Waterbird Monitoring of the Warden and Gore Wetlands in November 2010 and February 2011

red-necked avocets at Lake Warden (A. Pinder)

Adrian Pinder[1], David Cale[1], Stuart Halse[2] and Anna Leung[1]

[1] Science Division, Department of Environment and Conservation, Western Australia

[2] Bennelongia Environmental Consultants

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EXECUTIVE SUMMARY

- Waterbirds were surveyed across the Warden and Gore-Quallilup wetland systems by air and from the ground in November 2010 and February 2011.

- **Waterbird richness**. The number of species present on the Warden wetlands in spring or summer has been stable over the last few years, averaging about 43 species per survey. Forty seven species were recorded in November 2010 and 42 in February 2011, combining to 54 species over the two surveys. Richness on the Gore-Quallilup wetlands is more variable, with between 19 and 26 recorded during aerial surveys and 29 to 35 when both aerial and ground surveys have been completed, but without any trend over time. Thirty one species were recorded on the Gore-Quallilup wetlands in November 2010 and 35 in February 2011, with 40 species across the two surveys and 28 occurring in both surveys.

- **Notable records from the November 2010 and February 2011 surveys*:***

  - An Australasian grebe was present on one of the North Wheatfield wetlands in February 2011, although it was probably just in transit or scouting.
  - Two bar-tailed godwits were present at Mullet Lake in February 2011. Three individuals of this species were also seen at Ewans Lake in February 2010 and 7 were seen on Mullet in 2003 by Clarke and Lane (2003). Counts during the 1980s recorded this species infrequently but in about the same numbers.
  - In November 2010, four great knots were counted in the northern backwater area connected to Lake Wheatfield. These are the first records for the current monitoring program but Jaensch *et al.* (1988) recorded great knots on four occasions in 1985 (Station Lake, Ewans Lake and Lake Warden).
  - A fairy tern was observed flying over Windabout in February 2011. Fairy terns have recently been listed as threatened (vulnerable) under the EPBC Act (Department of Sustainability 2011). Jaensch *et al.* (1988) recorded fairy terns on numerous occasions during the 1980s (Station Lake, Wheatfield Lake, Windabout Lake and Lake Warden) but our record in February 2011 is the first for the recent (2006+) surveys.
  - The count of 350 pink-eared ducks on Lake Gore exceeds the previous recent maximum count of 10 at this lake in October 2006 and exceeds counts on this lake by Jaensch *et al.* (1988) which were all <60.
  - Counts of 34 and 25 great crested grebes on Gore-Quallilup wetlands in November 2010 and February 2011 are the highest recorded in recent years. Halse *et al.* (2007) recorded 3 on Lake Gore in 2006 but none were recorded on Gore by Jaensch *et al.* (1988).
  - The eight curlew sandpipers seen at Gidong Lake are the first recorded for the Gore-Quallilup wetlands during the current monitoring program. In the 1980s they were regularly seen around Lake Gore, usually in low numbers but 209 were seen in May 1983 and 600 were seen in October of the same year. There has been a well documented decline of this species over several decades in Australia (Rogers & Gosbell 2006).
  - Sixty four hooded plovers were seen at Kubitch Lake in February 2011. The only other record from Gore-Quallilup wetlands during the current monitoring program is the 213 seen on Carbul Lake in November 2009. Forty were seen by another observer on one of the wetlands that fringe the eastern side of Lake Gore (Ken Read, Esperance Bird Group, pers. comm., quoting Bruce Buchanan, West Australian Bird Notes 134). Tens to hundreds of hooded plovers were regularly seen on Lake Gore and associated wetlands in the early 1980s (maximum 393).

- **Waterbirds on Warden wetlands**. About 10100 and 7300 waterbirds were present on Warden wetlands in November 2010 and February 2011 respectively. The November 2010 count was about the same as the count for November 2009, higher than for October 2006 and November 2008, but 20% lower than for October 2007. The February 2011 total count was about the same as for February 2010 but only half that present in February 2008.

The number of ducks present in November 2010 (7333) is the highest recorded during recent spring surveys but was about the same as in February 2008 (7095). Shelducks were more numerous (3324) than during other recent surveys (normally <2500), as were grey teals (2693 versus normally < 1500), while little black cormorants were not as common as usual (33 versus usually >150). The 871 shorebirds (excluding banded stilts) was higher than average (525) for recent spring surveys, with higher than average numbers of several species. The number of banded stilts (21) was low compared to some previous surveys (up to 2290 in recent springs and 3520 in February 2008). Banded stilt is a wide ranging species whose numbers in the Warden-Gore systems are strongly dependant on habitat available elsewhere in southern and inland Australia.

The total of about 3800 ducks on the Warden wetlands in February 2011 is between counts from the previous two summer surveys: 7100 in February 2008 and 2600 in February 2010. They were primarily shelducks (1113), Pacific black ducks (683), grey teals (774) and chestnut teals (468). The number of shelducks was much higher than for the past two February surveys, perhaps due to low rainfall in the south-west leading to fewer flooded wetlands for moulted birds to disperse to. There were fewer black swans (351) than in February 2008 and 2010 (1522 and 924). There were also substantially fewer coots and hoary-headed grebes than for the previous two February counts, but the 752 little black cormorants counted on Warden wetlands in February 2011 is the highest count in Warden wetlands since the current monitoring began in 2006. These appeared to be migrating from the west in the morning (possibly from the Gore-Quallilup wetlands) and occurred on Lake Warden and Woody Lake at different times during the week. The number of hooded plovers was higher (31) than has been counted in recent years. Numbers of other shorebirds were similar to counts from the last two February surveys, though there were more sharp-tailed sandpipers (33 versus 6 and 15 previously).

- **Waterbirds on Gore-Quallilup wetlands**. In November 2010 and February 2011 numbers of most waterbirds in the Gore-Quallilup system were within ranges documented in surveys since 2006. The February count of musk duck (592) is the highest for recent surveys but the number of hoary-headed grebes (41) was low compared to previous recent surveys and had declined since the previous spring. Depth had declined from 1.5 metres to 1.0 metres over summer, but a similar depth change over the 2009/10 summer was associated with an increase in grebe numbers. Eurasian coots were seen on Lake Gore for most of the 2006 to 2008 surveys but have not been seen during any of the last four surveys. As in the Warden system, there were more sharp-tailed sandpipers (85 and 62) in November 2010 and February 2011 compared to the previous two surveys (10 and 27 in November 2009 and February 2010). Hooded plovers were not seen in November 2010 but 64 were counted on Kubitch Lake in February.

- **Seasonal differences**. Multivariate analyses showed that spring and summer communities in the Warden wetlands have different composition. Numbers of shelducks, swans, banded stilts, grey teals, Pacific black ducks, red-necked stints, hardheads and musk ducks contributed most to discriminating spring and summer communities. There is no evidence of a trend in the overall composition of the waterbird fauna using Warden system wetlands over the period 2006 to 2011.

- **Lake Warden**. At Lake Warden, there have been some changes in waterbird community composition over the 2006 to 2011 monitoring period. In particular, there has been a substantial increase in the richness and abundance of shorebirds for the last three surveys, probably associated with increased shallows and exposed beach around the lake. There also appears to have been an increase in the abundance of shelducks and grey teals in recent surveys, perhaps also associated with altered lake edge habitats.

  There appears to have been dramatic change in waterbird community composition between the 1980s (as documented in Jaensch *et al.* 1988) and the 2000s. Communities at Lake Warden are now, on average, more diverse (both in terms of total species richness and number of waterbird groups represented) and have different composition than recorded during the 1980s. In the 1980s, when depths were normally < 1m, shorebirds tended to contribute most to richness, with only one or two duck species normally present and rarely any herons, cormorants, pelicans and grebes. In the 2000s, depth has mostly been above 2 metres (though it has declined recently), there are many more duck species present and herons, cormorants, grebes and pelicans are usually or always present. In recent surveys, as depth has declined again, there has been a return to higher shorebird richness without a decline in

richness of other groups. Abundance was highly variable on Lake Warden during the 1980s, but with regular counts greater than 2000. Abundance is now normally below 2000 birds.

- **Central suite wetlands**. In wetlands of the central Warden suite (Lake Wheatfield, Woody Lake and Windabout Lake) there have been few major changes in waterbird composition since 2006, other than an increase in the richness and abundance of shorebirds for the last three surveys (February 2010 to February 2011). Ducks are normally the most abundant waterbirds in these wetlands, but composition is variable. In February 2008 the number of ducks present (mainly grey teals, Pacific black ducks and musk ducks) was higher than in the previous spring (despite shelducks declining in abundance), whereas the 2009/10 and 2010/11 seasons have shown the opposite trend, with duck numbers declining over summer. The large increase in duck numbers over the 2007/8 summer may reflect movement onto these permanent wetlands from less reliable wetlands elsewhere, although 2009/10 was almost as dry in the south-west (and drier in summer). Between October 2006 and November 2009 counts of shorebirds were 6 to 58 individuals of up to 4 species, but counts for the last three surveys have been 90 to 210 individuals of 8 to 11 species. This increase in diversity and abundance of shorebirds is presumably associated with greater shallow water and beach habitat resulting from operation of the gravity pipeline. Increased abundance is particularly notable for sharp-tailed sandpipers, black-fronted dotterels and masked lapwings.

  There have been considerable changes in waterbird abundance and composition in the central suite wetlands between the 1980s and the 2000s. These changes have been different (and, for some species, converse) in each of the three main central suite wetlands but, in general, abundance has increased across the suite and richness has more than doubled. Richness of shorebirds during the last three surveys has been greater than during equivalent surveys of the 1980s, although differences in survey methods may partly account for some patterns. Another significant difference between these two periods is the loss of clamorous reed warblers (with loss of reeds).

- **Concluding remarks**. The overall picture in the Warden and Gore wetlands is of relatively stable richness and species composition. Abundance is more variable, most likely reflecting climate patterns and associated population dynamics and migration across the south-west and beyond. There is little evidence of strong temporal trends over the last few years, other than those associated with changing water depth in Lake Warden and the central suite wetlands. The surveys planned for November 2011 and February 2012 will be the 9th and 10th such surveys since monitoring commenced in 2006. These will have been sufficient to characterise current waterbird usage patterns of these two wetland systems. There will have been five surveys prior to the management intervention to reduce depth in the central suite wetlands and five surveys immediately after this intervention. These surveys will allow an assessment of the short-term effects of this intervention on waterbird communities.

  There is scope for further detailed suite and wetland specific analyses and species by species analyses of this data to determine the relative importance of wetlands and habitats within the Warden and Gore systems. Extension of waterbird monitoring to other major wetland systems along the south-coast or even the broader south-west should be considered. This would provide a broader regional picture of waterbird populations and wetland usage and place data from the Warden and Gore systems (and data from other south-west waterbird surveys) in a regional context. At the very least, it would be advisable to ensure coordination of the various wetland survey and monitoring programs that are being undertaken in the south-west. A more regional survey could be done less frequently than is currently undertaken for the Warden/Gore wetlands, or be undertaken as a once off but multi-year program such as that undertaken by RAOU/Birds Australia in the 1980s and published by Jaensch *et al.* (1988).

INTRODUCTION

This report presents results of the 2010/11 waterbird monitoring of the Warden and Gore-Quallilup wetland systems near Esperance. This program is designed to provide information about waterbird diversity and abundance in relation to environmental conditions to assist with management of the wetlands and to provide data to address the need to regularly assess ecological character of the Warden and Gore Ramsar sites. A particular focus is the response of waterbird communities to reduced water levels in the Lake Wheatfield to Windabout Lake wetlands (the central suite of the Warden system) following installation of a gravity pipeline in March 2009 to drain excess water from these wetlands. The Warden and Gore-Quallilup wetlands were monitored for three consecutive years (October 2006 to November 2008) by Stuart Halse (either through DEC or Bennelongia Pty Ltd), who recommended that the program be repeated for three years after any significant management intervention (such as the gravity pipeline). The last four surveys (November 2009 to February 2011) have been carried out by DEC. Previous reports are Halse (2007), Bennelongia (2008a, b, 2009) and Pinder *et al*. (2010).

This report is largely restricted to presenting results of the most recent two surveys (November 2010 and February 2011) but some analyses of longer term data are presented.

2010/11 Climate

Figure 1 and Figure 2 show rainfall (as deciles) for the southern 2010 wet-season (April to November) and the northern 2010/11 wet season (October to February) respectively (note that there is a time overlap). There was above average to very much above average rains across large areas of northern, inland and eastern Australia during the 2010/11 northern wet season. This rain flooded major inland and northern Australian wetlands and waterways, including many known to attract very large numbers of waterbirds, such as Lake Eyre and Fortescue Marsh. South-western Australia stands in stark contrast, with average to below average summer rains. Low summer rainfall is normal in south-western Australia, but the particularly dry summer follows an extremely dry southern wet season in the south-west, coincident with above average winter rainfall throughout much of northern and inland Australia (Figure 1).

Rainfall in the Esperance area (Table 1) was not far below average for the winter 2010 and summer 2010/11 periods (399.6 mm in 2010/11 versus an average of 470.7 mm).

Table 1. Rainfall (mm) for the period June 2010 to February 2011 for Esperance (Bureau of Meteorology station number 9789). Source www.bom.gov.au 07-04-2011.

	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Total
2010/11	69.0	94.0	83.2	26.0	24.0	24.0	18.2	35.0	26.2	399.6
Average	81.3	96.7	81.7	61.2	46.7	33.3	17.9	27.7	24.2	470.7

Since 2006, winter/spring rainfall in south-western Australia has generally been average to below average (well below average in 2006), while rainfall in inland and northern Australia has been much more variable (ranging from an average to below average 2007 to an average to well above average 2010). Summer rainfall has mostly been average (i.e. low) to below average across the south-west, except that the eastern south coast (but not necessarily Esperance) had a couple of well above average years (2006/7 and 2008/9). In the inland and north, there has generally been some areas with above average to well above average rainfall each summer but this has varied from the Pilbara and inland (2006/7 and 2008/9) to the Mid-west (2007/8), to across all of the north and inland (2010/11). In the summer of 2009/10 most of the north and inland had average to below average rainfall. These rainfall patterns have undoubtedly influenced the type and number of waterbirds using Esperance wetlands during the last eight surveys, though such influences are not always obvious and consistent, especially because they act simultaneously across a range of spatial scales and there is usually little corroborating waterbird data from elsewhere.

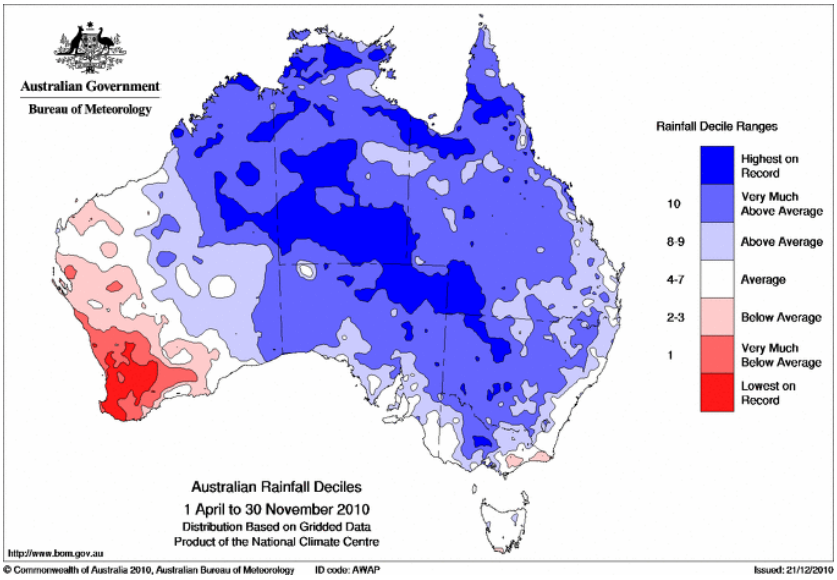

Figure 1. Rainfall deciles for Australia during the 2010 southern wet season. Sourced from the Australian Bureau of Meteorology 31 March 2011. (http://www.bom.gov.au/jsp/awap/rain/index.jsp?colour=colour&time=latest&step=0&map=decile&period=cnws&area).

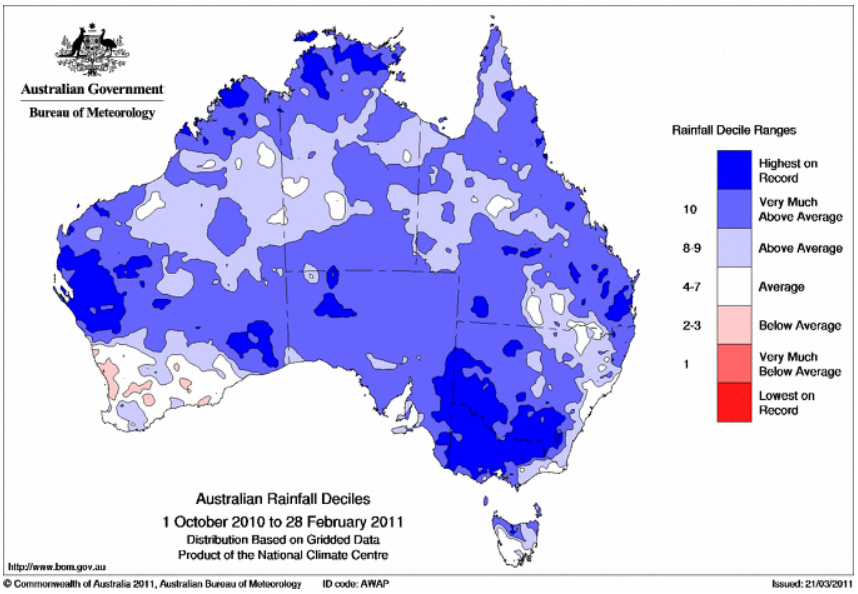

Figure 2. Rainfall deciles for Australia during the 2010/11 northern wet season. Sourced from the Australian Bureau of Meteorology 31 March 2011 (http://www.bom.gov.au/jsp/awap/rain/index.jsp?colour=colour&time=latest&step=0&map=decile&period=cnws&area).

Lake Depths

Depth, salinity, pH and nutrients have been measured in most of the larger Warden system wetlands in recent years by DEC Esperance staff (start date depends on measurement and wetland). Figure 3 shows depths in the eastern Warden suite (Mullet to Station), the central Warden suite (Wheatfield to Windabout) and in Lake Warden from 2002 or 2003. There has been no trend in depths in the eastern suite of wetlands (bottom graph of Figure 3), with winter/spring maxima and autumn minima not changing over the time shown. In the central suite depths have also been relatively constant (other than seasonal variation and a summer spike in depth in early

2007). Depth of Lake Wheatfield was lower in 2002/3 than in the next six years and minimum and maximum depths have declined at all three central suite wetlands since the gravity pipeline began operating in autumn 2009. Depth at Lake Warden was also lower in autumn 2003 than in subsequent years and the lake is now at its shallowest in the last 10 years.

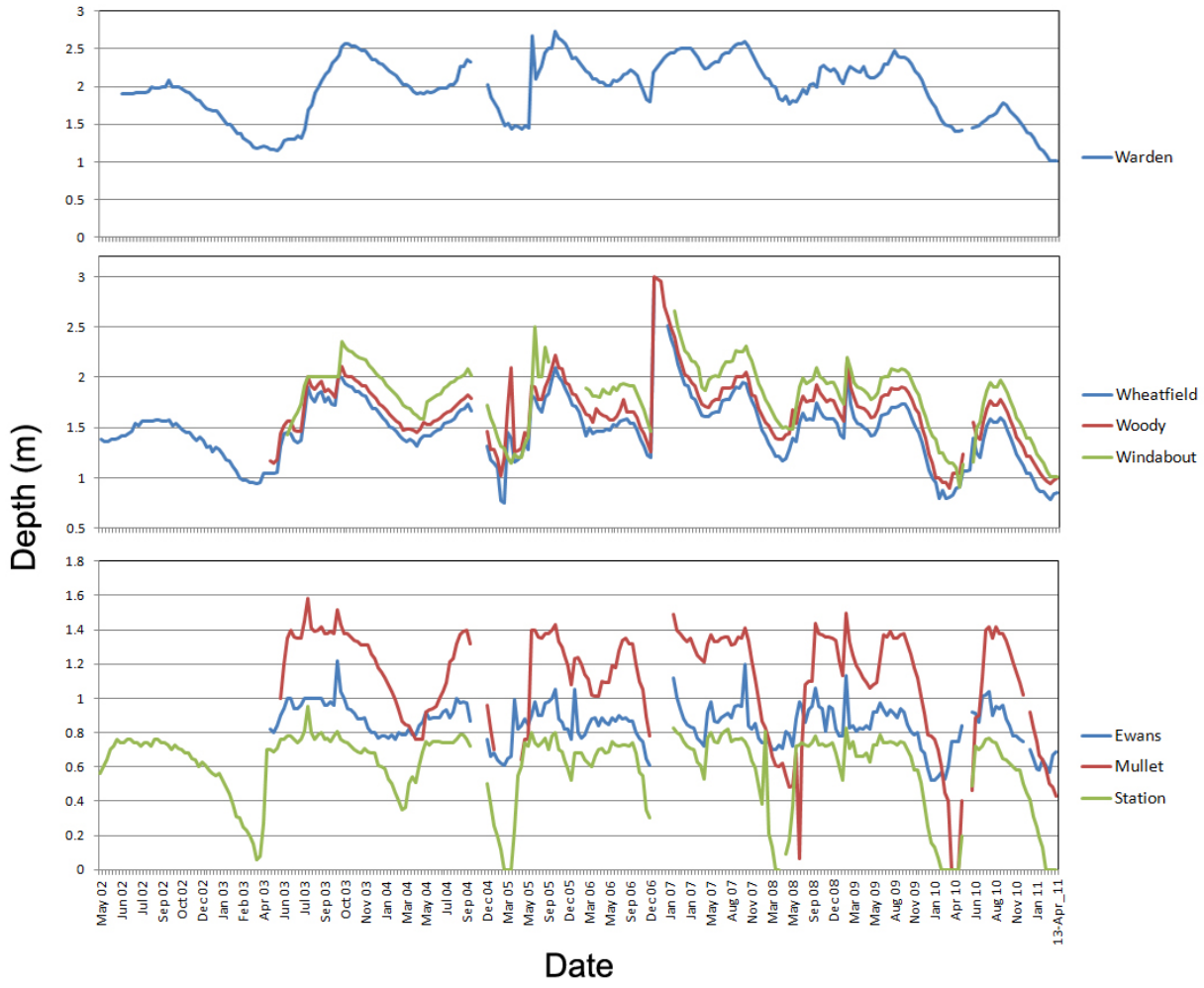

Figure 3. Depths in Warden Recovery catchment wetlands 2002 to 2011.

To better put the depth of Lake Warden into the context of a longer time series, Figure 4 shows the depth of this lake over the period November 1979 to November 2010 (data from Lane *et al.* 2011). This graph shows that prior to 1999 the depth of Lake Warden rarely exceeded 1.5 metres, frequently dropped to below 1 metre, and was below 1 metre for much of the early 1980s. Between 1999 and 2009, depth of Lake Warden was always above 1.5 metres and usually above 2 metres. In late 2009 depth fell below 2 metres for the first time since 2003 and had declined to 1 metre by April 2011.

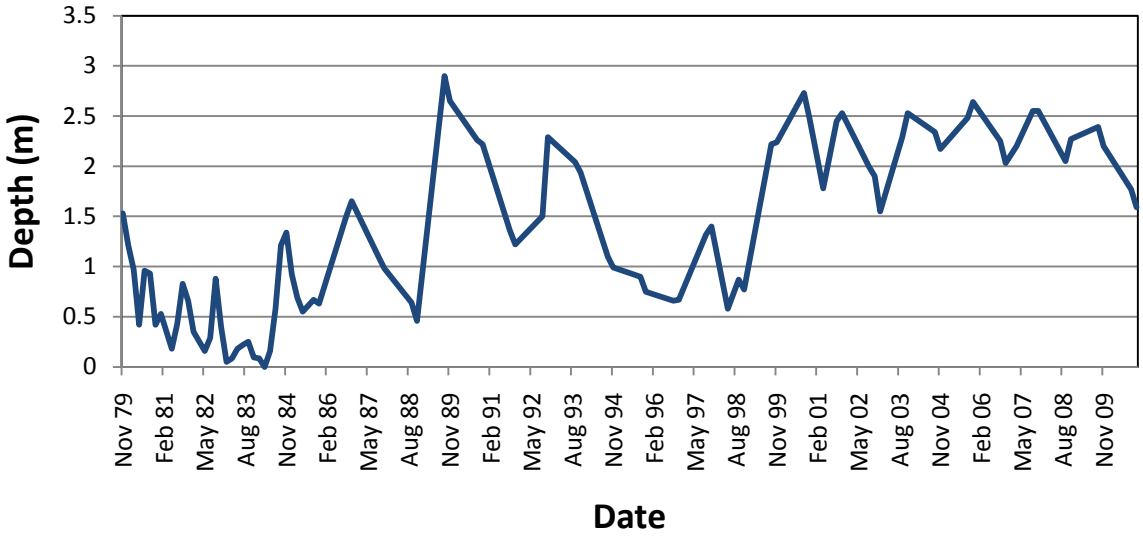

Figure 4. Depth of Lake Warden November 1979 to November 2010. Data from DEC's SWWMP project (Lane *et al.* 2011).

METHODS

Count methods

Ground counts (on foot or by boat) were made at 55 and 56 separate wetland areas in November 2010 and February 2011 respectively, within 19 wetland suites. Aerial counts were made at the same wetlands during the same week in both seasons. In February, 24 wetlands were dry but all were visited to check for shorebirds. Most of the satellite wetlands around Lake Gore (and included in the count for Lake Gore in November) were dry in February.

All counts were undertaken by David Cale (DC), Anna Leung (AL) and Adrian Pinder (AP), assisted by John Lizamore (JL) and George Sutter (GS). Where there were multiple observers they contributed to single counts unless otherwise stated.

November 2010 ground counts

Ground counts were undertaken as per Table 2.

Table 2. Details of ground counts undertaken in November 2010.

Wetland or Suite	Date	Observers	Notes
Neridup and Bandy Creek Suites and Station Lake	15 November 2010	AP, DC, AL	
Ewans Lake	15 November 2010	DC	
Mullet Lake 9including Merivale wetlands)	15 November 2010	AP, AL	
Gun Club and North Wheatfield Suites	16 November 2010	AP, DC, AL	
Six Mile Hill Suite	16 November 2010	AL	
Wheatfield to Windabout Suites	17 November 2010	AP, JL, AL	Main lakes by boat. AL surveying some satellite wetlands not accessible from main lakes, AP and JL from boat
Lake Warden and Burkenup Suites	18 November 2010	AP, AL, JL	Main lake by boat
Pink Lake	18 November 2010	AP, AL	

Lake Gore, Dalyup and Carbul Suites	19 November 2010	AP, GS	No ground count of Gidong, as per previous surveys. Gore surveyed by boat.
Quallilup Lake	19 November 2010	DC	Main lake by boat
Quallilup to Kubitch flow-through	19 November 2010	DC	By boat

November 2010 aerial counts

An aerial survey of all Warden and Gore system wetlands was undertaken on 16 November. This involved two observers, one in the rear of the plane (DC) looking to the left and one in the front (AP) looking to the right.

The Dalyup wetlands were surveyed during three north-south transects and the swale wetlands along the eastern shore of Lake Gore were surveyed by two north-south transects. Lake Gore was surveyed by flying a counter clockwise circuit and a clockwise circuit near the shore, followed by another circuit further away from the shore, then five north-south transects. Lakes Carbul, Kubitch and Gidong were counted by two flights over the suite. The flow-through was counted by flying four transects in a generally north-west/south-east orientation. Lake Quallilup was surveyed from two anti-clockwise circuits.

Pink Lake was surveyed during two circuits of the lake – one counter clockwise and one clockwise. Lake Warden was surveyed from two counter clockwise circuits, one clockwise circuit and two transects across the lake, followed by two flights over the Burkenup wetland. Remaining wetlands were surveyed by between 1 and seven transects, with the minimum of one being a flight over the Gun Club wetlands and the maximum being seven transects over Mullet Lake.

February 2011 ground counts

Ground counts were undertaken as per Table 3.

Table 3. Details of ground counts undertaken in February 2011.

Wetland or Suite	Date	Observers	Notes
Neridup, Bandy Creek Suites	14 February 2011	AL	
Ewans Lake	14 February 2011	DC	
Mullet Lake (including Merivale wetlands)	14 February 2011	AP, AL	Separate counts from east and west shores
Station Lake, Gun Club and North Wheatfield Suites	14 February 2011	AP, DC, AL	
Six Mile Hill and North Windabout Suites	15 February 2011	AL	
Wheatfield to Woody Suites	16 February 2011	AP, DC	Main lake by boat. AP later surveying some satellite wetlands on foot not accessible from main lake
Windabout Suite	16 February 2011	AL, DC	Main lake by boat
Warden Suite, Pink Lake and the Carbul Suite, including Gidong	17 February 2011	AP, DC, AL	Lake Warden by boat
Lake Gore and Dalyup Suites and partial recount at Kubitch	18 February 2011	AP, GS	Lake Gore surveyed on foot, too shallow to use boat. Walked most of eastern and south-eastern shore, then spotted from western and northern shore.
Quallilup Lake	18 February 2011	AL, DC	Main lake by boat
Quallilup to Kubitch flow-through	18 February 2011	AL, DC	By boat

February 2011 aerial counts

An aerial survey of all Warden and Gore system wetlands was undertaken on 14 February. This involved two observers, one in the rear of the plane looking to the left (DC) and one in the front (AP) looking to the right. Figure 5 show the GPS track recorded during the aerial survey of the Warden wetlands, but reception was lost occasionally and point recording rate was low, so some sections are incomplete or approximate.

The shore and near-shore areas of Lake Gore were surveyed by two anti-clockwise circuits and one clockwise circuit about 50 metres in from the edge, followed by a flight over the peripheral wetlands along the eastern shore of Gore and nine transects across the middle of the lake. The transects allowed complete coverage of the middle of the lake with each observer surveying about 150 metres either side of the plane (i.e. 300 metre transects). The data suggests we were not recounting birds on consecutive transects. Birds near the edges of the lake were ignored during the transects. The Dalyup channel near Lake Gore and the wetland to its south were surveyed by two transects. The Carbul lakes were also surveyed by two transects except that extra flights were made to count the banded stilts on Karbul Lake. Quallilup Lake was surveyed by a single anti-clockwise circuit and a single transect down the middle. The Quallilup-Kubitch flow-through was surveyed by six transects, with the last being a flight up the channel.

Pink Lake was surveyed by a single anti-clockwise circuit near the shore. Lake Warden was surveyed by two near shore anti-clockwise circuits and six transects across the lake. The Windabout, Woody and Wheatfield Suites were each counted by several transects, followed by single transects over the dry Six Mile Hill Suite and the largely dry North Windabout Suite. Station, Mullet and Ewans lakes were surveyed separately with 3 to 4 transects per lake, followed by a single transect over the mostly dry Neridup and Bandy Creek wetlands.

Total flight time was about 3 hours, with about 2.5 hours of counting.

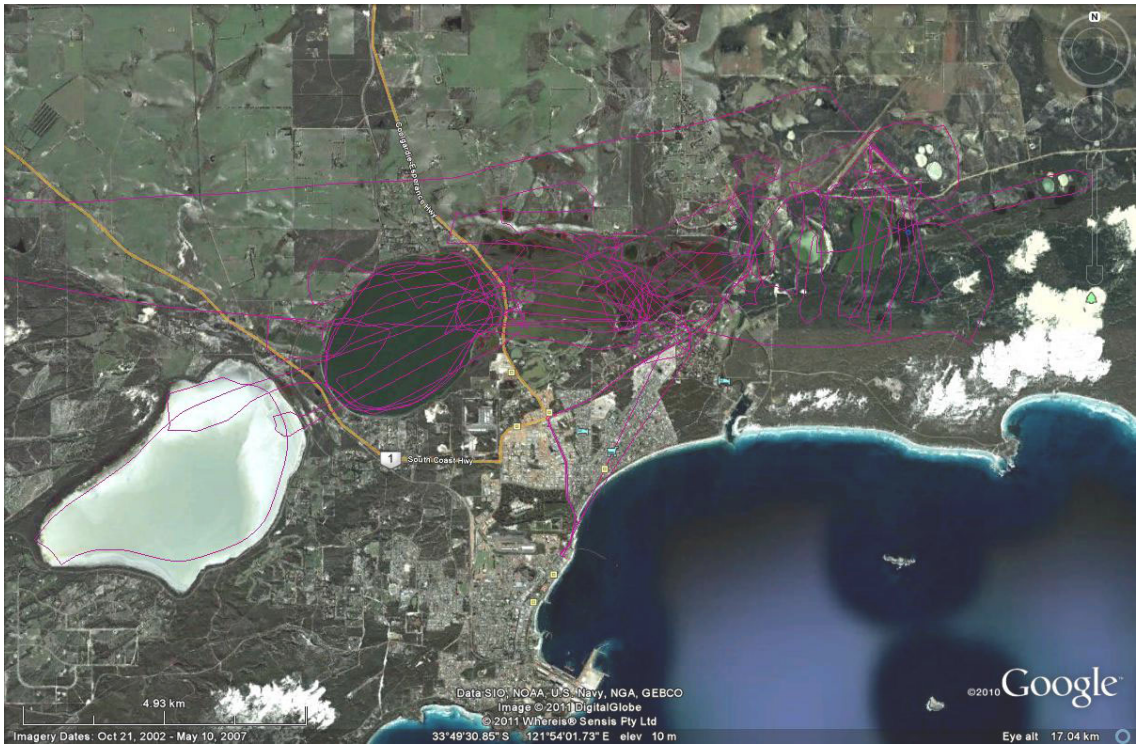

Figure 5. GPS track (purple lines) recorded during the aerial survey of the Warden system wetlands in February 2011.

Data analysis

Consensus abundance estimates

Neither aerial surveys nor ground counts provide complete and accurate waterbird abundance data, especially where multiple wetlands are being surveyed. Aerial counts of many wetlands can be undertaken within a few hours, largely eliminating problems of waterbird movement between wetlands. However, aerial surveys can miss some species and/or provide only rough counts of others. More accurate counts can be made at a single

wetland on the ground, but counts of multiple wetlands over a period of days can result in inaccuracies due to bird movements between wetlands.

In an attempt to reconcile aerial and ground counts to give a single best estimate of abundance, a 'consensus' estimate of the numbers of each species present across the Warden and Gore suites was calculated for each species on each survey using the following guidelines:

The default rule was that aerial counts were considered to be the most accurate unless there was a reason to believe otherwise (see below). For the Warden wetlands, aerial totals were used for the consensus estimate for 79% of species records. In the Gore system only 12% of aerial counts were used in preference to ground counts due to the predominance of shorebirds, diving species, moulting shelducks, cormorants not taking flight from trees in the flow-through system and the number of species not seen or properly counted from the air. In the Gore system all ground counts are done on the same day, with the Quallilup and flow-through counts done at the same time as separate observers count at Lake Gore and the Carbul-Kubitch wetlands. That means that double counting from the ground is much less likely in the Gore-Quallilup wetlands than in the Warden wetlands, which are surveyed over several days.

Reasons to prefer a ground count are as follows:

- A species was only observed during the ground survey.
- For species that are low in abundance and/or not easily seen or identified from the air, a higher ground count may represent better detection rather than double counting, especially where most of the individuals are seen together. This was particularly the case for small shorebirds. A non-shorebird example is the 18 blue-billed ducks seen from the ground in the Warden system in October 2007 (17 from one wetland) versus 5 seen from the air. Similarly, 13 darters were seen from the ground in the Warden system in February 2011 (12 in one wetland) versus only 5 seen from the air.
- For diving species like grebes and musk ducks ground counts were generally used as these species tend not to be so mobile and they are more easily counted from the ground. Exceptions were where aerial counts suggested significantly higher numbers or ground counts were known to be incomplete. As an example, 173 musk duck were seen on Warden wetlands from the air in November 2008 (including 129 from one wetland) whereas only 86 in total were seen from the ground. Ground counts of such species on large wetlands can be difficult where they are highly dispersed and constantly diving and reappearing, especially where there are waves. On Lake Gore in spring, aerial counts sometimes underestimate abundance of moulting shelducks when they are highly scattered, because they tend to dive as the plane approaches. For November 2010, the ground count of shelducks on Lake Gore was used.
- Where a ground count at an individual wetland (or a number of adjacent wetlands surveyed one after the other without evidence of waterbird movement) was higher than the total aerial count then it is likely that the aerial count is an underestimate. As an example, from the ground 630 straw-necked ibis were estimated to have been on Lake Wheatfield in October 2007, whereas the estimate from the air was just 350. In this case the total Warden ground count of 655 (including the Wheatfield count) is deemed to have been more accurate. Another example is the 393 Eurasian coots counted from the air in Warden wetlands in February 2008 versus the 885 counted from the ground, including 779 from the Wheatfield to Windabout wetlands (600 on Windabout alone). In such circumstances the ground count was used.
- For aerial counts of unidentified shorebirds, only that portion of the count that was greater than counts of small shorebirds from the ground (including unidentified shorebirds) was used. Generally, larger congregations of shorebirds were seen on the same wetlands from the air and ground so reconciliation was simple. It was assumed that all of the unidentified shorebirds counted from the air were smaller species not easily identified from the air (i.e. they were not greenshanks or avocets).
- Wetlands were not reliably surveyed from the air in November 2009, so only ground counts were used.
- Other than the aerially counted unidentified shorebirds (see above) either the entire ground count or the entire aerial count were used, with few exceptions. An exception was made for two counts of ducks from February 2011 in the Warden system. Firstly, chestnut teals were grossly underestimated from the air (only 14 individuals counted) whereas 1114 were counted from the ground 3 days later (557 males and an equivalent number of females subtracted from the grey teals ground count). Some of these would have been scored as unidentified ducks during the aerial survey: e.g. 262 grey teals and 100 chestnut teals on Ewans Lake from the ground versus 114 grey teals and 300 unidentified ducks from the air. However, there were other large flocks of chestnut teals (e.g. 468 on Lake Warden on 17

February and 375 on Windabout Lake on the previous day) which were not seen from the air. We are fairly confident that these were not present during the aerial survey so they presumably migrated into the system between the aerial and ground counts. As a conservative measure we have included just the 468 chestnut teals counted during a single ground count at Lake Warden, though this is likely to be an underestimate (partly offset by the unidentified ducks from the aerial survey).

The second example of using partial counts was for Pacific black ducks on the Warden wetlands in February 2011. Many more were counted from the ground (1158) than were counted from the air (422). This may have been due to bird movements during the three days of ground counts, but an intermediate number (683) were counted from Bandy Creek, Ewans Lake, Mullet Lake and the North Wheatfield wetlands in one afternoon without signs of movement between them. This number was used as a conservative estimate.

Multivariate analyses

Ordinations are a way of graphically showing how similar the overall composition of waterbird communities was between surveys (across or within wetlands). These analyses reduce presence/absence or abundance data of multiple species down to a single value that represents the overall similarity between two surveys. An ordination graph attempts shows each survey as a symbol and attempts to place them so that the distance between two surveys on the graph is proportional to their similarity. The extent to which an ordination achieves this is indicated by the stress value (more stress = less success, with stress values under 0.2 desirable). Two and three dimensional non-hybrid multidimensional scaling (nMDS) ordinations were performed using Primer v6 (Primer-E Ltd 2008) on either presence/absence data or abundance data (the latter either raw or square root transformed). These ordinations used similarity matrices calculated using Sorenson (for presence/absence) or Bray-Curtis (for abundance) dissimilarity indices. Square root transformation of counts reduces the influence of high abundance species on the similarity between surveys. Permanova+ (an add-on to Primer) was used to examine whether groups of surveys were statistically dissimilar to one another (e.g. spring versus summer surveys). SIMPER analyses (in Primer) were used to identify which species best discriminate two groups of surveys. BVSTEP analyses (also in Primer) are used to identify which species are most highly correlated with similarities in overall waterbird community composition between surveys.

Comparisons between surveys undertaken in the 1980s with the current survey program

A number of comparisons between surveys in the 2000s and surveys undertaken in the 1980s by Birds Australia/DEC (then RAOU/CALM), reported in Jaensch *et al.* (1988) have been made in this report. It should be kept in mind that the 1980s surveys may not have been as thorough as those undertaken in recent years. For most wetlands, the 1980s surveys were done from multiple vantage points on the edge of the wetlands, rather than by traversing the whole wetland on foot or by using a boat (although Windabout Lake was often surveyed by boat). Subtle differences between these two periods should probably therefore be viewed with caution, but some analyses revealed major differences in composition and abundance that are very unlikely to be due to differences in survey methods. Small differences in diversity and numbers of shorebirds, in particular, should be viewed with caution.

RESULTS AND DISCUSSION

In this report, aerial counts are often demoted by an 'A' and ground counts by a 'G', e.g. A109/G110 for chestnut teals at Lake Warden in November 2010.

Warden wetlands

Richness and composition

Fifty four species of waterbird were recorded using wetlands in the Warden system over spring/summer 2010/11. Forty seven were recorded in November 2010 and 42 in February 2011, with 39 present in both seasons. While richness in November 2010 was the highest thus far recorded, the combined spring/summer richness was about the same as for previous occasions when waterbirds have been surveyed in both seasons since 2006: 56 species in 2009/10 (35 in both seasons) and 54 species in 2007/8 (35 in both seasons).

Figure 6 shows the number of species within each major group of waterbirds recorded in Warden wetlands since October 2006. Species richness has been remarkably stable in recent years, varying between 42 and 47, with the exception of October 2006 when only 35 species were recorded. The number of species within each major group of waterbirds has also remained fairly stable. The number of shorebirds present in November 2010 (15 species) was the second highest recorded since 2006, the highest being February 2010 (17 species). Shorebird richness was slightly lower in February 2011 (14 species).

Significant records for the November 2010 and February 2011 surveys are as follows:

1) An Australasian grebe was seen in one of the North Wheatfield wetlands in February 2011. This species tends to prefer low salinity wetlands and the individual was probably just in transit or scouting. Australasian grebes have not been recorded in the Warden wetlands in recent years but do occur in the region (e.g. Shark Lake) and Jaensch *et al.* (1988) recorded them at Mullet Lake, Lake Wheatfield and Woody Lake on several occasions during the early 1980s.

2) Two bar-tailed godwits were present at Mullet Lake in February 2011. Three individuals of this species were also seen in February 2010, whereas they have not been seen during other recent surveys. Jaensch *et al.* (1988) recorded this species from Mullet Lake (once) and Lake Warden (twice) between 1982 and 1985. Black-tailed godwit were also seen in the 1980s.

3) In November 2010, four great knots were present in the northern backwater area connected to Wheatfield. Jaensch *et al.* (1988) also recorded great knots on four occasions in 1985 (Station Lake, Ewans Lake and Lake Warden).

4) A fairy tern was observed flying over Windabout in February 2011. Fairy terns have recently been listed as threatened (vulnerable) under the EPBC Act. Jaensch *et al.* (1988) recorded fairy terns on a number of occasions during the 1980s (at Station Lake, Wheatfield Lake, Windabout Lake and Lake Warden) but our record in February 2011 was the first for the recent (>2006) surveys.

The only notable absence for the 2010/11 season was a lack of hardhead ducks in February 2011, though they were also absent in February 2010.

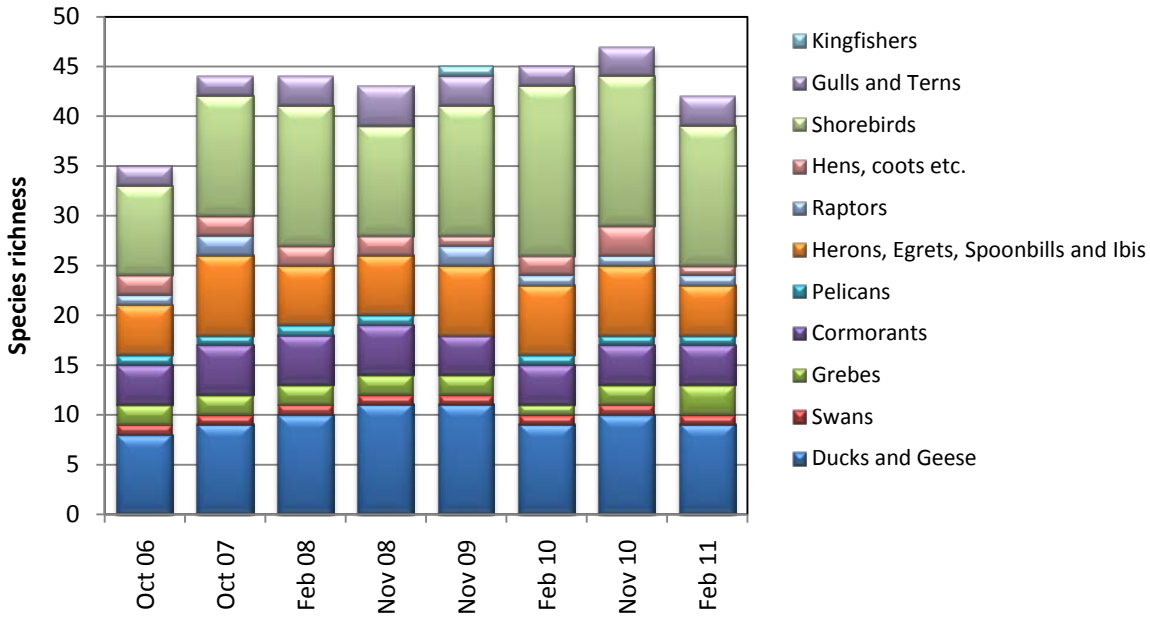

Figure 6. Richness of waterbirds in the Warden system wetlands from October 2006 to February 2011, combined from aerial and ground counts.

Abundance

Waterbird abundances from the aerial and ground counts in November 2010 and February 2011 are presented in Table 4. They are also provided along with all of the other October 2006 to February 2011 ground and aerial counts by wetland suite as a separate electronic appendix. Figure 7 shows waterbird abundance (calculated by

combining aerial and ground counts, as detailed in the Methods section above) by major taxonomic group across the Warden wetlands for the period October 2006 to February 2011.

Table 4. Total abundances of waterbirds across the Warden wetland system from aerial and ground counts in November 2010 and February 2011.

Species	November 2010 aerial counts	November 2010 ground counts	February 2011 aerial counts	February 2011 ground counts
blue-billed duck	0	3	0	0
musk duck	57	132	89	48
freckled duck	0	0	0	1
black swans	999	984	351	308
Cape Barren goose	0	2	0	3
Australian shelducks	3324	3222	1113	993
Pacific black duck	161	540	422	1158
Australasian shoveler	20	35	8	155
grey teals	2693	3677	774	929
chestnut teals	225	383	14	1257
pink-eared duck	0	48	0	10
hardhead	30	64	0	0
unidentified duck	503	0	551	0
hoary-headed grebes	41	208	144	101
Australasian grebes	0	0	0	1
great crested grebes	13	8	0	15
darter	5	5	5	13
little pied cormorant	2	11	7	32
little black cormorant	6	33	401	752
great cormorant	5	5	4	15
Australian pelican	34	65	233	47
white-faced heron	26	82	16	49
great egret	36	43	64	11
nankeen night heron	0	1	0	0
little egret	0	2	0	0
Australian white ibis	10	24	9	43
straw-necked ibis	18	61	0	101
yellow-billed spoonbill	4	36	63	63
white-bellied sea-eagle	0	0	0	1
swamp harrier	0	1	0	0
spotless crake	0	1	0	0
Eurasian coot	93	297	10	49
unidentified hens (not crake or coot)	0	1	0	0
bar-tailed godwit	0	0	0	2
common greenshank	30	128	28	120
common sandpiper	0	9	0	4
red-necked stint	0	28	0	512
sharp-tailed sandpiper	0	54	0	33
curlew sandpiper	0	1	0	8
black-winged stilt	49	47	17	84

banded stilt	21	24	120	149
red-necked avocets	145	207	250	231
grey plover	0	2	0	2
great knot	0	4	0	0
red-capped plover	0	58	0	38
black-fronted dotterel	0	16	0	38
hooded plover	0	20	0	31
red-kneed dotterel	0	1	0	0
masked lapwing (southern)	0	24	5	30
unidentified shorebird	295	1	55	0
silver gull	42	107	198	186
fairy tern	0	0	0	1
Caspian tern	0	2	0	2
whiskered tern	3	2	0	0

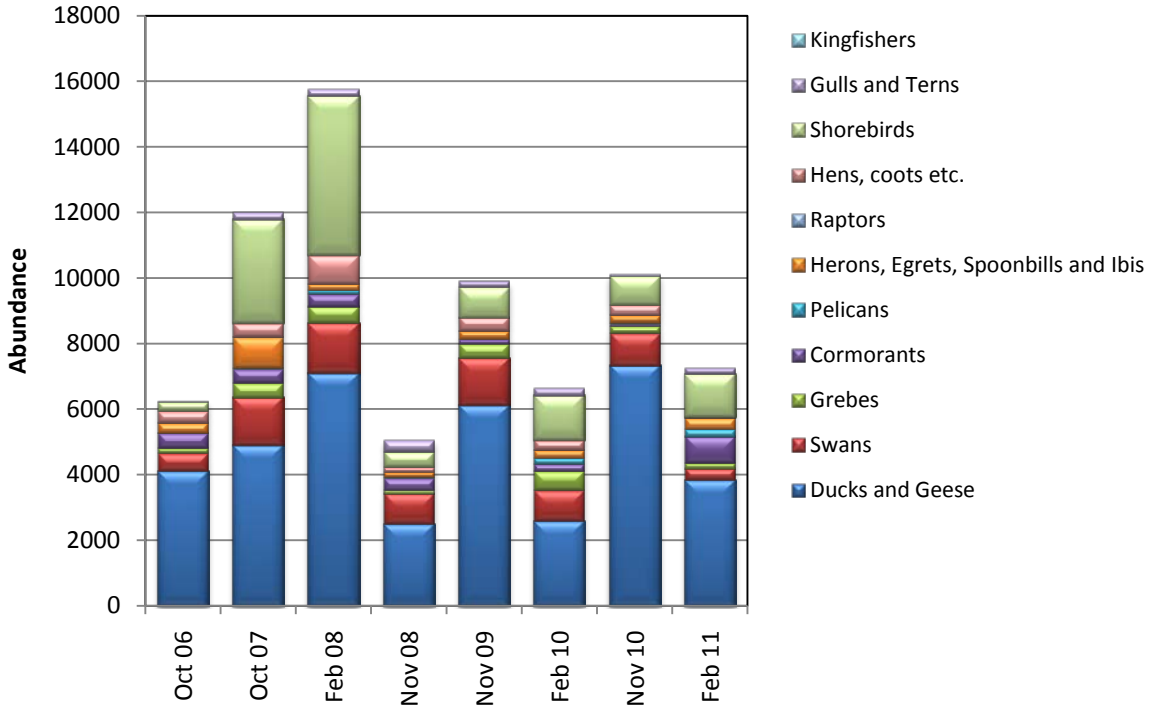

Figure 7. Consensus abundance of waterbirds in Warden system wetlands October 2006 to February 2011.

November 2010

In November 2010, 8890 birds were counted from the air whereas 10709 were counted from the ground. The consensus estimate of total Warden waterbird abundance (see methods) was 10122, including 7333 ducks, 999 swans and 892 shorebirds.

Half of the discrepancy between aerial and ground counts is the greater number of ducks counted from the ground (8106) than from the air (7013). The largest discrepancies were for grey teals (A2693/G3677) and black duck (A161/G540). The lower aerial counts for these ducks are partly offset by the 503 unidentified ducks counted from the air, but it is likely that movement between wetlands resulted in some double counting from the ground. The ground count of musk duck (132) is likely to be more accurate than the number recorded from the air (57) due to their habit of diving as the aircraft approaches. It is difficult to say whether aerial versus ground

counts are more accurate for less abundant ducks since they are more easily missed from the air, but individual wetland counts constitute a minimum. For example, 53 hardhead were counted on Wheatfield Lake on the ground whereas only 30 were counted from the air from all wetlands. The number of pink-eared duck counted from the ground (48 on Windabout, 1 on Ewans Lake) is clearly more accurate, since none were identified from the air.

Wetlands with the largest number of ducks were Ewans (A1501/G1528), Mullet Lake (A1322/G1259) and Windabout (A1544/G1739). Substantial numbers of ducks were also present on North Windabout (A900/G776), the Neridup wetlands (A493/G845) and Lake Wheatfield (A857/G1131). The most abundant ducks were shelducks (A3324/G3222, mostly on Ewans, Mullet and North Windabout) and grey teals (A2693/G3677, mostly on Neridup, Ewans, Wheatfield and Windabout), but there were also numerous chestnut teals (A225/G383, mostly on Windabout and Lake Warden) and Pacific black ducks (A161/G540, primarily on one of the Neridup wetlands and Windabout).

The total number of ducks is about the same as was recorded in February 2008 (7095) but is the highest spring count of ducks since the recent surveys began in 2006. In particular, the number of shelducks was about 600 more than the previous maximum count (in November 2009) and the number of grey teals was about 800 more than the previous maximum (in February 2008). By contrast, Pacific black ducks (A161/G540) were less abundant than has been the case in recent years.

The number of black swans (A999/G994) is within the range of previous recent spring surveys. These were primarily on the larger lakes of the eastern suites (Ewans, Mullet and Station) plus the Windabout and North Windabout Suites.

Ground counts of grebes are likely to be more accurate than aerial counts, except that 13 great crested grebes were seen from the air on Lake Warden, whereas on the ground only 8 were seen scattered over four lakes (with none on Lake Warden). The number of hoary headed grebes was 208 from the ground, with most on Mullet and Ewans (91) and the Wheatfield to Windabout wetlands (100), plus 17 on Lake Warden.

Five great cormorants and five darters were seen from both the air and ground, all in the Wheatfield to Windabout wetlands. Little pied cormorants were not abundant, with 6 on Lake Wheatfield and 11 in total from the ground (only 2 from the air). The count of little back cormorants was higher on the ground (33) than from the air (6), with 21 seen together on Windabout alone. This count is quite low, with the average for recent spring surveys being 273. Little black cormorants often move in flocks, so numbers present on any one day can fluctuate wildly. These are usually in greatest numbers on Lake Warden, Lake Wheatfield and Windabout Lake, but are highly mobile across the Warden and Gore systems (and beyond).

Thirty eight pelicans were seen from the ground at Lake Windabout, with ground counts totalling 65 (34 from the air, indicating movement or immigration after the aerial counts).

Thirty four white-faced herons (23 on one wetland) were seen from the ground on the Six Mile wetlands on 15 November, whereas only 10 were seen on these wetlands from the air on the same day. On the same day, 3 were seen on the Wheatfield to Windabout Suites by air whereas 19 were seen from these wetlands on the ground on the 17th November. The latter may have been some of those seen 2 days earlier on the Six Mile wetlands and the total number of this species present during the survey is likely to be somewhere between the aerial and ground counts (26 to 82).

Counts of great egrets were about the same on the ground (43) as from the air (36), with these mostly on the Wheatfield to Windabout wetlands and Lake Warden. A single nankeen night-heron was seen at Woody Lake and two little egrets were seen (1 at Mullet Lake and 1 at Lake Wheatfield two days later) but these may have been the same bird. Ibis seem to have been undercounted from the air: White ibis (A10/G24) and straw-necked ibis (A18/G61). Sixteen white ibis and 40 straw-necked ibis were roosting in trees along the western shore of Lake Wheatfield when surveyed from the ground on 17th November whereas only 6 white ibis and no straw-necked ibis were seen at the same lake from the air on the previous day.

The ground count of Eurasian coots (297) is likely to be more accurate than the aerial count (93) since these tend to dive as the aircraft approaches. Moreover, 196 were counted at Lake Windabout alone from the ground (in a single count) and another 75 were present on Lake Wheatfield earlier on the same day. A single spotless crake was seen near the golf club at Lake Windabout, as was another unidentified hen on the same wetland.

The number of shorebirds seen from the air was reasonably similar to the ground counts (540 and 624 respectively), though this is misleading since numbers of individual species differed considerably between the aerial and ground counts. The consensus count (892) was higher than these figures due to the large number of unidentified small shorebirds (most likely red-necked stints) counted from the air on Pink Lake. The most abundant shorebirds (other than the putative red-necked stints on Pink Lake) were common greenshanks

(A30/G128) and red-necked avocets (A145/G207). For these species, ground counts are likely to be closer to the actual numbers. Seventy eight greenshanks were seen on the Neridup to Mullet wetlands over a few hours with little evidence of movement. Similarly, 206 avocets were seen on Lake Warden and the Burkenup wetland during a single count (see cover photo), compared to 145 from the air two days earlier. Ground and aerial counts matched for the black-winged stilt (A49/G47) and banded stilt (A21/G24).

Most other small shorebirds were not seen from the air. Notable records are a curlew sandpiper at Ewans Lake, 2 grey plovers and 4 great knots on a backwater area near the northern shore of Lake Wheatfield and 54 sharp-tailed sandpipers (mostly on Warden and Woody). The latter is a high count compared to other recent surveys but there may have been some double counting. Masked lapwings (A0/G24) were present on one of the Gun Club wetlands, Windabout Lake, Lake Warden and the Burkenup wetland.

If banded stilt are excluded, then the total number of shorebirds (871) is about average for contemporary surveys and is about the same as in spring 2007 (891) but a third lower than the 1335 in February 2008. Banded stilt numbers (21) were low in comparison with other recent surveys, probably because of high rainfalls across inland Australia. Abundances of other shorebird species are within ranges observed since 2006.

The number of silver gulls seems to have been underestimated in aerial counts, though that may have been because aerial counts were undertaken first thing in the morning whereas ground counting was done throughout the day. Silver gulls tend to roost along the coast and islands overnight and visit the lakes during the day (see van Tets 1969). Few other seabirds were seen.

February 2011

Total aerial and ground counts for the Warden wetlands in February 2011 were 4896 and 7626 respectively and the consensus estimate was 7256, including 3847 ducks, 351 swans and 1282 shorebirds (Figure 7).

The difference between aerial and ground counts is primarily due to much larger numbers of chestnut teals and black ducks counted on the ground. This suggests either inaccurate counting from the air or significant movement of ducks between wetlands (perhaps for black ducks) or immigration into wetlands (possibly for the chestnut teals) over the 3 days of ground counts. Chestnut teals were hardly counted at all from the air (14 individuals) whereas 1257 were counted from the ground (especially on Warden: 468). The higher ground count of chestnut teal could have been due to immigration between ground and aerial counts, but as a conservative measure, the number counted on Lake Warden (468) is used as a consensus estimate. Similarly, much larger numbers of Pacific black ducks were counted on the ground (1158) than from the air (422). A count of this species in the Bandy Creek pans plus Ewans, Mullet and the North Wheatfield wetlands in a single afternoon was 683 so this was used as a conservative consensus estimate. The aerial count of 430 unidentified ducks across those wetlands only partially makes up for the low aerial count of these two species. The number of shelducks was about the same for both counts (A1113/G993), and counts for grey teals were not too dissimilar (A783/G929).

Wetlands with large numbers of ducks were Ewans and Mullet (about 2200 in total), Lake Warden (877) and Windabout Lake (625). The most abundant ducks were shelducks (A1113/G993, primarily on Mullet and Warden) and chestnut teals (A14/G1257, mostly Windabout and Warden), black duck (A422/G1158, especially Wheatfield and Mullet) and grey teals (A774/G929, most on Ewans, Mullet and Wheatfield). The number of shelducks is two to three times more than has been recorded during the last two February surveys, perhaps because of the very dry conditions in the south-west, causing some shelducks to remain on the Esperance wetlands after moulting rather than dispersing. It might have been expected that shelduck number would be down on previous counts because of the wet conditions in the north and inland but this was clearly not the case. The count of pink-eared ducks (A0/G10) was quite low compared to previous February surveys of Warden wetlands (A55/G130 in 2008 and A0/G264 in 2010).

Ground and aerial counts of swans were similar (A351/G308), with most swans occurring on Ewans and Mullet Lake, but these counts are low compared to February 2008 (A1522/G1165) and February 2010 (A924/G930).

The count of hoary headed grebes (A144/G101), primarily on Warden Lake and Lake Windabout, was lower than for the two previous February counts (A436/G445 in 2008 and A600/G420 in 2010). A single Australasian grebe was seen on the western-most of the North Wheatfield wetlands and 15 great crested grebes were present on Lake Wheatfield.

The count of 752 little black cormorants is the highest on the Warden wetlands since the current surveys began in 2006. Almost all of these (723) were counted on (or flying over) Lake Warden during the ground count. However, they were quite mobile, with 400 counted on Woody Lake from the air a few days earlier. These

seemed to be flying in from the west in the mornings. This may explain the very low counts of this species seen from the air in the Gore/Quallilup wetlands, although later in the week 560 were counted on the Gore/Quallilup wetlands – possibly the same birds. Fewer of the other cormorant species were seen, as is usually the case: 32 little pied cormorants (distributed through the Wheatfield to Windabout wetlands), 15 great cormorants and 13 darters (almost all of the latter two species on Windabout Lake).

A large flock of pelicans (200) were counted from the air on Lake Wheatfield (out of a total of 233 seen from the air) but only 44 were still present on Wheatfield the following day (with a total ground count of 47), so they were evidently moving around during the survey period.

Numbers of herons, egrets etc. were well within ranges observed in recent years, with 49 white-faced herons, 64 great egrets, 101 straw-necked ibis and 63 yellow-billed spoonbills (all ground counts). The number of Australian white ibis (43) was higher than has been recorded in recent years (primarily present on one of the North Wheatfield wetlands), but glossy ibis, little egrets and nankeen night herons were absent (or at least not seen), although these are not usually present in high numbers on Warden wetlands.

Spotless crakes and native hens were not seen at all in February 2011 and the number of coots (A0/G49, mostly Lake Wheatfield) was much lower than has been seen in recent years (normally >300).

The consensus number of shorebirds present in the Warden system in February 2011 is the number counted from the ground (1282). This number was about the same as in February 2010 (1368) but much lower than were present in February 2008 (4855). Excluding banded stilt (because they tend to vary so greatly between surveys), the February 2011 consensus shorebird count (1133) was double the February 2010 count (1168) but slightly lower than the February 2008 count (1335). In February 2011, the most abundant shorebird was the red-necked stint (G512, slightly higher than previous counts since 2006). Other high counts were of red-necked avocets (A250/G231, slightly lower than for the two previous February surveys), banded stilts (149, under the February 2010 count of A200/G204 and much lower than in February 2008 count of A3520/G2805) and common greenshank (A28/G120a, about the same as 2008 and 2010). The number of hooded plover (31) was higher than for other recent surveys, as was the number of masked lapwings. Counts of other birds were within post-2006 ranges.

The count of silver gulls (G198/A186) is as high as has been counted previously (A195/G159 in February 2008). The number of terns seen over these wetlands varies between very few in some years to two or three hundred. In February 2011 only 1 fairy tern and 1 Caspian tern were seen.

Community composition in Warden wetlands 2006 to 2011

Figure 8 is an nMDS ordination based on raw waterbird abundance data for surveys between October 2006 and February 2011. This analysis shows that community composition differs between spring and summer. There is no evidence from this analysis of a trend in waterbird composition over time for the spring surveys. For the February surveys the 2010 and 2011 surveys were quite well separated from the 2008 survey, but with only three February surveys in total this cannot be seen as a temporal trend. Using raw abundance data means that the ordination is driven largely by abundant species. A second ordination was produced using square root transformed abundance data so that the contribution of species to the analysis is not so biased towards abundant taxa (Figure 9), though abundance still influences patterns. The results are very similar to the analysis using untransformed abundances, with spring and summer communities clearly different, but with a somewhat different arrangement of the spring communities. In particular, the analysis of transformed data places the 2009 and 2010 spring communities closer to the summer 2010 and 2011 communities.

For both of these analyses a permanova test suggested that spring and late summer communities are different. Simper analysis suggested that differences in occurrence and abundance between seasons were strongest for the eight species listed in Table 5. Overall, these eight species explained 69% of the difference between spring and late summer waterbird communities. Thus, spring communities tend to have greater numbers of shelducks, black swans and hardheads, but lower numbers of banded stilt, grey teals, black ducks, red-necked stints and musk ducks. Averages are misleading, however, as some of these species have increased in numbers over summer in some seasons but decreased in others. There is a consistent reduction in shelducks numbers over summer as moulted birds leave the system. Hardheads also seem to decline in abundance over summer but for grey teals, musk duck black duck there is less consistency. Red-necked stints have increased in abundance over all three summer periods as a greater number of migrating individuals reach the south coast. Banded stilts tend to move over large distances in significant numbers in response to rainfall and their numbers are less predictable.

For the analysis of transformed abundance data, seven of the eight species in Table 5 (all except for black swans) were also the best discriminators of spring and summer communities, but these seven species, plus

pelicans, together only explained 44% of the difference. This is expected since transformation allows a larger number of species to significantly contribute to dissimilarity between surveys.

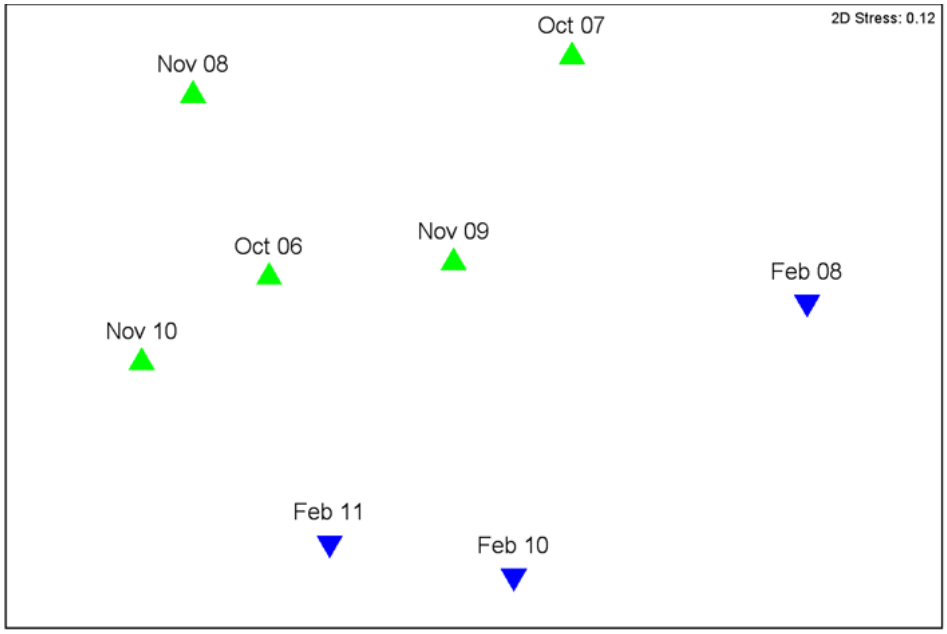

Figure 8. A two dimensional nMDS ordination based on raw abundance data for all Warden wetlands.

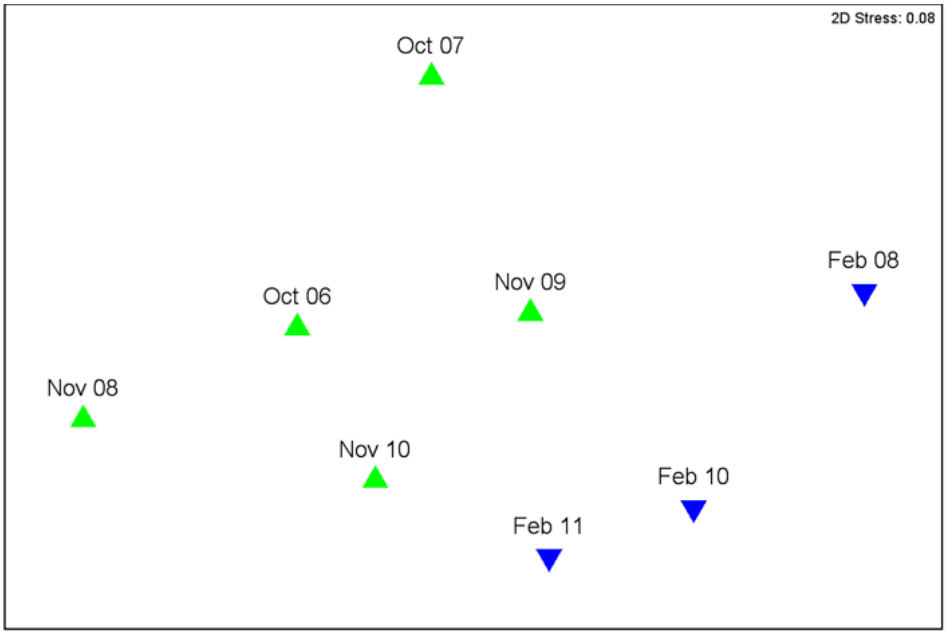

Figure 9.A two dimensional nMDS ordination based on square root transformed abundance data for all Warden wetlands.

Table 5. Results of a SIMPER analysis in Primer, listing those species best discriminating spring from summer surveys of all Warden wetlands.

Species	Average abundance in spring	Average abundance in summer	Contribution to discriminating spring and summer communities (%)	Cumulative contribution to discriminating spring and summer communities (%)
Australian shelduck	2402	586	20.7	20.7
banded stilt	560	1290	13.1	33.8
grey teal	934	1202	11.0	44.8
Pacific black duck	598	856	6.5	51.3
black swan	1069	932	5.7	57.0
red-necked stint	101	475	4.6	61.6
hardhead	385	69	4.0	65.7
musk duck	133	455	3.5	69.2

Analyses of selected wetlands of the Warden system

Since much of the management focus within the Warden Recovery Catchment is on water levels in Lake Warden and the central wetland suite, more detailed analyses of these lakes are presented below.

Lake Warden

Figure 10 shows changes in depth and electrical conductivity (EC) between January 2006 and April 2011, with timing of the eight waterbird surveys indicated. The three most recent surveys have been undertaken during the lowest lake depths and highest salinities over this period. During 2006 to 2009 EC was variable but within a range of about 6500 to 9000 mS/m, other than a few negative spikes (perhaps caused by readings taken immediately after rainfalls in some cases). During 2010 and 2011 EC rose to >16000 mS/m, reflecting the decline in depth.

Between October 2006 and February 2011, 42 species were recorded at Lake Warden. Figure 11 shows the richness recorded during these surveys by major waterbird group. It should be noted that the ground surveys between October 2006 and November 2008 were carried out using a spotting scope from vantage points around the lake whereas a boat was used between November 2009 and February 2011.

For most groups there has been little directional change in richness over this period, but there was a substantial increase in shorebird richness between November 2009 and February 2010 and shorebird richness has remained high at eight species. This increase in shorebird richness coincides with lower lake depths (Figure 10). Shorebird species not recorded prior to February 2010 (in the current monitoring program) are common sandpipers, red-necked stints, sharp-tailed sandpipers, black-winged stilts, banded stilts, red-capped plovers, black-fronted dotterels and hooded plovers. Two pairs of hooded plovers had chicks at Lake Warden in November 2010 and juveniles were present in February 2011. Total waterbird richness (but not abundance) was higher in October 2007 than adjacent surveys, with more duck species and presence of pelicans and yellow-billed spoonbills, coincident with highest recorded depth in recent years. It was the only time that pink-eared ducks were present on the lake, although only 2 individuals were recorded so it is not a significant record.

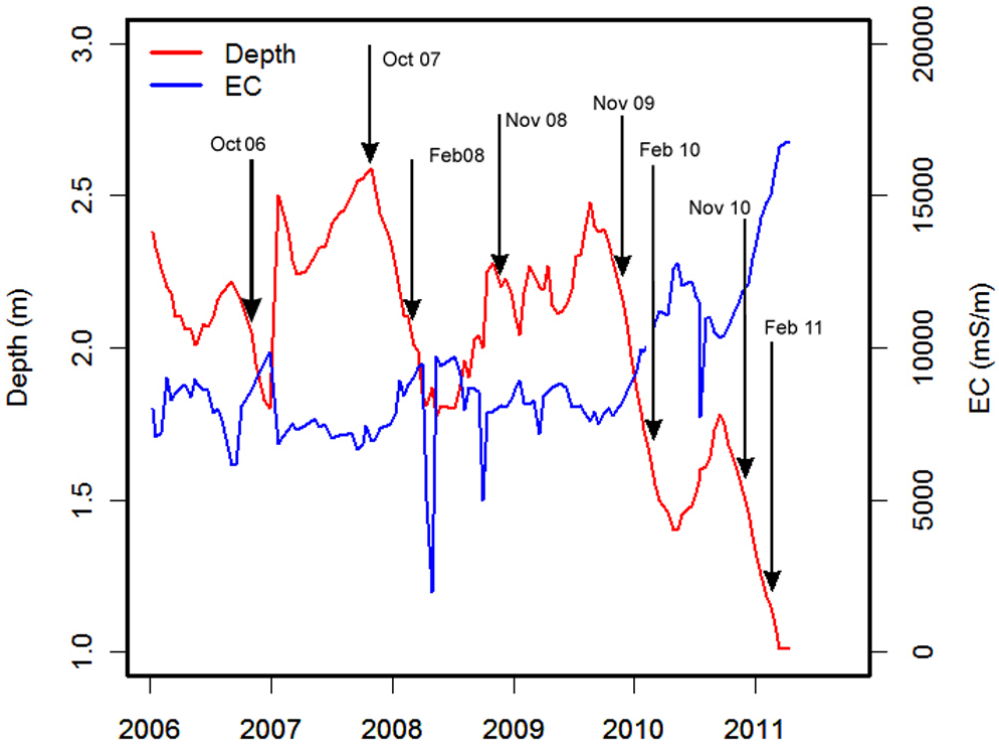

Figure 10. Depth and electrical conductivity (EC) of Lake Warden from Jan 2006 to April 2011, with dates of surveys indicated by arrows. Data from DEC Esperance.

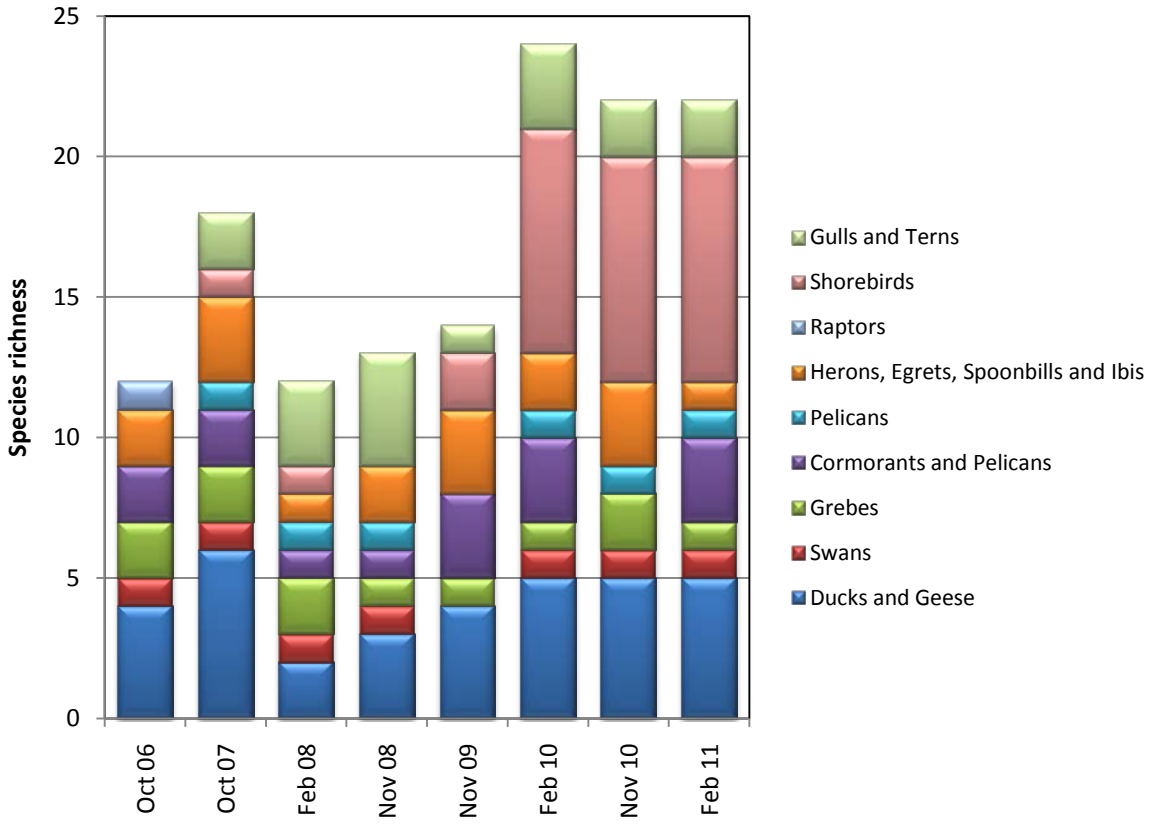

Figure 11. Species richness of major waterbird groups at Lake Warden October 2006 to February 2011 based on aerial and ground counts.

Figure 12 shows richness within waterbird groups for the recent surveys (≥ 2006) and for equivalently timed surveys (mid to late spring and mid to late summer) during the 1980s (Jaensch *et al.* 1988). The graph suggests three distinct periods for waterbird composition (1980s, 2006-2009 and 2010+). In the 1980s, when depth was mostly less than 1.5 m (Figure 4), few groups of waterbirds were present, other than ducks, swans, shorebirds and seabirds. Shorebirds were the richest group in most years in the 1980s, with an average of 5 species per survey, whereas only 1 or 2 species of ducks were present. In the 2000s a much wider range of waterbird groups were present. During the five surveys from 2006 to 2009, when depth was mostly 1.5 to 2.5 m, no single group clearly dominated richness but there were more species of ducks (average 4) than in the 1980s and fewer species of shorebirds (0 to 2 species). Finally, since February 2010 depth has mostly been < 1.5 m and there has been a return to high shorebird richness (8 species) but also a slight increase in the richness of ducks (to 5 species). These changes are reflected in an ordination of the 1980s and 2000s communities based on presence/absence data (Figure 13). This ordination shows a distinct separation of communities present in the 1980s from those present in the 2000s, except that the November 1984 survey is intermediate in position (possibly reflecting the presence of white-faced herons and whiskered terns). The ordination also shows separation of the 2006 to 2009 surveys from those in 2010 to 2011, with the latter slightly closer to the 1980s surveys.

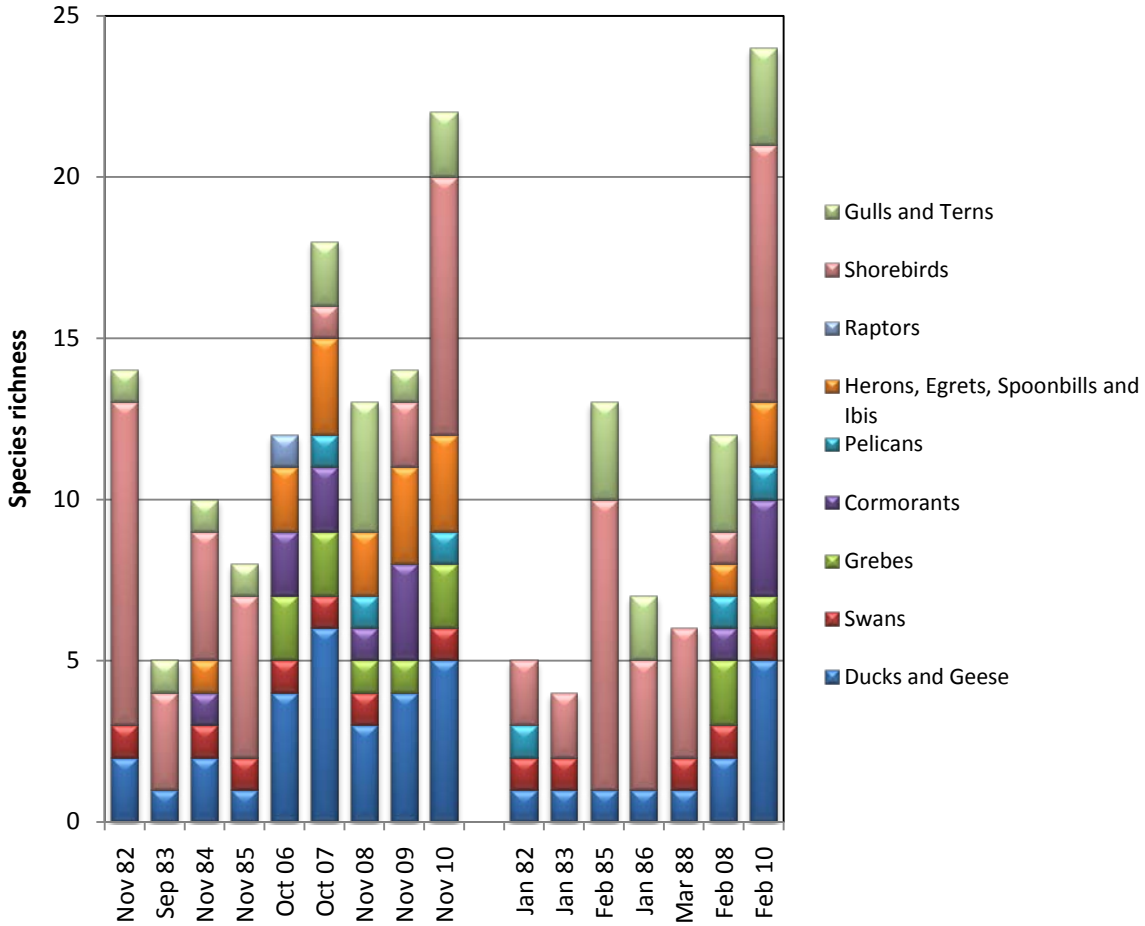

Figure 12. Richness of waterbirds on Lake Warden during spring/summer by major waterbird group for the 1980s (Jaensch *et al.* 1988) and for the October 2006 to February 2011 surveys.

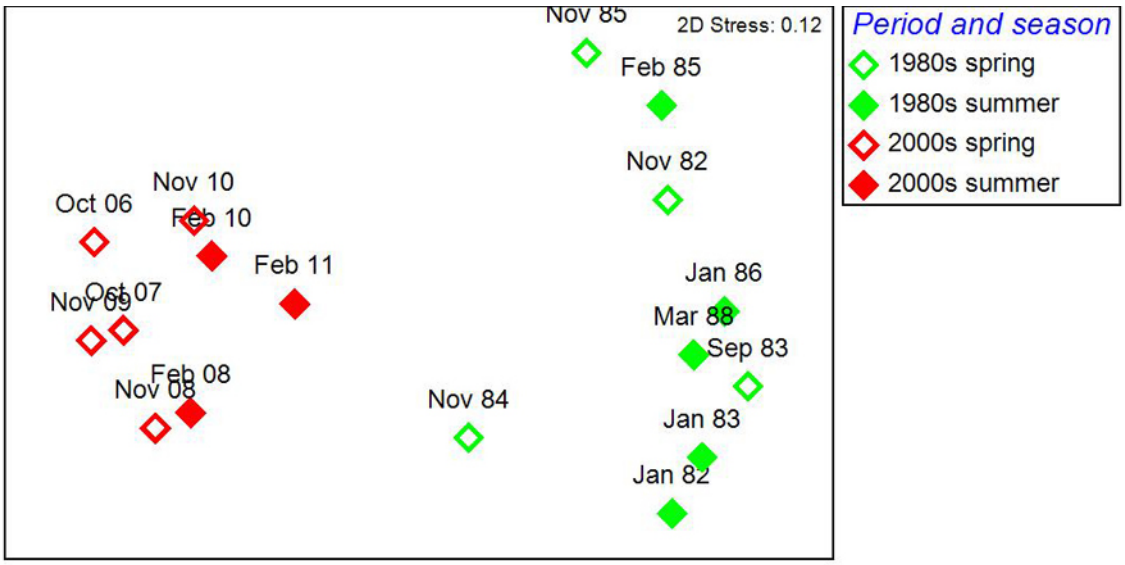

Figure 13. 2 dimensional nMDS ordination of waterbird communities (presence/absence data) at Lake Warden, from surveys undertaken in the 1980s by Jaensch *et al.* (1988) and in the 2000s.

Figure 14 shows ground and aerial counts at Lake Warden by major group since October 2006. There has been significant variability in abundance and composition of waterbirds using Lake Warden in recent years. Very low numbers were recorded during aerial and ground counts during the October 2006 survey. However, only half the lake was surveyed from the ground and Halse (2007) noted that "high water levels and strong winds … appeared to provide sub-optimal waterbird habitat". October 2007 to November 2008 counts were also from vantage points around the lake (but of a greater proportion of the lake) whereas subsequent surveys were of the whole wetland by boat. Counts were higher in October 2007 than in 2006, mostly representing larger numbers of silver gulls (A74/G17) and whiskered terns (A122/G52). November 2008 counts were slightly higher again, with larger numbers of little-black cormorants (A182/G0) than in previous years. Little black cormorants are highly mobile over the Warden-Gore wetlands so can be present one day but not the next or at certain times of the day but not others. In November 2009 total abundance (from ground surveys) was about the same as in Oct 2007 but composition was very different (more ducks, especially musk ducks and teals, and fewer seabirds). In November 2010 total abundance was much higher than the previous three years, with large numbers of shelducks (AA54/G108), grey teals (A60/G194), chestnut teals (A109/G110), red-necked avocets (A115/G125) and black-winged stilts (A40/G39).

Counts have been consistently higher in February than in October/November and have been increasing in recent years, with greater than 1500 birds present in February 2010 and 2011. Composition in summer has varied greatly but there has generally been greater numbers of ducks, grebes and (in two years) swans than in spring. The two most recent February surveys have resulted in higher numbers of shorebirds than was recorded in February 2008.

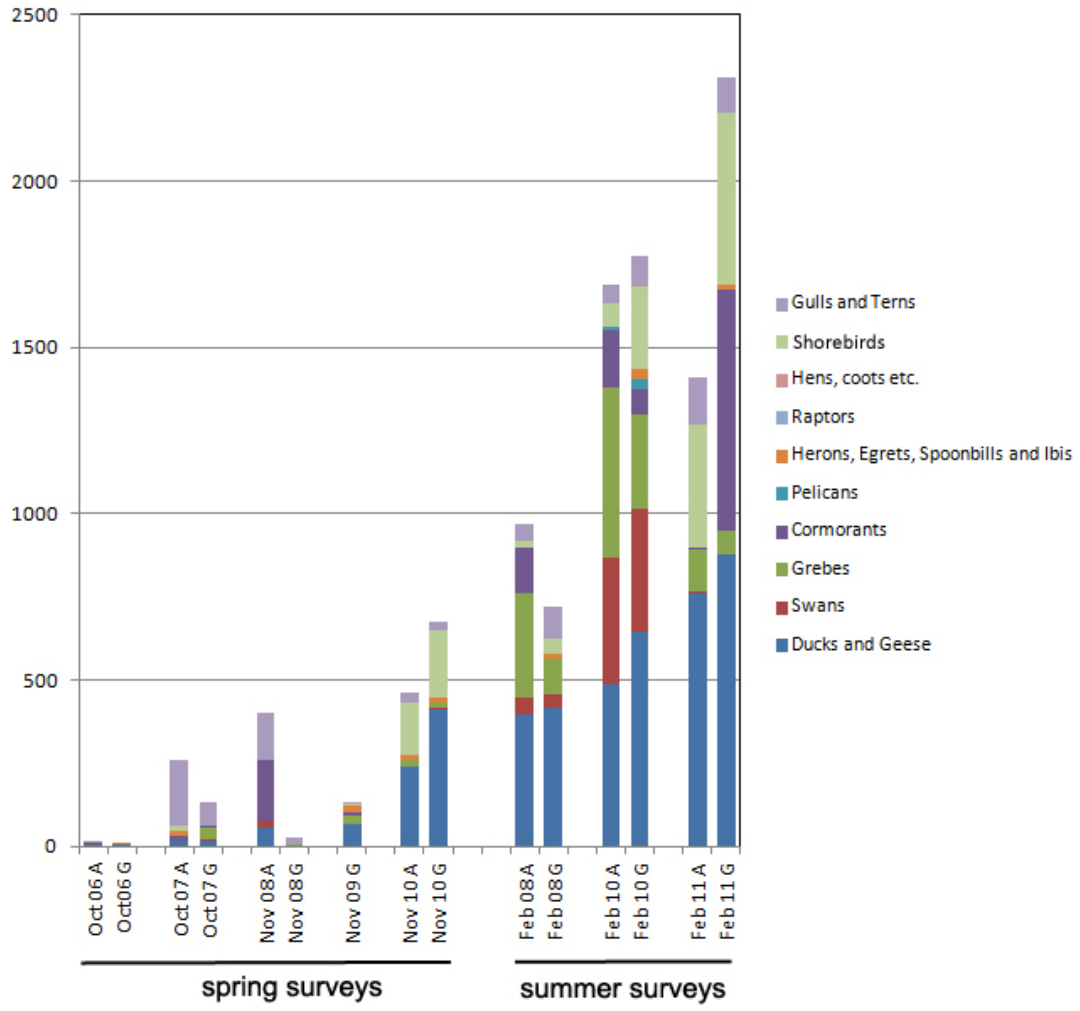

Figure 14. Abundance of waterbirds from aerial and ground counts at Lake Warden from October 2006 to February 2011.

The much higher abundance of shorebirds in the last three surveys (February 2010 to February 2011), and of ducks in the last two summer surveys, coincides with declining lake depth and increasing salinity (Figure 10 and Figure 4). The increase in shorebird abundance is likely to be associated with greater shallow water and beach habitat. Ducks that have become more abundant are shelducks and the two species of teal. Shelducks used to be much more abundant in the 1980s on Lake Warden (see below), with populations regularly exceeding 2000 birds when the lake was shallow, whereas teals were not. The shelducks may be responding to greater edge resting areas and perhaps greater food availability and/or accessibility in shallow waters. The teals have mostly been observed sheltering in shallow water or on the shoreline under dead trees (or on fallen tree limbs) along the northwestern and southern shores in the last three surveys. Prior to summer 2009/10 the water under these trees was deeper, with narrower shores and, perhaps, not as suitable as resting areas, although food resources may be a factor.

Figure 15 is an ordination of all eight recent Lake Warden surveys based on raw (untransformed) consensus abundance data, showing spring (green) and late summer (blue) surveys and with symbols scaled to total abundance. There are a couple of patterns to note in this plot. Firstly, there is a total abundance gradient from left to right, with the lowest abundance October 2006 survey to the left and the more abundant February surveys and November 2010 surveys to the right. This left to right gradient may also be a temporal one for spring surveys, with the October 2006 survey to the left, October 2007, November 2008 and November 2009 in the middle and the November 2010 survey placed to the right. It should be noted, however, that survey intensity was greater for the most recent four surveys as they were carried out across the whole lake by boat, rather than from vantage points on the shore. Also, the November 2009 data is for a ground survey only. The ordination suggests

that the waterbird community present in November 2010 was more like that of the three February surveys than like other spring surveys.

In a BVSTEP analysis in Primer, the species most highly correlated (r = 0.94) with the overall patterns in waterbird community composition at Lake Warden are hoary headed grebes, little black cormorants, black-winged stilts, red-necked avocets and whiskered terns. That is, an ordination performed using just these five species would result in a similar pattern to that shown in Figure 15. These species were most abundant during surveys lying to the right in Figure 15, although whiskered terms were more abundant in November 2008 and October 2007 in the middle of the plot.

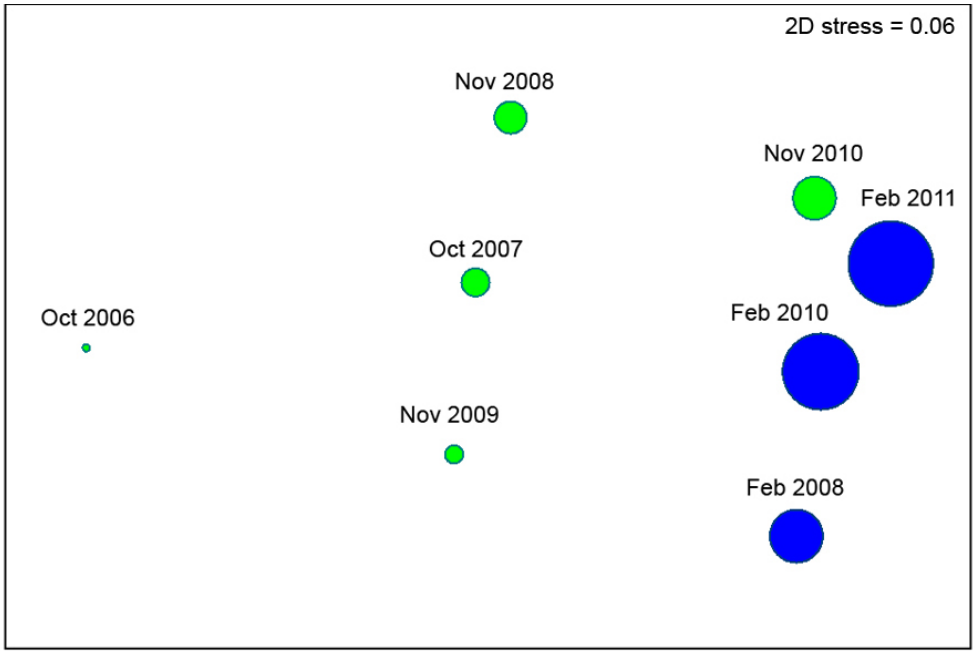

Figure 15. Two-dimensional ordination of untransformed waterbird abundance at Lake Warden from October 2006 to February 2011. Symbols size is scaled to total consensus abundance.

Figure 16 puts the 2006 to 2011 counts in perspective by including spring and late summer data for Lake Warden from Jaensch *et al.* (1988). For comparability with recent data, only a single spring and summer survey is used for each year in the 1980s. It should be borne in mind that surveys from 2009 to 2011 were carried out by boat whereas surveys during the 1980s and from 2006 to 2008 were from vantage points around the lake. Survey results can be influenced by methods used, but the major changes in richness and abundance do not coincide with the timing of method changes described above. Counts at the level of 'duck' versus 'cormorant' or 'shorebird', should be reasonably similar for both survey methods.

In general, Lake Warden was shallower in the 1980s (average November depth 1982 to 1988 0.79 m) and salinity was higher and more variable (average 86 ± 27 g/L) compared to the 2000s (average November depth 2006 to 2010 2.13 m and salinity 62 ± 9 g/L) (Figure 10 and Figure 4).

The very high count in November 1982 (16919) was one of three counts over 10000 in the Jaensch *et al.* (1988) project. The other two such counts (13500 two months earlier and 10700 in May 1985) are not shown because they are at times of the year not surveyed in the current (2006+) program. All other total counts not shown on Figure 16 for the same reason are <5500.

Most of the 1980s surveys presented in Figure 16 resulted in higher total waterbird counts than have been recorded in recent years, but composition seems to have been simpler. In the 1980s, most birds were ducks, swans or shorebirds whereas cormorants and grebes have also made up substantial proportions of total abundance in recent surveys. Major differences between spring and summer counts from the 1980s and the 2000s are:

- Australian shelducks were always abundant during the 1980s, with most surveys recording more than 1000 and counts over 2000 to 3000 common. Surveys since 2006 have only recorded between 1 and

519 shelduck, but the numbers have been increasing in the most recent surveys. Lower shelduck numbers in the 2000s may be related to reduced lake edge roosting area compared to the 1980s.

- The numbers of chestnut and grey teals counted in recent years have regularly exceeded counts for the 1980s and musk ducks have always been present during surveys in the 2000s (sometimes >400) but were never present in the 1980s. Teals are often found roosting under dead inundated trees and there is currently plenty of that habitat around the lake.
- Counts of black swans regularly exceeded 500 in the 1980s (e.g. 3500 in November 1982 and 2000 in November 1985) but in recent years there has only been one count above 50 (February 2010), presumably indicating a decline in submerged macrophytes and increased depth.
- Grebes were rarely present in any numbers during the 1980s, whereas they have always been present in the 2000s (maximum 510 in February 2010), perhaps again reflecting greater depth (more diving habitat) and lower salinity. Cormorants (which are also divers) were similarly rare in the 1980s (2 little black cormorants in November 1984) whereas they have nearly always been present in the 2000s (4 surveys with > 100 little black cormorants: maximum 723).
- Many smaller shorebirds were much more abundant at Lake Warden in the 1980s. Examples are 100 great knots in October 2005, several records of > 100 hooded plovers (maximum 240), up to 95 red knots, regularly more than 50 red-capped plovers, more than 200 red-necked stints (maximum 700 in March 2008), up to 220 curlew sandpipers and 120 sharp-tailed sandpipers. A few other less common small shorebirds were also occasionally recorded in the 1980s but have not been recorded in recent surveys (long toed stints, pectoral sandpipers, broad-billed sandpiper).
- Of the larger shorebirds, red-necked avocets and black-winged stilts were rarely present in great numbers during the 1980s (spring/summer maxima 77 and 24 for these species respectively). By contrast, there have been 125 to 230 red-necked avocets in the three most recent surveys and up to 82 black-winged stilts. Banded stilt were occasionally recorded at numbers at or above 1000 (7000 in November 1982 and records of 9000 and 10000 in May 1985 and September 1982), whereas the only recent record is of 142 present in February 2011. One or two bar-tailed godwits were occasionally present in the 1980s but have not been seen during the recent surveys. The occurrence of common greenshanks hasn't changed much.
- White-faced herons are much more frequently recorded now than in the 1980s, but are not more abundant when present.

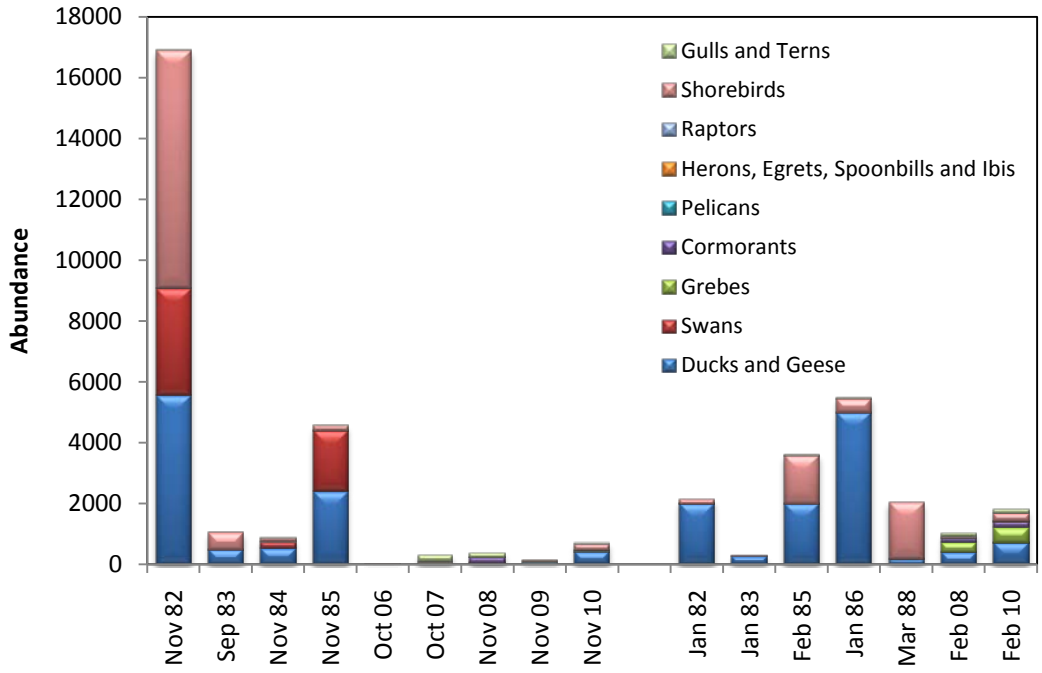

Figure 16. Abundance of waterbirds on Lake Warden during spring/summer by major waterbird group during the early 1980s and since 2006.

These differences between the 1980s and the 2000s surveys are summarised in an ordination (Figure 17) based on raw abundance data for the dates shown in Figure 16. This suggests that communities in the 1980s were different to those in the 2000s but that communities in November 2010 and February 2011 had a somewhat intermediate composition. A Permanova analysis suggested that there was a statistically significant difference in community composition between these decades ($p<0.001$). The other interesting point from this ordination is that there appears to be a greater difference between spring and summer surveys in the 2000s than there was in the 1980s.

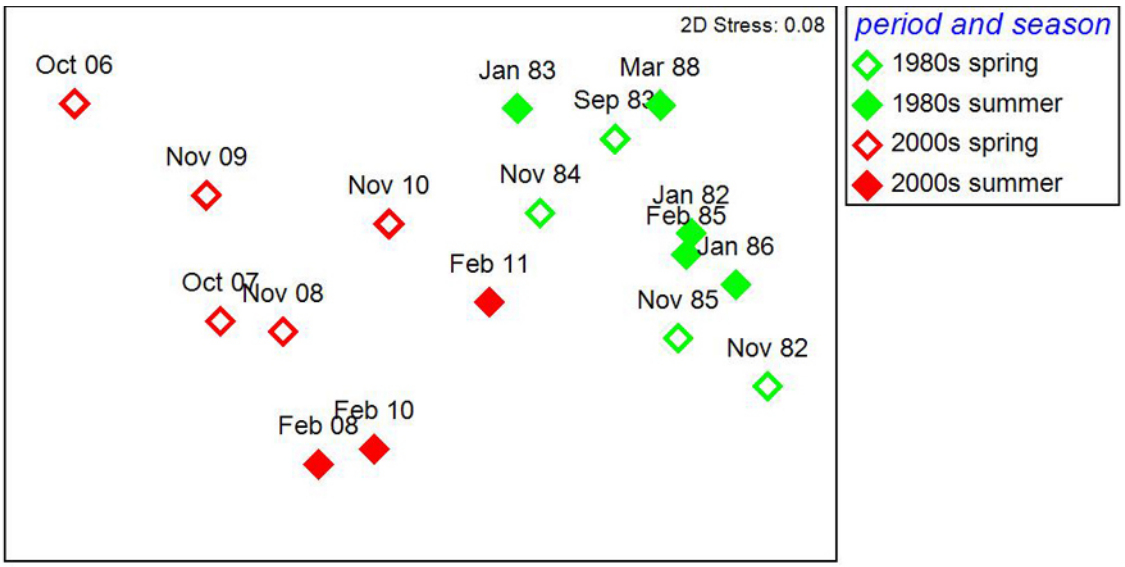

Figure 17. 2 dimensional nMDS ordination of untransformed waterbird abundance data for Lake Warden surveys from the 1980s (Jaensch *et al.* (1988) and recent surveys.

The central suite (Wheatfield to Windabout)

In this section we have analysed waterbird data for the three main wetlands in the central suite: Lake Wheatfield, Woody Lake and Windabout Lake. These data include the satellite wetlands (because they have not always been scored separately) but not the North Wheatfield, Six Mile and North Windabout wetlands. Between October 2006 and February 2011, 55 species have been recorded. Figure 18 shows richness during these surveys by major waterbird group. The only notable change over this time has been the increased number of shorebird species since February 2010, in both spring and summer. The richness of other groups has remained stable or shown no consistent trend over this period.

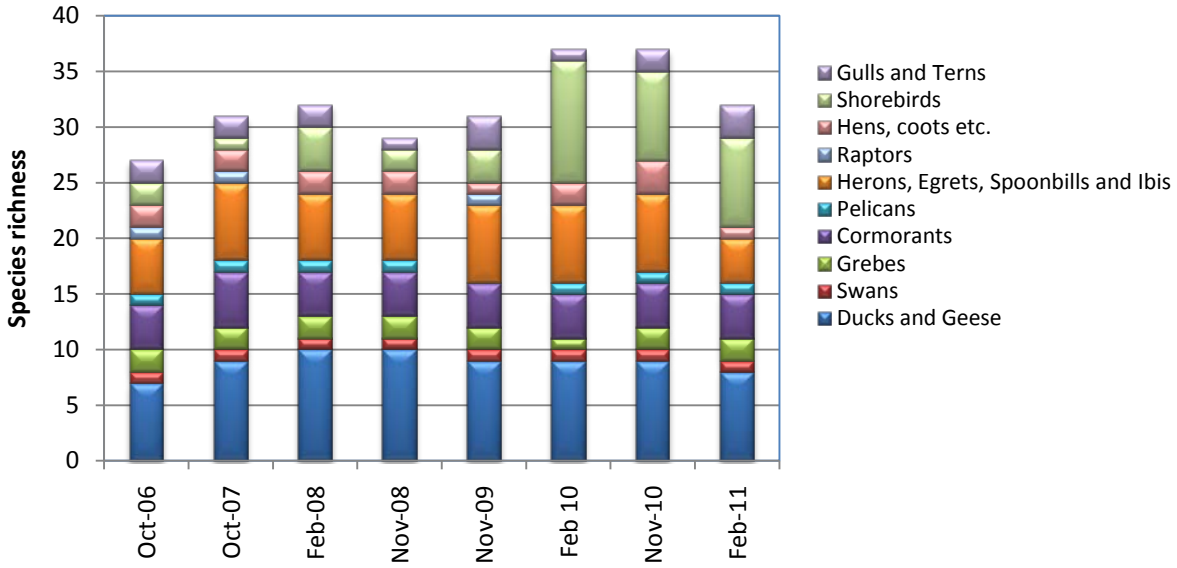

Figure 18. Species richness (combined aerial and ground counts) within major waterbird groups on the central Warden wetlands (Wheatfield, Woody and Windabout) between October 2006 and February 2011.

Abundance of waterbirds across the central suite wetlands during the 2000s is shown in Figure 19. Ducks have always been the dominant group, but their abundance has varied greatly, from about 1000 to almost 5000. Highest duck numbers were recorded in February 2008, with counts of several duck species (e.g. grey teals, Pacific black ducks and musk ducks) much higher than in the previous spring (October 2007). The exception was shelducks which reduced in numbers, as seems to be usual for the Warden wetlands as ducks leave the system after moulting. The lowest counts of ducks have been the most recent two summer surveys (February 2010 and 2011) where shelducks have left these central wetlands but have not been replaced by other species. Whether the counts of ducks for February 2010 and 2011 are lower than in other recent years is impossible to say since the February 2008 survey was the only other recent late summer count. It is likely that the February 2008 count was unusually high, resulting from movement of ducks on to the Warden system from elsewhere following a particularly dry year, although 2009/10 was almost as dry but did not result in the same increase in duck numbers over summer. An unknown factor here is patterns in recruitment in the broader south-west and beyond, which affects abundance but is difficult to account for. There is no trend in total duck numbers (or numbers of individual duck species) for spring counts.

The number of swans was highest in February 2008 and 2010 (about 1000 and 500 respectively) whereas other counts were all lower than 350 and the February 2011 count was the second lowest at 58A/14G. The number of shorebirds appears to have increased on the central wetlands in recent years. Prior to February 2010, almost all counts of shorebirds were under 10 and the maximum was 59 (in February 2008). In February 2010 210 shorebirds were recorded and the two subsequent counts in November 2010 and February 2011 were 90 and 163. Increased abundance has been particularly notable for sharp-tailed sandpipers, black-fronted dotterels and masked lapwings but there have been small numbers of numerous other shorebirds (such as red-capped plovers and Great Knot) in recent surveys that were largely or entirely absent prior to February 2010.

Figure 20 shows abundance within waterbird groups for the recent surveys (since 2006) and for equivalently timed (late spring and late summer) surveys during the early to mid 1980s (Jaensch *et al.* 1988) in the central suite wetlands, including some satellite wetlands (some of which were also surveyed in the 1980s). The following discussion relates only to data from these dates for comparability but it must be borne in mind that species composition could be different on other dates of the 1980s. Surveys for Wheatfield and Woody were done using spotting scopes from vantage points on the shore in the 1980s, but Windabout was usually surveyed by boat (Jaensch *et al.* 1988), so data from these surveys should be reasonably comparable to that from the 2000s.

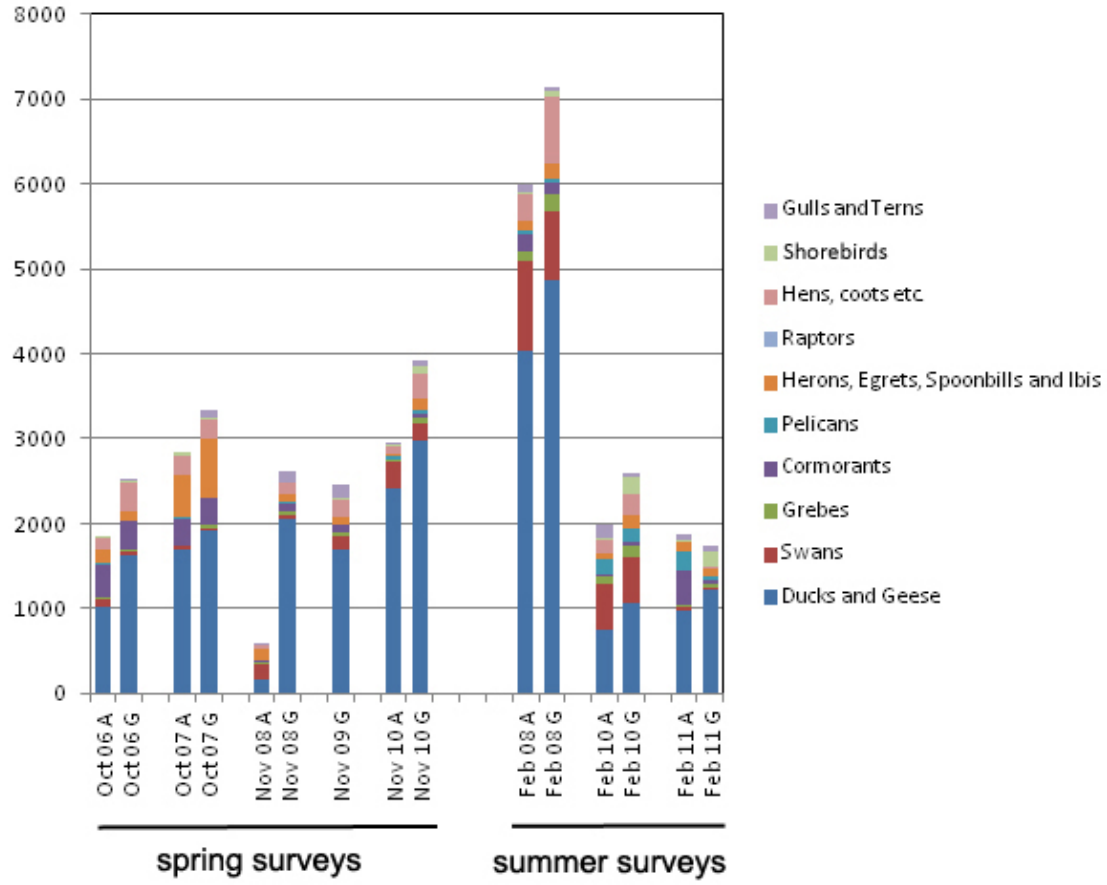

Figure 19. Abundance of major waterbird groups across the central suite wetlands October 2006 to February 2011, based on aerial (A) and ground (G) counts, separated by season.

Figure 21 shows the results of a three-dimensional nMDS ordination of square root transformed abundance data, with surveys at all three wetlands coloured according to survey period (1980s versus 2000s). There is a clear separation of surveys from these two periods and there was much greater heterogeneity in composition in the 1980s. Not surprisingly, a permanova analysis suggested that the two periods had significantly different community composition across the suite ($p<0.001$).

Figure 22 to Figure 24 show the results of two-dimensional nMDS ordinations of square root transformed survey abundance data for each of the three wetlands. There were significant differences in waterbird composition between the 1980s and the 2000s for all three wetlands, though significance was higher ($p<0.001$) for Wheatfield and Windabout than for Woody ($p<0.01$). The effect of season (spring versus summer) within these periods was significant only for Wheatfield and Woody ($p<0.001$ and $p<0.05$ respectively).

In general, there has been a significant increase in richness and abundance of most groups of waterbirds on the central suite wetlands between the 1980s and 2000s, with very few declines other than the disappearance of clamorous reed warblers.

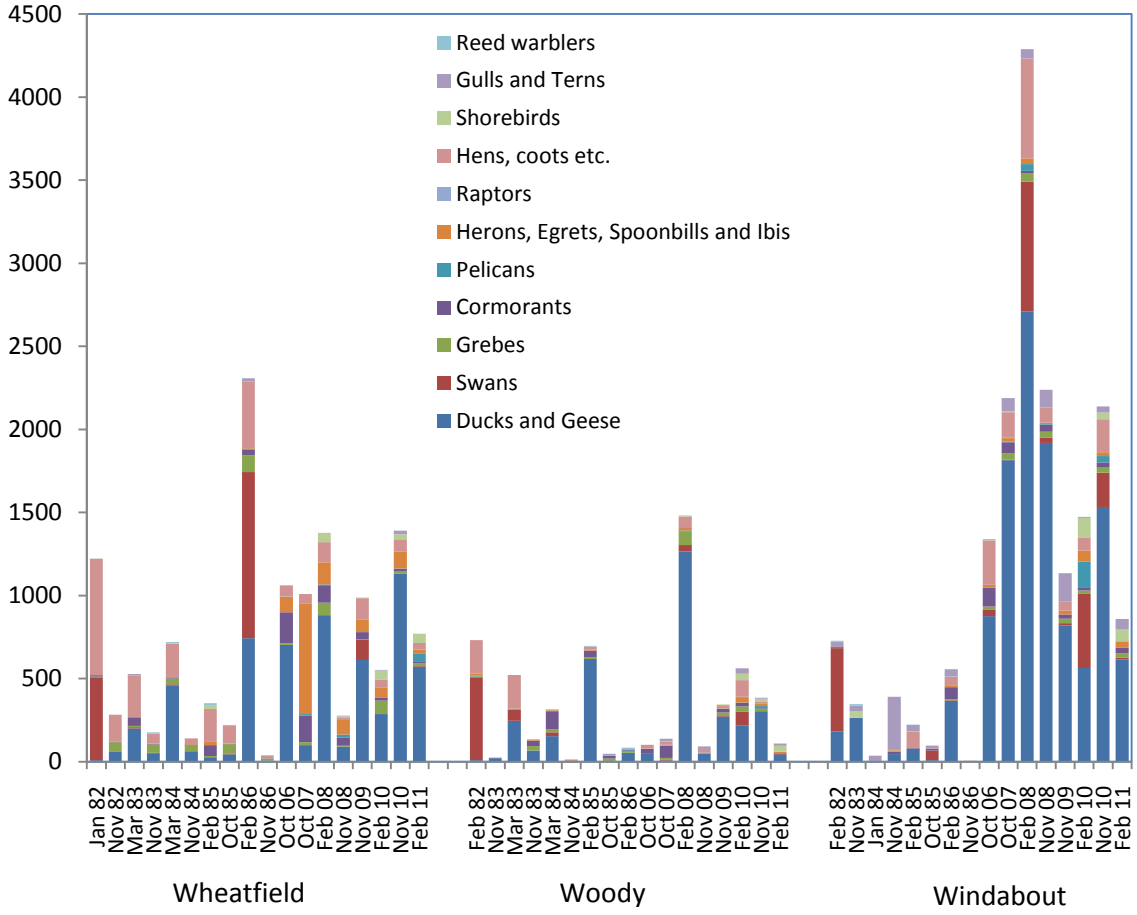

Figure 20. Abundance of waterbirds on wetlands of the central Warden suite during spring/summer by major waterbird group for the 1980s (Jaensch *et al.* 1988) and for the October 2006 to February 2011 surveys.

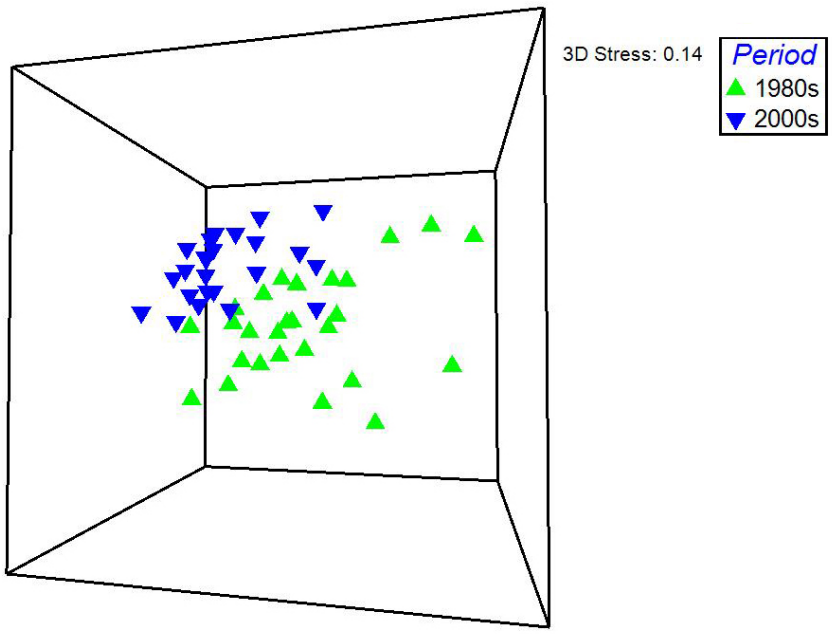

Figure 21. Three dimensional nMDS ordination of surveys within the central suite of Warden wetlands during spring or summer in the 1980s and the 2000s.

Lake Wheatfield. Overall composition of waterbird communities using Lake Wheatfield was different in the 2000s than it was in the 1980s and spring and summer communities have usually had different composition (Figure 22).

The average number of species recorded at Lake Wheatfield during surveys in the 2000s (24 ± 1) is more than twice that recorded during surveys in the 1980s (11 ± 1), with additional species being ducks, darters, herons, ibis, egrets, spoonbills and shorebirds. During the 1980s, ducks (mostly musk duck, black ducks and grey teals), coots and occasionally swans were normally the most abundant waterbirds and most total counts were between 100 and 1000 (Figure 20). Total abundance has usually been 500 to 1500 in recent years and ducks have been even more numerous and diverse (Figure 20). Shelducks, hardheads, pink-eared ducks, grey teals and chestnut teals seem have increased in abundance whereas numbers of musk duck are lower. Egrets, spoonbills, ibis and cormorants have also become much more common but swans are now rarely seen and there have been far fewer coots in the 2000s. These changes are most likely associated with the greater depth in the 2000s. Greater depth would have encouraged larger numbers of some ducks, but depth probably became too great for bottom feeding waterfowl (coots, swans) especially if it resulted in a decline in macrophyte beds. The egrets, ibis (mostly Australian white ibis) and spoonbills use the now numerous dead trees as perching sites and, for the ibis and spoonbills, as nesting sites. Australian white ibis moved into the south-west prior to the 1980s (Blakers *et al.* 1984; Brown et al 2005) but may not have reached Esperance until after the Jaensch et al (1988) surveys., However, they may not have used Wheatfield in the 2000s in such numbers had there not been such extensive tree death. Although there is no data on fish populations in Wheatfield, it likely that they have increased in numbers since Wheatfield has had permanently deeper water and this (plus the greater depth itself) may have attracted the greater number of fish feeding species (cormorants and egrets).

Other changes are the loss of clamorous reed warblers (coincident with loss of fringing vegetation) and an increase in the diversity and abundance of shorebirds. Just three species of shorebirds (banded stilt, common sandpiper and marsh sandpiper) were seen in the 1980s surveys considered here (out of a total of 7 for all 1980s counts) and only two were seen on any one survey. By contrast, 12 species have been seen in the smaller number of counts in the 2000s and as many as 9 species on any one survey, but with most of these records being since November 2010. Between October 2006 and November 2009 0 to 4 species were recorded per survey and 4 species in total (common sandpiper, black-fronted dotterel, common greenshank, red-kneed dotterel). By contrast, the three most recent surveys have recorded 5 to 9 species per survey and 12 species in total.

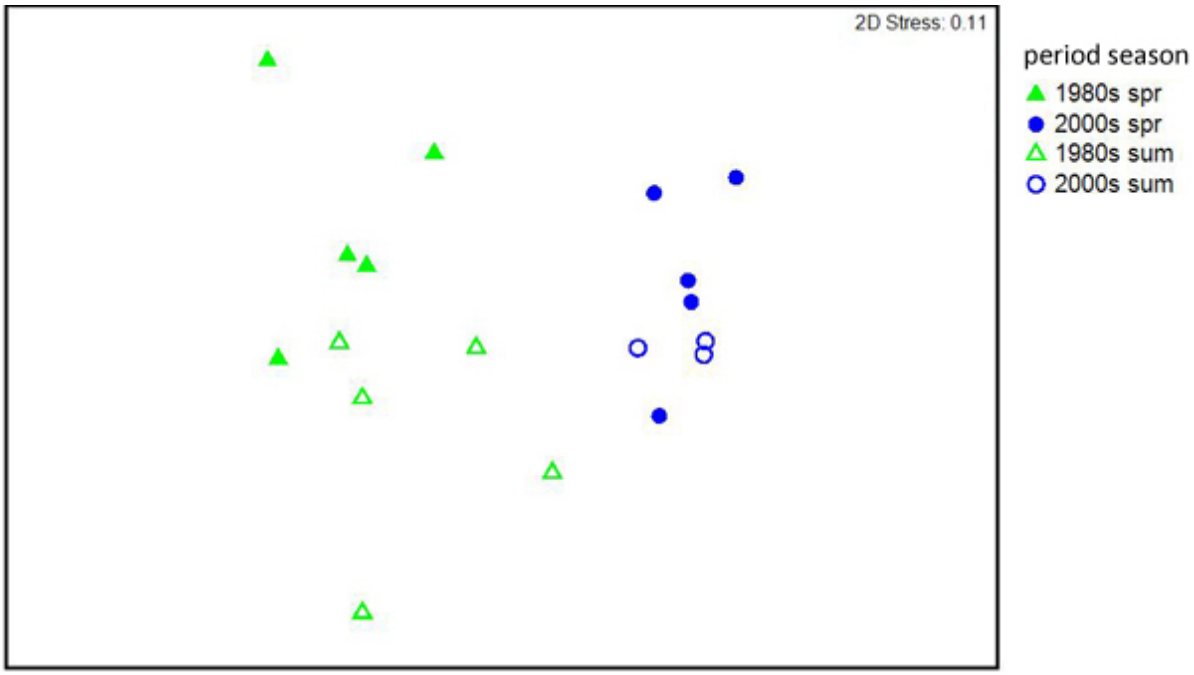

Figure 22. Two-dimensional ordination of surveys at Lake Wheatfield from the 1980s and the 2000s, based on square root transformed abundance.

Woody Lake. Changes in species composition and abundance have been less obvious at Woody Lake. In Figure 23 there is a clear separation of surveys undertaken in spring during the 1980s (solid green triangles) from similarly timed surveys in the 2000s (solid blue circles) and of summer surveys from the 1980s (open green triangles) from summer surveys of the 2000s (open blue circles). Figure 23 also suggests some similarity in waterbird community composition between spring surveys in the 2000s and summer surveys in the 1980s, but this is mostly an artefact of the two-dimensional ordination. In a 3D ordination, surveys from these two season-period combinations are more separated. Richness has increased from 9 ± 1 in the 1980s to 16 ± 2 in the 2000s, with the same range of species contributing to higher richness in the 2000s as at Wheatfield. Species composition and abundance was highly variable in the 1980s, with ducks usually the dominant group (primarily black ducks, grey and chestnut teals and shelducks). Duck richness is now normally greater (average 5 in the 2000s compared to 3 in the 1980s), with pink-eared ducks, hardheads and Australasian shovelers regularly recorded now, but rarely seen in the 1980s (and not at all on the dates used for Figure 20). Shorebirds were not seen on Woody Lake at all during the 1980s spring and summer periods shown in Figure 20 whereas up to four species (and usually at least 1) have been observed during the 2000s. As at Wheatfield, Australian white ibis are now regularly counted whereas they were absent in the 1980s, and yellow-billed spoonbills, great egrets and nankeen night herons are now seen more often and in greater numbers. Reed warblers have disappeared, and great crested grebes are far less common, but coots occur more frequently.

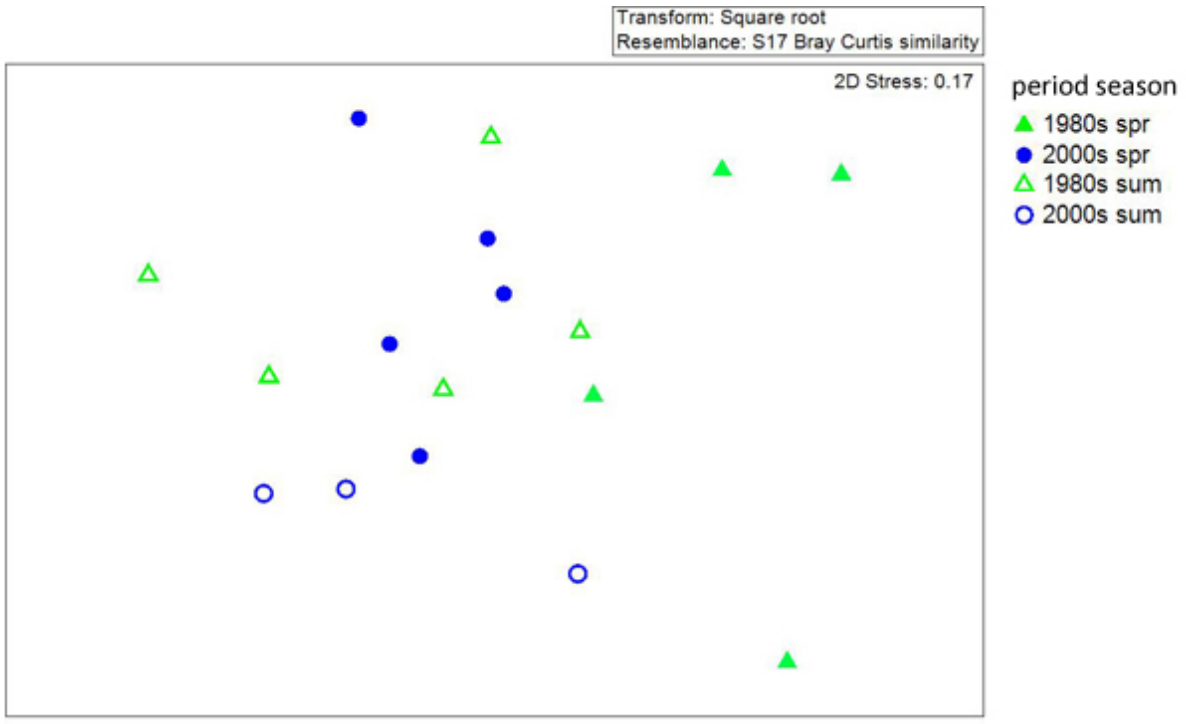

Figure 23. Two-dimensional ordination of surveys at Woody Lake from the 1980s and the 2000s, based on square root transformed abundance.

Windabout Lake. There has been a clear change in waterbird community composition on Windabout Lake between the 1980s and the 2000s and composition has been much less variable in the 2000s (Figure 24). Average richness at Windabout has increased nearly threefold, from 9 ± 2 in the 1980s to 25 ± 1 in the 2000s. Virtually all taxonomic groups were richer, on average, during the 2000s. Abundance has also been much higher during the 2000s than during the 1980s, most notably amongst the ducks. Twelve species of duck have been recorded during the 2000s whereas only six were present during the larger number of 1980s surveys. In the

1980s, there were no records of freckled ducks, hardheads, shovelers, pink-eared ducks or blue-billed ducks (on any dates), whereas these have all been recorded during the 2000s and some are now common. The most abundant ducks in the 2000s (chestnut and grey teals, shelducks and Pacific black ducks) are the only ones that were regularly present in the 1980s. Other species that are now regularly recorded but were rare or absent in the 1980s are hardheads, great-crested and hoary-headed grebes, great egrets, spoonbills, darters, great cormorants, pelicans and coots. Swans were also more regularly present in the 2000s than in the 1980s, which is the opposite trend to that seen at Wheatfield, so there has been a shift in basin preference within the central Warden wetlands for this species. Many other species were recorded a few times during the 2000s but were not noted during the 1980s, including black-tailed native hens and spotless crakes, although these two species are likely to have been present but undetected in the 1980s. Between 0 and 3 shorebirds were seen per survey during the 1980s surveys used for Figure 24, representing five species in total (banded stilt, common sandpiper, curlew sandpiper, hooded plover and red-capped plover) but with 5 others observed (rarely) on other 1980s dates. From 2006 to 2009 shorebirds were mostly absent, with just one record of a common sandpiper and one record of a common greenshank. However, seven shorebird species have been counted in each of the two most recent February surveys (in 2010 and 2011), representing nine species in total.

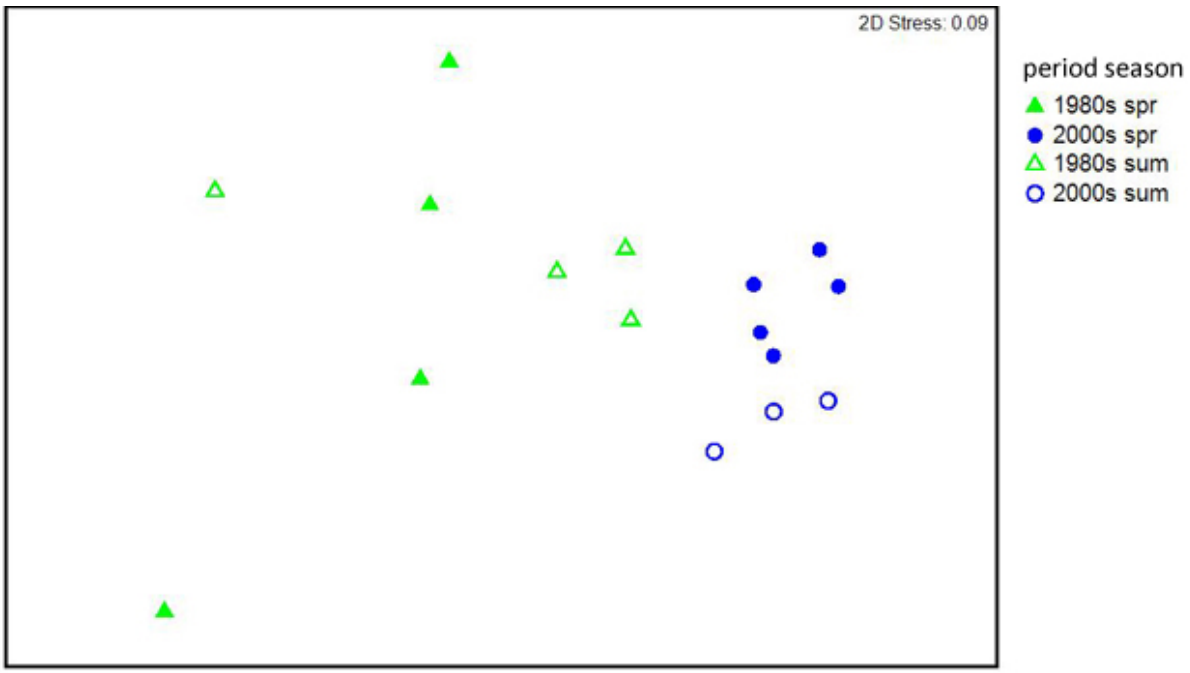

Figure 24. Two-dimensional ordination of surveys at Windabout Lake from the 1980s and the 2000s, based on square root transformed abundance.

Gore-Quallilup wetlands

Richness and composition

Figure 25 shows waterbird richness across the Gore-Quallilup wetlands from October 2006 to February 2011, with richness shown separately for aerial surveys only (except for November 2009), ground surveys only (November 2009 to February 2011) and combined aerial/ground surveys (February 2010 to February 2011). A total of 49 species has been recorded on these wetlands since 2006 and 40 of these were recorded over spring/summer 2010/11. Thirty one species were recorded in November 2010 and 35 in February 2011 (Figure 25), with 28 present in both seasons.

The apparently lower richness from aerial surveys in the years 2009 to 2011 compared to the 2006 to 2008 period may be associated with the greater experience of the counters during the earlier period (Bennelongia Pty Ltd 2009). Richness during the recent four surveys has been an average of 3 species lower than during the earlier four surveys. Overall there has probably been no real change in richness over the last 6 years.

Significant records for the 2010/11 surveys are as follows:

1) Three hundred and fifty six pink-eared ducks were present on Lake Gore in November 2010 compared to the previous recent record of 10 on this lake in October 2006. Pink-eared ducks were occasionally recorded in low numbers on Lake Gore (≤ 60) in the 1980s (Jaensch *et al.* 1988).

2) Thirty four great crested grebes were present in the Gore-Quallilup wetlands (mostly on Lake Gore) in November 2010 and 25 were present in February 2011 (23 on Gore). Halse (2007) recorded 3 on Lake Gore in 2006 but none were observed on the Gore or Quallilup wetlands in the 1980s.

3) The eight curlew sandpipers seen at Gidong Lake in February 2011 are the first records for the Gore-Quallilup wetlands during the current monitoring program, but this lake has not been surveyed from the ground in other 2006+ surveys. In the 1980s they were regularly seen around Lake Gore, usually in low numbers but 209 were seen in May 1983 and 600 were seen in October of the same year. This species has been declining in numbers for several decades in Australia (Rogers & Gosbell 2006).

4) Sixty four hooded plover were seen at Kubitch Lake in February 2011. The only other record for the current monitoring program is the 213 seen on Kubitch Lake and 6 on Carbul Lake in November 2009. Tens to hundreds of hooded plover were regularly seen on Lake Gore in the early 1980s (maximum 393) but none have been detected there during recent surveys, almost certainly because of the much reduced shore habitats.

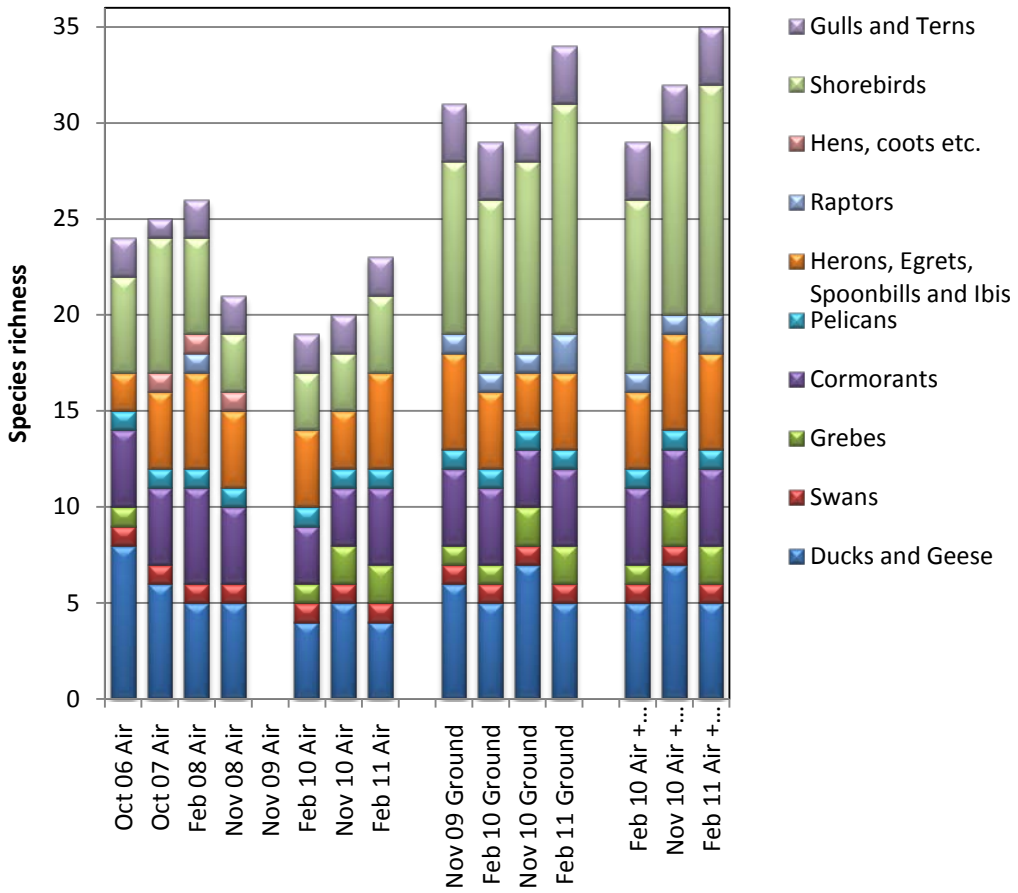

Figure 25. Richness of waterbirds in Lake Gore-Quallilup wetlands from October 2006 to February 2011 from aerial surveys or ground surveys or combined from ground/aerial surveys.

Abundance

Waterbird abundances from aerial and ground counts of the Gore-Quallilup wetlands in November 2010 and February 2011 are presented in Table 6. They are also provided, along with all of the other 2009 to 2011 ground count data by wetland in Appendix 3 and with October 2006 to February 2011 ground and aerial counts by wetland suite in Appendix 4. Figure 26 is a graph of waterbird abundance (aerial and ground surveys and consensus) by major taxonomic group across the Gore-Quallilup wetlands for the period October 2006 to February 2011.

Table 6. Total abundances of waterbirds across the Gore-Quallilup wetland system from aerial and ground counts in November 2010 and February 2011.

Species	November 2010 aerial counts	November 2010 ground counts	February 2011 aerial counts	February 2011 ground counts
musk duck	32	20	478	592
Australian shelducks	4138	6137	3413	2324
Pacific black duck	160	5	4	14
Australasian shoveler	5	17	0	0
grey teals	1066	839	232	161
chestnut teals	0	71	0	242
pink-eared duck	0	356	0	0
unidentified duck	89	0	69	0
black swans	554	979	652	272
hoary-headed grebes	427	1156	24	41
great crested grebes	1	34	12	25
darter	20	74	11	14
little pied cormorant	3	8	45	60
little black cormorant	236	524	132	560
great cormorant	0	0	3	7
Australian pelican	59	103	1	38
white-faced heron	9	28	23	32
great egret	47	41	6	22
Australian white ibis	0	2	2	6
straw-necked ibis	2	0	27	0
yellow-billed spoonbill	0	0	7	18
white-bellied sea-eagle	0	1	0	2
swamp harrier	0	0	0	1
bar-tailed godwit	0	1	0	0
common greenshank	4	19	12	47
common sandpiper	0	4	0	4
red-necked stint	0	22	0	823
sharp-tailed sandpiper	0	85	0	62
curlew sandpiper	0	0	0	8
black-winged stilt	54	106	98	48
banded stilt	280	273	400	1084
red-necked avocets	0	159	66	127
red-capped plover	0	4	0	11

black-fronted dotterel	0	0	0	4
hooded plover	0	0	0	64
masked lapwing (southern)	0	2	0	5
unidentified shorebird	71	0	14	0
silver gull	97	186	36	96
Caspian tern	2	7	1	1
Pacific gull	0	0	0	3

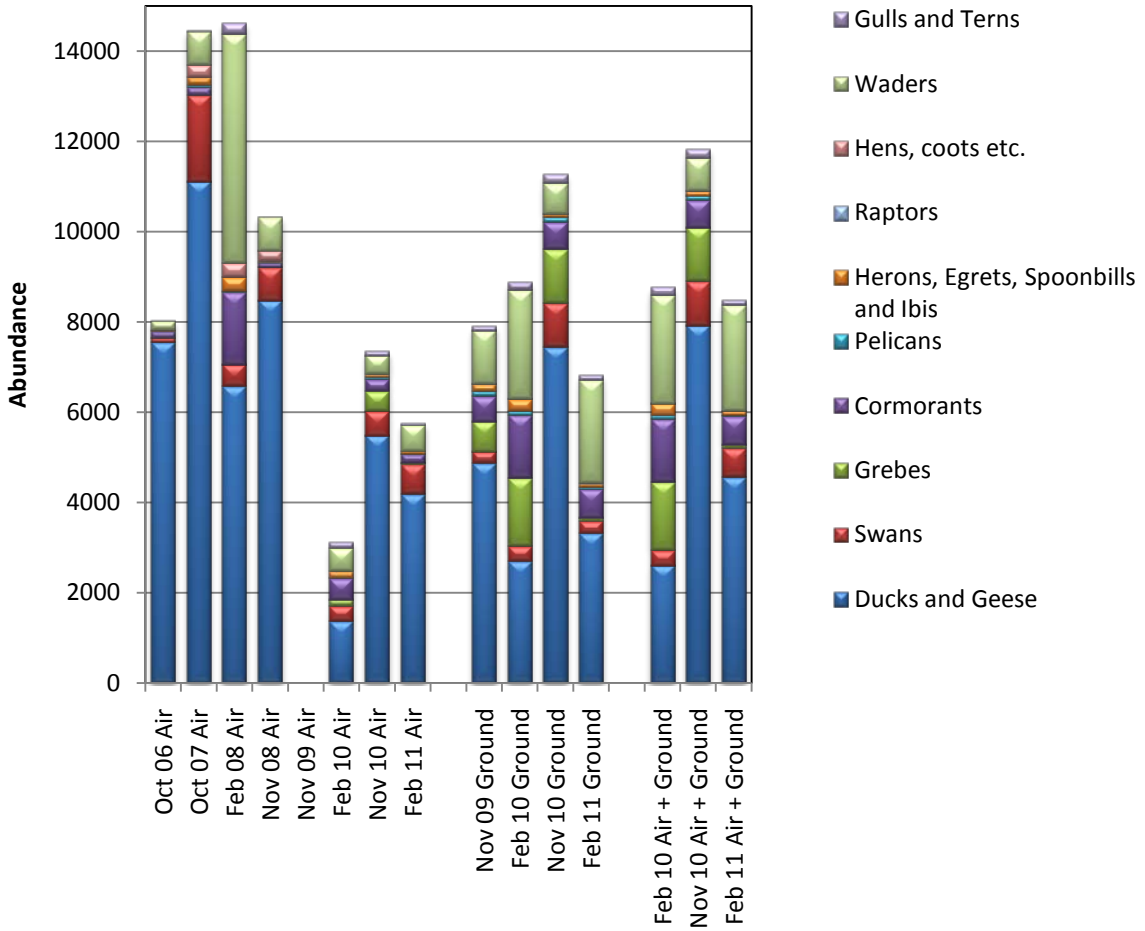

Figure 26. Abundance of waterbirds on the Gore-Quallilup wetlands between October 2006 and February 2011 from aerial surveys or ground surveys or consensus estimates from ground and aerial surveys.

November 2010

In November 2010, 7356 birds were counted from the air whereas 11263 were counted from the ground on Gore-Quallilup wetlands. The consensus figure is 11803. Most of the discrepancy is the 2000 extra shelducks (1500 on Lake Gore alone) and 729 extra hoary headed grebes seen from the ground at Lake Gore. Moulting shelducks were highly scattered across the lake and were diving before they came into view of the aerial observers, as were the grebes. These species were just as scattered and mobile during the ground count at Lake Gore, making counting difficult for the same reason (and shallow depth hindered boat navigation). Ground surveys also estimated an additional 425 swans (across Lake Gore and Carbul lakes) and 356 pink-eared ducks (all on Lake Gore, none seen from the air). The higher number of swans seen from the ground is difficult to

explain as they are easily counted from the air, but there may have been additional swans move into the Gore-Quallilup wetlands between the aerial survey and the ground counts.

On balance, the numbers of most ducks were probably better estimated from the ground; although where aerial and ground counts were similar, aerial counts were used for the consensus estimates. Most of the ducks were on Lake Gore, although many shelducks (A1250/G1167) and grey teals (A204/G152) were seen on Quallilup flow-through. Pink-eared ducks were all on Lake Gore, as were almost all of the Pacific black ducks, chestnut teals and musk ducks. Numbers of individual duck species were generally within the range of previous recent counts. All of the swans were on either Lake Gore (A319/G445) or Carbul Lake (A235/G534) and were in similar numbers as have been recorded since 2006.

Grebes are assumed to have been best estimated from the ground. Almost all of the great crested grebes were on the flow-through, with one present on Quallilup Lake and two on Lake Gore. Most of the nearly 1200 hoary-headed grebes were on Lake Gore, with 24 present on the Dalyup wetlands.

Pelicans (A59/G103) were distributed across the Dalyup wetlands, Lake Gore and the flow-through.

Most of the white-faced herons (A9/G28) and great egrets (A47/G41) were counted on the flow-through, with fewer on Lake Gore. A count of yellow-billed spoonbills was made from the air (on the small lake just south of Dalyup River and in the Quallilup flow-through), but on the ground only great egret was seen, so it is assumed the aerial identifications were wrong, which makes the aerial and ground counts of egrets match. Two white ibis were present in the flow-through (ground count only).

A white-bellied sea-eagle was seen flying over the flow-through system during the ground count but no swamp harriers were observed.

Sharp-tailed sandpipers were the most abundant small shorebird (38 on the eastern shore of Lake Gore, 25 at Quallilup Lake and 22 in the flow-through) and this count was the highest in recent years. Otherwise there were 22 red-necked stints on Carbul Lake and a small number of red-capped plovers (4) and common sandpipers (4) on Lake Gore and Kubitch Lake. Black winged stilts (A54/G106) were present on Lake Gore (A12/G106), Banded Stilt were present on Carbul Lake and Lake Gore during the aerial count (80 and 200 respectively) but these were mostly on Carbul Lake (271) during the ground count. Red-necked avocets were seen only from the ground, on Lake Gore (68) and Carbul Lake (91). No hooded plovers were seen using the Gore-Quallilup wetlands.

February 2011

In February 2011, 5768 birds were counted from the air whereas 6818 were counted from the ground. The ground count includes 675 shorebirds from Gidong Lake, which had not been included in ground counts until this survey, but was included in all previous aerial counts. The consensus figure is 8477.

Major discrepancies between the aerial and ground counts are 1200 fewer shelducks and 400 fewer swans counted from the ground, but an additional 430 little black cormorants and many more shorebirds (especially black-winged stilts and red-necked stints) were seen from the ground. From the air, 400 banded stilt were counted on Kubitch Lake while 1084 were counted on the ground.

Most of the ducks were on Lake Gore, where shelducks (A2890/G1552), musk ducks (A478/G590) and grey teals (A172/G40) predominated. Kubitch Lake also had a large number of shelducks (A513/G720) and there were a few shelducks (A10/G52), grey teals (A54/G121) and chestnut teals (A0/G116) on the flow-through system. The musk duck count is the highest on the Gore-Quallilup wetlands since monitoring began in 2006, with previous counts being ≤ 130.

Swans were all on Lake Gore (A645/G272), with most of those present during the aerial survey presumably moving away from the system prior to the ground count 3 days later.

Hoary-headed grebes were present on Lake Gore (A24/G19) and on the flow-through (A0/G22), as were great crested grebes (Gore A4/G23 and flow-through A8/G2). Hoary-headed grebe abundance was quite low compared to recent counts (>1500 in February 2010 and November 2010), although they were not detected during aerial surveys prior to Nov 2009. The large decline in grebe numbers between November 2010 and February 2011 indicates large scale emigration from Lake Gore over summer. By contrast, over the 2009/10 summer there was an increase in numbers of this species, despite almost identical changes in depth. Our data suggests that they did not move onto any of the Warden wetlands.

As is usual in the Gore-Quallilup wetlands, little black cormorants were underestimated from the air. These remain in trees and are difficult to see during the aerial survey, despite a conscious effort to look for them.

However, large numbers of these were seen on different Warden system wetlands during the same week, so they were probably moving between the two systems and may have been absent during the Gore-Quallilup aerial survey. Little black cormorants were mostly on Lake Gore (A95/G276) and the flow-through (A37/G278). For other cormorants and the darter, ground and aerial counts were closer. Darters were almost all on the flow-through (A10/G13) but one was using Lake Quallilup (A1/G1). Most of the little pied cormorants were also using the flow-through (A44/G57) and Lake Quallilup (A1/G2). A small number of great cormorants was using the flow through (A3/G7).

Thirty six pelicans were counted on Lake Gore from the ground and two were seen on the flow-through whereas only 1 (on Quallilup Lake) was seen from the air. These are difficult to miss from the air so presumably flew onto these wetlands after the aerial survey.

Most of the 23 white-faced herons seen from the air were on Lake Gore (15), whereas most of the 31 seen from the ground were on the flow-through (24). The 27 straw-necked ibis were only seen from the air (in the flow-through) and all of the Australian white ibis (A2/G6) were also on the flow-through. Yellow-billed spoonbills and great egrets were seen on Lake Gore (A9/G0 and A6/G21 respectively) and the flow-through (A7/G9 and A0/G1).

There were two sightings of white-bellied sea-eagles (on Lake Gore and the flow-through, both from the ground), although this may have been the same individual, and one swamp harrier was spotted from the ground on Lake Gore.

No gallinules (coots, crakes etc.) were observed on the Gore-Quallilup system in February 2011. Aerial surveys recorded 228 to 314 Eurasian coots per survey between October 2007 and November 2008, whereas none have been seen from the ground or from the air during the last four surveys.

Eleven species of shorebirds were seen using the Gore-Quallilup system. The most abundant were banded stilts (A400/G1084) on Kubitch Lake and red-necked stints (117 at Lake Gore, 667 at Gidong Lake, 7 on Kubitch Lake and 32 on the flow-through, all from the ground). The count of red-necked stint is the highest since recent surveys began in 2006, although ground counts did not begin until November 2009. The shores of Lake Gore frequently had 100s of this species in the early 1980s (Jaensch *et al.* 1988).

Other moderately common shorebirds were red-necked avocets (totals of A66/G127; on Lake Gore, Kubitch Lake and the flow-through), common greenshanks (total of A12/G47, present on most suites), sharp-tailed sandpipers on Quallilup Lake (A0/G17) and the flow-through (A0/G45) and black-winged stilts (A98/G48 on a number of wetlands). At Kubitch Lake 64 hooded plovers were observed from the ground. There were smaller numbers of common sandpipers (A0/G4), red-capped plovers (A0/G11), curlew sandpipers (A0/G8) and masked lapwings (A0/G5).

Seabirds on the Gore-Quallilup system in February 2011 were silver gulls (A36/G96, mostly on Lake Gore and Quallilup Lake), a single Caspian tern over the flow-through and 3 Pacific gulls over Quallilup Lake.

ACKNOWLEDGEMENTS

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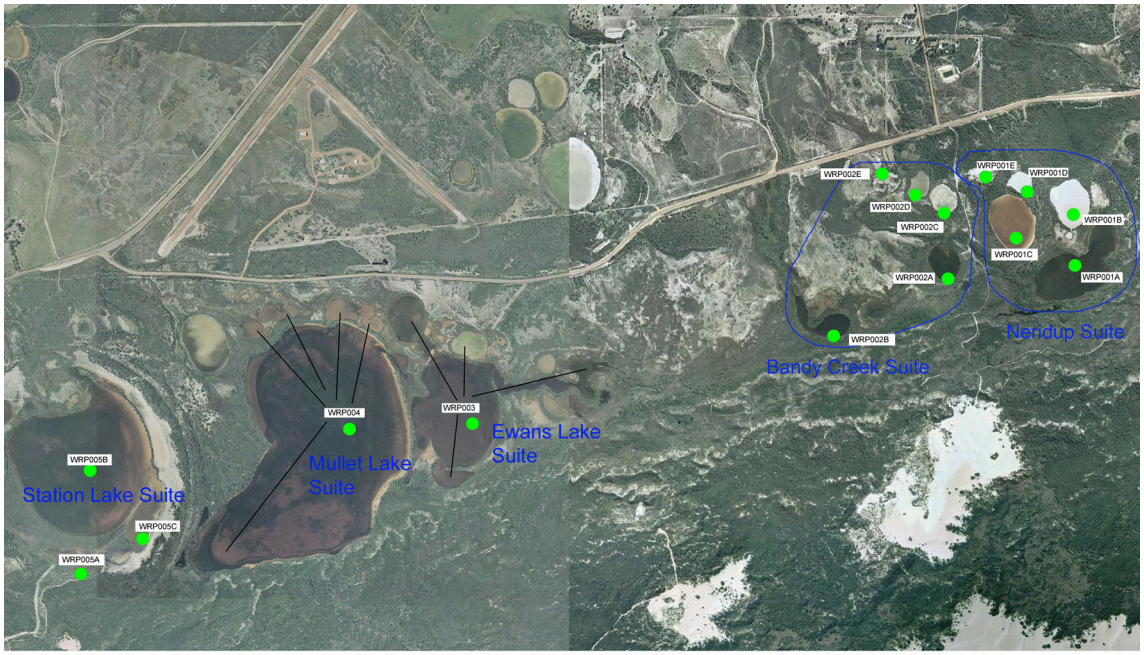
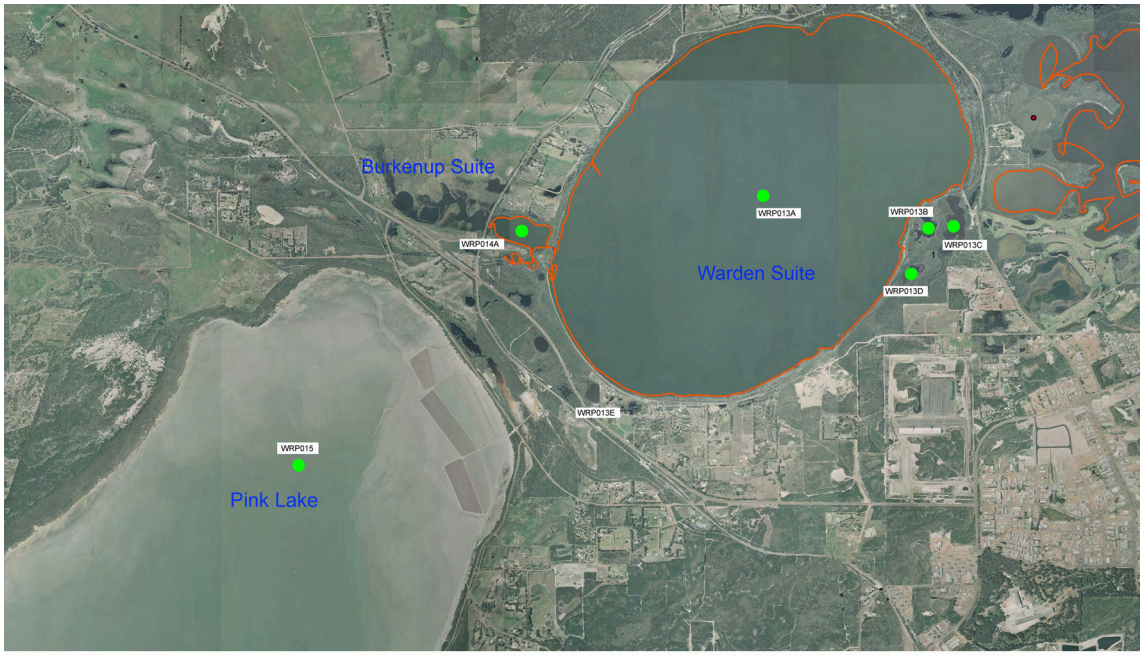
APPENDIX 1: Wetlands surveyed for waterbirds in the Warden and Gore systems in November 2010 and February 2011

Wetland Suite Code	Wetland Suite Name	Wetland	Location	November 2010 ground counts	February 2011 ground counts
WRP001	Neridup Suite	A	large southern lake with two basins	15/11/2010	14/02/2011
		B	medium sized central eastern lake	15/11/2010	DRY 14/02/2011
		C	medium sized central western lake	15/11/2010	DRY 14/02/2011
		D	small lake just above WRP001C	15/11/2010	DRY 14/02/2011
		E	small northern-most lake	DRY 15/11/2010	DRY 14/02/2011
WRP002	Bandy Creek Suite	A	south-eastern lake	15/11/2010	DRY 14/02/2011
		B	south-western lakes and adjacent areas	15/11/2010	14/02/2011
		C	eastern lake closest to track	DRY 15/11/2010	DRY 14/02/2011
		D	lake between C and D	DRY 15/11/2010	DRY 14/02/2011
		E	north-western most lake close to Merivale Road	DRY 15/11/2010	DRY 14/02/2011
WRP003	Ewens Lake	A	includes large wetland areas to north and north-west of Ewans that are connected to Ewans, but didn't get into the southern-most eye-shaped section in 2009	15/11/2010	14/02/2011
WRP004	Mullet Lake	A	includes pans to north of main lake	15/11/2010	14/02/2011
WRP005	Station Lake	A	flats to south of main lake	15/11/2010	DRY 14/02/2011
		B	main lake	15/11/2010	14/02/2011
		C	overflow areas to east of main lake	15/11/2010	14/02/2011
WRP005B	Merivale Suite	A	surveyed with Mullet Lake	15/11/2010	14/02/2011
WRP006	Gun Club wetlands	A	main lake opposite Lake Road (north of Gun Club)	16/11/2010	DRY 14/02/2011
		B	hour-glass shaped on eastern edge of Gun Club	16/11/2010	DRY 14/02/2011
WRP007	Wheatfield Suite	A	Wheatfield Lake plus channel to Woodie Lake	17/11/2010	15/02/2011
		B/C	areas between the larger eastern section of the Wheatfield to Woodie channel and the narrower northern channel that goes through to 007D and E.	17/11/2010	DRY (except for channel) 15/02/2011
		D	satellite wetland north-west of main channel	17/11/2010	DRY 15/02/2011
		E	satellite wetland north-west of 007D near Lake Road	17/11/2010	DRY 15/02/2011
WRP008	North Wheatfield Suite	A	western	16/11/2010	14/02/2011
		B	central	not surveyed	not surveyed
		C	eastern	16/11/2010	14/02/2011
WRP009	Woodie Suite	A	main lake	17/11/2010	15/02/2011
		B	very small wetland just near western edge of main lake	17/11/2010	DRY 15/02/2011
		C	spectacle' lake north of Woodie	17/11/2010	DRY 15/02/2011
		D	Woodie to Windabout channel	17/11/2010	15/02/2011
		E	small wetland opposite boat lauch area	17/11/2010	DRY 15/02/2011
		F	long wetland between Woodie and Windabout	17/11/2010	15/02/2011
		G	wetland at end of Windabout Way	17/11/2010	DRY 15/02/2011
WRP010	Windabout Suite	A	main lake	17/11/2010	15/02/2011
		B	triangular lake south-east of main body	17/11/2010	15/02/2011
		C	small wetland south of south-east bay	17/11/2010	15/02/2011
		D	small wetland north of south-west bay	17/11/2010	15/02/2011
		E	large wetland south of north-west bay	17/11/2010	15/02/2011
		F	large wetland east of north-east bay	17/11/2010	15/02/2011
WRP011	North Windabout Suite	A	series of interconnected wetlands between Lake Road and Windabout	17/11/2010	DRY 15/02/2011
WRP012	Six Mile Hill Suite	A	south-east	16/11/2010	DRY 15/02/2011
		B	south-west	16/11/2010	DRY 15/02/2011
		C	south-central	16/11/2010	DRY 15/02/2011
		D	southern wetland of central pair	16/11/2010	DRY 15/02/2011
		E	northern wetland of central pair	16/11/2010	DRY 15/02/2011
		F	northern wetland	not surveyed	not surveyed
WRP13	Lake Warden Suite	A	main lake	18/11/2010	16/02/2011
		B	middle of three satellite wetlands on south-eastern edge	18/11/2010	16/02/2011
		C	long wetland immediately west of boat ramp track	18/11/2010	15/02/2011
		D	western-most of three stallite wetlands on south-eastern edge	not surveyed	not surveyed
		E	small satellite wetland on southern edge of lake	18/11/2010	16/02/2011
WRP014	Burkenup Suite	A	west of rail-line only, including sattelite wetlands to south of main area	18/11/2010	16/02/2011

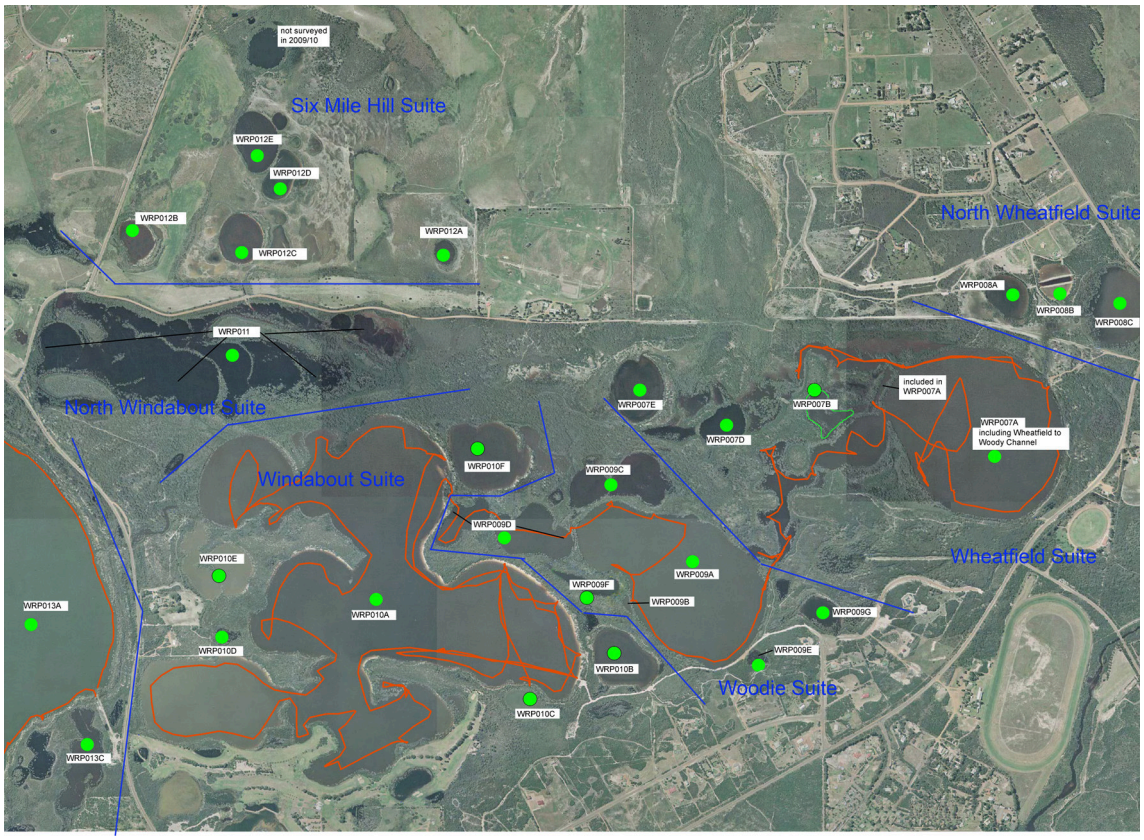
WRP015	Pink Lake	A	main lake	18/11/2010	16/02/2011
WRP016+18	Lake Gore Suite including Dalyup channel and wetland to south of channel	A	main lake plus elongate flats behind dunes on eastern side of lake and small basins on western shore.	19/11/2010	17/02/2011
WRP017	Carbul Lakes	A	Carbul Lake	19/11/2010	16/02/2011
		B	Kubitch Lake	19/11/2010	16/02/2011
		C	Gidong Lake	Aerial only	16/02/2011
WRP019	Quallilup Lake	A	main lake	19/11/2010	17/02/2011
		B	satellite wetland on north-eastern edge	19/11/2010	17/02/2011
WRP020	Kubitch to Quallilup flow-through	A	From Quallilup north through wetland complex as far as water depth allows boat access	19/11/2010	17/02/2011



Appendix 2. Wetland suites and individual wetlands. Station Lake to Neridup Suites



Appendix 2 (cont). Warden Lake to Pink Lake suites and wetlands. The orange line is the route taken during the November 2009 boat survey (excluding on-foot visits to satellite wetlands).



Appendix 2 (cont.). Windabout to North Wheatfield suites and wetlands. Purple lines delineate suites. The orange line is the route taken during the November 2009 boat survey (excluding on-foot visits to satellite wetlands.

Appendix 2 (cont.). Lake Gore wetlands

APPENDIX 3: All ground counts of waterbirds by wetland for Nov 2010 and Feb 2011

(Electronic appendix for Pinder A M, Cale D J, Halse S A & Leung A E 2011 Waterbird Monitoring of the Warden and Gore Wetlands in November 2010 and February 2011. Department of Environment and Conservation, Perth).

	Suite	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Ewans Lake (WRP003)	Mullet Lake (WRP004)	Station Lake (WRP005)	Station Lake (WRP005)	Station Lake (WRP005)	Gun Club Suite (WRP006)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	North Wheatfield Suite (WRP008)	North Wheatfield Suite (WRP008)	North Wheatfield Suite (WRP008)	Woodie Lake Suite (WRP009)
	System	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Season	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09
	Date	19/11/2009	19/11/2009	19/11/2009	19/11/2009	19/11/2009	19/11/2009	19/11/2009	19/11/2009	19/11/2009	19/11/2009	19/11/2009	19/11/2009	20/11/2009	20/11/2009	20/11/2009	19/11/2009	20/11/2009	20/11/2009	20/11/2009	20/11/2009	21/11/2009	20/11/2009	20/11/2009	20/11/2009	20/11/2009
	Suite code	WRP001	WRP001	WRP001	WRP001	WRP001	WRP002	WRP002	WRP002	WRP002	WRP002	WRP003	WRP004	WRP005	WRP005	WRP005	WRP006	WRP007	WRP007	WRP007	WRP007	WRP007	WRP008	WRP008	WRP008	WRP009
	Wetland code	A	B	C	D	E	A	B	C	D	E	A	A	A	B	C	A	A	B	C	D	E	A	B	C	A
	*** = No waterbirds present		***	***	***	***			***	***	***					***								***		
	Comments																								
ORDER	Common name																								
Anseriformes (ducks geese and swans)	blue-billed duck																								
	musk duck												107	2				7		4	1				1	
	freckled duck												2													
	black swan	46						7				234	280	446				10				110	1		2	
	Cape Barren goose																								
	Australian shelduck	29					10	24				207	1405	298				270	1			15	1			4
	Australian wood duck																								
	Pacific black duck	48						46				61	660	104			9	22		30	5	25	2		6	15
	Australasian shoveler	1										21		20												
	grey teal	270						1				180		210			41	98		19		2				12
	chestnut teal	12										46	33	29			36	9							4	2
	pink-eared duck													82				105								
	hardhead													2												
	unidentified duck																								
Podicipediformes (grebes)	hoary-headed grebe											63	129	70			38						32			
	Australasian grebe																								
	great crested grebe											2	20					2								
Pelecaniformes (cormorants and pelicans)	darter											1	2					4								
	little pied cormorant	1										1						2							3	1
	pied cormorant																								
	little black cormorant							6				1	3					35					1		1	2
	great cormorant																	3								
	Australian pelican																								
	unidentified cormorant																								
Ciconiiformes (herons, egrets, ibises and spoonbills)	white-faced heron							4				2	1	4			2		1						1	1
	great egret											1	3	1			4	12					3		8	1
	nankeen night heron																								
	little egret																								
	glossy ibis																	3					3			
	Australian white ibis																	11					3		4	
	straw-necked ibis																	22							48	
	yellow-billed spoonbill											1	5					26					3		4	1
Falconiformes (raptors)	white-bellied sea-eagle																									1
	swamp harrier											1	1					1					1			
Gruiformes (crakes and hens)	spotless crake																								
	black-tailed native hen																								
	Eurasian coot											22	81	2			2	83		23	22				9	
	unidentified hens (not crake or coot)																								
Charadriiformes (waders, gulls and terns)	bar-tailed godwit																								
	marsh sandpiper																								
	common greenshank	47						39				1														
	wood sandpiper																								
	common sandpiper							12							15			1								
	ruddy turnstone																								
	red-necked stint							3																		
	pectoral sandpiper																								
	sharp-tailed sandpiper																								
	curlew sandpiper																								
	black-winged stilt																								7	
	banded stilt													440												
	red-necked avocet											2		198												
	grey plover							5							4											
	great knot																								
	red-capped plover						1	3						6												
	greater sand plover																								
	black-fronted dotterel																		1				1		2	
	hooded plover														1											
	red-kneed dotterel																	1								
	banded lapwing																								
	masked lapwing (southern)																2									
	unidentified wader																	1								
	silver gull																								
	gull-billed tern																								
	fairy tern																								
	Caspian tern																								
	crested tern																								
	whiskered tern																								
	Pacific gull																								
	unidentified terns																								
Coraciiformes (kingfishers)	sacred kingfisher																								

	Suite	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	North Windabout (WRP011)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Burkenup Suite (WRP014)	Pink Lake (WRP015)	Carbul Suite (WRP017)	Carbul Suite (WRP017)	Qualilup Lake (WRP019)	Kubitch - Qualilup flow-through (WRP020)
	System	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Gore	Gore	Gore	Gore
	Season	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09	Nov-09
	Date	20/11/2009	20/11/2009	20/11/2009	20/11/2009	20/11/2009	20/11/2009	20/11/2009	20/11/2009	20/11/2009	20/11/2009	20/11/2009	20/11/2009	20/11/2009	21/11/2009	21/11/2009	21/11/2009	21/11/2009	21/11/2009	21/11/2009	21/11/2009	21/11/2009	21/11/2009	21/11/2009	21/11/2009	22/11/2009	22/11/2009	22/11/2009	22/11/2009
	Suite code	WRP009	WRP009	WRP009	WRP009	WRP009	WRP009	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP011	WRP012	WRP012	WRP012	WRP012	WRP012	WRP013	WRP013	WRP013	WRP013	WRP014	WRP015	WRP017	WRP017	WRP019	WRP020
	Wetland code	B	C	D	E	F	G	A	B	C	D	E	F	A	A	B	C	D	E	A	B	C	D	A	A	A	B	A	A
	*** = No waterbirds present					***										***			***				***						
	Comments																											
ORDER	Common name																											
Anseriformes (ducks geese and swans)	blue-billed duck							1																					
	musk duck		12	9				10			2									21				1					5
	freckled duck																											
	black swan			3				11					2	203	1		6	68									2		16
	Cape Barren goose																											
	Australian shelduck							395				2		11			17	42		9					14		62	102	1913
	Australian wood duck							2																					
	Pacific black duck		96	27			4	128		1	15	4		43										3					17
	Australasian shoveler													30															
	grey teal		80	1				153			30			113				1		24	1	1		25				18	123
	chestnut teal		5					9			1			23						11		2		21				9	13
	pink-eared duck			1				65																					
	hardhead		3						2																				
	unidentified duck																											
Podicipediformes (grebes)	hoary-headed grebe		18	4				12	11		5			10						24				7					80
	Australasian grebe																											
	great crested grebe																											
Pelecaniformes (cormorants and pelicans)	darter							6												5				2				7	10
	little pied cormorant						1																					1	33
	pied cormorant																											
	little black cormorant		15	1			1	17		1										5				1				71	220
	great cormorant																			1								2	2
	Australian pelican																											26	66
	unidentified cormorant																											
Ciconiiformes (herons, egrets, ibises and spoonbills)	white-faced heron							7			1			2			3			15	2	2		5				11	77
	great egret							5												1								1	27
	nankeen night heron						1													1									1
	little egret																											
	glossy ibis																											
	Australian white ibis													3															21
	straw-necked ibis																											
	yellow-billed spoonbill							8			2			10										1				1	3
Falconiformes (raptors)	white-bellied sea-eagle																											1	
	swamp harrier																											
Gruiformes (crakes and hens)	spotless crake																											
	black-tailed native hen																											
	Eurasian coot		4	9	2		3	51		3	1			93															
	unidentified hens (not crake or coot)																											
Charadriiformes (waders, gulls and terns)	bar-tailed godwit																											
	marsh sandpiper																					1							
	common greenshank													13			1			1				1				2	7
	wood sandpiper																											
	common sandpiper																							1				1	
	ruddy turnstone																											
	red-necked stint																								66		6		2
	pectoral sandpiper																											
	sharp-tailed sandpiper																												9
	curlew sandpiper																											
	black-winged stilt													27															24
	banded stilt																										550		
	red-necked avocet																											
	grey plover																											
	great knot																											
	red-capped plover																								9	26	30		
	greater sand plover																											
	black-fronted dotterel			2										1															
	hooded plover													4											1	6	207		
	red-kneed dotterel	1																											
	banded lapwing																											
	masked lapwing (southern)													8															
	unidentified wader																											
	silver gull							10												1					10			70	18
	gull-billed tern																											
	fairy tern																											
	Caspian tern																											6	1
	crested tern							1																					
	whiskered tern							160																				1	
	Pacific gull																											2	
	unidentified terns																											
Coraciiformes (kingfishers)	sacred kingfisher																					1							

	Suite	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Ewans Lake (WRP003)	Mullet Lake (WRP004)	Station Lake (WRP005)	Station Lake (WRP005)	Station Lake (WRP005)	Gun Club Suite (WRP006)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	North Wheatfield Suite (WRP008)	North Wheatfield Suite (WRP008)	North Wheatfield Suite (WRP008)	Woodie Lake Suite (WRP009)
	System	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Season	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10
	Date	22/02/2010	22/02/2010	22/02/2010	22/02/2010	22/02/2010	22/02/2010	22/02/2010	22/02/2010	22/02/2010	22/02/2010	22/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	24/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	24/02/2010	24/02/2010	24/02/2010	23/02/2010
	Suite code	WRP001	WRP001	WRP001	WRP001	WRP001	WRP002	WRP002	WRP002	WRP002	WRP002	WRP003	WRP004	WRP005	WRP005	WRP005	WRP006	WRP007	WRP007	WRP007	WRP007	WRP007	WRP008	WRP008	WRP008	WRP009
	Wetland code	A	B	C	D	E	A	B	C	D	E	A	A	A	B	C	A	A	B	C	D	E	A	B	C	A
	*** = No waterbirds present	***	***	***	***	***	***		***	***	***				***	***	***		***	***		***	***		***	
	Comments																								
ORDER	Common name																								
Anseriformes (ducks geese and swans)	blue-billed duck																								
	musk duck																	1								2
	freckled duck																	1								
	black swan											15	8											7		74
	Cape Barren goose																								
	Australian shelduck											4														
	Australian wood duck																								
	Pacific black duck											28						20								3
	Australasian shoveler											39						10								
	grey teal											598						180								
	chestnut teal											15						28								
	pink-eared duck																	46								
	hardhead																								
	unidentified duck																								
Podicipediformes (grebes)	hoary-headed grebe																	81						2		
	Australasian grebe																								
	great crested grebe																								
Pelecaniformes (cormorants and pelicans)	darter																	9								
	little pied cormorant											2						2								1
	pied cormorant																								
	little black cormorant											2						6								
	great cormorant																								
	Australian pelican											6						1								1
	unidentified cormorant																								
Ciconiiformes (herons, egrets, ibises and spoonbills)	white-faced heron							1				9	18					7			1			3		3
	great egret																	2								1
	nankeen night heron																								
	little egret																									1
	glossy ibis																								
	Australian white ibis																	5								
	straw-necked ibis																	1								
	yellow-billed spoonbill											1						43								1
Falconiformes (raptors)	white-bellied sea-eagle																									1
	swamp harrier							1																		
Gruiformes (crakes and hens)	spotless crake																								
	black-tailed native hen																								
	Eurasian coot																	50						70		
	unidentified hens (not crake or coot)																								
Charadriiformes (waders, gulls and terns)	bar-tailed godwit											3														
	marsh sandpiper																	2								
	common greenshank							1				30	19					11								9
	wood sandpiper																								
	common sandpiper																	5								6
	ruddy turnstone																								
	red-necked stint											9	200													
	pectoral sandpiper																								
	sharp-tailed sandpiper																	3								
	curlew sandpiper												3													
	black-winged stilt																	3								
	banded stilt											4	200													
	red-necked avocet											39	47													
	grey plover																								
	great knot																								
	red-capped plover							2				4	40	3				4								
	greater sand plover																									1
	black-fronted dotterel																	19								15
	hooded plover													11												
	red-kneed dotterel																	3								
	banded lapwing																								
	masked lapwing (southern)																	5								
	unidentified wader																								
	silver gull																	3								32
	gull-billed tern																								
	fairy tern																								
	Caspian tern												2													
	crested tern																								
	whiskered tern																								
	Pacific gull																								
	unidentified terns																								
Coraciiformes (kingfishers)	sacred kingfisher																								

	Suite	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	North Windabout (WRP011)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)
	System	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Season	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10
	Date	23/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	23/02/2010	24/02/2010	24/02/2010	24/02/2010	24/02/2010	24/02/2010	24/02/2010	24/02/2010	24/02/2010	24/02/2010	24/02/2010	24/02/2010
	Suite code	WRP009	WRP009	WRP009	WRP009	WRP009	WRP009	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP011	WRP012	WRP012	WRP012	WRP012	WRP012	WRP013	WRP013	WRP013	WRP013	WRP013
	Wetland code	B	C	D	E	F	G	A	B	C	D	E	F	A	A	B	C	D	E	A	B	C	D	E
	*** = No waterbirds present	***	***		***						***				***	***	***	***	***		***		***	
	Comments																						
ORDER	Common name																						
Anseriformes (ducks geese and swans)	blue-billed duck																						
	musk duck			1				2	2											350				
	freckled duck																						
	black swan						7	275	104			8	61							371				
	Cape Barren goose							6																
	Australian shelduck							7												15				
	Australian wood duck																						
	Pacific black duck			4		7	27	82	2	8		3								3				
	Australasian shoveler			6			2																	
	grey teal			16		2	10	120	6			33	10							205				
	chestnut teal			14			4	178		2		2	4							68				2
	pink-eared duck			94			27	96				1												
	hardhead																						
	unidentified duck																						
Podicipediformes (grebes)	hoary-headed grebe			32		1		15				3								286				
	Australasian grebe																						
	great crested grebe																						
Pelecaniformes (cormorants and pelicans)	darter							2												16				
	little pied cormorant			4			12	1												2				
	pied cormorant																						
	little black cormorant						4	8												54				
	great cormorant							5																
	Australian pelican							157												35				
	unidentified cormorant																						
Ciconiiformes (herons, egrets, ibises and spoonbills)	white-faced heron			3		1		25				1	1	8						25				
	great egret							12																
	nankeen night heron						12																	
	little egret																						
	glossy ibis																						
	Australian white ibis			2				4												2				
	straw-necked ibis																						
	yellow-billed spoonbill			3			7	24	1															
Falconiformes (raptors)	white-bellied sea-eagle																						
	swamp harrier																						
Gruiformes (crakes and hens)	spotless crake							4																
	black-tailed native hen																						
	Eurasian coot						101	53				23												
	unidentified hens (not crake or coot)																						
Charadriiformes (waders, gulls and terns)	bar-tailed godwit																						
	marsh sandpiper																						
	common greenshank			2		2		42	15	1		2	2							10		8		
	wood sandpiper																						
	common sandpiper																			2				
	ruddy turnstone																						
	red-necked stint													215						3				
	pectoral sandpiper							2																
	sharp-tailed sandpiper					1						7												
	curlew sandpiper													24										
	black-winged stilt							16				9	3							2				
	banded stilt																						
	red-necked avocet																			215				
	grey plover																						
	great knot																						
	red-capped plover													0										
	greater sand plover																						
	black-fronted dotterel					2		6		1		3								6				
	hooded plover																			4				
	red-kneed dotterel							1				1												
	banded lapwing																						
	masked lapwing (southern)							3				3								1				
	unidentified wader																						
	silver gull							6												69				
	gull-billed tern																						
	fairy tern																						
	Caspian tern																			19				
	crested tern																						
	whiskered tern																						
	Pacific gull																						
	unidentified terns																						
Coraciiformes (kingfishers)	sacred kingfisher																						

APPENDIX 3: All ground counts of waterbirds by wetland for Nov 2010 and Feb 2011

(Electronic appendix for Pinder A M, Cale D J, Halse S A & Leung A E 2011 Waterbird Monitoring of the Warden and Gore Wetlands in November 2010 and February 2011. Department of Environment and Conservation, Perth).

	System	Warden	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Warden	Warden	Warden	Warden
	Season	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Feb-10	Nov-10	Nov-10	Nov-10	Nov-10
	Date	24/02/2010	25/02/2010	25/02/2010	25/02/2010	11/22/2009	25/02/2010	25/02/2010	25/02/2010	15/11/2010	15/11/2010	15/11/2010	15/11/2010
	Suite	Burkenup Suite (WRP014)	Carbul Suite (WRP017)	Carbul Suite (WRP017)	Lake Gore and Dalyup Suites (WRP016 and WRP018)	Lake Gore and Dalyup Suites (WRP016 and WRP018)	Quallilup Lake (WRP019)	Quallilup Lake (WRP019)	Kubitch - Quallilup flow-through (WRP020)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)
	Suite code	WRP014	WRP017	WRP017	WRP018	WRP018	WRP019	WRP019	WRP020	WRP001	WRP001	WRP001	WRP001
	Wetland code	A	A	B	A	A	A	B	A	A	B	C	D
	*** = No waterbirds present		***	***							***		***
	Comments												
ORDER	Common name												
Anseriformes (ducks geese and swans)	blue-billed duck					2							
	musk duck	1			126	3			4				
	freckled duck												
	black swan				320	236			12	38		5	
	Cape Barren goose												
	Australian shelduck	254			1365	2572			7	59		20	
	Australian wood duck												
	Pacific black duck	1			2	2	2		18	135			
	Australasian shoveler									2			
	grey teal	21			142	23	2		609	579		3	
	chestnut teal	12			262	14	3	18	147	4			
	pink-eared duck												
	hardhead												
	unidentified duck												
Podicipediformes (grebes)	hoary-headed grebe				1427	584		10	74				
	Australasian grebe												
	great crested grebe												
Pelecaniformes (cormorants and pelicans)	darter					1	18		42				
	little pied cormorant					5			200				
	pied cormorant												
	little black cormorant				10	201	171	1	947				
	great cormorant					9			5				
	Australian pelican				48	26			40				
	unidentified cormorant												
Ciconiiformes (herons, egrets, ibises and spoonbills)	white-faced heron	1			8	15	24	1	74			7	
	great egret					5			109				
	nankeen night heron												
	little egret												
	glossy ibis												
	Australian white ibis						1	2	23				
	straw-necked ibis												
	yellow-billed spoonbill							1	19				
Falconiformes (raptors)	white-bellied sea-eagle								1				
	swamp harrier												
Gruiformes (crakes and hens)	spotless crake												
	black-tailed native hen												
	Eurasian coot												
	unidentified hens (not crake or coot)												
Charadriiformes (waders, gulls and terns)	bar-tailed godwit												
	marsh sandpiper												
	common greenshank				3	7	4	2	35	12		1	
	wood sandpiper												
	common sandpiper	1				5							
	ruddy turnstone												
	red-necked stint				10	56			13				
	pectoral sandpiper								22				
	sharp-tailed sandpiper	4				1		4	23				
	curlew sandpiper												
	black-winged stilt	47			102	3			7				
	banded stilt				1080								
	red-necked avocet				1061	215							
	grey plover												
	great knot												
	red-capped plover					12							
	greater sand plover												
	black-fronted dotterel	3					1		26				
	hooded plover												
	red-kneed dotterel												
	banded lapwing												
	masked lapwing (southern)								10				
	unidentified wader												
	silver gull				127	5	29		18				
	gull-billed tern												
	fairy tern												
	Caspian tern						1		2				
	crested tern												
	whiskered tern												
	Pacific gull						1		2				
	unidentified terns												
Coraciiformes (kingfishers)	sacred kingfisher												

	System	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Season	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10
	Date	15/11/2010	15/11/2010	15/11/2010	15/11/2010	15/11/2010	15/11/2010	15/11/2010	15/11/2010	15/11/2010	15/11/2010	16/11/2010	17/11/2010
	Suite	Neridup Suite (WRP001)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Ewans Lake (WRP003)	Mullet Lake (WRP004)	Station Lake (WRP005)	Station Lake (WRP005)	Gun Club Suite (WRP006)	Lake Wheatfield Suite (WRP007)
	Suite code	WRP001	WRP002	WRP002	WRP002	WRP002	WRP002	WRP003	WRP004	WRP005	WRP005	WRP006	WRP007
	Wetland code	E	A	B	C	D	E	A	A	A	B+C	A	A
	*** = No waterbirds present	***			***	***							
	Comments												
ORDER	Common name												
Anseriformes (ducks geese and swans)	blue-billed duck												
	musk duck							1	70				57
	freckled duck												
	black swan							170	192		141		
	Cape Barren goose												
	Australian shelduck			22				627	738	5	135		71
	Australian wood duck												
	Pacific black duck			8				41	13		12		85
	Australasian shoveler							23			3		
	grey teal			165				653	246		222		819
	chestnut teal							12			2		46
	pink-eared duck							1					
	hardhead												53
	unidentified duck												
Podicipediformes (grebes)	hoary-headed grebe							28	63				15
	Australasian grebe												
	great crested grebe								3				2
Pelecaniformes (cormorants and pelicans)	darter												2
	little pied cormorant												6
	pied cormorant												
	little black cormorant			1				2	2		1		4
	great cormorant												1
	Australian pelican							8	2				3
	unidentified cormorant												
Ciconiiformes (herons, egrets, ibises and spoonbills)	white-faced heron			4				1				4	7
	great egret			1					4				14
	nankeen night heron												
	little egret								1				1
	glossy ibis												
	Australian white ibis								1				16
	straw-necked ibis												40
	yellow-billed spoonbill							4			1		22
Falconiformes (raptors)	white-bellied sea-eagle												
	swamp harrier								1				
Gruiformes (crakes and hens)	spotless crake												
	black-tailed native hen												
	Eurasian coot								11				75
	unidentified hens (not crake or coot)												
Charadriiformes (waders, gulls and terns)	bar-tailed godwit												
	marsh sandpiper												
	common greenshank		16	10				38	1				1
	wood sandpiper												
	common sandpiper												4
	ruddy turnstone												
	red-necked stint												
	pectoral sandpiper												
	sharp-tailed sandpiper								1				
	curlew sandpiper							1					
	black-winged stilt							2					
	banded stilt							16					
	red-necked avocet										1		
	grey plover												
	great knot												
	red-capped plover		1	10			9	10		1			
	greater sand plover												
	black-fronted dotterel												6
	hooded plover						2			1	11		
	red-kneed dotterel									1			
	banded lapwing												
	masked lapwing (southern)											4	
	unidentified wader							1					
	silver gull								2		19		20
	gull-billed tern												
	fairy tern												
	Caspian tern												1
	crested tern												
	whiskered tern												
	Pacific gull												
	unidentified terns												
Coraciiformes (kingfishers)	sacred kingfisher												

	System	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Season	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10
	Date	17/11/2010	17/11/2010	17/11/2010	16/11/2010	16/11/2010		17/11/2010	17/11/2010	17/11/2010	17/11/2010	17/11/2010	17/11/2010
	Suite	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	North Wheatfield Suite (WRP008)	North Wheatfield Suite (WRP008)	~~North Wheatfield Suite (WRP008)~~	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)
	Suite code	WRP007	WRP007	WRP007	WRP008	WRP008	WRP008	WRP009	WRP009	WRP009	WRP009	WRP009	WRP009
	Wetland code	B/C	D	E	A	C	~~B~~	A	B	C	D	E	F
	*** = No waterbirds present		***	***					***	***		***	***
	Comments												
ORDER	Common name												
Anseriformes (ducks geese and swans)	blue-billed duck												
	musk duck												
	freckled duck												
	black swan					2							
	Cape Barren goose												
	Australian shelduck										2		
	Australian wood duck												
	Pacific black duck				1	2		2			74		
	Australasian shoveler												
	grey teal				12						217		
	chestnut teal							2			6		
	pink-eared duck												
	hardhead												
	unidentified duck												
Podicipediformes (grebes)	hoary-headed grebe				38			1			15		
	Australasian grebe												
	great crested grebe				1			1			1		
Pelecaniformes (cormorants and pelicans)	darter												
	little pied cormorant				2								
	pied cormorant												
	little black cormorant				1			1					
	great cormorant												
	Australian pelican							1			12		
	unidentified cormorant												
Ciconiiformes (herons, egrets, ibises and spoonbills)	white-faced heron					2		1			7		
	great egret							1			7		
	nankeen night heron												
	little egret												
	glossy ibis												
	Australian white ibis				4			1					
	straw-necked ibis				17								
	yellow-billed spoonbill										2		
Falconiformes (raptors)	white-bellied sea-eagle												
	swamp harrier												
Gruiformes (crakes and hens)	spotless crake												
	black-tailed native hen												
	Eurasian coot				1	3					11		
	unidentified hens (not crake or coot)												
Charadriiformes (waders, gulls and terns)	bar-tailed godwit												
	marsh sandpiper												
	common greenshank	4			1	2							
	wood sandpiper												
	common sandpiper							1					
	ruddy turnstone												
	red-necked stint												
	pectoral sandpiper												
	sharp-tailed sandpiper	9						15					
	curlew sandpiper												
	black-winged stilt				2								
	banded stilt												
	red-necked avocet												
	grey plover	2											
	great knot	4											
	red-capped plover	1											
	greater sand plover												
	black-fronted dotterel							2					
	hooded plover												
	red-kneed dotterel												
	banded lapwing												
	masked lapwing (southern)												
	unidentified wader												
	silver gull							5			1		
	gull-billed tern												
	fairy tern												
	Caspian tern												
	crested tern												
	whiskered tern												
	Pacific gull												
	unidentified terns												
Coraciiformes (kingfishers)	sacred kingfisher												

	System	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Season	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10
	Date	17/11/2010	17/11/2010	17/11/2010	17/11/2010	17/11/2010	17/11/2010	17/11/2010	17/11/2010	16/11/2010	16/11/2010	16/11/2010	16/11/2010
	Suite	Woodie Lake Suite (WRP009)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	North Windabout (WRP011)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)
	Suite code	WRP009	WRP010	WRP010	WRP010	WRP010	WRP010	~~WRP010~~	WRP011	WRP012	WRP012	WRP012	WRP012
	Wetland code	G	A	B	C	D	E	F	A	A	B	C	D
	*** = No waterbirds present				***						***		
	Comments												
ORDER	Common name												
Anseriformes (ducks geese and swans)	blue-billed duck		3										
	musk duck		3										
	freckled duck												
	black swan		183					22	174			47	8
	Cape Barren goose		2										
	Australian shelduck		672					5	577			45	1
	Australian wood duck												
	Pacific black duck		136					4	14	4		7	
	Australasian shoveler								7				
	grey teal		490	18			1	2					
	chestnut teal		134	6					4				
	pink-eared duck		47										
	hardhead		11										
	unidentified duck												
Podicipediformes (grebes)	hoary-headed grebe		23	8									
	Australasian grebe												
	great crested grebe												
Pelecaniformes (cormorants and pelicans)	darter		3										
	little pied cormorant		3										
	pied cormorant												
	little black cormorant		21										
	great cormorant		4										
	Australian pelican		37					1					
	unidentified cormorant												
Ciconiiformes (herons, egrets, ibises and spoonbills)	white-faced heron	2	7	1			2		2	11		23	
	great egret		6				1			1			
	nankeen night heron	1											
	little egret												
	glossy ibis												
	Australian white ibis									2			
	straw-necked ibis									4			
	yellow-billed spoonbill		7										
Falconiformes (raptors)	white-bellied sea-eagle												
	swamp harrier												
Gruiformes (crakes and hens)	spotless crake		1										
	black-tailed native hen												
	Eurasian coot		196										
	unidentified hens (not crake or coot)		1										
Charadriiformes (waders, gulls and terns)	bar-tailed godwit												
	marsh sandpiper												
	common greenshank		21				1						1
	wood sandpiper												
	common sandpiper												
	ruddy turnstone												
	red-necked stint								22				
	pectoral sandpiper												
	sharp-tailed sandpiper					9				3			
	curlew sandpiper												
	black-winged stilt								2				
	banded stilt												
	red-necked avocet												
	grey plover												
	great knot												
	red-capped plover								24				
	greater sand plover												
	black-fronted dotterel												
	hooded plover								2				
	red-kneed dotterel												
	banded lapwing												
	masked lapwing (southern)		6			4							
	unidentified wader												
	silver gull		35										
	gull-billed tern												
	fairy tern												
	Caspian tern		1										
	crested tern												
	whiskered tern												
	Pacific gull												
	unidentified terns												
Coraciiformes (kingfishers)	sacred kingfisher												

	System	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Gore	Gore	Gore	Gore
	Season	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10	Nov-10
	Date	16/11/2010	18/11/2010	18/11/2010	18/11/2010	18/11/2010		18/11/2010	18/11/2010	19/11/2010	19/11/2010	19/11/2010	19/11/2010
	Suite	Six Mile Hill Suite (WRP012)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	~~Lake Warden Suite (WRP013)~~	Burkenup Suite (WRP014)	Pink Lake (WRP015)	Lake Gore and Dalyup Suites (WRP016 and WRP018)	Carbul Suite (WRP017)	Carbul Suite (WRP017)	Quallilup Lake (WRP019)
	Suite code	WRP012	WRP013	WRP013	WRP013	WRP013	WRP013	WRP014	WRP015	WRP016+18	WRP017	WRP017	WRP019
	Wetland code	E	A	B	C	E	~~D~~	A	A	A	A	B	A
	*** = No waterbirds present			***		***	***						
	Comments							Assumed all Grey Teals were Chestnut Teals					
ORDER	Common name												
Anseriformes (ducks geese and swans)	blue-billed duck												
	musk duck		1							16		4	
	freckled duck												
	black swan		2							445		534	
	Cape Barren goose												
	Australian shelduck		108					135		4308	154	491	1
	Australian wood duck												
	Pacific black duck		1					1					
	Australasian shoveler									17			
	grey teal		154							674		2	9
	chestnut teal		160					113		54			2
	pink-eared duck									356			
	hardhead												
	unidentified duck												
Podicipediformes (grebes)	hoary-headed grebe		17							1156			
	Australasian grebe												
	great crested grebe									2			1
Pelecaniformes (cormorants and pelicans)	darter												4
	little pied cormorant									2			
	pied cormorant												
	little black cormorant												4
	great cormorant												
	Australian pelican		1							69			8
	unidentified cormorant												
Ciconiiformes (herons, egrets, ibises and spoonbills)	white-faced heron		7					2		11			1
	great egret		8							3			1
	nankeen night heron												
	little egret												
	glossy ibis												
	Australian white ibis												
	straw-necked ibis												
	yellow-billed spoonbill												
Falconiformes (raptors)	white-bellied sea-eagle												
	swamp harrier												
Gruiformes (crakes and hens)	spotless crake												
	black-tailed native hen												
	Eurasian coot												
	unidentified hens (not crake or coot)												
Charadriiformes (waders, gulls and terns)	bar-tailed godwit									1			
	marsh sandpiper												
	common greenshank	17		1	1					6			3
	wood sandpiper												
	common sandpiper		3					1		3		1	
	ruddy turnstone												
	red-necked stint								6		22		
	pectoral sandpiper												
	sharp-tailed sandpiper		13					4		38			
	curlew sandpiper												
	black-winged stilt		39					2		106			
	banded stilt							8		2	271		
	red-necked avocet		125					81		68	91		
	grey plover												
	great knot												
	red-capped plover								2	2	2		
	greater sand plover												
	black-fronted dotterel		4	2	2								
	hooded plover		3						1				
	red-kneed dotterel												
	banded lapwing												
	masked lapwing (southern)		8					2		2			
	unidentified wader												
	silver gull	1	23						1	182		3	1
	gull-billed tern												
	fairy tern												
	Caspian tern									1			3
	crested tern												
	whiskered tern		2										
	Pacific gull												
	unidentified terns												
Coraciiformes (kingfishers)	sacred kingfisher												

	System	Gore	Gore	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Season	Nov-10	Nov-10	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11
	Date	19/11/2010	19/11/2010	14/02/2011	14/02/2011	14/02/2011	14/02/2011	14/02/2011	14/02/2011	14/02/2011	14/02/2011	14/02/2011	14/02/2011
	Suite	Quallilup Lake (WRP019)	Kubitch - Quallilup flow-through (WRP020)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)
	Suite code	WRP019	WRP020	WRP001	WRP001	WRP001	WRP001	WRP001	WRP002	WRP002	~~WRP002~~	WRP002	WRP002
	Wetland code	B	A	A	B	C	D	E	A	B	C	D	E
	*** = No waterbirds present				***		***	***	***		***	***	***
	Comments				the 100 SNI were flying over								
ORDER	Common name												
Anseriformes (ducks geese and swans)	blue-billed duck												
	musk duck												
	freckled duck												
	black swan												
	Cape Barren goose												
	Australian shelduck	16	1167										
	Australian wood duck												
	Pacific black duck		5							44			
	Australasian shoveler									11			
	grey teal	2	152							4			
	chestnut teal		15										
	pink-eared duck												
	hardhead												
	unidentified duck												
Podicipediformes (grebes)	hoary-headed grebe												
	Australasian grebe												
	great crested grebe		31										
Pelecaniformes (cormorants and pelicans)	darter		70										
	little pied cormorant		6										
	pied cormorant												
	little black cormorant		520										
	great cormorant												
	Australian pelican		26							1			
	unidentified cormorant												
Ciconiiformes (herons, egrets, ibises and spoonbills)	white-faced heron		16										
	great egret		37										
	nankeen night heron												
	little egret												
	glossy ibis												
	Australian white ibis		2										
	straw-necked ibis				100								
	yellow-billed spoonbill												
Falconiformes (raptors)	white-bellied sea-eagle		1										
	swamp harrier												
Gruiformes (crakes and hens)	spotless crake												
	black-tailed native hen												
	Eurasian coot												
	unidentified hens (not crake or coot)												
Charadriiformes (waders, gulls and terns)	bar-tailed godwit												
	marsh sandpiper												
	common greenshank		10							2			
	wood sandpiper												
	common sandpiper												
	ruddy turnstone												
	red-necked stint												
	pectoral sandpiper												
	sharp-tailed sandpiper	25	22										
	curlew sandpiper												
	black-winged stilt												
	banded stilt												
	red-necked avocet												
	grey plover												
	great knot												
	red-capped plover			3		1				3			
	greater sand plover												
	black-fronted dotterel												
	hooded plover			2									
	red-kneed dotterel												
	banded lapwing												
	masked lapwing (southern)												
	unidentified wader												
	silver gull												
	gull-billed tern												
	fairy tern												
	Caspian tern		3										
	crested tern												
	whiskered tern												
	Pacific gull												
	unidentified terns												
Coraciiformes (kingfishers)	sacred kingfisher												

	System	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Season	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11
	Date	14/02/2011	14/02/2011	14/02/2011	14/02/2011	14/02/2011	15/02/2011	15/02/2011	15/02/2011	15/02/2011	14/02/2011	14/02/2011	
	Suite	Ewans Lake (WRP003)	Mullet Lake (WRP004)	Station Lake (WRP005)	Station Lake (WRP005)	Gun Club Suite (WRP006)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	North Wheatfield Suite (WRP008)	North Wheatfield Suite (WRP008)	~~North Wheatfield Suite (WRP008)~~
	Suite code	WRP003	WRP004	WRP005	WRP005	WRP006	WRP007	WRP007	WRP007	WRP007	WRP008	WRP008	WRP008
	Wetland code	A	A	A	B+C	A	A	B/C	D	E	A	C	~~B~~
	*** = No waterbirds present			***				***	***	***			
	Comments												
ORDER	Common name												
Anseriformes (ducks geese and swans)	blue-billed duck												
	musk duck		1				18						
	freckled duck												
	black swan	184	101				5					9	
	Cape Barren goose												
	Australian shelduck		605								2	4	
	Australian wood duck												
	Pacific black duck	116	267				249				116	140	
	Australasian shoveler	97	26				2				1	16	
	grey teal	384	262				219				1	125	
	chestnut teal	116	100				43					12	
	pink-eared duck						10						
	hardhead												
	unidentified duck												
Podicipediformes (grebes)	hoary-headed grebe						1				2		
	Australasian grebe										1		
	great crested grebe						15						
Pelecaniformes (cormorants and pelicans)	darter												
	little pied cormorant	2					11				7	1	
	pied cormorant												
	little black cormorant	1					1				27		
	great cormorant						1						
	Australian pelican						44						
	unidentified cormorant												
Ciconiiformes (herons, egrets, ibises and spoonbills)	white-faced heron	4	5				5				1	2	
	great egret						1						
	nankeen night heron												
	little egret												
	glossy ibis												
	Australian white ibis	1					3				36	1	
	straw-necked ibis										1		
	yellow-billed spoonbill						18				12	8	
Falconiformes (raptors)	white-bellied sea-eagle												
	swamp harrier												
Gruiformes (crakes and hens)	spotless crake												
	black-tailed native hen												
	Eurasian coot						38					9	
	unidentified hens (not crake or coot)												
Charadriiformes (waders, gulls and terns)	bar-tailed godwit		2										
	marsh sandpiper												
	common greenshank	10	45			6	8					2	
	wood sandpiper												
	common sandpiper						2						
	ruddy turnstone												
	red-necked stint	4	67		393								
	pectoral sandpiper												
	sharp-tailed sandpiper												
	curlew sandpiper		8										
	black-winged stilt												
	banded stilt		6										
	red-necked avocet						5						
	grey plover	1	1										
	great knot												
	red-capped plover	4	6		8								
	greater sand plover												
	black-fronted dotterel						34						
	hooded plover		14		9								
	red-kneed dotterel												
	banded lapwing												
	masked lapwing (southern)	2					8						
	unidentified wader												
	silver gull	1	1										
	gull-billed tern												
	fairy tern												
	Caspian tern												
	crested tern												
	whiskered tern												
	Pacific gull												
	unidentified terns												
Coraciiformes (kingfishers)	sacred kingfisher												

	System	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Season	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11
	Date	15/02/2011	15/02/2011	15/02/2011	15/02/2011	15/02/2011	15/02/2011	15/02/2011	15/02/2011	15/02/2011	15/02/2011	15/02/2011	15/02/2011
	Suite	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Woodie Lake Suite (WRP009)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)
	Suite code	WRP009	WRP009	WRP009	WRP009	WRP009	WRP009	WRP009	WRP010	WRP010	WRP010	WRP010	WRP010
	Wetland code	A	B	C	D	E	F	G	A	B	C	D	E
	*** = No waterbirds present		***			***		***				***	
	Comments												
ORDER	Common name												
Anseriformes (ducks geese and swans)	blue-billed duck												
	musk duck								2				
	freckled duck								1				
	black swan								9				
	Cape Barren goose								3				
	Australian shelduck												
	Australian wood duck												
	Pacific black duck	6			13				116	9	1		81
	Australasian shoveler								2				
	grey teal	10			11				26				
	chestnut teal								338				37
	pink-eared duck												
	hardhead												
	unidentified duck												
Podicipediformes (grebes)	hoary-headed grebe								28				
	Australasian grebe												
	great crested grebe												
Pelecaniformes (cormorants and pelicans)	darter								12				
	little pied cormorant	5							4	2			
	pied cormorant												
	little black cormorant												
	great cormorant								14				
	Australian pelican												
	unidentified cormorant												
Ciconiiformes (herons, egrets, ibises and spoonbills)	white-faced heron	3			1				6				5
	great egret								4				6
	nankeen night heron												
	little egret												
	glossy ibis												
	Australian white ibis	1			1								
	straw-necked ibis												
	yellow-billed spoonbill	2			6				17				
Falconiformes (raptors)	white-bellied sea-eagle				1								
	swamp harrier												
Gruiformes (crakes and hens)	spotless crake												
	black-tailed native hen												
	Eurasian coot								2				
	unidentified hens (not crake or coot)												
Charadriiformes (waders, gulls and terns)	bar-tailed godwit												
	marsh sandpiper												
	common greenshank	4		10	1				28				2
	wood sandpiper												
	common sandpiper								2				
	ruddy turnstone												
	red-necked stint												
	pectoral sandpiper												
	sharp-tailed sandpiper				19					12			2
	curlew sandpiper												
	black-winged stilt								2				
	banded stilt												1
	red-necked avocet												
	grey plover												
	great knot												
	red-capped plover												
	greater sand plover												
	black-fronted dotterel						1		3				
	hooded plover												
	red-kneed dotterel												
	banded lapwing												
	masked lapwing (southern)								17				2
	unidentified wader												
	silver gull	15							61				
	gull-billed tern												
	fairy tern								1				
	Caspian tern								1				
	crested tern												
	whiskered tern												
	Pacific gull												
	unidentified terns												
Coraciiformes (kingfishers)	sacred kingfisher												

APPENDIX 3: All ground counts of waterbirds by wetland for Nov 2010 and Feb 2011

(Electronic appendix for Pinder A M, Cale D J, Halse S A & Leung A E 2011 Waterbird Monitoring of the Warden and Gore Wetlands in November 2010 and February 2011. Department of Environment and Conservation, Perth).

	System	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore
	Season	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11	Feb-11
	Date	15/02/2011	15/02/2011	15/02/2011	15/02/2011	15/02/2011	15/02/2011	15/02/2011	15/02/2011	16/02/2011	16/02/2011	16/02/2011	16/02/2011	16/02/2011	16/02/2011	17/02/2011	16/02/2011	16/02/2011	17/02/2011	17/02/2011	17/02/2011	17/02/2011	17/02/2011
	Suite	Wirrabbout Suite (WRP010)	North Wirrabbout (WRP011)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Six Mile Hill Suite (WRP012)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Gore and Diplyp Suites (WRP016 and WRP018)	Carbul Suite (WRP017)	Carbul Suite (WRP017)	Carbul Suite (WRP017)	Quailtup Lake (WRP019)	Quailtup Lake (WRP019)	Kulotich - Quailtup flow-through (WRP020)
	Suite code	WRP010	WRP011	WRP012	WRP012	WRP012	WRP012	WRP012	WRP012	WRP013	WRP013	WRP013	WRP013	WRP013	WRP013	WRP016+18	WRP017	WRP017	WRP017	WRP019	WRP019	WRP020
	Wetland code	F	A	A	B	C	D	E	A	B	C	D	E	A	A	A	A	B	C	A	B	A
	*** = No waterbirds present			***	***	***	***	***		***	***	***	***									
	Comments								423 of the LBC were flying over to the east. large numbers of Chestnut Teal, assumed all Grey Teal were female chestnuts								recount on same day as Gore survey = 679 Shelduck, 4 Swans, 1 WFH, 33 RNS						
ORDER	**Common name**																					
Anseriformes (ducks geese and swans)	blue-billed duck																				0	0
	musk duck								27							591					0	1
	freckled duck																				0	0
	black swan															272					0	0
	Cape Barren goose																				0	0
	Australian shelduck	3							382							1552		720			0	52
	Australian wood duck																				0	0
	Pacific black duck															11					0	3
	Australasian shoveler																				0	0
	grey teal															40					0	121
	chestnut teal								468							116				10	10	116
	pink-eared duck																				0	0
	hardhead																				0	0
	unidentified duck																				0	0
Podicipediformes (grebes)	hoary-headed grebe								70							19					0	22
	Australasian grebe																				0	0
	great crested grebe															23					0	2
Pelecaniformes (cormorants and pelicans)	darter								1											1	1	13
	little pied cormorant															1				2	2	57
	pied cormorant																				0	
	little black cormorant								723							276				6	6	278
	great cormorant																				0	7
	Australian pelican	276							2							36					0	2
	unidentified cormorant																				0	
Ciconiiformes (herons, egrets, ibises and spoonbills)	white-faced heron								16					1		5	1			2	2	24
	great egret															21					0	1
	nankeen night heron																				0	
	little egret																				0	
	glossy ibis																				0	
	Australian white ibis																				0	6
	straw-necked ibis																				0	
	yellow-billed spoonbill															9					0	9
Falconiformes (raptors)	white-bellied sea-eagle															1				1	1	
	swamp harrier															1					0	
Gruiformes (crakes and hens)	spotless crake																				0	
	black-tailed native hen																				0	
	Eurasian coot																				0	
	unidentified hens (not crake or coot)																				0	
Charadriiformes (waders, gulls and terns)	bar-tailed godwit																				0	
	marsh sandpiper																				0	
	common greenshank								2							7		3		1	1	36
	wood sandpiper																				0	
	common sandpiper																				0	4
	ruddy turnstone																				0	
	red-necked stint								48							117		7	667		0	32
	pectoral sandpiper																				0	
	sharp-tailed sandpiper																			17	17	45
	curlew sandpiper																		8		0	
	black-winged stilt								82							34					0	14
	banded stilt								142									1084			0	
	red-necked avocet	37							226							24					0	103
	grey plover																				0	
	great knot																				0	
	red-capped plover		1						8						4	6		3			0	2
	greater sand plover																				0	
	black-fronted dotterel																				0	4
	hooded plover								5						1			64			0	
	red-kneed dotterel																				0	
	banded lapwing																				0	
	masked lapwing (southern)								1							5					0	
	unidentified wader																				0	
	silver gull	11							108							60				30	30	6
	gull-billed tern																				0	
	fairy tern																				0	
	Caspian tern								1												0	1
	crested tern																				0	
	whiskered tern																				0	
	Pacific gull																			3	3	
	unidentified terns																				0	
Coraciiformes (kingfishers)	sacred kingfisher																				0	

APPENDIX 4: Ground and aerial counts of waterbirds by wetland suite for October 2006 to February 2011

(Electronic appendix for Pinder A M, Cale D J, Halse S A & Leung A E 2011 Waterbird Monitoring of the Warden and Gore Wetlands in November 2010 and February 2011. Department of Environment and Conservation, Perth).

ORDER	Wetland suite name	Neridup Suite	Bandy Creek Suite	Ewans Lake	Mullet Lake	Station Lake	Merivale Road Wetlands	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake
	Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Date	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06
	Wetland suite code	WRP001	WRP002	WRP003	WRP004	WRP005	WRP005B	WRP006	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015
	Survey type	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air
	Comment																
ORDER	Common name																
Anseriformes (Ducks Geese and Swans)	blue-billed duck																
	musk duck				22				19			2			1		
	freckled duck																
	Cape Barren goose											2					
	Australian shelduck		107	482	411	228	128		187			318	319	1	1	6	12
	Australian wood duck																
	Pacific black duck	14	185	56	22	87	47		36			117	130	6	4	2	
	Australasian shoveler		20	20	2	5							2				
	grey teal		158	60	10	68			50			100	15	40			
	chestnut teal		87	35		30			55			64	18	1	1		
	pink-eared duck																
	hardhead				10			40	57			1					
	unidentified duck							25									
	black swan		38	35	53	174	68		11			93	65	3	2		
Podicipediformes (Grebes)	hoary-headed grebe				1												
	Australasian grebe																
	great crested grebe				1				8								
Pelecaniformes (Cormorants and Pelicans)	darter								1			6			1		
	little pied cormorant	1	1	1	1	6	5			1		25	1	1	1		
	pied cormorant																
	little black cormorant		3	5	6	8			241	6		127		1		3	
	great cormorant								1								
	unidentified cormorant																
	Australian pelican				2				4			2					
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	white-faced heron		23		2	7	9		1	1		3	13	5	1	1	
	great egret	1	7	6	14	4	5		11	1		14	5		1	1	
	nankeen night heron																
	little egret																
	glossy ibis																
	Australian white ibis						1		6	1		2	1			2	
	straw-necked ibis		3	1	1	1	3		89				6				
	yellow-billed spoonbill				6	4	2		32			3					
Falconiformes (Raptors)	white-bellied sea-eagle																
	swamp harrier												1		1		
Gruiformes (Crakes and Hens)	spotless crake																
	black-tailed native hen																
	Eurasian coot								30			110	4				
	unidentified hens (not crake or coot)																
Charadriiformes (Waders, Gulls and Terns)	bar-tailed godwit																
	marsh sandpiper																
	common greenshank			8					10	1			5	2			
	wood sandpiper																
	common sandpiper																
	ruddy turnstone																
	red-necked stint																
	pectoral sandpiper																
	sharp-tailed sandpiper																
	curlew sandpiper																
	black-winged stilt		6						2			1				1	
	banded stilt		30	12													6
	red-necked avocet												2			2	
	grey plover																
	great knot																
	red-capped plover																
	greater sand plover																
	black-fronted dotterel																
	hooded plover															2	
	red-kneed dotterel																
	banded lapwing																
	masked lapwing (southern)											1				1	
	unidentified wader			15												1	121
	silver gull					20	1										7
	gull-billed tern																
	fairy tern																
	Caspian tern																
	crested tern																
	whiskered tern				1												
	Pacific gull																
	unidentified terns																
Coraciiformes (Kingfishers)	sacred kingfisher																

Wetland suite name	Neridup Suite	Bandy Creek Suite	Ewans Lake	Mullet Lake	Station Lake	Merivale Road Wetlands	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake
Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
Date	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06
Wetland suite code	WRP001	WRP002	WRP003	WRP004	WRP005	WRP005B	WRP006	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015
Survey type	~~Ground~~	~~Ground~~	~~Ground~~	Ground	Ground	Ground	Ground	Ground	~~Ground~~	Ground	Ground	Ground	~~Ground~~	Ground	~~Ground~~	Ground
Comment																
Common name																
blue-billed duck																
musk duck				79	1		1	24		1	5	1		5		
freckled duck																
Cape Barren goose											5					
Australian shelduck				100	85	26		25		12	110	169				30
Australian wood duck																
Pacific black duck				130	35	62	6	174		28	263	40				
Australasian shoveler												46				
grey teal				60	152		12	304		7	265	1				
chestnut teal				40	30	20	18	45			225					
pink-eared duck																
hardhead							29	130		4	3					
unidentified duck				250												
black swan				68	231	60					41	77				
hoary-headed grebe				11	57		17	8			13	17		2		
Australasian grebe																
great crested grebe				24				2			3	1		1		
darter								1			1					
little pied cormorant				9	5			3		4	3					
pied cormorant																
little black cormorant				5				178		20	110					
great cormorant								5								
unidentified cormorant																
Australian pelican											2					
white-faced heron				1	3	1		2		1	4	5		1	1	
great egret				1	2			4		2	4	4			1	
nankeen night heron																
little egret																
glossy ibis																
Australian white ibis				1	2	2		7			1				1	
straw-necked ibis				1	1			34								
yellow-billed spoonbill					3	1		48			6					
white-bellied sea-eagle																
swamp harrier								1			1					
spotless crake																
black-tailed native hen											2					
Eurasian coot							2	63		23	263					
unidentified hens (not crake or coot)																
bar-tailed godwit																
marsh sandpiper																
common greenshank											2				1	
wood sandpiper																
common sandpiper								4								
ruddy turnstone																
red-necked stint												41				37
pectoral sandpiper																
sharp-tailed sandpiper																
curlew sandpiper																
black-winged stilt																
banded stilt																12
red-necked avocet					1							6				
grey plover																
great knot																
red-capped plover												9				78
greater sand plover																
black-fronted dotterel																
hooded plover					3							2				
red-kneed dotterel																
banded lapwing																
masked lapwing (southern)																
unidentified wader					1											
silver gull											1					
gull-billed tern																
fairy tern																
Caspian tern																
crested tern																
whiskered tern											6					
Pacific gull																
unidentified terns																
sacred kingfisher																

Wetland suite name	Neridup Suite	Bandy Creek Suite	Ewans Lake/Mullet Lake combined	Mullet Lake (see Ewans)	Station Lake	Merivale Road Wetlands	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake
Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
Date	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07
Wetland suite code	WRP001	WRP002	WRP003	WRP004	WRP005	WRP005B	WRP006	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015
Survey type	Air	Air	Air	~~Air~~	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air
Comment																
Common name																
blue-billed duck								2			3					
musk duck			22		2						4		1	10		
freckled duck																
Cape Barren goose																
Australian shelduck	1	75	1519		190	105			2		122	118	32	5	2	37
Australian wood duck																
Pacific black duck	11	110	324		40	61		7	8		36	2	35		3	
Australasian shoveler		20	30										30		1	
grey teal	10	10	2		17	32		10			30				1	
chestnut teal		60	94		24	14	20	16	4		18		19		79	
pink-eared duck						5										
hardhead											1440					
unidentified duck																
black swan	4	197	576		364	71		1			43	188	7	1		
hoary-headed grebe		4	45		16		1		3		2	2		2	3	
Australasian grebe																
great crested grebe											6				12	
darter								1	6		6	2		1		
little pied cormorant		2	1				1	10	2	3	3		3			
pied cormorant																
little black cormorant			19		15	2		108	2	51	129	9	2	11	10	
great cormorant								5								
unidentified cormorant																
Australian pelican								15			3	2		1	1	
white-faced heron		1				4	3	5	2		1	5	28	5	3	1
great egret		2	13			2		14	1		2	2	3	2	3	
nankeen night heron																
little egret																
glossy ibis								70				15				
Australian white ibis			1						1						2	
straw-necked ibis			2			1	3	350			3		1		2	
yellow-billed spoonbill			5		4			51	1		4	1	1	7	2	
white-bellied sea-eagle																
swamp harrier																
spotless crake																
black-tailed native hen																
Eurasian coot								52	6		180	149	29			
unidentified hens (not crake or coot)																
bar-tailed godwit																
marsh sandpiper																
common greenshank		47	31									15	2	19	2	
wood sandpiper																
common sandpiper																
ruddy turnstone																
red-necked stint																330
pectoral sandpiper																
sharp-tailed sandpiper																
curlew sandpiper																
black-winged stilt											2	10	12		54	
banded stilt																2290
red-necked avocet																10
grey plover																
great knot																
red-capped plover																50
greater sand plover																2
black-fronted dotterel																
hooded plover																2
red-kneed dotterel																
banded lapwing								30								
masked lapwing (southern)																
unidentified wader		6													1	329
silver gull														74		1
gull-billed tern																
fairy tern																
Caspian tern																
crested tern																
whiskered tern														122		
Pacific gull																
unidentified terns																
sacred kingfisher																

Wetland suite name	Neridup Suite	Bandy Creek Suite	Ewans Lake	Mullet Lake	Station Lake	Merivale Road Wetlands	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite
Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
Date	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07
Wetland suite code	WRP001	WRP002	WRP003	WRP004	WRP005	WRP005B	WRP006	WRP007	WRP008	WRP009	WRP010
Survey type	~~Ground~~	~~Ground~~	Ground	Ground	Ground	Ground	Ground	Ground	~~Ground~~	Ground	Ground
Comment											
Common name											
blue-billed duck								1			17
musk duck			3	17				6			31
freckled duck											
Cape Barren goose											
Australian shelduck			373	435	127	85		1		1	22
Australian wood duck											
Pacific black duck			121	18	49	49		18		2	59
Australasian shoveler			23	11	2	1					7
grey teal			30	10	6	11		47		2	13
chestnut teal			14			20		24		2	78
pink-eared duck								2			
hardhead								1			1587
unidentified duck											
black swan			166	89	207	21				4	5
hoary-headed grebe			94	105	31	1	16	16		12	32
Australasian grebe											
great crested grebe				20							3
darter								4		3	10
little pied cormorant				1			1	22		2	11
pied cormorant											1
little black cormorant			5					129		68	45
great cormorant								6			2
unidentified cormorant											
Australian pelican			3	1	1			10		1	3
white-faced heron			1	3	4	2		4		1	3
great egret			4	2	4	1		13		1	15
nankeen night heron								2			
little egret								3			
glossy ibis											
Australian white ibis			4	1	1			1		1	2
straw-necked ibis				2	20	1		630			
yellow-billed spoonbill			5	2	4			14			2
white-bellied sea-eagle										1	
swamp harrier											1
spotless crake											
black-tailed native hen											3
Eurasian coot								55		22	151
unidentified hens (not crake or coot)											
bar-tailed godwit											
marsh sandpiper											
common greenshank			2		1						
wood sandpiper											
common sandpiper										2	6
ruddy turnstone			2								
red-necked stint			1								
pectoral sandpiper											
sharp-tailed sandpiper			1								
curlew sandpiper											
black-winged stilt											
banded stilt											
red-necked avocet											
grey plover											
great knot											
red-capped plover			6								
greater sand plover											
black-fronted dotterel											
hooded plover											
red-kneed dotterel											
banded lapwing											
masked lapwing (southern)											
unidentified wader											
silver gull										13	8
gull-billed tern											
fairy tern											
Caspian tern											
crested tern											
whiskered tern											71
Pacific gull											
unidentified terns											
sacred kingfisher											

APPENDIX 4: Ground and aerial counts of waterbirds by wetland suite for October 2006 to February 2011

(Electronic appendix for Pinder A M, Cale D J, Halse S A & Leung A E 2011 Waterbird Monitoring of the Warden and Gore Wetlands in November 2010 and February 2011. Department of Environment and Conservation, Perth).

	Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Wetland suite name	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake	Neridup Suite	Bandy Creek Suite	Evans Lake	Mullet Lake	Station Lake	Merivale Road Wetlands	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake
	Date	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
	Wetland suite code	WRP011	WRP012	WRP013	WRP014	WRP015	WRP001	WRP002	WRP003	WRP004	WRP005	WRP005B	WRP006	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015
	Survey type	Ground	Ground	Ground	Ground	Ground	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air
	Comment											DRY										
ORDER	Common name																					
Anseriformes (Ducks Geese and Swans)	blue-billed duck																					
	musk duck	2		6				4		31				5		6	557			396	4	
	freckled duck																					
	Cape Barren goose																20					2
	Australian shelduck	3	8	2	2				65	80			50				73	10			88	
	Australian wood duck																					
	Pacific black duck		8	1	1			4	346	113			40	236		277	593				10	
	Australasian shoveler		2						410	57			80	11	50	4						
	grey teal	3		2					202	240			270	303	30	100	720				29	
	chestnut teal		6	4	12				32	70				72		97	201				7	
	pink-eared duck			2										50		5						
	hardhead													101		5	100					
	unidentified duck							5								500						
	black swan	127	11	4				10	108	164	2		35	1	3	150	916	82		50	1	
Podicipediformes (Grebes)	hoary-headed grebe	14		34	23	40?								70		20	10			316	20	
	Australasian grebe																					
	great crested grebe			2	3																	
Pelecaniformes (Cormorants and Pelicans)	darter							2						5	2		10	2				
	little pied cormorant		2					5	8					3	10		1	2				
	pied cormorant													1								
	little black cormorant		1	4	1									187			1	2		134		
	great cormorant													5								
	unidentified cormorant																					
	Australian pelican	1			1				8		5			21			12			1	13	
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	white-faced heron	1	11	1	2			2	2	1	7			7		2	9	3		1	3	
	great egret	1	2		2				2					1		3	7	2				
	nankeen night heron																					
	little egret																					
	glossy ibis																					
	Australian white ibis	3						2						1								
	straw-necked ibis	1	1											6								
	yellow-billed spoonbill				1				2					63		3	21					
Falconiformes (Raptors)	white-bellied sea-eagle																					
	swamp harrier																					
Gruiformes (Crakes and Hens)	spotless crake																					
	black-tailed native hen																					
	Eurasian coot	25						50	30					18			295					
	unidentified hens (not crake or coot)																					
Charadriiformes (Waders, Gulls and Terns)	bar-tailed godwit																					
	marsh sandpiper																					
	common greenshank	1	12					1	2	11				5	2		1					
	wood sandpiper																					
	common sandpiper																					
	ruddy turnstone																					
	red-necked stint					131																
	pectoral sandpiper																					
	sharp-tailed sandpiper																					
	curlew sandpiper																					
	black-winged stilt																				27	
	banded stilt					970				3510	10											
	red-necked avocet					24					177		15					70		20		
	grey plover																					
	great knot																					
	red-capped plover					86																
	greater sand plover					3																
	black-fronted dotterel																					
	hooded plover					6																8
	red-kneed dotterel																					
	banded lapwing																					
	masked lapwing (southern)																				1	
	unidentified wader					201					700			10							5	
	silver gull			17					2	30	18			5			90			50		
	gull-billed tern																					
	fairy tern																					
	Caspian tern																1					
	crested tern																					
	whiskered tern	18		52																		
	Pacific gull																					
	unidentified terns					1																
Coraciiformes (Kingfishers)	sacred kingfisher																					

	Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Wetland suite name	Neridup Suite	Bandy Creek Suite	Evans Lake	Mullet Lake	Station Lake	Merivale Road Wetlands	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake
	Date	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
	Wetland suite code	WRP001	WRP002	WRP003	WRP004	WRP005	WRP005B	WRP006	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015
	Survey type	~~Ground~~	~~Ground~~	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground
	Comment						DRY										
ORDER	Common name																
Anseriformes (Ducks Geese and Swans)	blue-billed duck																
	musk duck				22				3		16	434			411	31	
	freckled duck										1	4					
	Cape Barren goose											43					
	Australian shelduck			2	61							166	5		6	2	
	Australian wood duck																
	Pacific black duck			82	134				388	20	501	882					
	Australasian shoveler			692	25			87	40		2	26					
	grey teal			459	150			658	299		563	366					
	chestnut teal			27				12	59	3	159	607				6	
	pink-eared duck								52		18	60					
	hardhead								40		6	123					
	unidentified duck																
	black swan			77	118			32			37	779	81		41		
Podicipediformes (Grebes)	hoary-headed grebe			58					73	33	83		6		97	95	
	Australasian grebe																
	great crested grebe								2			53			11		
Pelecaniformes (Cormorants and Pelicans)	darter								24	3	1	8					
	little pied cormorant			1					1			5					
	pied cormorant																
	little black cormorant								72		4					1	
	great cormorant								5			1					
	unidentified cormorant																
	Australian pelican			8					9		1	40				56	
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	white-faced heron			2	1				5	1	1	7	2		12	4	
	great egret			1					5	1	7	7				2	
	nankeen night heron											2					
	little egret																
	glossy ibis																
	Australian white ibis								3		2						
	straw-necked ibis								31								
	yellow-billed spoonbill			4					88		10	18					
Falconiformes (Raptors)	white-bellied sea-eagle																
	swamp harrier																
Gruiformes (Crakes and Hens)	spotless crake								6			2					
	black-tailed native hen																
	Eurasian coot			88				18	116		63	600					
	unidentified hens (not crake or coot)																
Charadriiformes (Waders, Gulls and Terns)	bar-tailed godwit																
	marsh sandpiper																
	common greenshank			22	16	3		1	33	29	5		6	2		3	
	wood sandpiper															2	
	common sandpiper								2								
	ruddy turnstone																
	red-necked stint				107	370										9	
	pectoral sandpiper																
	sharp-tailed sandpiper															6	
	curlew sandpiper					210											
	black-winged stilt												4			13	
	banded stilt				2800	5											
	red-necked avocet				16	280							176		44		
	grey plover																
	great knot																
	red-capped plover			3	28	6											
	greater sand plover																
	black-fronted dotterel								14	14				2		2	
	hooded plover																
	red-kneed dotterel								4	4							
	banded lapwing																
	masked lapwing (southern)																
	unidentified wader																
	silver gull			3	4				3			53			96		
	gull-billed tern																
	fairy tern																
	Caspian tern										1	2			2		
	crested tern														1		
	whiskered tern																
	Pacific gull																
	unidentified terns																
Coraciiformes (Kingfishers)	sacred kingfisher																

	Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Wetland suite name	Neridup Suite	Bandy Creek Suite	Evans Lake/Mullet Lake combined	Mullet Lake (see Evans)	Station Lake	Merivale Road Wetlands	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake	Neridup Suite	Bandy Creek Suite	Evans Lake	Mullet Lake	Station Lake	Merivale Road Wetlands	Gun Club Suite
	Date	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
	Wetland suite code	WRP001	WRP002	WRP003+4	WRP004	WRP005	WRP005B	WRP006	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015	WRP001	WRP002	WRP003	WRP004	WRP005	WRP005B	WRP006
	Survey type	Air	Air	Air	~~Air~~	~~Air~~	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	~~Ground~~	~~Ground~~	~~Ground~~	Ground	Ground	Ground	Ground
	Comment																							
ORDER	Common name																							
Anseriformes (Ducks Geese and Swans)	blue-billed duck		1																					
	musk duck			129				12		2		5			25						73	1		
	freckled duck																							
	Cape Barren goose											11												
	Australian shelduck		21	820			67		36	10		69	26	10	28	70	368				125	15	95	
	Australian wood duck																							2
	Pacific black duck		5	2			4		3			28			2							13	14	1
	Australasian shoveler																					2	2	
	grey teal			80						5		2		2		12						62	8	
	chestnut teal																					9	2	2
	pink-eared duck																							
	hardhead						3					7												
	unidentified duck																							
	black swan	1	31	576			32		2		5	180	65	8	21						160	136	92	
Podicipediformes (Grebes)	hoary-headed grebe											9	3								13	17		
	Australasian grebe																							
	great crested grebe																				4			
Pelecaniformes (Cormorants and Pelicans)	darter								3			6				1								
	little pied cormorant		2	34				1	3			5		1										
	pied cormorant								2															
	little black cormorant		2	14					5	1					182	42								
	great cormorant								6			1												
	unidentified cormorant																							
	Australian pelican						1		6	1		1	10		1	16								
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	white-faced heron			3								2	7		2								1	
	great egret		1	3			2					2				3							1	
	nankeen night heron																							
	little egret																							
	glossy ibis																							
	Australian white ibis																							
	straw-necked ibis		2						103															
	yellow-billed spoonbill						15	1	12	1						1								
Falconiformes (Raptors)	white-bellied sea-eagle																							
	swamp harrier																							
Gruiformes (Crakes and Hens)	spotless crake																							
	black-tailed native hen																							
	Eurasian coot								1			50												
	unidentified hens (not crake or coot)																							
Charadriiformes (Waders, Gulls and Terns)	bar-tailed godwit																							
	marsh sandpiper																							
	common greenshank		1	1									6			10								
	wood sandpiper																							
	common sandpiper																							
	ruddy turnstone																							
	red-necked stint																							
	pectoral sandpiper																							
	sharp-tailed sandpiper																							
	curlew sandpiper																							
	black-winged stilt		2										50	2										
	banded stilt																							
	red-necked avocet																70							
	grey plover																							
	great knot																							
	red-capped plover																							
	greater sand plover																							
	black-fronted dotterel																							
	hooded plover																							
	red-kneed dotterel																							
	banded lapwing																							
	masked lapwing (southern)																							
	unidentified wader			5										20			100							
	silver gull														5		54							
	gull-billed tern											2			3									
	fairy tern																							
	Caspian tern														1									
	crested tern																							
	whiskered tern											29	5		130	1	120							
	Pacific gull																							
	unidentified terns																							
Coraciiformes (Kingfishers)	sacred kingfisher																							

APPENDIX 4: Ground and aerial counts of waterbirds by wetland suite for October 2006 to February 2011

(Electronic appendix for Pinder A M, Cale D J, Halse S A & Leung A E 2011 Waterbird Monitoring of the Warden and Gore Wetlands in November 2010 and February 2011. Department of Environment and Conservation, Perth).

ORDER	Wetland suite name	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake	Neridup Suite	Bandy Creek Suite	Evans Lake	Station Lake	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake
	Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Date	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
	Wetland suite code	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015	WRP001	WRP002	WRP003	WRP005	WRP006	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015
	Survey type	Ground	~~Ground~~	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air	Air
	Comment																						East only	
ORDER	**Common name**																							
Anseriformes (Ducks Geese and Swans)	blue-billed duck				3																			
	musk duck			2	6	3		1																
	freckled duck																							
	Cape Barren goose				1																			
	Australian shelduck	41		1	1417	5			172															
	Australian wood duck																							
	Pacific black duck	7		10	76		9		4															
	Australasian shoveler	12			1																			
	grey teal	12		4	12	1			4															
	chestnut teal	18		2	62		2		24															
	pink-eared duck				90																			
	hardhead			31	251																			
	unidentified duck									40														
	black swan				30	72	5																	
Podicipediformes (Grebes)	hoary-headed grebe	6		3	35	46		3	5															
	Australasian grebe																							
	great crested grebe				2																			
Pelecaniformes (Cormorants and Pelicans)	darter	3		2	3																			
	little pied cormorant	2			2																			
	pied cormorant																							
	little black cormorant	36			5																			
	great cormorant	6		1	32																			
	unidentified cormorant																							
	Australian pelican	20			4				1															
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	white-faced heron	3			1				13															
	great egret	1			2			1	11															
	nankeen night heron																							
	little egret	1																						
	glossy ibis																							
	Australian white ibis	2																						
	straw-necked ibis	70			3																			
	yellow-billed spoonbill	16			2				4															
Falconiformes (Raptors)	white-bellied sea-eagle																							
	swamp harrier																							
Gruiformes (Crakes and Hens)	spotless crake																							
	black-tailed native hen				10																			
	Eurasian coot	12		21	83																			
	unidentified hens (not crake or coot)																							
Charadriiformes (Waders, Gulls and Terns)	bar-tailed godwit																							
	marsh sandpiper																							
	common greenshank					1	5		3															
	wood sandpiper								3															
	common sandpiper	3																						
	ruddy turnstone																							
	red-necked stint																							
	pectoral sandpiper																							
	sharp-tailed sandpiper						5																	
	curlew sandpiper																							
	black-winged stilt																							
	banded stilt																							
	red-necked avocet									189														
	grey plover																							
	great knot																							
	red-capped plover									10														
	greater sand plover																							
	black-fronted dotterel	1																						
	hooded plover									4														
	red-kneed dotterel						1																	
	banded lapwing																							
	masked lapwing (southern)								4															
	unidentified wader									170														
	silver gull									8														
	gull-billed tern																							
	fairy tern																							
	Caspian tern									2														
	crested tern																							
	whiskered tern	5		14	106	3	35	20																
	Pacific gull																							
	unidentified terns																							
Coraciiformes (Kingfishers)	sacred kingfisher																							

ORDER	Wetland suite name	Neridup Suite	Bandy Creek Suite	Evans Lake	Mullet Lake	Station Lake	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake
	Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Date	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
	Wetland suite code	WRP001	WRP002	WRP003	WRP004	WRP005	WRP006	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015
	Survey type	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground
	Comment														East only	
ORDER	**Common name**															
Anseriformes (Ducks Geese and Swans)	blue-billed duck										1					
	musk duck				107	2		12	1	21	12			21	1	
	freckled duck				2											
	Cape Barren goose															
	Australian shelduck	29	34	207	1405	298		286	1	4	397	11	59	9		14
	Australian wood duck										2					
	Pacific black duck	48	46	61	660	104	9	82	8	142	148	43			3	
	Australasian shoveler	1		21		20						30				
	grey teal	270	1	180		210	41	119		93	183	113	1	26	25	
	chestnut teal	12		46	33	29	36	9	4	7	10	23		13	21	
	pink-eared duck					82		105		1	65					
	hardhead					2				3	2					
	unidentified duck															
	black swan	46	7	234	280	446		120	3	3	13	203	75			
Podicipediformes (Grebes)	hoary-headed grebe			63	129	70	38		32	22	28	10		24	7	
	Australasian grebe															
	great crested grebe			2	20			2								
Pelecaniformes (Cormorants and Pelicans)	darter			1	2			4			6			5	2	
	little pied cormorant	1		1				2	3	2						
	pied cormorant															
	little black cormorant		6	1	3			35	2	19	18			5	1	
	great cormorant							3						1		
	unidentified cormorant															
	Australian pelican															
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	white-faced heron		4	2	1	4	2	1	1	1	8	2	3	19	5	
	great egret			1	3	1	4	12	11	1	5			1		
	nankeen night heron									1				1		
	little egret															
	glossy ibis							3	3							
	Australian white ibis							11	7			3				
	straw-necked ibis							22	48							
	yellow-billed spoonbill			1	5			26	7	2	10	10			1	
Falconiformes (Raptors)	white-bellied sea-eagle									1						
	swamp harrier			1	1			1	1							
Gruiformes (Crakes and Hens)	spotless crake															
	black-tailed native hen															
	Eurasian coot			22	81	2	2	128	9	18	55	93				
	unidentified hens (not crake or coot)															
Charadriiformes (Waders, Gulls and Terns)	bar-tailed godwit															
	marsh sandpiper													1		
	common greenshank	47	39	1								13	1	1	1	
	wood sandpiper															
	common sandpiper		12			15		1							1	
	ruddy turnstone															
	red-necked stint		3													66
	pectoral sandpiper															
	sharp-tailed sandpiper															
	curlew sandpiper															
	black-winged stilt								7			27				
	banded stilt					440										
	red-necked avocet			2		198										
	grey plover		5			4										
	great knot															
	red-capped plover		4			6										9
	greater sand plover															
	black-fronted dotterel							1	3	2		1				
	hooded plover					1						4				1
	red-kneed dotterel							1		1						
	banded lapwing															
	masked lapwing (southern)						2					8				
	unidentified wader							1								
	silver gull										10			1		10
	gull-billed tern															
	fairy tern															
	Caspian tern															
	crested tern										1					
	whiskered tern										160					
	Pacific gull															
	unidentified terns															
Coraciiformes (Kingfishers)	sacred kingfisher													1		

ORDER	Wetland suite name	Neridup Suite	Bandy Creek Suite	Evans Lake	Mullet Lake	Station Lake	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake	Neridup Suite	Bandy Creek Suite	Evans Lake	Mullet Lake
	Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Date	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
	Wetland suite code	WRP001	WRP002	WRP003	WRP004	WRP005	WRP006	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015	WRP001	WRP002	WRP003	WRP004
	Survey type	Air	Air	Air	Air	Air	~~Air~~	Air	Air	Air	Air	Air	Air	Air	Air	Air	Ground	Ground	Ground	Ground
	Comment	DRY	DRY			DRY							DRY		East only	DRY	DRY	DRY		
ORDER	**Common name**																			
Anseriformes (Ducks Geese and Swans)	blue-billed duck																			
	musk duck							12			4			405						
	freckled duck																			
	Cape Barren goose																			
	Australian shelduck				3			30			16			5	55				4	
	Australian wood duck																			
	Pacific black duck			23	3			27		111	74			27					28	
	Australasian shoveler																		39	
	grey teal			433	48			158		71	155			50	14				598	
	chestnut teal										7								15	
	pink-eared duck																			
	hardhead																			
	unidentified duck			30				38			38									
	black swan			4					1	222	317			380					15	8
Podicipediformes (Grebes)	hoary-headed grebe							90						510						
	Australasian grebe																			
	great crested grebe																			
Pelecaniformes (Cormorants and Pelicans)	darter							4	1		3			11						
	little pied cormorant			6				2		1	1			10					2	
	pied cormorant																			
	little black cormorant									3	10			154					2	
	great cormorant																			
	unidentified cormorant							1												
	Australian pelican										177			8					6	
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	white-faced heron			1	9			3	2	1	11			2					9	18
	great egret							1		11	4									
	nankeen night heron																			
	little egret																			
	glossy ibis																			
	Australian white ibis			5				8												
	straw-necked ibis																			
	yellow-billed spoonbill							30			12								1	
Falconiformes (Raptors)	white-bellied sea-eagle																			
	swamp harrier																			
Gruiformes (Crakes and Hens)	spotless crake																			
	black-tailed native hen																			
	Eurasian coot							12	46	91	54									
	unidentified hens (not crake or coot)																			
Charadriiformes (Waders, Gulls and Terns)	bar-tailed godwit																		3	3
	marsh sandpiper																			
	common greenshank				6			2	1	6	6			1					30	19
	wood sandpiper																			
	common sandpiper																			
	ruddy turnstone																			
	red-necked stint																		9	200
	pectoral sandpiper																			
	sharp-tailed sandpiper																			
	curlew sandpiper											29								3
	black-winged stilt			1				1			8				10					
	banded stilt				200														4	200
	red-necked avocet													70					39	47
	grey plover																			
	great knot																			
	red-capped plover																		4	40
	greater sand plover																			
	black-fronted dotterel																			
	hooded plover																			
	red-kneed dotterel																			
	banded lapwing																			
	masked lapwing (southern)																			
	unidentified wader				115					2	2	50								
	silver gull				1					53	1			17						
	gull-billed tern																			
	fairy tern																			
	Caspian tern																			2
	crested tern																			
	whiskered tern																			
	Pacific gull																			
	unidentified terns										100			40						
Coraciiformes (Kingfishers)	sacred kingfisher																			

APPENDIX 4: Ground and aerial counts of waterbirds by wetland suite for October 2006 to February 2011

(Electronic appendix for Pinder A M, Cale D J, Halse S A & Leung A E 2011 Waterbird Monitoring of the Warden and Gore Wetlands in November 2010 and February 2011. Department of Environment and Conservation, Perth).

ORDER	Wetland suite name	Station Lake	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake	Neridup Suite	Bandy Creek Suite	Evans Lake	Mullet Lake	Station Lake	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite
	Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Date	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
	Wetland suite code	WRP005	WRP006	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015	WRP001	WRP002	WRP003	WRP004	WRP005	WRP006	WRP007	WRP008	WRP009
	Survey type	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Air	Air	Air	Air	Air	~~Air~~	Air	Air	Air
	Comment	DRY							DRY		East only	DRY									
ORDER	Common name																				
Anseriformes (Ducks Geese and Swans)	blue-billed duck																				
	musk duck			1		3	4			350	1					36			14		
	freckled duck			1																	
	Cape Barren goose						6														
	Australian shelduck						7			15	254		72	78	795	662	70		134	5	10
	Australian wood duck																				
	Pacific black duck			20		41	95			3	1		35		8	24			3		
	Australasian shoveler			10		8									3	17					
	grey teal			180		28	169			205	21		362		584	145	160		520		248
	chestnut teal			28		18	186			70	12								3		
	pink-eared duck			46		121	97														
	hardhead																		14		16
	unidentified duck														10	300			122		50
	black swan				7	81	448			371			24	4	101	138	148		47		2
Podicipediformes (Grebes)	hoary-headed grebe			81	2	33	18			286					4	16			13		
	Australasian grebe																				
	great crested grebe																				
Pelecaniformes (Cormorants and Pelicans)	darter			9			2			16											1
	little pied cormorant			2		17	1			2										2	
	pied cormorant																				
	little black cormorant			6		4	8			54									2	1	
	great cormorant						5														
	unidentified cormorant																				
	Australian pelican			1		1	157			35						1			10		2
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	white-faced heron			8	3	7	27	8		25	1				5	2			2	1	1
	great egret			2		1	12												14		4
	nankeen night heron					12															
	little egret					1															
	glossy ibis																				
	Australian white ibis			5		2	4			2									6		
	straw-necked ibis			1										10						3	
	yellow-billed spoonbill			43		11	25												2		
Falconiformes (Raptors)	white-bellied sea-eagle					1															
	swamp harrier																				
Gruiformes (Crakes and Hens)	spotless crake						4														
	black-tailed native hen																				
	Eurasian coot			50	70	101	76												1	2	
	unidentified hens (not crake or coot)																				
Charadriiformes (Waders, Gulls and Terns)	bar-tailed godwit																				
	marsh sandpiper			2																	
	common greenshank			11		13	62			18			1	20	1						
	wood sandpiper																				
	common sandpiper			5		6				2	1										
	ruddy turnstone																				
	red-necked stint							215		3											
	pectoral sandpiper						2														
	sharp-tailed sandpiper			3		1	7				4										
	curlew sandpiper							24													
	black-winged stilt			3			28			2	47				3				5	1	
	banded stilt														20						
	red-necked avocet									215											
	grey plover																				
	great knot																				
	red-capped plover	3		4																	
	greater sand plover					1															
	black-fronted dotterel			19		17	10			6	3										
	hooded plover	11								4											
	red-kneed dotterel			3			2														
	banded lapwing																				
	masked lapwing (southern)			5			6			1											
	unidentified wader																		2		
	silver gull			3		32	6			69									6	2	
	gull-billed tern																				
	fairy tern																				
	Caspian tern									19											
	crested tern																				
	whiskered tern																				
	Pacific gull																				
	unidentified terns																				
Coraciiformes (Kingfishers)	sacred kingfisher																				

ORDER	Wetland suite name	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake	Neridup Suite	Bandy Creek Suite	Evans Lake	Mullet Lake	Station Lake	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite
	Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Date	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
	Wetland suite code	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015	WRP001	WRP002	WRP003	WRP004	WRP005	WRP006	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014
	Survey type	Air	Air	Air	Air	Air	Air	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground
	Comment																				
ORDER	Common name																				
Anseriformes (Ducks Geese and Swans)	blue-billed duck																3				
	musk duck				7					1	70			57			3			1	
	freckled duck																				
	Cape Barren goose																2				
	Australian shelduck	710	500	9	54	225		79	22	627	738	140		71		2	677	577	46	108	135
	Australian wood duck																				
	Pacific black duck	87		4				135	8	41	13	12		85	3	76	140	14	11	1	1
	Australasian shoveler							2		23		3						7			
	grey teal	368	200		60	46		582	165	653	246	222		819	12	217	511			194	56
	chestnut teal	113			109			4		12		2		46		8	140	4		110	57
	pink-eared duck									1							47				
	hardhead													53			11				
	unidentified duck				9	10	2														
	black swan	266	200	68			1	43		170	192	141			2		205	174	55	2	
Podicipediformes (Grebes)	hoary-headed grebe	2			6					28	63			15	38	16	31			17	
	Australasian grebe																				
	great crested grebe				13						3			2	1	2					
Pelecaniformes (Cormorants and Pelicans)	darter	4												2			3				
	little pied cormorant													6	2		3				
	pied cormorant																				
	little black cormorant	3							1	2	2	1		4	1	1	21				
	great cormorant	5												1			4				
	unidentified cormorant																				
	Australian pelican	20			1					8	2			3		13	38			1	
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	white-faced heron			10	4		1	7	4	1			4	7	2	2	10	2	34	7	2
	great egret	6		1	11				1		4			14		8	7		1	8	
	nankeen night heron															1					
	little egret										1			1							
	glossy ibis																				
	Australian white ibis	2		2							1			16	4	1			2		
	straw-necked ibis			4	1									40	17				4		
	yellow-billed spoonbill	2								4		1		22		2	7				
Falconiformes (Raptors)	white-bellied sea-eagle																				
	swamp harrier										1										
Gruiformes (Crakes and Hens)	spotless crake																1				
	black-tailed native hen																				
	Eurasian coot	90									11			75	4	11	196				
	unidentified hens (not crake or coot)																1				
Charadriiformes (Waders, Gulls and Terns)	bar-tailed godwit																				
	marsh sandpiper																				
	common greenshank			7	1			13	26	38	1			5	3		22		18	2	
	wood sandpiper																				
	common sandpiper													4		1				3	1
	ruddy turnstone																				
	red-necked stint																	22			
	pectoral sandpiper																				
	sharp-tailed sandpiper										1			9		15	9		3	13	4
	curlew sandpiper									1											
	black-winged stilt				40					2					2			2		39	2
	banded stilt						1			16											8
	red-necked avocet				115	30						1								125	81
	grey plover													2							
	great knot													4							
	red-capped plover								20	10		1		1				24			
	greater sand plover																				
	black-fronted dotterel													6		2				8	
	hooded plover								2			12						2		3	
	red-kneed dotterel											1									
	banded lapwing																				
	masked lapwing (southern)												4				10			8	2
	unidentified wader	13		50	1		229			1											
	silver gull		2	2	29		1				2	19		20		6	35		1	23	
	gull-billed tern																				
	fairy tern																				
	Caspian tern													1			1				
	crested tern																				
	whiskered tern				3															2	
	Pacific gull																				
	unidentified terns																				
Coraciiformes (Kingfishers)	sacred kingfisher																				

ORDER	Wetland suite name	Pink Lake	Neridup Suite	Bandy Creek Suite	Evans Lake	Mullet Lake	Station Lake	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake	Neridup Suite	Bandy Creek Suite
	Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden
	Date	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
	Wetland suite code	WRP015	WRP001	WRP002	WRP003	WRP004	WRP005	WRP006	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015	WRP001	WRP002
	Survey type	Ground	Air	Air	Air	Air	Air	~~Air~~	Air	Air	Air	Air	Air	Air	Air	Air	Air	Ground	Ground
	Comment																		
ORDER	Common name																		
Anseriformes (Ducks Geese and Swans)	blue-billed duck																		
	musk duck								10			5			74				
	freckled duck																		
	Cape Barren goose																		
	Australian shelduck			25	13	376		5		2		173			519				
	Australian wood duck																		
	Pacific black duck			30	35	34			66	120	66	66			5				44
	Australasian shoveler				3	5													11
	grey teal			20	114	17			256	20	174	26			147				4
	chestnut teal														14				
	pink-eared duck																		
	hardhead																		
	unidentified duck				300				72	130		49							
	black swan			2	40	235				10	25	33			6				
Podicipediformes (Grebes)	hoary-headed grebe											16			128				
	Australasian grebe																		
	great crested grebe																		
Pelecaniformes (Cormorants and Pelicans)	darter											4			1				
	little pied cormorant								3		1	1			2				
	pied cormorant																		
	little black cormorant										400				1				
	great cormorant								1		3								
	unidentified cormorant																		
	Australian pelican					3			200			29			1				1
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	white-faced heron				1	2					3	8			1	1			
	great egret								10		14	40							
	nankeen night heron																		
	little egret																		
	glossy ibis																		
	Australian white ibis								7		2								
	straw-necked ibis																	100	
	yellow-billed spoonbill								5	50	6	2							
Falconiformes (Raptors)	white-bellied sea-eagle																		
	swamp harrier																		
Gruiformes (Crakes and Hens)	spotless crake																		
	black-tailed native hen																		
	Eurasian coot									10									
	unidentified hens (not crake or coot)																		
Charadriiformes (Waders, Gulls and Terns)	bar-tailed godwit																		
	marsh sandpiper																		
	common greenshank				1				5	12	4	6							2
	wood sandpiper																		
	common sandpiper																		
	ruddy turnstone																		
	red-necked stint	6																	
	pectoral sandpiper																		
	sharp-tailed sandpiper																		
	curlew sandpiper																		
	black-winged stilt														17				
	banded stilt														120				
	red-necked avocet											20			230				
	grey plover																		
	great knot																		
	red-capped plover	2																4	3
	greater sand plover																		
	black-fronted dotterel																		
	hooded plover	1																2	
	red-kneed dotterel																		
	banded lapwing																		
	masked lapwing (southern)									3		2							
	unidentified wader						55												
	silver gull	1									3	51			144				
	gull-billed tern																		
	fairy tern																		
	Caspian tern																		
	crested tern																		
	whiskered tern																		
	Pacific gull																		
	unidentified terns																		
Coraciiformes (Kingfishers)	sacred kingfisher																		

APPENDIX 4: Ground and aerial counts of waterbirds by wetland suite for October 2006 to February 2011

(Electronic appendix for Pinder A M, Cale D J, Halse S A & Leung A E 2011 Waterbird Monitoring of the Warden and Gore Wetlands in November 2010 and February 2011. Department of Environment and Conservation, Perth).

	Wetland system	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Warden	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore
	Wetland suite name	Ewans Lake	Mullet Lake	Station Lake	Gun Club Suite	Lake Wheatfield Suite	North Wheatfield Suite	Woodie Lake Suite	Windabout Lake Suite	North Windabout Suite	Six Mile Hill Suite	Lake Warden Suite	Burkenup Suite	Pink Lake	Lake Gore	Dalyup Suite	Quallilup Lake	Kubitch to Quallilup Flow-through (including Carbul Lakes)	Lake Gore	Dalyup Suite	Quallilup Lake	Kubitch to Quallilup Flow-through (including Carbul Lakes)	Lake Gore	Dalyup Suite	Quallilup Lake	Kubitch to Quallilup Flow-through (including Carbul Lakes)	Lake Gore	Dalyup Suite	Quallilup Lake	Kubitch to Quallilup Flow-through (including Carbul Lakes)	Lake Gore	Dalyup Suite	Quallilup Lake	Kubitch to Quallilup Flow-through (including Carbul Lakes)	Lake Gore	Dalyup Suite	Quallilup Lake	Kubitch to Quallilup Flow-through (including Carbul Lakes)	Lake Gore	Dalyup Suite	Quallilup Lake	Kubitch to Quallilup Flow-through (including Carbul Lakes)	Lake Gore	Dalyup Suite	Quallilup Lake	Kubitch to Quallilup Flow-through (including Carbul Lakes)	Lake Gore and Dalyup Suite	Dalyup Suite (included in Gore counts)	Quallilup Lake	Kubitch to Quallilup Flow-through (including Carbul Lakes)	Lake Gore and Dalyup Suite	Dalyup Suite (included in Gore counts)	Quallilup Lake	Kubitch to Quallilup Flow-through (including Carbul Lakes)	Lake Gore and Dalyup Suite
	Date	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-06	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	Oct-07	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
	Wetland suite code	WRP003	WRP004	WRP005	WRP006	WRP007	WRP008	WRP009	WRP010	WRP011	WRP012	WRP013	WRP014	WRP015	WRP016	WRP018	WRP019	WRP017/20	WRP016	WRP018	WRP019	WRP017/20	WRP016	WRP018	WRP019	WRP017/20	WRP016	WRP018	WRP019	WRP017/20	WRP016	WRP018	WRP019	WRP017/20	WRP016	WRP018	WRP019	WRP017/20	WRP016	WRP018	WRP019	WRP017/20	WRP016	WRP018	WRP019	WRP017/20	WRP016/18	WRP018	WRP019	WRP017/20	WRP016/18	WRP018	WRP019	WRP017/20	WRP016/18
	Survey type	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	Ground	air	~~air~~	air	air	~~ground~~	~~ground~~	~~ground~~	~~ground~~	air	air	air	air	~~ground~~	~~ground~~	~~ground~~	~~ground~~	air	air	air	air	~~ground~~	~~ground~~	~~ground~~	~~ground~~	air	air	air	air	~~ground~~	~~ground~~	~~ground~~	~~ground~~	~~air~~	~~air~~	~~air~~	~~air~~	ground	~~ground~~	ground	ground	air
	Comment																																																						
ORDER	Common name																																																						
Anseriformes (Ducks Geese and Swans)	blue-billed duck																									2																									2				
	musk duck		1			18			2			27			80			10					9			1													3	1											3			5	1
	freckled duck								1																																														
	Cape Barren goose								3																																														
	Australian shelduck		605				6					382			4141		2	2466					6789	364	7	3227					3351			1470					5331	73	85	2634									2572		102	1975	1269
	Australian wood duck																																																						
	Pacific black duck	116	267			249	256	19	207						28			54					1			37						22										4									2			17	3
	Australasian shoveler	97	26			2	17		2						10			8																70																					
	grey teal	384	162			206	126	21	26						183			86					157	65		33					28	96		554					190	120		35									23		18	123	61
	chestnut teal	116	200			86	12		375			468			319			148					282			134					884	21		96								2									14		9	13	
	pink-eared duck					10												10																																					
	hardhead																	1																																					
	unidentified duck														4																																								1
	black swan	184	101			5	9		9						51			55					577	25		1314					26			447					123	5		601									236			18	221
Podicipediformes (Grebes)	hoary-headed grebe					1	2		28			70																																							584			80	146
	Australasian grebe						1																																																
	great crested grebe					15									3																																								
Pelecaniformes (Cormorants and Pelicans)	darter								12			1						1								2						3	1	43							1	7									1		7	10	
	little pied cormorant	2				11	8	5	6						1			1					2			1					1		1	43					2	1	1	4									5		1	33	
	pied cormorant																																	7																					
	little black cormorant	1				1	27					723						122					88		57	15					1		53	1434						3	1	86									201		71	220	199
	great cormorant					1			14									5							1	1							1	3								4									9		2	2	
	unidentified cormorant																																																						
	Australian pelican					44						2						10					15	35	3	4							1	29								12									26		26	66	
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	white-faced heron	4	5			5	3	4	11			16	1		14			10					39			8					2		2	93					1		1	2									15		11	77	1
	great egret					1			10														7			17								147								6									5		1	27	13
	nankeen night heron																																																					1	
	little egret																																																						
	glossy ibis																																	1																					
	Australian white ibis	1				3	37	2							1																4			34								1												21	
	straw-necked ibis						1																			1																													
	yellow-billed spoonbill					18	20	8	17														54	31		17					1		1	23								10											1	3	
Falconiformes (Raptors)	white-bellied sea-eagle							1																																													1		
	swamp harrier																															2																							
Gruiformes (Crakes and Hens)	spotless crake																																																						
	black-tailed native hen																																																						
	Eurasian coot					38	9		2																	274					4			310								228													
	unidentified hens (not crake or coot)																																																						
Charadriiformes (Waders, Gulls and Terns)	bar-tailed godwit		2																																																				
	marsh sandpiper																																																						
	common greenshank	10	45		6	8	2	15	30			2			1			1					15	3		16					4	2	1	50					1			1									7		2	7	1
	wood sandpiper																																																						
	common sandpiper					2			2																																										5		1		
	ruddy turnstone																																																						
	red-necked stint	4	67	393								48																																							56			8	
	pectoral sandpiper																																																						
	sharp-tailed sandpiper							19	14																																										1			9	
	curlew sandpiper		8																																																				
	black-winged stilt								2			82			3			4					57	10							12	140		12					92	10											3			24	66
	banded stilt		6						1			142			10			7						50										3860																				550	423
	red-necked avocet					5						226			60			112					202	352							140	110		260					480												215				
	grey plover	1	1																																																				
	great knot																																																						
	red-capped plover	4	6	8						1		8		4										15																											12			56	
	greater sand plover																																																						
	black-fronted dotterel					34		1	3																																														
	hooded plover		14	9								5		1																																								213	
	red-kneed dotterel																																																						
	banded lapwing																						3									4																							
	masked lapwing (southern)	2				8			19			1			2									10																															
	unidentified wader																	1					2	2		1					3			460					15			140													
	silver gull	1	1					15	61			108			3			1					17	2		2					155		65	32					1		1	2									5		70	18	122
	gull-billed tern																																																						
	fairy tern								1																																														
	Caspian tern								1			1						1															2						3			1											6	1	
	crested tern																																																						
	whiskered tern																																																				1		
	Pacific gull																																																				2		
	unidentified terns																																																							
Coraciiformes (Kingfishers)	sacred kingfisher																																																						

APPENDIX 4: Ground and aerial counts of waterbirds by wetland suite for October 2006 to February 2011

(Electronic appendix for Pinder A M, Cale D J, Halse S A & Leung A E 2011 Waterbird Monitoring of the Warden and Gore Wetlands in November 2010 and February 2011. Department of Environment and Conservation, Perth).

ORDER	Wetland system	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore	Gore
	Wetland suite name	Dalyup Suite (included in Gore counts)	Quallilup Lake	Kubitch to Quallilup Flow-through (including Carbul Lakes)	Lake Gore and Dalyup Suite	Dalyup Suite (included in Gore counts)	Quallilup Lake	Kubitch to Quallilup Flow-through (including Carbul Lakes)	Lake Gore and Dalyup Suite	Dalyup Suite (included in Gore counts)	Quallilup Lake	Kubitch to Quallilup Flow-through (including Carbul Lakes)	Lake Gore and Dalyup Suite	Dalyup Suite (included in Gore counts)	Carbul Suite	Quallilup Lake	Quallilup-Kubitch flow-through	Lake Gore and Dalyup Suite	Dalyup Suite (included in Gore counts)	Carbul Suite	Quallilup Lake	Quallilup-Kubitch flow-through	Lake Gore and Dalyup Suite	Dalyup Suite (included in Gore counts)	Carbul Suite	Quallilup Lake	Quallilup-Kubitch flow-through
	Date	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
	Wetland suite code	WRP018	WRP019	WRP017/20	WRP016/18	WRP018	WRP019	WRP017/20	WRP016/18	WRP018	WRP019	WRP017/20	WRP016/18	WRP018	WRP017	WRP019	WRP020	WRP016/18	WRP018	WRP017	WRP019	WRP017/20	WRP016/18	WRP018	WRP017	WRP019	WRP020
	Survey type	~~air~~	air	air	ground	~~ground~~	ground	ground	air	~~air~~	air	air	ground	~~ground~~	ground	ground	ground	air	~~air~~	~~air~~	air	air	ground	~~ground~~	ground	ground	ground
	Comment																										
ORDER	Common name																										
Anseriformes (Ducks Geese and Swans)	blue-billed duck																										
	musk duck				126			4	32				16		4			478					591				1
	freckled duck																										
	Cape Barren goose																										
	Australian shelduck		1		1365			7	2875		13	1250	4308		645	17	1167	2890		513		10	1552		720		52
	Australian wood duck																										
	Pacific black duck				2		2	18	149			11					5	4					11				3
	Australasian shoveler								5				17														
	grey teal			10	142		2	609	860		2	204	674		2	11	152	172		6		54	40				121
	chestnut teal				262		21	147					54			2	15						116			10	116
	pink-eared duck												356														
	hardhead																										
	unidentified duck			22					82			7						69									
	black swan			125	320			12	319			235	445		534			645		6		1	272				
Podicipediformes (Grebes)	hoary-headed grebe				1427		10	74	422			5	1156					24					19				22
	Australasian grebe																										
	great crested grebe								1				2			1	31	4				8	23				2
Pelecaniformes (Cormorants and Pelicans)	darter		11	4			18	42			5	15				4	70				1	10				1	13
	little pied cormorant			13				200			3		2				6				1	44	1			2	57
	pied cormorant																										
	little black cormorant			250	10		172	947	220		4	12				4	520	95				37	276			6	278
	great cormorant							5														3					7
	unidentified cormorant																										
	Australian pelican			2	48			40	25		14	20	69			8	26				1		36				2
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	white-faced heron		12	2	8		25	74			2	7	11			1	16	15		1	1	6	5		1	2	24
	great egret			82				109	16			31	3			1	37	6					21				1
	nankeen night heron																										
	little egret																										
	glossy ibis																										
	Australian white ibis		1	20			3	23									2					2					6
	straw-necked ibis											2										27					
	yellow-billed spoonbill			4			1	19														7	9				9
Falconiformes (Raptors)	white-bellied sea-eagle							1									1						1			1	
	swamp harrier																						1				
Gruiformes (Crakes and Hens)	spotless crake																										
	black-tailed native hen																										
	Eurasian coot																										
	unidentified hens (not crake or coot)																										
Charadriiformes (Waders, Gulls and Terns)	bar-tailed godwit												1														
	marsh sandpiper																										
	common greenshank			16	3		6	35			2	2	6			3	10	2				10	7		3	1	36
	wood sandpiper																										
	common sandpiper												3		1												4
	ruddy turnstone																										
	red-necked stint				10			13							22								117		674		32
	pectoral sandpiper							22																			
	sharp-tailed sandpiper						4	23					38			25	22									17	45
	curlew sandpiper																								8		
	black-winged stilt		1	9	102			7	12			42	106					1		90		7	34				14
	banded stilt				1080				80			200	2		271					400					1084		
	red-necked avocet				1061								68		91			38		18		10	24				103
	grey plover																										
	great knot																										
	red-capped plover												2		2								6		3		2
	greater sand plover																										
	black-fronted dotterel						1	26																			4
	hooded plover																								64		
	red-kneed dotterel																										
	banded lapwing																										
	masked lapwing (southern)							10					2										5				
	unidentified wader		1	2								71						12				2					
	silver gull		9		127		29	18	95		1	1	182		3	1		16			13	7	60			30	6
	gull-billed tern																										
	fairy tern																										
	Caspian tern		2				1	2			1	1	1			3	3					1					1
	crested tern																										
	whiskered tern																										
	Pacific gull						1	2																		3	
	unidentified terns																										
Coraciiformes (Kingfishers)	sacred kingfisher																										