Waterbird and Invertebrate Monitoring of the Warden and Gore Wetlands in November 2009 and February 2010

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Our environment, our future

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INTRODUCTION

This report presents the fifth and sixth round of waterbird surveys of the Lake Warden and Lake Gore wetland systems, following on from the surveys between October 2006 and November 2008 (Halse 2007; Bennelongia 2008ab and 2009). We also present results of a third round of invertebrate sampling of selected Warden system wetlands, following sampling in 2006 and 2007 by Cook *et al.* (2007) and Cook and Farrell (2008). The aims of these monitoring programs have been to:

- Evaluate the ongoing value of these wetland systems as habitat for waterbirds, especially in relation to their status as Wetlands of International Importance.

- Monitor the diversity and abundance of aquatic invertebrates, particularly in relation to physical and chemical conditions, in the Warden system.

- Monitor the effects of the engineering intervention (drainage of water from Wheatfield to the ocean via Bandy Creek) to reduce the depth of the central complex of the Warden wetlands (Wheatfield to Windabout).

Warden system wetlands

Detailed descriptions of the Lake Warden and Lake Gore wetland systems, their biodiversity values and landscape settings are provided in DEC (2009ab). The Lake Warden system consists of three main wetland complexes, described in the draft Lake Warden Recovery Catchment Recovery Plan (2005-2030) as follows:

> The eastern suite includes Ewans Lake, Mullet Lake and Station Lake. Neridup Creek and Bandy Creek flow into this suite at Ewans Lake. The surface water transported by these creeks flows from Ewans Lake into Mullet Lake and into Station Lake via a braided network when water levels reach 6.4 mAHD. Once Station Lake fills to an AHD depth of 4.4 meters it outflows to the Bandy Creek Weir at 1.27m AHD and into the Southern Ocean. Average water depths in the eastern suite of wetlands have doubled since 1985 (CALM Science Depth Data).
>
> The central suite includes Lake Wheatfield, Woody Lake and Lake Windabout. Coramup Creek flows directly into this suite at Lake Wheatfield. The surface water transported by Coramup Creek flows from east to west through this suite by flowing from Lake Wheatfield directly into Woody Lake via a well defined channel. Once Woody Lake fills to an AHD depth of 4.3 meters it flows into Lake Windabout. At an AHD of 4.5 meters, Lake Windabout will overflow a natural high point down through culverts under the Esperance Coolgardie Highway (4.05 m AHD) into Lake Warden (which is in the western wetland suite). Once Lake Wheatfield fills to an AHD depth of 4.8 meters it will outflow over a natural high point to the east through culverts under Fisheries Road (4.26m AHD) down to the Bandy Creek Weir.
>
> The western suite includes Pink Lake and Lake Warden. Pink Lake has no inflow creeks from the surrounding catchment and no surface water connectivity with Lake Warden. Monjimup, Buckenerup and Melijinup Creeks flow directly into Lake Warden and contribute about 5 per cent of the total surface flows that enter the entire LWWS. Lake Warden receives inflows from Lake Windabout when the depth of the latter exceeds than 4.5 meters AHD but the direction of water movement can reverse when depth in the whole Warden to Wheatfield system exceeds 4.8 metres and Wheatfield overflows to the east.

A major threatening process in the Lake Warden system is the increased volumes of water delivered to the wetlands by a number of creek systems (and lesser groundwater inputs) following extensive land clearing in the catchment. Increased lake depth has resulted in extensive death of fringing vegetation and greatly reduced shorebird habitat (DEC 2009a; unpublished Draft Recovery Plan for the Warden Recovery Catchment; Robertson *et al*. 2005). To ameliorate this problem for the central suite of wetlands a pipeline was installed to drain excess water from Lake Wheatfield into Bandy Creek. The 2009/10 waterbird and invertebrate surveys are the first since the pipeline began operating in May 2009. At the time of the October 2009 invertebrate sampling and the November 2009 waterbird surveys, depth at Lake Wheatfield was about 1.6 metres (Figure 1), which is not much lower than the average for these months in the last decade (1.7 ± 0.23 m, calculated from 2001 to 2008 data). However, in February 2010 Lake Wheatfield had fallen to 0.8 metres, which is the lowest depth for this lake since February 2004. It should be noted, however, that summer rainfall was particularly low (38.5 mm) in 2009/10[1] and this may have contributed to low water depth at Wheatfield. Summer rainfall was also low in 2004/5 (19.6 mm) and that summer saw lake depth fall to about the same as February 2010 (Figure 1).

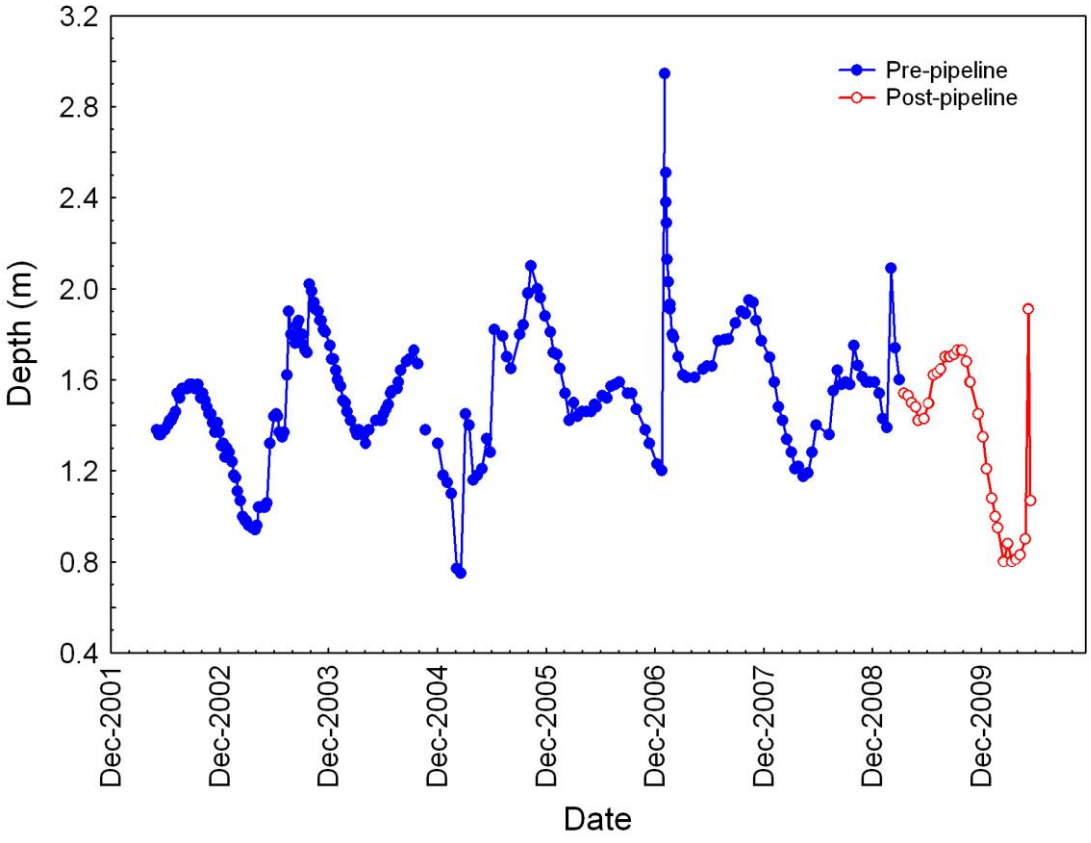

Figure 1. Depth of Lake Wheatfield measured from the depth gauge from May 2002 to May 2010.

[1] December to February rainfall measured at the Bureau of Meteorology weather station 009789.

Gore system wetlands

Lake Gore is a large (740 ha) semi-permanent lake fed primarily by flow down the Dalyup River which enters the lake on its eastern side. Several intermittently inundated lagoons are connected to the Dalyup River near the inlet and elongate interdunal wetlands lie parallel to the eastern shore of Lake Gore. Some flow also reaches Lake Gore from the Coobidge Creek catchment via smaller basins such as Carbul and Kubitch Lakes and associated flats to the west. Overflow from the Gore and the Coobidge wetlands flows into a large complex of seasonally inundated flats, lagoons and channels (the "Kubitch to Quallilup flow-through") and some eventually flows into Quallilup Lake. In exceptionally wet years this system can also feed westwards into Barker inlet 12 km to the west. Land clearing in the Dalyup and Coobidge catchments has resulted in increased volumes of water reaching the Gore system wetlands, resulting in death of fringing vegetation. For further information see DEC (2009b).

Climate in 2009-2010

Figure 2 shows rainfall during the southern Australian 2009 wet season, illustrating average to below average rainfall across most of Australia including the south-west. Most of northern Australia had below average rainfall during this time. During the 2009/10 summer (Figure 3), almost the whole of Western Australia had average to below average rainfall, whereas much of central and inland eastern had above average rainfall.

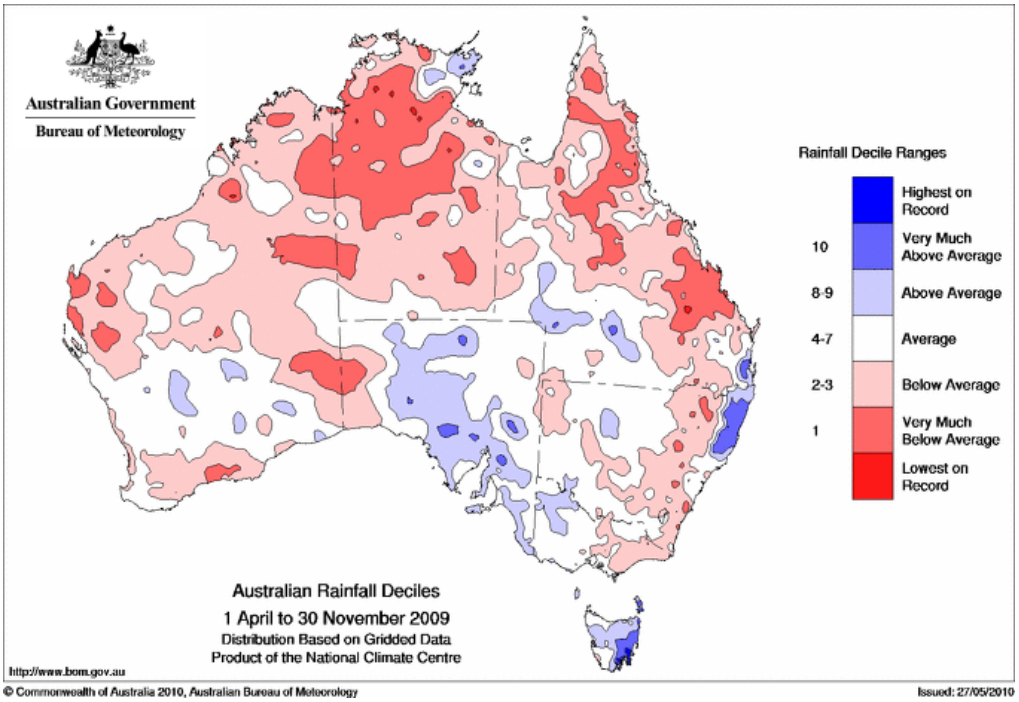

Figure 2. Rainfall deciles for the southern wet season (1 April to 30 November 2009).

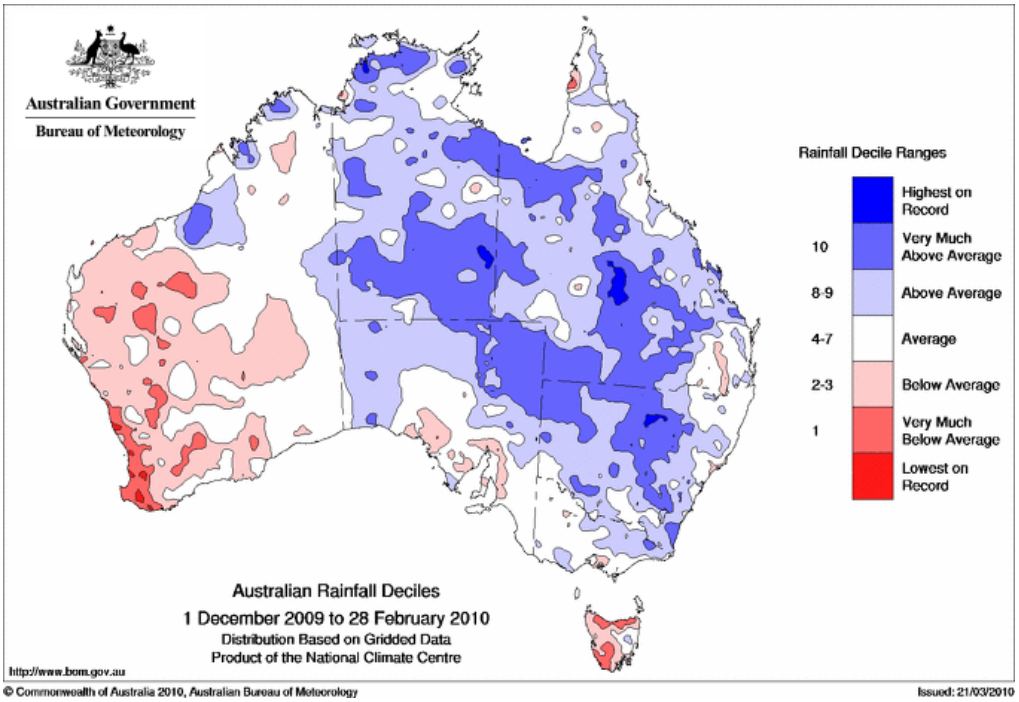

Figure 3. Summer rainfall (1 December 2009 to 28 February 2008).

METHODS

Waterbird surveys

Two waterbird surveys were undertaken, in November 2009 and February 2010. Ground counts (on foot or by boat) were made at 54 and 51 separate wetland areas in November 2009 and February 2010 respectively, within 19 wetland suites (Appendices 1 and 2). Only the Merrivale wetlands north of the Ewans-Station Lake suite were not surveyed during 2009/10. In February 2010, 33 wetlands were dry. Of these, 26 were visited on foot to determine presence of waterbirds and the other 7 (Six Mile Hill Suite plus Pink Lake) were seen to be dry from the air and not visited. Of the 26 dry wetlands that were visited, only Station Lake had any waterbirds. Most of the satellite wetlands around Lake Gore (and included in the count for Lake Gore in November 2009) were dry in February 2010. All counts were undertaken by David Cale and Adrian Pinder, assisted by John Lizamore, Kimberley Oswald and Laurent Marsol.

November 2009 ground counts

The Neridup and Bandy Creek suites, plus Ewans Lake, Mullet Lake and the Gun Club wetland were surveyed on November 19th. The Wheatfield to Windabout lake system was surveyed by boat with two observers (contributing to a single count) on November 20th, with most of the small satellite wetlands visited on foot from the main wetland during the boat survey. A few satellite lakes in this chain, plus Station Lake and the North Windabout and North Wheatfield Suites were surveyed on foot by a separate single observer on the same day (mostly) or the following day (one of the Woody Suite wetlands). Lake Warden and the eastern part of the Burkenup Complex were surveyed by boat with two observers (contributing to a single count) on the November 21st, with three satellite wetlands surveyed

on foot during the boat survey. The Six Mile Hill Suite was also surveyed on foot by one observer on November 21st and Pink Lake was partly surveyed (from 4 vantage points on the shore) by two observers on the same day. The Lake Gore system was surveyed by two teams of two observers, each team contributing to one count (team 1 surveying the Lake Gore Suite plus Kubitch, Gidong and Carbul lakes and team 2 surveying Lake Quallilup and the Kubitch-Quallilup flow-through system).

November 2009 aerial counts

The aerial survey in November was treated as a training exercise by the novice counters (AP and DC). This, together with windy conditions (30 knot winds) and technical problems with tape recorders meant that the data are of low value and are not presented. All of the species recorded from the air were also seen on the ground.

February 2009 ground counts

All of the Neridup and most of the Bandy Creek suite wetlands were dry. The single inundated Bandy Creek wetland and Ewans Lake were counted on February 22nd. Mullet Lake was partially counted on the 22nd but dusk prevented a full count. This wetland was fully surveyed on the 23rd February, with a re-survey of Ewans Lake immediately afterwards because of the possibility of overnight bird movements between the two wetlands. Station Lake was also surveyed on foot on the 23rd February. On the same day, the Wheatfield to Windabout system was surveyed by boat with two observers (contributing to a single count) on February 23rd, with the satellite wetlands visited on foot by the same observers. Lake Warden and the eastern part of the Burkenup Complex were surveyed by boat with two observers (contributing to a single count) on February 24th, with four satellite wetlands surveyed on foot. The North Windabout Suite was also surveyed on foot on the 24th and the Six Mile wetlands were dry (as seen from the air). The Lake Gore system was surveyed on February 25th by two teams of two observers, each team contributing to one count (team 1 surveying the Lake Gore Suite plus Kubitch and Carbul lakes and team 2 surveying Lake Quallilup and the Kubitch-Quallilup flow-through system). Lake Gore was too shallow to survey by boat so it was counted by two observers (contributing to a single count) by walking around parts of the lake and spotting from additional vantage points (Figure 4). This involved walking around the south-eastern (south of the Dalyup River inlet) and southern shores of the lake, parts of the western shore and spotting from the north of the lake (near the corner of McCalls Road). Little bird movement was observed during the survey so double-counting was not considered a problem. The Kubitch-Quallilup flow-through was surveyed by boat as much as possible but the upper channel was surveyed on foot after conditions became too shallow for boating.

Figure 4. Aerial photograph of Lake Gore showing area of shoreline from which the waterbird ground survey was undertaken.

February 2010 aerial counts

An aerial survey of the entire Warden and Gore systems (excluding the Neridup and Bandy Creek wetlands because they were dry) was undertaken on February 24th. Conditions were very still. A Cessna 206 aircraft was used (piloted by Lindsay Joyce of Albany Air Charter), flying at up to 80 knots. One hour and 45 minutes were spent counting over the two systems. The largest wetlands (Warden, Pink, Gore and Quallilup) were counted by circling the wetland (usually twice) in both clockwise and counter-clockwise directions on the lake side of the shore-line. Additional transects were then flown across these large wetlands to ensure waterbirds in the lake centres were counted. Two anti-clockwise circuits and one clock-wise circuit were flown at Lake Gore. Suites of smaller wetlands were counted by flying 1 to 5 transects, usually repeated to pick up additional species or confirm counts.

Invertebrate sampling locations

The sites sampled in 2009 (Table 1) match those sampled in 2006 and 2007 by the Centre for Excellence in Natural Resource Management (CENRM) (Cook *et al*. 2007, Cook and Farrell 2008) except for the following:

Lake Wheatfield. This wetland was sampled at the two sites (SPM005A and SPM005B) usually sampled for the State Salinity Strategy wetland monitoring program (see Cale *et al*. 2004). One of these sites (SPM005A) is in the same location as the CENRM site Whe_1. The CENRM sites Whe_2 (lake centre) and Whe_3 (in the Wheatfield to Woody flow-through channel) were not sampled, although SPM005B is on the western shore only about 150 metres from Whe_3.

Woody Lake. This is an addition to the sampling program, with 2 sites (Woo_1 and Woo_2). Site 1 was just south of the Wheatfield to Woody Channel on the south-eastern shore and site 2 was on the north-eastern shore.

This is an addition to the sampling program, with 2 sites (Win_1 and Win_2). Site 1 was near the boat ramp in the south-east bay. Site 2 was in the next bay to the north (i.e. the eastern-most of the two northern bays).

Lake Warden. The site in the middle of the lake (War_3) was not sampled.

Table 1. Wetland locations sampled for invertebrates 2006 to 2009.

Wetland Name	Sampling site	Northing	Easting	Sampled in		
				2006	2007	2009
Ewans Lake	Ewa_1	6259419	0404098	●	●	●
	Ewa_2	6259358	404224	●	●	●
Station Lake	Sta_1	6259170	0402547	●	●	●
	Sta_2	6259112	0402504	●	●	●
Lake Wheatfield	Whe_1 (=SPM005A)	6258941	400862	●	●	●
	Whe_2	-	-	●	●	
	Whe_3	-	-	●	●	
	SPM005B (near Whe_3)	6258598	0400376			●
Lake Warden	War_1	6257459	0396950	●	●	●
	War_2	6257549	396860	●	●	●
	War_3	-	-	●	●	
Woody Lake	Woo_1	6257878	0399842			●
	Woo_2	6758201	0399624			●
Windabout Complex	Win_1	6257962	0398493			●
	Win_2	6258392	0398460			●

Water chemistry

At each location sampled for invertebrates, pH, temperature and electrical conductivity were measured in-situ using a calibrated meter (WTW multi 340i). Water samples were taken for the determination of nutrients (total nitrogen, total dissolved nitrogen, total phosphorus, total dissolved phosphorus), turbidity and total dissolved solids. Chlorophyll ‘a’, ‘b’, ‘c’ and phaeophytin ‘a’ were measured from phytoplankton retained on glass-fibre paper after filtering at least 500 ml of water. Notes were also made on sediment composition and cover of emergent and submerged macrophytes and benthic detritus.

Invertebrate sampling methods

Two invertebrate samples were collected at each sampling location: one ‘benthic’ sample collected using a 250 µm mesh net to sample all habitats within wadeable depth (e.g. open water, sediments, detritus, submerged vegetation and streambed of flowing areas, where present), and one ‘plankton’ sample collected using a 50 µm mesh net to sample the water column and submerged vegetation in the same area as the first sample. Each sample involved sweeping for a total of 50 m (not usually contiguous). The benthic sample was preserved in 100% ethanol and the plankton sample in 4% buffered formalin.

Invertebrate sample processing

Each benthic sample was passed through a stack of 3 sieves with mesh sizes of 2.0 mm, 0.5 mm and 0.25 mm. Each plankton sample was passed through a stack of 3 sieves with mesh

sizes of 2 mm, 0.09 mm and 0.053 mm. The contents of each sieve were sorted and counted separately in water using a stereo dissecting microscope at a magnification of up to 184x. The entire contents of each sieve were examined and representative specimens of all observed species removed. For the less abundant animals (fewer than ~ 100 animals) all animals were counted (and generally most were removed). For abundant animals, each sieve fraction was subsampled with a sample-splitting jug which divided the sample into consecutive halves and all individuals from within a sub-sample were counted. Sub-sampling fractions were normally 1/4 to 1/16th, though extremely abundant rotifers were sub-sampled at fractions of up to 1/256th (e.g. the >30000 *Hexarthra* in the Lake Warden plankton samples). The contents of each sieve size were subsampled separately and to different degrees as required. Chironomid and copepod abundance at the species level was estimated by multiplying total abundance by the proportional representation of species amongst the individuals removed from the sample (i.e. species were not counted separately during sorting).

Estimation of invertebrate biomass

To enable comparison of biomass estimates with those presented in Cook *et al.* (2007) and Cook and Farrell (2008), we have used the same estimates of invertebrate dry weights, except that we had to weigh our own palaemonid prawns since these were not collected in 2006 or 2007. These weights, presented in Table 2, are based on dry weight measurements for larger invertebrates and length-weight relationships for smaller taxa: see Cook and Farrell (2008) for methods. All specimens within a group (e.g. all beetles or all cladocerans) are assumed to weigh the same, so biomass values should be seen only as very rough estimates. Total biomass per sample (benthic and plankton combined) was divided by the length of sweep netting. For the latter, one benthic sample (coarse mesh net) and one plankton sample (fine mesh net) were together counted as 50 metres of sampling, so two sites sampled at a wetland is 100 m of sampling. Note that the y-axes of biomass graphs in Cook *et al*. (2007) and Cook and Farrell (2008) are biomass per metre of sampling, not biomass per m^2 of lake bed and that the value for Wheatfield in 2006 is wrong (it should be 2/3rds of this value as it was divided by 2 samples not 3).

Table 2. Dry weights of individual specimens of invertebrates.

Invertebrate group	Individual dry weight (g)
Rotifers	0.00000325
Copepods, Oribatid mites, Cladocerans and Collembolans	0.000104
Mytilocypris ostracods	0.00133
Other ostracods	0.000443
Palaemonetes prawn	0.0261
Gastropods	0.01016
Bivalves	0.00607
Isopods	0.01157
Amphipods	0.001043
Beetles	0.00532
Diptera, Lepidopterans, Annelids and Nematodes	0.000539
Hemipterans	0.00532
Trichopterans	0.035547
Odonates	0.00702

Micro versus macro-invertebrates

Micro-invertebrates are defined as rotifers, protozoans, ostracods, copepods and cladocerans. Macro-invertebrates are all other taxa.

Invertebrate identifications

Invertebrates were identified using published keys where available or by comparison with specimens from previous projects whose identity has been confirmed by relevant taxonomic experts. Chironomids were cleared and mounted in euparyl, representative copepods and ostracods were dissected and mounted in CMCP or polyvinyl lactophenol. Rotifers were either mounted in Kaiser's glycerin jelly (loricate taxa) or were dissolved in 10% sodium hypochlorite for examination of the trophi (non-loricate taxa). Oligochaetes were examined in glycerol or were stained in Grenacher's Borax Carmine and mounted in Permount. Harpacticoids were mostly not identified but will be in due course.

RESULTS AND DISCUSSION

Water chemistry

Water chemistry data for October 2009 are presented in Table 3 and
Table 4. All wetlands were saline, but salinity varied greatly between wetlands. Lake Warden had the highest salinity (61 g/L, 8140 mS/m) and the Woody to Wheatfield main waterbodies were the lowest (7.1 to 9.4 g/L, 1100 to 1800 mS/m). Ewans Lake and Station Lake had intermediate salinities (15 and 17 g/L, 2400 and 2750 mS/m, respectively). These EC measurements closely match those taken by the DEC Esperance office. Since the latter is the most consistent measure of salinity across the period in question the DEC Esperance measurements are used when comparing invertebrate data across years. In October 2009 conductivity in all wetlands was higher than in October 2007 but lower than in October 2006.

All wetlands were alkaline (8.4 to 9.4), as in 2006 and 2007 (8.3 to 8.6 and 8 to 9.3 respectively). Turbidity was generally very low, albeit higher in Wheatfield (30 NTU) and were generally lower than those measured in 2006 and 2007. However, the laboratory measured turbidity in 2009 is not directly comparable to the field measured turbidity in 2006 and 2007 because of the time between sample collection and analysis.

Total phosphorus (TP) concentrations were at or below detectable limits (10 µg/L), except at Windabout where TP was 160 µg/L. The latter is 2.5 times the interim trigger values suggested for south-western Australian wetlands in ANZECC/ARMCANZ (2000) and comparatively high for these wetlands. Total phosphorus values have been measured at Station Lake, Lake Wheatfield and Lake Warden since 1991 by Lane (2008), as reported in DEC (2009a). For Station Lake TP has varied between <10 and 50 µg/L, for Wheatfield the range is <10 to 240 µg/L and for Lake Warden the range is 10 to 140 µg/L. Total filterable (= soluble) P in Windabout was 40 to 50 µg/L which is much higher than the interim trigger value of 30 µg/L. Total nitrogen concentrations were mostly < 2000 µg/L and well within the ranges of values recorded for Warden wetlands since 1995 by Lane *et al*. (2008) e.g. ~500 to 4500 µg/L in Station Lake and ~500 to 3400 µg/L for Wheatfield. Lake Warden had much higher TN concentrations than the other wetlands but these were also within the ranges recorded for this lake in the past (3000 to 8200 µg/L). Nitrogen concentrations are frequently

elevated in highly saline lakes in south-western Australia (Pinder *et al*. 2004). Chlorophyll concentrations (indicative of phytoplankton growth) were generally at or below detectable limits but high at Windabout (19 µg/L) and moderately high in Wheatfield (11 µg/L). At Wheatfield Lake site 1 there was a bloom of algae secreting a gelatinous substance which made the water quite viscous. Nutrient and chlorophyll concentrations were not measured in 2006 and 2007.

Table 3. Water chemistry for wetlands sampled for invertebrates in October 2009.

SiteCode	Site name	Date	Subsite	Water Temperature	Field Conductivity	Field Conductivity (DEC Esperance) for nearest date	Field Salinity	TDS	pH
				ºC	(mS/m)	(mS/m)	g/L	g/L	
WRP003	Ewans Lake	26/10/2009	Ewa_1	20.5	2390	2210	14.4	15	8.9
			Ewa_2	20.2	2410		14.6	-	8.8
WRP005	Station Lake	26/10/2009	Sta_1	17.7	2750	2650	-	17	8.9
			Sta_2	18.4	2750		-	-	8.8
WRP009	Woody Lake	27/10/2009	Woo_1	21.9	1178	1137	6.8	7.1	9.2
			Woo_2	19.8	1179		6.7	-	9.1
WRP007	Wheatfield	27/10/2009	Whe_1	20.4	1261	1215	7.3	7.9	9.4
			Whe_2	19.8	1251		7.2		9
WRP010	Windabout	27/10/2009	Win_1	22.8	1565	1509	9.2	9.4	8.9
			Win_2	21.4	1602		9.4	-	8.9
WRP013	Lake Warden	26/10/2009	War_1	21.1	8140	7750	-	61	8.4
			War_2	21.1	8140		-	-	8.5

Table 4. Nutrient and chlorophyll data for wetlands sampled for invertebrates in October 2009.

SiteCode	Site name	Date	Turbidity	Nitrate	Total N	Total soluble N	Total P	Total soluble P	Total chlorophyll
			NTU	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
WRP003	Ewans Lake	26/10/2009	<0.5	<10	1200	1200	<10	10	<1
			-	<10	-	830	-	10	1
WRP005	Station Lake	26/10/2009	<0.5	10	1800	830	<10	10	<1
			-	<10	-	640	-	10	<1
WRP009	Woody Lake	27/10/2009	1.1	40	1600	1600	<10	10	<1
			-	50	-	1100	-	10	<1
WRP007	Wheatfield	27/10/2009	30		-	1300	-	<10	<1
					-	1400	-	10	11
WRP010	Windabout	27/10/2009	2	10	6700	1800	160	40	<1
			-	10	-	1200	-	50	19
WRP013	Lake Warden	26/10/2009	<0.5	10	6200	5000	<10	<10	7
			-	<10	-	5200	-	10	7

Waterbirds

Appendix 3 contains all of the ground count data for all individual wetlands for the 2009/10 surveys. Aerial data are not included as the aerial counts were made per suite rather than per

wetland. Appendix 4 contains all of the waterbird survey data (aerial and ground) between October 2006 and February 2010 for each suite.

2009 survey data

November 2009.

In the Lake Warden and Lake Gore systems, totals of 9809 individuals of 45 species and 7906 individuals of 32 species were recorded respectively during ground counts in November 2009. Although this is based on ground counts only, and may therefore be an overestimate due to bird movements between wetlands, all of the main central wetlands (Wheatfield to Windabout) plus Station Lake were counted on one day, as were the Neridup, Bandy Creek, Ewans and Mullet wetlands and the entire Gore/Quallilup wetlands. The survey included the first records of Marsh Sandpipers (from Lake Warden) and Grey Plovers (from a Bandy Creek wetland and Lake Mullet) in the 2006-2010 monitoring program. Jaensch *et al*. (1988) reported six records of Marsh Sandpipers in the Warden system during summer and autumn between 1982 and 1986 and Grey Plovers twice in Mullet Lake in summer 1983. Sacred Kingfishers were not listed as waterbirds in other recent surveys even when observed, but 2009/10 records are listed in Appendices 3 and 4.

In the Warden system, highest counts were on Mullet Lake (2732, mostly Australian Shelducks and Pacific Black Ducks), Station Lake (1934, mostly Black Swans, Banded Stilts and Australian Shelducks), the Windabout Suite (1134, mostly Shelducks, Grey Teals and Whiskered Terns) and the Wheatfield Suite (987, mostly Shelducks, Eurasian Coots and Black Swans).

The most abundant non-waders in the Warden system were Shelducks (2755), Grey Teals (1262), Pacific Black Ducks (1354) and Black Swans (1430). Other relatively abundant species were Hoary-headed Grebes (423), Eurasian Coots (410), Chestnut Teals (243) and Pink-eared Ducks (253). Most of the 930 waders were Banded Stilts (440) and Red-necked Avocets (200), but Common Greenshanks (103) and Red-necked Stints (69) were also common.

In the Gore system, Lake Gore (including the lower Dalyup River and associated wetlands) and the Kubitch to Quallilup flow-through had similar numbers of birds (4002 and 3577 respectively). Quallilup Lake had far fewer birds (332). Kubitch Lake was notable for the presence of 207 Hooded Plovers, which is by far the highest count of this species for the present monitoring program. The most abundant non-waders in the Gore system were Australian Shelducks (4649), Hoary-headed Grebes (664), Little Black Cormorants (492) and Black Swans (254). Of the waders, Banded Stilts were most abundant (550), but Red-necked Avocets (215) and Hooded Plovers (213) were also numerous.

February 2010

February 2010 counts for the Warden system totalled 4778 individuals of 26 species from the air and 6396 individuals of 45 species from the ground. The 427 Red-necked Stints (mostly at North-Windabout and Mullet Lake) were not seen from the air and ground counts were also higher for Common Greenshanks, Red-necked Avocets, Black-fronted Dotterels and Red-capped Dotterels, with the aerial count of 169 unidentified waders only partially accounting for these. Counts of some duck species were also higher on the ground, particularly Shelducks, Chestnut Teals (counted with Grey Teals from the air) and Pink-eared Ducks. Other significant differences between aerial and ground counts in the Warden system were greater numbers of Yellow-billed Spoonbills and White-faced Herons on the ground and more terns and grebes seen from the air (the latter the reverse of the usual bias towards fewer grebes seen from the air). If it is assumed that grebes, musk ducks and waders were more accurately counted on the ground and that other species were more accurately counted from

the air, then the total count for the Warden system would be 5396 individuals, though this would exclude some of the rarer species seen only from the ground. The total species richness for the Warden wetlands in February was 45, which is the same as for November 2009.

The records of Pectoral Sandpipers (from Windabout Lake, but also in Quallilup in the Gore system) in February 2010 are tentative: they may have been mis-identified Sharp-tailed Sandpipers. Jaensch *et al*. (1988) recorded Pectoral Sandpipers twice in autumn 1985 at Lake Warden so their presence in 2010 is not unreasonable, but they are difficult to tell apart and Sharp-tailed Sandpipers are the more common species. Also, the Godwits (from Mullet and Ewans lakes in February 2010) were only seen from a distance and not in flight. There is a chance these were Black-tailed Godwits, although both species were recorded by Jaensch *et al*. (1988).

In the Warden system, highest February total counts were on Lake Warden (1690 from the air, 1773 on the ground, mostly Musk Ducks, Black Swans, Hoary-headed Grebes and Red-necked Avocets). Other high counts were at Windabout Lake (1000 from the air, 1474 on the ground, mostly Black Swans, Grey and Chestnut Teals and Australian Pelicans) and at Ewans Lake (503 from the air, 808 on the ground, mostly Grey Teals).

The most abundant non-waders in the Warden system were Grey Teals (about 1000), Black Swans (about 930), Musk Ducks (about 400), Hoary-headed Grebes (at least 400), Pelicans (about 200) and Coot (200-300). Other relatively abundant species were White-faced Heron, Pink-eared Ducks and Australian Shelducks. Of the waders, Banded Stilts (200), Red-necked Avocets (300) and Red-necked Stints (427) were most abundant, but there were also reasonably high numbers of Common Greenshanks, Black-winged Stilts, Black-fronted Dotterels and Red-capped Plovers. A significant result is the 10 species of waders present in the Wheatfield to Windabout complex, with 8 of these occurring in Lake Wheatfield alone.

In the Lake Gore system, February counts totalled 3125 individuals of 18 species from the air and 8751 individuals of 29 species from the ground. Counts of some species were similar from the air and ground (346 versus 332 Black Swans, 1269 versus 1377 Shelducks and 95 versus 109 Great Egrets) but for most species ground counts were higher. For some diving species that are difficult to count from the air, the greater ground counts are not unusual (1511 versus 146 Hoary-headed Grebes and 130 versus 1 Musk Ducks). The largest differences were for Banded Stilts and Red-necked Avocets on Lake Gore (just over 1000 of each from the ground versus 423 Banded Stilts and no Red-necked Avocets from the air, although some of the birds identified as stilts were probably avocets) and Little Black Cormorants and Grey Teals from the Kubitch-Quallilup flow-through (947 cormorants on the ground versus 250 from the air and 609 Grey Teals on the ground versus 10 from the air).

Some additional birds may have moved onto Lake Gore during the two days between the aerial count and the ground count, but bird behaviour may also be part of the explanation of higher ground counts. The water level in Lake Gore was too low to survey the lake by boat, so surveys were done by walking around segments of the wetland and then spotting from additional access points. Care was taken to take account of waterbird movements during the survey and little movement seemed to be occurring, but it is possible that some double counting occurred. Also, during the ground count, the stilts and avocets were highly scattered over large areas of the wetland and were feeding in water up to about the birds' breasts, with just the upper body and heads visible. This made counting difficult from the ground and if the birds were behaving similarly during the aerial count we might not have seen many of them from the air, especially if the place was not close enough to make them take flight.

The Little Black Cormorants in the flow-through were mostly roosting and even the boat did not cause many to take to the wing. Most would not therefore have been seen from the air. Presumably the Grey Teals were also largely hidden within the dense stands of dead trees

rather than out in the open or flying. There was probably some movement of Little Black Cormorants between the aerial and ground counts, with 199 seen on Lake Gore from the air but only 10 from the ground, whereas at Quallilup none were seen from the air but 172 were seen during the ground count two days later. The flow-through system is also very complex and difficult to survey in its entirety from the air, so particular sections can be missed.

Overall, the ground count of 8751 birds is likely to have been more accurate than the aerial count in the Lake Gore/Quallilup system for the reasons noted above – there were certainly many more than 3000 birds present in this system.

Patterns in waterbird diversity and abundance 2006-2010

Lake Warden system

The number of waterbird species using the Warden system during surveys has remained remarkably constant since October 2007, varying by only two species (43 to 45) between surveys over this time (Figure 5). Richness was lower in October 2006 when only 35 species were recorded, with lower richness of most groups, but especially waders. Also, kingfishers were included in counts of waterbirds in previous surveys.

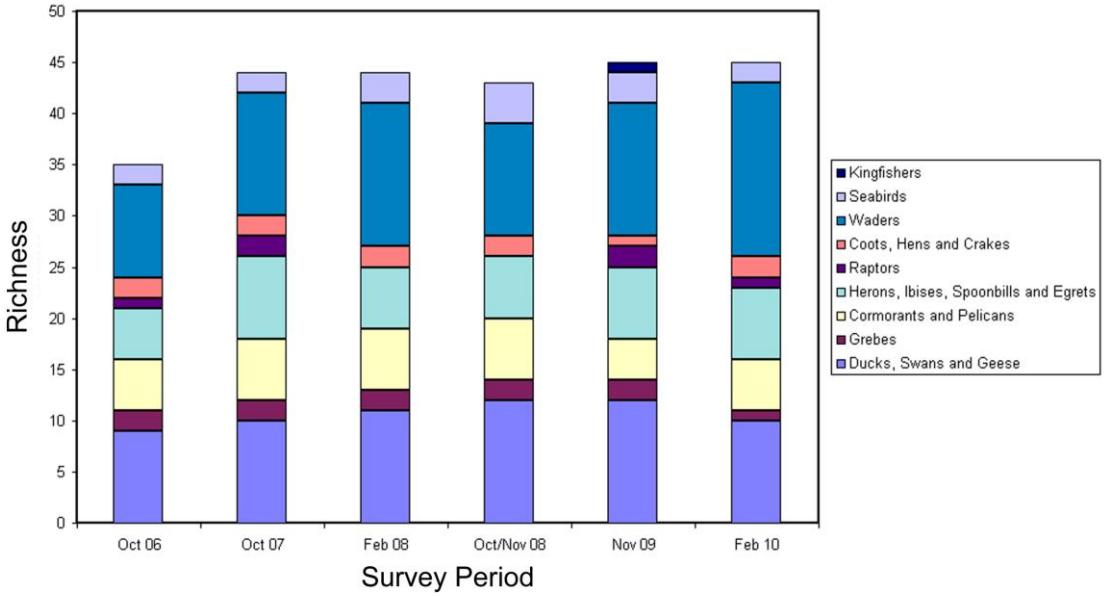

Figure 5. Species richness by major waterbird group between October 2006 and February 2010. Richness combined from aerial and ground counts.

In total, 61 waterbird species have been recorded from the Warden system across the six surveys since October 2006. Figure 6 shows how frequently these species have been recorded, e.g. 15% of species (yellow segment) have been recorded during only two of the surveys. About half of the species (51%) have been recorded during five or six of the surveys, with the rest fairly evenly divided among those recorded during 1, 2, 3 or 4 surveys.

Wetlands in the Mullet Lake and Lake Warden nature reserves were surveyed in the 1980s as part of a study of waterbird usage in south-west nature reserves, summarised in Jaensch *et al*. (1988). The seven largest Warden system wetlands (excluding Pink Lake) were surveyed over seven years: Ewans, Station, Mullet, Woody, Wheatfield, Windabout and Warden. During those surveys, ten species were counted that haven't been seen in the Warden system during

the more recent surveys. These are Pacific Herons, White-winged Black Terns, Fairy Terns, Clamorous Reed Warblers, Black-tailed Godwits[2], Broad-billed Sandpipers, Long-toed Stints, Whimbrels, Terek Sandpipers and Red Knots. An additional four species (not seen during the 1980s surveys or during the current monitoring) have been seen at the Warden wetlands during other surveys (DEC 2009): Cattle Egrets, Purple Swamp Hens, Spotless Crakes and Sanderlings. These records bring the total waterbird species list for the Warden system to 76.

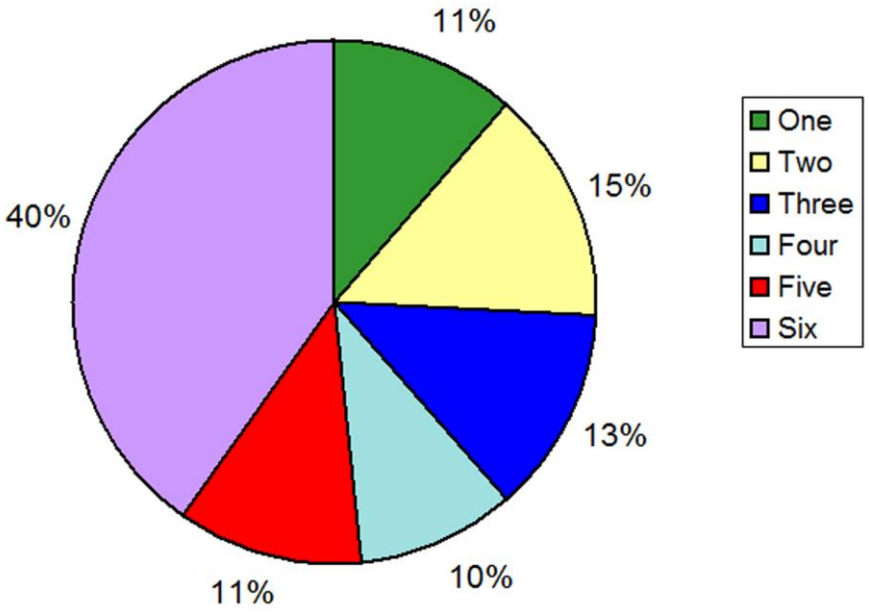

Figure 6. Frequency of occurrence of waterbird species in Warden wetlands. Colours indicate the number of surveys in which waterbirds have been recorded and the percentage values indicate the proportion of waterbirds.

Most of the additional shorebird species were only rarely encountered and in low numbers. The exception was the Red Knots which was recorded on 11 occasions at four wetlands (Warden, Station, Windabout and Ewans) and up to 60 individuals at a time (Jaensch *et al.* 1988), although this migratory species is generally uncommon in the south-west. Many of these extra species tend to be coastal shorebirds rather than inland species and the proximity of the Warden wetlands to the coast means they are occasionally seen around the lakes. It is possible that these shorebirds still use the Warden wetlands but have simply not been detected recently, though this seems unlikely for the Red Knots. The recent survey program has involved about 239 wetland surveys (6 surveys with an average of about 40 individual wetlands/survey), compared to 254 wetland surveys during the 1980s (12 wetlands counted an average of about 21 times each), so it might be expected that we would have detected these rarer species had they still been present in the system. However, our surveys have been restricted to one or two surveys a year and it may be that the more frequent surveys of the 1980s work (albeit at a smaller number of wetlands) were more likely to detect these very rare species. On the other hand, given the reduced area of exposed shores and extensive death of riparian vegetation, it may not be a coincidence that most of the 'missing' species are riparian species (Swamphens, Spotless Crakes and Clamorous Reed Warblers) or shorebirds.

[2] But Bar-tailed Godwits identified in February 2010 from Mullet and Ewans lakes may have been Black-tailed Godwits. Nonetheless, neither species have been recorded prior to February 2010 in the current monitoring program.

The number of ducks, geese and swan species at Lake Warden has varied between nine and twelve, with the least frequently observed being Blue-billed Ducks and Wood Ducks. Cape Barren Geese are usually restricted to the Golf Club Lawns at Windabout but were recorded at Pink Lake on one occasion. Swans are always present and other duck species have been recorded on all occasions or were absent only once. Abundance of all species varies greatly between surveys, with no single species consistently more abundant than the rest.

Hoary-headed Grebes are always present and Great Crested Grebes were absent only in February 2010. Abundance of the former has varied between just over 100 to about 600 whereas Great Crested Grebes have reached only 66 individuals (in February 2008). Usually four cormorant species are present, although Pied Cormorants were absent in October 2006, November 2009 and February 2010. Little Black Cormorants are always the most abundant (up to 400) but up to 163 Little Pied Cormorants have been observed during a single survey. Pelicans are also almost always present in low to moderate numbers (<200) in the Warden system but were absent in November 2009. Of the eight Herons, Ibises, Spoonbills and Egrets, most are always present, although Little Egrets are rarer and have been recorded only three times. Glossy Ibis are also usually absent or rare but 85 were present in October 2007. Straw-necked Ibis and/or Yellow-billed Spoonbills are usually the most abundant of this group, although only a single individual of the former was observed in February 2010. On that occasion a higher than normal number of White-faced Herons was observed (106).

The two wetland associated raptors present in the Warden system (White-bellied Sea Eagle and Swamp Harrier) have each been recorded in 50% of surveys. The White-bellied Sea Eagle has only been observed over the Wheatfield to Windabout suite, no doubt reflecting the presence of large fish in these now permanent lakes.

Eurasian Coots are always present. Black-tailed Native Hens and Spotted Crakes may be more prevalent than the data suggests, but their secretive nature means they are not always seen. They tend to be irruptive species, present in moderate numbers for a while then disappearing.

Wader species composition has been much more variable. The number of wader species has varied between 9 (October2006) and 17 (February 2010), with 21 recorded in total. The February 2010 count is three species higher than the next highest wader richness of 14 in February 2008. Only six waders have been recorded in all six surveys. These are Common Greenshanks, Common Sandpipers, Black-winged Stilts, Red-necked Avocets, Red-capped Plovers and Hooded Plovers). Of these, only the Common Sandpiper is an international migratory species. Other common species are Red-necked Stints (a migratory species), Banded Stilts and Masked Lapwings. Nine species have only been recorded once or twice: Bar-tailed Godwits, Marsh Sandpipers, Wood Sandpipers, Ruddy Turnstones, Pectoral Sandpipers (a vagrant)[3], Curlew Sandpipers, Grey Plovers, Banded Lapwings and Greater Sand Plovers. Large numbers of the latter occur in north-western Australia but few travel much further south. The Ruddy Turnstones and Greater Sand Plovers are coastal shorebirds and generally rarer on inland wetlands. Most of these nine species were also uncommon and in low abundance during the 1980s surveys reported on by Jaensch *et al*. (1988), with the exception of the Curlew Sandpipers for which several counts of more than 50 individuals were made (maximum 230). Greater Sand Plovers were not recorded at all during those earlier counts.

The engineering intervention to reduce lake depths in the Wheatfield to Windabout system is partly aimed at creating more exposed beach and shallow wading zones for waders, so wader richness and abundance will be an indicator of the success of this intervention. Wheatfield,

[3] Possibly mis-identified Sharp-tailed Sandpiper

Woody and Windabout lakes had 0 to 4 species of waders (excluding lapwings) per count between October 2006 and November 2009 and 0 to 8/count in the 1980s. In February 2010 10 species of waders were observed in this complex (or 9 if the Pectoral Sandpipers were actually Sharp-tailed Sandpipers), all of which occurred in the main lake bodies and some of which also occurred in satellite wetlands. Of these, 8 occurred in Lake Wheatfield, 4 occurred in Woody Lake (plus 1 in a satellite) and 5 occurred in Windabout Lake (plus 1 in a satellite).

Between 4 and 59 individual waders were recorded in these three central lakes (and their satellite wetlands) between October 2006 and November 2009 (average 20). These figures were calculated using the highest count from either aerial or ground survey at each wetland suite. The most abundant species were Black-fronted Dotterels (maximum 14 in February 2008) and Greenshanks (maximum 39 in February 2008). In February 2010 148 individual waders were counted from the three main waterbodies alone, the most abundant being Black-fronted Dotterels (40) and Greenshanks (62), but there were also 19 Black-winged Stilts and 11 Common Sandpipers. Greatest abundance was in Windabout Lake (67 individuals).

This increase in both richness and abundance in the Wheatfield to Windabout wetlands may be a response to the greater areas of exposed shoreline. The installed drainage system undoubtedly contributed to lower water depths in these central wetlands but it should be noted that the 2009/10 summer was the second driest (32.8 mm) in the last 10 years in Esperance[4]. This low rainfall may also have contributed to the lower water depths in these wetlands in February and to complete drying in many of the smaller wetlands in the region, such as the Bandy Creek and Neridup suites. Drying of these outlying lakes may have contributed to higher wader diversity and abundance in the Wheatfield to Windabout wetlands.

Surveys in coming years will determine whether the higher wader richness and abundance in February 2010 is a one-off result (perhaps related to rainfall) or reflects a change to lake ecology, as a result of reducing water levels, that has been the aim of management.

Abundance of waterbirds has varied greatly in the larger Lake Warden system in the current monitoring program, with counts varying from about 15000 in February 2008 to about 4000 (in November 2008) (Figure 7). Ducks and swans have always been numerically dominant, although at times there has been significant numbers of waders, particularly Banded Stilt in October 2007 and February 2008.

Interpreting waterbird abundance data is notoriously difficult due to local, regional and even national and international movement of individuals. As a general pattern, Australian resident waterbirds in the south-west tend to be dispersed across the region in winter as temporary waterbodies fill, then congregate on remaining permanent wetlands as others dry during summer. This pattern can be modified by longer distance continental migration to take advantage of large flood events in inland and northern Australia (such as in Lake Gregory, Lake Eyre and Fortescue Marsh). Counts in any one year are thus inadequate to provide a complete picture of usage patterns. For this reason, Bennelongia (2009) advocated that waterbirds in the Lake Warden and Gore systems should be monitored in blocks of at least three years so that they are likely to be counted under a range of climatic scenarios.

Between Oct/Nov 2007 and February 2008 waterbird numbers in the Warden system rose from about 11335 to 14473 (aerial counts), which seems to fit the pattern of waterbirds concentrating on more permanent wetlands in the south-west during summer. The south-west had below average winter and spring rainfall in 2007 and about average (i.e. low) summer rainfall in 2008. The increase in waterbird abundance was mostly in the numbers of ducks: especially Musk Ducks, Pacific Black Ducks and Grey Teals. However, the increase in these species was partially offset by significantly reduced numbers of Australian Shelducks and

[4] December to February rainfall measured at the Bureau of Meteorology weather station 009789.

Hardheads suggesting movement out of the Warden system over summer, after the spring moult. These species that declined in numbers over summer do not seem to have simply moved to the Gore wetlands: there was also a significant decline in Shelduck numbers in the Gore system over the same period and Hardheads were not recorded in the Gore system during either season. Whiskered Terns seem to have left Warden wetlands completely over summer (130 were present in spring but none were seen in February).

There were less obvious changes in numbers of waders over the 07/08 summer, but most species occur in low numbers making changes difficult to assess. Some increase in wader numbers would be expected as additional migratory shorebirds arrive, as was observed for Red-necked Stints. Red-necked Avocets increased from tens to hundreds across the system and Black-fronted Dotterels were absent in Oct/Nov 2007 but present in February 2008.

The average to below average rainfall in most of Western Australia in winter/spring 2009 and summer 2009/10 (Figure 2 and Figure 3) led us to expect a similar increase in numbers of waterbirds using the Warden and Gore wetlands between November 2009 and February 2010. Instead, there was a decline in total waterbird abundance in the Warden wetlands over summer. Species with greatest declines were Black Swans, Shelducks and Pacific Black Ducks. The number of Shelducks also declined in the Gore wetlands (see below) but this was not the case for Pacific Black Ducks (which always have low abundance in the Gore system) and Black Swans. There were increases in some less abundant species over summer, including Pelicans and Musk Ducks, some migratory waders (Curlew Sandpipers, Red-capped Plovers) and the non-migratory Black-fronted Dotterels. As for 2007/8, Whiskered Terns were common in spring 2009 (160 on Windabout Lake) but absent in February 2010.

Bennelongia (2009) advocated that monitoring should be resumed for a similar period (of three years) if major anthropogenic change is expected and that "Useful information about trends in waterbird use of the Lakes Warden and Gore systems will not be possible until the second three years of monitoring is undertaken". For the Warden system, the 2009/10 monitoring should be seen as the start of a three year period of monitoring (i.e. comprehensive surveys in November and February) to assess whether the drainage scheme to reduce water levels in the Wheatfield to Windabout wetlands has affected waterbird diversity and abundance. For this reason we have not attempted a detailed comparison of the 2009/2010 data with the 2006 to 2008 data.

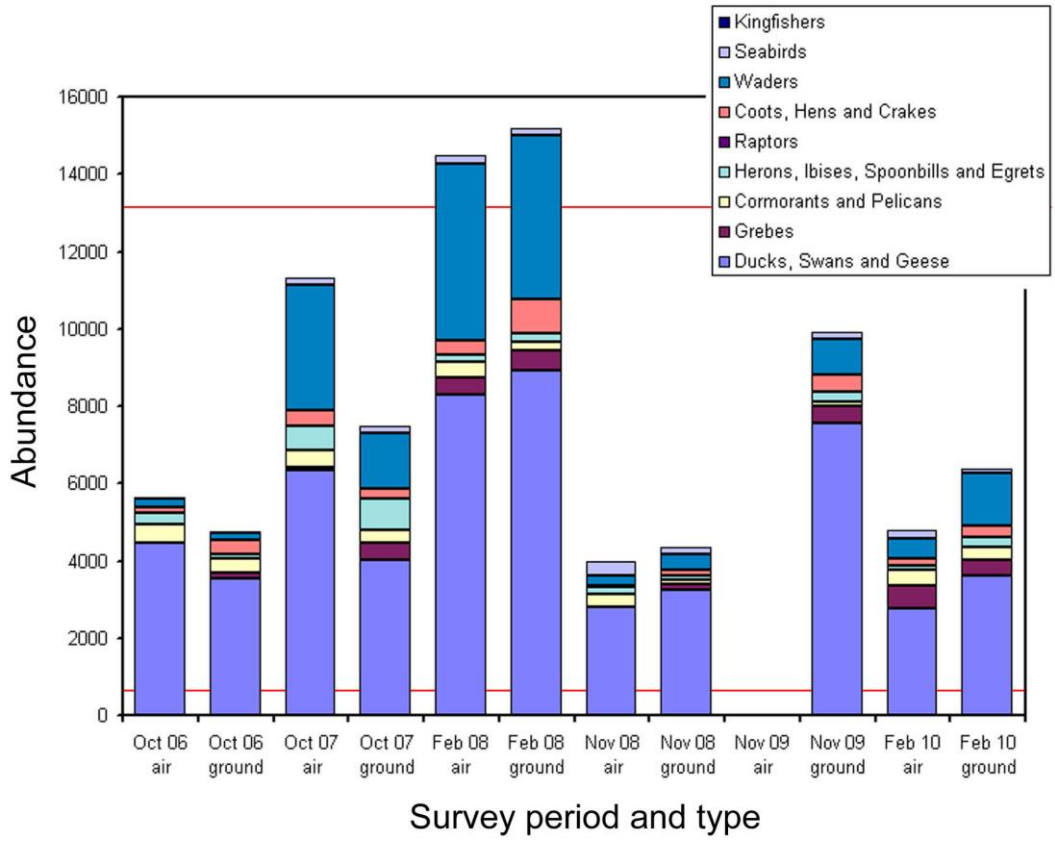

Figure 7. Waterbird abundance (aerial and ground counts) in the Warden system by major waterbird group between October 2006 and February 2010. Horizontal red lines are the 90% confidence limits from the 2006 to 2008 data.

Bennelongia (2009) calculated the 90% confidence interval for total spring aerial abundance for the 2006 to 2008 surveys at Lake Warden. This interval (692 to 13111: red lines on Figure 7) is the range within which total counts would be expected to lie assuming no change in the ecological character of the wetlands. Total abundance recorded in spring 2009 was well within this range: similar to the counts in Oct/Nov 2007 and higher than those for October 2006 and November 2008. However, the 90% confidence interval is very wide, reflecting the small number of surveys and high variability between years. It would thus be unwise to rely too heavily on this interval to judge whether there has been a change in total waterbird abundance.

Lake Gore system

Unlike the Warden system, the number of species recorded using the Lake Gore system has varied substantially (Figure 8). Aerial counts have recorded between 18 (February 2010) and 26 (February 2008) species. The low aerial richness in February 2010 was undoubtedly due, in part, to the inexperience of the counters. Ground counts in November 2009 and February 2010 revealed the presence of 32 and 29 species respectively; the higher richness values (compared to 2006 - 2008) being due to a wider range of waders seen on the ground.

The total number of waterbird species recorded at Lake Gore since October 2006 is 45, which is much lower than for the Warden wetlands. Only one of these species, the Pacific Gull, recorded in November 2009 and February 2010, has not been observed at the Lake Warden wetlands during the current monitoring program. This marine species is common on Esperance beaches and its absence from the Warden system reflects habitat preference.

An additional 13 species were recorded by Jaensch *et al*. (1988) from Lake Gore, of which nine were shorebirds. These were Australian Wood Ducks, Australasian Shovelers, Black-tailed Native Hens, Fairy Terns, Curlew Sandpipers, Red Knots, Great Knots, Sanderlings, Ruddy Turnstones, Greater Sand Plovers, Lesser Golden Plovers and Black-tailed Godwits. Interestingly, three of these shorebirds are the same as those also absent from Warden in recent years (Sanderlings, Red Knots and Black-tailed Godwits). The Department of Environment and Conservation (2009b) also list Pacific Herons from the Gore wetlands, bringing the total to 59 species. Most surveys in the current monitoring program have been aerial only, so some of these 14 additional species may have been present but not counted, especially the shorebirds.

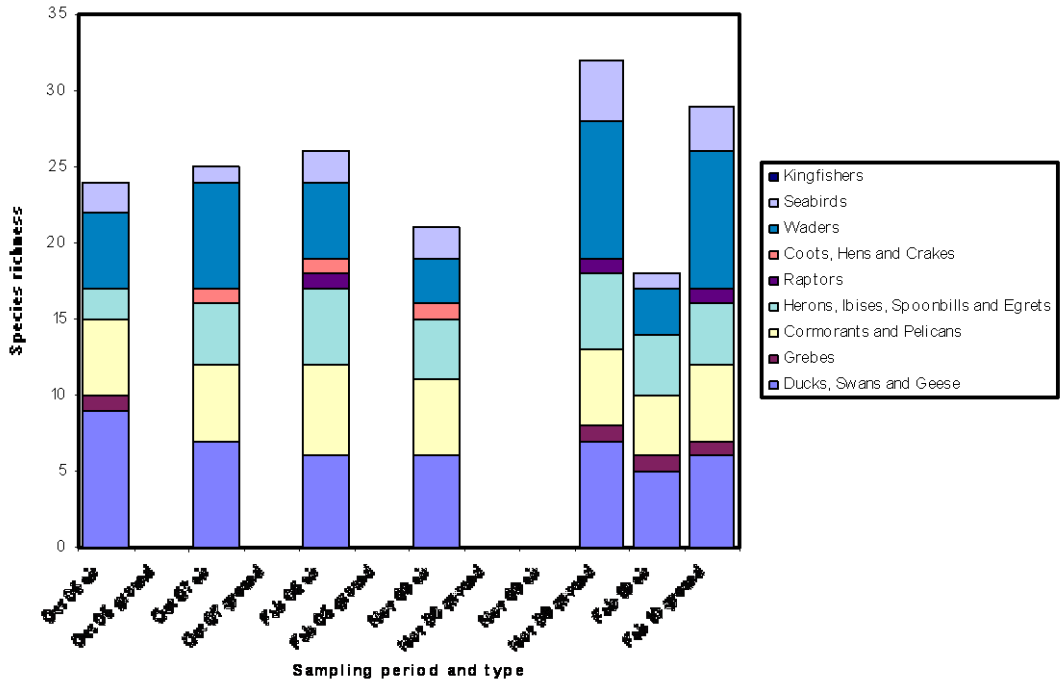

Figure 8. Species richness in the Gore system by major waterbird group between October 2006 and February 2010. Aerial and ground counts shown separately.

Forty-seven percent of species recorded in the Gore system were counted during all six surveys (Figure 9), which is close to the 51% of species recorded during all surveys in the Warden system. However, the proportion of species recorded during only 1 or 2 surveys in the Gore wetlands (49%) was twice that for the Warden system (26%), reflecting the greater variability in composition in the Gore wetlands.

Swans were always present in the Gore wetlands and the number of duck species ranged from 5 (on most occasions) to 8 in October 2006 (when only Freckled Ducks, Wood Ducks and Blue-billed Ducks were absent). Freckled Ducks and Wood Ducks have not been recorded during any of the surveys and Blue-billed Ducks, Australian Shovelers and Pink-eared Ducks were rarely seen and not abundant when present. Blue-billed Ducks and Wood Ducks have a general preference for low salinity waters so their absence is not surprising. These two species were each recorded only once in very low numbers during the 1980s surveys (Jaensch *et al*. 1988).

Grebes have rarely been observed in the Gore wetlands during the current monitoring program, despite apparently suitable habitat for Hoary-headed Grebes in the large open and saline Lake Gore. This observation is almost certainly an artefact of a lack of ground survey between October 2006 and November 2008. Hoary-headed Grebes are difficult to spot from the air because of their small size and habit of diving as the aircraft approaches. They were commonly recorded during the 1980s surveys, with up to 1000 counted during a single count and 346 were counted during the Salinity Action Plan survey in 1998 (Halse *et al*. 2004). In February 2010 146 Hoary-headed Grebes were seen from the air on Lake Gore whereas ten times this number were counted from the ground two days later. Three Great Crested Grebes were seen on Lake Gore in October 2006.

Pelicans were present on the Gore wetlands during all six surveys, as were Darters and most of the cormorants (the exception being Pied Cormorants seen only in February 2008 in the Kubitch-Quallilup flow-through). Normally four or five of the ciconiiformes (herons etc.) have been recorded per survey, except for October 2006 when only Australian White Ibis and White-faced Herons were seen. The latter is the only species in this group to have been counted on all occasions. The Little Egrets has not been recorded in the Gore wetlands during these surveys and the Nankeen Night Herons, Glossy Ibis and Straw-necked Ibis have only been recorded once each.

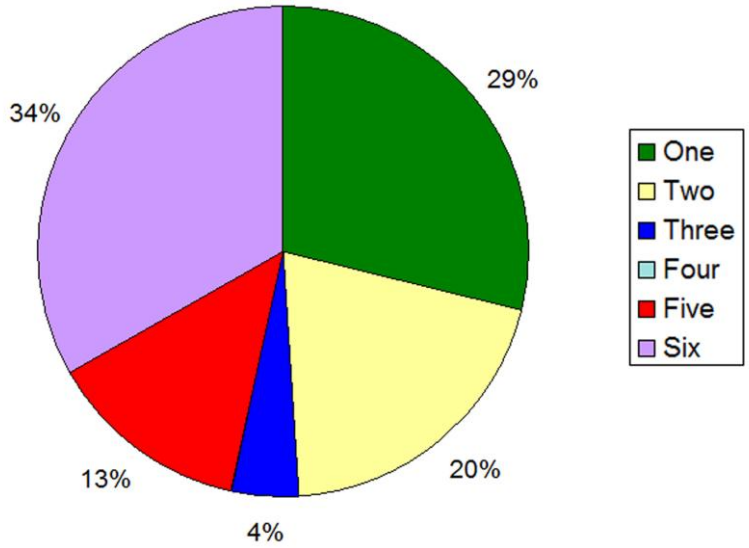

Figure 9. Frequency of occurrence of waterbird species in Gore system wetlands. Colours indicate the number of surveys in which waterbirds have been recorded and the percentage values indicate the proportion of waterbirds.

Swamp Harriers were only seen once (2 individuals in February 2008 over the Dalyup wetlands) and the White-bellied Sea Eagle twice (1 at Quallilup Lake in November 2009 and 1 over the flow-through in February 2010).

Of the 13 waders recorded since 2006, only Common Greenshanks and Red-necked Avocets have been seen on all occasions and half have only been seen only once or twice. However, the low number of records of most waders reflects a lack of ground counts prior to 2009.

In four of the six surveys total abundance on the Gore wetlands has been 8000 to 10000 birds. The spring and summer counts of 2007/8 were much higher at just over 14000 birds. These two high counts were very similar but the species contributing to this abundance differed

between seasons. In October 2007, ducks and swans made up 90% of abundance whereas in February 2010 ducks and swans made up only 48% of abundance and had much reduced actual abundance (Figure 10). Most of the remaining February 2010 abundance was made up by waders (35%), mostly Banded Stilt in the Kubitch-Quallulup flow-through. The numbers of ducks using the Gore wetlands declined by about 50% over summer in both 2007/8 and 2009/10. The decline was entirely in the numbers of Shelduck. In spring, large numbers of Shelducks congregate on Lake Gore and the Kubitch-Quallilup flow-through wetlands to moult and then, evidently, disperse to other wetlands, leaving reduced numbers in February. These birds seem to move away from the Esperance area since a similar pattern of decline over summer occurred in both of these years in the Warden wetlands. The numbers of some less numerous ducks did increase significantly over summer in 2007/8 and 2009/10: Chestnut Teals and Grey Teals in both years, Australasian Shovelers in 2007/8 and Musk Ducks in 2009/10. Numbers of some other non-waders also tended to increase over summer, especially Little Black Cormorants, which increased from 160 to 1488 between October and February 2007/8 (aerial counts) and from 272 to 1372 over the same months in 2009/10 (ground counts), with most of these observed in the flow-through system.

Banded Stilts increased in numbers significantly over summer in the Gore wetlands (50 to 3860 in 2007/8 and 423 to 1080 in 2009/10). Red-necked Avocets increased from 215 in November 2009 to 1061 in February 2010 (entirely in Lake Gore) but remained constant at around 500 birds in 2007/8.

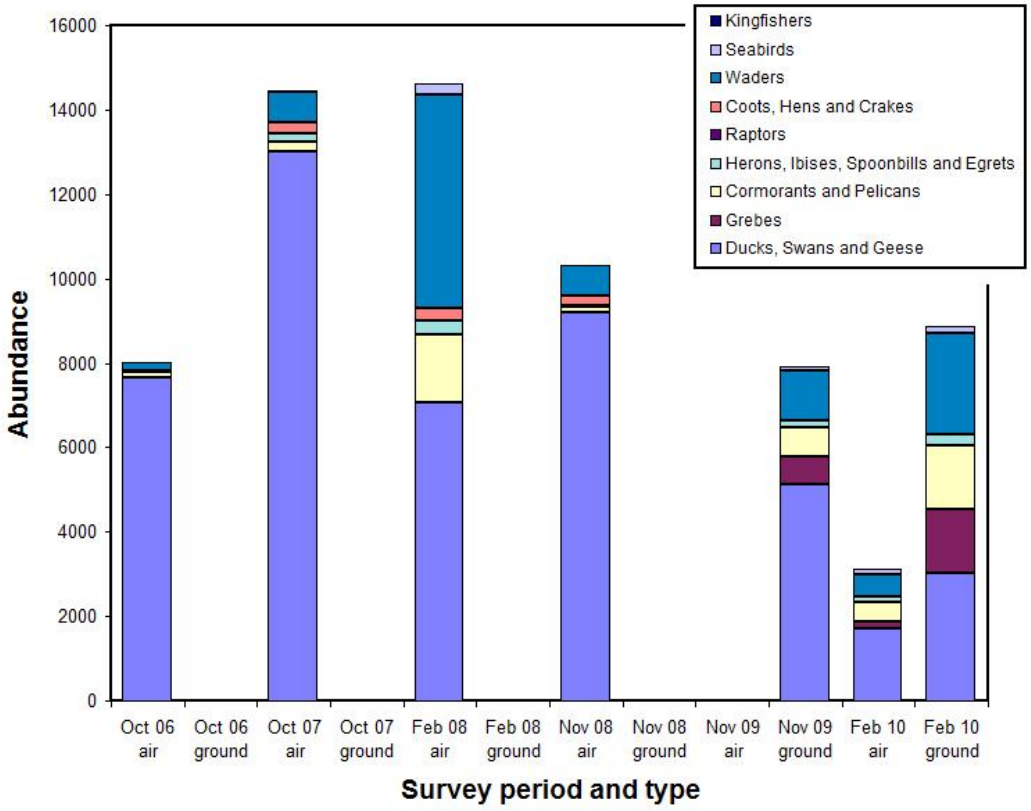

Figure 10. Waterbird abundance (aerial and ground counts) in the Gore system wetlands by major waterbird group between October 2006 and February 2010.

Waterbird species of note

Hooded Plover

Totals of 219 and 15 individuals were counted in November 2009 and February 2010 respectively across the Warden and Gore systems (Table 5). Only a few wetlands have had Hooded Plovers during the 2006-2010 monitoring, with multiple records for Station Lake, Pink Lake and the North Windabout Suite. Pink Lake may have had more Hooded Plover in November 2009 than was actually seen since it was only surveyed from a few spot points. This lake was dry and not surveyed by us in February 2010, although Birds Australia counted 17 individuals at this lake on 5 March 2010. Station Lake was also dry but had 11 Hooded Plovers in February 2010. During the 1980s surveys (Jaensch *et al*. 1988) Lake Warden and Station Lake were the sites at which Hooded Plovers were most frequently observed (with 539 birds present on Warden in April 1988). Ewans, Racecourse, Mullet and Windabout lakes had Hooded Plovers less frequently and usually in lower numbers. A count of 607 at Lake Warden was recorded in 1998 (DEC 2009a, K. Read pers. comm.[5]) and 60 were recorded on Station and Mullet lakes in February 2003 by Clarke and Lane (2003). High numbers of Hooded Plovers are unlikely to be present on Lake Warden while lake depths remain as high as they have been over the last decade (see Lane *et al*. 2009).

The record of 207 Hooded Plovers on Kubitch Lake in November 2009 represents a significant proportion of the total numbers counted in Western Australia during dedicated late summer Hooded Plover surveys by Birds Australia over the last decade (367 to 730). It is also one of the largest individual counts in recent years. The count certainly constitutes more than 1% (> 60 individuals) of the estimated total population of this species. The Lake Gore wetlands have supported up to 1600 Hooded Plovers in the past (DEC 2009a).

Table 5. Records of Hooded Plovers in the Warden and Gore wetland systems during the 2006 to 2010 monitoring program.

Survey	Wetland system	Wetland	Number
February 2010	Warden	Station Lake	11
		Lake Warden	4
November 2009	Warden	Station	1
		North Windabout	4
		Pink Lake	1
	Gore	Carbul Lake	6
		Kubitch Lake	207
November 2008	Warden	Pink Lake	4
February 2008	Warden	Pink Lake	8
October 2007	Warden	Pink Lake	6
October 2006	Warden	Station Lake	3
		North Windabout	2
		Burkenup Suite	2

Chestnut Teal

The numbers of Chestnut Teal on the Warden system wetlands were 243 and 329 in November 2009 and February 2010 respectively. In the Gore system counts were 36 and 430 for the same surveys. Other surveys since 2006 have counted between 121 and 873 Chestnut Teals in the Warden system and between 2 and 1001 in the Gore system. In the Warden

[5] Ken Read, Esperance Bird Observers Group.

wetlands, Chestnut Teal occur most reliably and in greatest numbers on the main lakes in the Wheatfield to Windabout chain, plus Ewans Lake, but most of the larger wetlands have up to a few dozen Chestnut Teals on occasion. In the Gore system, highest numbers tend to be found on Lake Gore itself, with lesser numbers on the flow-through and very few on Quallilup Lake and the Dalyup wetlands.

In spring 2008 a National Waterbird Survey counted waterbirds at just over 4103 wetlands across Australia (including most of the wetlands considered to be important waterbird habitats) and another 837 were surveyed at the same time for other projects[6]. This survey counted almost 11000 Chestnut Teals, although this is certainly an underestimate of the continental populations, with south-west WA populations alone estimated at 5000 to 40000 in the 1988/9 to 1991/2 annual waterfowl counts (e.g. Halse *et al*. 1990, 1995). In any case counts in both the Warden and Gore wetlands occasionally represent at least 1% of the State, if not the Australian, populations.

Cape Barren Goose (south-western)

This subspecies is a casual visitor to areas along the coast between Bremer Bay and Cape Arid but primarily inhabits islands along the south coast, especially the Recherche Archipelago. In the Warden system it is usually observed on the southern edge of Windabout Lake on the Golf Course where counts have ranged from 1 to 43 individuals. Several were seen in this location but not counted in November 2009 and 6 were present in February 2010. Two geese were seen at Pink Lake in February 2008 but none have been seen in the Gore system.

Pink-eared Ducks

A larger than average number of Pink-eared Ducks were counted on the Warden wetlands in 2009/10, with about the same number present in November 2009 (253, mostly on Station, Wheatfield and Windabout) as in February 2010 (264, mostly on Wheatfield, Woody and Windabout). Counts of this species in Warden wetlands have ranged from 0 to 130 between 2006 and 2008, although 290 were counted at Warden wetlands by Clarke and Lane (2003). During surveys in the 1980s a maximum of 12 Pink-eared Ducks were recorded in the Warden wetlands (Jaensch *et al*. 1988). Pink-eared Ducks have rarely been observed on the Gore wetlands: 10 were counted in the flow-through system in October 2006 and up to 60 were observed at a time in the 1980s.

Spotless Crake

Bennelongia (2008b) highlighted the occurrence of six Spotless Crakes at Wheatfield Lake and two at Windabout in February 2008, noting that this species didn't appear to have been observed previously at Wheatfield. A survey for the State Salinity Strategy in April of the same year recorded two individuals in April 2008 (DEC unpublished data) and four were counted at Windabout Lake in February 2008. None were recorded in the Warden system during the 1980s surveys and none have been recorded in the Gore wetlands.

Curlew Sandpipers

This species has been recorded in both of the summer counts in the Warden wetlands (February 2008 and February 2010). In February 2008 210 were recorded on Station Lake while in February 2010 3 were recorded on Mullet Lake and about 25 were recorded on the North Windabout wetlands. The global population is estimated to be around 180000, which is a decline from previous counts of 250000 (Bamford *et al*. 2008) and counts in Victoria, South Australia, Tasmania and Western Australia have all declined over the last 20 years (Gosbell and Clemens 2006 and the website below[7]. During the (Jaensch *et al*. (1988) Curlew

[6] http://www.wetrivers.unsw.edu.au/docs/rp_nws_home.html

[7](http://www.environment.gov.au/cgibin/sprat/public/publicspecies.pl?taxon_id=856#population_information)

Sandpipers were commonly observed and sometimes in high numbers on Lake Warden (up to 220) and Station Lake (up to 230) and less commonly on some other wetlands (especially Ewans and Mullet lakes. This species was also frequently encountered at Lake Gore, including one record of 600 individuals in October 1983.

Invertebrate communities

Species richness in 2009

A total of 86 species of aquatic invertebrate were recorded in October 2009 from the six wetlands studied. Reducing the dataset to be comparable with the 2006 and 2007 data (i.e. excluding Woody and Windabout, using comparable taxonomic resolution and including only the < 250 µm fraction from the plankton sample) the total richness for 2009 is 54 species. This compares to 44 species in 2006 and 41 in 2007.

The total species list for the six wetlands as a result of all three years sampling is now 92. Species recorded in 2006 and 2007 but not in 2009 are the beetles *Antiporus gilberti*, springtails (Hypogasturidae), velvet water bugs (Hebridae, genus *Hebrus*), the damselfly *Austrolestes analis* and tallitrid (paramelitid?, see below) amphipods. Cook and Farrell (2008) also record the beetles *Berosus discolor* and *Sternopriscus multimaculatus* but these are probably adult forms of the *Berosus* and *Sternoproscus* larvae recorded in 2009. Recent examination of the ostracods listed by Cook and Farrell (2008) has shown that they are the same species as collected in 2009, despite differences in the names used.

Invertebrate taxa collected in 2009

Protozoans. Protozoans are often very diverse and abundant in freshwater, but in these salt lakes very few species were collected. *Lesquerusia* secrete bead-like particles to form a spiral shaped case whereas *Centropyxis* primarily make a case from adhered detritus. The *Lesquerusia* and *Centropyxis* were only found in Lake Wheatfield, where salinity was lowest, whereas ciliate protozoans were present in Lake Wheatfield and Lake Warden. At Lake Wheatfield they were very abundant at site 1 on the southern shore, probably feeding on the algal bloom or secretions from the algae.

Cnidaria (jellyfish and hydroids). *Cordylophora* hydroids were present at site 2 of Lake Wheatfield but are difficult to detect in samples so may have been more widespread.

Turbellaria (flatworms). The two specimens from Station Lake probably belong to a group commonly known as microturbellaria (for their very small size). It is not possible to identify these flatworms as properly fixed specimens and specialist techniques and knowledge are required.

Nematodes (roundworms). These are generally abundant in most wetlands and were collected in all samples, although abundance varied considerably. There are undoubtedly numerous species but, as for flatworms, specialist knowledge and (preferably) live specimens are required for identification.

Rotifers. Rotifers are tiny animals (mostly < 0.5 mm), very diverse in freshwater and a few, such as those collected in this study, are halophilic. The *Hexarthra* species is undescribed but common in south-west salt lakes. It is related to *Hexarthra fennica* but with an extra pair of teeth (8 on each side of the trophy rather than 7). There is a suite of *Brachionus* species related to *Brachionus plicatilis* around the world, including some undescribed species known

only from south-west WA to date (Mills 2008). The specimens from the Warden wetlands include more than one species, possibly including a previously unrecognised species (Russell Shiel, University of Adelaide pers. comm.). For this report they have been lumped as *Brachionus plicatilis sensu lato* until they are better resolved. These were one of the most abundant animals collected in 2009, with tens to hundreds of thousands per sample in Woody and Windabout Lakes. The algal bloom at Whe_1 may have been the reason that rotifers were absent from that site: rotifers would find it particularly difficult to swim through the viscous water created by the alga.

Gastropods. *Coxiella* snails are salt lake specialists and possibly more diverse in southern Western Australia than elsewhere. There appear to be more than one species of *Coxiella* present in these lakes, but the taxonomy of this genus is in needs of revision and they are difficult to distinguish. Some of them may belong to the subgenus *Coxiellada* but we were not sufficiently confident to attempt species separation. There tends to be a high degree of variability within many snails, partly depending on water chemistry and growth rates. The other gastropod present was the hydrobiid *Ascorhis occidua*, which is known only from coastal wetlands and inlets around the south-western Australian coast (Ponder and Clark, 1988). These are easily mistaken for *Coxiella* as they have similar morphology and live in coastal salt lakes and estuaries. *Coxiella* were only recorded from the eastern three wetlands (Ewans, Station and Wheatfield) whereas *Ascorhis* was more widespread, occurring in Ewans, Wheatfield, Woody and Windabout. Gastropods in the Lake Warden samples were all dead prior to collection (shells only) whereas they were present as live animals in that lake in both 2006 and 2007. Large population crashes seem common for *Coxiella* in temporary salt lakes.

Bivalves. Sphaerid clams are common in streams, ponds and almost any permanent or semi-permanent water. These appear to belong to the genus *Pisidium*.

Clitellata (leeches and oligochaetes). Leeches are very rare in saline water and only one very immature specimen was found in this study (from Woody Lake). Oligochaetes are also usually depauperate in non-marine saline water, but *Paranais litoralis* inhabits moderately saline coastal wetlands and marine littoral habitats. Lake Warden was too saline for this species but it did occur in Ewans, Wheatfield and Woody lakes. Enchytraeid oligochaetes are also common in saline wetlands and occurred in Station, Wheatfield and Windabout.

Polychaetes (bristle worms). Some polychaetes, such as capitellids (which are primarily marine) will colonise near-coastal saline waters and move upstream in saline rivers. However, the undescribed *Manayunkia* is a species that only inhabits salt lakes of inland and coastal south-western Australia. This undescribed species, first collected by Pinder *et al*. (2004), only occurred only in Station Lake during this study and these are the first records from the Warden system. The nearest other records are in salt lakes of Beaumont Nature reserve, north-east of Esperance and in a salt lake within Helms Arboretum north of Esperance.

Acarina (water mites). Water mites are very rare in saline waters. Oribatids are one of the exceptions, though they are difficult to identify. These were present only in Lake Wheatfield. Mesostigmata are also fairly common in saline water, but some records may be terrestrial specimens that have fallen or been washed into the lake, as is probably the case for the single specimen from Station Lake.

Cladocera (water fleas). Water fleas are not very diverse in saline waters and in this study occurred only in the lower salinity Wheatfield, Woody and Windabout Lakes. These were a species that belongs to the *Daphnia carinata* complex and *Macrothrix breviseta*. The former is a very widespread complex of very similar species yet to be formally distinguished. These are normally considered to be freshwater species but there are many records in south-western Australia from brackish to mildly saline water.

Ostracods (seed shrimps). Ostracods are fairly diverse in mildly saline waters. Most of the species collected from these wetlands are halophilic (meaning that they prefer saline waters) but *Sarscypridopsis aculeata* and *Candonocypris novaezelandiae* are freshwater species with limited salt tolerance. *Sarscypridopsis* occurred only at the lower salinities in Ewans, Woody and Wheatfield lakes and *C. novaezelandiae* was restricted to the lowest salinity at Lake Wheatfield. Some ostracods (*Reticypris clava*, *Mytilocypris mytiloides*, *Diacypris spinosa* and *Leptocythere lacustris* were amongst the most abundant species in this study. *Diacypris compacta* was present only in the higher salinity Lake Warden. All of these species are common in south-west WA salt lakes and most occur across southern Australia. Re-examination of ostracods collected during the 2006 and 2007 sampling show them to be the same species as collected in 2009, but they were not all formally identified in the 2006 and 2007 reports so the names used in the earlier reports are different.

Copepoda. Copepods are split into three suborders (Calanoida, Cyclopoida and Harpacticoida). The only calanoid species present was *Gladioferens imparipens*, which is common in estuarine and near coastal saline habitats of sourthern and eastern Australia and New Zealand. Three species of halophilic Cyclopoida were present: *Halicyclops* sp. 1 occurred in Ewans, Station and Wheatfield lakes, *Apocyclops dengizicus* occurred only in Lake Warden and *Mesocyclops brooksi* was rare in both Wheatfield and Woody lakes. *Halicyclops* sp. 1 has a lower salinity tolerance (generally restricted to 35 g/L or lower) whereas *Apocyclops dengizicus* regularly occurs over 50 g/L (Pinder *et al*. 2005). At least two species of harpacticoid copepod were present: *Onychocamptus bengalensis* and *Nitocra* 'sp. 4'. These were both present in both of the Lake Wheatfield sites and in Station Lake site 1. However, these are very time consuming and difficult to identify and most specimens are recorded only as "Harpacticoida" for the time being. *Onychocamptus bengalensis* is widely distributed in brackish to saline coastal wetlands and is not restricted to Australia. The distribution of *Nitocra* "sp. 4" is uncertain, but in WA it is known from brackish waters between the Warden system and the Murchison River. Several other harpacticoids have been recorded from Lake Wheatfield in the past and may have been collected during this study.

Juvenile copepods are known as nauplii and very juvenile specimens cannot be placed into a suborder. For this reason all nauplii were counted separately.

Amphipoda. Amphipods are not very diverse in inland waters of south-western Australia. *Austrochiltonia subtenuis* is tolerant of a particularly wide range of salinities, though is less common at salinities over 100 g/L, and was present in all wetlands except for Lake Warden. Amphipods of the family Tallitridae are normally thought of as being terrestrial but were collected by Cook *et al*. (2007) from Station Lake. DEC has mistakenly identified amphipods from Lake Wheatfield as tallitrids in the past, but comparison with voucher material identified by independent amphipod experts has shown them to be *Melita kauerti* (Paramelitidae).

Isopods. All oniscoid isopods occurring in south-west WA salt lakes used to be called *Haloniscus searlei*. However, it is now known that WA specimens of this species may belong to a number of species related to, but not the same as, *H. searlei*, which is now thought to be restricted to south-eastern Australia (Cooper *et al*. 2008). *Haloniscus* were present only in Station Lake. Sphaeromatid isopods are largely marine/estuarine but occur in near coastal saline lakes. These occurred in Ewans, Wheatfield and Woody lakes in low abundance.

Decapoda. Decapods include crabs and yabbies, but in these lakes *Palaemonetes australis* was the only representative. These prawns, which are related to the northern Australian Cherubin, occurred only in Windabout and Wheatfield lakes. They are generally restricted to salinities less than 20 g/L.

Coleoptera (beetles). Not many beetles inhabit salt lakes, but some, such *Necterosoma penicillatus* and *Berosus discolor*, are characteristic of moderately saline waters. Cook and Farrell (2008) recorded the latter whereas we only collected *Berosus* larvae which cannot be identified to species. Other beetles collected by ourselves and/or Cook and Farrall (2008) belong to *Sternopriscus*, *Antiporus*, and *Enochrus*. These have a preference for freshwater but are tolerant of mild salinity to some extent.

Diptera (flies). Dipterans were the most diverse group, with several families represented. Since these are present in wetlands only as larvae most cannot be identified beyond family level, with the significant exception of the chironomids (non-biting midges). Ephydrids are commonly known as brine flies because they are common in salt lakes. The two species recognised in 2009 are probably the same as forms recorded quite commonly in the Wheatbelt. Tipulidae (crane fly) "species J" is a form that has not been recorded previously in DEC wetland projects but that is not to say that it is rare.

Hemiptera (water bugs). Only three species of hemipterans were collected in 2009: *Micronecta robusta*, *Anisops thienemanni* and *Diaprepocoris barycephala*. The first two are very common and widespread, but have limited salt tolerance, so were restricted to Wheatfield and Woody lakes in 2009. *Micronecta robusta* was restricted to Lake Wheatfield in 2006 and was absent entirely in 2007. *Anisops thienemanni* was not listed in the 2006 and 2007 lists but it may be equivalent to Notonectidae sp. F of Cook and Farrell (2008). The *Diaprepocoris* is less common and in the south-west is largely restricted to freshwater wetlands of the higher rainfall areas, so its presence in Woody and Windabout is surprising.

Odonata (damselflies and dragonflies). These are uncommon in the Warden wetlands. *Austrolestes annulosus* is he most salt tolerant odonate in Western Australia and occurred only in Station and Ewans lakes. The related *Austrolestes io* is less salt tolerant and occurred only in Wheatfield Lake site 2 in 2009. *Austrolestes annulosus* has also occurred in Wheatfield Lake (in 2006) and A. io has occurred in Station Lake in 2007. A third species, *Austrolestes analis* occurred in Wheatfield and Ewans Lake in 2006. These species are all damselflies. Dragonflies have only been collected as unidentifiable juveniles in Wheatfield in 2009.

Trichoptera (caddisflies). Most caddisflies are restricted to freshwaters but *Symphitoneuria wheeleri* is a salt water specialist, occurring in mildly saline rivers and lakes along the south-coast of WA and costal south-eastern South Australia. This species occurred in Station and Ewans Lake in 2006 and 2009. *Notalina spira* is less tolerant of salinity and only occurred in Wheatfield in 2006 and Wheatfield and Woody in 2009. Specimens of *Oecetis*, which cannot be identified to species at present, occurred only in Windabout Lake in 2009 and Ewans Lake in 2006 and 2007.

Wetland invertebrate communities in 2009

Figure 11 shows invertebrate composition in the six lakes sampled in 2009 by taxonomic group. Lake Wheatfield had highest richness with 44 species, Ewans, Woody and Windabout also had relatively high richness (34 to 38 species), Station Lake a little lower (28 species) and lake Warden had the lowest with 14 species. At the higher taxonomic level shown in Figure 11 the wetlands had fairly similar composition, with dipterans, and/or ostracods tending to have the greatest number of species, but most groups were represented in most wetlands. Lake Warden had a much simpler community, with only six groups represented, reflecting the much higher salinity in that wetland.

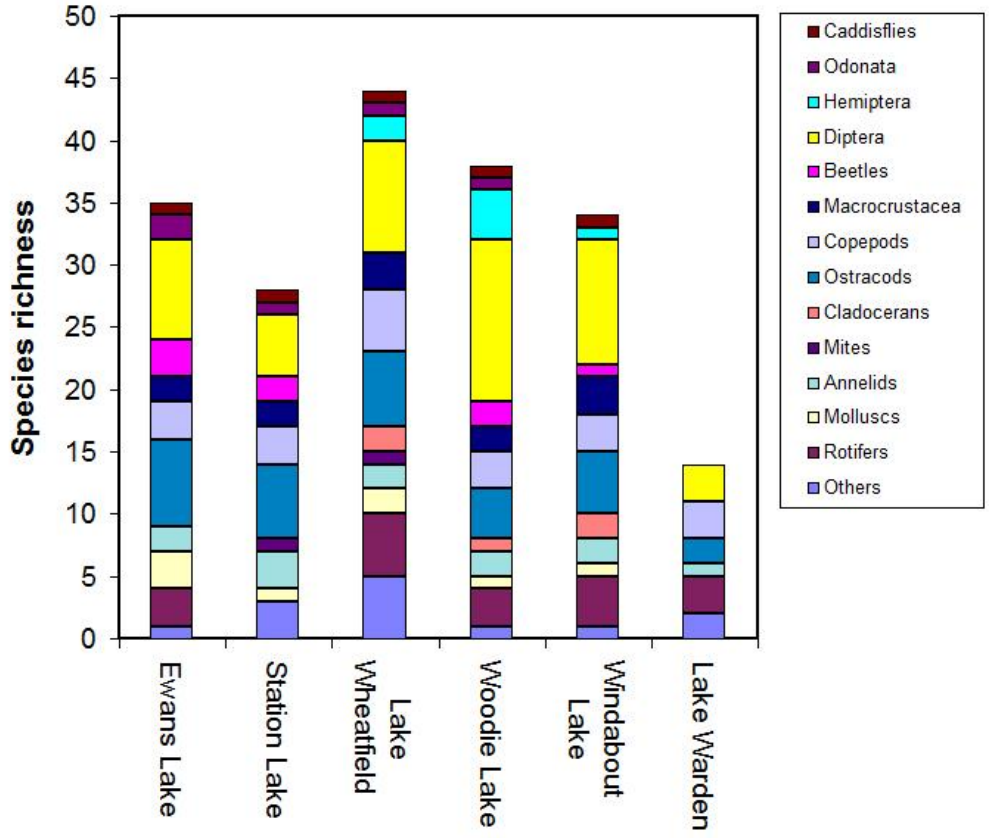

Figure 11. Species richness by taxonomic group of the Warden system wetlands sampled in October 2009.

Ewans Lake. Thirty five species of invertebrate were collected from Ewans Lake in 2009, with dipterans and ostracods being the richnest groups (Figure 11). Ewans Lake was the only location at which the rotifers *Notholca salina* and *Colurella uncinata*, beetles *Necterosoma penicillata* and *Enochrus* and *Pisidium* clams were collected in 2009 (Appendix 4), though these are common species in the south-west and all except the *Notholca* have been recorded in Warden system wetlands previously.

Station Lake. Twenty eight species were collected at Station Lake in 2009 (Figure 11). Overall species composition was very similar to Ewans Lake, with over a third of species being either dipterans or ostracods. Station Lake site one was the only location at which the endemic salt lake polychaete *Manayunkia* and the salt lake isopod *Haloniscus* were collected (Appendix 4). *Manayunkia* has not been collected previously in the Warden system wetlands, although it is possible that some of the 'oligochaetes' collected in 2006 and 2007 from Station Lake were polychaetes. *Capitella* polychaetes, which are marine worms, were also most abundant in Station Lake, possibly because of the direct connection to the ocean via Bandy Creek.

Lake Wheatfield. This lake had the highest species richness (44) but lowest total abundance in 2009 (Figure 14). As for other wetlands sampled in 2009, dipterans and ostracods were the most species rich groups, but rotifers and copepods were richer here than in other wetlands. This wetlands was also the only one to have the protozoans *Centropyxis* sp. and *Lesquereusia* sp., the copepod *Nitocra* sp. 4 and some insects (e.g. the damselfly *Austrolestes io* and chironomid *Kiefferulus intertinctus*), though the latter have been found in low abundance at some other wetlands in the system in other years. These insects are generally widespread in

the south-west, but the *Nitocra* seems to be a fairly uncommon brackish water specialist and the *Lesquereusia* may be a species not previously recorded in Western Australia.

***Lake Warden*.** Fourteen species were collected from Lake Warden in 2009, with richness not dominated by any one group (Figure 11). Both collecting sites had almost identical species composition, with the exception of the rotifer *Brachionus rotundiformis*, ephydrids (brine flies) and *Culicoides* (biting midges) present only at site 1 (Appendix 4). Several species with preferences for higher salinities were present only in Lake Warden (or were much more abundant in this lake), including *Hexarthra* cf. *fennica*, *Apocyclops dengizicus*, *Diacypris compacta* and *Tanytarsus barbitarsus*. All of these are widespread in salt lakes of south-western Australia.

Figure 12 shows abundance of invertebrates by taxonomic group for the six wetlands sampled in 2009, with values for the two sites at each wetland summed. Sweep net sampling is not a suitable method for estimating abundance or biomass, so values in Figure 12 and Figure 13 and values for 2006 and 2007, should be used only for rough comparisons between these wetlands and years rather than absolute estimates of abundance or biomass per unit area (see Discussion). Station Lake and Windabout Lake had the highest abundance, Ewans and Woody had intermediate abundance and Warden and Wheatfield the lowest. Composition by abundance varied greatly between the six wetlands. Copepods were dominant or co-dominant at most wetlands, except at Warden and Wheatfield, representing 85% of abundance in Ewans. Rotifers were very abundant at Woody, Windabout and Warden and ostracods were co-dominant at Station Lake. Abundance at Wheatfield was more evenly distributed across ostracods, copepods and nematodes, but there were also relatively high numbers of cladocerans and dipterans.

Figure 13 shows estimates of relative biomass for the six wetlands sampled in 2009 (summed across samples and divided by sampling effort measured as metres of sampling). Biomass varied greatly between wetlands. Station Lake had much higher biomass than the other five wetlands due to high abundance of two of the larger species (amphipods and gastropods) compared to other wetlands, and very high abundance of ostracods. Gastropods also contributed significantly to biomass at Ewans Lake and Wheatfield Lakes, but at Ewans, Windabout and Woody it was copepods that made the greatest contribution to biomass. While rotifers were frequently very abundant they contributed little to biomass because of their very small size, other than at Lake Warden which had very high numbers of the rotifer *Hexarthra* cf. *fennica*. Overall, molluscs, copepods, ostracods, amphipods and rotifers contributed most to biomass in 2009. These groups were also the largest contributors to biomass in 2006 and 2007, although chironomids and nematodes were major contributors at Lake Wheatfield in both those years.

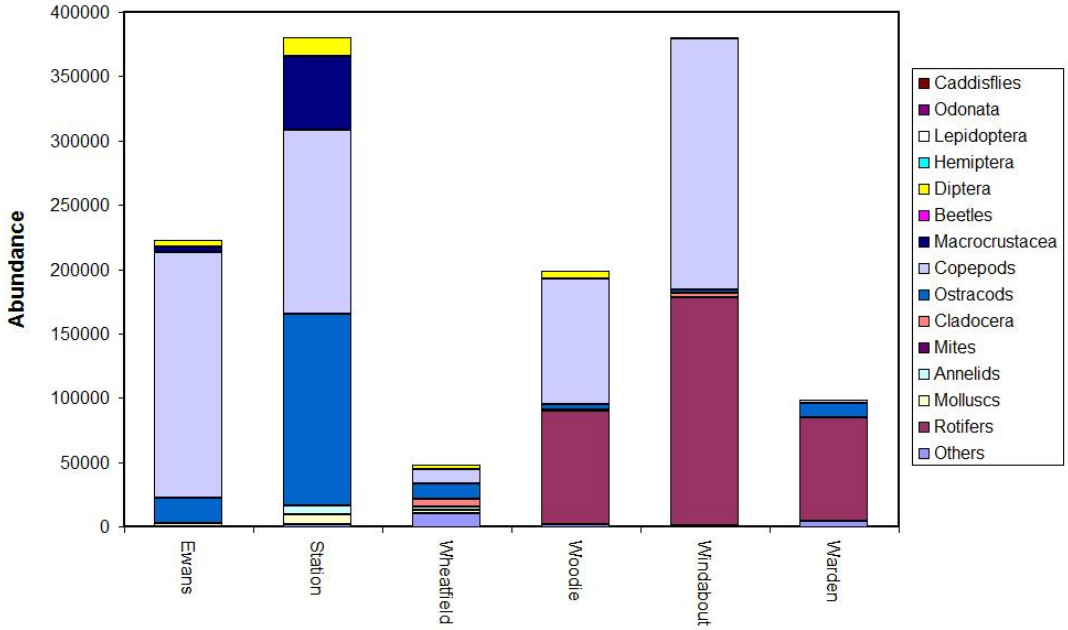

Figure 12. Abundance of aquatic invertebrates in the higher level taxonomic groups collected by all four samples per wetland in 2009. For compatibility with 2006 and 2007 datasets, abundance excludes larger individuals collected in the plankton net (those retained on a 250 µm mesh sieve).

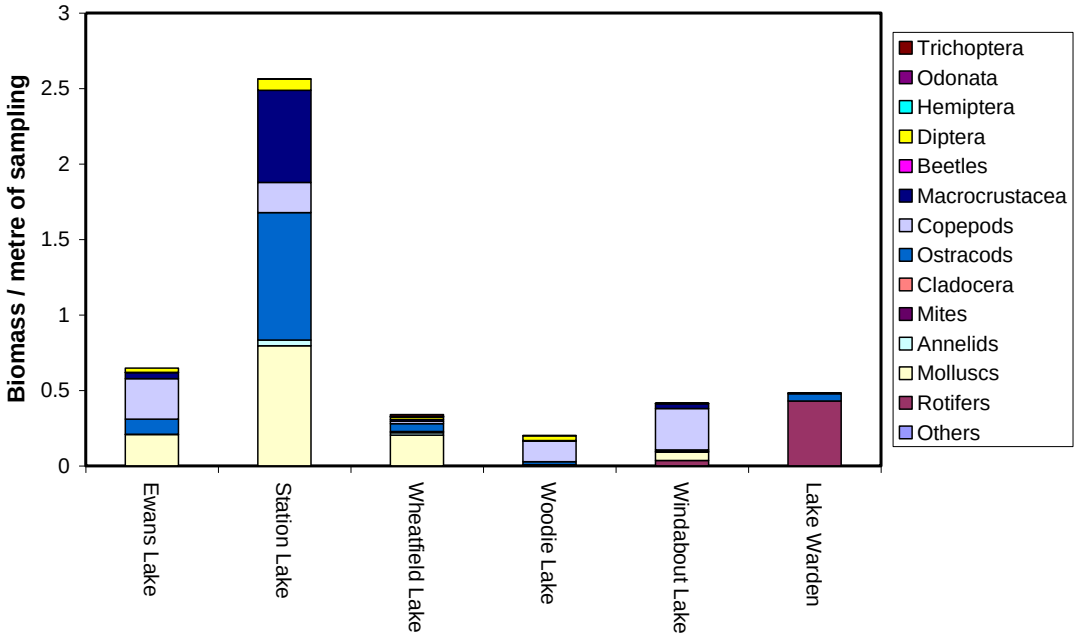

Figure 13. Estimation of biomass of aquatic invertebrates in the higher level taxonomic groups collected by all four samples per wetland in 2009. For compatibility with 2006 and 2007 datasets, biomass excludes larger individuals collected in the plankton net (those retained on a 250 µm mesh sieve).

Wetland invertebrate communities 2006 to 2009

Figure 14 and Figure 15 show richness of invertebrates in the four wetlands sampled in all three years (for each sample and for samples combined) plus conductivity for the period July 2006 to November 2009. To match the taxonomic scope and resolution of the 2006-7 data, the richness values for 2009 are reduced by 1) ignoring taxa only found in the >250 µm fraction of the plankton sample, 2) lumping some species into higher level groups (cladocerans, ceratopogonids, calanoid, harpacticoid and cyclopoid copepods and annelids) and 3) excluding rotifers and protozoans.

Figure 17 shows biomass of micro-invertebrates and macro-invertebrates in the six lakes between 2006 and 2009. The more saline wetlands (Ewans, Station and Warden) had consistently higher biomass compared to the three wetlands in the Wheatfield to Windabout suites. Only at Lake Wheatfield is biomass consistently dominated by macro-invertebrates. At other wetlands there was a more even split between micro- and macro-invertebrates or micro-invertebrates were always dominant (Lake Warden). Plots of abundance have not been produced because some of the 2006 and 2007 micro-invertebrate data have not yet been obtained from CENRM (biomass values for these years are estimated from the graphs provided in Cook *et al*. (2007) and Cook and Farrell (2008).

There has been considerable inter-annual variation in the richness, composition and abundance of the aquatic invertebrate communities within these wetlands over the three years of sampling. An analysis of the extent to which this biotic variability is related to variation in measured environmental variables is yet to be undertaken, but species richness, at least, does not appear to be strongly related to salinity. Several more years of data and modelling and multivariate analyses will be required to quantify fauna-environment relationships, as is proving to be the case for wetlands monitored for the State Salinity Strategy (e.g. Cale *et al*. 2010). Analysis of changes in community composition is hindered by incomplete identifications (copepods, cladocerans, rotifer, ceratopogonid, ostracods) for the 2006 and 2007 invertebrates. These specimens should be re-examined and fully identified to bring the 2006 and 2007 data up to 2009 taxonomic resolution, rather than undertaking analyses of community composition at a lower resolution.

Ewans Lake. Richness in 2009 (as scaled down for compatibility) was about the same as in 2006, with both these years somewhat higher than in 2007 (Figure 14). There appears to be a weak inverse relationship between conductivity and richness, but little relationship would be expected over this narrow range of salinities and the apparent relationship is probably an artefact of having only three data points. In 2006, calanoid copepods (probably *G. imparipens*) and the amphipod *A. subtenuis* were most abundant. Calanoid copepods were also abundant in 2007 but *A. subtenuis* and the ostracod *D. spinosa* were the most abundant species. In 2009 calanoid (*G. imparipens*) and harpacticoid (*O. bengalensis*) copepods plus ostracods (mostly *L. lacustris* and *R. clava*) were the most abundant taxa, with relatively few *D. spinosa* or *A. subtenuis*. In all three years there has been a tendency for site 1 to have much higher numbers of the most abundant species than site 2. Biomass varied between 0.65 g/m and 1.2 g/m over the three sampling events and was lowest in 2009 (Figure 17). In 2006 amphipods and the ostracod *Mytilocypris mytiloides* accounted for almost all of the biomass whereas in 2009 it was snails (*Coxiella/Coxiellada*) with a smaller proportion accounted for by ostracods and amphipods.

Station Lake. Richness in 2009 was 24% higher than in 2006 and 62% higher than in 2007, despite very similar salinities across the three sampling events (Figure 14). In 2006, the amphipod *A. subtenuis* and some ostracods (especially *D. spinosa* and *M. mytiloides*) were most abundant, but total abundance and biomass was quite low. Abundance was more than twice as high in 2007 but with the same species dominant. In 2009 abundance was higher again, but with copepods (mostly juveniles), *A. subtenuis* and several ostracods (including *M.*

mytiloides, *D. spinosa* and *R. clava*) most abundant. Increasing biomass over 2006 to 2009 (Figure 17) reflected abundance, but with amphipods and gastropods contributing most to biomass in 2006 and these species plus some ostracods contributing most to biomass in 2009.

Lake Wheatfield. Lake Wheatfield had the highest invertebrate richness of all of the lakes for all three years. Richness (as reduced for data compatibility) was higher in 2009 than in both 2006 and 2007 (Figure 14), despite similar conductivities in all three years. In 2006 oligochaetes (probably including polychaetes) were by far the most abundant taxa (mainly at site 1), although there were also significant numbers of chironomids (mainly at site 3) and calanoid copepods were relatively abundant at all sites. Calanoid and cyclopoid copepods were much more abundant than any other species in 2007 and total abundance was more than twice that recorded in 2006. In 2009 total abundance was between the 2006 and 2007 values but was more evenly distributed across several dominant taxa, especially the harpacticoid copepod O. bengalensis, ostracod L. lacustris, nematodes and cladoceran Daphnia carinata (Appendix 4). Lake Wheatfield had consistently low biomass compared to Ewans, Station and Warden lakes, but was similar to the other two wetlands in the interconnected Wheatfield to Windabout wetland complex. Biomass was 2.5 times higher in 2009 than in 2007 and 4.5 times higher than in 2006.

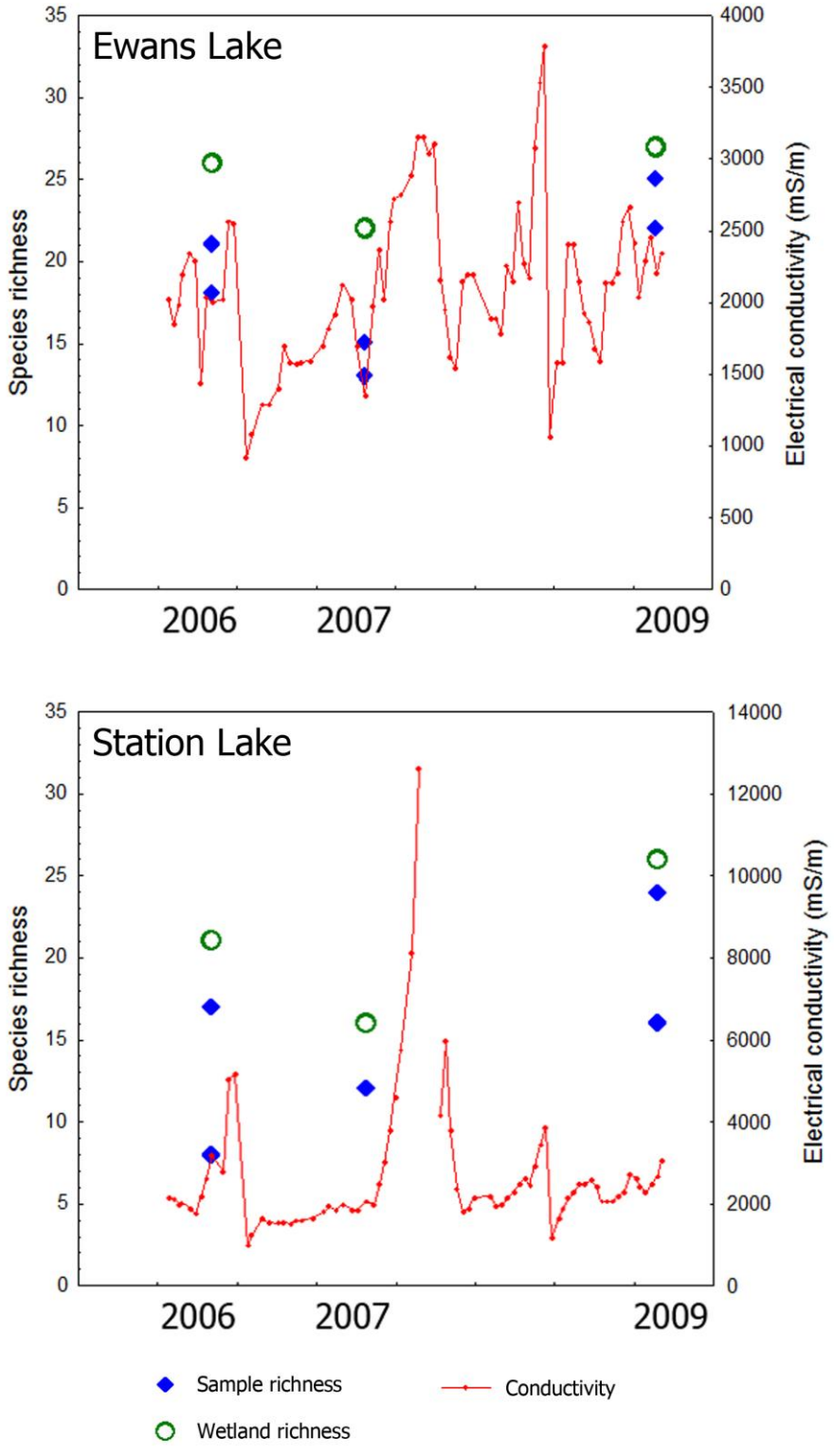

Figure 14. Species richness (per sample and total for wetland) and conductivity (red line) in Ewans Lake and Station Lake for the period 2006 to 2009.

The higher richness for Lake Wheatfield in 2009 in Figure 15 contrasts strongly with results from the State Salinity Strategy (SSS) wetland monitoring project, for which Lake Wheatfield has been monitored every two years since 1997. Data from the SSS project (which uses a finer taxonomic resolution for some groups) suggests that total invertebrate richness was actually lower in 2009 than in any of the other six sampling events during the previous decade including 2007 (Figure 16). The SSS data shows that total invertebrate richness at Lake Wheatfield has been between 52 and 61 for most of the last 12 years, with two exceptions. Sixty nine species were recorded in 1999, with rotifers making up most of the additional richness. By contrast, richness was relatively low in 2009, with dipterans, odonates and caddisflies having especially low diversity. The same 2009 data was used for both the current project and the SSS study, but it was cut down for Figure 15 to match the lower taxonomic resolution used in the CENRM reports.

In 2007, invertebrate sampling at Lake Wheatfield for both projects (SSS and the current project) occurred during the same week in October and largely in the same locations (except that one less sample was collected for the SSS project). However, total richness obtained in 2007 by Cook and Farrell (2008) from 3 samples was 20 species whereas 53 were recorded for the SSS project from 2 samples. Using the same taxonomic scope and resolution as Cook and Farrell (2008) the SSS richness for 2007 would be 41 species.

Lake Warden. Richness in 2009 was slightly higher than in 2006 but was 50% greater than in 2007. Conductivities at the time of sampling were not significantly different across the 3 years. The site within Lake Warden that had lowest richness in 2007 was site 3 (centre of the lake), which was not sampled in 2009. "Cyprididae sp. A" (which was mostly a combination of *Reticypris clava* and *Diacypris compacta*) accounted for over 90% of individuals in 2006. (excluding rotifers if collected). A greater range of species were abundant in 2007, especially calanoid copepods and several ostracods (identity uncertain), and total abundance was an order of magnitude higher (>13000/m) than in 2006 (~1500/m). Abundance appears to have been lower (~1000/m) in 2009, with the rotifer *Hexarthra* cf. *fennica* most abundant (although rotifer data was not available for 2006 and 2007 at the time of writing this report). The very high abundance of calanoid copepods (*Gladioferans imparipens*) in 2007 is reflected in the very high biomass values for that year in Figure 17. This was the highest biomass recorded for any wetland for the three years of sampling.

Although there is clearly some variability between years, there is little in the results to date to suggest any directional trends in the aquatic invertebrate communities. Lake Wheatfield appears to have had lower invertebrate richness in 2009 than in any of the six previous sampling occasions since 1997 (based on the State Salinity Strategy monitoring). Sampling in coming years will determine whether this is an anomaly or something more persistent. Biomass in Wheatfield and Station Lake has increased between each of the three consecutive sampling events whereas there is no such trend for Ewans and Station lakes. For all four of the lakes with three years of data, richness was lower in 2007 than in 2006, but returned to higher levels in 2009. However, trends in community composition, richness, abundance or biomass would be very difficult to detect over only three sampling rounds at four wetlands.

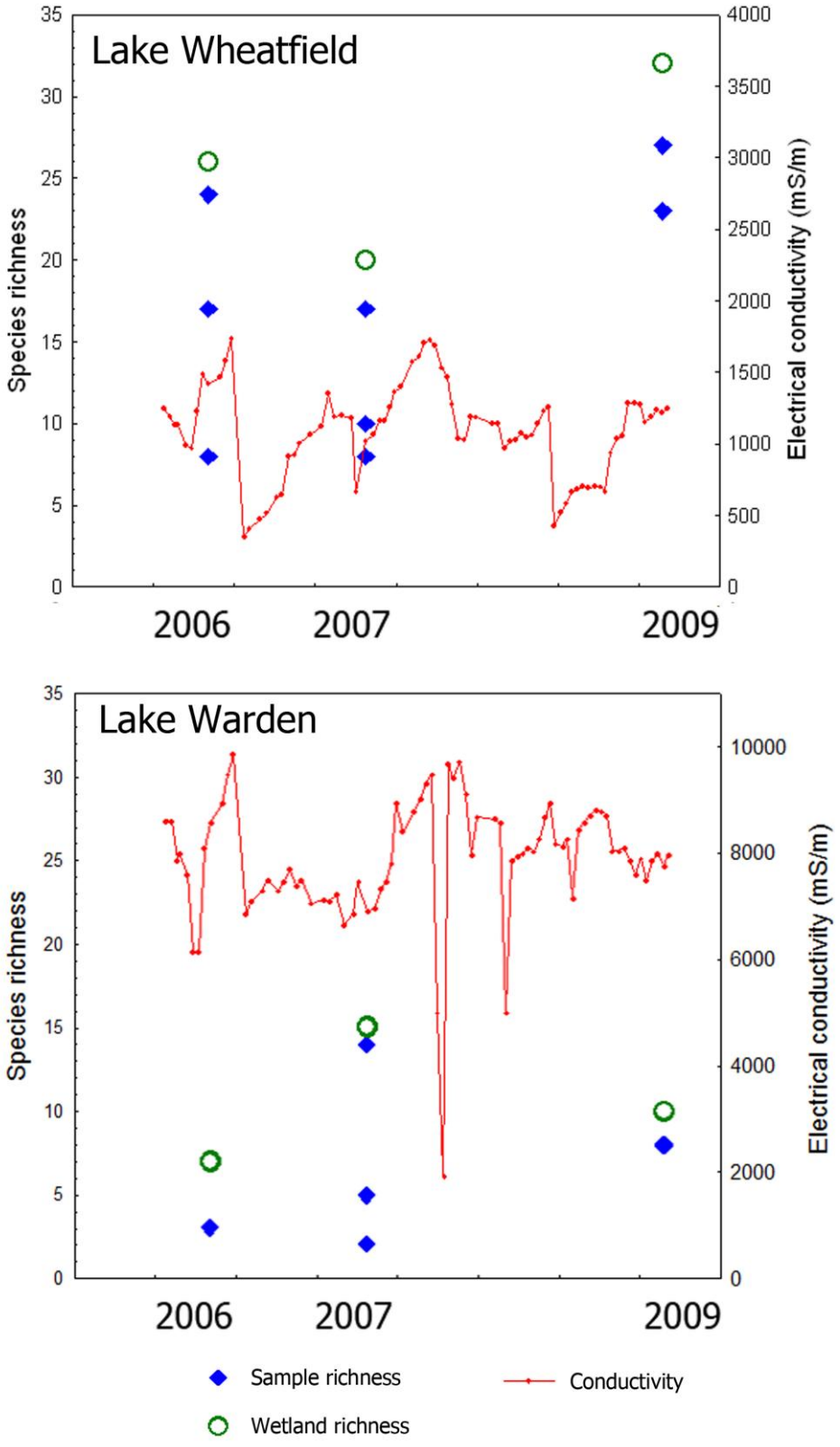

Figure 15. Species richness (per sample and per wetland = samples combined) and conductivity (red line) in Lake Wheatfield and Lake Warden for the period 2006 to 2009.

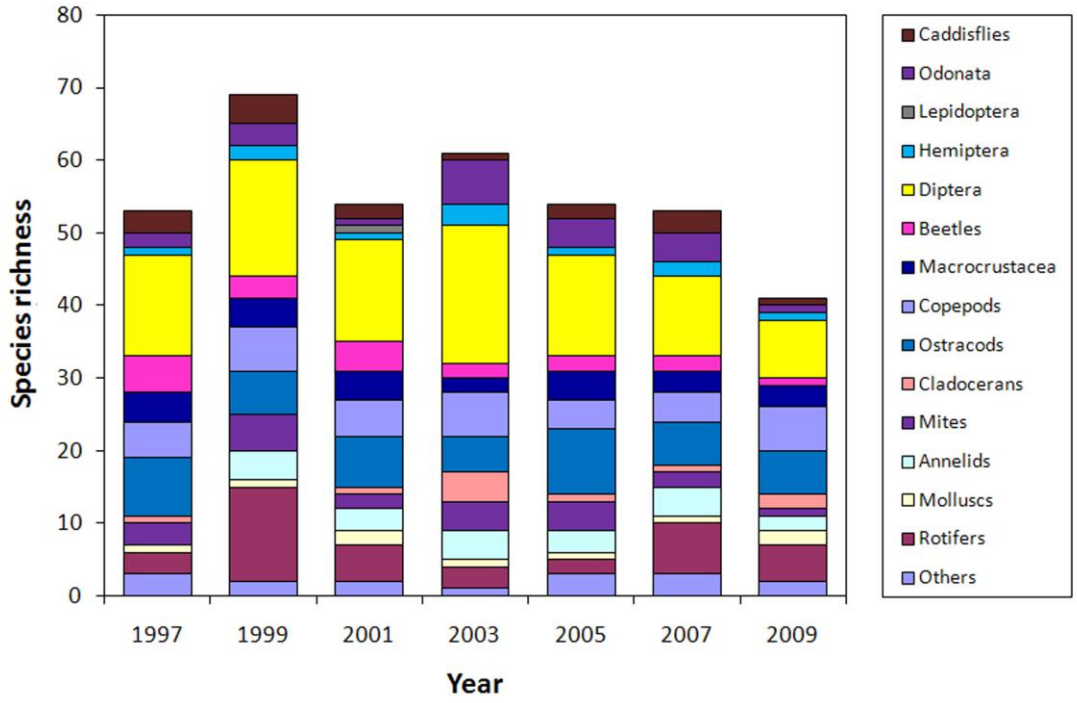

Figure 16. Richness and composition by major taxonomic group (excluding protozoans) for Lake Wheatfield 1997 to 1999. Data from the State Salinity Strategy wetland monitoring project.

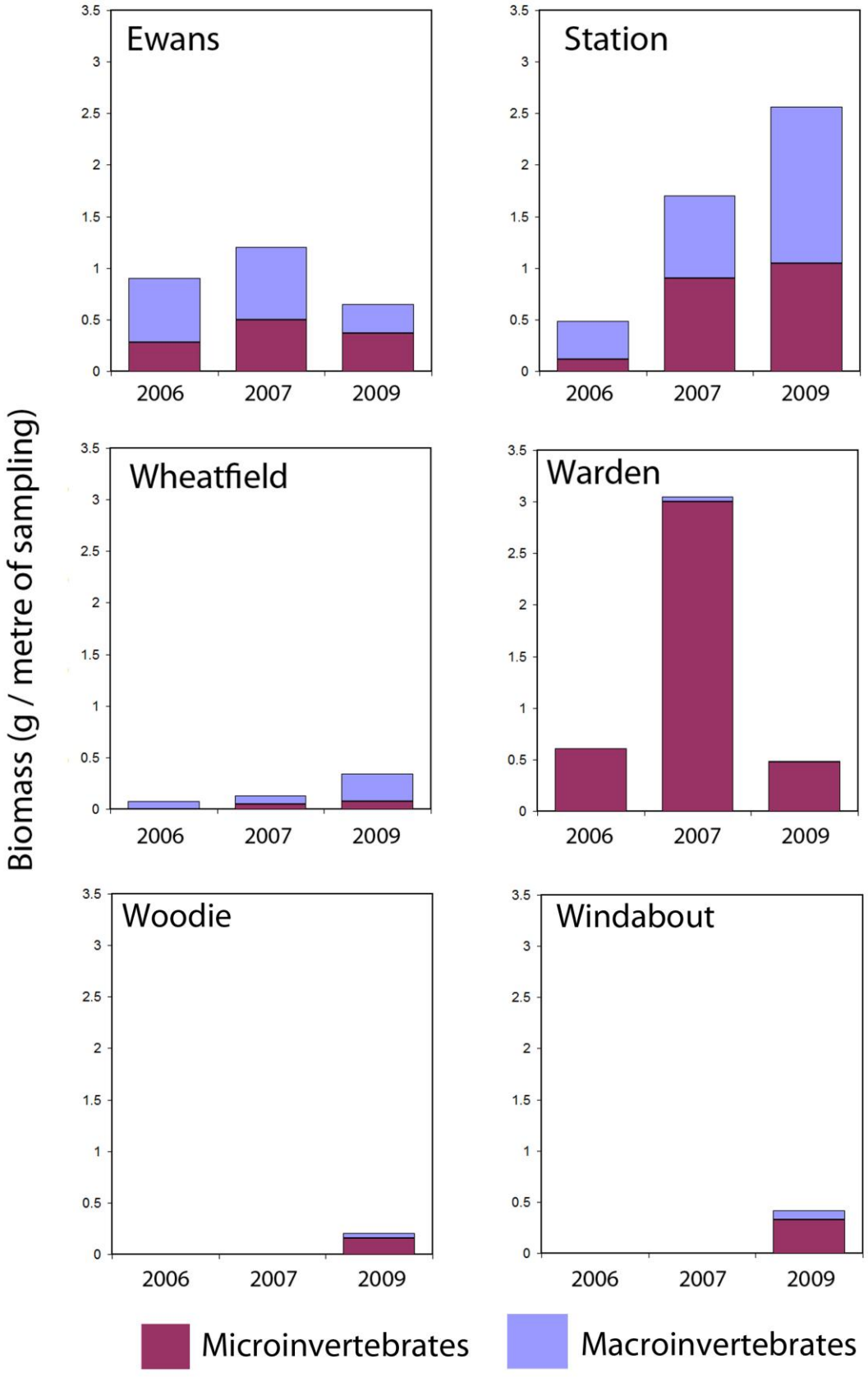

Figure 17. Estimated biomass for all six wetlands 2006 to 2009. Biomass excludes larger individuals collected in the plankton net (those retained on a 250 µm mesh sieve).

Aquatic invertebrate sampling methods

Sweep netting is best suited for determining species richness and presence/absence of species and has been shown to be an adequate method for this purpose (e.g. Halse *et al.*, 2002, Pinder *et al.* (2010). Counting of individuals collected in a sweep net sample does provide an indication of the abundance of species in relation to one another (i.e. which are more abundant and which are rarer – assuming that all are equally collectable with the method). However, sweep net sampling is not a quantitative method, i.e. it is unsuitable for determining abundance or biomass per unit area of lake bed or volume of water. It is prone to differences in operator technique and, in any case, does not collect all (or probably even most) invertebrate specimens over the 'area' sampled. If all that is required is an indication of relative abundance and biomass in the wetlands then the current method of sweep netting is perhaps suitable. However, abundance and biomass then needs to be expressed as per sample or per unit of sampling effort, as in this report. If more quantitative estimates of biomass are required (e.g. to estimate absolute food resource availability for waterbirds) then a more quantitative technique, such as water column/sediment cores and/or plankton traps, needs to be employed.

SUMMARY AND RECOMMENDATIONS

- The present waterbird survey program addresses knowledge gaps and biological monitoring requirements identified in the Ecological Character Descriptions for the Lake Warden and Lake Gore Ramsar sites (DEC 2009ab). In particular, it addresses gaps in knowledge of waterbird usage over time and in knowledge of ecological water requirements of the biota. For the 2009/10 surveys of waterbirds using the Warden and Gore wetland systems we employed the same methods as used for surveys between 2006 and 2008, except that no useful aerial count data were obtained in November 2009. For the Warden wetlands approximately 10000 (ground counts) and 5500 (ground/aerial combined) waterbirds were counted in November 2009 and February 2010 respectively. For the Gore wetlands, 8000 to 9000 waterbirds (based on ground counts) were counted in each season. Overall, the number and diversity of waterbirds counted in 2009/10 is within the range of counts made in recent years for both systems.

- The total number of waterbird species recorded in the Warden and Gore wetlands during the current monitoring programme (2006 to 2010) is now 61 and 45 respectively, bringing the total number of species known to have occurred in these systems since the early 1980s to 76 and 59 respectively.

- Altered hydrology, especially elevated lake depths, and consequent reduced areas of shorebird habitat, is one of the main threats to the Lake Warden system identified in the Ecological Character Description (DEC 2009a). A drainage program to reduce depth in the central suite of the Warden wetlands (Wheatfield to Windabout) began operating in early 2009. By February 2010 the depth in Lake Wheatfield had fallen to the second lowest level since weekly to fortnightly depth monitoring began in 2002, although low summer rainfall may have contributed to the low depth. The occurrence of 10 wader species in this complex in February 2010 compared to a maximum of four species in 2006-2009 surveys, is significant, irrespective of the cause the low lake depths. Wader abundance in these wetlands was also much higher in February 2010 than for other recent counts.

- The November 2009 and February 2010 surveys should be seen as the first year of a post-drainage monitoring program that should extend until at least 2011/12. Two

more spring/summer surveys will also provide additional baseline data for other wetlands in the Warden system. The latter is important should the engineering works be expanded in the future (e.g. to Lake Warden). Additional surveys of the Gore wetlands will also provide refined estimates of current usage. Unless major management actions are planned in the Gore system in the near future, surveys at Gore need not be as frequent as are required in the Warden wetlands. However, simultaneous surveys in both systems can help to interpret fluctuations in numbers using either system.

- To further improve understanding of changes in waterbird numbers and diversity in the Warden and Gore system wetlands we recommend that a detailed review be undertaken of all available waterbird data.

- Sampling of invertebrates using the same taxonomic scope and resolution as for the 2006 and 2007 sampling suggests that Wheatfield and Station lakes had slightly higher invertebrate richness in 2009 than in previous years. The value of using a finer taxonomic resolution is shown by data from the State Salinity Strategy, which indicates the converse pattern for Lake Wheatfield: 2009 invertebrate richness being lower than in previous years. Richness in Lake Warden and Ewans Lake was about the same as in previous years.

- The total number of invertebrates recorded from the Warden wetlands in the current monitoring program is now 92 species. Overall, the fauna is typical of mildly to moderately saline wetlands in south-western Australia, comprising a mix of widespread halotolerant or halophilic species. Almost all species present are very widespread in the inland south-west and many have even larger ranges. Mildly saline wetlands along the Western Australian south coast tend to have a combination of inland water species plus some species that are more coastal or near coastal in distribution, such as *Palaemonetes* shrimps, *Paranais* oligochaetes, *Ascorhis* snails and capitellid polychaetes. This coastal element appears to be particularly well represented in the Warden wetlands. Significant new records are the hemipteran *Diaprepocoris barycephala*, which is not usually recorded this far east in Western Australia, and the polychaete *Manayunkia* n. sp., which has not previously been recorded in south coast wetlands (although is quite common in the inland south-west).

- Aquatic invertebrates are an integral biological component of the Warden wetland system. In addition to their intrinsic value as a major element of aquatic biodiversity, they are critical to processes such as sediment biogeochemistry, nutrient and carbon cycling and controlling phytoplankton. Invertebrates also constitute the primary food resource for most of the waterbirds that give these wetlands international significance. Monitoring invertebrate communities is therefore an important component of adaptive management in the Warden wetlands, as recognised in the ECD for these wetlands (DEC 2009a). However, monitoring aquatic invertebrates needs to be targeted and provide useful information that can inform management.

- We suggest a two-pronged approach to aquatic invertebrate monitoring in the Lake Warden system:

    1. Continued monitoring of aquatic invertebrate community composition at selected wetlands. This will provide greater understanding of changes in the invertebrate fauna in relation to hydrology, salinity and other factors, including responses to present and future management actions. Priorities should be to monitor responses to the effects of the present drainage system in the Lake Wheatfield to Windabout suite and to collect additional baseline

data for wetlands that may be affected by any extension of the engineering works (e.g. Lake Warden).

2. Quantitative determination and monitoring of waterbird (especially wader) invertebrate food resources. The engineering solution to reduce lake depths in the Wheatfield to Windabout wetland suite is expected to expand wader habitat (especially exposed beaches and shallow water zones). The extent to which this increases the abundance (if not the diversity) of waders is also dependant on the amount of aquatic invertebrate food resources. Existing aquatic invertebrate monitoring is adequate for species composition monitoring but inadequate to provide consistent information on changes in abundance and biomass of aquatic invertebrates. For the latter we recommend randomised, properly replicated fixed area sampling, such as the use of combined sediment/water column coring.

The balance between these two approaches will be determined by availability of resources and priorities for management. We suggest that the second approach is a priority since it directly relates to the main biodiversity asset (waterbirds) that the current management program is trying to recover.

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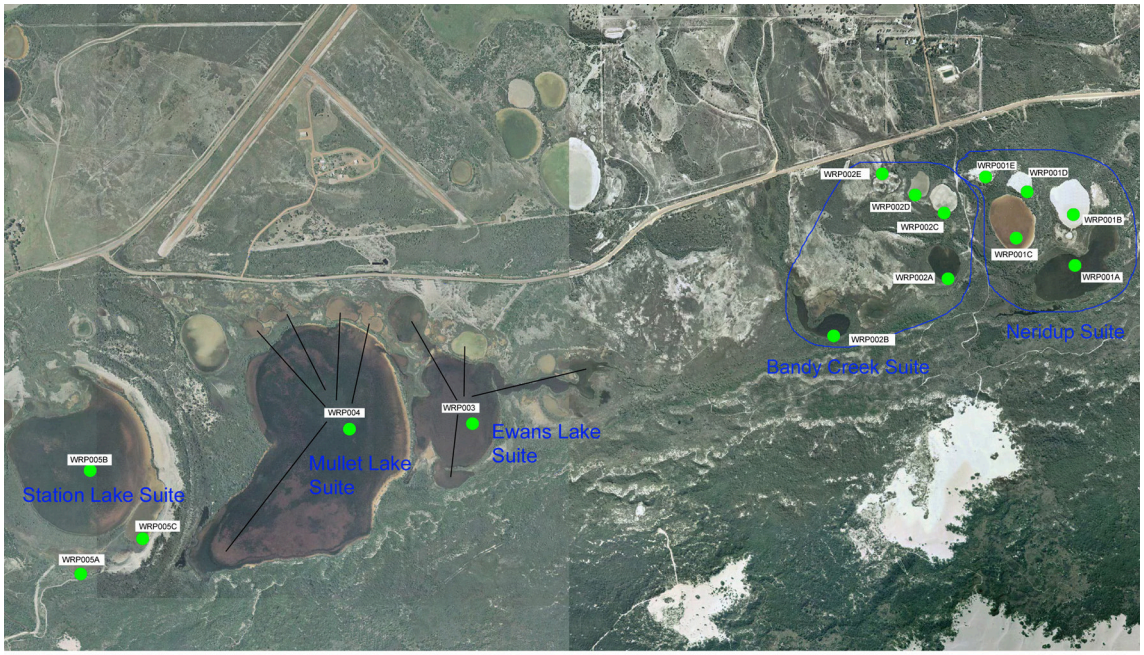
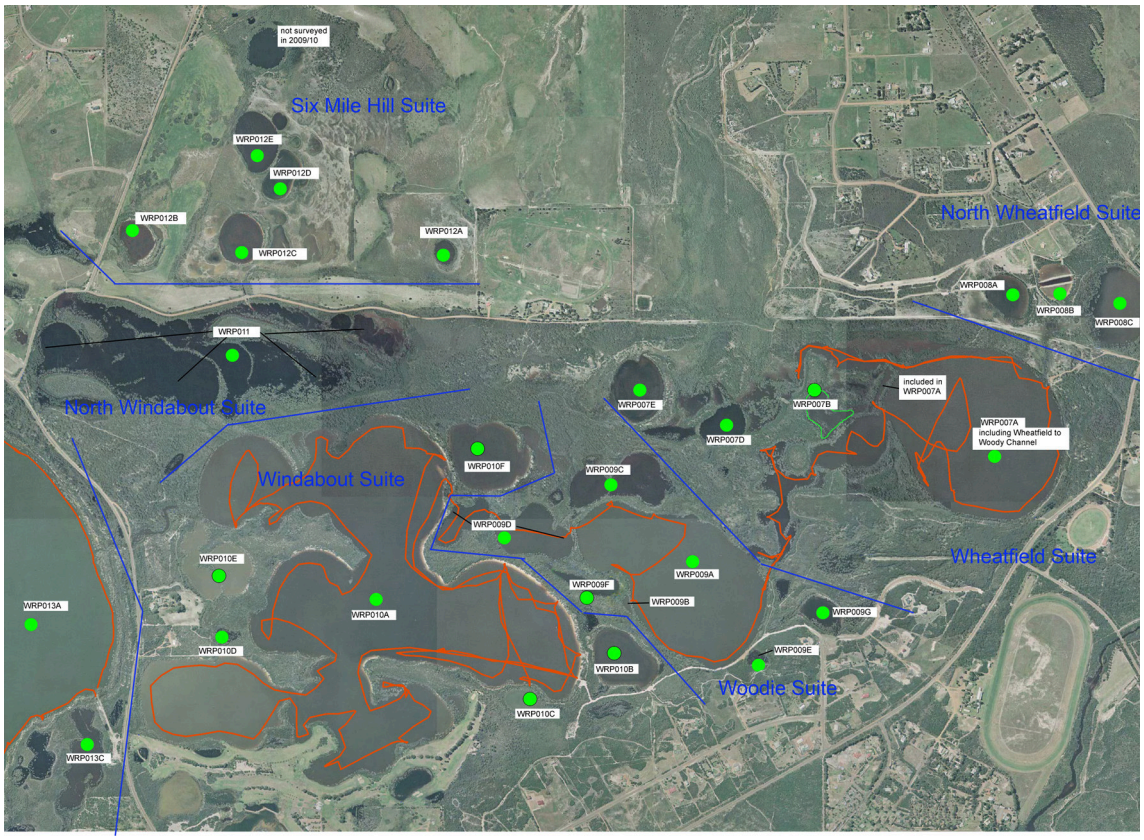
Appendix 1. Wetlands surveyed for waterbirds in the Warden and Gore systems in 2009/10

Wetland Suite Code	Wetland Suite Name	Wetland	Location	Nov-09	Feb-10
WRP001	Neridup Suite	A	large southern lake with two basins	19/11/2009	DRY
		B	medium sized central eastern lake	19/11/2009	DRY
		C	medium sized central western lake	19/11/2009	DRY
		D	small lake just above WRP001C	19/11/2009	DRY
		E	small northern-most lake	19/11/2009	DRY
WRP002	Bandy Creek Suite	A	south-eastern lake	19/11/2009	DRY
		B	south-western lakes and adjacent areas	19/11/2009	22/02/2010
		C	eastern lake closest to track	19/11/2009	DRY
		D	lake between C and D	19/11/2009	DRY
		E	north-western most lake close to Merivale Road	19/11/2009	DRY
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	19/11/2009	22/02/2010 and 23/02/2010
WRP004	Mullet Lake	A	includes pans to north of main lake	19/11/2009	23/02/2010
WRP005	Station Lake	A	flats to south of main lake	20/22/2009	DRY
		B	main lake	20/22/2009	DRY
		C	overflow areas to east of main lake	20/22/2009	DRY
WRP005B	Merivale Suite	A		not surveyed	not surveyed
WRP006	Gun Club wetlands	A	main lake opposite Lake Road (north of Gun Club)		DRY
		B	hour-glass shaped on eastern edge of Gun Club	19/11/2009	DRY
WRP007	Wheatfield Suite	A	Wheatfield Lake plus channel to Woodie Lake	20/11/2009	23/02/2010
		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.	20/11/2009	DRY
		D	satellite wetland north-west of main channel	20/11/2009	23/02/2010
		E	satellite wetland north-west of 007D near Lake Road	20/11/2009	DRY
WRP008	North Wheatfield Suite	A	western	20/11/2009	DRY
		B	central	20/11/2009	DRY
		C	eastern	20/11/2009	DRY
WRP009	Woodie Suite	A	main lake	20/11/2009	23/02/2010
		B	very small wetland just near western edge of main lake	20/11/2009	DRY
		C	spectacle' lake north of Woodie	20/11/2009	DRY
		D	Woodie to Windabout channel	20/11/2009	23/02/2010
		E	small wetland opposite boat lauch area	20/11/2009	23/02/2010
		F	long wetland between Woodie and Windabout	20/11/2009	23/02/2010
		G	wetland at end of Windabout Way	20/11/2009	23/02/2010
WRP010	Windabout Suite	A	main lake	20/11/2009	23/02/2010
		B	triangular lake south-east of main body	20/11/2009	23/02/2010
		C	small wetland south of south-east bay	20/11/2009	23/02/2010
		D	small wetland north of south-west bay	20/11/2009	DRY
		E	large wetland south of north-west bay	20/11/2009	23/02/2010
		F	large wetland east of north-east bay	20/11/2009	23/02/2010
WRP011	North Windabout Suite	A	series of interconnected wetlands between Lake Road and Windabout	20/11/2009	24/02/2010
WRP012	Six Mile Hill Suite	A	south-east	21/11/2009	DRY - aerial only
		B	south-west	21/11/2009	DRY - aerial only
		C	south-central	21/11/2009	DRY - aerial only
		D	southern wetland of central pair	21/11/2009	DRY - aerial only
		E	northern wetland of central pair	21/11/2009	DRY - aerial only
		F	northern wetland	not surveyed	DRY - aerial only
WRP103	Lake Warden Suite	A	main lake	21/11/2009	24/02/2010
		B	middle of three satellite wetlands on south-eastern edge	21/11/2009	DRY
		C	long wetland immediately west of boat ramp track	21/11/2009	24/02/2010
		D	western-most of three stallite wetlands on south-eastern edge	21/11/2009	DRY

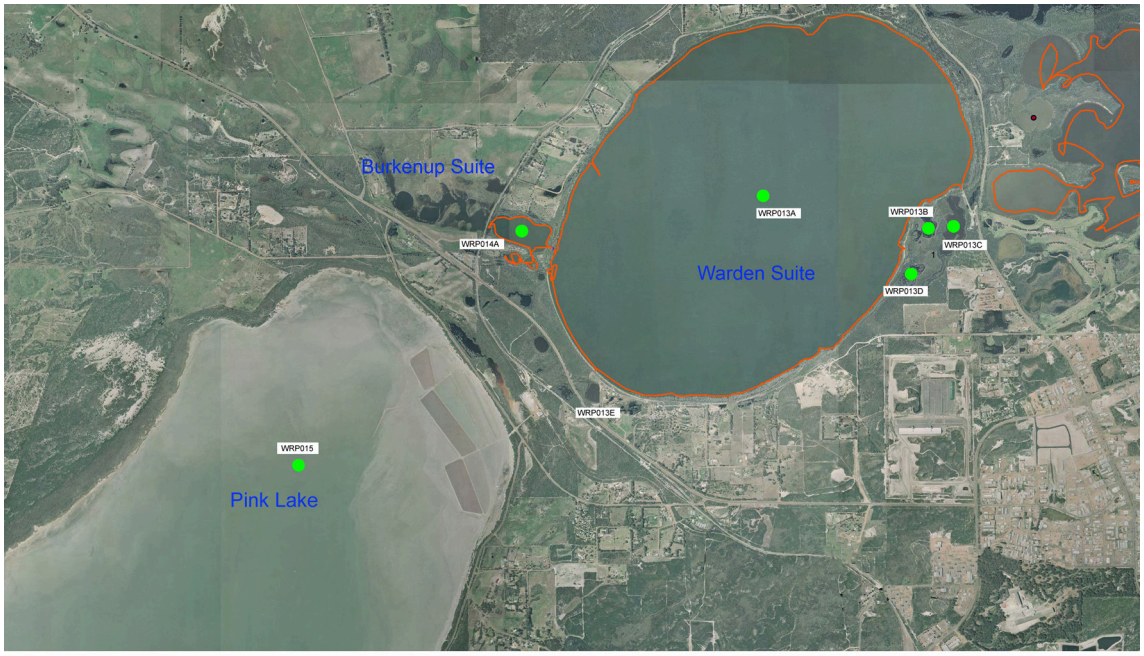
Wetland Suite Code	Wetland Suite Name	Wetland	Location	Nov-09	Feb-10
		E	small satellite wetland on southern edge of lake	not surveyed	24/02/2010
WRP014	Burkenup Suite	A	west of rail-line only, including sattelite wetlands to south of main area	21/11/2009	24/02/2010
WRP015	Pink Lake	A	main lake	21/11/2009	DRY - aerial only
WRP016	Lake Gore Suite	A	main lake plus elongate flats behind dunes on eastern side of lake and small basins on western shore.	22/11/2009	25/02/2010
WRP017	Carbul Lakes	A	Carbul Lake	22/11/2009	DRY
		B	Kubitch Lake	22/11/2009	DRY
		C	Gidong Lake	11/22/2009 (air only)	DRY
WRP018	Dalyup Suite	A	Dalyup River and associated wetlands near Gore	22/11/2009	25/02/2010
WRP019	Quallilup Lake	A	main lake	22/11/2009	25/02/2010
		B	satellite wetland on north-eastern edge	not surveyed	25/02/2010
WRP020	Kubitch to Quallilup flow-through	A	From Quallilup north through wetland complex as far as water depth allows boat access	22/11/2009	25/02/2010



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



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). 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.). Lake Gore wetlands

Appendix 3. November 2009 and February 2010 waterbird data. Provided separately.

Appendix 4. All 2006 to 2010 waterbird data. Provided separately.

Appendix 5. Abundance of aquatic Invertebrates from Warden Wetlands in October 2009 (* = records from the >250 micron fraction of the plankton sample not included in graphs of abundance and biomass)**

National Code	Major group	Subgroup	Family	Lowest level of identification	Ewans Lake	Ewans Lake	Station Lake	Station Lake	Wheatfield Lake	Wheatfield Lake	Woodie Lake	Woodie Lake	Windabout Lake	Windabout Lake	Lake Warden	Lake Warden
					Ewa_1	Ewa_2	Sta_1	Sta_2	Whe_1	Whe_2	Woo_1	Woo_2	Win_1	Win_2	War_1	War_2
BP020199	Protozoa	"Testates"	Centropyxidae	*Centropyxis* sp.					10							
BP070199			Lesquereusidae	*Lesquereusia* sp.					200	96						
BP9999A3		"Ciliates"		Ciliate protozoan					2897	1					2163	329
IB020199	Cidaria/Hydrozoa (jellyfish etc.)		Clavidae	*Cordylophora* sp.			48			28						
IF9999A0	Turbellaria (flatworms)			Microturbellaria			2									
II999999	Nematoda (round worms)			Nematoda	8	4	1390	64	1056	6231	1023	281	16	848	1023	1039
JB9999A2	Rotifera	Bdelloidea		Bdelloidea sp. (with 2:2 unci teeth)	14				1	11		1	752	4932		
JF040105		Floscullariacea	Hexarthridae	*Hexarthra* cf. *fennica* (8:8 teeth)						24				17	47400	32332
JF050201			Testudinellidae	*Testudinella patina*						24						
JP020227		Ploimida	Brachionidae	*Brachionus quadridentatus cluniorbicularis*						45		1281		10505		
JP020228				*Brachionus rotundiformis*											244	
JP020299				*Brachionus* sp.											244	329
JP0202B7				*Brachionus plicatilis* s.l.						45	56896	30112	15456	145301		
JP020401				*Notholca salina*	36											
JP030106			Lepadellidae	*Colurella uncinata*	7											
KG130299	Gastropoda (snails)	Neotaeniglossa	Pomatiopsidae	*Coxiella/Coxiellada* spp.	273	1055	5684	2145	252	1069						
KG021201			Hydrobiidae	*Ascorhis occidua*	156	528			676		2***		21	524		
KP039999	Bivalvia (clams)	Veneroida	Sphaeriidae	*Pisidium* sp.	21	53										
LH999999	Clitellata (oligochaetes and leeches)	Hirudinida		Hirudinida								1				
LO050801		Tubificida	Naididae	*Paranais litoralis*	3	54			594	2234	649	198		80		
LO089999			Enchytraeidae				35		198					20		
LP020199	Polychaeta (bristle worms)		Capitellidae	*Capitella* sp.	2	45	1177								8	101
LP060199			Sabellidae	*Manayunkia* n. sp.			5834									
MM9999A1	Arachnida (spiders and mites)	Acariformes (mites)		Oribatida					16							
MM9999A2				Mesostigmata			1									
OG040299	Crustacea	Cladocera (water fleas)	Daphniidae	*Daphnia carinata* s.l.					4457	678	111	16		2116		
OG060299			Macrothricidae	*Macrothrix breviseta*						678			1195			
OH040101		Ostracoda (seed shrimps)	Cytherideidae	*Cyprideis australiensis*	22	373	1			124	52		50	608		
OH080403			Cyprididae	*Candonocypris novaezelandiae*					248	26						
OH080703				*Diacypris spinosa*	509	329	28915	4934	410				562	4		
OH080704				*Diacypris compacta*											1052	1670
OH081204				*Mytilocypris mytiloides*	739	595	20335	612					9	13		
OH081299				*Mytilocypris* sp. (females)								3				
OH081501				*Reticypris clava*	5492	132	90957	1					2	124	3156	5010
OH081999				*Ilyodromus* sp.						1						
OH082601				*Platycypris baueri*		3	2241	385								
OH090101			Cypridopsidae	*Sarscypridopsis aculeata*		3			176	99	639	495				
OH100101			Leptocytheridae	*Leptocythere lacustris*	10960	743	130		6326	4457	1835	1388	500	248		
OJ110401		Copepoda (Calanoida)	Centropagidae	*Gladioferens imparipens*	18036	12246	3787	15756	198	738	277	37	27106	65801	1	64
OJ3102A0		Copepoda (Cyclopoida)	Cyclopidae	*Metacyclops* sp. 442						16						
OJ3104A0				*Halicyclops* sp. 1 (nr *ambiguus*)	112	6	385	2240	26	15			49	257		

Appendix 5. Abundance of aquatic Invertebrates from Warden Wetlands in October 2009 (* = records from the >250 micron fraction of the plankton sample not included in graphs of abundance and biomass)**

National Code	Major group	Subgroup	Family	Lowest level of identification	Ewans Lake	Ewans Lake	Station Lake	Station Lake	Wheatfield Lake	Wheatfield Lake	Woodie Lake	Woodie Lake	Windabout Lake	Windabout Lake	Lake Warden	Lake Warden
					Ewa_1	Ewa_2	Sta_1	Sta_2	Whe_1	Whe_2	Woo_1	Woo_2	Win_1	Win_2	War_1	War_2
OJ310703				*Mesocyclops brooksi*						17	23	195				
OJ311201				*Apocyclops dengizicus*											17	256
OJ620101		Copepoda (Harpacticoida)	Laophontidae	*Onychocamptus bengalensis*	12735	353			2557	4681						
OJ6401A4			Ameiridae	*Nitocra* sp. 4					597							
OJ640101				*Nitocra reducta*		9										
OJ699999				Harpacticoida sp.		363	249	711			14174	14315	5826	9713	369	1617
OJ999999		Copepoda (nauplii)		Copepod nauplii	16200	131280	6905	113216	1088	1088	13072	55808	23072	64096		
OP020102		Amphipoda	Ceinidae	*Austrochiltonia subtenuis*	1888	1968	40585	17359	52	230	28	58	31	5		
OR139999		Isopoda	Sphaeromatidae	Sphaeromatidae	1	2			68		1	13	10	36		
OR250101			Oniscidae	*Haloniscus* sp.			51	3								
OT020201		Decapoda (shrimps)	Palaemonidae	*Palaemonetes australis*					1					98		
QC091899	Insecta	Coleoptera (beetles)	Dytiscidae	*Sternopriscus* sp.								1				
QC092001				*Necterosoma penicillatus*	1	11										
QC092099				*Necterosoma* sp.	2	6	1									
QC110499			Hydrophilidae	*Berosus* sp.		1	3									
QC111102				*Enochrus eyrensis*		1										
QC1303A6			Hydraenidae	*Ochthebius* sp. 4								3	1			
QD0199A9		Diptera (flies)	Tipulidae	Tipulidae type J				1								
QD090899			Ceratopogonidae	*Culicoides* sp.	3		52	1			8	6	11	24	1	
QD092099				*Nilobezzia* sp.	2				4							
QD249999			Stratiomyidae	Stratiomyidae								4				
QD3699A1			Dolichopodidae	Dolichopodidae sp. B	1											
QD459999			Sciomyzidae	Sciomyzidae			7									
QD789999			Ephydridae	Ephydridae (early instars)											4	
QD7899A7				Ephydridae sp. 3								1				
QD7899B1				Ephydridae sp. 7		1***						1				
QD899999			Muscidae	Muscidae							2	2				
QDAE0803			Chironomidae	*Procladius paludicola*	72	590	523	1373	452	63	296	62	22	18		
QDAF1202				*Paralimnophyes pullulus*								31				
QDAH03A0				*Cladotanytarsus* sp. A									4			
QDAH0402				*Tanytarsus barbitarsis*											22	216
QDAH0410				*Tanytarsus fuscithorax/semibarbitarsus*	40	214			25		296	31		15		
QDAI0408				*Chironomus occidentalis*					549	649	172	15	25	68		
QDAI04A0				*Chironomus* aff. *alternans* (V24)										9		
QDAI0611				*Dicrotendipes* sp. (2 species?)	254	909			330	284	123	1919		40		
QDAI0701				*Kiefferulus intertinctus*					8	42						
QDAI0703				*Kiefferulus martini*					39							
QDAI0804				*Polypedilum nubifer*					576	200	2831	77				
QDAI08A1				*Polypedilum* nr *vespertinus* (M2)							24	31	4	31		
QDAI1901				*Cryptochironomus griseidorsum*					17	10	123	31		3		
QDAI2201				*Cladopelma curtivalva*		3207	254	11599					73	120		

Appendix 5. Abundance of aquatic Invertebrates from Warden Wetlands in October 2009 (* = records from the >250 micron fraction of the plankton sample not included in graphs of abundance and biomass)**

National Code	Major group	Subgroup	Family	Lowest level of identification	Ewans Lake	Ewans Lake	Station Lake	Station Lake	Wheatfield Lake	Wheatfield Lake	Woodie Lake	Woodie Lake	Windabout Lake	Windabout Lake	Lake Warden	Lake Warden
					Ewa_1	Ewa_2	Sta_1	Sta_2	Whe_1	Whe_2	Woo_1	Woo_2	Win_1	Win_2	War_1	War_2
QH650101		Hemiptera (true bugs)	Corixidae	*Diaprepocoris barycephala*							2	5		1		
QH650199				*Diaprepocoris* sp. (juveniles)										1		
QH650502				*Micronecta robusta*					28	7	2					
QH659999				Corixidae (juveniles)							1	1		1		
QH670401			Notonectidae	*Anisops thienemanni*							1					
QH670499				*Anisops* sp. (juveniles or females)							2					
QH679999				Notonectidae (juveniles)					1***			2				
QL9999A7		Lepidoptera (moth larvae)	-	Lepidoptera (non-Pyralidae)		1										
QO050102		Odonata (damselflies	Lestidae	*Austrolestes annulosus*	1	2		2								
QO050105				*Austrolestes io*						16						
QO050199				*Austrolestes* sp. (early instars)					4							
QO999998				Epiproctophora (=Anisoptera)							5***					
QT250504		Trichoptera (caddisflies)	Leptoceridae	*Notalina spira*					33		3					
QT250799				*Oecetis* sp.										1		
QT250903				*Symphitoneuria wheeleri*	1		6***	1								
QT259999				Leptoceridae (early instars)									1			

Suite	
WRP001 Neridup Suite	A
	B
	C
	D
	E
WRP002 Bandy Creek Suite	A
	B
	C
	D
	E
WRP003 Ewens Lake	A
WRP004 Mullet Lake	A
WRP005 Station Lake	A
	A
	B
	B
	C
	C
WRP006 Gun Club Suite	A
WRP007 Lake Wheatfield	A
	B
	C
	D
	E
WRP008 North Wheatfield Suite	A
	B
	C
WRP009 Woodie Lake Suite	A
	B
	C
	D
	E
	F
	G
WRP010 Windabout Suite	A
	B
	C
	D
	E
	F
WRP011 North Windabout Suite	A
WRP012 Six Mile Hill Suite	A
	B
	C
	D
	E
WRP013 Lake Warden Suite	A
	B
	C
	D
	E
WRP014 Burkenup Suite	A

WRP015 Pink Lake	A
WRP016 Lake Gore Suite	A
WRP017 Carbul Lakes	A
	B
WRP019 Qualilup Lake	A
	B
WRP020 Qualilup-Gore Flowthrough	A

Subsite
southern wetland
north-eastern wetland
large western wetland
central north wetland
north-western wetland
north-eastern wetland
south-western wetland
north-eastern wetland
central north wetland
north-western wetland
main lake and connected wetlands
main lake and connected wetlands
main lake
main lake - dry
elongate wetland to south-west of main lake
elongate wetland to south-west of main lake -dry
wetland to south-east of main lake
wetland to south-east of main lake - dry
north and east of Gun Club
main lake and Wheatfield-Woodie channel
satellite wetland 1
satellite wetland 2
wetland north of Wheatfield-Woodie Channel
second wetland north-west of Wheatfield-Woodie channel
western wetland
middle wetland
eastern wetland
main wetland
south-eastern satellite
paired northern satellite
Woodie-Windabout channel
wetland at Woodie Lake carpark
long satellite wetland between Windabout and Woodie
Tranquil Road satellite
main wetland
south-eastern satellite
satellite south of eastern bay
satellite north of south-western bay
satelite south of north-western bay
satellite east of north-eastern bay
entire complex
south-eastern wetland
south-western wetland
central south wetland
middle long wetland
middle round wetland
main lake
open satellite wetland
long wetland near boat ramp
southern satellite
south-west satellite
area east of rail line

main wetland and fringing wetlands including eastern channel
north
south
main lake
Satellite Lake east of Channel Entrance
series of channels and associated wetlands

	Warden wetlands	
	Nov-09	**Feb-10**
Anseriformes (Ducks Geese and Swans)	7557	3615
Podicipediformes (Grebes)	447	420
Pelecaniformes (Cormorants and Pelicans)	123	330
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	253	229
Falconiformes (Raptors)	5	2
Gruiformes (Crakes and Hens)	410	301
Charadriiformes (Waders)	930	1373
Charadriiformes (Gulls and Terns)	182	131
Coraciiformes (Kingfishers)	1	0
Totals	**9908**	**6401**

Abundance 2009/10			
Gore-Quallilup wetlands		All wetlands	
Nov-09	Feb-10	Nov-09	Feb-10
5132	3039	12689	6654
664	1511	1111	1931
680	1482	803	1812
162	262	415	491
1	1	6	3
0	0	410	301
1169	2403	2099	3776
103	180	285	311
0	0	1	0
7911	**8878**	**17819**	**15279**

Appendix 3. Ground counts of waterbirds for 2009/10

ORDER	SPECIES	WA Fauna Census Code	Suite	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	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)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Ewans Lake (WRP003)	Ewans Lake (WRP003)	Mullet Lake (WRP004)	Mullet Lake (WRP004)	Station Lake (WRP005)	Station Lake (WRP005)	Station Lake (WRP005)	Station Lake (WRP005)	Station Lake (WRP005)	Station Lake (WRP005)	Gun Club Suite (WRP006)	Gun Club Suite (WRP006)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	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)
			Wetland code	A	A	B	B	C	C	D	D	E	E	A	A	B	B	C	C	D	D	E	E	A	A	A	A	A	A	B	B	C	C	A	A	A	A	B	B	C	C	D	D	E	E	A	A	B
			Date	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	19/11/2009	24/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	21/11/2009	23/02/2010	20/11/2009	24/02/2010	20/11/2009
Anseriformes (Ducks Geese and Swans)	Blue-billed Duck	24328 OXYAUS																																														
	Musk Duck	24319 BIZLOB																								107		2							7	1						1					
	Freckled Duck	24329 STINAE																								2										1											
	Black Swan	24322 CYGATR	46										7											234	15	280	8	446							10								110		1			
	Cape Barren Goose	24320 CERNOVGR																																														
	Australian Shelduck	24331 TADTAD	29										24											207	4	1405		298							270			1					15		1			
	Australian Wood Duck	24321 CHEJUB																																														
	Pacific Black Duck	24316 ANASUP	48										46											61	28	660		104						9	22	20		30		5		25		2			
	Australasian Shoveler	24315 ANARHYRH	1																					21	39			20								10										
	Grey Teal	24312 ANAGRA	270										1											180	598			210						41	98	180		19				2					
	Chestnut Teal	24310 ANACAS	12																					46	15	33		29						36	9	28										
	Pink-eared Duck	24326 MALMEM																										82							105	46										
	Hardhead	24318 AYTAUS																										2																			
Podicipediformes (Grebes)	Hoary-headed Grebe	24681 POLPOL																						63		129		70						38		81								32			
	Great Crested Grebe	25704 PODCRI																						2		20									2											
Pelecaniformes (Cormorants and Pelicans)	Darter	25553 ANHMEL																						1		2									4	9										
	Little Pied Cormorant	25698 PHAMEL	1																					1	2										2	2										
	Little Black Cormorant	24667 PHASUL											6											1	2	3									35	6								1		
	Great Cormorant	25697 PHACAR																																	3											
	Australian Pelican	24648 PELCON																							6											1										
Ciconiiformes (Herons, Egrets, Ibises and Spoonbills)	White-faced Heron	24340 ARDNOV											4	1										2	9	1	18	4						2		7	1			1					
	Nankeen Night Heron	25564 NYCCAL																																													
	Little Egret	24337 ARDGARNI																																													
	Great Egret	24336 ARDALBMO																						1		3		1						4	12	2								3		
	Glossy Ibis	24843 PLEFAL																																	3										3		
	Australian White Ibis	24844 THRMOL																																	11	5									3		
	Straw-necked Ibis	24845 THRSPI																																	22	1											
	Yellow-billed Spoonbill	24841 PLAFLA																						1	1	5									26	43								3		
Falconiformes (Raptors)	White-bellied Sea-eagle	24293 FALSUB																																													
	Swamp Harrier	24288 CIRAPP												1										1		1									1									1		
Gruiformes (Crakes and Hens)	Spotless Crake	24771 PORTAB																																													
	Eurasian Coot	24761 FULATRAU																						22		81		2						2	83	50		23		22						
Charadriiformes (Waders, Gulls and Terns)	Bar-tailed Godwit	30932 LIMLAP																							3(3)		3(3)																				
	Marsh Sandpiper	24809 TRISTA																																		2											
	Common Greenshank	24808 TRINEB	47										39	1										1	30		19								11											
	Common Sandpiper	24807 TRIHYP											12																				15	1	5										
	Red-necked Stint	24788 CALRUF											3												9		200																				

Appendix 3. Ground counts of waterbirds for 2009/10

		Suite	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	Neridup Suite (WRP001)	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)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Bandy Creek Complex (WRP002)	Ewans Lake (WRP003)	Ewans Lake (WRP003)	Mullet Lake (WRP004)	Mullet Lake (WRP004)	Station Lake (WRP005)	Station Lake (WRP005)	Station Lake (WRP005)	Station Lake (WRP005)	Station Lake (WRP005)	Station Lake (WRP005)	Gun Club Suite (WRP006)	Gun Club Suite (WRP006)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	Lake Wheatfield Suite (WRP007)	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)
		Wetland code	A	A	B	B	C	C	D	D	E	E	A	A	B	B	C	C	D	D	E	E	A	A	A	A	A	A	B	B	C	C	A	A	A	A	B	B	C	C	D	D	E	E	A	A	B
		Date	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	22/02/2010	19/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	19/11/2009	24/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	21/11/2009	23/02/2010	20/11/2009	24/02/2010	20/11/2009
ORDER	SPECIES	WA Fauna Census Code																																													
	Pectoral Sandpiper	24786 CALMEL																																													
	Sharp-tailed Sandpiper	24779 CALACU																																		3											
	Curlew Sandpiper	24784 CALFER																								3																					
	Black-winged Stilt	25734 HIMHIM																																		3											
	Banded Stilt	24774 CLALEU																						4		200	440																				
	Red-necked Avocet	24776 RECNOV																					2	39		47	198																				
	Grey Plover	24383 PLUSQU													5														4																		
	Red-capped Plover	24377 CHARUF											1		3	2								4		40	6	3								4											
	Greater Sand Plover	25575 CHALES																																													
	Black-fronted Dotterel	24373 CHAMEL																																		19	1								1		
	Hooded Plover	24376 CHARUB																										11	1																		
	Red-kneed Dotterel	24379 ERYCIN																																	1	3											
	Masked Lapwing (southern)	24385 VANMILNO																															2			5											
	Unidentified wader	- -																																	1												
	Silver Gull	24511 LARNOVNO																																		3											
	Pacific Gull	25638 LARPAC																																													
	Caspian Tern	24523 STECAS																								2																					
	Crested Tern	24522 STEBER																																													
	Whiskered Tern	25643 STEHYB																																													
Coraciiformes (Kingfishers)	Sacred Kingfisher	25549 TODSAN																																													
		Species richness	8	0	0	0	0	0	0	0	0	0	2	0	11	4	0	0	0	0	0	0	18	16	15	9	16	2	3	0	0	0	8	0	22	28	3	0	4	0	3	1	4	0	11	0	0
		Total abundance	454	0	0	0	0	0	0	0	0	0	11	0	150	5	0	0	0	0	0	0	847	805	2732	537	1914	14	20	0	0	0	134	0	728	551	3	0	76	0	28	1	152	0	51	0	0

(1) Includes some counts on following day to account for overnight movement between Ewans Lake and Mullet Lake

(2) not surveyed

(3) possibly mis-identified Black-tailed Godwits

(4) possibly misidentified Sharp-tailed Sandpipers

WA Fauna Census Code	North Wheatfield Suite (WRP008) B 24/02/2010	North Wheatfield Suite (WRP008) C 20/11/2009	North Wheatfield Suite (WRP008) C 24/02/2010	Woodie Lake Suite (WRP009) A 20/11/2009	Woodie Lake Suite (WRP009) A 23/02/2010	Woodie Lake Suite (WRP009) B 20/11/2009	Woodie Lake Suite (WRP009) B 23/02/2010	Woodie Lake Suite (WRP009) C 20/11/2009	Woodie Lake Suite (WRP009) C 23/02/2010	Woodie Lake Suite (WRP009) D 20/11/2009	Woodie Lake Suite (WRP009) D 23/02/2010	Woodie Lake Suite (WRP009) E 20/11/2009	Woodie Lake Suite (WRP009) E 23/02/2010	Woodie Lake Suite (WRP009) F 20/11/2009	Woodie Lake Suite (WRP009) F 23/02/2010	Woodie Lake Suite (WRP009) G 20/11/2009	Woodie Lake Suite (WRP009) G 23/02/2010
24328 OXYAUS																	
24319 BIZLOB		1			2			12		9	1						
24329 STINAE																	
24322 CYGATR	7	2			74					3							7
24320 CERNOVGR																	
24331 TADTAD				4													
24321 CHEJUB																	
24316 ANASUP		6		15	3			96		27	4				7	4	27
24315 ANARHYRH											6						2
24312 ANAGRA				12				80		1	16				2		10
24310 ANACAS		4		2				5			14						4
24326 MALMEM										1	94						27
24318 AYTAUS								3									
24681 POLPOL	2							18		4	32				1		
25704 PODCRI																	
25553 ANHMEL																	
25698 PHAMEL		3		1	1						4					1	12
24667 PHASUL		1		2				15		1						1	4
25697 PHACAR																	
24648 PELCON					1												
24340 ARDNOV	3	1		1	3						3				1		
25564 NYCCAL																1	12
24337 ARDGARNI					1												
24336 ARDALBMO		8		1	1												
24843 PLEFAL																	
24844 THRMOL		4									2						
24845 THRSPI		48															
24841 PLAFLA		4		1	1			1			3						7
24293 FALSUB				1	1												
24288 CIRAPP																	
24771 PORTAB																	
24761 FULATRAU	70	9						4		9		2				3	101
30932 LIMLAP																	
24809 TRISTA																	
24808 TRINEB					9						2				2		
24807 TRIHYP					6												
24788 CALRUF																	

WA Fauna Census Code	Windabout Suite (WRP010) A 20/11/2009	Windabout Suite (WRP010) A 23/02/2010	Windabout Suite (WRP010) B 20/11/2009	Windabout Suite (WRP010) B 23/02/2010	Windabout Suite (WRP010) C 20/11/2009	Windabout Suite (WRP010) C 23/02/2010	Windabout Suite (WRP010) D 20/11/2009	Windabout Suite (WRP010) D 23/02/2010	Windabout Suite (WRP010) E 20/11/2009	Windabout Suite (WRP010) E 23/02/2010	Windabout Suite (WRP010) F 20/11/2009	Windabout Suite (WRP010) F 23/02/2010	North Windabout (WRP011) A 20/11/2009	North Windabout (WRP011) A 24/02/2010
24328 OXYAUS	1													
24319 BIZLOB	10	2		2			2							
24329 STINAE														
24322 CYGATR	11	275		104						8	2	61	203	
24320 CERNOVGR		6												
24331 TADTAD	395	7							2				11	
24321 CHEJUB	2													
24316 ANASUP	128	82		2	1	8	15		4	3			43	
24315 ANARHYRH													30	
24312 ANAGRA	153	120		6			30			33		10	113	
24310 ANACAS	9	178				2	1			2		4	23	
24326 MALMEM	65	96								1				
24318 AYTAUS			2											
24681 POLPOL	12	15	11				5			3			10	
25704 PODCRI														
25553 ANHMEL	6	2												
25698 PHAMEL		1												
24667 PHASUL	17	8			1									
25697 PHACAR		5												
24648 PELCON		157												
24340 ARDNOV	7	25					1			1		1	2	8
25564 NYCCAL														
24337 ARDGARNI														
24336 ARDALBMO	5	12												
24843 PLEFAL														
24844 THRMOL		4											3	
24845 THRSPI														
24841 PLAFLA	8	24		1			2						10	
24293 FALSUB														
24288 CIRAPP														
24771 PORTAB		4												
24761 FULATRAU	51	53			3		1			23			93	
30932 LIMLAP														
24809 TRISTA														
24808 TRINEB		42		15		1				2		2	13	
24807 TRIHYP														
24788 CALRUF														215

WA Fauna Census Code	Six Mile Hill Suite (WRP012) A 21/11/2009	Six Mile Hill Suite (WRP012) A 24/02/2010	Six Mile Hill Suite (WRP012) B 21/11/2009	Six Mile Hill Suite (WRP012) B 24/02/2010	Six Mile Hill Suite (WRP012) C 21/11/2009	Six Mile Hill Suite (WRP012) C 24/02/2010	Six Mile Hill Suite (WRP012) D 21/11/2009	Six Mile Hill Suite (WRP012) D 24/02/2010	Six Mile Hill Suite (WRP012) E 21/11/2009	Six Mile Hill Suite (WRP012) E 24/02/2010	Lake Warden Suite (WRP013) A 21/11/2009	Lake Warden Suite (WRP013) A 24/02/2010	Lake Warden Suite (WRP013) B 21/11/2009	Lake Warden Suite (WRP013) B 24/02/2010	Lake Warden Suite (WRP013) C 21/11/2009	Lake Warden Suite (WRP013) C 24/02/2010	Lake Warden Suite (WRP013) D 21/11/2009	Lake Warden Suite (WRP013) D 24/02/2010	Lake Warden Suite (WRP013) E (2)	Lake Warden Suite (WRP013) E 24/02/2010	Burkenup Suite (WRP014) A 21/11/2009	Burkenup Suite (WRP014) A 24/02/2010	Pink Lake (WRP015) A 21/11/2009	Pink Lake (WRP015) A (2)	Lake Gore and Dalyup Suites (WRP016 and WRP018) A 11/22/2009
24328 OXYAUS																									2
24319 BIZLOB											21	350									1	1			3
24329 STINAE																									
24322 CYGATR	1				6		68					371													236
24320 CERNOVGR																									
24331 TADTAD					17		42				9	15										254	14		2572
24321 CHEJUB																									
24316 ANASUP												3									3	1			2
24315 ANARHYRH																									
24312 ANAGRA							1				24	205	1		1						25	21			23
24310 ANACAS											11	68			2					2	21	12			14
24326 MALMEM																									
24318 AYTAUS																									
24681 POLPOL											24	286									7				584
25704 PODCRI																									
25553 ANHMEL											5	16									2				1
25698 PHAMEL												2													5
24667 PHASUL											5	54									1				201
25697 PHACAR											1														9
24648 PELCON												35													26
24340 ARDNOV					3						15	25	2		2						5	1			15
25564 NYCCAL											1														
24337 ARDGARNI																									
24336 ARDALBMO											1														5
24843 PLEFAL																									
24844 THRMOL												2													
24845 THRSPI																									
24841 PLAFLA																					1				
24293 FALSUB																									
24288 CIRAPP																									
24771 PORTAB																									
24761 FULATRAU																									
30932 LIMLAP																									
24809 TRISTA															1										
24808 TRINEB					1						1	10				8					1				7
24807 TRIHYP												2									1	1			5
24788 CALRUF												3											66		56

Suite	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)	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)	Woodie Lake Suite (WRP009)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	Windabout Suite (WRP010)	North Windabout (WRP011)	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)	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 Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Lake Warden Suite (WRP013)	Burkenup Suite (WRP014)	Burkenup Suite (WRP014)	Pink Lake (WRP015)	Pink Lake (WRP015)	Lake Gore and Dalyup Suites (WRP016 and WRP018)
Wetland code	B	C	C	A	A	B	B	C	C	D	D	E	E	F	F	G	G	A	A	B	B	C	C	D	D	E	E	F	F	A	A	A	A	B	B	C	C	D	D	E	E	A	A	B	B	C	C	D	D	E	E	A	A	A	A	A
Date	24/02/2010	20/11/2009	24/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	23/02/2010	20/11/2009	24/02/2010	21/11/2009	24/02/2010	21/11/2009	24/02/2010	21/11/2009	24/02/2010	21/11/2009	24/02/2010	21/11/2009	24/02/2010	21/11/2009	24/02/2010	21/11/2009	24/02/2010	21/11/2009	24/02/2010	21/11/2009	24/02/2010	(2)	24/02/2010	21/11/2009	24/02/2010	21/11/2009	(2)	11/22/2009
WA Fauna Census Code																																																								
24786 CALMEL																			2 (4)																																					
24779 CALACU															1												7																										4			1
24784 CALFER																															24																									
25734 HIMHIM		7																	16								9		3	27													2										47			3
24774 CLALEU																																																								
24776 RECNOV																																											215													215
24383 PLUSQU																																																								
24377 CHARUF																															0																							9		12
25575 CHALES					1																																																			
24373 CHAMEL		2			15					2					2				6				1				3			1													6										3			
24376 CHARUB																														4													4											1		
24379 ERYCIN						1													1								1																													
24385 VANMILNO																			3								3			8													1													
- -																																																								
24511 LARNOVNO					32													10	6																							1	69											10		5
25638 LARPAC																																																								
24523 STECAS																																											19													
24522 STEBER																		1																																						
25643 STEHYB																		160																																						
25549 TODSAN																																														1										
Species richness	4	14	0	10	15	1	0	9	0	9	12	1	0	0	7	5	11	19	26	2	6	3	4	8	0	2	14	1	6	16	3	1	0	0	0	4	0	3	0	0	0	13	23	2	0	5	1	0	0		1	11	10	5	0	23
Total abundance	82	100	0	40	151	1	0	234	0	57	181	2	0	0	16	10	213	1051	1150	13	130	5	12	57	0	6	99	2	81	594	247	1	0	0	0	27	0	111	0	0	0	119	1763	3	0	7	8	0	0		2	68	345	100	0	4002

Suite	Wetland code	Date	WA Fauna Census Code	24328 OXYAUS	24319 BIZLOB	24329 STINAE	24322 CYGATR	24320 CERNOVGR	24331 TADTAD	24321 CHEJUB	24316 ANASUP	24315 ANARHYRH	24312 ANAGRA	24310 ANACAS	24326 MALMEM	24318 AYTAUS	24681 POLPOL	25704 PODCRI	25553 ANHMEL	25698 PHAMEL	24667 PHASUL	25697 PHACAR	24648 PELCON	24340 ARDNOV	25564 NYCCAL	24337 ARDGARNI	24336 ARDALBMO	24843 PLEFAL	24844 THRMOL	24845 THRSPI	24841 PLAFLA	24293 FALSUB	24288 CIRAPP	24771 PORTAB	24761 FULATRAU	30932 LIMLAP	24809 TRISTA	24808 TRINEB	24807 TRIHYP	24788 CALRUF
Lake Gore and Dalyup Suites (WRP016 and WRP018)	A	25/02/2010		126		320		1365		2		142	262		1427					10		48	8													3		10
Carbul Suite (WRP017)	A	25/02/2010																																				
Carbul Suite (WRP017)	A	22/11/2009																																				
Carbul Suite (WRP017)	B	25/02/2010																																				
Carbul Suite (WRP017)	B	22/11/2009				2		62																														6
Quallilup Lake (WRP019)	A	25/02/2010								2		2	3					18			171			24				1	4									
Quallilup Lake (WRP019)	A	22/11/2009						102				18	9					7	1		71	2	26	11		1					1	1				2	1	
Quallilup Lake (WRP019)	B	25/02/2010											18			10					1			1				2		1						2		
Quallilup Lake (WRP019)	B	(2)																																				
Kubitch - Quallilup flow-through (WRP020)	A	25/02/2010			4		12		7		18		609	147		74			42	200	947	5	40	74		109		23		19	1					35		13
Kubitch - Quallilup flow-through (WRP020)	A	22/11/2009			5		16		1913		17		123	13		80			10	33	220	2	66	77	1	27		21		3						7		2

Suite	Lake Gore and Dalyup Suites (WRP016 and WRP018)	Carbul Suite (WRP017)	Carbul Suite (WRP017)	Carbul Suite (WRP017)	Carbul Suite (WRP017)	Quallilup Lake (WRP019)	Quallilup Lake (WRP019)	Quallilup Lake (WRP019)	Quallilup Lake (WRP019)	Kubitch - Quallilup flow-through (WRP020)	Kubitch - Quallilup flow-through (WRP020)
Wetland code	A	A	A	B	B	A	A	B	B	A	A
Date	25/02/2010	22/11/2009	25/02/2010	22/11/2009	25/02/2010	22/11/2009	25/02/2010	(2)	25/02/2010	22/11/2009	25/02/2010
WA Fauna Census Code											
24786 CALMEL											22 [4]
24779 CALACU									4	9	23
24784 CALFER											
25734 HIMHIM	102									24	7
24774 CLALEU	1080			550							
24776 RECNOV	1061										
24383 PLUSQU											
24377 CHARUF		26		30							
25575 CHALES											
24373 CHAMEL							1				26
24376 CHARUB		6		207							
24379 ERYCIN											
24385 VANMILNO											10
- -											
24511 LARNOVNO	127					70	29			18	18
25638 LARPAC						2	1				2
24523 STECAS						6	1			1	2
24522 STEBER											
25643 STEHYB						1					
25549 TODSAN											
Species richness	16	2	0	6	0	18	12	0	8	23	26
Total abundance	6093	32	0	857	0	332	257	0	39	2688	2467

Appendix 4. All waterbird data for the Warden and Gore systems 2006 to 2010

						Dalyup Suite	Dalyup Suite	Dalyup Suite	Dalyup Suite	Dalyup Suite	Lake Gore and Dalyup Suite	Lake Gore and Dalyup Suite	Lake Gore and Dalyup Suite	Lake Gore and Dalyup Suite	Lake Gore	Lake Gore	Lake Gore	Lake Gore	Lake Gore	Lake Gore
						WRP018	WRP018	WRP018	WRP018	WRP018	WRP016/18	WRP016/18	WRP016/18	WRP016/18	WRP016	WRP016	WRP016	WRP016	WRP016	WRP016
Order	WA Fauna Census Genus/Species names	Common name				Oct-06	Oct-06	Oct-07	Oct-07	Feb-08	Feb-08	Nov-08	Nov-08	Nov-09	Nov-09	Feb-10	Feb-10	Oct-06	Oct-06	Oct-07	Oct-07	Feb-08	Feb-08
						air	ground	air	ground	air	ground	air	ground	air	ground	air	ground	air	ground	air	ground	air	ground
Anseriformes (Swans, Geese and Ducks)	OXYAUS	Blue-billed Duck	4	bbdu	24328										2								
	BIZLOB	Musk Duck	5	mudu	24319	80		9				3			3	1	126						
	STINAE	Freckled Duck	6	frdu	24329																		
	CYGATR	Black Swan	8	blsw	24322	51		577		26		123			236	221	320			25			
	CERNOVGR	Cape Barren Goose	9	cbgo	24320																		
	TADTAD	Australian Shelduck	10	shel	24331	4141		6789		3351		5331			2572	1269	1365			364			
	CHEJUB	Australian Wood Duck	12	awdu	24321																		
	ANASUP	Pacific Black Duck	14	pbdu	24316	28		1							2	3	2					22	
	ANARHYRH	Australasian Shoveler	15	shov	24315	10																	
	ANAGRA	Grey Teal	16	grte	24312	183		157		28		190			23	61	142			65		96	
	ANACAS	Chestnut Teal	17	chte	24310	319		282		884					14		262					21	
	MALMEM	Pink-eared Duck	20	pedu	24326																		
	AYTAUS	Hardhead	21	hard	24318																		
	-	Unidentified Duck	22	uidu	-	4										1							
Podicipediformes (Grebes)	POLPOL	Hoary-headed Grebe	24	hhgr	24681										584	146	1427						
	PODCRI	Great Crested Grebe	25	gcgr	25704	3																	
Pelecaniformes (Cormorants, Darters and Pelicans)	ANHMEL	Darter	27	dart	25553										1							3	
	PHAMEL	Little Pied Cormorant	28	lpco	25698	1		2		1		2			5								

	29	pico	25699	PHAVAR	Pied Cormorant																		
	30	lbco	24667	PHASUL	Little Black Cormorant		88	1			201	199	10										
	31	grco	25697	PHACAR	Great Cormorant						9												
	32	unco	-	-	Unidentified Cormorant																		
	33	aupe	24648	PELCON	Australian Pelican		15				26		48		35								
Ciconiiformes (Herons, Spoonbills, Egrets etc.)	34	wfhe	24340	ARDNOV	White-faced Heron	14	39	2	1		15	1	8										
	35	lieg	24337	ARDGARNI	Little Egret																		
	40	greg	24336	ARDALBMO	Great Egret		7				5	13											
	45	nnhe	25564	NYCCAL	Nankeen Night Heron																		
	49	glib	24843	PLEFAL	Glossy Ibis																		
	50	awib	24844	THRMOL	Australian White Ibis	1		4															
	51	snib	24845	THRSPI	Straw-necked Ibis																		
	53	ybsp	24841	PLAFLA	Yellow-billed Spoonbill		54	1							31								
Falconiformes (raptors)	56	wbse	24293	FALSUB	White-bellied Sea-eagle																		
	57	swha	24288	CIRAPP	Swamp Harrier																	2	
Gruiformes (hens, crakes etc.)	65	spcr	24771	PORTAB	Spotless Crake																		
	70	blnh	24764	GALVEN	Black-tailed Native Hen																		
	71	euco	24761	FULATRAU	Eurasian Coot			4															
Charadriiformes (waders)	74	bago	30932	LIMLAP	Bar-tailed Godwit																		
	79	masa	24809	TRISTA	Marsh Sandpiper																		
	80	gree	24808	TRINEB	Common Greenshank	1	15	4	1		7	1	3		3		2						
	81	wosa	24806	TRIGLA	Wood Sandpiper																		
	83	cosa	24807	TRIHYP	Common Sandpiper						5												
	86	rutu	25736	AREINT	Ruddy Turnstone																		
	92	rnst	24788	CALRUF	Red-necked Stint						56		10										
	96	pesa	24786	CALMEL	Pectoral Sandpiper																		
	97	stsa	24779	CALACU	Sharp-tailed Sandpiper						1												
	98	cusa	24784	CALFER	Curlew Sandpiper																		
	108	bwst	25734	HIMHIM	Black-winged Stilt	3	57	12	92		3	66	102		10		140						
	109	bast	24774	CLALEU	Banded Stilt	10						423	1080		50								
	110	rnav	24776	RECNOV	Red-necked Avocet	60	202	140	480		215		1061		352		110						
	112	grpl	24383	PLUSQU	Grey Plover																		
	114	rcpl	24377	CHARUF	Red-capped Plover						12				15								
	116	gspl	25575	CHALES	Greater Sand Plover																		
	120	bfdo	24373	CHAMEL	Black-fronted Dotterel																		
	121	hopl	24376	CHARUB	Hooded Plover																		
	122	rkdo	24379	ERYCIN	Red-kneed Dotterel																		
	123	bala	24386	VANTRI	Banded Lapwing		3										4						
	127	uiwa	-	-	Unidentified wader		2	3	15						2								
	158	mals	24385	VANMILNO	Masked Lapwing (southern)	2									10								
Charadriiformes (gulls)	128	sigu	24511	LARNOVNO	Silver Gull	3	17	155	1		5	122	127		2								
	130	gubt	30949	STENIL	Gull-billed Tern																		
	131	cate	24523	STECAS	Caspian Tern				3														
	132	crte	24522	STEBER	Crested Tern																		
	138	whte	25643	STEHYB	Whiskered Tern																		
	151	pagu	25638	LARPAC	Pacific Gull																		
	140	uite	-	-	Unidentified Terns																		
Coraciiformes (kingfishers)	146	saki	25549	TODSAN	Sacred Kingfisher																		
					Species richness	18	0	18	0	15	0	12	0	0	23	14	16	0	0	13	0	9	0
					Abundance	4914	0	8316	0	4616	0	6242	0	0	4002	2527	6093	0	0	964	0	400	0

(1) May be mis-identified Black-tailed Godwits

Dalyup Suite WRP018 Nov-08 air	Dalyup Suite WRP018 Nov-08 ~~ground~~	Dalyup Suite (included in Gore counts) WRP018 Nov-09 ~~air~~	Dalyup Suite (included in Gore counts) WRP018 Nov-09 ~~ground~~	Dalyup Suite (included in Gore counts) WRP018 Feb-10 ~~air~~	Dalyup Suite (included in Gore counts) WRP018 Feb-10 ~~ground~~	Quallilup Lake WRP019 Oct-06 air	Quallilup Lake WRP019 Oct-06 ~~ground~~	Quallilup Lake WRP019 Oct-07 air	Quallilup Lake WRP019 Oct-07 ~~ground~~	Quallilup Lake WRP019 Feb-08 air	Quallilup Lake WRP019 Feb-08 ~~ground~~	Quallilup Lake WRP019 Nov-08 air	Quallilup Lake WRP019 Nov-08 ~~ground~~	Quallilup Lake WRP019 Nov-09 ~~air~~	Quallilup Lake WRP019 Nov-09 ground	Quallilup Lake WRP019 Feb-10 air	Quallilup Lake WRP019 Feb-10 ground	Kubitch to Quallilup Flow-through (including Carbul Lakes) WRP017/20 Oct-06 air	Kubitch to Quallilup Flow-through (including Carbul Lakes) WRP017/20 Oct-06 ~~ground~~	Kubitch to Quallilup Flow-through (including Carbul Lakes) WRP017/20 Oct-07 air	Kubitch to Quallilup Flow-through (including Carbul Lakes) WRP017/20 Oct-07 ~~ground~~	Kubitch to Quallilup Flow-through (including Carbul Lakes) WRP017/20 Feb-08 air	Kubitch to Quallilup Flow-through (including Carbul Lakes) WRP017/20 Feb-08 ~~ground~~	Kubitch to Quallilup Flow-through (including Carbul Lakes) WRP017/20 Nov-08 air	Kubitch to Quallilup Flow-through (including Carbul Lakes) WRP017/20 Nov-08 ~~ground~~	Kubitch to Quallilup Flow-through (including Carbul Lakes) WRP017/20 Nov-09 ~~air~~	Kubitch to Quallilup Flow-through (including Carbul Lakes) WRP017/20 Nov-09 ground	Kubitch to Quallilup Flow-through (including Carbul Lakes) WRP017/20 Feb-10 air	Kubitch to Quallilup Flow-through (including Carbul Lakes) WRP017/20 Feb-10 ground
																				2									
1																		10		1							5		4
5																		55		1314		447		601			18	125	12
73						2		7				85			102	1		2466		3227		1470		2634			1975		7
																	2	54		37				4			17		18
																		8				70							
120															18		2	86		33		554		35			123	10	609
															9		21	148		134		96		2			13		147
																		10											
																		1											
																												22	
																	10										80		74
										1		1			7	11	18	1		2		43		7			10	4	42
1										1		1			1			1		1		43		4			33	13	200

																						7							
3								57		53		1			71		172	122		15		1434		86			220	250	947
								1		1					2			5		1		3		4			2		5
								3		1					26			10		4		29		12			66	2	40
										2		1			11	12	25	10		8		93		2			77	2	74
															1					17		147		6			27	82	109
																											1		
																						1							
																1	3					34		1			21	20	23
																				1									
										1					1		1			17		23		10			3	4	19
															1														1
																				274		310		228					
										1					2		6	1		16		50		1			7	16	35
															1														
																											8		13
																													22 [1]
																	4										9		23
10																1		4				12					24	9	7
																		7				3860					550		
																		112				260							
																											56		
																	1												26
																											213		
																1		1		1		460		140				2	
																													10
										65		1			70	9	29	1		2		32		2			18		18
										2					6	2	1	1						1			1		2
															1														
															2		1												2
7	0	0	0	0	0	1	0	4	0	10	0	6	0	0	18	8	15	22	0	20	0	23	0	19	0	0	26	14	27
213	0	0	0	0	0	2	0	68	0	128	0	90	0	0	332	38	296	3114	0	5107	0	9478	0	3780	0	0	3577	561	2467

						Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite	Bandy Creek Suite
						WRP002	WRP002	WRP002	WRP002	WRP002	WRP002	WRP002	WRP002	WRP002	WRP002	WRP002	WRP002	WRP002	WRP002	WRP002	WRP002	WRP002	WRP002
						Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite	Neridup Suite
						WRP001	WRP001	WRP001	WRP001	WRP001	WRP001	WRP001	WRP001	WRP001	WRP001	WRP001	WRP001	WRP001	WRP001	WRP001	WRP001	WRP001	WRP001
Order	No. of WA Fauna Census projects	No. of previous DEC waterbird projects	Species codes used in previous DEC waterbird projects	WA Fauna Census Codes	WA Fauna Census Genus/Species names	Common name	Oct-06	Oct-06	Oct-07	Oct-07	Feb-08	Feb-08	Nov-08	Nov-08	Nov-09	Nov-09	Feb-10	Feb-10	Oct-06	Oct-06	Oct-07	Oct-07	Feb-08	Feb-08
							Air	~~Ground~~	Air	~~Ground~~	Air	~~Ground~~	Air	~~Ground~~	Air	Ground	Air	Ground	Air	~~Ground~~	Air	~~Ground~~	Air	~~Ground~~
																	DRY	DRY						
Anseriformes (Swans, Geese and Ducks)	4	bbdu	24328	OXYAUS	Blue-billed Duck																		
	5	mudu	24319	BIZLOB	Musk Duck																		4
	6	frdu	24329	STINAE	Freckled Duck																		
	8	blsw	24322	CYGATR	Black Swan			4				1			46				38		197		10
	9	cbgo	24320	CERNOVGR	Cape Barren Goose																		
	10	shel	24331	TADTAD	Australian Shelduck			1							29				107		75		
	12	awdu	24321	CHEJUB	Australian Wood Duck																		
	14	pbdu	24316	ANASUP	Pacific Black Duck	14		11							48				185		110		4
	15	shov	24315	ANARHYRH	Australasian Shoveler										1				20		20		
	16	grte	24312	ANAGRA	Grey Teal			10							270				158		10		
	17	chte	24310	ANACAS	Chestnut Teal										12				87		60		
	20	pedu	24326	MALMEM	Pink-eared Duck																		
	21	hard	24318	AYTAUS	Hardhead																		
	22	uidu	-	-	Unidentified Duck																		5
Podicipediformes (Grebes)	24	hhgr	24681	POLPOL	Hoary-headed Grebe																4		
	25	gcgr	25704	PODCRI	Great Crested Grebe																		

Pelecaniformes (Cormorants, Darters and Pelicans)	27	dart	25553	ANHMEL	Darter																		2
	28	lpco	25698	PHAMEL	Little Pied Cormorant	1									1					1		2	5
	29	pico	25699	PHAVAR	Pied Cormorant																		
	30	lbco	24667	PHASUL	Little Black Cormorant															3			
	31	grco	25697	PHACAR	Great Cormorant																		
	32	uico	-	-	Unidentified Cormorant																		
	33	aupe	24648	PELCON	Australian Pelican																		
Ciconiiformes (Herons, Spoonbills, Egrets etc.)	34	wfhe	24340	ARDNOV	White-faced Heron															23		1	2
	35	lieg	24337	ARDGARNI	Little Egret																		
	40	greg	24336	ARDALBMO	Great Egret	1														7		2	
	45	nnhe	25564	NYCCAL	Nankeen Night Heron																		
	49	glib	24843	PLEFAL	Glossy Ibis																		
	50	awib	24844	THRMOL	Australian White Ibis																		2
	51	snib	24845	THRSPI	Straw-necked Ibis															3			
	53	ybsp	24841	PLAFLA	Yellow-billed Spoonbill																		
Falconiformes (raptors)	56	wbse	24293	FALSUB	White-bellied Sea-eagle																		
	57	swha	24288	CIRAPP	Swamp Harrier																		
Gruiformes (hens, crakes etc.)	65	spcr	24771	PORTAB	Spotless Crake																		
	70	blnh	24764	GALVEN	Black-tailed Native Hen																		
	71	euco	24761	FULATRAU	Eurasian Coot																		50
Charadriiformes (waders)	74	bago	30932	LIMLAP	Bar-tailed Godwit																		
	79	masa	24809	TRISTA	Marsh Sandpiper																		
	80	gree	24808	TRINEB	Common Greenshank										47							47	1
	81	wosa	24806	TRIGLA	Wood Sandpiper																		
	83	cosa	24807	TRIHYP	Common Sandpiper																		
	86	rutu	25736	AREINT	Ruddy Turnstone																		
	92	rnst	24788	CALRUF	Red-necked Stint																		
	96	pesa	24786	CALMEL	Pectoral Sandpiper																		
	97	stsa	24779	CALACU	Sharp-tailed Sandpiper																		
	98	cusa	24784	CALFER	Curlew Sandpiper																		
	108	bwst	25734	HIMHIM	Black-winged Stilt															6			
	109	bast	24774	CLALEU	Banded Stilt															30			
	110	rnav	24776	RECNOV	Red-necked Avocet																		
	112	grpl	24383	PLUSQU	Grey Plover																		
	114	rcpl	24377	CHARUF	Red-capped Plover																		
	116	gspl	25575	CHALES	Greater Sand Plover																		
	120	bfdo	24373	CHAMEL	Black-fronted Dotterel																		
	121	hopl	24376	CHARUB	Hooded Plover																		
	122	rkdo	24379	ERYCIN	Red-kneed Dotterel																		
	123	bala	24386	VANTRI	Banded Lapwing																		
	127	uiwa	-	-	Unidentified wader																	6	
	158	mals	24385	VANMILNO	Masked Lapwing (southern)																		
Charadriiformes (gulls)	128	sigu	24511	LARNOVNO	Silver Gull																		
	130	gubt	30949	STENIL	Gull-billed Tern																		
	131	cate	24523	STECAS	Caspian Tern																		
	132	crte	24522	STEBER	Crested Tern																		
	138	whte	25643	STEHYB	Whiskered Tern																		
	140	uite	-	-	Unidentified terns																		
	151	pagu	25638	LARPAC	Pacific Gull																		
Coraciiformes (Kingfishers)	146	saki	25549	TODSAN	Sacred Kingfisher																		

Species richness	**3**	**0**	**4**	**0**	**0**	**0**	**1**	**0**	**0**	**8**	**0**	**0**	**#**	**13**	**0**	**12**	**0**	**10**	**0**
Total abundance	**16**	**0**	**26**	**0**	**0**	**0**	**1**	**0**	**0**	**454**	**0**	**0**	**#**	**668**	**0**	**534**	**0**	**85**	**0**

(1) May be mis-identified Sharp-tailed Sandpipers
(2) May be mis-dentified Black-tailed Godwits

Bandy Creek Suite WRP002 Nov-08 Air	Bandy Creek Suite WRP002 Nov-08 ~~Ground~~	Bandy Creek Suite WRP002 Nov-09 Air	Bandy Creek Suite WRP002 Nov-09 Ground	Bandy Creek Suite WRP002 Feb-10 Air	Bandy Creek Suite WRP002 Feb-10 Ground	Ewans Lake WRP003 Oct-06 Air	Ewans Lake WRP003 Oct-06 ~~Ground~~	Ewans Lake/Mullet Lake combined WRP003 Oct-07 Air	Ewans Lake WRP003 Oct-07 Ground	Ewans Lake WRP003 Feb-08 Air	Ewans Lake WRP003 Feb-08 Ground	Ewans Lake/Mullet Lake combined WRP003+4 Nov-08 Air	Ewans Lake WRP003 Nov-08 ~~Ground~~	Ewans Lake WRP003 Nov-09 Air	Ewans Lake WRP003 Nov-09 Ground	Ewans Lake WRP003 Feb-10 Air	Ewans Lake WRP003 Feb-10 Ground	Mullet Lake WRP004 Oct-06 Air	Mullet Lake WRP004 Oct-06 Ground	Mullet Lake (see Ewans) WRP004 Oct-07 ~~Air~~	Mullet Lake WRP004 Oct-07 Ground	Mullet Lake WRP004 Feb-08 Air	Mullet Lake WRP004 Feb-08 Ground	Mullet Lake (see Ewans) WRP004 Nov-08 ~~Air~~	Mullet Lake WRP004 Nov-08 Ground	Mullet Lake WRP004 Nov-09 Ground	Mullet Lake WRP004 Feb-10 Air	Mullet Lake WRP004 Feb-10 Ground	Station Lake WRP005 Oct-06 Air	Station Lake WRP005 Oct-06 Ground	Station Lake WRP005 Oct-07 Air	Station Lake WRP005 Oct-07 Ground	Station Lake WRP005 Feb-08 Air	Station Lake WRP005 Feb-08 Ground	Station Lake WRP005 Nov-08 ~~Air~~
				DRY	DRY																														
1																																			
								22	3			129						22	79		17	31	22		73	107				1	2				
																										2									
31			7			35		576	166	108	77	576			234	4	15	53	68		89	164	118		160	280		8	174	231	364	207	2		
21			34			482		1519	373	65	2	820			207		4	411	100		435	80	61		125	1405	3		228	85	190	127			
5			46			56		324	121	346	82	2			61	23	28	22	130		18	113	134			660	3		87	35	40	49			
						20		30	23	410	692				21		39	2			11	57	25						5			2			
			1			60		2	30	202	459	80			180	433	598	10	60		10	240	150				48		68	152	17	6			
						35		94	14	32	27				46		15		40			70				33			30	30	24				
																		10																	
																30			250																
								45	94		58				63			1	11		105				13	129				57	16	31			
															2			1	24		20				4	20									

																1												2										
2							1		1		8	1	34			1	6	2		1	9		1									6	5					
2			6				5		19	5			14			1		2		6	5							3				8		15				
										3	8	8						6		2			1												1	5		
			4							1	2	2	3			2	1	9		2	1		3	1	1			1	9	18		7	3		4	7		
1							6		13	4	2	1	3			1				14	1		2					3				4	2		4			
									1	4							5				1		1										2		1			
2							1		2											1	1		2									1	1		20			
									5	5	2	4				1		1		6			2					5				4	3	4	4			
																1												1										
											30	88				22												81										
																		3 (2)												3 (2)								
1			39				8		31	2	2	22	1			1		30						11	16				6	19					1		3	
			12																																			
										2																												
			3							1								9							107					200							370	
										1																												
																														3							210	
2																	1																					
							12											4						3510	2800				200	200						10	5	
																2		39							16					47			1			177	280	
			5																																			
			4							6		3						4							28					40							6	
																																	3					
							15						5																115				1			700		
											2	3												30	4				1			20				18		
																														2								
																				1																		
10	0	0	11	0	0	#	13	0	15	19	14	16	11	0	0	18	8	17	#	17	15	0	15	11	13	0	5	15	8	10	#	13	16	9	13	7	6	0
68	0	0	161	0	0	#	736	0	2684	858	###	1529	1667	0	0	847	503	808	#	565	780	0	717	4307	3482	0	375	2732	385	540	#	642	612	672	457	919	874	0

Station Lake WRP005 Nov-08 Ground	Station Lake WRP005 Nov-09 Air	Station Lake WRP005 Nov-09 Ground	Station Lake WRP005 Feb-10 Air	Station Lake WRP005 Feb-10 Ground	Merivale Road Wetlands WRP005B Oct-06 Air	Merivale Road Wetlands WRP005B Oct-06 Ground	Merivale Road Wetlands WRP005B Oct-07 Air	Merivale Road Wetlands WRP005B Oct-07 Ground	Merivale Road Wetlands WRP005B Feb-08 Air	Merivale Road Wetlands WRP005B Feb-08 Ground	Merivale Road Wetlands WRP005B Nov-08 Air	Merivale Road Wetlands WRP005B Nov-08 Ground	Merivale Road Wetlands WRP005B Nov-09 ~~Air~~	Merivale Road Wetlands WRP005B Nov-09 ~~Ground~~	Merivale Road Wetlands WRP005B Feb-10 ~~Air~~	Merivale Road Wetlands WRP005B Feb-10 ~~Ground~~	Gun Club Suite WRP006 Oct-06 Air	Gun Club Suite WRP006 Oct-06 Ground	Gun Club Suite WRP006 Oct-07 Air	Gun Club Suite WRP006 Oct-07 Ground	Gun Club Suite WRP006 Feb-08 Air	Gun Club Suite WRP006 Feb-08 Ground	Gun Club Suite WRP006 Nov-08 Air	Gun Club Suite WRP006 Nov-08 Ground	Gun Club Suite WRP006 Nov-09 Air	Gun Club Suite WRP006 Nov-09 Ground	Gun Club Suite WRP006 Feb-10 ~~Air~~	Gun Club Suite WRP006 Feb-10 Ground	Lake Wheatfield Suite WRP007 Oct-06 Air	Lake Wheatfield Suite WRP007 Oct-06 Ground	Lake Wheatfield Suite WRP007 Oct-07 Air	Lake Wheatfield Suite WRP007 Oct-07 Ground	Lake Wheatfield Suite WRP007 Feb-08 Air	Lake Wheatfield Suite WRP007 Feb-08 Ground	Lake Wheatfield Suite WRP007 Nov-08 Air	Lake Wheatfield Suite WRP007 Nov-08 Ground	Lake Wheatfield Suite WRP007 Nov-09 Air
			DRY	DRY					DRY	DRY					DRY	DRY																					
																															2	1					
1		2																1					12						19	24		6	5	3			
136		446			68	60	71	21			32	92									35	32							11		1		1		2		
15		298			128	26	105	85			67	95									50								187	25		1			36	41	
																								2													
13		104			47	62	61	49			4	14						6			40			1		9			36	174	7	18	236	388	3	7	
2		20						1				2									80	87											11	40		12	
62		210					32	11				8						12			270	658				41			50	304	10	47	303	299		12	
9		29				20	14	20				2						18	20			12		2		36			55	45	16	24	72	59		18	
		82					5																									2	50	52			
		2									3						40	29											57	130		1	101	40			
																	25																				
17		70						1										17	1	16						38				8		16	70	73		6	
																													8	2				2			

																																1	1	1	4	5	24	3	3	
						5															1	1			1								3	10	22	3	1	3	2	
																																				1		2		
								2																								241	178	108	129	187	72	5	36	
																																1	5	5	6	5	5	6	6	
												1																				4		15	10	21	9	6	20	
		4				9	1	4	2				1								3							2				1	2	5	4	7	5		3	
																																			3				1	
		1				5		2	1			2	1															4				11	4	14	13	1	5		1	
																																			2					
																																		70						
						1	2																									6	7		1	1	3		2	
						3		1	1												3											89	34	350	630	6	31	103	70	
						2	1					15													1							32	48	51	14	63	88	12	16	
																																	1							
																																					6			
		2																		2				18				2				30	63	52	55	18	116	1	12	
																								1								10				5	33			
		15																															4				2		3	
																																2								
		440																																						
		198																					15																	
		4																																						
		6		3																																				
																																					14		1	
		1		11																																				
																																					4			
																																		30						
																																				10				
																												2												
						1																														5	3			
																																							5	
8	0	19	0	2	#	10	7	10	10	0	0	7	8	0	0	0	0	#	2	7	5	2	6	6	3	3	0	8	0	0	#	20	20	17	22	24	26	12	21	0
255	0	1934	0	14	#	269	172	297	192	0	0	###	215	0	0	0	0	#	65	85	28	17	490	808	14	5	0	134	0	0	#	851	1062	747	1009	###	1377	182	277	0

Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite
WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010
Oct-06	Oct-06	Oct-07	Oct-07	Feb-08	Feb-08	Nov-08	Nov-08	Nov-09	Nov-09	Feb-10	Feb-10	Nov-09	Feb-10
Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Ground	Air
3	17								3		1		
4	31	557	434	5	6		12					12	4
			4										
43	5	916	779	180	30		13						317
		20	43	11	1								
122	22	73	166	69	1417		397						16
							2						
36	59	593	882	28	76		148						74
	7		26		1								
30	13	720	366	2	12		183						155
18	78	201	607		62		10						7
			60		90		65						
1440	1587	100	123	7	251		2						
													38
2	32	10		9	35		28						
6	3		53		2								

Woodie Lake Suite	Woodie Lake Suite	Woodie Lake Suite	Woodie Lake Suite	Woodie Lake Suite	Woodie Lake Suite	Woodie Lake Suite	Woodie Lake Suite	Woodie Lake Suite	Woodie Lake Suite	Woodie Lake Suite	Woodie Lake Suite	Woodie Lake Suite	Woodie Lake Suite
WRP009	WRP009	WRP009	WRP009	WRP009	WRP009	WRP009	WRP009	WRP009	WRP009	WRP009	WRP009	WRP009	WRP009
Oct-06	Oct-06	Oct-07	Oct-07	Feb-08	Feb-08	Nov-08	Nov-08	Nov-09	Nov-09	Feb-10	Feb-10	Nov-09	Feb-10
Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Ground	Air
	1			6	16		2		21		3		
					1								
			4	150	37	5			3	222	81		
	12		1				1		4				
	28		2	277	501		10		142	111	41		
				4	2						8		
	7		2	100	563		4		93	71	28		
			2	97	159		2		7		18		
				5	18				1		121		
	4			5	6		31		3				
				500									
			12	20	83		3		22		33		

Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite	Windabout Lake Suite
WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010	WRP010
Oct-06	Oct-06	Oct-07	Oct-07	Feb-08	Feb-08	Nov-08	Nov-08	Nov-09	Nov-09	Feb-10	Feb-10	Nov-09	Feb-10
Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Ground	Air
2	5	4	31	557	434	5	6		12		4		
					4								
93	41	43	5	916	779	180	30		13		317		
2	5			20	43	11	1						
318	110	122	22	73	166	69	1417		397		16		
									2				
117	263	36	59	593	882	28	76		148		74		
			7		26		1						
100	265	30	13	720	366	2	12		183		155		
64	225	18	78	201	607		62		10		7		
					60		90		65				
1	3	1440	1587	100	123	7	251		2				
											38		
	13	2	32	10		9	35		28				
	3	6	3		53		2						

North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite
WRP008	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008
Oct-06	Oct-06	Oct-07	Oct-07	Feb-08	Feb-08	Nov-08	Nov-08	Nov-09	Nov-09	Feb-10	Feb-10	Nov-09	Feb-10
Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Ground	Air

Lake Wheatfield Suite	Lake Wheatfield Suite	Lake Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite	North Wheatfield Suite
WRP007	WRP007	WRP007	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008	WRP008
Oct-06	Oct-06	Oct-07	Oct-07	Feb-08	Feb-08	Nov-08	Nov-08	Nov-09	Nov-09	Feb-10	Feb-10	Nov-09	Feb-10
Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Ground	Air

4	4	9				6		2	3					1						3		1		2						6	1	6	10	10	8	6	3		6	3
2	2	2		1		2		10					3					4	3	2						2	1	17		25	3	3	11	1	5	5	2			1
																																	1							
35		6		6		2				1			2					20	51	68		4				19	3	4		127	110	129	45	1			5		18	10
3																								1									2		1	1	32			
	1																																							
		1								1										1		1						1		2	2	3	3	12	40	1	4			177
1	3	8		1		2			1				1	2	3			1		1	2	1				1	1	7		3	4	1	3	9	7	2	1		8	11
0																												1												
12	1	2		1		1			1				11					2		1	3	7				1	11	1		14	4	2	15	7	7	2	2		5	4
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22		1											48																			3					3			
26	30	43				1				1			7								3	10				2		11		3	6	4	2	21	18		2		10	12
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128	12	50				6							9	46	70			23		22		63		21		18	91	101		110	263	180	151	295	600	50	83		55	54
		2																																						
	2	11		1				2	29					1								5					6	13			2			1						6
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																								14							6		71			29	106		160	
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24	16	28	#	6	0	12	0	6	9	6	0	0	18	5	4	#	0	10	2	17	13	20	1	11	0	19	11	25	#	19	24	20	27	20	24	17	25	0	20	20
987	419	552	#	11	0	38	0	97	108	20	0	0	151	51	82	#	0	102	54	138	###	1481	5	91	0	344	572	561	#	991	1339	2037	2188	###	4288	409	2239	0	1134	###

Burkenup Suite	WRP014												
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 Warden Suite	WRP013												
Lake Warden Suite	WRP013												
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												
Six Mile Hill Suite	WRP012												
Six Mile Hill Suite	WRP012												
North Windabout Suite	WRP011												
North Windabout Suite	WRP011												
North Windabout Suite	WRP011												
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North Windabout Suite	WRP011												
North Windabout Suite	WRP011												
North Windabout Suite	WRP011												
North Windabout Suite	WRP011												
Windabout Lake Suite	WRP010												

Feb-10	Oct-06	Oct-06	Oct-07	Oct-07	Feb-08	Feb-08	Nov-08	Nov-08	Nov-09	Nov-09	Feb-10	Feb-10	Oct-06	Oct-06	Oct-07	Oct-07	Feb-08	Feb-08	Nov-08	Nov-08	Nov-09	Nov-09	Feb-10	Feb-10	Oct-06	Oct-06	Oct-07	Oct-07	Feb-08	Feb-08	Nov-08	Nov-08	Nov-09	Nov-09	Feb-10	Feb-10	Oct-06
Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	~~Ground~~	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air
											DRY	DRY																									
4		1		2				3							1										1	5	10	6	396	411	25	1		21	405	350	
448	65	77	188	127	82	81	65	72		203			3		7	11			8	5		75			2		1	4	50	41	21				380	371	
6																																					
7	319	169	118	3	10	5	26	5		11			1		32	8			10			59			1		5	2		6	28			9	5	15	6
95	130	40	2							43			6		35	8				9					4			1			2			27	3	2
	2	46								30					30	2																				
169	15	1		3				1		113			40						2			1						2					26	50	205	
186	18									23			1		19	6				2					1			4					13		70	
97																												2								
18		17	2	14		6	3	46		10																2	2	34	316	97		3		510	286	
		1																								1		2		11						

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1		1				2									1		3	2			1							1				134						10	2		
8				9		2									1		2	1												11	4			182			5	154	54		3
5																																					1				
157				2	1			10																						1		1		1				8	35		
27		13	5	5	1	3	2	7			2		8		5		28	11						3				1	1	5	1	1	12	2			19	2	25		1
12		5	4	2	1	2											3	2										1		2					1		1				1
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76		4		149	25						93						29																								
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62		5		15	1		6	6	1		13				2		2	12		2		5		1						19							1	1	18		
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			41										215																										3		
2 (1)																																									
7																						5																			
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28				10			4	50			27						12				2																		2		1
		2	6			70	176																									20	44					70	215		2
			9										0																												
10											1									2																			6		
			2								4																												4		2
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6											8																												1		1
6																														74	17	50	96	5			1	17	69		
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																																	2	1					19		
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					18			5	3													35								122	52			130	20						
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28	#	15	14	14	13	8	7	8	7	0	16	2	3	#	9	0	15	11	0	2	6	7	0	5	0	0	#	10	4	13	13	8	10	11	4	0	15	15	23	#	11
1474	#	587	419	520	200	###	280	###	131	0	594	79	247	#	60	0	###	64	0	4	43	62	0	139	0	0	#	14	9	260	131	968	721	400	25	0	129	###	1773	#	22

Burkenup Suite	Burkenup Suite	Burkenup Suite	Burkenup Suite	Burkenup Suite	Burkenup Suite	Burkenup Suite	Burkenup Suite	Burkenup Suite	Burkenup Suite	Burkenup Suite	Pink Lake	Pink Lake	Pink Lake	Pink Lake	Pink Lake	Pink Lake	Pink Lake	Pink Lake	Pink Lake	Pink Lake	Pink Lake	Pink Lake
WRP014	WRP014	WRP014	WRP014	WRP014	WRP014	WRP014	WRP014	WRP014	WRP014	WRP014	WRP015	WRP015	WRP015	WRP015	WRP015	WRP015	WRP015	WRP015	WRPO15	WRP015	WRp015	WRp015
Oct-06	Oct-07	Oct-07	Feb-08	Feb-08	Nov-08	Nov-08	Nov-09	Nov-09	Feb-10	Feb-10	Oct-06	Oct-06	Oct-07	Oct-07	Feb-08	Feb-08	Nov-08	Nov-08	Nov-09	Nov-09	Feb-10	Feb-10
~~Ground~~	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground
							East only	East only	East only	East only											DRY	DRY
			4	31				1		1												
			1																			
															2							
	2	2	88	2	70	172			55	254	12	30	37				368			14		
	3	1	10			4		3		1												
	1																					
	1		29		12	4		25	14	21												
	79	12	7	6		24		21		12												
																		40				
	3	23	20	95		5		7						40								
	12	3																				

					1			2															
	10	1		1	42			1															
	1	1	13	56	16	1																	
1	3	2	3	4		13		5		1				1									
1	3	2		2	3	11																	
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	2	1			1	4		1															
1	2			3	10	3		1															
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				9									37	330	131						66		
				6						4													
	54		27	13					10	47													
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4	17	10	12	14	9	12	0	11	3	10	#	4	4	10	9	2	0	5	7	0	5	0	0
4	###	48	###	232	###	248	0	68	79	345	#	146	157	3052	1462	10	0	712	423	0	100	0	0