

Victorian Summer Waterbird Counts: 2014 and 2015

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Summary

The Victorian Summer Waterbird Count (SWC) is a state-wide survey of selected wetlands that aims to gather numerical, locational and breeding data of game and non-game duck species for management during the forthcoming duck hunting season.

The number of wetlands counted has varied over the 29 years of SWCs. This variation in survey effort between years has resulted in biases in the database which affect its utility. In years of fewer surveyed wetlands, effort is concentrated on typically productive wetlands, or popular hunting areas, in order to better serve the main hunting management objective of the SWC; that is, to identify areas that could be considered for closure to hunting to protect significant concentrations of threatened species, or colonies of breeding waterbirds. Therefore, total numbers counted for each species cannot be compared between years or regions. Only counts for individual wetlands can be compared inter-annually.

2014 SWC

The 2014 Victorian SWC was conducted during the two weeks from 10 to 23 February and covered 145 wetlands. Additional data from 21 wetlands surveyed close to the nominated period were also included in this report. Therefore, a total of 166 wetlands were surveyed for 2014 and 267,055 game ducks and 113,717 non-game waterbirds were counted. The most abundant of the eight game species counted in 2014 were Pink-eared Duck (37.9 % of all game ducks counted), Grey Teal (22.7%) and Australian Shelduck (19.1%). These three species made up almost 80% of the game ducks counted with the remaining 20% made up by the other five game species.

Of the eight non-game species counted, Eurasian Coot comprised 61% of the total count in 2014, Hoary-headed Grebe was next most numerous with 19.6% of the total followed by Black Swan with 10.5%. Six species made up the remaining 9% of non-game species counted. The total count of Freckled Duck *Stictonetta naevosa* was the highest ever – 2,803 compared to a mean count over the 29 years of 308. South West Region contributed 76% of this total while no Freckled Ducks were recorded in the North East Region.

In 2014, information collected during the Summer Waterbird Count contributed to the decision to close eight wetlands to duck hunting, mostly because of the presence of significant numbers of Freckled Duck. These were Round Lake, Hird Swamp, Bartlett's Swamp, Lake Natimuk, Lake Colac, and part of Lake Connewarre State Game Reserve near Geelong. Kow Swamp and Reedy Lakes near Kerang were also closed to duck hunting to reinforce their status as Wildlife Sanctuaries where hunting is not permitted.

2015 SWC

In 2015 the Victorian SWC was conducted from 16 to 28 February and covered 126 wetlands. A total of 159,666 game ducks was counted across 126 wetlands, 60% of the 2014 total. The mean number of game birds per wetland was 1,267 which is 1.7 times the average of 738 game birds/wetland over 29 years of SWC surveys.

In 2015 the total count of non-game species was 74,290 which is 65% of the 2014 total. The mean number of non-game birds per wetland across 126 wetlands was 590, which is 1.4 times the average of 408 non-game birds/wetland over 29 years of SWC surveys. By February 2015 the influx of Freckled Duck to Victorian wetlands observed in the previous two years had finished and below average numbers of the species were counted.

In 2015 two wetlands were closed to hunting – Round Lake at Lake Boga because of the presence of two threatened duck species, Blue-billed Duck and Freckled Duck, and Krause Swamp, near Hamilton, to provide refuge for Brolga.

Introduction

Annual counts of waterbirds have been conducted at wetlands across Victoria since 1987, when the then Department of Conservation, Forests and Lands (CFL) implemented a recommendation from a review of the management of duck hunting within the state (Loyn 1989, 1991).

Throughout this period, the purpose of the Summer Waterbird Count (SWC) has been to collect selected information regarding waterbird numbers and distribution. This information helps to inform management of the forthcoming open season on waterfowl. Dates for the SWC are set so that enough time is available for recommended wetland closures to be authorised and implemented prior to opening day.

Results of SWCs have been published in various reports (Martindale 1988; Hewish 1988; Peter 1989–1992; Purdey and Loyn 2011, 2013; Purdey and Menkhorst 2014) or are available as unpublished summaries (Price 1993; O'Brien 1994; Pert 1995; Norman 1996–2006; Norman and Purdey 2007; Purdey and Loyn 2008–2013).

All count data obtained during these surveys are stored in departmental databases held at the Arthur Rylah Institute for Environmental Research (ARI) and are submitted to the Victorian Biodiversity Atlas (VBA).

The extent of recent SWCs has reduced from those of previous years because of declining departmental capacity to cover a large sample of wetlands. In the 2015 SWC, rather than including any wetland, regardless of whether or not it is open to hunting, only important duck hunting wetlands were recommended for monitoring. Thus the objectives were to:

1. identify wetlands open to hunting which are holding large numbers of Freckled Duck *Stictonetta naevosa* or other significant non-game waterbirds (to allow consideration of closing individual wetlands to hunting)
2. provide information on local breeding of waterbirds, particularly colonial species (for consideration of potential closures to hunting)
3. provide details on the distribution and numbers of non-game and game species of waterfowl on wetlands open to hunting.

This report presents a summary of results obtained in the 2014 and 2015 SWCs, which were conducted between 10 and 23 February in 2014 and 16 and 28 February inclusive in 2015. Note that there was a change in the department's regional boundaries between the two Summer Waterbird Counts considered here, including the splitting of the former South West Region into two – Barwon South West and Grampians Regions. Thus, two sets of regional names are used, one for 2014 and one for 2015, and the capacity to make comparisons between regions over time has once again been fractured.

Methods

Species counted

Sixteen species of waterbirds (eight game and eight non-game) are considered for routine analysis in the SWC. These species include all eight game ducks (family Anatidae) as well as non-game waterbirds that commonly associate with these ducks. The prescribed game species are Australasian Shoveler *Anas rhynchosotis*, Australian Shelduck *Tadorna tadornoides*, Australian Wood Duck *Chenonetta jubata*, Chestnut Teal *Anas castanea*, Grey Teal *Anas gracilis*, Hardhead *Aythya australis*, Pacific Black Duck *Anas superciliosa* and Pink-eared Duck *Malacorhynchus membranaceus*.

The eight non-game species included in the SWC are four other species of Anatidae – Freckled Duck *Stictonetta naevosa*, Blue-billed Duck *Oxyura australis*, Musk Duck *Biziura lobata* and Black Swan *Cygnus atratus* – and four other waterbirds that commonly associate with species of Anatidae in Victoria – Australasian Grebe *Tachybaptus novaehollandiae*, Hoary-headed Grebe *Poliiocephalus poliocephalus*, Great Crested Grebe *Podiceps cristatus* and Eurasian Coot *Fulica atra*. Other notable (rare or threatened) species are also recorded if present.

Wetlands surveyed

In 2014 the traditional approach applied – counts could be accepted from any wetland, regardless of habitat type, size or whether or not hunting is permitted. For the 2015 SWC it was decided to restrict surveys to wetlands open to hunting or of strategic waterbird importance such as the Western Treatment Plant at Werribee, with emphasis on a list of 149 priority wetlands provided by the Game Management Authority (GMA) (Appendix 1). However, only 126 wetlands were actually surveyed in 2015.

Count dates

Both SWCs were held over a 14 day period – between 10 and 23 February 2014 (with 21 additional wetlands just outside this period), and 16 and 28 February 2015. The survey dates approximated the time of year of previous counts and allowed sufficient time for a preliminary review of the data to enable decisions regarding the management of the forthcoming duck hunting season. Details from counts conducted after the nominated SWC period, but before opening day, have been included in this report where appropriate.

Survey methods

Although most wetlands were surveyed by staff from DELWP and the GMA, a small number were surveyed by volunteers from the Field and Game Australia or Birdlife Australia. During the 2015 count a helicopter was used to survey 23 wetlands in the Barwon South West Region of DELWP. All other counts were made from the ground. For ground surveys, waterbirds were counted using binoculars or a spotting scope. Observers were asked to record the wetland name, location (using Australian Map Grid (AMG) references or nearby towns as a guide), date, time, species and number of birds of each species present. At each wetland an estimate of water level was taken as a percentage of its full supply and the proportion of the wetland area covered, if the entire wetland could not be surveyed. Observations of breeding for any waterbird species were to be reported, with numbers of broods or nests (and contents where appropriate).

Survey organisation

The SWC was coordinated centrally through the Arthur Rylah Institute (ARI) in collaboration with the GMA. Five regional coordinators were assigned the task of arranging the on-ground logistics. Because Port Phillip Region had only one priority wetland (the Western Treatment Plant (WTP) which is actually an extensive complex of wetlands between Werribee South and Pt Wilson), no Coordinator was required from that region in 2015. However, a total of nine wetlands were surveyed within the Port Phillip Region.

Each regional coordinator was responsible for liaising locally with other DELWP and GMA officers in their region, organising voluntary observers, distributing instructions and count forms, and ensuring adequate coverage of local wetlands without duplication. The coordinators acted as a

conduit for problems encountered during surveys, and were expected to review completed forms before forwarding them to the central coordinator by a specified date. Regional coordinators were also required to inform the central coordinator immediately if Freckled Ducks, large aggregations of other uncommon or threatened waterbirds, or significant breeding events (e.g. colonial waterbirds), were detected during counts.

Completed forms, once processed locally, were scanned and emailed or delivered to the central coordinator as soon as they were available. This allowed preliminary data to be examined for records of Freckled Duck and other rare or threatened non-game species, or any evidence of breeding birds that might require special protection. At ARI, staff checked all data sheets for accuracy and completeness, queried coordinators or individual observers on unusual or deficient records and entered data into a Microsoft Excel© file. Erroneous, omitted or unrecognised map grid references and wetland names and identification numbers were checked and verified to ensure they corresponded. Wetland identification numbers are based on the AMG, allowing wetlands to be easily located.

Data presentation

Results are presented as summed counts of species at wetlands within each DEPI region (2014), each DELWP region (2015) and state-wide. Year by year comparisons are made in relation to the long-term mean of counts for a species. However, comparisons between departmental regions are confounded by the regular changes to regional boundaries that have occurred over the 29 year period of the Summer Waterbird Counts and so provide only very coarse information.

Results

Numbers of wetlands counted

The two SWCs considered here contribute to a dataset now spanning 29 years from 1987. Table 1 provides the total counts of eight game and eight non-game waterbird species from each of the SWCs along with the number of wetlands counted. These data show that the numbers of wetlands surveyed peaked in the 1989–1993 period and declined thereafter. The 2015 SWC included 126 wetlands across Victoria (Table 1), the lowest number surveyed since the SWCs began. However, the strategy for selecting wetlands to be counted changed in 2015 from one of encouraging surveys of any wetland to requesting surveys only of important duck-hunting wetlands. One result of this approach is that wetland selection is not biased by factors such as proximity and ease of access, rather, it focusses on wetlands that are likely to be visited by hunters and thereby reduces the risk of missing important waterbird populations that may be at risk from hunting. The numbers of priority wetlands in each DELWP Region and the number that were actually surveyed in 2015 are shown in Table 2.

Game species – 2014 and 2015

In 2014 a total of 267,055 ducks belonging to the eight game species was counted (Tables 1 and 3), a 44% increase on the 2013 total. The mean number of game birds per wetland across 166 wetlands was 1,609 which is 2.2 times the average of 738 game birds/wetland over 29 years of SWC surveys.

In 2015 the total count of game species was 159,666 (Tables 1 and 4), 60% of the 2014 total. The mean number of game birds per wetland across 126 wetlands was 1,267 which is 1.7 times the average of 738 game birds/wetland over 29 years of SWC surveys.

Numbers of birds per wetland have been high in recent years since the end of the 'millennium' drought but these figures should be treated with caution because of annual variation in wetlands surveyed. For example, in years when fewer wetlands were surveyed resources are likely to have been concentrated on wetlands known to be productive for waterfowl, and wetlands thought to have been less relevant to the hunting season are less likely to have been covered.

The most numerous game species counted in 2014 were Pink-eared Duck (37.9 % of all game ducks counted), Grey Teal (22.7%) and Australian Shelduck (19.1%). These three species made up almost 80% of the game ducks counted with the other five game species making up the remaining 20% (Table 3). In 2015 a very similar picture emerged with the same three species comprising 81.5% of game ducks counted, although this time Australian Shelduck (25.9%) and Grey Teal (21.4%) exchanged places in the sequence (Table 4).

Table 1. Summary of Summer Waterbird Counts conducted in Victoria from 1987 to 2015.

Year	Count Period	Numbers of wetlands surveyed	Total count of game species	Total count of non-game species
1987	17–25 January	332	205,000	177,000
1988	6–14 February	472	294,108	185,821
1989	4–12 February	626	292,598	170,375
1990	18–26 February	668	385,148	225,230
1991	16–24 February	786	414,417	264,610
1992	22 February–1 March	659	408,004	219,411
1993	20–28 February	534	218,562	107,650
1994	26 February–6 March	284	292,899	173,887
1995	25 February–5 March	367	196,955	141,609
1996	24 February–3 March	234	200,861	197,916
1997	22 February–2 March	223	124,914	92,003
1998	21 February–1 March	309	216,476	152,348
1999	27 February–7 March	312	206,839	128,969
2000	26 February–5 March	298	128,021	78,675
2001	24 February–4 March	336	240,671	102,926
2002	23 February–3 March	225	231,235	106,191
2003	22 February–2 March	175	155,623	93,972
2004	21–29 February	249	187,139	85,468
2005	19–27 February	272	155,069	81,950
2006	25 February–5 March	268	182,487	85,887
2007	24 February–4 March	176	91,210	46,770
2008	23 February–2 March	191	58,628	41,454
2009	21 February–1 March	161	78,723	38,283
2010	20–28 February	153	77,649	35,485
2011	19 February–6 March	201	104,903	16,768
2012	11 February–4 March	136	212,865	81,848
2013	9 February–2 March	133	185,507	103,467
2014	10-23 February	166	267,055	113,717
2015	16-28 February	126	159,666	74,290
Mean		313	205,973	118,068

Table 2. Spread of priority wetlands in the 2015 SWC by DELWP Region.

DELWP Region	Number of priority wetlands	Number surveyed (%)	Number of non-priority wetlands surveyed
Gippsland	9	8 (89)	3
Hume	28	9 (32)	0
Loddon Mallee	40	37 (92)	2
Port Phillip	1	1 (100)	8
Grampians	31	18 (58)	6
Barwon South West	40	24 (60)	10
All	149	97 (65)	29

Non-game species – 2014 and 2015

In 2014 a total of 113,717 waterbirds belonging to the eight non-game species was counted (Tables 1 and 5), a 10% increase on the 2013 total. The mean number of non-game birds per wetland across 166 wetlands was 685, 1.7 times the average of 408 non-game birds/wetland over 29 years of SWC surveys. In 2015 the total count of non-game species was 74,290 (Tables 1 and 6), 65% of the 2014 total. The mean number of non-game birds per wetland across 126 wetlands was 590, 1.4 times the average of 408 non-game birds/wetland over 29 years of SWC surveys.

Eurasian Coot dominated the non-game species comprising 61% of the total count for the eight species in 2014 (Table 5). Hoary-headed Grebe was next most numerous with 19.6% of the total followed by Black Swan with 10.5%. The remaining six species made up the remaining 10% of the total (Table 5). A similar situation prevailed in 2015 (Table 6) with the same three non-game species accounting for 92.4% of the total count, though Eurasian Coot was less dominant (43%) and Black Swan more so (18%).

As for previous years, Port Phillip Region (i.e. Western Treatment Plant), accounted for very large proportions of Blue-billed Duck (98.3% in 2014; 92.2% in 2015), Hoary-headed Grebe (89.9%; 94.4) and Musk Duck (68.5%; 92.1). South West Region provided 76% of Freckled Duck in 2014 and in 2015 they were mostly in Port Phillip Region (64.3%).

The contribution of the Western Treatment Plant

The high counts of both game and non-game species in the Port Phillip Region is mainly due to the disproportionate impact of the Western Treatment Plant (WTP) near Werribee (Table 7). This 11,000 ha site is comprehensively and meticulously counted as part of a monitoring program undertaken for Melbourne Water (Loyn et al 2014). Part of this extensive complex of permanent wetlands is used for the treatment of sewage, and the entire site is managed to maintain its value as wildlife habitat, as recognised under the Ramsar Convention. It is not open to hunting. The site has regularly contributed more than half of birds counted during SWCs, particularly in some recent years with fewer wetlands surveyed state-wide. More than 68% of the state-wide total for Hardhead were counted at the WTP in both 2014 and 2015 (Table 7). The WTP also accounted for greater than one third of the state-wide total of Australian Shelduck, Australasian Shoveler, Chestnut Teal and Pink-eared Duck. This effect is even greater for some non-game species, particularly Hoary-headed Grebe and Blue-billed Duck (Table 7). Because it is regularly (six times per year) and meticulously counted, the WTP provides an excellent baseline against which trends determined from the Summer Waterbird Counts can be assessed. For this reason we recommend that the WTP should continue to be counted during the Summer Waterbird count, noting that this is done at no cost to DELWP or the GMA.

Freckled Duck

The Freckled Duck *Stictonetta naevosa* is a non-game species that is of particular concern because it is listed as a threatened species under the *Flora and Fauna Guarantee Act 1988* and meets the criteria for Endangered status (DEPI 2013). Furthermore, there have been cases of Freckled Ducks being shot during the open season and the Game Management Authority is keen to minimise the risk posed by the open season to this species.

In 2014 the Freckled Duck was recorded in the highest numbers of any SWC – 2,803 compared to the mean over the 29 years of 308. This total was spread across all regions bar North East, but South West Region contributed 76% (Table 8). By 2015 numbers counted had fallen to 258 as birds presumably returned to the preferred inland habitat, indicating an end to the influx of this species to Victoria during 2013 and 2014 (Table 8).

Breeding and moulting

The SWC is timed to fall immediately prior to the annual duck hunting season and after the main waterbird breeding period (July-January in Victoria). However, as in other years, evidence of breeding amongst some species was recorded.

In 2014 Port Phillip Region breeding records were: two juvenile Dusky Moorhen and three broods of Chestnut Teal at the Eastern Treatment Plant; one Dusky Moorhen chick and some Purple Swamphen chicks at Cherry Lake. In South West Region, breeding records were: Great Crested Grebe chicks at Lake Wendouree; a juvenile Hoary-headed Grebe and five Grey Teal ducklings on Lake Lorne and one juvenile Chestnut Teal at Belmont Common. In North West Region two breeding observations were made: four Pacific Black Duck ducklings at Cairn Curran Reservoir and six active Darter nests at Heywoods Lake.

In 2015 very few breeding records were made: one juvenile White-bellied Sea-eagle at Lake Buffalo (Hume Region), six Pacific Black Duck ducklings at Lake Laanecoorie and two Darter chicks at Cairn Curran Reservoir (Loddon Mallee). No reports of breeding came from Hume Region or Gippsland. No reports of breeding activity were from wetlands open to hunting in either year.

No incidence of large-scale moulting was reported during the 2014 or 2015 SWC surveys. Most species have typically finished moulting by the time of the SWC, and no need has been recognised to close waters to protect moulting birds for many years. Moulting was considered a significant management issue in the 1970s when duck hunting seasons sometimes opened as early as January (Loyn 1989), coinciding with the peak moulting period for species such as Australian Shelduck, which often gather to moult in large concentrations (Frith 1982). However, with the season prescribed to open on the third Saturday in March of each year, it seems that this is no longer a significant management issue.

Wetlands with high numbers of waterbirds

Wetlands which produced the highest numbers of all waterbirds for both years are listed in Table 9a and 9b. In general, wetlands that held high numbers of birds had high numbers of both game and non-game species. Leaving aside the Western Treatment Plant, South West Region had the top 5 wetlands in 2014, but these were spread between Barwon South West, Grampians and Port Phillip Regions in 2015. Of 18 wetlands surveyed in the Grampians Region in 2015, only four held any waterbirds.

Wetland Closures

In 2014 information collected during the Summer Waterbird Count was used in considering whether to close any wetlands to duck hunting. Eight wetlands were closed, mostly because of the presence of significant numbers of Freckled Duck. These were Round Lake, Hird Swamp, Bartlett's Swamp, Lake Natimuk, Lake Colac, and part of Lake Connewarre State Game Reserve near Geelong. Kow Swamp and Reedy Lakes near Kerang were also closed to duck hunting to reinforce their status as Wildlife Sanctuaries where hunting is not permitted.

In 2015 two wetlands were closed – Round Lake near Lake Boga because of the presence of large numbers of the threatened Blue-billed Duck and Krause Swamp to provide refuge for Brolga.

Table 3. Game species counted in each DEPI region during the 2014 Victorian Summer Waterbird Count. Percentages are the species proportion of all eight game species.

DEPI Region	Game Species								Total
	Australian Wood Duck	Australian Shelduck	Pacific Black Duck	Chestnut Teal	Grey Teal	Australasian Shoveler	Pink-eared Duck	Hardhead	
Gippsland	92	40	156	1,932	152	72	308	105	2,857
North East	1,317	16	500	52	1,712	48	280	505	4,430
Mallee	2,372	1,648	557	1,702	16,863	504	3,669	1,675	28,990
Port Phillip	316	23,073	2,248	9,779	17,815	3,795	41,324	11,733	110,083
South West	1,588	26,230	3,632	6,815	24,086	480	55,535	2,329	120,695
TOTAL (%)	5,685 (2.1%)	51,007 (19.1%)	7,093 (2.7%)	20,280 (7.6%)	60,628 (22.7%)	4,899 (1.8%)	101,116 (37.9%)	16,347 (6.1%)	267,055 (100%)

Table 4. Game species counted in each DELWP region during the 2015 Victorian Summer Waterbird Count. Percentages are the species proportion of all eight game species.

DELWP Region	Species								Total
	Australian Wood Duck	Australian Shelduck	Pacific Black Duck	Chestnut Teal	Grey Teal	Australasian Shoveler	Pink-eared Duck	Hardhead	
Gippsland	30	62	160	1,259	237	58	18	61	1,885
Hume	1,145	4,191	335	1,003	1,204	4	3,633	0	11,515
Loddon Mallee	191	582	333	10	6,735	161	2,062	482	10,556
Port Phillip	32	26,961	1,655	6,045	7,761	4,993	25,665	1,936	75,048
Grampians	0	4,699	67	1,015	5,611	186	3,613	0	15,191
Barwon South West	260	4,827	791	3,222	12,604	4,083	19,684	0	45,471
TOTAL (%)	1,658 (1.0%)	41,322 (25.9%)	3,341 (2.1%)	12,554 (7.9%)	34,152 (21.4%)	9,485 (5.9%)	54,675 (34.2%)	2,479 (1.6%)	159,666 (100%)

Table 5. Selected species of non-game waterbirds counted in each DEPI region during the 2014 Victorian Summer Waterbird Count. Percentages are the proportion of all eight non-game species.

DEPI Region	Species								Total
	Eurasian Coot	Great Crested Grebe	Australasian Grebe	Hoary-headed Grebe	Freckled Duck	Black Swan	Blue-billed Duck	Musk Duck	
Gippsland	1,980	1	3	14	193	672	11	31	2,905
North East	209	0	76	121	0	23	6	2	437
Mallee	5,976	7	148	651	155	1,614	20	57	8,628
Port Phillip	22,038	63	36	20,051	321	5,449	5,321	850	54,129
South West	39,345	53	111	1,456	2,134	4,165	54	300	47,618
TOTAL	69,548	124	374	22,293	2,803	11,923	5,412	1,240	113,717
(%)	(61.1%)	(0.1%)	(0.3%)	(19.6%)	(2.5%)	(10.5%)	(4.8%)	(1.1%)	(100%)

Table 6. Selected species of non-game waterbirds counted in each DELWP region during the 2015 Victorian Summer Waterbird Count. Percentages are the species proportion of all eight non-game species.

DELWP Region	Species								Total
	Eurasian Coot	Great Crested Grebe	Australasian Grebe	Hoary-headed Grebe	Freckled Duck	Black Swan	Blue-billed Duck	Musk Duck	
Gippsland	672	0	13	205	19	877	49	19	1,854
Hume	230	0	16	19	0	158	0	15	438
Loddon Mallee	1,801	8	219	1,024	51	2,755	250	36	6,144
Port Phillip	17,426	83	18	21,909	166	5,844	3,530	1,162	50,138
Grampians	266	0	2	12	0	130	0	4	414
Barwon South West	11,599	0	0	36	22	3,620	0	25	15,302
TOTAL (%)	31,994 (43.2%)	91 (0.1%)	268 (0.4%)	23,205 (31.2%)	258 (0.3%)	13,384 (18.0%)	3,829 (5.1%)	1,261 (1.7%)	74,290 (100%)

Table 7. Proportions (%) of statewide counts of (a) game and (b) non-game species for 2014 and 2015 that were recorded at the Western Treatment Plant (WTP).

Species	2014			2015		
	Total count	WTP count	WTP %	Total count	WTP count	WTP %
Game						
Australian Wood Duck	5,685	11	0.2%	1,658	4	0.2%
Australian Shelduck	51,007	21,535	42.2%	41,322	26,661	64.5%
Pacific Black Duck	7,093	1,868	26.3%	3,341	1,516	45.4%
Chestnut Teal	20,280	7,909	39.0%	12,554	6,016	47.9%
Grey Teal	60,628	12,935	21.3%	34,152	7,720	22.6%
Australasian Shoveler	4,899	3,428	70.0%	9,485	4,993	52.6%
Pink-eared Duck	101,116	35,577	35.2%	54,675	25,665	46.9%
Hardhead	16,347	11,180	68.4%	2,479	1,854	74.8%
Game species total	267,055	94,443	35.4%	159,666	74,429	46.6%
Non-game						
Eurasian Coot	69,548	11,403	16.4%	31,994	11,066	34.6%
Great Crested Grebe	124	32	25.8%	91	59	64.8%
Australasian Grebe	374	9	2.4%	268	8	3.0%
Hoary-headed Grebe	22,293	18,936	84.9%	23,205	21,556	92.9%
Freckled Duck	2,803	308	11.0%	258	166	64.3%
Black Swan	11,923	5,208	43.7%	13,384	5,809	43.4%
Blue-billed Duck	5,412	3,529	65.2%	3,829	2,980	77.8%
Musk Duck	1,240	776	62.6%	1,261	1,079	85.6%
Non-game species total	113,717	40,201	35.4%	74,290	42,723	57.5%

Table 8. Numbers of Freckled Duck recorded during Summer Waterbird Counts, Victoria, 1987–2015.

Year	Number of wetlands counted	Number of wetlands with Freckled Duck	Number of individual Freckled Duck
1987	445	23	219
1988	484	7	69
1989	642	11	76
1990	665	13	95
1991	786	12	167
1992	664	14	106
1993	504	13	149
1994	343	6	44
1995	367	4	63
1996	234	1	2
1997	223	2	55
1998	309	1	4
1999	298	8	82
2000	328	2	16
2001	336	7	32
2002	225	9	550
2003	175	10	798
2004	249	11	929
2005	272	9	186
2006	268	13	661
2007	176	5	82
2008	191	3	46
2009	161	2	69
2010	153	2	9
2011	201	2	8
2012	136	7	133
2013	133	23	1,056
2014	166	18	2,803
2015	126	9	258
Mean	319	9	302

Table 9a. 2014: Five most populous wetlands in each DEPI Region (eight game and eight non-game species).

DEPI Region	Wetland	Total Number of Waterbirds Counted 2014
Gippsland	Lake Wat Wat	1,916
	Jones Bay South (Nth King Lake)*	1,520
	Newmerella Sewage Farm	1,071
	Swan Lake*	518
	McLeod Morass*	388
North East	Wangaratta Sewage Lagoons	2,223
	Lake Eildon	877
	Lake Hume	799
	Lake Nillahcootie	540
	Lake Moodemere	222
North West	Hird Swamp	6,353
	Lake Nurrumbeet	5,772
	Hollands NCR*	2,769
	Bartlett's Swamp (Boost)*	2,618
	Wourinen North*	2,588
Port Phillip	Werribee Treatment Plant	134,644
	Yan Yean	11,859
	Eastern Treatment Plant*	9,936
	Parwon Sewerage Farm	4,684
	Melton Sewage Farm	2,515
South West	Lake Bolac	39,633
	Lake Natimuk	23,768
	Lake Rosine	21,274
	Lake Lonsdale	18,005
	Lake Gnarpurt	12,220

* Wetland was not surveyed in the 2015 SWC

Table 9b. 2015: Five most populous wetlands in each DELWP Region (eight game and eight non-game species).

DELWP Region	Wetland	Total Number of Waterbirds Counted 2015
Gippsland	Lake Wat Wat	1,667
	Newmerella Sewage Farm	913
	Sale Common*	554
	Lake Corringale	328
	Dowd's Morass*	157
Hume	Lake Eildon	973
	Lake Buffalo	542
	Lake Nagambie & Surrounds	390
	Lake Cooper*	340
	Lake Moodemere	110
Loddon Mallee	Lake Elizabeth	5,427
	Lake Murphy	3,739
	Walkers Lake	1,636
	Round Lake	1,580
	Heywoods Lake*	1,242
Port Phillip	Werribee Treatment Plant	117,152
	Yan Yean	7,573
	Lake Burn	300
	Banyule flat main wetland	112
	Streeton Views	73
Barwon South West	Lake Bullrush*	16,746
	Lake Rosine	15,849
	Lake Colac	5,349
	Pine Lake	3,600
	Reedy Lake	2,951
Grampians	Lake Bolac	9,013
	Lake Lonsdale	6,080
	Lake Burrumbeet	295
	Toolondo Reservoir	217

* Wetland was not surveyed in the 2014 SWC

Discussion

The limitations and constraints of the SWC must be appreciated when considering the results. While it is the only long-term, land-based survey of the state's waterbirds with annual counts since 1987, the number of wetlands surveyed has been declining from a peak of 786 wetlands in 1991, to an all-time low of 126 in 2015. The current level of survey effort renders meaningful state-wide, year by year comparisons increasingly difficult. Staff are encouraged to focus available effort on those wetlands which consistently hold large numbers of game species and are therefore popular hunting sites. This biases the data towards large and more permanent wetlands.

The period over which the SWC is to be conducted was reduced to 14 days during the two SWCs reported on here. This reduction aimed to have the counts conducted as close as possible to opening day, to minimise error due to waterbird population fluctuations between the count and opening day. Even so, the period between those two events, which is necessitated by requirements within the Game Regulations, was a minimum of 19 days (2014) and 20 days (2015), meaning that the time lag remains a shortcoming in the decision making process as currently structured.

Results of the 2014 and 2015 Summer Waterbird Counts

Many reports of flocks of Freckled Duck were received from Victoria during and immediately preceding the 2013 and 2014 SWCs, building to a record number of 2,803 in the 2014 SWC. However, by the 2015 SWC most Freckled Duck had left Victoria and only 258 were counted. Most of these reports came from the south of the state with Lake Lorne (South West region) and Lake Natimuk (South West Region) attracting high numbers (note that Lake Lorne was previously included in Port Phillip region but is now included in the Barwon South West region).

The future

The SWC was designed to achieve two main objectives (Loyn 1989, 1991):

1. To locate flocks of threatened waterfowl and breeding aggregations of waterbirds that may warrant closure of the wetland for the duck hunting season.
2. To obtain data on numbers of waterbirds in Victoria for long-term monitoring.

Management of game species requires long-term information on changes in species abundance across the state and the continent. The inherent variability of the Australian climate has profound effects on the availability of habitat for waterbirds, and breeding opportunities are typically provided by flood events in disparate parts of the continent (e.g. Frith 1982; Kingsford and Norman 2002). To understand the effect of these influences as well as immediate human impacts, such as hunting, long-term data sets are essential. Such data sets are rare in Australia, being available for sites in NSW (e.g. Briggs 1977; Kingsford 1999), the Northern Territory (by aerial survey: Bayliss and Yeomans 1990), and south-west Western Australia (Jaensch et al 1988a, b; Halse and Vervest 1990, 1992, 1994). In Victoria, only Western Port has been monitored long-term, since 1973 (Loyn et al 1994; Hansen et al 2015) and the Western Treatment Plant has been intensively monitored since 2000 (Loyn et al 2014). On a much broader scale, the Eastern Australian Waterbird Count, which began in 1983, has provided annual abundance indices of waterbirds and viable wetlands across a standard series of aerial census lines from Queensland to Victoria and into South Australia (Braithwaite et al 1985; Kingsford et al 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1999, 2000, 2003; Porter and Kingsford 2006).

The SWC adds a broad perspective to our understanding of waterfowl numbers and distribution in Victoria, with data having been collected from a large number of wetlands (126+ annually, and approximately 1,500 altogether) between 1987 and 2015. Data summarised here adds to the series which is used to assist future decisions about duck hunting and wetland management in the State, as envisaged in Loyn (1991). Only a sub-sample of the State's wetlands is surveyed each year and it should be stressed that most of these counts do not provide data on absolute numbers of waterbirds. Their main aim (in terms of monitoring) is to provide indices of abundance for comparisons between years (for example, Murray et al 2012).

Until recent years the coverage of Victorian wetlands achieved during the SWC was adequate to meet both objectives. Summer Waterbird Count data have provided helpful contextual information for the interpretation of other waterfowl monitoring programs (see, for example, Loyn et al 2014). However, declining capacity and effort raises doubts about the efficacy of the SWC to meet these objectives, particularly objective 2.

We recommend a reassessment of the aims and methods adopted to assess the impact of the Victorian duck hunting season on populations of game species, and to monitor waterbird populations more generally.

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Appendix 1: List of priority sites for Summer Waterbird Count, 2015

DELWP REGION	MAP	AMG	WETLAND NAME
Gippsland	8321	073784	Sale Common
	8321	174861	Lake Kakydra
	8321	178778	Dowd Morass
	8321	350736	
	8321	395891	Victoria Lagoon
	8422	742226	Toolong Swamp
	8522	313175	Lake Corringale
			Lake Guthridge
	8622	379200	Lake Curlip
Hume	7825	040632	Racecourse Lake
	7825	060654	Green Lake
	7925	486898	Loch Garry
	8023	020920	Lake Eildon
	8124	110170	Lake Nillahcootie
	8125	130040	Dowdle Swamp
	8125	448096	Lake Moodemere
	8325	060960	Lake Hume
			Lower Ovens
			Buffalo Dam
			Lake Nagambie and surrounds
			Big Reedy Lagoon
			Black Swamp (Black dog creek)
			Black Swamp (Nine mile creek)
			Dowdle Swamp
			Jubilee Swamp
			Lehmann Swamp
			Mc Burney Swamp
			Moodie Swamp
			Morphett swamp
			Murchison Swamp
			Rowan Swamp
			Tungamah Swamp
			Reedy Lake Nagambie
			Lake Cooper
			Gaynors Swamp
			Wallenjoe
			Mansfield Swamp

DELWP REGION	MAP	AMG	WETLAND NAME
Port Phillip	7821	880910	Western Treatment Plant
Barwon Southwest	7721	470630	Lake Modewarre
	7721	491604	Brown Swamp
	7721	733642	
	7721	739680	Reedy Lake
	7721	770658	Lake Connewarre
	7721	770658	Hospital Swamp
	7321	185576	
	7322	040185	Lake Kennedy
	7322	071205	Lake Linlithgow
	7324	157293	Dock Lake
	7324	203286	Pine Lake
	7324	232280	Lake Taylor
	7422	665228	Lake Turangmoroke
	7621	255870	Lake Rosine
	7621	268572	Lake Colac
	7621	280809	Lake Martin/Cundare Pool
	7621	350710	Lough Calvert
	7621	351812	Lake Weering
	7621	355609	Lake Forest
	7621	362762	Eurack Swamp
	7621	412565	
	7621	540707	Lake Murdeduke
	7721	430617	Lake Gherang
	7521	038768	Lake Terangpom
	7521	064793	Lake Coradgill
	7521	074780	Lake Terang Goodwitch
	7521	079769	Lake Punpundal
	7521	079776	Lake Balkil Narra
	7521	121897	Lake Struan
	7521	754526	Lake Elingamite
	7521	858772	Lake Bookar
	7521	898723	Lake Colongulac
	7521	932773	Lake Round
	7521	934727	Lake Kariah
	7521	942799	Lake Milangil
	7521	958712	Lake Koreetnung
	7522	778199	Lake Oundell
	7522	901350	Lake Wongan
	7522	907998	Deep Lake
	7522	994938	Lake Tooliorook

DELWP REGION	MAP	AMG	WETLAND NAME
Grampians	7423	424499	Lake Muirhead
	7423	442884	Lake Fyans
	7423	444012	Lake Lonsdale
	7423	565487	Shooters Swamp
	7423	577507	Lake Buninjon
	7521	013647	Carter Swamp
	7521	024805	
	7521	029789	Horsepoles Dam
	7521	029800	
	7521	988822	
	7522	080430	Lake Goldsmith
	7522	767254	Holdsworth Swamp
	7622	300458	Black Swamp
	7622	339460	Lake Burrumbeet
	7623	433583	Coghills Creek Dam
	7623	483763	Merin Merin Swamp
	7124	190379	Waurin Swamp
	7124	198346	Boorooki Swamp
	7124	212363	Yarrackigarra Swamp
	7124	239180	Winter Lake
	7124	285213	Lake Carpolac
	7124	423304	Wally Allens Swamp
	7224	453252	Lake Koynock
	7224	456236	Lake Karnak
	7224	703388	Connan Swamp
	7224	722263	Jacka Lake
	7224	763195	Lake Clarke
	7224	838374	Lake Natimuk
	7223	671945	McGlashins Swamp
	7223	841032	Toolondo Reservoir

DELWP REGION	MAP	AMG	WETLAND NAME
Loddon Mallee	7225	820090	Lake Hindmarsh
	7226	880425	Lake Albacutya
	7124	424190	Woolshed Swamp
	7299	920084	Meridian Basin
	7326	259448	Lake Coorong
	7328	230530	Lake Hattah
	7328	231536	Little Lake Hattah
	7329	973215	Horseshoe Bend Billabong
	7424	723544	Lake Hancock
	7424	735570	Lake Batyo Catyo
	7425	744792	Little Lake Buloke
	7425	756856	Lake Buloke
	7428	715580	Lake Powell
	7525	821629	Browns Lake
	7525	845622	Lake Nurrumbeet
	7525	847632	Lake Grassy
	7525	975835	Wooroonook Lake (Main)
	7525	988840	Wooroonook Lake (Church)
	7623	640990	Cairn Curran Reservoir
	7624	550150	Laanecoorie Reservoir
	7626	470566	Third Marsh (Top Marsh)
	7626	480513	First Marsh (The Marsh)
	7626	482472	Lake Bael Bael
	7626	483545	Second Marsh (Middle Marsh)
	7626	495662	Lake Tutchewop
	7626	510523	Lake Cullen
	7626	533280	Tobacco Lake
	7626	551457	Lake Elizabeth
	7626	587335	Lake Murphy
	7626	602408	Brandy Lake (L. Wandella)
	7726	344450	McDonalds Swamp
	7726	380275	Hird Swamp
			Johnson's Swamp
			Lake Meran
			Lake Yando
			Lake Boort
			Richardson's Lagoon
			Lake Leaghur
			Gil Gil
			Heywoods Lake
			Racecourse Lake
			Lake Gilmour