

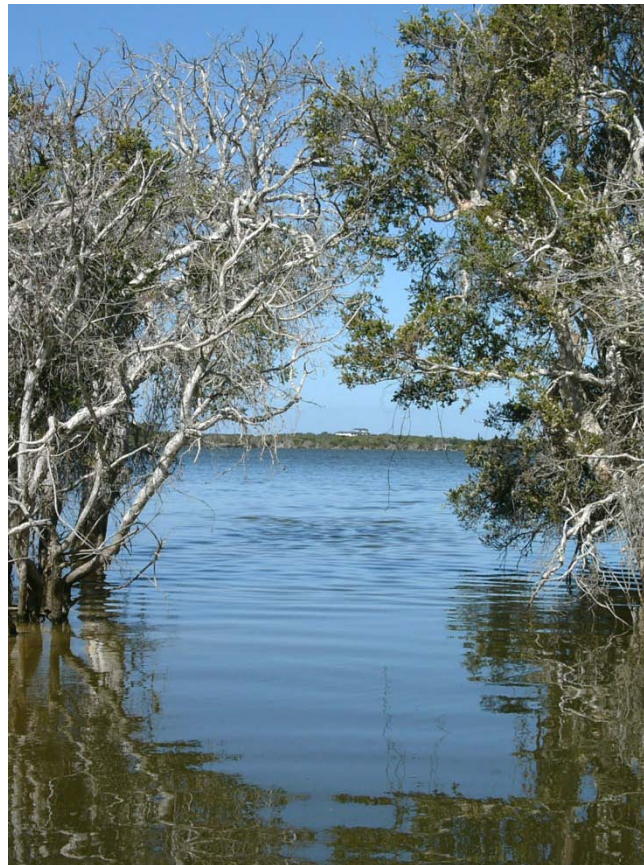


Waterbird Monitoring of the Lake Warden and Lake Gore Wetland Systems, October 2007

**Prepared for
SCRIPT and Department of
Environment and
Conservation
by Bennelongia Pty Ltd**

January 2008

Report 2008/18



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1 INTRODUCTION

The Lake Warden and Lake Gore wetland systems were nominated by the State Government as Wetlands of International Importance in 1990 and 2000, respectively, and the Lake Warden catchment was made a Natural Diversity Recovery Catchment under the State Salinity Strategy in 1997.

The Lake Warden system lies immediately north of Esperance and encircles the town (Fig. 1.1). It emerged from the sea during the Holocene and the eastern part of the system remains naturally connected, intermittently, to the sea via Bandy Creek. Most of the larger lakes in the eastern and central parts of the system are permanently inundated and sub-saline with an invertebrate fauna that reflects their marine origin.

In the eastern part of the system Station Lake (Fig. 1.1) usually has a depth in spring of about 0.7 m, dries over summer and has spring salinity about 15 g L⁻¹ (see Lane et al., 2004). Mullet and Wheatfield Lakes are more-or-less permanent and have spring salinities of about 5-8 g L⁻¹. Salinities increase at the western end of the system in Warden and Pink Lakes. Both these large playa lakes are hyper saline, with Warden semi-permanently and Pink Lake seasonally inundated, although in recent years Warden has been retaining more water. Salinities at Lake Warden usually range between 20 and 100 g L⁻¹ (see Lane et al., 2004).

The Lake Warden system provides important waterbird habitat in south-western Australia and waterbird values were much of the reason the system was nominated as a Ramsar wetland. Lake Warden supported the 4th highest waterbird count of 285 wetlands surveyed in south-western Australia between 1981 and 1985 (Jaensch et al., 1988) and the system contains important habitat for the Hooded Plover, a shorebird species endemic to Australia.

The Lake Gore system (Fig. 1.2) lies about 40 km west of Esperance and is also close to the coast. Waterbird values were the reason for nominating Lake Gore as a Ramsar wetland and, with a maximum count of 14,179 in November 1984, Gore supported the 7th highest number of waterbirds of 285 wetlands surveyed between 1981 and 1985 (Jaensch et al., 1989). The highest recorded count of waterbirds at Gore is 29,273 when 20,000 Banded Stilt occurred. Banded Stilt are often found at Gore in large numbers in spring and summer. However, the most significant waterbird record from Gore is the occurrence of 1600 Hooded Plover in January 1995: this was almost one-third of the known species population. Previously the highest number of Hooded Plovers recorded at the lake was 393 in February 1993.

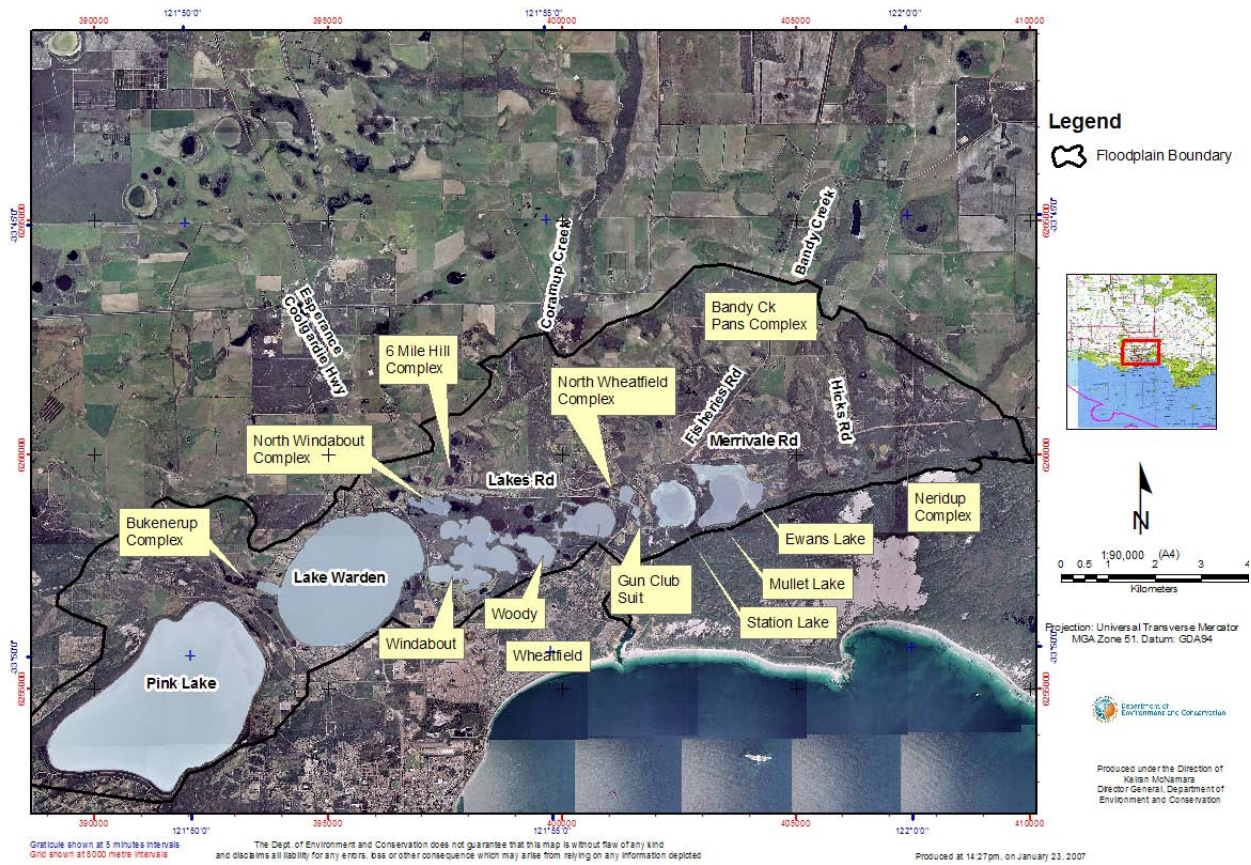


Fig. 1.1. The Lake Warden system showing the wetlands surveyed in October 2007.

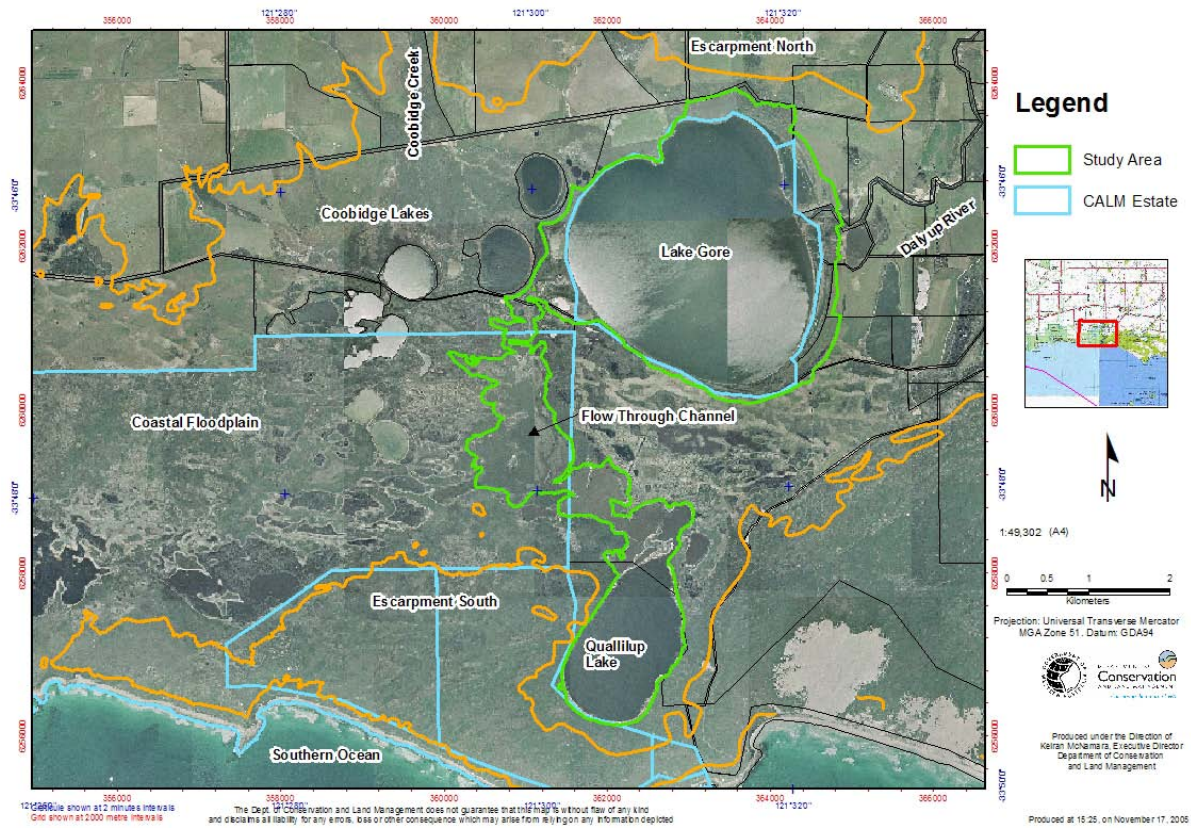


Fig. 1.2. The Lake Gore system showing the wetlands surveyed in October 2007.

1.1 Waterbird monitoring

Many waterbird surveys have occurred over the past 25 years in the Lake Warden and Lake Gore systems but, since the Lake Warden system was nominated as a Natural Diversity Recovery Catchment, structured waterbird monitoring has occurred at Wheatfield Lake (Cale et al., 2004). A comparison of Cale et al.'s surveys with results of other survey sets for Wheatfield suggests that bird counts are very strongly influenced by methodology and that counts may vary by a factor of about four between survey sets (Robertson & Massenbauer, 2005).

Given that methodology strongly influences the number of waterbirds counted, reliance on ad hoc counting to track waterbird use of a wetland through time is beset with interpretation difficulties. Trends can only be studied reliably if there has been a structured monitoring program in place that employs consistent methodology. Therefore, structured monitoring was implemented in the Lake Warden and Lake Gore systems in 2006, when sections of the Lake Warden system were counted on the ground (by foot or boat) and all of the Lake Warden and Lake Gore systems were counted from the air (Halse 2007). The counts in October 2007 represent the second year of the monitoring program.

Even with structured monitoring, there will be variation in counts across years that have nothing to do with the underlying condition of the wetland because annual counts are affected by a hierarchy of factors. While the underlying condition of the wetland being monitored (i.e. type of wetland and degree of naturalness) is the strongest determinant of counts, they will also be influenced by annual climatic fluctuations that affect the amount of water in other wetlands in the district, in the broader region and in the Australian continent as a whole. The Western Australian and continental drought during 2006/2007 is likely to have lifted counts in October 2007 above the levels that would have been counted in wetter years. However, there is also a secondary lagged effect of broad-scale climatic fluctuations, with overall waterbird numbers in Australia rising after wet years and declining during widespread drought. The current number of waterbirds in Australia is likely to be much lower than the historical average because of prolonged drought in eastern Australia and, to a lesser extent, the south-west. This is a third influence on the numbers of waterbirds in the Lake Gore and Lake Warden systems.

Given the above background, the specific objectives of the counting in 2007 were:

1. To undertake aerial surveys of the Lake Warden and Lake Gore systems with the same methodology as 2006
2. To undertake ground surveys in the same parts of the Lake Warden system as counted in 2006
3. To compare waterbird usage between years to provide an estimate of the annual variability that occurs because of climatic fluctuation. Once a measure of natural variability in counts has been obtained, thresholds can be calculated that represent real changes in waterbird usage rather than natural fluctuations

This report provides the results of counting in October 2007 and interprets them in relation to conditions at the time of survey and historical information on waterbird numbers in the Lake Warden and Lake Gore systems.

2 CLIMATE

The 2007 survey occurred after 18 months of very dry conditions in south-west and eastern Australia, in contrast to wet conditions in the north-west (Fig. 2.1). It is likely that waterbird numbers in southern Australia declined throughout this period because of a very significant reduction of inland aquatic habitats available to waterbirds.

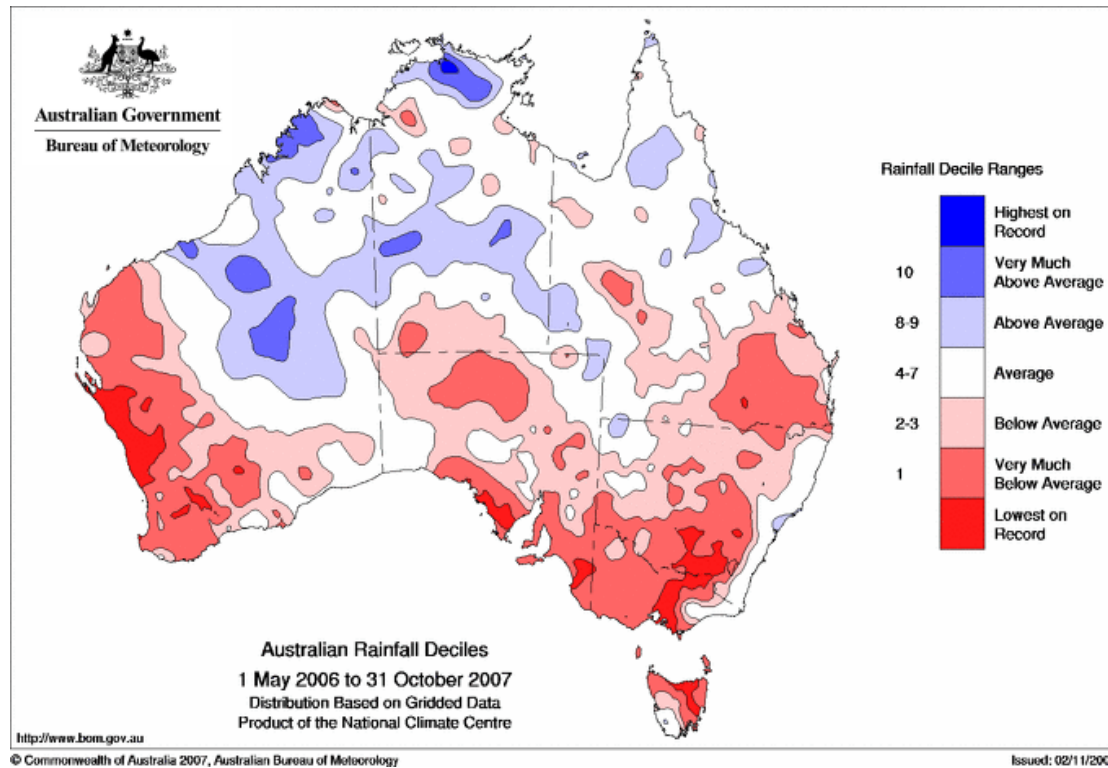


Fig. 2.1. Rainfall in Australia, May 2006 to October 2007, expressed in deciles and showing drought in southern Australia and wet conditions in the north. Esperance rainfall was average for the period.

Rainfall at Esperance was average (Fig. 2.1) and much greater than in most other parts of south-west Western Australia because of heavy rainfall in January 2007 (monthly rainfall 196 mm) and significant winter rainfall (July, 84 mm, August, 86 mm, September 86 mm). These wet periods filled local wetlands, including the Lake Warden and Lake Gore systems. Wetland depths are reported in the lake accounts below and compared with October 2006 levels in Fig. 3.1.

3 METHODS

3.1 Monitored wetlands

Maps of the Lake Warden and Lake Gore systems are provided in Figs 1.1 and 1.2. All water bodies were surveyed between 24 and 26 October 2007. Local conditions at the time of survey reflected the rainfall referred to earlier in January and April and were relatively wet. Rainfall from June to October totaled about 330 mm and evaporation was about 468 mm. Lake levels were markedly elevated above 2006 levels (Fig. 3.1) and, due to hydrological changes over the last 20 years, water levels were high in relation to established wetland boundaries, resulting in very little habitat for shorebirds. Filamentous alga was notably reduced from 2006 and macrophyte (*Ruppia* and *Lamprothamnion*) biomass in most of the water bodies was typical for the time of year.

3.2 Survey methods

Three survey methods were used – aerial, boat and ground. The aim of survey was to record all birds of all species present at the wetland at the time of survey.

Aerial surveys were flown using a Cessna 172 flying at a height of 25 to 30 m and speed of 60 to 80 knots with a front-right-seat observer (SH) and a rear left- seat observer (GP). Large wetlands were orbited anti-clock-wise, about 50 m inside the wetland boundary, and waterbirds on the shore and in the wetland margins were counted. Conditions were not very windy during the surveys and, apart from occasional clouding were optimal for counting. Smaller wetlands were counted during a single pass along their length or a pass down each side of the wetland. If necessary, additional passes were made to confirm species identifications and the composition of mixed species flocks. Few birds occurred in the centre of large wetlands. Identifications and estimates of numbers were made with the naked eye and results recorded digitally for later transcription to datasheets.

Lakes Wheatfield, Woody and Windabout were surveyed in a small punt by SH, GP, Kimberley Oswald and Tilo Massenbauer by following along the shoreline of the lakes and counting birds ahead of the punt or as they flushed from lakeside vegetation. Where trees were extensive, the punt usually traveled on the lakeside of the trees, with short detours into areas of open water within the stands of trees. To avoid excessive disturbance, little attempt was made to count accurately in the flooded trees on the south side of Wheatfield, where colonies of cormorants and other birds were breeding. Bird identifications were made using binoculars and results were recorded in a notebook.

Most wetlands other than Wheatfield, Woody and Windabout were surveyed on the ground. Observations were made from vantage points around the wetland using a spotting scope and an attempt was made to view all parts of the wetlands and count all birds present. Results were recorded in a notebook.

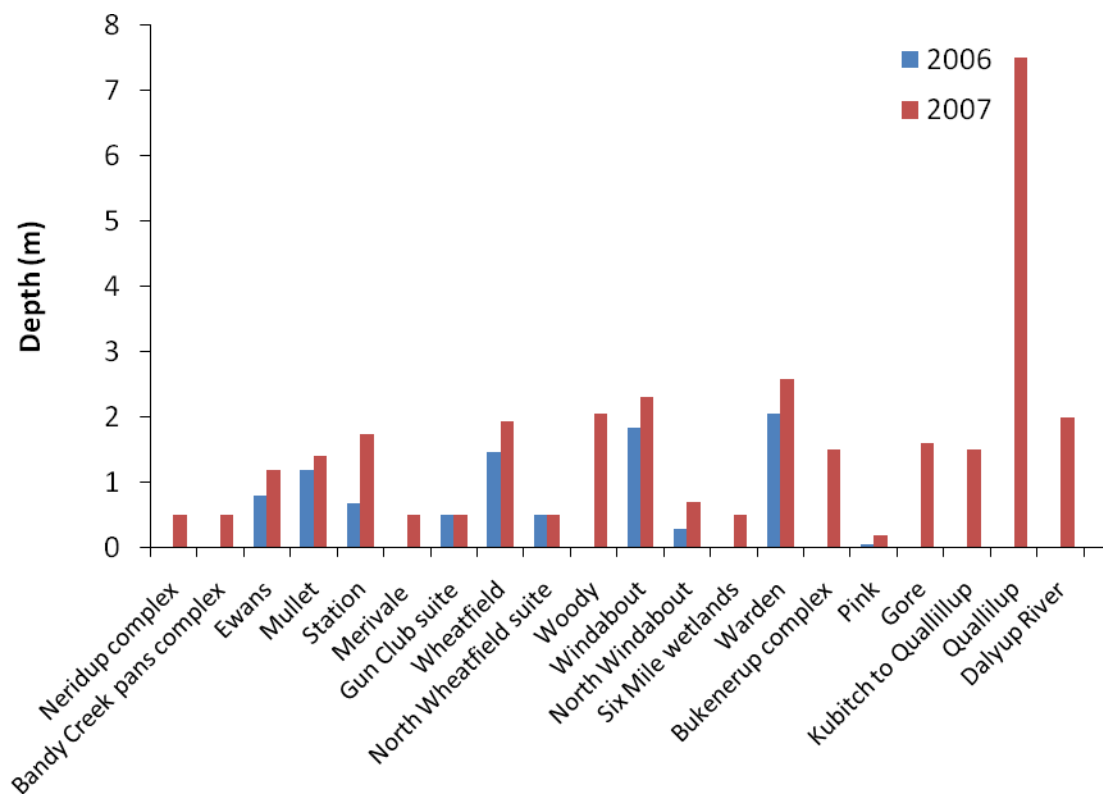


Fig. 3.1. Wetland depths in October 2006 and 2007 at monitored wetlands. Data provided by Tilo Massenbauer (DEC).

4 WATERBIRD COUNTS

4.1 Lake Warden system

4.1.1 Neridup complex

Location: South of Merivale Road, east of Hicks Road and Nature Reserve 23825. West of eastern end of the escarpment.

Land status: Freehold

Wetland description: Three small linear wetlands fringed by sedges and occasional *Melaleuca* trees at the eastern end of the Lake Warden system. The wetlands are connected to other wetlands and marshland in the Warden system by a drainage line on the south side of system. The land around the linear wetlands supports terrestrial vegetation and there is a small escarpment to the east.

Extent of water and depth: The wetlands are small and probably retain water year-round. Depth was estimated to be <0.5 m at the time of survey.

Waterbird survey: Waterbirds were surveyed by plane on 26 October. A total of 26 birds comprising 4 species, including 11 Pacific Black Duck, were counted (Appendix 1). Black Swan were recorded breeding.

Previous surveys: Apart from the October 2006 waterbird surveys there are no previous recorded surveys of the linear wetlands. The 2006 surveys reported a total of 31 waterbirds of which 29 were Pacific Black Duck. These wetlands are unlikely to contain significant numbers of waterbirds at any time in relation to waterbird use of the Lake Warden system as a whole

4.1.2 Bandy Creek pans complex

Location: South of Merivale Road, east of Ewans Lake and west of Hicks Road Reserve.

Land status: Nature Reserve 23825.

Wetland description: Four interconnected circular wetlands east of Ewans Lake in the eastern part of the Lake Warden system. Surrounding land is low-lying marsh with samphire and low thickets of *Melaleuca*.

Extent of water and depth: The wetlands were close to full at the time of survey and all had a narrow band of open shoreline. Depth is unknown but was estimated to be <0.5 m at the time of survey. The wetlands dry most summers.

Waterbird survey: A total of 534 waterbirds of 12 species were counted on 26 October (Appendix 1). Black Swan, Pacific Black Duck, Chestnut Teal and Australian Shelduck were the most abundant species. Relatively high numbers (47) of Common Greenshank were counted, reflecting the high value of these wetlands for medium sized migratory shorebirds.

Previous surveys: Apart from the October 2006 aerial surveys there are no previous recorded surveys of the Bandy Creek complex, which is likely to sometimes contain up to one-quarter of all waterbirds in Lake Warden system east of Norseman Road.

4.1.3 Ewans, Mullet, Station Lakes

Location: South of Merivale Road, east of Fisheries Road, in the western part of Nature Reserve 23825.

Land status: Nature Reserve 23825.

Wetland description: Mullet and Ewans Lakes are now permanent wetlands that are connected to a series of smaller wetlands around them. These smaller wetlands grade into the surrounding marsh and dry out during summer. Station Lake is usually seasonal and, together with a couple of satellite wetland areas forms a more discrete wetland body. The flow of water in the system is from Ewans through the Merivale Road wetlands (overflowing into Mullet) and into Station Lake before passing into Bandy Creek and the sea. Counts of the Ewans, Mullet and Station were combined during the 2007 aerial survey because it was difficult for the rear observer to keep track of location. The wetlands close

to Merivale Road, on the north side of Mullet, consist of an inter-connected series of small seasonal wetlands and were counted separately as the Merivale Road wetlands.

Extent of water and depth: The large lakes were nearly full at the time of counting, with a narrow band of bare shoreline around parts of all lakes. Depth in Ewans was 1.20 m (and conductivity 1345 mS m⁻¹), Mullet was 1.41 m (1828 mS m⁻¹) and Station was 1.75 m (2050 mS m⁻¹).

Waterbird survey: A total of 21 species were recorded in one aerial survey on 26 October and one ground count on 25 October. A total of 3356 waterbirds were recorded during the aerial count for the three lakes combined. (Appendix 1). This represents a significant increase on the 2006 count. The numerically dominant species were Australian Shelduck, Black Swan, Pacific Black Duck and Chestnut Teal. Species of interest were Australasian Shoveler (maximum count 30), Musk Duck (24) and Hoary-headed Grebe (61).

Previous surveys: Ewans, Mullet and Station Lakes were surveyed regularly during the early 1980s (Jaensch et al., 1989). Results of October counts were 413 waterbirds of 18 species in 1982, 1013 waterbirds of 18 species in 1983, 380 waterbirds of 13 species in 1984 (a dry year when Station held about 15 cm of water), and 1236 waterbirds of 22 species in 1985. The most notable differences between the 1980s and 2006 and 2007 counts, apart from the fact that 2007 was higher in terms of total numbers and species richness, were the lower numbers of dominant duck species in the 1980s (Black Swan numbers were similar) and the absence of Eurasian Coots in 2006 and 2007.

Counts of ducks, coots and swans made in Ewans and Mullet each November between 1988 and 1991 were 1171, 1202, 1439, and 1461 birds (Halse et al., 1995 and earlier publications) compared with about 1400 in 2006 and about 3400 in October 2007.

4.1.4 Merivale Road Wetlands

Location: South of Merivale Road, east of Fisheries Road, in the western part of Nature Reserve 23825.

Land status: Nature Reserve 23825.

Wetland description: The wetlands close to Merivale Road, on the north side of Mullet, consist of an inter-connected series of small seasonal wetlands. At the time of the survey the wetlands comprised shallow pools surrounded by samphire marsh and *Juncus*.

Extent of water and depth: Depth was unknown but estimated to be <0.5m.

Waterbird survey: These wetlands were counted from the air for a total of 297 waterbirds of 10 species. A ground count produced 189 waterbirds of 10 species that differed slightly in composition from the aerial count. The wetlands are characterized by small numbers of a diverse range of species dominated numerically by Australian Shelduck, Black Swan, Pacific Black Duck, Grey Teal and Chestnut Teal.

Previous surveys: The Merivale Wetlands were surveyed by air and ground in October 2006 and results were similar to the October 2007 counts.

4.1.5 Gun Club suite

Location: East of Fisheries Road, 1 km south of Merivale Road and south of Station Lake.

Land status: Nature Reserve 15231.

Wetland description: Small oval semi-permanent wetland fringed by *Melaleuca*, which is dense at northern end.

Extent of water and depth: Depth was unknown but likely to be approximately 0.5 m.

Waterbird survey: These wetlands were counted both air and ground. The small number of waterbirds (28 representing 5 species) recorded during the aerial count was slightly greater than from the ground and reflected the relatively low level of use of this wetland.

Previous surveys: The only previous survey of the wetland was in 2006 when 85 birds were counted. The wetland is never likely to contain a significant number of birds in relation to the total in the Lake Warden system.

4.1.6 Lake Wheatfield

Location: On west side of Norseman Road about 1.5 km south of Merivale Road.

Land status: Nature Reserve 15231.

Wetland description: Moderate-sized lake (ca. 50 ha) fringed with *Melaleuca*. It receives water from Coramup Creek and discharges into Woody Lake to the west. There are extensive stands of flooded *Melaleuca* on the south side of Wheatfield where colonial waterbirds (cormorants, ibis, spoonbills etc) nest. There are also extensive flooded stands of trees and open channels along the drainage between Wheatfield and Woody and a number of small satellite wetlands that hold water seasonally.

Extent of water and depth: Depth was 1.94 m (1017 mS m⁻¹).

Waterbird survey: A total of 745 waterbirds of 17 species were recorded at Wheatfield in the aerial survey on October 26. The boat survey on October 24 recorded 1008 waterbirds representing 22 species (Appendix 1). Combining boat and aerial counts, a total of 25 species were recorded. The dominant species were Straw-necked Ibis, Little Black Cormorant, Grey Teal, Chestnut Teal, Eurasian Coot, Pacific Black Duck, Glossy Ibis and Yellow-billed Spoonbill. There was a large breeding colony of Straw-necked Ibis, Yellow-billed Spoonbills and Little Black Cormorant (and perhaps other species) in the flooded trees on the south side of the lake. A thorough assessment of numbers and species present in the colony was not undertaken to avoid excessive disturbance to the nesting birds. Counts were fairly consistent between surveys. The absence of Musk Duck and Hoary-headed Grebe from the aerial count reflects the difficulty of counting diving species accurately from the air.

Previous surveys: Wheatfield has been surveyed in October (as well as August and March) biennially since 1997 by boat (Cale et al., 2004). Numbers have been variable but usually lower than our counts in 2006 (975 waterbirds and 23 species) and 2007 (745 waterbirds and 25 species) with 1246 waterbirds of 23 species in 1997, 726 waterbirds of 21 species in 1999, 212 waterbirds of 21 species in 2001, 191 waterbirds of 18 species in 2003, 224 waterbirds of 18 species in 2005 and 318 waterbirds of 25 species in 2007. Counts in October or November of the early 1980s (Jaensch et al., 1989) were relatively low with 410 waterbirds of 14 species in 1982, 176 waterbirds of 10 species in 1983, 167 waterbirds of 15 species in 1984, and 220 waterbirds of 11 species in 1985. There is no definite evidence of change in species composition over time.

Counts of ducks, coots and swans made in Wheatfield each November between 1988 and 1991 were 101 in 1988, 58 in 1999, 182 in 1990 and 424 in 1991 (Halse et al., 1995 and earlier publications) compared with about 500 in October 2006 and about 150 in October 2007 but counts were not comparable, with greater aerial survey effort as well as ground effort, in 2006 and 2007.

4.1.7 North Wheatfield suite

Location: On west side of Fisheries Road about 1.3 km south of Merivale Road, immediately north of Lake Wheatfield.

Land status: Freehold.

Wetland description: Two small wetlands. Surrounding land cleared and wetlands degraded.

Extent of water and depth: Wetlands were moderately full at time of survey but depth was likely to have been <0.5 m.

Waterbird survey: Aerial counts on 24 October recorded 32 waterbirds of 12 species which is higher than the numbers recorded in October 2006. The wetlands were open and easy to survey. Differences between the 2006 and 2007 counts perhaps reflect greater water level and natural variation

in use, with Lake Wheatfield very close so that regular movement in and out of the North Wheatfield wetlands is likely to occur.

Previous surveys: Apart from the 2006 counts there are no previous recorded surveys of the North Wheatfield suite, which does not contain a significant number of birds in relation to the total in the Lake Warden system.

4.1.8 Windabout complex

Location: East of Coolgardie-Esperance Highway and west of Lake Wheatfield.

Land status: Nature Reserves 15231 and 32259.

Wetland description: Woody Lake receives water from Lake Wheatfield and, in turn, flows into Windabout Lake. There are a number of small satellite wetlands around Woody and Windabout, some of which are on the connecting drainage line while others are separate. The lakes are fringed with *Melaleuca*, although there is a boat ramp on the shores of Woody and the Lake Windabout Golf Club is located on the edge of Windabout. There are several small wetlands within the golf course supporting *Melaleuca*. The condition of these wetlands varies from degraded to moderately intact.

Extent of water and depth: Wetlands were full at the time of survey and depth in Woody was 2.05 m (1133 mS m⁻¹) and Windabout was 2.31 (1225 mS m⁻¹).

Waterbird survey: A total of 2089 waterbirds of 28 species occurred in the Windabout complex. The numerically dominant species were Hardhead, Eurasian Coot, Chestnut Teal, Whiskered Tern, Pacific Black Duck, Little Black Cormorant and Musk Duck. There was generally acceptable correlation between aerial and ground counts but some discrepancies appeared. It may be expected that aerial counts of Chestnut Teal will be lower than ground counts due to the difficulty of distinguishing female Chestnut Teal from the air. However, Chestnut Teal are a species that, like Great Egret, tend to move ahead of ground observers so that the same birds may be repeatedly counted. Lower aerial counts may be more accurate than the ground count for such species. Conversely, higher aerial counts of mobile waterbirds such as Black Swan, Little Black Cormorant and Australian Shelduck (numbers of the latter two species are sensitive to time of survey because they often feed outside the wetland where they roost) may reflect the potential for feeding movements and the proximity of the surveyed lakes to other lakes. The high variability in number of species at Woody Lake in different surveys was also observed in 2006 and appears to reflect the character of the lake rather than survey method and associated error.

Previous surveys: Lakes Woody and Windabout were surveyed regularly during the early 1980s with November 1983, 1984 and 1985 (Jaensch et al., 1989) counts of 481 waterbirds of 13 species, 403 waterbirds of 8 species and 144 waterbirds of 16 species, although satellite wetlands were not surveyed. The counts were much higher in 2006 and 2007 than the 1980s but there is little suggestion of changes in species composition and improved coverage of the wetland complex is likely to be the main reason significantly more species were counted in 2006 and 2007.

4.1.9 North Windabout complex

Location: South of Lakes Road about 0.8 km east of the Coolgardie-Esperance Highway, north of the Windabout Complex.

Land status: Nature Reserve 15231.

Wetland description: Shallow seasonally filled playa wetlands with low gypsum dunes around them. The wetlands are subsaline with shores that are largely open and fringed with samphire. Low *Melaleuca* occurs behind.

Extent of water and depth: Depth unknown but probably > 0.7 m. Hardly any bare shoreline was present in 2007, in contrast to 2006 when most of the lakebed was exposed.

Waterbird survey: The North Windabout wetlands were surveyed from the air on 26 October and from the ground on 24 October. They supported about 520 waterbirds of 20 species and Black Swans were slightly more common than any other species. In 2006 five species of shorebird were

recorded, including 2 Hooded Plover, and the wetlands were considered an important shorebird site. In the 2007 survey the only shorebirds recorded were 15 Common Greenshank. This variation in waterbird species composition illustrates the capacity for seasonal changes to water depth to alter waterbird habitat use.

Previous surveys: Prior to the 2006 waterbird surveys there are no recorded surveys of the North Windabout wetlands, although it was recognized that the wetland was likely to contain significant numbers of waterbirds, especially shorebirds, at times.

4.1.10 Six Mile wetlands

Location: North of Lakes Road about 1.3 km east of the Coolgardie-Esperance Highway.

Land status: Freehold.

Wetland description: A series of at least 5 small seasonal wetlands in a cleared paddock with open shorelines. A few sedges occur.

Extent of water and depth: Most of the wetlands were half full when surveyed and depth was <0.5 m.

Waterbird survey: The Six Mile wetlands were surveyed from the air on 26 October and about 236 waterbirds of 15 species were seen. Black Swan, Pacific Black Duck, Australian Shelduck, Australasian Shoveler, Eurasian Coot and White-faced Heron were the numerically dominant species but the wetland is probably characterized by small numbers of an array of species. The flock of about 30 shoveler recorded during the aerial survey is a significant record in the context of the numbers of that species recorded for all wetlands surveyed in October 2007, although not in the context of overall numbers of shoveler (annual duck counts in the 1980s and 1990s always recorded at least one wetland containing > 100 shoveler, Halse et al. 1995 and earlier publications).

Previous surveys: Apart from the 2006 survey there are no previous recorded surveys of the Six Mile wetlands, which will at times contain significant species diversity although never a high proportion of total bird numbers in Lake Warden system.

4.1.11 Lake Warden

Location: Between Coolgardie-Esperance and South Coast Highways about 6 km from the centre of Esperance.

Land status: Nature Reserve 32257.

Wetland description: A large semi-permanent saline wetland. At water depths experienced historically, it usually has a short open shoreline fringed by samphire and low *Melaleuca* trees (Halse et al., 1993). Water levels in Lake Warden are principally an expression of groundwater, although the lake receives surface water input from Bukenerup Creek to the north and overflow from the Windabout complex to the east.

Extent of water and depth: Warden was full at the time of survey, with little exposed shoreline. Depth was 2.59 m (6930 mS m⁻¹).

Waterbird survey: Lake Warden was surveyed from the air on 26 October and about half the lake was surveyed from the ground on 25 October. About 260 waterbirds of 13 species were recorded from the air. The ground count, at two vantage points on the northern shore, recorded 13 species of about 130 waterbirds. The total number of species was 19. Whiskered Tern was the numerically dominant species. A count of 19 Common Greenshank during the aerial survey contrasts with none being recorded during ground counting and the ground count of 26 Hoary-headed Grebe contrasts with an aerial count of only 2 of that species. Common Greenshank is a mobile species and may well have been present during ground survey but in a section of the wetland that was not visited.

Previous surveys: Lake Warden was surveyed regularly in the early 1980s with November 1982, 1983, 1984 and 1985 counts of 16,919 waterbirds of 15 species, 1062 waterbirds of 5 species, 883 waterbirds of 10 species and 2872 waterbirds of 12 species. Counts of ducks, coots and swans made in

Wheatfield each November between 1988 and 1991 were 810 in 1988, 55 in 1999, 87 in 1990 and 878 in 1991 (Halse et al., 1995 and earlier publications) compared with < 20 in October 2006. While the very high numbers of waterbirds recorded in 1982 should probably be regarded as unusual, the 2006 counts represented uniquely low numbers and the 260 waterbirds of 18 species recorded in October 2007, perhaps more accurately reflects the lake's attractiveness for waterbirds during spring, although it also represents relatively low use in historical terms.

4.1.12 Bukenerup complex

Location: Wetlands along Bukenerup Creek at south-western side of Lake Warden. North of South Coast Highway and both sides of railway.

Land status: Freehold and railway reserve.

Wetland description: A series of small semi-permanent wetlands along the inflow into Lake Warden from Bukenerup Creek, fringed by sedges and *Melaleuca* trees. Some of the wetlands are degraded and a rail line passes through the complex.

Extent of water and depth: The Bukenerup wetlands were moderately full at the time of survey and depth was about 1.5 m.

Waterbird survey: About 181 birds of 17 species were recorded. More birds were recorded from the air on 26 October than ground counting on 25 October. Chestnut Teal (79) and Black-winged Stilt (54) constituted almost three quarters of the waterbird population.

Previous surveys: The October 2006 survey produced low numbers of waterbirds with high species richness. The survey in October 2007 produced moderate numbers of waterbirds with lower species richness. The high proportion of Chestnut Teal in these counts suggests the wetland may have value as habitat for that species.

4.1.13 Pink Lake

Location: South-west of South Coast Highway about 6 km from the centre of Esperance.

Land status: Unallocated Crown land, freehold and Nature Reserve 24511 on western side.

Wetland description: A large seasonally drying hypersaline wetland containing a series of evaporation ponds in the northern end for salt production. The western side of the wetland contains freshwater seeps along the shore and extensive sedges and samphire, with *Melaleuca* behind. The remainder of the shoreline supports samphire and scattered *Melaleuca* trees.

Extent of water and depth: At the time of survey the wetland contained shallow water (about 0.2 m) outside the evaporation ponds and deeper water within the ponds.

Waterbird survey: Pink Lake contained 3052 waterbirds in total, with Banded Stilt, Red-necked Stint, Red-capped Plover, Australian Shelduck and unidentified shorebirds being the main species present.

Previous surveys: The 2006 survey recorded very few birds at Pink Lake at a time when water levels were lower. The 2007 survey illustrates the potential for Pink Lake to support high numbers of shorebirds during summer if sufficient water is present.

4.2 Lake Gore system

4.2.1 Lake Gore

Location: Terminus of Dalyup River, south of McCall's Road between South Coast Highway and coast. About 40 km west of Esperance in a direct line.

Land status: Nature Reserve 32419.

Wetland description: Lake Gore is a large open saline lake fringed with *Melaleuca cuticularis* trees, many of which have died over the past 25 years. The Dalyup River enters on the eastern side of

Lake Gore and there is a long lagoon-like backwater, parallel to the shoreline of the main waterbody, associated with the river inflow. There are other wetlands associated with the Dalyup as it approaches the lake. Although Lake Gore is the terminus for the Dalyup River in most years, it overflows to the west in wet years into the Coobidge to Quallilup flow-through system.

Extent of water and depth: Lake Gore was full at the time of survey with little exposed shoreline and a considerable amount of flooding around the inflow of the Dalyup River. Depth was 1.60 m.

Waterbird survey: A total of 8317 waterbirds of 18 species were recorded for Lake Gore and adjacent inflow wetlands on 26 October 2007 compared with about 5000 waterbirds of 9 species on 12 October 2006. The numerically dominant species was the Australian Shelduck, which accounted for more than 80% of birds in both counts. Chestnut Teal occurred in significant, albeit much lower, numbers as well and were more abundant than Grey Teal. Musk Duck occurred in comparatively high numbers in 2006 but were uncommon in 2007.

Previous surveys: Counts in October in the 1980s by Jaensch et al. (1988) yielded highly variable numbers of birds and similar, or fewer, species than recorded in October 2007. Counts in October 1982, 1983, 1984, 1985, 1986 (November) and 1987 (November) were 1880 waterbirds of 9 species, 3763 waterbirds of 14 species, 5996 waterbirds of 18 species, 2500 waterbirds of 1 species, 14,327 waterbirds of 19 species and 12,000 waterbirds of 2 species. A more recent comprehensive count on 8 September 1998 (part of the State Salinity Strategy survey, Halse et al., 2004) recorded 9832 waterbirds of 21 species. The early counts were dominated by Australian Shelduck and Banded Stilt, with Musk Duck recorded in very low numbers (1 in 1984, 5 in 1998). The main differences in recent counts are increases in Chestnut Teal, Grey Teal and Musk Duck and a decrease in Banded Stilt. The reasons for the variations in numbers of teal and Musk Duck are unclear, although they may relate to counting methods. The decrease in Banded Stilt probably reflects the high water levels in recent years. The 1998 count, which was done from a boat, recorded 349 Hoary-headed Grebe. This species is usually missed from the air and seems likely to have been under-counted in the early 1980s.

Counts of ducks, coots and swans made in Gore each November between 1988 and 1991 were 3928 in 1988, 7741 in 1999, 12,172 in 1990 and 6147 in 1991 (Halse et al., 1995 and earlier publications) compared with about 5000 in October 2006. About 600 Pink-eared Ducks were counted in November 1990 but this species was not recorded in the early 1980s, 2006 or 2007, highlighting that occurrence of some species is sporadic and determined by lake conditions. Eurasian Coot, which were seen in 1989 and 1990, were recorded only once in low numbers during October or November of the early 1980s counts and were not seen in 2006 or 2007 although the habitat appears to be suitable.

4.2.2 Coobidge to Quallilup flow-through system

Location: The Coobidge to Quallilup flow-through system consists of four named wetlands – Lakes Carbul, Coobidge, Gidong in the north and Quallilup in the south – and many flow-through channels and smaller wetlands between them. The system is west of Lake Gore and not easily accessible. Lake Coobidge is the terminus of Coobidge Creek.

Land status: Freehold and Reserve. Lake Quallilup is in Reserve 30672 and much of the flow-through system south of Lakes Carbul, Coobidge and Carbul is in Nature Reserve 26885.

Wetland description: Gidong, Coobidge, Carbul receive overflow from Lake Gore and flow through into Lake Quallilup.

Extent of water and depth: The lakes appeared to be full especially towards the southern part of the flow-through. Depth in Lake Coobidge was <1.5 m; depth in Lake Quallilup was 7.5 m.

Waterbird survey: The Coobidge to Quallilup flow-through system was counted from the air on 26 October and appeared to support more than 5100 waterbirds of 20 species. This count represents

more waterbirds of slightly fewer species than in 2006 when more than 3000 birds of 22 species were recorded. The dominant species in 2007 was the Australian Shelduck, accounting for about 60% of all birds. Black Swan, Chestnut Teal and Eurasian Coot occurred in significant numbers, as did Yellow-billed Spoonbill and Pacific Black Duck.

Previous surveys: Counts of ducks, coots and swans were made in the Coobidge to Quallilup flow-through system each November between 1988 and 1991. Lake Quallilup itself was included in these counts (it was done separately in 2006 and 2007). Totals of 5455 waterfowl were counted in 1988, 745 in 1989, 5761 in 1990 and 1788 in 1991 (Halse et al., 1995 and earlier publications) compared with about 3000-3500 birds in 2006 and 5107 in 2007. The dominant species in all earlier counts was the Australian Shelduck, with Black Swan and Eurasian Coot occurring in substantial numbers in 1990.

4.2.3 Barker flow-through system

Location: Barker Inlet flow-through system consists of one main waterbody about 2.5 km long and 1.2 km wide and two smaller interconnected waterbodies to the west. The system is west of Coobidge to Quallilup flow-through system.

Land status: Nature Reserve 27888

Wetland description: The system represents a series of swamps that fill in wet years as water overflows from the Coobidge to Quallilup flow-through system into Barker Inlet.

Extent of water and depth: The depth of water was unknown but probably <0.5 m.

Waterbird survey: The Barker Inlet flow-through system was counted from the air on 26 October and only a small number of waterbirds of only 7 species were recorded.

Previous surveys: The Barker Inlet flow-through did not contain water in 2006.

5 DISCUSSION

The counts of about 12,000 waterbirds of 53 species and 13,800 waterbirds of 35 species in the Lake Warden and Lake Gore complexes, respectively, in October 2007 (Appendix 1) represent significant concentrations of waterbirds in south-west Western Australia, although higher counts have been recorded from the Warden and Gore complexes previously, especially in late summer (see Jaensch et al. 1989; Halse et al. 1995 and earlier publications). In most years waterbird numbers in both complexes increase over summer as water in smaller coastal, and more inland, wetlands dries up.

5.1 Counting consistency

The October 2007 survey employed the same methods and counted the same wetlands or wetland sections as in 2006 in order to minimize the difference in results across years owing to different counting techniques rather than real changes in waterbird use of wetlands. Variations between aerial and ground accounts made on successive days during the October 2007 surveys reflected some of the known biases of both survey methods (e.g. under-counting diving birds from the air and over-counting some species on the ground as they move ahead of the observer, Halse 2007). More importantly, however, the overall species composition obtained with both methods is similar and the dataset obtained from combining all counting provides a robust measure of waterbird use that will reliably detect significant changes in species use of the wetland systems.

5.2 Hooded Plover

Few Hooded Plover were present in the Lake Warden system during the October 2007 surveys. The only record was 6 birds at Pink Lake. Lake Warden, Station Lake and the North Windabout system have supported high numbers in the past when lake water levels have been lower.

5.3 Australasian Shoveler

Australasian Shoveler are a widespread species across southern Australian wetlands but they usually represent only a small percentage of waterbirds present. The survey recorded shoveler on 6 wetlands in total (4 wetlands during the aerial survey and 4 wetlands from ground counts). The numbers of shoveler recorded in October 2007 on several of the Lake Warden and Lake Gore system wetlands are significant and illustrate the value of the two wetland systems for this species.

5.4 Wetland values

The counts made in October 2007 suggest that the Lake Warden and Lake Gore systems continue to have high waterbird values. In the Lake Warden system, this includes the extensive breeding of colonial waterbirds at Lake Wheatfield and the moderately high numbers and species diversity of birds from Lake Windabout eastwards.

Lake Warden itself supported few birds but this may change as water levels decline, thus increasing the extent of available waterbird habitat. Waterbird surveys in the past 25 years have been interpreted as suggesting that, historically, Lake Warden provided important October habitat for Australian Shelduck, Black Swan and migratory shorebirds. However, the lake may principally be a summer refuge.

During the 2006 and 2007 October surveys, the open shorelines required by shorebirds were under water. Even Australian Shelduck and Black Swan appear to be finding most of the lake inaccessible for feeding at lake depth exceeds about 2 m and are seeking more suitable habitat in other parts of the Warden system or beyond it. There was a very considerable contrast between the October 2006 and October 2007 surveys, when Lake Warden was 2.05 m and 2.51 m deep, and that of Clarke & Lane (2004) in February 2003 when the lake was 1.50 m deep and 4484 waterbirds of 18 species were recorded. However, more surveys in October period are required to confirm that low waterbird use at Lake Warden is associated only with high water levels. Summer surveys, which reflect drought-refuge values of wetlands, would provide additional information about any change of function of Lake Warden.

Waterbirds on Lake Gore itself were mostly Australian Shelduck, which reflects the historical pattern. The lake is a major moulting habitat for Australian Shelduck, which also dominated the Coobidge to Quallilup flow-through system numerically. However, a variety of other species also use the Lake Gore system in lower numbers and it is an important waterbird site, although the values of the Coobidge-Quallilup overflow and the wetlands on the eastern edge of Lake Gore are relatively poorly documented.

5.5 High water levels

Results presented in this report show that many waterbird species use the Lake Warden and Lake Gore systems in high numbers when these systems contain high water levels. It is not the purpose of this report to discuss the benefits and disadvantages of particular water regimes but readers should be aware that not all species benefit from high water levels. The low numbers of Hooded Plover observed in the Lake Warden system as a whole in 2007 is an example of this, as well as the comparatively low level of use of the flooded Lake Warden itself. In addition to immediate negative effects on numbers of shorebirds and some other species, high water levels often kill riparian vegetation (Froend & van der Moezel 1994) with detrimental longer term effects on waterbird numbers and species diversity.

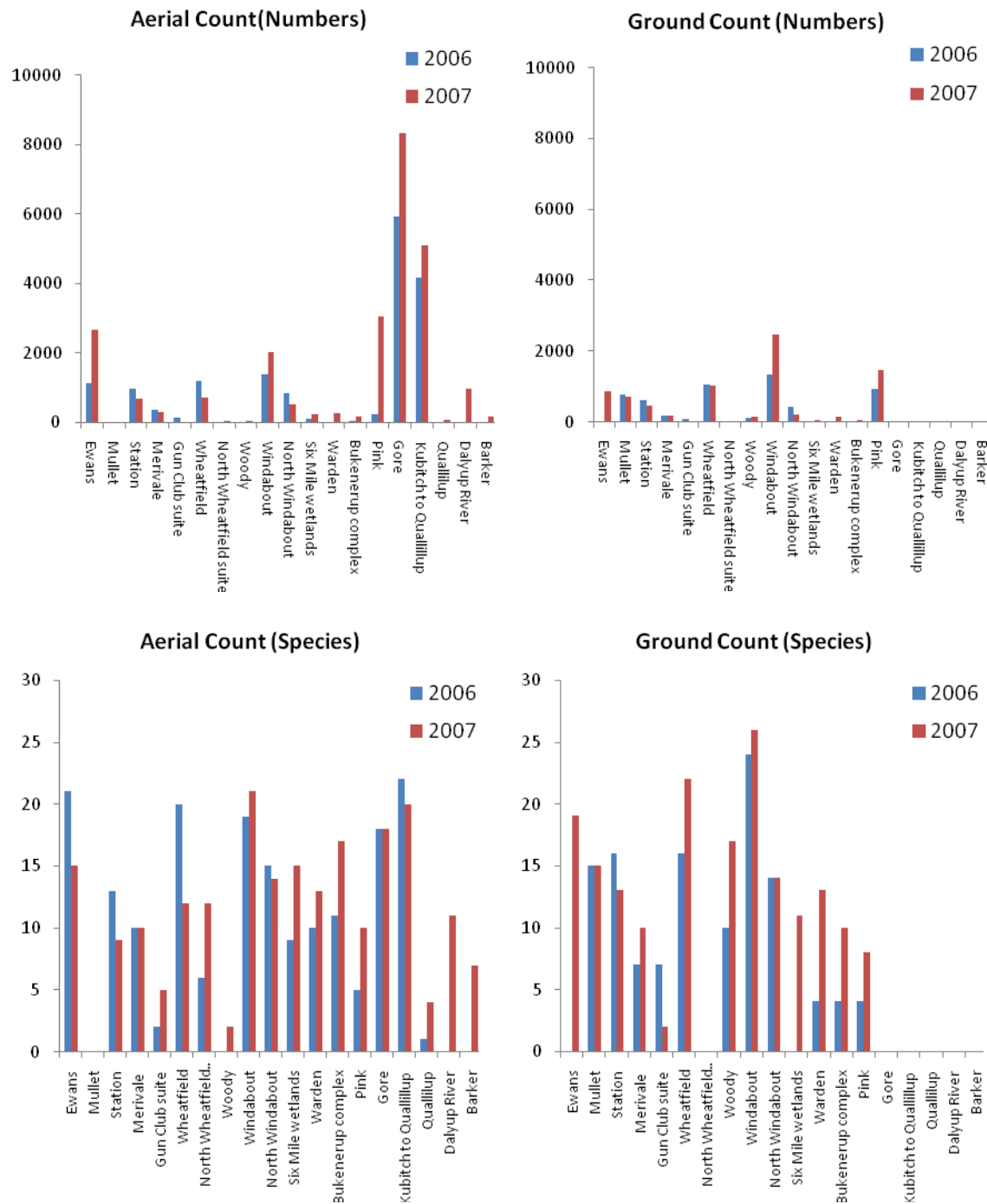


Fig. 5.1. Numbers of waterbirds and species counted from air and ground in 2006 and 2007 in the Lake Warden and Lake Gore systems. Note that results from Ewans and Mullet have been combined in aerial counts and that Dalyup River was not distinguished from Lake Gore in 2006. Results from Ewans and Mullet have been combined in aerial counts

5.6 Monitoring the systems

The aim of the October 2006, October 2007 and planned 2008 surveys is to establish the current level of waterbird use of the Lakes Warden and Lake Gore systems in terms of the species present and their overall numbers. This baseline will include measurement of the changes in species and numbers that occur in the two systems between years as a result of different rainfall patterns, both locally and at larger spatial scales (see Introduction). Without understanding the magnitude of changes due to climate fluctuations, the significance of changes in waterbird populations cannot be assessed.

The total number of waterbirds counted from the air was 47 % higher in 2007 than 2006, which was similar to the ground counts results (41 % higher) (Fig. 5.1). This pattern was reflected at most wetlands other than Station Lake. The overall numbers of species recorded at wetlands from the air seemed to be a little out of kilter with other statistics, being only 17 % higher in 2007, but this is partly a reflection of less efficient counting of diving birds in 2007. The overall numbers of species recorded in ground counts followed the same pattern as total waterbird numbers, being 49 % higher in 2007.

The most likely explanation for the greater waterbird use of both the Lake Warden and Lake Gore systems in 2007 is that the relatively dry conditions in most of winter 2007 around Esperance meant only small areas of local seasonal and ephemeral wetlands remained flooded in October. Therefore, large numbers of birds moved onto the two large systems, which contained ample water as a result of flooding in January as well as the long-term increase in inundation that they are experiencing. The dry conditions across the whole of southern Australia (Fig. 1.3) is likely to have exaggerated this trend through immigration of waterbirds into the Esperance region from elsewhere.

In contrast to the 2007 pattern, waterbirds use of the Lake Warden and Lake Gore systems is likely to be below 2006 levels in future years of high winter rainfall around Esperance. If the reduction on 2006 levels of use is of a similar magnitude to the changes observed between 2006 and 2007, then changes of waterbird use in excess of 50 % between years can probably be expected as a result of annual variation in wetland conditions while the overall ecological character of the wetland remains the same. Providing further quantitative information about this variation, as well as information about waterbird distribution in the systems, is the purpose of the monitoring planned for 2008. Unless the magnitude of annual variability in biological activity is understood, possible changes in the ecological character of a wetland over time cannot be evaluated.

6 ACKNOWLEDGEMENTS

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Appendix 1. Waterbird counts from the Lake Warden and Lake Gore systems in October 2007.

	SH	Aerial		Ground		
		GP	Combined	24/10/2007	25/10/2007	26/10/2007
LAKE WARDEN SYSTEM						
Neridup complex						
Black Swan	2	2	4			
Australian Shelduck	1		1			
Pacific Black Duck	9	2	11			
Grey Teal		10	10			
Subtotal	12	14	26			
Bandy Creek pans complex						
Black Swan	112	85	197			
Australian Shelduck	40	35	75			
Pacific Black Duck	100	10	110			
Australasian Shoveler	20		20			
Grey Teal	10		10			
Chestnut Teal	50	10	60			
Little Pied Cormorant	2		2			
White-faced Heron	1		1			
Great Egret	2		2			
Common Greenshank	35	12	47			
Hoary-headed Grebe		4	4			
Unidentified wader	6		6			
Subtotal	378	156	534			
Ewans/Mullet/Station complex						
Ewans						
Musk Duck	8	14	22			3
Black Swan	224	352	576			166
Australian Shelduck	1006	513	1519			373
Pacific Black Duck	296	28	324			121
Australasian Shoveler	30		30			23
Grey Teal	2		2			30
Chestnut Teal	70	24	94			14
Hoary-headed Grebe		45	45			94
Australian Pelican						3
Little Pied Cormorant	1		1			
Little Black Cormorant	12	7	19			5
White-faced Heron						1
Great Egret	3	10	13			4
Australian White Ibis	1		1			4
Straw-necked Ibis	2		2			
Yellow-billed Spoonbill	1	4	5			5
Common Greenshank	30	1	31			2
Ruddy Turnstone						2
Red-necked Stint						1
Sharp-tailed Sandpiper						1
Red-capped Plover						6
<i>Tally</i>	1686	998	2684			858

	SH	Aerial GP	Combined	24/10/2007	Ground 25/10/2007	26/10/2007
Mullet						
Musk Duck					17	
Black Swan					89	
Australian Shelduck					435	
Pacific Black Duck					18	
Australasian Shoveler					11	
Grey Teal					10	
Hoary-headed Grebe					105	
Great Crested Grebe					20	
Little Pied Cormorant					1	
Australian Pelican					1	
White-faced Heron					3	
Great Egret					2	
Australian White Ibis					1	
Straw-necked Ibis					2	
Yellow-billed Spoonbill					2	
Whiskered Tern						
<i>Tally</i>					717	
Station						
Musk Duck		2	2			
Black Swan	250	114	364		207	
Australian Shelduck	100	90	190		127	
Pacific Black Duck	30	10	40		49	
Australian Shoveler					2	
Grey Teal	10	7	17		6	
Chestnut Teal		24	24			
Hoary-headed Grebe	1	15	16		31	
Little Black Cormorant	15		15			
Australian Pelican					1	
White-faced Heron					4	
Great Egret					4	
Australian White Ibis					1	
Straw-necked Ibis					20	
Yellow-billed Spoonbill		4	4		4	
Greenshank					1	
<i>Tally</i>	406	266	672		457	
Merivale Road wetlands (north of Ewans/Mullet/Station)						
Black Swan	39	32	71		21	
Australian Shelduck	20	85	105		85	
Pacific Black Duck	21	40	61		46	
Australasian Shoveler					1	
Grey Teal		32	32		11	
Chestnut Teal		14	14		20	
Pink-eared Duck		5	5			
Hoary-headed Grebe					1	
Little Black Cormorant	1	1	2			
White-faced Heron	4		4		2	
Great Egret	1	1	2		1	
Straw-necked Ibis	1		1		1	

	Aerial			Ground		
	SH	GP	Combined	24/10/2007	25/10/2007	26/10/2007
<i>Tally</i>	87	210	297		189	
Subtotal	2569	1644	4213		2221	
Gun Club suite						
Chestnut Teal		20	20			
Hoary-headed Grebe	1		1			16
Little Pied Cormorant	1		1			1
White-faced Heron	3		3			
Straw-necked Ibis	3		3			
Subtotal	8	20	28			17
Wheatfield						
Blue-billed Duck	2		2	1		
Musk Duck				6		
Black Swan	1		1			
Australian Shelduck				1		
Pacific Black Duck	7		7	18		
Grey Teal	10		10	47		
Chestnut Teal	16		16	24		
Pink-eared Duck				2		
Hardhead				1		
Hoary-headed Grebe				16		
Darter	1		1	4		
Little Pied Cormorant	10		10	22		
Little Black Cormorant	67	41	108	129		
Great Cormorant	5		5	6		
Australian Pelican	15		15	10		
White-faced Heron	5		5	4		
Great Egret	13	1	13	13		
Little Egret				3		
Rufous Night Heron				2		
Glossy Ibis	40	30	70			
Australian White Ibis				1		
Straw-necked Ibis	350		350	630		
Yellow-billed Spoonbill	47	4	51	14		
Eurasian Coot	22	30	52	55		
Banded Lapwing	20	10	30			
Subtotal	629	116	745	1008		
North Wheatfield suite						
Australian Shelduck		2	2			
Chestnut Teal		4	4			
Pacific Black Duck	8		8			
Hoary-headed Grebe	3		3			
Darter	6		6			
Little Pied Cormorant	2		2			
Little Black Cormorant	2		2			
White-faced Heron	2		2			
Great Egret	1		1			
Australian White Ibis	1		1			
Yellow-billed Spoonbill		1	1			

	Aerial			Ground		
	SH	GP	Combined	24/10/2007	25/10/2007	26/10/2007
Eurasian Coot	6		6			
Subtotal	31	1	32			
Windabout complex						
Woody						
Black Swan				4		
Australian Shelduck				1		
Pacific Black Duck				2		
Grey Teal				2		
Chestnut Teal				2		
Hoary-headed Grebe				12		
Darter				3		
Little Pied Cormorant	3		3	2		
Little Black Cormorant	51		51	68		
Australian Pelican				1		
White-faced Heron				1		
Great Egret				1		
Australian White Ibis				1		
White-bellied Sea-eagle				1		
Eurasian Coot				22		
Common Sandpiper				2		
Silver Gull				13		
<i>Tally</i>	54		54	138		
Windabout						
Blue-billed Duck	3		3	17		
Australian Pelican	1	2	3	3		
Musk Duck	4		4	31		1
Black Swan	23	20	43	5		
Australian Shelduck	120	2	122	22		
Pacific Black Duck	24	12	36	59		10
Australasian Shoveler				7		
Grey Teal	10	20	30	13		
Chestnut Teal	14	4	18	78		10
Hardhead	140	1300	1440	1587		220
Hoary-headed Grebe	2		2	32		6
Great Crested Grebe	3	3	6	3		
Darter	5	1	6	10		
Little Pied Cormorant	3		3	11		
Pied Cormorant				1		
Little Black Cormorant	15	114	129	45		1
Great Cormorant				2		
White-faced Heron	1		1	3		1
Great Egret	1	1	2	15		
Rufous Night Heron				1		
Australian White Ibis				2		
Straw-necked Ibis		3	3			
Yellow-billed Spoonbill	4		4	2		
Black-tailed Native-Hen						3
Eurasian Coot	34	146	180	151		20
Common Sandpiper				6		

	SH	Aerial GP	Combined	24/10/2007	Ground 25/10/2007	26/10/2007
Black-winged Stilt		2	2			
Silver Gull				8		
Whiskered Tern				70		
<i>Tally</i>	407	1630	2037	2184		272
Subtotal	461	1628	2089	2322		272
North Windabout						
Australian Pelican		2	2		1	
Musk Duck					2	
Black Swan	176	12	188		127	
Australian Shelduck	66	52	118		3	
Pacific Black Duck	2		2			
Grey Teal					2	
Hoary-headed Grebe	2		2		14	
Darter		2	2			
Australian Pelican					1	
Little Black Cormorant		9	9			
White-faced Heron	4	1	5		1	
Great Egret	1	1	2		1	
Australian White Ibis					3	
Glossy Ibis		15	15			
Straw-necked Ibis					1	
Yellow-billed Spoonbill		1	1			
Eurasian Coot		149	149		25	
Black-winged Stilt		10	10			
Common Greenshank	15		15		1	
Whiskered Tern					18	
Subtotal	266	254	520		200	
Six Mile wetlands						
Musk Duck	1		1			
Black Swan	7	31	38		2	
Australian Shelduck	22	10	32		3	
Pacific Black Duck	18	17	35		8	
Australasian Shoveler	30		30		2	
Chestnut Teal	2	17	19		6	
Eurasian Coot		29	29			
Little Pied Cormorant	3		3		2	
Little Black Cormorant	1	1	2		1	
White-faced Heron	10	18	28		11	
Great Egret	1	2	3		2	
Yellow-billed Spoonbill		1	1			
Straw-necked Ibis		1	1		1	
Common Greenshank		2	2		12	
Black-winged Stilt	12		12			
Subtotal	107	129	236		50	
Warden						
Musk Duck	10		10		6	
Black Swan	1		1		4	
Australian Shelduck	1	4	5		2	

	SH	Aerial		24/10/2007	Ground	
		GP	Combined		25/10/2007	26/10/2007
Pacific Black Duck						1
Grey Teal						2
Chestnut Teal						4
Pink-eared Duck						2
Hoary-headed Grebe	2		2			34
Great Crested Grebe						2
Darter	1		1			
Little Black Cormorant	7	4	11			4
Australian Pelican	1		1			
White-faced Heron	5		5			1
Great Egret	1	1	2			
Yellow-billed Spoonbill	3	4	7			
Common Greenshank	19		19			
Silver Gull	70	4	74			17
Whiskered Tern	104	18	122			52
Subtotal	225	35	260			131
Bukenerup complex						
Australian Pelican		1	1			1
Australian Shelduck	2		2			2
Pacific Black Duck	3		3			1
Grey Teal		1	1			
Chestnut Teal	68	11	79			12
Australasian Shoveler		1	1			
Hoary-headed Grebe	3		3			23
Great Crested Grebe	12		12			3
Little Black Cormorant	10		10			1
White-faced Heron	3		3			2
Great Egret	1	2	3			2
Australian White Ibis	2		2			
Straw-necked Ibis	2		2			
Yellow-billed Spoonbill	2		2			1
Common Greenshank		2	2			
Black-winged Stilt	48	6	54			
Unidentified wader	1		1			
Subtotal	157	23	181			47
Pink						
Australian Shelduck	34	3	37			
Hoary-headed Grebe						40
White-faced Heron	1		1			
Red-necked Stint		330	330			131
Banded Stilt	2180	110	2290			970
Red-necked Avocet	10		10			24
Red-capped plover		50	50			86
Greater Sand Plover		2	2			3
Hooded Plover	2		2			6
Unidentified wader	329		329			201
Silver Gull		1	1			
Subtotal	2556	496	3052			1461

	SH	Aerial		24/10/2007	Ground	
		GP	Combined		25/10/2007	26/10/2007
WARDEN SYSTEM TOTAL	7379	4506	11885		4110	
LAKE GORE SYSTEM						
Gore						
Musk Duck	1	8	9			
Black Swan	515	62	577			
Australian Shelduck	6169	620	6789			
Pacific Black Duck	1		1			
Grey Teal	127	30	157			
Chestnut Teal	185	97	283			
Darter	1	1	2			
Little Black Cormorant	83	5	88			
Australian Pelican	15		15			
Great Egret	6	1	7			
White-faced Heron	36	3	39			
Yellow-billed Spoonbill	54		54			
Greenshank	11	4	15			
Black-winged Stilt	41	16	57			
Banded Stilt						
Red-necked Avocet	202		202			
Banded Lapwing	1	2	3			
Unidentified wader	2		2			
Silver Gull	17		17			
Subtotal	7467	849	8317			
Coobidge to Quallilup flow-through						
Blue-billed Duck	2		2			
Musk Duck	0	1	1			
Black Swan	609	705	1314			
Australian Shelduck	2155	1072	3227			
Pacific Black Duck	20	17	37			
Grey Teal	10	23	33			
Chestnut Teal	81	53	134			
Darter		2	2			
Little Pied Cormorant	1		1			
Little Black Cormorant	9	6	15			
Great Cormorant	1		1			
Australian Pelican	1	3	4			
White-faced Heron	5	3	8			
Great Egret	8	9	17			
Straw-necked Ibis	1		1			
Yellow-billed Spoonbill	17		17			
Eurasian Coot	108	166	274			
Common Greenshank	15	1	16			
Unidentified wader		1	1			
Silver Gull		2	2			
Subtotal	3043	2064	5107			
Barker Inlet						
<i>Black Swan</i>	2	20	22			
Australian Shelduck	2	30	32			

	SH	Aerial		Ground		
		GP	Combined	24/10/2007	25/10/2007	26/10/2007
Grey Teal	4		4			
Chestnut Teal	25		25			
Eurasian Coot	3	2	5			
Little Pied Cormorant		82	82			
Darter	1		1			
Subtotal	37	134	171			
Quallilup						
Australian Shelduck		7	7			
Little Black Cormorant	3	54	57			
Great Cormorant	1		1			
Australian Pelican	1	2	3			
Subtotal	5	63	68			
Dalyup River						
Black Swan	5	20	25			
Australian Pelican	15	20	35			
Australian Shelduck	344	20	364			
Yellow-billed Spoonbill	30	1	31			
Grey Teal	55	10	65			
Common Greenshank		3	3			
Black-winged Stilt		10	10			
Red-necked Avocet	200	152	352			
Banded Stilt		50	50			
Masked Lapwing		10	10			
Red-capped Plover		15	15			
Unidentified wader	2		2			
Silver Gull	2		2			
Subtotal	653	311	964			
GORE SYSTEM TOTAL	11168	2976	14144			
GRAND TOTAL	18547	7482	26029			