These were expected to provide refuge for larger numbers and a greater diversity of waterbirds than usual, due to the prevailing drought conditions over much of southern and eastern Australia.

A selection of wetlands, both on and off CALM-managed conservation estate, that were *shallow* at this time, was specifically included in order to collect data concerning use made of these wetlands by shorebirds.

Initially, 34 wetlands were identified as providing good representation for the purposes of the census. From these, 23 were selected for survey in March 2003. The

remaining wetlands were not surveyed because they were dry or insufficient time was available. The surveyed wetlands included a range in size and salinity from the small, brackish site of Shark Lake, to large, highly saline estuaries such as Stokes Inlet. Wetlands that CALM already considers (based on Jaensch 1992) important for waterbird conservation and possibly under threat were also included.

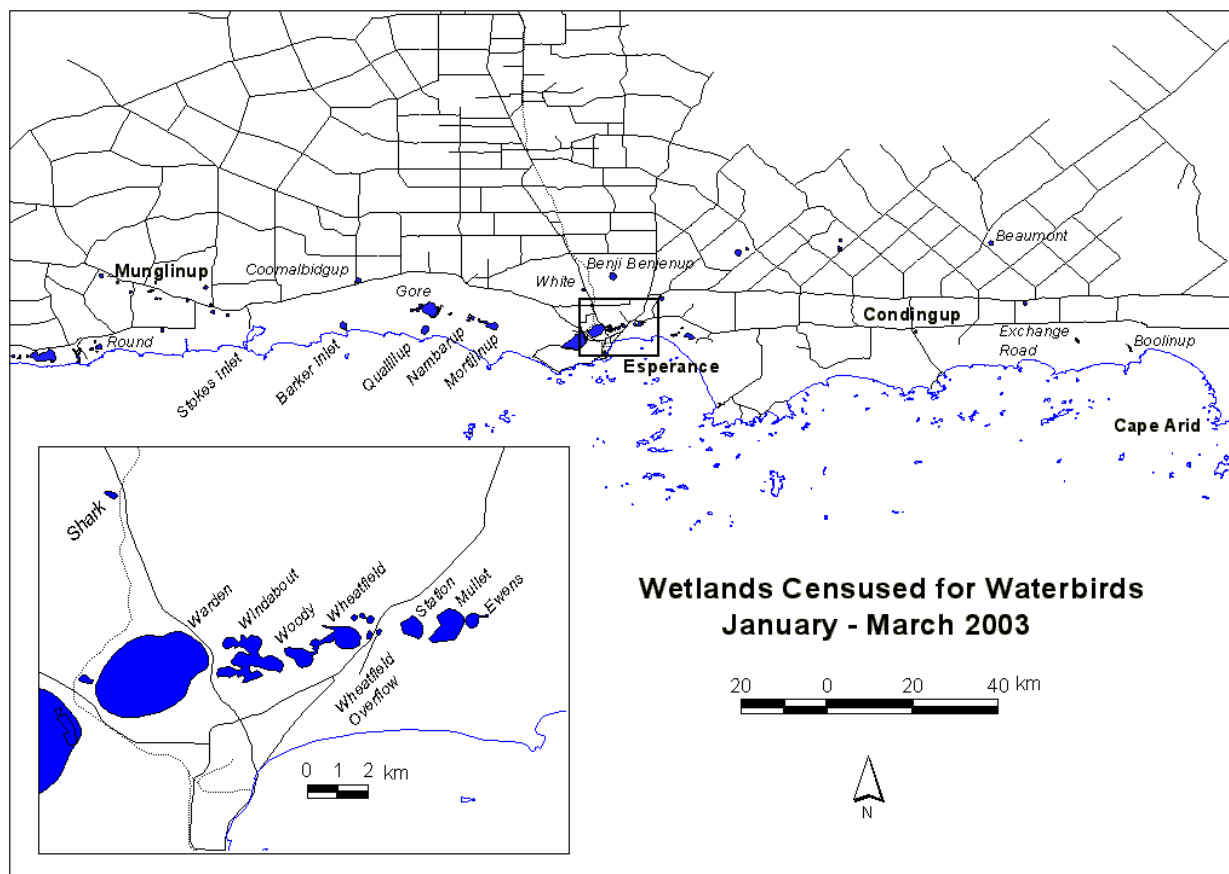


Figure 1. Study area.

Objectives

The objectives of the census were to:

1. Assess the use made of permanent wetlands of the Esperance coast by waterbirds under widespread drought conditions and thereby assist in further defining the biological importance of south coast wetlands.
2. Gather data that would assist in assessment of catchment land use impacts on waterbird habitats and in management of wetland values on CALM-managed conservation reserves.
3. Gather information on other wetlands to provide comparative data for evaluating relative importance of CALM-managed wetlands. These data could be used to raise awareness of the importance of wetlands not in the current reserve system.
4. Collect data concerning wetland habitat use by migratory shorebirds and other species of special significance under state and national policies and legislation.

Methods

AC traversed the large estuaries in a 3.4m punt with outboard motor. A second person assisted at 'Round Lake' by helping to haul the punt into the wetland and then operating the outboard while AC conducted the bird count. Shallow areas on the larger wetlands and the perimeters of smaller wetlands were walked with telescope and binoculars. Likely habitats, which included stands of *Baumea articulata* and overhanging *Melaleuca* species, were searched for evidence of past breeding activity by waterbirds. A six wheel drive, amphibious 'Argo' was used to access the northern half of Stokes Inlet through deep mud and water sections. General observations of waterbirds both from the boat and 'on foot' were made using Zeiss 8x56 or Mead 8x42 binoculars.

Census efforts were aimed at locating all species, with an emphasis on migratory shorebirds, and recording total numbers with as much precision as possible. Large mobile flocks were estimated. Aspects of habitat values and habitat condition were also recorded. Single water samples were taken from most wetlands and tested for conductivity as a measure of salinity. In wetlands where CALM depth gauges have been installed, the depth gauge readings (nearest cm) were recorded.

It was agreed with Esperance District that the results of the census would be presented in unpublished report format with accounts by wetland, highlighting significant species and numbers, waterbird use preference areas, vegetation habitat used by waterbirds, evidence of recent breeding activity, salinity, measured or approximate water depth and references to previous waterbird surveys of particular significance. All waterbird count data (species and numbers), water depth and conductivity/salinity data would also be presented in tabular format.

RESULTS

Barker Inlet

Location: 50km west of Esperance via track running east from Farrells Road.

Land status: Nature Reserve 27888

Date of survey: 5 March, 2003

Extent of water and Depth: 90% of the inlet was dry. A small pool 200m long and 20m wide to a max. depth of 2m was located on the east side of the outlet of the estuary. The water was highly saline, 80.4 ppt (parts per thousand) with a neutral pH (7.3 pH units).

Vegetation: There was no vegetation on the lake floor. The inlet's fringing vegetation would provide limited cover and/or breeding habitat when flooded.

Waterbird survey: Two Red-capped Plovers and two Red-necked Stints were recorded.

Previous surveys: JL conducted swan, pelican and egret aerial surveys of estuaries along the south coast in 1976 and 1977 that included Barker Inlet. The inlet was included in a series of 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91. These counts were of 13 native waterbird species, comprising all native duck species, the Black Swan and Eurasian Coot.

Beaumont Lake

Location: 20km northeast of Condingup at the intersection of Parmango Road and Howick Road.

Land status: Beaumont Nature Reserve

Date of survey: 28 March, 2003

Extent of water and Depth: The lake had dried to a 75m x 50m oval-shaped pool covering half of the normal open water area. The lake was highly saline (85.1 ppt) with a pH of 8.9. The deepest point was 0.21m read from the 1m gauge.

Vegetation: Tall *Melaleuca* spreads out into the lake from its steep sides. This provides cover when flooded, but is unsuitable for waterbird breeding habitat. The main body of the lake is not vegetated.

Waterbird survey: There were five species of waterbirds present. The most numerous were 110 Red-necked Stint and 63 Black-winged Stilt. There was an extensive line of waterfowl feathers around the edge of the lake, including Pink-eared Duck and Freckled Duck feathers, suggesting heavy use when water levels were higher. The muddy, relatively flat, lake floor is suitable for migratory shorebird species and other waders. AC expects this lake has had good duck and wading bird species diversity.

Previous surveys: This lake was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91.

Potential: Further survey work would reveal the importance of this lake in particular for Freckled Duck, Hooded Plover and other wading species.

Benje Benjenup

Location: 20km north of Esperance via Blumanns Road.

Land status: Private property

Date of survey: 15 February, 2003

Extent of water and Depth: The Lake was covered by 0.1m of hypo-saline water.

Vegetation: There was no vegetation on the lake floor and the fringing vegetation would provide limited cover or breeding habitat.

Waterbird survey: Twenty Red-capped Plovers and five Hooded Plovers were recorded. The birds were distributed around the shore of the lake.

Previous surveys: Benje Benjenup has been identified as a lake of international and national importance for shorebirds (Watkins 1993). The highest count (at that time) for Hooded Plover was 50, a state ranking of 26. A waterbird survey was conducted in late November 2002 by Bruce Buchanan (Buchanan 2003).

Boolinup Lake

Location: In the western end of the Cape Arid National Park via a walk trail near the Park Ranger's residence.

Land status: Cape Arid National Park

Date of survey: 6 February, 2003

Extent of water and Depth: The depth of water was estimated to be 3m.

Vegetation: There was no vegetation in the lake. The fringing vegetation would provide some cover and breeding habitat. Three duck nests (old) were located on the eastern shore in large over-hanging *Melaleuca* towards the northern end of the lake. The water level at time of survey was 1.5m below the nests.

Waterbird survey: There were fourteen species of waterbirds present. The total number of waterbirds was low (393). This total included 213 Musk Ducks and 14

Great Crested Grebe; the majority of other birds being Pacific Black Duck and Hoary-headed Grebe.

Previous surveys: This lake was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91.

Potential: Boolinup appears to have been surveyed for waterbirds on few occasions. Further survey work would reveal the importance of this lake, in particular for Musk Duck.

Coomalbidgup Swamp

Location: 50km west north west of Esperance on the north side of the South Coast Highway.

Land status: Shire Reserve

Date of survey: 5 March, 2003

Extent of water and Depth: The water was weakly saline (8.0 ppt) with a pH of 8.6. Water covered the main body of the lake to a depth of 1.12m recorded at gauge 3.

Vegetation: The lake is covered by a dense stand of dead tall timber and shrub skeletons providing good cover for Freckled Duck. The fringing vegetation would provide some cover and waterbird-breeding habitat when water levels are high.

Waterbird survey: There was a relatively high number of species (17), but total numbers were low (264). The Duck species diversity was high and these birds were evenly spread across the lake. The only records of Glossy Ibis and Wood Sandpiper from the entire survey were at Coomalbidgup. Two Swan nests were located in the northeastern area of the lake. They contained shell fragments and were in shallow water suggesting they were active last season.

Previous surveys: This lake was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91. Coomalbidgup is one of 25 wetlands being intensively monitored by CALM Science Division under the State Salinity Strategy. This ongoing work involves monitoring of vegetation plots, aquatic invertebrates and shallow ground waters, in addition to lake water levels and water quality. Waterbird counts are also conducted, three times per year, as part of this program, results are available in Cale *et al* 2004.

Ewens Lake

Location: Part of the Mullet Lake Nature Reserve chain of wetlands visible from Merivale Road 10km northeast of Esperance.

Land status: Mullet Lake Nature Reserve

Date of survey: 14 February, 2003

Extent of water and Depth: The water level is relatively stable throughout the year. The depth on gauge 1 was 0.7m. The lake was weakly saline (13.1 ppt) with a neutral pH (8.3).

Vegetation: Samphire and tussocks of *Juncus* spp. surround the lake. The main body of the lake is devoid of vegetation.

Waterbird survey: There was a relatively high number of species (20) and the total number of birds was high (1,821) considering the relatively small size of the lake. There was a notable diversity of duck species, with Pacific Black Duck, Grey Teal and Australian Shelduck the most abundant. One Freckled Duck was recorded and the only Australian Spotted Crake and Crested Tern from the entire survey were recorded.

Other Comments: AC often visited this area either while undertaking other work in the Reserve or traveling along Merivale Road, which provides an elevated view. There were consistently high numbers of birds and species diversity. The outflow

creek has shallow ponds that provided good migratory shorebird habitat before they dried out in late January 2003.

Exchange Road Swamp

Location: The lake is 5km west of the western boundary of Cape Arid National Park and is accessed via a track heading south from Exchange Road.

Land status: Unallocated Crown Land (UCL)

Date of survey: 7 February, 2003

Extent of water and Depth: The lake had dried to a small (400m x 200m), oval pool with an estimated depth of 0.3m.

Vegetation: The main body of the lake contains 'islands' of *Baumea articulata*. The *Baumea* occurs at varying lakebed levels and in varying densities. The denser stands closer to shore are suitable habitat for Little Bitten and other secretive waterbirds.

Waterbird survey: At the time of this survey the water was very low. Two species of wader (Red-necked Avocet and Red-necked Stint) were present; the latter is a migratory species and is on the JAMBA list. There were also 25 Grey Teal and one Common Greenshank. One Little Bittern nest (old) was found during an extensive search of the *Baumea*. There was an extensive line of waterfowl feathers around the lake edge suggesting substantial use when water levels were higher.

Potential: AC expects this lake would support many more waterbirds and species when water levels are higher, due to the presence of several habitat types including open water and emergent vegetation at various depths. The lake therefore warrants further survey work. Indications are that this lake has high conservation significance.

Lake Gore

Location: 35km west north west of Esperance via McCalls Road, which runs south of the South Coast Highway.

Land status: Lake Gore Nature Reserve

Date of survey: 20 February, 2003

Extent of water and Depth: The depth on gauge 2 was 0.65m. The lake water was highly saline (104 ppt) with a neutral pH (7.7).

Vegetation: The lake floor is devoid of live vegetation. Old dead trees that have fallen over are scattered throughout the lake.

Waterbird survey: Heavy rains across the District in mid February 2003 caused an exodus of waterbirds from many of the coastal lakes. Communication with a local landholder and keen lake watcher, Yohanus Marold, informed AC that the lake was 'covered black' with swans and other waterfowl prior to the rains. Numbers counted by AC after the rains were relatively low. Eight species were recorded in a total count of 1,042 birds. These included 700 Shelduck and 150 Black Swan. One Hooded Plover was sighted with low numbers of JAMBA-listed Red-necked Stint (146). An article by Buchanan (2003) provides count data for a survey he conducted in late November 2002. The Dalyup River inflow delta is the preferred roosting area for the majority of the birds. Feeding swans, ducks and coots were spread across the lake.

Previous surveys: Previous survey work has provided the data that resulted in Lake Gore being included on the 'Ramsar' list of internationally important wetlands. It is also listed in 'A Directory of Important Wetlands in Australia' (Environment Australia 2001). Previous highest numbers counted on Gore and their rankings (as presented in Jaensch *et al* 1993) include Australian Shelduck 12,000; State (WA) ranking of 3, Hoary-headed Grebe 1,000; State ranking of 8, Banded Stilt 20,000; State ranking of 2, Hooded Plover 393; State ranking of 2, Common Sandpiper 14;

State ranking of 2. The 'RAOU Report No. 30' (Jaensch *et al* 1988) presents the results of 34 waterbird surveys conducted from 1981-85. Thirteen of the 40 species recorded in these surveys are on the JAMBA list. High numbers of Hooded Plover have been recorded around the lakeshore in previous surveys. Gore was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91. A waterbird survey was conducted in late November 2002 by Buchanan (2003).

Comment: Increasing water levels resulting from catchment clearing are a potential threat to the suitability of the lake for Hooded Plovers as they could 'remove' (by inundation) the lake's exposed shore.

Mainbenup Swamp

Location: On track leading to Quallilup Lake, south of Murrays Road.

Land status: Private Property

Date of survey: 21 February, 2003

Extent of water and Depth: Depth estimated at 1m. Salinity was not recorded.

Vegetation: The main body of the lake was devoid of vegetation. Tall *Melaleuca* trees with little ground cover surrounded the lake.

Waterbird survey: A telescope was used to observe the birds from shore. Fifteen species were recorded in a total count of 1,139 birds. Eurasian Coot, Australian Shelduck and Hoary-headed Grebe dominated the count. Six Great Crested Grebe were also recorded. The only record of White-bellied Sea-Eagle from the entire survey was recorded. Feeding swans, ducks and coots were spread across the lake. Many ducks were roosting under the cover of overhanging *Melaleuca* on the eastern shoreline.

Previous surveys: This lake has held high numbers and species diversity for some time, see results of waterbird survey conducted in late November 2002 by Buchanan (2003). Many of the birds recorded are JAMBA listed species. Mainbenup Swamp was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91.

Comment: Further monitoring would determine whether or not this lake is filled by average winter rains or only during severe flood events.

Mortijinup Lakes

Location: 20km west of Esperance. Access is via private property from Telegraph Road, which is south of the South Coast Highway.

Land status: Mortijinup Lakes Nature Reserve

Date of survey: 19 February, 2003

Extent of water and Depth: Depth approximately 1.5m. The water in the main lake was weakly saline (6.8 ppt) and alkaline (pH 8.4).

Vegetation: The main body of the lake is devoid of vegetation. Tall *Melaleuca* trees and thick shrub surround the lakes.

Waterbird survey: A 12 foot punt was launched at the eastern edge of the largest water body and used to access the series of embayments to the west that were connected by narrow channels. A telescope and binoculars were used to observe the birds from the shore at each lake. 29 species were recorded with a total count of 7,345 birds. These lakes contained the highest species diversity and significantly more birds *in toto* than any of the other lakes surveyed during this project. The count of 1,952 Musk Duck was more than double that of the next most abundant species (Pacific Black Duck – 975 birds). Other species with relatively high numbers included Hoary-

headed Grebe (875), Little Black Cormorant (650), Australian Shelduck (622), Eurasian Coot (560), Blue-billed Duck (210), and Great Crested Grebe (79). 35 Fairy Terns were present with 10 showing juvenile plumage. Red-necked Stint were feeding in the shallows on the eastern edge of the lake in small groups that totaled 600 birds. Two Australasian Grebes were present in the fourth embayment to the west. This was the only record for the wetlands visited in these surveys.

Previous surveys: The previous highest numbers counted for Mortijinup, as presented in Jaensch *et al* (1993), include Australasian Shoveler 500; State ranking of 9, Musk Duck 535; State ranking of 4, Blue-billed Duck 300; State ranking of 10, Freckled Duck 54; State ranking of 6, Great Crested Grebe 50; State ranking of 4, and Little Black Cormorant breeding colony of 500 pairs. The Mortijinup Lakes were included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91. The Mortijinup Lakes group of wetlands is listed in 'A Directory of Important Wetlands in Australia' (Environment Australia 2001).

Mullet Lake

Location: Part of the Mullet Lake Nature Reserve chain of wetlands visible from Merivale Road 10km northeast of Esperance.

Land status: Mullet Lake Nature Reserve

Date of survey: 14 February, 2003

Extent of water and Depth: A shore varying from 10-20m wide was exposed with wide areas of shallow (<0.1m) water adjacent. Maximum depth was approximately 0.8m. The lake waters were highly saline (45.7 ppt) and had a pH of 8.3.

Vegetation: The main body of the lake is devoid of vegetation.

Waterbird survey: A telescope was used to observe the birds from shore. 12 species were recorded in a total count of 1,747 birds. Numbers were dominated by 1,000 Banded Stilt and 250 Red-necked Avocet that were feeding on the southeast shore. Two JAMBA-listed species were recorded, these being Red-necked Stint (425) and Common Greenshank (12). Twelve Hooded Plover were recorded spread around the lake.

Previous surveys: This lake has held high numbers and species diversity during many previous surveys. The previous highest numbers counted for Mullet Lake, as presented in Jaensch *et al* (1993), include 153 Common Greenshank with State ranking of 2. Mullet Lake was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91.

Lake Nambarup

Location: 20km west of Esperance. Access is via private property from Telegraph Road, which is south of the South Coast Highway.

Land status: Mortijinup Lakes Nature Reserve

Date of survey: 19 February, 2003

Extent of water and Depth: Depth estimated at over 2m. This water body is connected to the Mortijinup Lakes by a narrow channel. The water level was not high enough to connect between the lakes, but had only recently become disconnected. Access to the lake involved a long walk through thick woodland and scrub.

Vegetation: Access around the lake was difficult because of the dense fringing *Melaleuca*. Dead trees extended approximately 30m into the lake with the main body of the lake devoid of vegetation.

Waterbird survey: Viewing waterbirds on the lake was restricted by thick fringing vegetation. A telescope was used to observe the birds from shore. Access was

restricted around the lake resulting in some portions of the lake not being observed, numbers reported are therefore not a total count for the lake. Time was spent observing the lake from several vantage points and recording birds as they moved across the water. Seven species were recorded in a total count of 273 birds. 22 Great Crested Grebe were recorded with high numbers of Eurasian Coot, Musk Duck and Pacific Black Duck.

Previous surveys: This lake was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91.

Potential: Nambarup warrants further survey work. The habitat has potential for Freckled Duck.

Quallilup Lake

Location: 35km west of Esperance. Access is via track running south from Murrays Road and a private mine road.

Land status: Reserve 30672 (unvested). Inflow swamps are private property.

Date of survey: 21 February, 2003

Extent of water and Depth: Steep vegetated dunes and granite outcrops surround the main body of the lake. The inflow area has shallow areas overflowing from the main channel. These shallow lake areas are covered in dead timber providing cover for ducks and, in particular, potential Freckled Duck habitat. A sandy shore ranging from 5-10m wide was exposed with flooded *Melaleuca* stands adjacent. Maximum depth approximately 6.5m. The lake waters were saline (38.5 ppt) with a pH of 8.6.

Vegetation: The main body of the lake is devoid of vegetation.

Waterbird survey: A 12 foot punt was used to access the inflow areas. A telescope was used to observe the birds in the main body of the lake from the shore. 16 species were recorded in a total count of 860 birds. Numbers were dominated by Australian Shelduck (470) and Chestnut Teal (136). There was a relatively high count of the JAMBA-listed Common Greenshank.

Previous surveys: This lake was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91. A waterbird survey was conducted in late November 2002 by Buchanan (2003).

Round Lake (name is not official)

Location: 16km south-south-west of the town of Munglinup. Access is via a closed management track through the Lake Shaster Nature Reserve heading east from Munglinup Beach Road.

Land status: Lake Shaster Nature Reserve

Date of survey: 5 March, 2003

Extent of water and Depth: Maximum water depth was 2.2m. The lake waters were moderately saline (11.3 ppt) and had a pH of 9.1.

Vegetation: The shoreline was dominated by tall *Melaleuca* that extended into the lake to an average water depth of 0.8m. The main body of the lake is devoid of vegetation.

Waterbird survey: A 12 foot punt was used to access the lake and move amongst the flooded timber to flush birds and explore the inflow channel. The northern shore around the inflow sheltered many ducks amongst thick stands of dead timber. This area contained many egrets, herons, cormorants and ducks and included most of the Freckled Duck that were encountered. A telescope was used from the eastern shore to observe large numbers of birds sheltering from the southeast wind. 18 species were recorded in a total count of 2,583 birds. The count was dominated by ducks and coots

with nearly all south-western Australian duck species represented. Two of the rare ducks encountered during this survey were recorded here. These were Freckled Duck (70) and the second record of Blue-billed Duck (estimated 60). This lake supported relatively high numbers and species range for its size.

Comment: Access to this lake was through a closed management track for the Lake Shaster Nature Reserve. Natural history groups have a strong interest in regularly visiting this lake. Access management will need to be addressed by the District as required.

Shark Lake

Location: 12km north of Esperance at the junction of Shark Lake Road and the Coolgardie - Esperance Highway.

Land status: Shark Lake Nature Reserve

Date of survey: 15 February, 2003

Extent of water and Depth: The maximum depth was 1.73m on gauge 2. Previous monitoring indicates that this is a brackish lake with a neutral pH.

Vegetation: The lake is surrounded by *Baumea articulata* and low rushes (*Juncia* spp.). This vegetation type provides useful nesting habitat and good cover for crakes, rails and other secretive waterbirds. The main body of the lake is devoid of vegetation.

Waterbird survey: A telescope was used to observe the birds from shore in the main body of the lake. 13 species were recorded in a total count of 1166 birds. Numbers were dominated by Hardhead (850), Pacific Black Duck (150) and Pink-eared Duck (100).

Previous surveys: The previous highest numbers counted for Shark Lake identified in Jaensch *et al* (1993) include four Baillon's Crake (State ranking of 2). In the 'RAOU Report No. 30' (Jaensch *et al* 1988) describes the results of 37 waterbird surveys conducted between 1981-85. Seven of the 40 species recorded in these surveys are on the JAMBA List. This lake was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91. A waterbird survey was conducted in late November 2002 by Buchanan (2003).

Station Lake

Location: Part of the Mullet Lake Nature Reserve chain of wetlands visible from Merivale Road 10km northeast of Esperance.

Land status: Mullet Lake Nature Reserve

Date of survey: 14 February, 2003

Extent of water and Depth: A muddy shore 5-10m wide surrounded the shallow water body. Wading birds were feeding in the shallows on the eastern shore. The maximum depth was 0.30m on gauge 1. The lake waters were highly saline (43.3 ppt) with a pH of 8.3.

Vegetation: The main body of the lake is devoid of vegetation.

Waterbird survey: A telescope was used to observe the birds from shore. 11 species were recorded in a total count of 519 birds. The count numbers were dominated by 425 Red-necked Stint. There were two other JAMBA-listed species along with the Stints, namely Common Greenshank and Curlew Sandpiper. 48 Hooded Plover were recorded scattered around the lake edge.

Previous surveys: Previous surveys have revealed the importance of this lake for JAMBA-listed species. Large numbers of Hooded Plover and Banded Stilt have frequently been recorded. It has been identified as a lake of international and national

importance for shorebirds (Watkins 1993), with a highest count of 99 Hooded Plover and a State ranking of 18. This lake was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91.

Stokes Inlet

Location: 70km west of Esperance. Access is via Stokes Inlet Road, which runs south from the South Coast Highway.

Land status: Stokes National Park

Date of survey: 5 March, 2003

Extent of water and Depth: The maximum depth was estimated to be approximately 3m. The water was highly saline (53.4 ppt) and had a pH of 8.0. Stokes Inlet is an extensive, highly saline water body that receives flow from the Lort and Young Rivers, which drain an extensively cleared catchment. The lower half of the estuary reaches depths of approximately 3m and is bound by steep dunes. The northern half of the estuary has extensive shallow and wet-mud areas, exposed through summer drying, providing suitable habitat for wading species. The undisturbed nature of the mud flat areas has contributed to the high number and range of JAMBA-listed species encountered. The estuary has an extensive, shallow, overflow lake that is suitable for Hooded Plovers and other wading species. This area was dry at the time of the survey and did not contain any bird life.

Vegetation: The main body of the lake is devoid of vegetation. There are low rocky islands that provide roosting habitat for fish-eating birds and some wading species.

Waterbird survey: The majority of waterbirds recorded were in the northern half of the estuary. A 12 foot punt was used to access the main water body, rocky islands and the sand bar area. An amphibious, 6 wheel drive 'Argo' was used to travel around the extensive northern shoreline. This enabled access across the shallow water and soft mud areas. A telescope and binoculars were used to observe the birds from shore in this area. 25 species were recorded in a total count of 2,072 birds. During this survey the inlet did not support large duck or swan numbers *in toto*, however the count of 417 Chestnut Teal was notable. More Great Cormorants were recorded here than on any other wetland in this survey. Stokes had the only records of Great Knot (7) and Pied Cormorant (1) from the entire survey. The inlet had the second highest number of species compared with the other wetlands in this survey, but numbers were lower than expected, given the inlet's size. The northern area of the inlet does provide significant area and range of habitat types suitable for wading birds. Human activities and consistent high water levels will impact on the suitability of this area for wading species.

Previous surveys: The previous highest numbers counted on Stokes Inlet, as presented in Jaensch *et al* (1993), include Chestnut Teal (872); State ranking of 4, and Pacific Gull (12); State ranking of 2. JL conducted aerial surveys swan, pelican and egret numbers on estuaries along the south coast in 1976 and 1977 that included Stokes Inlet. This lake was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91.

Potential: Further survey work is required to determine the extent of use by JAMBA-listed species.

Lake Warden

Location: 5km north of Esperance on the western side of the Coolgardie - Esperance Highway.

Land status: Lake Warden Nature Reserve

Date of survey: 14 February, 2003

Extent of water and Depth: The depth on gauge 2 was 1.50m. The lake waters were highly saline (74.7 ppt) with a neutral pH (7.9).

Vegetation: The main water body is devoid of vegetation. The flooded area of *Melaleuca* along the southern shore provides cover and roosting habitat for cormorants, ducks, grebes, herons and egrets. It is also a suitable habitat for the Rufous Night Heron.

Waterbird survey: Waterbirds were observed using binoculars and telescope from various points around the lake. AC was able to walk along the shore from the depth gauge area around to the outflow. He then recommenced the survey from the northern shore and walked west until within telescope view of the inflow area. The remainder of the shore and open water was viewed with the 'scope from an entry point off Warden Road. 18 species were recorded in a total count of 4,484 birds. Three species, namely Black Swan, Australian Shelduck and Hoary-headed Grebe, were each present in large numbers (1,000+). 200 Little Black Cormorants were using the flooded *Melaleuca* to roost in the afternoon. Three JAMBA-listed species were recorded with the Red-necked Stint the most numerous (130 birds).

Previous surveys: Previous survey work has provided the data that resulted in Lake Warden and adjoining lakes being included on the 'Ramsar' list of internationally important wetlands. Lake Warden is also listed in 'A Directory of Important Wetlands in Australia' (Environment Australia 2001). The previous highest numbers counted for Lake Warden, as presented in Jaensch *et al* (1993), include Black Swan 3,500; a State ranking of 2, Chestnut Teal 328; State ranking of 10, Musk Duck 328; State ranking of 9, Australian Shelduck 5,500; State ranking of 9, Hooded Plover 539; State ranking of 1, Banded Stilt 10,000; State ranking of 5, Common Sandpiper 8; State ranking of 3, and Ruddy Turnstone 24; State ranking of 1. The 'RAOU Report No. 30' (Jaensch *et al* 1988) describes the results of 26 waterbird surveys conducted from 1981-85. The surveys included all lakes within the Lake Warden Nature Reserve, but some data are presented on an individual lake basis. Thirty-nine species were recorded on Lake Warden. Seventeen of the 59 species recorded across all lakes in the Nature Reserve during these surveys are on the JAMBA list. This lake was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91. High numbers of Hooded Plover have been recorded around the lakeshore in previous surveys.

Comment: Increasing water levels resulting from catchment clearing are a potential threat to the suitability of the lake for Hooded Plovers as they could 'remove' (by inundation) the lake's exposed shore.

Wheatfield Lake

Location: 8km northeast of Esperance on the northern side of Fisheries Road.

Land status: Lake Warden Nature Reserve

Date of survey: 13 February, 2003

Extent of water and Depth: The maximum depth was approximately 0.95m. The lake waters were saline (35.6 ppt) and had a pH of 8.2.

Vegetation: Dying *Melaleuca* and low rushes (*Juncia* spp.) surround the lake. Ducks use the overhanging cover around the lake and channel area to roost and loaf beneath. The dead stands of timber through the channel and western shore are used for roosting by cormorants, egrets and herons. The main body of the lake is devoid of vegetation.

Waterbird survey: A telescope and binoculars were used to observe the birds in the main body of the lake from the shore. Most birds were observed from the two observation hides at the lake. 17 species were recorded in a total count of 3,024 birds.

Numbers were equally dominated by Hardhead and Grey Teal, which when combined, totalled 2,450 birds. Pacific Black Duck were the next most numerous (220). One Freckled Duck was recorded. There was a notable variety of duck species and cormorants, egrets and herons.

Previous surveys: The previous highest numbers counted on Wheatfield Lake, as presented in Jaensch *et al* (1993), include Chestnut Teal 400; State ranking of 8, and Whiskered Tern 100; State ranking of 4. This lake was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990), conducted from 1988-91. Wheatfield is one of 25 wetlands being intensively monitored by CALM Science Division under the State Salinity Strategy. This ongoing work involves monitoring of vegetation plots, aquatic invertebrates and shallow ground waters, in addition to lake water levels and water quality. Waterbird counts are also conducted, three times per year, as part of this program, results are available in Cale *et al* 2004.

Wheatfield Lake overflow lake south of Fisheries Road

Location: 8km northeast of Esperance on the southern side of Fisheries Road.

Land status: Lake Warden Nature Reserve

Date of survey: 16 January, 2003

Extent of water and Depth: The water was only 0.2-0.3m deep.

Vegetation: The main body of the lake is devoid of vegetation.

Waterbird survey: A telescope and binoculars were used to observe the birds from shore. Eight species were recorded in a total count of 730 birds. The lake was crowded with ducks and swans. Chestnut Teal (70) and Australasian Shoveler (30) were present in notable numbers, given the small size of this lake.

Comment: Many of these smaller un-named lakes contained concentrations of birds during the summer, providing vital staging areas when the larger lakes are not at suitable water levels.

White Lake

Location: 16km north of Esperance on the western side of the Coolgardie - Esperance Highway.

Land status: Private Property

Date of survey: 15 February, 2003

Extent of water and Depth: A thick crust of salt covered most of the lake surface. There was a small pool of salt-saturated water in the process of crystallizing.

Vegetation: The main body of the lake is devoid of vegetation.

Waterbird survey: A telescope was used to observe the birds across this small lake. The two species recorded were Hooded Plover (8) and Red-capped Plover (2).

Previous surveys: Identified as a lake of international and national importance for shorebirds by Watkins (1993); highest count of Hooded Plover was 140; State ranking of 9. A waterbird survey was conducted in late November 2002 by Buchanan (2003), who referred to White Lake as Helms Arboretum Lake.

Windabout Lake

Location: 5km north of Esperance on the eastern side of the Coolgardie - Esperance Highway. Access is via Windabout Way off Fisheries Road.

Land status: Lake Warden Nature Reserve

Date of survey: 13 February, 2003

Extent of water and Depth: The maximum depth was 1.36m on gauge 1. The lake waters were moderately saline (19.5 ppt) with a neutral pH (7.4).

Vegetation: Dying *Melaleuca* and low rushes (*Juncia* spp.) surround the lake. Ducks use the overhanging cover around the lake to roost and loaf beneath. The dead stands of timber through the channel to Woody Lake are used for roosting by cormorants, egrets and herons. The main body of the lake is devoid of vegetation.

Waterbird survey: A telescope and binoculars were used to observe the birds in the main body of the lake from the shore. 23 species were recorded in a total count of 4,675 birds. Most abundant were swans, coots and ducks. More Black Swans (1,881) and Freckled Duck (164) were recorded here than on any other wetland in the survey. Most of the Freckled Duck were roosting on limestone outcrops under the cover of overhanging vegetation. All south-western Australian duck species except the Blue-billed Duck were encountered. Musk Duck were abundant with 847 recorded. A group of 153 Australian Pelicans was roosting on a small sandy island at the entrance to the flow-through channel to Woody Lake. This group had been observed on various lakes within the Lake Warden System during the survey period. Windabout had the only record of Black-tailed Native Hen (1) from the entire survey.

Comment: Windabout Lake was second only to Mortijinup Lakes for total numbers and species diversity. The numbers of swans, coots and ducks and, in particular, the high count of Freckled Duck, indicate that this lake is an important drought refuge for this area.

Woody Lake

Location: 7km north-east of Esperance. Access is via Windabout Way off Fisheries Road.

Land status: Lake Warden Nature Reserve

Date of survey: 13 February, 2003

Extent of water and Depth: The maximum depth was 0.95m on gauge 1. The lake waters were moderately saline (11.3 ppt) and had a neutral pH (7.9).

Vegetation: *Melaleuca* and low rushes (*Juncia* spp) surround the lake. Ducks use the overhanging cover around the lake and channel area to roost and loaf beneath. The main body of the lake is devoid of vegetation.

Waterbird survey: A telescope and binoculars were used to observe the birds from the shore. 10 species were recorded in a total count of 132 birds. The species diversity was relatively high for this deeper water lake, but the numbers were low.

Previous surveys: The previous highest numbers counted for Woody Lake, as presented in Jaensch *et al* (1993), include Musk Duck 360; a State ranking of 7. This lake was included in the 'Annual Waterfowl Counts in South-Western Australia' (Halse *et al* 1990) conducted from 1988-91.

SUMMARY OF RESULTS

Scientific names, common names and total counts of waterbird species recorded in February-March 2003 are presented in Table 1. Forty-seven species and 34,548 birds were recorded. Twelve species are listed under the Japan-Australia (JAMBA) or China-Australia (CAMBA) Migratory Bird Agreements and these totalled 3,153 birds. Waterfowl (Anatidae) were well represented in terms of both numbers of species (11) and numbers of individuals (21,353). Migratory shorebirds (Scolopacidae and some species of Charadriidae) were relatively low in species diversity (7; all Scolopacidae) and numbers (3,052).

More than 1,000 individuals were counted of 11 waterbird species (Table 2). These were Musk Duck (4,049), Black Swan (3,543), Australian Shelduck (3,357), Eurasian Coot (3,122), Grey Teal (3,114), Red-necked Stint (2,848), Hoary-headed Grebe (2,715), Pacific Black Duck (2,628), Hardhead (2,350), Banded Stilt (1,024) and Chestnut Teal (1,002). There was an obvious, positive correlation between total counts of each species and the number of wetlands on which they were recorded. The most noteworthy exception was the Blue-billed Duck which, although numerous (270 birds), was found on only two wetlands (Mortijinup and Round), with most (78%) on Mortijinup.

Three of the 23 wetlands surveyed supported more than 4,000 waterbirds (Mortijinup 7,345; Windabout 4,675; Warden 4,484), a further three (6 in total) had more than 2,000 and a further five (11 in total) had more than 1,000 (Table 3). Wetlands with highest numbers of JAMBA and/or CAMBA birds were Stokes Inlet (1067), Mortijinup (638), Mullet (438) and Station (433).

Ten or more waterbird species were recorded on 15 of the 23 wetlands visited (Table 4). Those with 20 or more species were Mortijinup (29), Stokes (25), Windabout (23) and Ewens (20). Stokes (7) supported most JAMBA/CAMBA species at the time of survey; others supported 0-4.

Nine waterbird species had highest numbers of individuals on Stokes Inlet than on any other visited wetland (Table 5). Mortijinup had highest numbers of eight species, Windabout had seven species and Round and Warden each had highest numbers of five species.

Six wetlands were visited in both November 2002 (Buchanan 2003) and February 2003 (this report) (Table 6). The total number of waterbirds (14,022) and waterbird species (43) recorded on these wetlands in November 2002 were substantially higher than in February 2003 (4,242 birds; 29 species). On an individual wetland basis, four wetlands (White, Benje Benjenup, Gore, Mainbenup) had higher numbers of waterbirds in November 2002 than in February 2003 and four (Shark, Benje Benjenup, Gore, Mainbenup) had higher numbers of species. Eighteen of the 29 species recorded in February 2003 were more abundant in that survey than three months previously. Numerically, the biggest increase was in numbers of Hardhead (8 to 850 individuals). The biggest decreases from November 2002 to February 2003 were Black Swan (4,243 to 200), Australian Shelduck (5,051 to 1,575), Pink-eared Duck (2,400 to 102) and Banded Stilt (648 to 0).

Nine wetlands that were surveyed over extensive periods (up to four years) between 1981 and 1985 (Jaensch *et al* 1988) were also visited in February 2003 (Tables 7a & 7b). Many species were more abundant on one or more of these wetlands during the February 2003 visit than during 1981-85. Species that were substantially more abundant in February 2003 were: Musk Duck (847 on Windabout), Freckled Duck (164 on Windabout), Black Swan (1,881 on Windabout), Pacific Black Duck (600 on Ewens), Grey Teal (1,100 on Wheatfield), Hardhead (1,350 and 850 on Wheatfield and Shark respectively), Hoary-headed Grebe (1,200 on Warden), Australian Pelican (153 on Windabout), Yellow-billed Spoonbill (30, 20, 17 on Wheatfield, Windabout, Ewens respectively), Eurasian Coot (900 on Windabout), Red-necked Stint (425 on Mullet) and Red-necked Avocet (250 on Mullet).

The Lake Warden System Ramsar Site (Wetland of International Importance under the 'Ramsar' *Convention on Wetlands*) comprises the Lake Warden and Mullet Lake Nature Reserves. Waterbird use of these reserves was surveyed during 1981-85 (Jaensch *et al* 1988) and in February 2003 (this study) (Table 8). Substantially higher counts of the following species were made in one or both of these Nature Reserves in February 2003 than during 1981-85: Musk Duck (1,147 v. 360 on Warden NR), Freckled Duck (165 v. 2 on Warden NR), Pacific Black Duck (603 v. 100 on Mullet NR), Pink-eared Duck (236 v. 12 on Warden NR), Hardhead (1,351 v. 12 on Warden NR), Hoary-headed Grebe (1,243 v. 70 on Warden NR), Australian Pelican (165 v. 6 on Warden NR), Yellow-billed Spoonbill (50 v. zero on Warden NR) and Eurasian Coot (1,118 v. 700 on Warden NR).

Jaensch *et al* (1993) reported the highest numbers (i.e. highest 5-10 counts of each species) of waterbirds on any wetland in south-western Australia during the period 1981-92. Highest counts made during Feb-Mar 2003 (this study) were within the range of the 1981-92 highest numbers for eight species (Table 9). Two Feb-Mar 2003 counts (1,952 Musk Duck at Mortijinup and 164 Freckled Duck at Windabout) rank second when compared with the 1981-92 data for all south-west wetlands; one count (79 Great Crested Grebe at Mortijinup) ranks third; two counts (1350 Hardhead at Wheatfield and 153 Australian Pelican at Windabout) rank fourth; two counts (417 Chestnut Teal at Stokes Inlet and 1,200 Hoary-headed Grebe at Warden) rank eighth, and one count (1000 Red-necked Stint at Stokes Inlet) ranks ninth.

Eight wetlands (Gore, Mortijinup, Mullet, Shark, Stokes, Warden, Wheatfield, Woody) referred to by Jaensch *et al* (1993) were visited in February 2003 (Table 10). Higher numbers of two species of waterbirds were recorded on one of these wetlands (Mortijinup) than were recorded during the entire 1981-92 period. These species were Musk Duck (1,952) and Great Crested Grebe (79).

Seventeen of the 23 wetlands surveyed in Feb-Mar 2003 were in Nature Reserves or National Parks. Of the remainder, one wetland (Coomalbidgup) was in a Shire Reserve; one (Exchange Rd) was on Unallocated Crown Land and three (Benje Benjenup, Mainbenup, White) were on private property. Quallilup was part Unvested Reserve and part private property (Table 11). The total number of waterbirds on these six "other than conservation reserve" wetlands ranged from 1,139 (Mainbenup) to 10 (White); the number of species from 17 (Coomalbidgup) to 2 (Benje Benjenup and White); the number of JAMBA/CAMBA birds from 53 (Quallilup) to 0 (Benje Benjenup and White) and the number of JAMBA/CAMBA species from 3 (Coomalbidgup) to 0 (Benje Benjenup and White). The most abundant species on each wetland ranged from 470 Australian Shelduck on Quallilup to 8 Hooded Plover on White. The total number of waterbirds on these six "non-conservation reserve" wetlands was 2,351, which is 7% of the total number counted on all 23 surveyed wetlands.

The number of recorded individuals of each waterbird species in each wetland in the February-March 2003 survey is presented in Tables 12 & 13, with wetlands arranged both alphabetically (Table 12) and chronologically (Table 13) for convenience. The total number of waterbirds counted on all 23 wetlands during this survey was 34,548, of which 3,153 were JAMBA/CAMBA birds and most (3,052 birds; 97%) of these were transequatorial migratory shorebirds.

Results of depth, conductivity, salinity and pH measurement of all wetlands visited are presented in Table 14. Almost half (11 of 23) of the wetlands visited were less than 1m deep at the time. Half of the remainder were less than 2m deep and only one (Quallilup 6.5m) exceeded 3m in depth. Measured salinities were generally high, ranging from 6.8 (Mortijinup) to 104 (Gore) ppt. Measured pH values were all within the range 7-9 pH units, except for 'Round Lake' (pH 9.1).

DISCUSSION

The principal objective of this brief study was to assess the use made of permanent wetlands of the Esperance coast by waterbirds under widespread drought conditions in summer-autumn of 2003. As expected, waterbird numbers were very high. Approximately 35,000 waterbirds were counted on the 23 wetlands that were visited; with highest numbers on Mortijinup, Windabout and Warden lakes. The 35,000 birds comprised 47 species; the most abundant of which were Musk Duck, Black Swan and Australian Shelduck. Two species - Musk Duck and Great Crested Grebe - were in greater abundance than had previously been reported from any survey of the same Esperance lakes in the 1980s and early 1990s. Counts of these and another six species, most notably the Freckled Duck, Great Crested Grebe and Hardhead, were very high compared with earlier counts of wetlands across the entire south-west. There can be no doubt that Esperance coast lakes were functioning as important drought refuges during summer-autumn 2003.

The high mobility of many species of Australian waterbirds was evidenced by the change in numbers on six wetlands from November 2002 (a previous study) to Feb-Mar 2003 (this study). Buchanan (2003) recorded substantially higher numbers of Black Swans, Australian Shelduck, Pink-eared Duck and Banded Stilt in November 2002. Their movement to other wetlands, either on the Esperance coast or surrounding districts, was likely linked to changes in food availability as summer progressed. Some moved in response to widespread rains across the south of the State on 17 February 2003. This was particularly evident at Lake Gore, where Black Swan and Australian Shelduck numbers dropped from 1,540 and 3,500 in November 2002 to 150 and 700 respectively on 20 February 2003. A local birdwatcher confirmed that there had been large numbers of waterfowl on Lake Gore shortly prior to the rain. While swan, shelduck and some other bird numbers decreased, 18 species were *more* abundant on this group of wetlands in February 2003 than they had been in November 2002. The above observations are consistent with the accepted view that many Australian waterbirds use, and are dependent upon the existence of, numerous wetlands in their lifetime.

Management emphasis on protecting habitat diversity and natural water level regimes, winter filling and summer drying, will maintain and restore the suitability of the wetlands for waterbird usage. The suite of wetlands within the Lake Warden and Mullet Lake Nature Reserves has consistently shown through previous survey work and during this 'snap shot' survey, a capacity to support high individual numbers and species diversity. However, constantly high water levels in the Warden wetlands and a consequent reduction in the diversity of water depths required by different species could result in lower usage by waterbirds.

The results of this study emphasise the importance of CALM-managed lands (Nature Reserves and National Parks) in the Esperance District for the maintenance of

waterbird populations, particularly in conditions of widespread drought. The great majority (93%) of birds counted were on conservation lands. Nonetheless, three (Mainbenup, Quallilup, Coomalbidgup) of the seven “non-conservation reserve” wetlands that were surveyed provided significant waterbird habitat during Feb-Mar 2003.

The total number of migratory shorebirds counted on the 23 Esperance coast wetlands that were visited in February-March 2003 was approximately 3,000. This represented 9% of the total number of waterbirds counted. The most abundant (c. 2,800) was the Red-necked Stint, a migrant with its breeding grounds in eastern Siberia. The Common Greenshank (150) was the next most abundant migratory shorebird; the other five species recorded were all in low numbers. Wetlands with the highest numbers of migratory shorebirds were Stokes Inlet, Mortijinup, Mullet and Station lakes. Numbers were low (<150) on all other visited wetlands. These migratory shorebirds are listed under the Japan-Australia and China-Australia Migratory Bird Agreements. The only other JAMBA / CAMBA listed species that was recorded in some abundance was the Great Egret: 84 birds, most of which were on Mortijinup, Quallilup and Windabout lakes.

Further survey work on the less known wetlands would be beneficial in determining their comparative importance within the region. Wetlands which show potential to support high numbers and species diversity, but did not rank highly during the brief period of survey, include Round Lake, Mortijinup Lakes, Lake Nambarup, Exchange Road Swamp and the northern end of Stokes Inlet.

A waterbird survey program concentrating on breeding activity in a range of wetlands during spring would provide information on their relative importance in terms of breeding habitat values. The lakes selected for this survey were chosen on the basis of their potential to provide drought refuge and/or migratory shorebird habitat. Those lakes important for breeding success in the region may differ from the drought refuge sites and require different management of potentially threatening processes.

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Table 1: Common and Scientific Names and Total Counts of Waterbird Species on surveyed Esperance coast wetlands in Feb-Mar 2003.

Family Name	Group and Scientific Names	Common Name	Total Count
ANATIDAE	Ducks & allies		
	<i>Oxyura australis</i>	Blue-billed Duck	270
	<i>Biziura lobata</i>	Musk Duck	4049
	<i>Stictonetta naevosa</i>	Freckled Duck	236
	<i>Cygnus atratus</i>	Black Swan	3543
	<i>Tadorna tadornoides</i>	Australian Shelduck	3357
	<i>Anas superciliosa</i>	Pacific Black Duck	2628
	<i>Anas rhynchos</i>	Australasian Shoveler	289
	<i>Anas gracilis</i>	Grey Teal	3114
	<i>Anas castanea</i>	Chestnut Teal	1002
	<i>Malacorhynchus membranaceus</i>	Pink-eared Duck	415
<i>Aythya australis</i>	Hardhead	2350	
PODICIPEDIDAE	Grebes		
	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	2
	<i>Poliocephalus poliocephalus</i>	Hoary-headed Grebe	2715
	<i>Podiceps cristatus</i>	Great Crested Grebe	133
ANHINGIDAE	Darters		
	<i>Anhinga melanogaster</i>	Darter	40
PHALACROCORACIDAE	Cormorants		
	<i>Phalacrocorax melanoleucos</i>	Little Pied Cormorant	97
	<i>Phalacrocorax varius</i>	Pied Cormorant	1
	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	949
	<i>Phalacrocorax carbo</i>	Great Cormorant	33
PELECANIDAE	Pelicans		
	<i>Pelecanus conspicillatus</i>	Australian Pelican	224
ARDEIDAE	Hérons, Egrets, Bitterns		
	<i>Egretta novaehollandiae</i>	White-faced Heron	132
	<i>Ardea alba</i> ^{CJ}	Great Egret	84
THRESKIORNITHIDAE	Ibises, Spoonbills		
	<i>Plegadis falcinellus</i> ^C	Glossy Ibis	4
	<i>Threskiornis molucca</i>	Australian White Ibis	21
	<i>Platalea flavipes</i>	Yellow-billed Spoonbill	169
ACCIPITRIDAE	Osprey, Kite, Eagles, Harriers		
	<i>Haliaeetus leucogaster</i> ^C	White bellied Sea-Eagle	1
RALLIDAE	Rails, Crakes, Water hens, Coot		
	<i>Porzana fluminea</i>	Australian Spotted Crake	2
	<i>Porphyrio porphyrio</i>	Purple Swamphen	7
	<i>Gallinula ventralis</i>	Black-tailed Native-hen	1
	<i>Fulica atra</i>	Eurasian Coot	3122
SCOLOPACIDAE	Sandpipers, Knots, Stint & allies		
	<i>Tringa nebularia</i> ^{CJM}	Common Greenshank	150
	<i>Tringa glareola</i> ^{CJM}	Wood Sandpiper	6
	<i>Actitis hypoleucos</i> ^{CJM}	Common Sandpiper	5
	<i>Calidris tenuirostris</i> ^{CJM}	Great Knot	7
	<i>Calidris ruficollis</i> ^{CJM}	Red-necked Stint	2848
	<i>Calidris acuminata</i> ^{CJM}	Sharp-tailed Sandpiper	9
	<i>Calidris ferruginea</i> ^{CJM}	Curlew Sandpiper	27
RECURVIROSTRIDAE	Stilts, Avocets		
	<i>Himantopus himantopus</i>	Black-winged Stilt	214
	<i>Cladorhynchus leucocephalus</i>	Banded Stilt	1024
	<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet	524
CHARADRIIDAE	Plovers, Dotterels		
	<i>Charadrius ruficapillus</i>	Red-capped Plover	258
	<i>Elsayornis melanops</i>	Black-fronted Dotterel	16
	<i>Thinornis rubricollis</i>	Hooded Plover	81
LARIDAE	Gulls, Terns		
	<i>Larus novaehollandiae</i>	Silver Gull	338
	<i>Sterna caspia</i> ^C	Caspian Tern	11
	<i>Sterna bergii</i> ^J	Crested Tern	1
	<i>Sterna nereis</i>	Fairy Tern	39
	Species: 47		Birds: 34548

NP=National Park, NR=Nature Reserve, PP=Private property, SR=Shire Reserve, UR=Unvested Reserve.

C=CAMBA species; J=JAMBA species; M=Transequatorial migratory shorebirds.

Table 2: Waterbird Species and Numbers, ranked in order of Total Count of Waterbirds on surveyed Esperance coast wetlands, Feb-Mar 2003.

Common Name	Total Count	No. of wetlands	Highest Count	Wetland of Highest Count
Musk Duck	4049	11	1952	Mortijinup (NR)
Black Swan	3543	13	1881	Windabout (NR)
Australian Shelduck	3357	15	1028	Warden (NR)
Eurasian Coot	3122	12	900	Windabout (NR) & Round (NR)
Grey Teal	3114	15	1100	Wheatfield (NR)
Red-necked Stint ^{CJM}	2848	9	1000	Stokes (NP)
Hoary-headed Grebe	2715	13	1200	Warden (NR)
Pacific Black Duck	2628	16	975	Mortijinup (NR)
Hardhead	2350	6	1350	Wheatfield (NR)
Banded Stilt	1024	6	1000	Mullet (NR)
Chestnut Teal	1002	13	417	Stokes (NP)
Little Black Cormorant	949	7	650	Mortijinup (NR)
Red-necked Avocet	524	5	250	Mullet (NR)
Pink-eared Duck	415	8	180	Windabout (NR)
Silver Gull	338	6	200	Warden (NR)
Australasian Shoveler	289	7	150	Round (NR)
Blue-billed Duck	270	2	210	Mortijinup (NR)
Red-capped Plover	258	8	172	Stokes (NP)
Freckled Duck	236	4	164	Windabout (NR)
Australian Pelican	224	9	153	Windabout (NR)
Black-winged Stilt	214	9	63	Beaumont (NR)
Yellow-billed Spoonbill	169	7	73	Round (NR)
Common Greenshank	150	15	34	Ewens (NR)
Great Crested Grebe	133	7	79	Mortijinup (NR)
White-faced Heron	132	13	37	Round (NR)
Little Pied Cormorant	97	8	30	Warden (NR)
Great Egret ^{CJ}	84	8	30	Mortijinup (NR)
Hooded Plover	81	6	48	Station (NR)
Darter	40	5	17	Quallilup (UR&PP)
Fairy Tern	39	2	35	Mortijinup (NR)
Great Cormorant	33	2	20	Stokes (NP)
Curlew Sandpiper ^{CJM}	27	2	25	Stokes (NP)
Australian White Ibis	21	7	10	Round (NR)
Black-fronted Dotterel	16	2	10	Shark (NR)
Caspian Tern ^C	11	2	10	Stokes (NP)
Sharp-tailed Sandpiper ^{CJM}	9	3	4	Stokes (NP) & Warden (NR)
Great Knot ^{CJM}	7	1	7	Stokes (NP)
Purple Swamphen	7	2	6	Shark (NR)
Wood Sandpiper ^{CJM}	6	1	6	Coomalbidgup (SR)
Common Sandpiper ^{CJM}	5	2	4	Windabout (NR)
Glossy Ibis ^C	4	1	4	Coomalbidgup (SR)
Australian Spotted Crake	2	1	2	Ewens (NR)
Australasian Grebe	2	1	2	Mortijinup (NR)
Black-tailed Native-hen	1	1	1	Windabout (NR)
Crested Tern ^J	1	1	1	Ewens (NR)
Pied Cormorant	1	1	1	Stokes (NP)
White-bellied Sea-Eagle ^C	1	1	1	Mainbenup (PP)
Total	34548	23		

NP=National Park, NR=Nature Reserve, PP=Private property, SR=Shire Reserve, UR=Unvested Reserve.

C=CAMBA species; J=JAMBA species; M=Transequatorial migratory shorebirds.

Table 3: Esperance coast wetlands ranked in order of Total Number of Waterbirds counted in Feb-Mar 2003.

Rank	Wetland (tenure)	Survey Date	Total No. of Waterbirds Counted	JAMBA and/or CAMBA Birds	Trans-Equatorial Migratory Shorebirds
1	Mortijinup (NR)	19/02/2003	7345	638	608
2	Windabout (NR)	13/02/2003	4675	31	9
3	Warden (NR)	14/02/2003	4484	138	138
4	Wheatfield (NR)	13/02/2003	3024	24	22
5	Round (NR)	5/03/2003	2583	1	1
6	Stokes Inlet (NP)	5/03/2003	2072	1067	1056
7	Ewens (NR)	14/02/2003	1821	37	35
8	Mullet (NR)	14/02/2003	1747	438	437
9	Shark (NR)	15/02/2003	1166	0	0
10	Mainbenup (PP)	21/02/2003	1139	3	2
11	Gore (NR)	20/02/2003	1042	146	146
12	Quallilup (UR & PP)	21/02/2003	860	53	26
13	Wheatfield o'flow (NR)	16/01/2003	730	0	0
14	Station (NR)	14/02/2003	519	433	432
15	Boolenup (NP)	6/02/2003	393	7	7
16	Nambarup (NR)	19/02/2003	273	0	0
17	Coomalbidgup (SR)	5/03/2003	264	12	8
18	Beaumont (NR)	28/03/2003	187	110	110
19	Woody (NR)	13/02/2003	132	2	2
20	Exchange Rd (UCL)	7/02/2003	53	11	11
21	Benje Benjenup (PP)	15/02/2003	25	0	0
22	White (PP)	15/02/2003	10	0	0
23	Barker Inlet (NR)	5/03/2003	4	2	2
Total Number of Birds:			34548	3143	3052

NP=National Park, NR=Nature Reserve, PP=Private property, SR=Shire Reserve, UCL=Unallocated Crown Land, UR=Unvested Reserve.

Table 4: Esperance coast wetlands ranked in order of Number of Waterbird Species recorded in Feb-Mar 2003.

Rank	Wetland (tenure)	Survey Date	Total No. of Waterbird Species Recorded	JAMBA and/or CAMBA Species	Trans-Equatorial Migratory Shorebird Species
1	Mortijinup (NR)	19/02/2003	29	3	2
2	Stokes Inlet (NP)	5/03/2003	25	7	5
3	Windabout (NR)	13/02/2003	23	3	2
4	Ewens (NR)	14/02/2003	20	4	2
5	Warden (NR)	14/02/2003	18	3	3
6	Round (NR)	5/03/2003	18	1	1
7	Wheatfield (NR)	13/02/2003	17	3	1
8	Coomalbidgup (SR)	5/03/2003	17	3	2
9	Quallilup (UR & PP)	21/02/2003	16	2	1
10	Mainbenup (PP)	21/02/2003	15	2	1
11	Boolenup (NP)	6/02/2003	14	2	2
12	Shark (NR)	15/02/2003	13	0	0
13	Mullet (NR)	14/02/2003	12	3	2
14	Station (NR)	14/02/2003	11	4	3
15	Woody (NR)	13/02/2003	10	1	1
16	Wheatfield o'flow (NR)	16/01/2003	8	0	0
17	Gore (NR)	20/02/2003	8	1	1
18	Nambarup (NR)	19/02/2003	7	0	0
19	Beaumont (NR)	28/03/2003	5	1	1
20	Exchange Rd (UCL)	7/02/2003	4	2	2
21	Benje Benjenup (PP)	15/02/2003	2	0	0
22	White (PP)	15/02/2003	2	0	0
23	Barker Inlet (NR)	5/03/2003	2	1	1
Total Number of Species (all 23 wetlands):			47	12	7

NP=National Park, NR=Nature Reserve, PP=Private property, SR=Shire Reserve, UCL=Unallocated Crown Land, UR=Unvested Reserve.

Table 5: Esperance coast wetlands ranked in order of Number of Highest Counts of Waterbird Species in Feb-Mar 2003.

Wetland	Number of Highest Counts	Species	Highest Count	% of Total Count of Sp.
Stokes (NP)	9	Red-necked Stint ^{CJM}	1000	35
		Chestnut Teal	417	42
		Red-capped Plover	172	67
		Curlew Sandpiper ^{CJM}	25	93
		Great Cormorant	20	61
		Caspian Tern ^C	10	91
		Great Knot ^{CJM}	7	100
		Sharp-tailed Sandpiper (=1) ^{CJM}	4	44
		Pied Cormorant	1	100
Mortijinup (NR)	8	Musk Duck	1952	48
		Pacific Black Duck	975	37
		Little Black Cormorant	650	68
		Blue-billed Duck	210	78
		Great Crested Grebe	79	59
		Fairy Tern	35	90
		Great Egret ^{CJ}	30	36
		Australasian Grebe	2	100
Windabout (NR)	7	Black Swan	1881	53
		Eurasian Coot (=1)	900	29
		Pink-eared Duck	180	43
		Freckled Duck	164	69
		Australian Pelican	153	68
		Common Sandpiper ^{CJM}	4	80
		Black-tailed Native-hen	1	100
Round (NR)	5	Eurasian Coot (=1)	900	29
		Australasian Shoveler	150	52
		Yellow-billed Spoonbill	73	43
		White-faced Heron	37	28
		Australian White Ibis	10	48
Warden (NR)	5	Hoary-headed Grebe	1200	44
		Australian Shelduck	1028	31
		Silver Gull	200	59
		Little Pied Cormorant	30	31
		Sharp-tailed Sandpiper (=1)	4	44
Ewens (NR)	3	Common Greenshank ^{CJM}	34	23
		Australian Spotted Crake	2	100
		Crested Tern ^J	1	100
Coomalbidgup (SR)	2	Wood Sandpiper ^{CJM}	6	100
		Glossy Ibis ^C	4	100
Mullet (NR)	2	Banded Stilt	1000	98
		Red-necked Avocet	250	48
Shark (NR)	2	Black-fronted Dotterel	10	62
		Purple Swamphen	6	86
Wheatfield (NR)	2	Hardhead	1350	57
		Grey Teal	1100	35
Beaumont (NR)	1	Black-winged Stilt	63	29
Station (NR)	1	Hooded Plover	48	59
Quallilup (UR & PP)	1	Darter	17	42
Mainbenup (PP)	1	White-bellied Sea-Eagle ^C	1	100

NP=National Park, NR=Nature Reserve, PP=Private property, SR=Shire Reserve, UR=Unvested Reserve.

Table 6: Species and Numbers of Waterbirds recorded on selected Esperance Coast wetlands from 18-24 November 2002 (Buchanan 2003) and 15-21 February 2003 (this study).

Species	Shark		White		Benji Benjenup		Gore		Mainbenup		Quallilup		Totals	
	Nov 02	Feb 03	Nov 02	Feb 03	Nov 02	Feb 03	Nov 02	Feb 03	Nov 02	Feb 03	Nov 02	Feb 03	Nov 02	Feb 03
Blue-billed Duck	3												3	0
Musk Duck	1	1							1	22			2	23
Black Swan	3						1540	150	2700	50			4243	200
Australian Shelduck	11	5					3500	700	1200	400	340	470	5051	1575
Pacific Black Duck	54	150							20	20		13	74	183
Australasian Shoveler									38				38	0
Grey Teal	9	2					126		42	12		41	177	55
Chestnut Teal	3	2					72				5	136	80	138
Pink-eared Duck		100							2400	2			2400	102
Hardhead	8	850											8	850
Hoary-headed Grebe	9	5			1				290	200	33	5	333	210
Great Crested Grebe										6		2	0	8
Darter											1	17	1	17
Little Pied Cormorant	4									10		8	4	18
Little Black Cormorant	1								3	10		13	4	23
Great Cormorant											3		3	0
Australian Pelican							7				2	2	9	2
White-faced Heron	6							2	2			28	8	30
Little Egret	1												1	0
Great Egret ^{CJ}	1								1			27	2	27
Australian White Ibis		1							1	2			1	3
Yellow-billed Spoonbill									23	2		4	23	6
White-bellied Sea-Eagle ^C										1			0	1
Swamp Harrier	1												1	0
Purple Swamphen	2	6											2	6
Black-tailed Native-hen									21				21	0
Eurasian Coot	112	6							80	400			192	406
Common Greenshank ^{CJM}							2		3	2		26	5	28
Wood Sandpiper ^{CJM}									1				1	0
Terek Sandpiper ^{CJM}									1				1	0
Common Sandpiper ^{CJM}									1				1	0
Red-necked Stint ^{CJM}					22		87	146					109	146
Sharp-tailed Sandpiper ^{CJM}									15				15	0
Curlew Sandpiper ^{CJM}							8						8	0
Black-winged Stilt		28					9	9	33			18	42	55
Banded Stilt					392		256						648	0
Red-necked Avocet							30	16					30	16
Pacific Golden Plover ^{CJM}									2				2	0
Red-capped Plover			59	2	147	20	55	18					261	40
Black-fronted Dotterel		10							33				33	10
Hooded Plover			3	8	66	5	87	1					156	14
Red-kneed Dotterel									16				16	0
Silver Gull											1	50	1	50
Fairy Tern											9		9	0
Clamorous Reed-Warbler	3												3	0
Total No. of Waterbirds	232	1166	62	10	628	25	5779	1042	6927	1139	394	860	14022	4242
Total No. of Species	18	13	2	2	5	2	13	8	24	15	8	16	43	29

- Notes:**
1. Where numbers recorded in Feb 2003 are higher than in Nov 2002, they are in **bold**.
 2. White Lake is "Helms Arboretum Lake" of Buchanan (2003).
 3. C=CAMBA species; J=JAMBA species; M=Transequatorial migratory shorebirds.

Table 7a: Comparison of Numbers of Waterbirds recorded on named wetlands of Lake Warden and Mullet Lake Nature Reserves in Feb 2003 (this study) with Highest Numbers recorded on the same wetlands during 1981-85 (Jaensch *et al* 1988²).

Species	Lake Warden Nature Reserve								Mullet Lake Nature Reserve					
	Warden		Wheatfield		Windabout		Woody		Ewens		Mullet		Station	
	81-85	Feb 03	81-85	Feb 03	81-85	Feb 03	81-85	Feb 03	81-85	Feb 03	81-85	Feb 03	81-85	Feb 03
Blue-billed Duck			9				8							
Musk Duck		260	200	40	70	847	360		100	40	54		17	
Freckled Duck				1		164	2			1				
Black Swan	3500	1066	500		500	1881	500		500	37	628		32	9
Cape Barren Goose					8				2					
Australian Shelduck	5500	1028	123		350	1	600	6	1000	100	118	12	1500	3
Australian Wood Duck			2											
Pacific Black Duck	50		530	220	650	258	500	30	87	600	51	2	100	1
Australasian Shoveler	12		38			2	22		40	83	29	7	21	
Grey Teal	700	30	200	1100	5500	72	200	60	1100	700	200		500	
Chestnut Teal	300	66	26	20	40	66	100	6	6	60	20		7	
Pink-eared Duck			8	50		180	12	6			2			
Hardhead	5		2	1350			12	1	8				1	
Exotic waterfowl			3											
Australasian Grebe			6				2				40			
Hoary-headed Grebe	15	1200	60		13	43	70		23	28	30			2
Great Crested Grebe		8	14				6		1		13			
Darter			1	7		3								
Little Pied Cormorant	1	30	100		20	1	100		50	6	120		13	
Pied Cormorant							1							
Little Black Cormorant	600	200	90	53	70	22	49		30		131		26	
Great Cormorant			1	13			2		1					
Australian Pelican	2	3	6		1	153	4	9	7	32	8		8	
White-faced Heron	13	3	16	4	9	9	18	4	15		10	4	6	3
White-necked Heron					1									
Great Egret ^{CJ}			26	1	36	22	18		8	1	28	1	12	1
Nankeen Night Heron			2											
Australian White Ibis				2						2				
Yellow-billed Spoonbill				30		20			1	17	1			
White-bellied Sea Eagle ^C							1							
Swamp Harrier	1		1		2		1		2		2		1	
Australian Spotted Crake										2				
Purple Swamp Hen						1								
Black-tailed Native Hen						1							9	
Eurasian Coot			700	110	300	900	450	8	150	36	180			
Black-tailed Godwit ^{CJM}									1					
Bar-tailed Godwit ^{CJM}	2										7			
Whimbrel ^{CJM}							1							
Marsh Sandpiper ^{CJM}			2						3					
Common Greenshank ^{CJM}	21	4	14	22	9	5	32	2	60	34	153	12	5	5
Terek Sandpiper ^{CJM}									1					
Common Sandpiper ^{CJM}	3		6		3	4	3		1				1	
Ruddy Turnstone ^{CJM}	24													
Great Knot ^{CJM}	1													
Red Knot ^{CJM}	95				20				60				52	
Red-necked Stint ^{CJM}	438	130			36				321		173	425	500	425
Long-toed Stint ^{CJM}	1													
Pectoral Sandpiper ^{JM}	6													
Sharp-tailed S'piper ^{CJM}	200	4							29	1			3	
Curlew Sandpiper ^{CJM}	220				35				3		2		230	2
B.-billed Sandpiper ^{CJM}	1													

Table 7a Contd:

Species	Lake Warden Nature Reserve								Mullet Lake Nature Reserve					
	Warden		Wheatfield		Windabout		Woody		Ewens		Mullet		Station	
	81-85	Feb 03	81-85	Feb 03	81-85	Feb 03	81-85	Feb 03	81-85	Feb 03	81-85	Feb 03	81-85	Feb 03
Black-winged Stilt	20	6							2	40				
Banded Stilt	10000	6	19		1000		6		200		2000	1000	400	
Red-necked Avocet	200	240			555				75		58	250	32	
Grey Plover ^{CM}											1			
Red-capped Plover	200				44						5	20	81	20
Black-fronted Dotterel	2				6		2		33					
Hooded Plover	240				6				21		39	12	99	48
Silver Gull	346	200	11		320	20	90		90		100	2	5	
Gull-billed Tern	5				1				1					
Caspian Tern ^C	1			1										
Crested Tern ^J										1				
Fairy Tern	30		13		1									
Whiskered Tern	100		100		15		20		35		30		20	
White-w. BlackTern ^{CM}											1			
Clam. Reed-Warbler			2											

Notes:

1. Where numbers recorded in Feb 2003 are higher than were recorded during 1981-85, they are in **bold**.
2. The 1981-85 data in this table was collected as part of the project described by Jaensch *et al* 1988, but does not appear by individual wetland in that report. The data comes from a more-detailed computer printout (copy held by Department of Conservation & Land Management) of project data by individual wetland.
3. C=CAMBA species; J=JAMBA species; M=Transequatorial migratory shorebirds.

Table 7b: Comparison of Numbers of Waterbirds recorded on Gore and Shark Lakes in Feb 2003 (this study) with Highest Numbers recorded on the same wetlands during 1981-85 (Jaensch *et al* 1988).

Species	Gore		Shark	
	81-85	Feb 03	81-85	Feb 03
Blue-billed Duck			9	
Musk Duck	112		23	1
Black Swan	112	150	3	
Australian Shelduck	7000	700	4	5
Australian Wood Duck	2		4	
Pacific Black Duck	17		500	150
Australasian Shoveler	61		10	
Grey Teal	692		2000	2
Chestnut Teal	167		70	2
Pink-eared Duck	60		38	100
Hardhead	18		35	850
Exotic waterfowl			1	
Australasian Grebe			4	
Hoary-headed Grebe	700		27	5
Darter			3	
Little Pied Cormorant	1		10	
Little Black Cormorant	54		30	
Great Cormorant			2	
Australian Pelican	7			
White-faced Heron	6	2	20	
White-necked Heron			1	
Great Egret ^{CJ}	1		2	
Australasian Bittern			1	
Australian White Ibis			1	1
Swamp Harrier	1		2	
Buff-banded Rail			1	
Baillon's Crake			4	
Australian Spotted Crake			6	
Spotless Crake			11	
Purple Swamp Hen			14	6
Black-tailed Native Hen	9		1	

Species	Gore		Shark	
	81-85	Feb 03	81-85	Feb 03
Eurasian Coot	91		50	6
Snipe (<i>Gallinago</i> sp.)			1	
Black-tailed Godwit ^{CJM}	1			
Common Greenshank ^{CJM}	10		2	
Wood Sandpiper ^{CJM}			13	
Common Sandpiper ^{CJM}	4		1	
Grey-tailed Tattler ^{CJM}			1	
Ruddy Turnstone ^{CJM}	8			
Great Knot ^{CJM}	3			
Red Knot ^{CJM}	40			
Sanderling ^{CJM}	13			
Red-necked Stint ^{CJM}	625	146	3	
Sharp-tailed Sandpiper ^{CJM}	50		4	
Curlew Sandpiper ^{CJM}	600			
Black-winged Stilt	46	9		28
Banded Stilt	10000			
Red-necked Avocet	150	16		
Pacific Golden Plover ^{CJM}	1			
Red-capped Plover	496	18		
Greater Sand Plover ^{CJM}	2			
Black-fronted Dotterel			24	10
Hooded Plover	393	1		
Red-kneed Dotterel	2			
Silver Gull	100			
Fairy Tern	4			
Whiskered Tern	36		3	
Clamorous Reed-Warbler			9	
Little Grassbird			2	

Notes:

1. Where numbers recorded in Feb 2003 are higher than were recorded during 1981-85, they are in **bold**.
2. C=CAMBA species; J=JAMBA species; M=Transequatorial migratory shorebirds.

Table 8: Comparison of Numbers of Waterbirds recorded on Lake Warden Nature Reserve and Mullet Lake Nature Reserve in Feb 2003 (this study) with Highest Numbers recorded on the same Nature Reserves during 1981-85 (Jaensch *et al* 1988).

Species	Lake Warden Nature Reserve		Mullet Lake Nature Reserve	
	81-85	Feb 03	81-85	Feb 03
Blue-billed Duck	9			
Musk Duck	360	1147	100	40
Freckled Duck	2	165		1
Black Swan	3500	2947	628	46
Cape Barren Goose	8		2	
Australian Shelduck	5500	1035	1500	115
Australian Wood Duck	2			
Pacific Black Duck	650	508	100	603
Australasian Shoveler	38	32	40	90
Grey Teal	5500	1262	1100	700
Chestnut Teal	300	158	20	60
Pink-eared Duck	12	236	2	
Hardhead	12	1351	8	
Exotic waterfowl	3			
Australasian Grebe	6		40	
Hoary-headed Grebe	70	1243	30	30
Great Crested Grebe	14	8	13	
Darter	1	10		
Little Pied Cormorant	100	31	120	6
Pied Cormorant	1			
Little Black Cormorant	600	275	131	
Great Cormorant	2	13	1	
Australian Pelican	6	165	8	32
White-faced Heron	145	20	15	7
White-necked Heron	1			
Great Egret ^{CJ}	57	23	28	3
Nankeen Night Heron	2			
Australian White Ibis		2		2
Yellow-billed Spoonbill		50	1	17
White-bellied Sea Eagle ^C	1			
Swamp Harrier	2		2	
Australian Spotted Crake				2
Purple Swamp Hen		1		
Dusky Moorhen	2			
Black-tailed Native Hen	20	1	9	

Species	Lake Warden Nature Reserve		Mullet Lake Nature Reserve	
	81-85	Feb 03	81-85	Feb 03
Eurasian Coot	700	1118	180	36
Black-tailed Godwit ^{CJM}			1	
Bar-tailed Godwit ^{CJM}	2		7	
Whimbrel ^{CJM}	1			
Marsh Sandpiper ^{CJM}	3		3	
Common Greenshank ^{CJM}	38	33	153	51
Wood Sandpiper ^{CJM}	1			
Common Sandpiper ^{CJM}	8	4	1	
Terek Sandpiper ^{CJM}			1	
Ruddy Turnstone ^{CJM}	24			
Great Knot ^{CJM}	1			
Red Knot ^{CJM}	95		60	
Red-necked Stint ^{CJM}	438	130	500	850
Long-toed Stint ^{CJM}	1			
Pectoral Sandpiper ^{JM}	6			
Sharp-tailed Sandpiper ^{CJM}	200	4	29	1
Curlew Sandpiper ^{CJM}	220		230	2
Broad-billed Sandpiper ^{CJM}	1			
Black-winged Stilt	24	6	2	40
Banded Stilt	10000	6	2000	1000
Red-necked Avocet	555	240	75	250
Grey Plover ^{CJM}			1	
Red-capped Plover	200		81	40
Black-fronted Dotterel	18			
Hooded Plover	240		99	60
Red-kneed Dotterel	8			
Silver Gull	346	220	90	2
Gull-billed Tern	5		1	
Caspian Tern ^C	1	1		
Crested Tern ^J				1
Fairy Tern	30			
Whiskered Tern	100		35	
White-winged Tern ^{CJM}			1	
Clamorous Reed-Warbler	2			

Notes:

1. Where numbers recorded in Feb 2003 are higher than were recorded during 1981-85, they are in **bold**.
2. The 1981-85 data for Nature Reserves in this table was obtained from 'Waterbirds in Nature Reserves of South-Western Australia 1981-1985: Reserve Accounts' (Jaensch *et al* 1988). Note this report includes areas surveyed in 1981-85 that were not included in the 2003 survey.
3. C=CAMBA species; J=JAMBA species; M=Transequatorial migratory shorebirds.

Table 9: Comparison of Highest Numbers of Waterbirds recorded on Esperance coast wetlands in Feb-Mar 2003 (this study) with Highest Numbers recorded on South West wetlands during 1981-92 (Jaensch *et al* 1993).

Common Name	Highest Count in Feb-Mar 2003	Wetland of Highest Count in Feb-Mar 2003	Highest counts on SW Wetlands , during 1981-92 (from Jaensch <i>et al</i> 1993), with highest Feb-Mar 2003 Esperance counts (and rankings) inserted for comparison.
Musk Duck	1952	Mortijinup (NR)	2302 (Clifton), 1952 (Mortijinup) (2nd) , 635 (Broke), 630 (Dumbleyung), 535 (Mortijinup), 435 (Preston), 400 (Guraga), 360 (Woody), 330 (Bibra), 328 (Warden), 250 (Monger).
Freckled Duck	164	Windabout (NR)	600 (Toolibin), 164 (Windabout) (2nd) , 145 (Chittering), 130 (Coomelberrup), 88 (East Bryde), 83 (Barrett-Lennard), 54 (Mortijinup).
Great Crested Grebe	79	Mortijinup (NR)	190 (Clifton), 108+ (Jerdacuttup), 79 (Mortijinup) (3rd) , 55 (Broke Inlet), 50 (Mortijinup), 41 (Joondalup).
Hardhead	1350	Wheatfield (NR)	2000 (Eganu), 2000 (Walyormouring), 1500 (Benger), 1350 (Wheatfield) (4th) , 1053 (Forrestdale), 800 (Parriup), 636 (Wannamal), 550 (Tordit-Gurrup), 500 (Moodiarrup), 500 (Pinjarrega), 414 (Chittering).
Australian Pelican	153	Windabout (NR)	750 (Vasse-Wonnerup Estuary), 500 (Indoon), 471 (Peel Inlet), 153 (Windabout) (4th) , 120 (Guraga), 111 (Styx Marshes).
Chestnut Teal	417	Stokes (NP)	1550 (Charles Bay Inlet), 1099 (Beaufort Inlet), 1005 (Lower Pallinup River), 872 (Stokes Inlet), 790 (Lower Fitzgerald River), 646 (Gordon Inlet), 452 (Oldfield Estuary), 417 (Stokes) (8th) , 400 (Bannitup), 400 (Wheatfield), 328 (Warden).
Hoary-headed Grebe	1200	Warden (NR)	4900 (Bibra), 3400 (Dumbleyung), 3000 (Guraga), 1890 (Forrestdale), 1692 (McLarty), 1550 (Yangebup), 1500 (Thomsons), 1200 (Warden) (8th) , 1000 (Gore).
Red-necked Stint ^{CJM}	1000	Stokes (NP)	10000 (Alfred Cove), 8063 (Peel Inlet), 3246 (Creery Marshes), 3000 (Forrestdale), 2500 (Thomsons), 2200 (Milyu), 2000 (Vasse-Wonnerup Estuary), 1500 (Yangebup), 1000 (Rushy Point), 1000 (Stokes) (9th) .

NP=National Park, NR=Nature Reserve.

C=CAMBA species; J=JAMBA species; M=Transequatorial migratory shorebirds.

Table 10: Comparison of Numbers of Waterbirds recorded on selected Esperance coast wetlands in Feb 2003 (this study) with Highest Numbers recorded on the same wetlands during 1981-92 (Jaensch *et al* 1993).

Wetland	Species	1981-1992 Highest Count	1981-92 Ranking in SW	Feb 2003 Count
Gore (NR)	Australian Shelduck	12 000	=3rd	700
	Hoary-headed Grebe	1000	8th	0
	Common Sandpiper ^{CJM}	14	2nd	0
	Hooded Plover	393	2nd	1
Mortijinup (NR)	Blue-billed Duck	300	10th	210
	Musk Duck	535	4th	1952
	Freckled Duck	54	6th	0
	Australasian Shoveler	500	=9th	15
	Great Crested Grebe	50	=3rd	79
Mullet (NR)	Common Greenshank ^{CJM}	153	5th	12
Shark (NR)	Baillon's Crake	4	2nd	0
Stokes (NP)	Chestnut Teal	872	4th	417
	Pacific Gull	12	2nd	0
Warden (NR)	Musk Duck	328	9th	260
	Black Swan	3500	2nd	1066
	Cape Barren Goose	8	1st	0
	Australian Shelduck	5500	9th	1028
	Chestnut Teal	400	10th	66
	Common Sandpiper ^{CJM}	8	=3rd	0
	Ruddy Turnstone ^{CJM}	24	1st	0
	Great Knot ^{CJM}	100	3rd	0
	Red Knot ^{CJM}	95	5th	0
	Pectoral Sandpiper ^{JM}	6	=4th	0
	Hooded Plover	539	1st	0
	Whiskered Tern	100	=4th	0
Wheatfield (NR)	Chestnut Teal	400	=8th	20
Woody (NR)	Musk Duck	360	7th	0

Notes

1. 1981-92 data are from Jaensch, Merrifield & Raines 1993.
2. Where numbers recorded in Feb 2003 are higher than those recorded 1981-92, they are in **bold**
3. NP=National Park, NR=Nature Reserve.
4. C=CAMBA species; J=JAMBA species; M=Transequatorial migratory shorebirds.

Table 11: Waterbird Species and Numbers on surveyed Esperance coast wetlands other than Nature Reserves and National Parks, in Feb-Mar 2003.

Wetland (tenure)	All Waterbird Species		JAMBA / CAMBA Species		Migratory Shorebird Species		Species Abundance (≥5 birds)
	Total Count	Spp	Total Count	Spp	Total Count	Spp	
Mainbenup (PP) Depth: c. 1m	1139	15	3	2	2	1	Australian Shelduck 400, Eurasian Coot 400, Hoary-headed Grebe 200. Black Swan 50, Musk Duck 22, Pacific Black Duck 20, Grey Teal 12, Little Pied Cormorant 10, Little Black Cormorant 10. Great-crested Grebe 6.
Quallilup (UR & PP) Depth: c. 6.5m Salinity: 38.5 ppt pH: 8.6	860	16	53	2	26	1	Australian Shelduck 470, Chestnut Teal 136. Silver Gull 50, Grey Teal 41, White-faced Heron 28, Great Egret ^{CJ} 27, Common Greenshank ^{CJM} 26, Black-winged Stilt 18, Darter 17, Pacific Black Duck 13, Little Black Cormorant 13. Little Pied Cormorant 8, Hoary-headed Grebe 5.
Coomalbidgup (SR) Depth: 1.12m Salinity: 8.0 ppt pH: 8.6	264	17	12	3	8	2	Grey Teal 116. Hoary-headed Grebe 40, Pacific Black Duck 32, Eurasian Coot 20, White-faced Heron 13. Pink-eared Duck 7, Wood Sandpiper ^{CJM} 6, Black-fronted Dotterel 6.
Exchange Rd (UCL) Depth: c. 0.3m	53	4	11	2	11	2	25 Grey Teal, Red-necked Avocet 17, Red-necked Stint ^{CJM} 10.
Benje Benjenup (PP) Depth: 0.1m	25	2	0	0	0	0	20 Red-capped Plover. 5 Hooded Plover.
White (PP) Depth: almost dry	10	2	0	0	0	0	8 Hooded Plover.

PP=Private Property, SR=Shire Reserve, UCL=Unallocated Crown Land, UR=Unvested Reserve.

C=CAMBA species; J=JAMBA species; M=Transequatorial migratory shorebirds.

Table 12: Waterbird numbers in Feb-Mar 2003, with wetlands listed alphabetically.

	Barker (NR)	Beaumont (NR)	Benje Benjenup (PP)	Boolenup (NP)	Coomalbidgup (SR)	Ewens (NR)	Exchange Rd (UCL)	Gore (NR)	Mainbenup (PP)	Mortijinup (NR)	Mullet (NR)	Nambarup (NR)	Quallilup (UR & PP)	Round (NR)	Shark (NR)	Station (NR)	Stokes Inlet (NP)	Warden (NR)	Wheatfield (NR)	Wheatfield o'flow (NR)	White (PP)	Windabout (NR)	Woody (NR)	Species Total	Species occurrence	
Species / Survey Date (d/m)	05/03	28/03	15/02	06/02	05/03	14/02	07/02	20/02	21/02	19/02	14/02	19/02	21/02	05/03	15/02	14/02	05/03	14/02	13/02	16/01	15/02	13/02	13/02			
Blue-billed Duck										210				60											270	2
Musk Duck				213	2	40			22	1952		60		612	1			260	40				847		4049	11
Freckled Duck						1								70					1				164		236	4
Black Swan				22	2	37		150	50	202		10		12		9	62	1066		40			1881		3543	13
Australian Shelduck		4		1	1	100		700	400	622	12		470	4	5	3		1028				1	6		3357	15
Pacific Black Duck				60	32	600			20	975	2	60	13	103	150	1	4		220	100			258	30	2628	16
Australasian Shoveler					2	83				15	7			150									2		289	7
Grey Teal				20	116	700	25		12	240			41	156	2		240	30	1100	300			72	60	3114	15
Chestnut Teal				5	4	60				90			136	60	2		417	66	20	70			66	6	1002	13
Pink-eared Duck					7				2	10					100				50	60			180	6	415	8
Hardhead					4					51				94	850				1350					1	2350	6
Australasian Grebe										2															2	1
Hoary-headed Grebe				42	40	28			200	875		40	5	228	5	2	7	1200					43		2715	13
Great Crested Grebe				14					6	79		22	2				2	8							133	7
Darter										2			17				11		7				3		40	5
Little Pied Cormorant						6			10	23			8	12			7	30					1		97	8
Pied Cormorant																	1								1	1
Little Black Cormorant									10	650			13	1				200	53				22		949	7
Great Cormorant																	20		13						33	2
Australian Pelican				2		32				9		1	2				13	3					153	9	224	9
White-faced Heron				2	13			2		14	4		28	37		3	9	3	4				9	4	132	13
Great Egret ^{Cf}						1				30	1		27			1	1		1				22		84	8
Glossy Ibis ^C					4																				4	1
Australian White Ibis					3	2			2	1				10	1				2						21	7
Yellow-billed Spoonbill						17			2	23			4	73					30				20		169	7
White-bellied Sea-Eagle ^C									1																1	1
Australian Spotted Crane						2																			2	1
Purple Swamp Hen															6									1	7	2
Black-tailed Native Hen																							1		1	1
Eurasian Coot				2	20	36			400	560		80		900	6				110	100			900	8	3122	12

Table 12 contd.

	Barker (NR)	Beaumont (NR)	Benje Benjenup (PP)	Boolenup (NP)	Coomalbidgup (SR)	Ewens (NR)	Exchange Rd (UCL)	Gore (NR)	Mainbenup (PP)	Mortijimup (NR)	Mullet (NR)	Nambarup (NR)	Quallilup (UR & PP)	Round (NR)	Shark (NR)	Station (NR)	Stokes Inlet (NP)	Warden (NR)	Wheatfield (NR)	Wheatfield o'flow (NR)	White (PP)	Windabout (NR)	Woody (NR)	Species Total	Species occurrence
Species / Survey Date (d/m)	05/03	28/03	15/02	06/02	05/03	14/02	07/02	20/02	21/02	19/02	14/02	19/02	21/02	05/03	15/02	14/02	05/03	14/02	13/02	16/01	15/02	13/02	13/02		
Common Greenshank ^{CJM}				6	2	34	1		2	8	12		26	1		5	20	4	22			5	2	150	15
Wood Sandpiper ^{CJM}					6																			6	1
Common Sandpiper ^{CJM}				1																		4		5	2
Great Knot ^{CJM}																	7							7	1
Red-necked Stint ^{CJM}	2	110					10	146		600	425					425	1000	130						2848	9
Sharp-tailed Sandpiper ^{CJM}						1											4	4						9	3
Curlew Sandpiper ^{CJM}																2	25							27	2
Black-winged Stilt		63				40		9		10			18		28		10	6		30				214	9
Banded Stilt		9		3						3	1000						3	6						1024	6
Red-necked Avocet		1					17	16			250							240						524	5
Red-capped Plover	2		20					18		4	20					20	172				2			258	8
Black-fronted Dotterel					6										10									16	2
Hooded Plover			5					1			12					48	7				8			81	6
Silver Gull										50	2		50				16	200				20		338	6
Caspian Tern ^C																	10		1					11	2
Crested Tern ^J						1																		1	1
Fairy Tern										35							4							39	2
Total Birds	4	187	25	393	264	1821	53	1042	1139	7345	1747	273	860	2583	1166	519	2072	4484	3024	730	10	4675	132	34548	
Total Species	2	5	2	14	17	20	4	8	15	29	12	7	16	18	13	11	25	18	17	8	2	23	10	47	
CAMBA/JAMBA Birds	2	110	0	7	12	37	11	146	3	638	438	0	53	1	0	433	1067	138	24	0	0	31	2	3153	
Migratory Shorebirds	2	110	0	7	8	35	11	146	2	608	437	0	26	1	0	432	1056	138	22	0	0	9	2	3052	
CAMBA/JAMBA Species	1	1	0	2	3	4	2	1	2	3	3	0	2	1	0	4	7	3	3	0	0	3	1	12	
Migratory Shorebird Species	1	1	0	2	2	2	2	1	1	2	2	0	1	1	0	3	5	3	1	0	0	2	1	7	

NP=National Park, NR=Nature Reserve, PP=Private property, SR=Shire Reserve, UCL=Unallocated Crown Land, UR=Unvested Reserve.

C=CAMBA species; J=JAMBA species; M=Transequatorial migratory shorebirds.

CAMBA=China-Australia Migratory Birds Agreement, JAMBA=Japan-Australia Migratory Birds Agreement.

Table 13: Waterbird numbers in Feb-Mar 2003, with wetlands listed chronologically (by date of survey).

Species / Survey Date (d/m)	Wheatfield o'flow (NR)	Boolenup (NP)	Exchange Rd (UCL)	Wheatfield (NR)	Windabout (NR)	Woody (NR)	Ewens (NR)	Mullet (NR)	Station (NR)	Warden (NR)	Benje Benjenup (PP)	Shark (NR)	White (PP)	Mortjinup (NR)	Nambarup (NR)	Gore	Mainbenup (PP)	Quallilup (UR & PP)	Barker Inlet (NR)	Coomalbidgup (SR)	Round (NR)	Stokes Inlet (NP)	Beaumont (NR)	Species Total	Species occurrence	
	16/01	06/02	07/02	13/02	13/02	13/02	14/02	14/02	14/02	14/02	15/02	15/02	15/02	19/02	19/02	20/02	21/02	21/02	05/03	05/03	05/03	05/03	28/03			
Blue-billed Duck														210							60				270	2
Musk Duck		213		40	847		40			260		1		1952	60		22			2	612				4049	11
Freckled Duck				1	164		1														70				236	4
Black Swan	40	22		1881			37		9	1066				202	10	150	50			2	12	62			3543	13
Australian Shelduck		1			1	6	100	12	3	1028		5		622		700	400	470		1	4		4		3357	15
Pacific Black Duck	100	60		220	258	30	600	2	1			150		975	60		20	13		32	103	4			2628	16
Australasian Shoveler	30				2		83	7						15						2	150				289	7
Grey Teal	300	20	25	1100	72	60	700			30		2		240			12	41		116	156	240			3114	15
Chestnut Teal	70	5		20	66	6	60			66		2		90					136	4	60	417			1002	13
Pink-eared Duck	60			50	180	6						100		10			2			7					415	8
Hardhead				1350		1						850		51						4	94				2350	6
Australasian Grebe														2											2	1
Hoary-headed Grebe		42			43		28		2	1200		5		875	40		200	5		40	228	7			2715	13
Great Crested Grebe		14								8				79	22		6	2					2		133	7
Darter				7	3									2					17				11		40	5
Little Pied Cormorant					1		6			30				23			10	8				12	7		97	8
Pied Cormorant																							1		1	1
Little Black Cormorant				53	22					200				650			10	13				1			949	7
Great Cormorant				13																			20		33	2
Australian Pelican		2			153	9	32			3				9	1			2					13		224	9
White-faced Heron		2		4	9	4		4	3	3				14		2		28		13	37	9			132	13
Great Egret ^C				1	22		1	1	1					30				27					1		84	8
Glossy Ibis ^C																				4					4	1
Australian White Ibis				2			2					1		1			2			3	10				21	7
Yellow-billed Spoonbill				30	20		17							23			2	4				73			169	7
White-bellied Sea-Eagle ^C																	1								1	1
Australian Spotted Crake							2																		2	1
Purple Swamp Hen					1							6													7	2
Black-tailed Native Hen					1																				1	1
Eurasian Coot	100	2		110	900	8	36					6		560	80		400			20	900				3122	12

Table 13 Contd:

Species / Survey Date (d/m)	Wheatfield o'flow (NR)	Boolenup (NP)	Exchange Rd (UCL)	Wheatfield (NR)	Windabout (NR)	Woody (NR)	Ewens (NR)	Mullet (NR)	Station (NR)	Warden (NR)	Benje-Benjenup (PP)	Shark (NR)	White (PP)	Mortjinup (NR)	Nambarup (NR)	Gore	Mainbenup (PP)	Quallilup (UR & PP)	Barker Inlet (NR)	Coomalbidgup (SR)	Round (NR)	Stokes Inlet (NP)	Beaumont (NR)	Species Total	Species occurrence	
Common Greenshank ^{CJM}		6	1	22	5	2	34	12	5	4				8			2	26		2	1	20		150	15	
Wood Sandpiper ^{CJM}																				6					6	1
Common Sandpiper ^{CJM}		1			4																				5	2
Great Knot ^{CJM}																							7		7	1
Red-necked Stint ^{CJM}			10					425	425	130				600		146			2			1000	110		2848	9
Sharp-tailed Sandpiper ^{CJM}							1			4												4			9	3
Curlew Sandpiper ^{CJM}									2													25			27	2
Black-winged Stilt	30						40			6		28		10		9		18				10	63		214	9
Banded Stilt		3						1000		6				3								3	9		1024	6
Red-necked Avocet			17					250		240						16								1	524	5
Red-capped Plover								20	20		20		2	4		18			2			172			258	8
Black-fronted Dotterel												10								6					16	2
Hooded Plover								12	48		5		8			1						7			81	6
Silver Gull					20			2		200				50				50				16			338	6
Caspian Tern ^C				1																		10			11	2
Crested Tern ^J							1																		1	1
Fairy Tern														35								4			39	2
Total Birds	730	393	53	3024	4675	132	1821	1747	519	4484	25	1166	10	7345	273	1042	1139	860	4	264	2583	2072	187	34548		
Total Species	8	14	4	17	23	10	20	12	11	18	2	13	2	29	7	8	15	16	2	17	18	25	5	47		
CAMBA/JAMBA Birds	0	7	11	24	31	2	37	438	433	138	0	0	0	638	0	146	3	53	2	12	1	1067	110	3153		
Migratory Shorebirds	0	7	11	22	9	2	35	437	432	138	0	0	0	608	0	146	2	26	2	8	1	1056	110	3052		
CAMBA/JAMBA Species	0	2	2	3	3	1	4	3	4	3	0	0	0	3	0	1	2	2	1	3	1	7	1	12		
Migratory Shorebird Species	0	2	2	1	2	1	2	2	3	3	0	0	0	2	0	1	1	1	1	2	1	5	1	7		

NP=National Park, NR=Nature Reserve, PP=Private property, SR=Shire Reserve, UCL=Unallocated Crown Land, UR=Unvested Reserve.

C=CAMBA species; J=JAMBA species; M=Transequatorial migratory shorebirds.

CAMBA=China-Australia Migratory Birds Agreement, JAMBA=Japan-Australia Migratory Birds Agreement.

Table 14: Depth, conductivity, salinity and pH measurements of visited wetlands.

Wetland (tenure)	Date	CALM depth gauge reading	Depth (m)	ECond (mS/m)	Salinity (ppt) (Williams formula 1986)	pH	Comments
Barker Inlet (NR)	5/03/03		2	11380	80.4	7.3	Depth was estimated
Beaumont (NR)	28/03/03	Y	0.21	12000	85.1	8.9	
Benji Benjenup (PP)	15/02/03		0.1				Hypo-saline
Boolinup (NP)	6/02/03		c. 3				Depth was estimated
Coomalbidgup (SR)	5/03/03	Y	1.12	1359	8.0	8.6	
Ewens (NR)	14/02/03	Y	0.70	2150	13.1	8.3	
Exchange Rd (UCL)	7/02/03		0.3				Depth was estimated
Gore (NR)	20/02/03	Y	0.65	14430	104	7.7	
Mainbenup (PP)	21/02/03		1				Depth was estimated
Mortijinup (NR)	19/02/03		c. 1.5	1184	6.8	8.4	
Mullet (NR)	14/02/03	Y	c. 0.8	6770	45.7	8.3	
Nambarup (NR)	19/02/03		2+				Depth was estimated
Quallilup (UR & PP)	21/02/03		c. 6.5	5780	38.5	8.6	Depth calculated
Round (NR)	7/03/03		2.2	1876	11.3	9.1	
Shark (NR)	15/02/03	Y	1.73				
Station (NR)	14/02/03	Y	0.30	6450	43.3	8.3	
Stokes Inlet (NP)	6/03/03		c. 3	7820	53.4	8.0	Depth was estimated
Warden (NR)	14/02/03	Y	1.50	10640	74.7	7.9	
Wheatfield (NR)	13/02/03	Y	c. 0.95	5390	35.6	8.2	
Wheatfield o'flow (NR)	16/01/03		0.2-0.3				
White (PP)	15/02/03		c. 0				Thick salt crust
Windabout (NR)	18/02/03	Y	1.36	3090	19.5	7.4	
Woody (NR)	13/02/03	Y	0.95	1874	11.3	7.9	

NP=National Park, NR=Nature Reserve, PP=Private property, SR=Shire Reserve, UCL=Unallocated Crown Land, UR=Unvested Reserve.