Victorian Summer Waterbird Count 2016

Peter Menkhorst and Daniel Purdey

June 2016

Arthur Rylah Institute for Environmental Research

Unpublished Client Report for Ecological Policy Branch, Department of Environment, Land, Water and Planning

Arthur Rylah Institute for environmental research

Department of Environment, Land, Water & Planning

State Government Victoria

Victorian Summer Waterbird Count 2016

Peter Menkhorst and Daniel Purdey

Arthur Rylah Institute for Environmental Research
123 Brown Street, Heidelberg, Victoria 3084

June 2016

Arthur Rylah Institute for Environmental Research
Department of Environment, Land, Water and Planning
Heidelberg, Victoria

Report produced by: Arthur Rylah Institute for Environmental Research
Department of Environment, Land, Water and Planning
PO Box 137
Heidelberg, Victoria 3084
Phone (03) 9450 8600
Website: www.delwp.vic.gov.au/ari

Citation: Menkhorst, P. and Purdey, D. (2016) Victorian Summer Waterbird Count 2016. Arthur Rylah Institute for Environmental Research. Unpublished Client Report. Department of Environment, Land, Water & Planning, Heidelberg, Victoria.

Front cover photo: Pacific Black Duck, photographer Peter Menkhorst

Contents

Acknowledgements

Funding for the preparation of this report was provided by the Ecological Policy Section of the Department of Environment, Land, Water and Planning (DELWP). We are grateful to Stuart McConnell, Director of Ecological Policy for this support. We also thank Simon Toop, Director Game at the Game Management Authority for his continuing support of the Summer Waterbird Count.

Special thanks are due to the observers who collected the data which form the basis of this survey. They included staff of DELWP and the Game Management Authority, and volunteers from Birdlife Australia and the Victorian Field and Game Association. We thank the DELWP regional coordinators who carried out the task of organising most of the local surveys.

Dr Kasey Stamation, Tim O'Brien and the Game Management Authority provided helpful comments on earlier drafts of this report.

Summary

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

The number of wetlands counted has varied over the 30 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.

The 2016 Victorian SWC was conducted during the two weeks from 15 to 26 February and covered 131 wetlands, 87 of which were dry at the time. The total count of ducks belonging to the eight game species was 92,168, a 42% decrease on the 2015 total and a 65% decrease on the 2014 total, reflecting the continuing dry conditions, as indicated by the large proportion (67%) of wetlands that were dry at the time of the count.

The most numerous game species counted in 2016 were Grey Teal (33.6% of all game ducks counted), Pink-eared Duck (25.1%) and Australian Shelduck (21.3%). These three species made up 80% of the game ducks counted with the other five game species making up the remaining 20%. In 2015 a very similar picture emerged with the same three species comprising 81.5% of game ducks counted.

In 2016, the total count of birds belonging to the eight non-game species was 74,452, a similar total to that of 2015 (74,290) and a 34.5% decrease on the 2014 total. In numerical abundance, the eight non-game species are dominated by two species, the Hoary-headed Grebe and Eurasion Coot which made up 70% of the total count of non-game species. Both species may occur at very high densities in prime habitat and did so at the Western Treatment Plant during the 2016 count when they made up 98.8% and 64.7% respectively of the Statewide total. The very high bias towards the Western Treatment Plant, a permanent wetland with a constant water source, likely masked a more widespread decline in the non-game species due to dry conditions elsewhere. Black Swan (16.6%) and Blue-billed Duck (10.5%) were the only other species with significant numbers.

In 2016, information collected during the Summer Waterbird Count contributed to the decision to close four wetlands to duck hunting due to the presence of significant numbers of threatened species, specifically Australasian Bittern at Johnson Swamp State Game Reserve and Blue-billed Duck at Heywood Lake State Game Reserve and Round Lake.

Introduction

Annual counts of waterbirds have been conducted at wetlands across Victoria since 1987, when the then Department of Conservation, Forests and Lands 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 duck hunting season. 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.

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). 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, 2015) or are available as unpublished summaries (Price 1993; O'Brien 1994; Pert 1995; Norman 1996–2006; Norman and Purdey 2007; Purdey and Loyn 2008–2010).

The coverage achieved during SWCs has been reduced from those of previous years because of declining departmental capacity to cover a large sample of wetlands. Therefore, the 2016 SWC continued the strategy, introduced in 2015, of limiting survey coverage to a total of 130 wetlands deemed to be important duck hunting sites on public land, rather than including any wetland, regardless of whether or not it is open to hunting. The one exception to this strategy is the inclusion of the Western Treatment Plant, an extensive series of wetlands not open to hunting, where comprehensive waterbird counts have been conducted six times per year since 2000 (Loyn et al. 2014). Date from the Western Treatment Plant provide detailed baseline data against which the results of the SWC from elsewhere in the State can be compared.

Thus the objectives of the 2016 Summer Waterbird Count were to:

1. identify wetlands open to hunting which are holding large numbers of significant non-game waterbirds (to inform consideration of potential closures of individual wetlands to hunting)
2. identify cases of local breeding by 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 2016 SWC conducted between 15 and 26 February in 2016.

Methods

Survey methods

Although most wetlands were surveyed by staff from DELWP and the GMA, a small number were surveyed by volunteers from Field and Game Australia or Birdlife Australia. 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 DELWP 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), no Coordinator was required from that 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 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 Mircosoft 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.

Count dates

The 2016 SWC was conducted over a two week period (15-26 February 2016), corresponding closely to the time of year of previous counts and allowing sufficient time for a preliminary review of the data to enable decisions regarding the management of the forthcoming duck hunting season.

Wetlands surveyed

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. Before the 2016 SWC, the list of priority wetlands was further refined to remove very large wetlands that cannot be comprehensively counted, such as water supply dams (e.g. Lake Hume and Lake Eildon) and Western Port. The list of priority wetlands for 2016 is provided in Appendix 1.

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 rhynchotis,* 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 *Poliocephalus poliocephalus*, Great Crested Grebe *Podiceps cristatus* and Eurasian Coot *Fulica atra*. Other notable (rare or threatened) species are also recorded if present.

Data presentation

Results are presented as summed counts of species at wetlands within each DELWP region and state-wide. However, comparisons between departmental regions are confounded by the regular changes to regional boundaries that have occurred over the 30 year period of the Summer Waterbird Counts and so provide only very coarse information.

Results

Numbers of wetlands counted

The 2016 SWC contributes to a dataset now spanning the 30 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 number of surveyed wetlands peaked in the 1989–1993 period and declined thereafter. The 2016 SWC included 131 wetlands across Victoria (Table 1), a slight increase over the previous year. However, 87 (67%) of these wetlands were dry during the count period and mostly lacked waterbirds, accounting for the low total numbers recorded. The numbers of priority wetlands in each DELWP Region and the number that were actually surveyed in 2016 are shown in Table 2.

In 2016 most (125) of the 130 recommended wetlands were surveyed (Table 1), the exceptions being McLeods Morass (Gippsland Region), Loch Garry and Lake Moodemere (Hume Region), and Lakes Hindmarsh and Albacutya (Grampians Region). In addition, six other wetlands not on the recommended list, were counted opportunistically (Lake Gilmour, Loddon Mallee Region; Lake Bookar and Balkil Narra, Grampians Region; Lake Guyat, Heart Morass and Lake Wat Wat, Gippsland Region).

Game species

In 2016, the total count of ducks belonging to the eight game species was 92,168 (Tables 1 and 3). This total represents a 42% decrease on the 2015 total and a 65% decrease on the 2014 total (Purdey and Menkhorst 2015) and reflects the continuing dry conditions, as indicated by the large proportion (67%) of wetlands that were dry at the time of the count.

The most numerous game species counted in 2016 were Grey Teal (33.6% of all game ducks counted), Pink-eared Duck (25.1%) and Australian Shelduck (21.3%). These three species made up 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 in that year the sequence was Pink-eared Duck (34.2%), Australian Shelduck (25.9%) and Grey Teal (21.4%).

Non-game species

In 2016, the total count of ducks belonging to the eight non-game species was 74,452 (Tables 1 and 4). This total is very similar to that of 2015 (74,290) and a 34.5% decrease on the 2014 total (Purdey and Menkhorst 2015). In numerical abundance, the eight non-game species are dominated by two species, the Hoary-headed Grebe and Eurasion Coot. Both species may occur at very high densities in prime habitat and did so at the Western Treatment Plant during the 2016 count when they made up 98.8% and 64.7% respectively of their Statewide total (Table 5). The very high bias towards the Western Treatment Plant, a permanent wetland with a constant water source, likely masked a more widespread decline in the non-game species due to dry conditions elsewhere.

As in previous years, Hoary-headed Grebe and Eurasian Coot dominated the non-game species, comprising 70% of the total count for the eight species in 2016 (Table 4). Black Swan (16.6%) and Blue-billed Duck (10.5%) were the only other species with significant numbers.

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

Year	Count Period	Number 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
2016	15-26 February	131	92,168	74,452
Mean		299	202,180	117,107

Table 2. Coverage of priority wetlands in the 2016 SWC by DELWP Region.

DELWP Region	Number of priority wetlands	Number surveyed (%)	Number of non-priority wetlands surveyed
Barwon South West	36	36 (100)	0
Grampians	30	28 (93)	2
Gippsland	7	6 (86)	3
Hume	16	14 (88)	0
Loddon Mallee	40	40 (100)	1
Port Phillip	1	1 (100)	0
All	**130**	**125 (96)**	**6**

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 5). 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 the birds counted during SWCs, particularly in recent years when the number of wetlands surveyed state-wide has been low (Table 1).

In 2016, the WTP accounted for more than 55% of game ducks counted and more than 80% of the non-game species (Table 5). It held more than 70% of birds counted for eight species: Australian Shelduck, Australasian Shoveler, Pink-eared Duck, Great Crested Grebe, Hoary-headed Grebe, Freckled Duck, Blue-billed Duck and Musk Duck (Table 5).

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). Freckled Duck are at risk of being shot during duck hunting season because they can be difficult to distinguish from Pacific Black Duck when flying. The Game Management Authority is keen to minimise the risk to this species during the duck hunting season.

In 2016 few Freckled Duck were present in southern parts of the species range and only 174 were counted during the SWC (Table 6); 149 of these (86%) were at the WTP. Other sites with Freckled Duck were: Johnsons Swamp (Loddon Mallee Region) (up to 16 birds), and Dowd Morass and Lake Guyat (Gippsland Region) (2 and 7 birds respectively).

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). In 2016, with widespread dry conditions, only a single observation of breeding was recorded: juvenile Caspian Terns were present amongst a flock of 18 at Snipe Point, Victoria Lagoon, Hollands Landing in Gippsland Region.

No incidence of large-scale moulting was reported during the 2016 SWC. 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 during the 2016 SWC are listed in Table 7. In general, large waterbodies in the west of the State provided the best waterbird habitat, most smaller wetlands being dry. Wetlands that held high numbers of birds had high numbers of both game and non-game species. Leaving aside the Western Treatment Plant, Loddon Mallee Region had the most waterbirds due to environmental flows supplied to Johnson Swamp, Lake Elizabeth and Round Lake. Barwon South West Region had good numbers of birds at Lakes Burrumbeet and Tooliorook, and Grampians Region at Lakes Bolac and Lonsdale.

Wetland Closures

In 2016 information collected during the Summer Waterbird Count was used in considering whether to close any wetlands to duck hunting. Three wetlands were closed due to the presence of significant numbers of threatened species, specifically Australasian Bittern at Johnson Swamp State Game Reserve and Blue-billed Duck at Heywood Lake State Game Reserve and Round Lake. Lake Elizabeth State Game Reserve was also closed when counts taken after the SWC had finished indicated that significant numbers of Blue-billed Duck had occupied that wetland. 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.

Table 3. Numbers of each game species counted in each DELWP region during the 2016 Victorian Summer Waterbird Count. Percentages are the species proportion of the total count 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	38	130	219	1,326	499	116	71	21	2,420
Hume	22	0	62	0	90	0	0	0	174
Loddon Mallee	53	69	1161	200	18,591	331	5,730	714	26,849
Port Phillip	12	14,932	1,507	5,526	9,579	1,487	16,766	1,318	51,127
Grampians	0	2,179	946	340	2,023	134	550	6	6,178
Barwon South West	0	2,276	250	2,694	200	0	0	0	5,420
TOTAL (%)	**125 (0.1%)**	**19,586 (21.3%)**	**4,145 (4.5%)**	**10,086 (10.9%)**	**30,982 (33.6%)**	**2,068 (2.2%)**	**23,117 (25.1%)**	**2,059 (2.2%)**	**92,168 (100%)**

Table 4. Numbers of the selected species of non-game waterbirds counted in each DELWP region during the 2016 Victorian Summer Waterbird Count. Percentages are the species proportion of the total count 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	133	0	2	88	9	1318	26	21	1,597
Hume	56	0	0	0	0	0	0	7	63
Loddon Mallee	3,972	32	382	186	16	1,034	120	29	5,571
Port Phillip	14,896	12	59	28,778	149	7,442	7,662	1,232	60,230
Grampians	3,820	0	100	5	0	852	0	27	4,804
Barwon South West	130	0	1	60	0	1,711	40	45	1987
TOTAL (%)	**23,007 (30.9%)**	**44 (0.1%)**	**544 (0.7%)**	**29,117 (39.1%)**	**174 (0.2%)**	**12,357 (16.6%)**	**7,848 (10.5%)**	**1,361 (1.8%)**	**74,452 (100%)**

Table 5. Proportions (%) of Statewide counts of game and selected non-game species for 2016 that were recorded at the Western Treatment Plant (WTP).

Species	Total count	WTP count	WTP %
Game species			
Australian Wood Duck	125	12	9.6%
Australian Shelduck	19,586	14,932	76.2%
Pacific Black Duck	4,145	1,507	36.4%
Chestnut Teal	10,086	5,526	54.8%
Grey Teal	30,982	9,579	30.9%
Australasian Shoveler	2,068	1,487	71.9%
Pink-eared Duck	23,117	16,766	72.5%
Hardhead	2,059	1,318	64.0%
Game species total	**92,168**	**51,127**	**55.5%**
Non-game species			
Eurasian Coot	23,007	14,896	64.7%
Great Crested Grebe	44	32	72.7%
Australasian Grebe	544	12	2.2%
Hoary-headed Grebe	29,117	28,778	98.8%
Freckled Duck	174	149	85.6%
Black Swan	12,357	7,442	60.2%
Blue-billed Duck	7,848	7,662	97.6%
Musk Duck	1,361	1,232	90.5%
Non-game species total	**74,452**	**60,203**	**80.9%**

Table 6. Numbers of Freckled Duck recorded during Summer Waterbird Counts, Victoria, 1987–2016.

Year	Number of wetlands counted	Number of wetlands with Freckled Duck	Total count of 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
2016	130	4	174
Mean	313	8.4	298

Table 7. Five most populous wetlands (for the eight game and eight non-game species) in each DELWP Region in 2016.

DELWP Region	Wetland	Count
Barwon South West	Lake Burrumbeet	5,962
	Lake Tooliorook	2,762
	Lake Fyans	961
	Lake Toolondo	924
	Lake Bolac	263
Gippsland	Lake Wat Wat	1,777
	Dowd's Morass	895
	Newmerella Sewage Farm	639
	Lake Corringle	172
	Lake Curlip	169
Grampians	Lake Bolac	9,013
	Lake Lonsdale	6,080
	Lake Burrumbeet	295
	Toolondo Reservoir	217
Hume	Lake Buffalo	542
Loddon Mallee	Johnsons Swamp	25,708
	Lake Elizabeth	3,189
	Round Lake	1,606
	Lake Powell	664
	Heywoods Lake	506
Port Phillip	Werribee Treatment Plant	111,357

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 fewer than 150 in recent years. 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 are on public land, are open to hunting and consistently hold large numbers of game species. This biases the data towards waterbird species that prefer large, open and more permanent wetlands, and against those species that prefer shallower, more highly vegetated wetlands. Furthermore, as wetland coverage decreases the chances of the survey failing to record aggregations of significant species increases, thereby reducing its value as a tool for managing duck hunting.

The period over which the SWC is to be conducted has been reduced to 14 days during the second half of February. This reduction aimed to have the counts conducted as close as possible to opening day, to minimise error due to waterbird movements between the count and opening day. Even so, the period between those two events, which is necessitated by requirements within the *Wildlife Act* (1975), was 21 days in 2016 (an increase of one day over 2015 due to 2016 being a leap year), an ample period for flocks of waterfowl to move location. This time lag remains a shortcoming in the decision making process as currently structured.

Results of the 2016 Summer Waterbird Count

The most distinctive feature of the 2016 SWC was the number of wetlands that were dry at the time of the count, concentrating the remaining birds onto a few permanent or artificially-maintained wetlands. More than 60% of priority wetlands were completely dry in all DELWP regions apart from Gippsland, with 83% and 75% dry in Grampians Region and Hume Region respectively. Because of the dry conditions waterbird numbers were generally low with the total counts for both game and non-game species being less than half the long term mean.

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 tracking of 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 climatic influences, as well as immediate human impacts, such as hunting and the provision of environmental water, long-term data sets are essential. Such data sets are rare in Australia and many have been discontinued. 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 Survey, which began in 1983, has provided annual abundance indices of waterbirds and wetland habitats across a standard series of aerial census lines from Queensland to Victoria and into South Australia (see https://www.ecosystem.unsw.edu.au/content/rivers-and-wetlands/waterbirds/eastern-australian-waterbird-survey).

The SWC adds a broad perspective to our understanding of waterfowl numbers and distribution within Victoria, with data having been collected from a large number of wetlands (126+ annually, and approximately 1,500 altogether) between 1987 and 2016. 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 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. While the main aim is to identify wetlands that warrant consideration for closure to hunting (objective 1), they also have value as indices of abundance for comparisons between years (objective 2) (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.

References

Frith, H.J. (1982) Waterfowl in Australia. Angus & Robertson, Sydney

Hansen, B.D., Menkhorst, P., Maloney, P. and Loyn, R.H. (2015) Long-term declines in multiple waterbird species in a tidal embayment, south-east Australia. *Austral Ecology* 40: 515-527

Hewish, M. (1988) Waterfowl count in Victoria, February 1988. *RAOU Report* No. 52

Kingsford, R.T. and Norman, F.I. (2002) Australian waterbirds – products of the nation's ecology. *Emu* 102: 29–46

Loyn, R.H. (1989) The management of duck hunting in Victoria – a review. *ARI Tech. Rep. Ser.* No. 70

Loyn, R.H. (1991) Assessing and managing the impact of duck hunting in Victoria – a new approach. *Wildfowl* 42: 155–61

Loyn, R.H., Dann, P. and Bingham, P. (1994) Ten years of waterbird counts in Western Port, Victoria, 1973–83. I. Waterfowl and large wading birds. *Aust. Bird Watcher* 15: 333–350

Loyn, R.H., Rogers, D.I, Swindley, R.J., Stamation, K., Macak, P. and Menkhorst, P. (2014) Waterbird monitoring at the Western Treatment Plant, 2000-12: the effects of climate and sewage treatment processes on waterbird populations. Arthur Rylah Institute for Environmental Research Technical Report Series No. 256. Department of Environment and Primary Industries, Heidelberg

Martindale, J. (1988) Waterfowl count in Victoria, January 1987. *RAOU Report* No. 37

Murray, C.G., Loyn, R.H., Kasel, S., Hepworth, G., Stamation, K. and Hamilton, A.J. (2012) What can a database compiled over 22 years tell us about the use of different types of wetlands by waterfowl in southeastern Australian summers? *Emu* 112: 209–217

Norman, F.I. (1996) A report on some results of the 1998 Summer Waterfowl Count in Victoria. Unpublished report, Parks, Flora and Fauna Branch

Norman, F.I. (1997) A report on some results of the 1998 Summer Waterfowl Count in Victoria. Unpublished report, Parks, Flora and Fauna Branch

Norman, F.I. (1998) A report on some results of the 1998 Summer Waterfowl Count in Victoria. Unpublished report, Parks, Flora and Fauna Branch

Norman, F.I. (1999) A report on some results of the 1999 Summer Waterfowl Count in Victoria. Unpublished report, Parks, Flora and Fauna Branch

Norman, F.I. (2000) A report on some results of the 2000 Summer Waterfowl Count in Victoria. Unpublished report, Parks, Flora and Fauna Branch

Norman, F.I. (2001) A report on some results of the 2001 Summer Waterfowl Count in Victoria. Unpublished report, Parks, Flora and Fauna Branch

Norman, F.I. (2002) A report on some results of the 2002 Summer Waterfowl Count in Victoria. Unpublished report, Biodiversity and Natural Resources Branch

Norman, F.I. (2003) A report on some results of the 2003 Summer Waterfowl Count in Victoria. Unpublished report, Biodiversity and Natural Resources Branch

Norman, F.I. (2004) A report on some results of the 2004 Summer Waterfowl Count in Victoria. Unpublished report, Biodiversity and Natural Resources Branch

Norman, F.I. (2005) A report on some results of the 2005 Summer Waterfowl Count in Victoria. Unpublished report, Biodiversity and Natural Resources Branch

Norman, F.I. (2006) A report on some results of the 2006 Summer Waterfowl Count in Victoria. Unpublished report, Biodiversity and Natural Resources Branch

Norman, F.I. and Purdey, D.C. (2007) The 2007 Summer Waterbird Count in Victoria. Unpublished report, Biodiversity and Natural Resources Branch.

O'Brien, M. (1994) Summer Waterfowl Count 1994. Unpublished report, Arthur Rylah Institute for Environmental Research

Pert, P. (1995) Results of the 1995 Summer Waterfowl Count in Victoria. Unpublished report, Arthur Rylah Institute for Environmental Research

Peter, J. (1989) Waterfowl count in Victoria, February 1989. *RAOU Report* No. 57

Peter, J. (1990) Waterfowl count in Victoria, February 1990. *RAOU Report* No. 72

Peter, J. (1991) Waterfowl count in Victoria, February 1991. *RAOU Report* No. 79

Peter, J. (1992) Waterfowl count in Victoria, February 1992. *RAOU Report* No. 85

Price, R. (1993) 1993 Summer Waterfowl Count. Unpublished report, Arthur Rylah Institute for Environmental Research.

Purdey, D.C. and Loyn, R.H. (2008) A report on some results of the 2008 Summer Waterfowl Count in Victoria. Unpublished report, Biodiversity and Natural Resources Branch.

Purdey, D.C. and Loyn, R.H. (2009) The 2009 Summer Waterbird Count in Victoria. Unpublished report, Biodiversity and Natural Resources Branch.

Purdey, D.C. and Loyn, R.H. (2010) The 2010 Summer Waterbird Count in Victoria. Unpublished report, Biodiversity and Natural Resources Branch.

Purdey, D. and Loyn, R. (2011) The 2011 Summer Waterbird Count in Victoria. Arthur Rylah Institute for Environmental Research Technical Report Series No. 231, Department of Sustainability and Environment, Heidelberg.

Purdey, D. and Loyn, R. (2013) The 2012 Summer Waterbird Count in Victoria. Arthur Rylah Institute for Environmental Research Technical Report Series No. 242, Department of Sustainability and Environment, Heidelberg, Victoria.

Purdey, D. and Menkhorst, P. (2014) The 2013 Summer Waterbird Count in Victoria. Unpublished report to Game Victoria, Arthur Rylah Institute for Environmental Research, Department of Sustainability and Environment, Heidelberg, Victoria.

Purdey, D. and Menkhorst, P. (2015) Victorian Summer Waterbird Counts: 2014 and 2015. Unpublished report to Ecological Policy Branch, Department of Environment, Land, Water and Planning. Arthur Rylah Institute for Environmental Research, Heidelberg Victoria.

Appendix 1: List of priority wetlands for Summer Waterbird Count, 2016

REGION	MAP	AMG	WETLAND NAME
Gippsland			
			McLeod Morass
			Jack Smith Lake
	8321	174861	Lake Kakydra
	8321	178778	Dowd Morass
	8321	395891	Victoria Lagoon
	8522	313175	Lake Corringle
	8622	379200	Lake Curlip
Hume			
	7925	486898	Loch Garry
	8125	130040	Dowdle Swamp
	8125	448096	Lake Moodemere
			Buffalo Dam
			Big Reedy Lagoon
			Black Swamp (Black dog creek)
			Black Swamp (Nine mile creek)
			Jubilee Swamp
			Lehmann Swamp
			McBurney Swamp
			Moodie Swamp
			Morphett swamp
			Murchison Swamp
			Rowan Swamp
			Tungamah Swamp
			Reedy Lake Nagambie
Port Phillip			
	7821	880910	Western Treatment Plant
Barwon South West			
	7721	470630	Lake Modewarre
	7721	491604	Brown Swamp
	7721	739680	Reedy Lake, Connewarre
	7721	770658	Lake Connewarre
	7721	770658	Hospital Swamp
	7721	430617	Lake Gherang
	7322	40185	Lake Kennedy
	7322	71205	Lake Linlithgow
	7422	665228	Lake Turangmoroke
	7521	13647	Carter Swamp
	7521	29789	Horsepoles Dam
	7521	38768	Lake Terangpom
	7521	64793	Lake Coradgill

REGION	MAP	AMG	WETLAND NAME
	7521	74780	Lake Terang Goodwitch
	7521	79769	Lake Punpundal
	7521	79776	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	907998	Deep Lake
	7522	994938	Lake Tooliorook
	7522	767254	Holdsworth Swamp
	7522	778199	Lake Oundell
	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	540707	Lake Murdeduke
Grampians			
	7225	820090	Lake Hindmarsh
	7226	880425	Lake Albacutya
	7423	424499	Lake Muirhead
	7423	442884	Lake Fyans
	7423	444012	Lake Lonsdale
	7324	157293	Dock Lake
	7324	203286	Pine Lake
	7324	232280	Lake Taylor
	7423	565487	Shooters Swamp
	7423	577507	Lake Buninjon
	7522	80430	Lake Goldsmith
	7522	901350	Lake Wongan
	7622	300458	Black Swamp
	7622	339460	Lake Burrumbeet
	7623	433583	Coghills Creek Dam
	7623	483763	Merin Merin Swamp
	7124	190379	Waurn Swamp
	7124	198346	Booroopki Swamp
	7124	212363	Yarrackigarra Swamp

REGION	MAP	AMG	WETLAND NAME
	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
Loddon Mallee			
	7124	424190	Woolshed Swamp
	7299	920084	Meridian Basin
	7326	259448	Lake Coorong
	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)
	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	McDonald Swamp
	7726	380275	Hird Swamp
			Johnson Swamp
			Lake Meran
			Lake Yando
			Lake Boort
			Richardson Lagoon

REGION	MAP	AMG	WETLAND NAME
			Lake Leaghur
			Gil Gil
			Heywood Lake
			Lake Cooper
			Gaynor Swamp
			Wallenjoe
			Mansfield Swamp
	7825	40632	Racecourse Lake
	7825	60654	Green Lake