Victorian Summer Waterbird Count, 2018

P. Menkhorst, K. Stamation and G. Brown

June 2018

Arthur Rylah Institute for Environmental Research
Unpublished Report

Arthur Rylah Institute for environmental research

VICTORIA State Government | Environment, Land, Water and Planning

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.ari.vic.gov.au

Citation: Menkhorst, P., Stamation, K. and Brown, G. (2018). Victorian Summer Waterbird Count, 2018. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

Front cover photo: Great Crested Grebe (Photo: Peter Menkhorst)

Edited by Organic Editing

Victorian Summer Waterbird Count, 2018

Peter Menkhorst[1], Kasey Stamation[1] and Geoff Brown[1]

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

Arthur Rylah Institute for Environmental Research
Unpublished Report
Department of Environment, Land, Water and Planning

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

Acknowledgements

Funding for the preparation of this report was provided by the Regulatory Strategy and Design Branch of the Department of Environment, Land, Water and Planning (DELWP). We also thank the Game Management Authority for its continuing support of the Summer Waterbird Count.

Special thanks are due to the observers who collected the data that form the basis of this survey. They include 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.

A draft of this report was improved by comments from Simon Toop and Zac Powell at the Game Management Authority, and Phoebe Macak and Claire Moxham, ARI.

Contents

Summary

Context

The Victorian Summer Waterbird Count is a statewide survey of waterbirds using selected wetlands and is conducted in late February each year, prior to the beginning of the Victorian duck hunting season.

Aims

The Summer Waterbird Count gathers numerical, locational and breeding data about game ducks and non-game waterbirds to inform management decisions regarding the forthcoming duck hunting season. Specifically, the aims were:

1. to identify wetlands that are open to hunting and are holding large numbers of significant, non-game waterbirds (to inform consideration of further regulation, including closure of individual wetlands to hunting)
2. to identify cases of local breeding by waterbirds, particularly colony-breeding species (for consideration of further regulation, including closure to hunting)
3. to provide details on the distribution and numbers of game and non-game species of waterfowl on wetlands open to hunting.

Methods

During the 2018 Summer Waterbird Count, held between 12 and 23 February, 144 wetlands across Victoria were surveyed, a 7% increase over the previous year; however, 54 (40%) of these were dry at the time. Counts were made of all waterbirds on a wetland (or a defined part of a large wetland), using binoculars or a spotting scope. Observations of breeding of any waterbird species were also recorded, including numbers of broods or nests, and nest contents where appropriate.

Count data were collated in the last week of February, and a preliminary report detailing significant findings was conveyed to the regulatory authorities (Department of Environment, Land, Water and Planning, and Game Management Authority) during the first week of March in time for management decisions to be implemented prior to opening day of the hunting season (17 March).

Key results

Threatened waterbird species were detected in numbers above agreed thresholds at 13 wetlands, and these wetlands received extra monitoring in the lead-up to opening weekend.

The most numerous game species in the count results were Grey Teal (34.6%), Pink-eared Duck (20.1%) and Australian Shelduck (19.9%), together accounting for almost three-quarters of all game ducks counted. Non-game waterbirds were dominated by three species: Eurasian Coot (48.4%), Hoary-headed Grebe (25.7%) and Black Swan (15.8%), and together they comprised almost 90% of non-game birds counted. Great Crested Grebe and Freckled Duck showed very large increases over their 2017 totals.

Conclusions and implications

1. Overall, counts in 2018 were similar to those of the previous year, but, due to the dry conditions, waterbirds tended to be concentrated on a smaller number of large, more permanent wetlands.
2. Particularly large numbers of Freckled Duck, a listed threatened species, were present on wetlands south-east of Swan Hill.
3. Based on the survey results, six wetlands were closed to hunting for the start of the season, and partial closures or other management actions were applied at a further four wetlands.
4. The number of wetlands counted has varied over the 32 years of Summer Waterbird Counts. This variation in survey effort between years has resulted in biases in the database that affect its value as a basis for making management decisions.
5. A thorough review of the methods adopted to assess the impact of the Victorian duck hunting season on populations of both game and non-game species is warranted.

1 Introduction

1.1 Project context

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 is used to inform management decisions about further regulation of hunting on specific wetlands during the forthcoming duck hunting season. Dates for the SWC are set so that enough time is available to recommend further regulation of duck hunting and for recommended management action to be legally enacted 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. The 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; Menkhorst and Purdey 2016; Menkhorst et al. 2017).

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 2018 SWC continued the strategy (introduced in 2015) of limiting survey coverage to wetlands deemed by the GMA 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). Data 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 2018 SWC were:

1. to identify wetlands that are open to hunting and are holding large numbers of significant, non-game waterbirds (to inform consideration of further regulation, including closure of individual wetlands to hunting)
2. to identify cases of local breeding by waterbirds, particularly colony-breeding species (for consideration of further regulation, including closure to hunting)
3. to provide details on the distribution and numbers of game and non-game species of waterfowl on wetlands open to hunting.

2 Methods

2.1 Survey methods

Most wetlands were surveyed by staff from either the Department of Environment, Land, Water and Planning (DELWP) or the Game Management Authority (GMA), and a small number were independently surveyed (or partially surveyed) by volunteers from Birdlife Australia or Field and Game Australia. Counts were made of all waterbirds on a wetland (or a defined part of a large wetland), 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, if the entire wetland could not be surveyed, an estimate of the proportion of the wetland that was surveyed was sought. Observations of breeding of any waterbird species were also recorded, including numbers of broods or nests (and contents where appropriate).

2.2 Survey organisation

The SWC was coordinated centrally through the ARI (DELWP) 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), no Coordinator was required from that region.

Each regional coordinator was responsible for liaising locally with other DELWP and GMA officers in their region, distributing instructions and count forms, and ensuring adequate coverage of regional 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 at ARI 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. colony-breeding waterbirds) were detected during counts. In cases where a wetland was counted by persons other than government agency staff and significant waterbird values were reported, a government agency staff member was sent to the site to verify the report.

Completed forms, once processed locally, were scanned and emailed 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 Microsoft Access© database.

2.3 Count dates

The 2018 SWC was conducted over a 12-day period (12–23 February 2018), corresponding closely to the time of year of previous counts and allowing sufficient time for a preliminary review of the data to enable decisions to be made regarding the management of the forthcoming duck hunting season.

2.4 Wetlands surveyed

In recent years (2015 onwards), the strategy for selecting wetlands to be counted changed 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 focuses on wetlands that are likely to be visited by hunters, thereby reducing 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 at which waterbirds 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 2018 is provided in Appendix 1. A list of other wetlands surveyed in 2018 is provided in Appendix 2.

2.5 Species counted and analysed

Sixteen species of waterbirds (eight game and eight non-game) are considered for routine analysis in the SWC. These species include all eight species of 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*. Note that the Australasian Shoveler was a prohibited species during the 2018 duck hunting season.

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 counted if present.

3 Results

3.1 Number of wetlands counted

The 2018 SWC contributes to a dataset now spanning the 32 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, but has now stabilised at between 126 and 137 wetlands.

During the 2018 SWC, 144 wetlands across Victoria were surveyed (Table 1), a 7% increase over the previous year; however, 54 (40%) of these were dry at the time. The numbers of priority wetlands in each DELWP region and the number that were actually surveyed in 2018 are shown in Table 2.

In 2018, 136 of the 154 recommended wetlands were surveyed (Table 2) (those not surveyed are indicated in Appendix 1), and a further 8 non-priority wetlands were also surveyed.

3.2 Game species

In 2018, the total count of ducks belonging to the eight game species was 262,397 (Tables 1 and 3). This total represents a 7.4% decrease on the 2017 total (Table 3). The most numerous species were Grey Teal (34.6%), Pink-eared Duck (20.1%) and Australian Shelduck (19.9%), together accounting for almost three-quarters of all game ducks counted. The grazing ducks and two common dabbling ducks (the Pacific Black Duck and Grey Teal) comprised a much lower proportion of the count than in 2017 (Table 3).

3.3 Non-game species

In 2018, the total count of ducks belonging to the eight non-game species was 130,762 (Tables 1 and 4), a 14% increase on the 2017 total (Table 4). In numerical abundance, the eight non-game species were dominated by three species: Eurasian Coot (48.4%), Hoary-headed Grebe (25.7%) and Black Swan (15.8%), and together they comprised almost 90% of non-game birds counted. These species may occur at very high densities in prime habitat, and did so at the Western Treatment Plant during the 2018 count, when they made up 23%, 49% and 46%, respectively, of their statewide total (Table 5). About half the statewide count of two threatened duck species, Blue-billed Duck (52%) and Musk Duck (49%) were present at the WTP during the 2018 Summer Waterbird Count (Table 5).

Great Crested Grebe and Freckled Duck showed very large increases over their 2017 totals (Table 4).

3.4 The contribution of the Western Treatment Plant

The high counts of both game and non-game species in the Port Phillip Region are mainly due to the disproportionate impact of the Western Treatment Plant 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 much of the site is managed to maintain its value as wildlife habitat, as recognised under the Ramsar Convention. It is not open to hunting. In years of relatively low rainfall, the site has regularly contributed more than half the birds counted during SWCs.

The relatively dry lead-up to the 2018 SWC probably partly explains the higher proportion of birds counted at the permanent wetlands within the treatment plant than in the past few years—46% of all game ducks counted and 46% of the non-game species (Table 5). The treatment plant held more than 50% of birds counted for four species: Australasian Shoveler and Hardhead (thus providing important refuge for the two least common game ducks), and Australian Shelduck and Blue-billed Duck. The treatment plant counts of Hoary-headed Grebe and Musk Duck were also high—49% of the statewide total (Table 5).

Because it is counted frequently (six times per year) and meticulously, the Western Treatment Plant provides an excellent baseline against which trends determined from the SWCs can be assessed. For this reason, we recommend that the Western Treatment Plant should continue to be counted during the SWC, noting that this is done at no cost to DELWP or the GMA.

Table 1. Summary of Summer Waterbird Counts conducted in Victoria from 1987 to 2018

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
2017	13–24 February	127	283,430	114,463
2018	12–23 February	144	262,397	130,762
Mean		**301**	**204,801**	**116,545**

Table 2. Coverage of priority wetlands in the 2018 Summer Waterfowl Count by DELWP region

DELWP region	Number of priority wetlands	Number of priority wetlands surveyed (%)	Number of non-priority wetlands surveyed
Barwon South West	42	32 (76)	0
Gippsland	14	10 (71)	3
Grampians	37	36 (97)	3
Hume	17	14 (82)	1
Loddon Mallee	43	43 (100)	1
Port Phillip	1	1 (100)	0
All	**154**	**136 (88)**	**8**

3.5 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 (DSE 2013). Freckled Ducks are at risk of being shot during duck hunting season because they can be difficult to distinguish from Pacific Black Duck and Hardhead when flying. The GMA is keen to minimise the risk to this species during the duck hunting season.

In 2018, the number of Freckled Duck present in Victoria was the second highest on record—1658 birds counted (Table 6). They were concentrated at Lake Bael Bael in the Loddon Mallee Region, where 400 were observed early in the count and up to 1200 were counted after the SWC had finished. Smaller numbers were scattered across another 12 of the 144 wetlands counted.

3.6 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). No colony-breeding events, or incidences of large-scale moulting were reported during the 2018 SWC. Most species have typically finished moulting and breeding 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 aggregations (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.

3.7 Wetlands with high numbers of waterbirds

The wetlands that produced the highest numbers of all waterbirds during the 2018 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 large numbers of birds had large numbers of both game and non-game species. Leaving aside the WTP, Barwon South West and Loddon Mallee regions had the most waterbirds.

3.8 Further regulation of hunting activity

In 2018, information collected during the SWC contributed to decisions to further regulate hunting activity, including the closure of wetlands to duck hunting due to the presence of significant numbers of threatened species (Table 8). Other closures (and re-openings) were made progressively through the duck hunting season, but these were not based on data collected during the SWC and so are not mentioned here.

Table 3. Numbers of each game species counted in each DELWP region during the 2018 Victorian Summer Waterbird Count

Percentages are the species proportions of the total count of all eight game species. Note that the Australasian Shoveler was removed from the list of game species for the 2018 duck hunting season

DELWP region	Species								Total
	Australian Wood Duck	Australian Shelduck	Pacific Black Duck	Chestnut Teal	Grey Teal	Australasian Shoveler	Pink-eared Duck	Hardhead	
Barwon South West	70	6,887	1,507	8,682	39,462	2,499	19,086	951	79,144
Gippsland	30	60	298	1,351	354	80	0	3	2,176
Grampians	259	2,218	607	3,356	8,729	994	3,304	510	19,997
Hume	218	114	727	0	2,521	115	110	51	3,856
Loddon Mallee	1,008	1,296	526	14	24,647	552	7,380	1,303	36,726
Port Phillip	9	41,545	2,743	9,294	15,066	7,315	22,891	21,655	120,518
2018 total (% of total game birds)	**1,594 (0.6%)**	**52,120 (19.8%)**	**6,408 (2.4%)**	**22,697 (8.6%)**	**90,779 (34.6%)**	**11,555 (4.4%)**	**52,771 (20.1%)**	**24.473 (9.3%)**	**262,397 (100%)**
2017 total (% difference, 2018–2017)	**3,994 (–60%)**	**80,206 (–35%)**	**15,120 (–58%)**	**15,175 (49.6%)**	**123,754 (–26.6%)**	**8,832 (30.8%)**	**17,053 (209.4%)**	**19,296 (26.8%)**	**283,430 (–7.4%)**

Table 4. Numbers of the selected species of non-game waterbirds counted in each DELWP region during the 2018 Victorian Summer Waterbird Count

Percentages are the species proportions 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	
Barwon South West	24,540	31	1,062	869	853	5,657	3,363	158	36,533
Gippsland	259	0	12	57	120	2,412	0	0	2,860
Grampians	6,767	0	799	619	22	551	153	202	9,113
Hume	411	0	17	2	100	70	0	1	601
Loddon Mallee	16,818	237	824	912	426	2,532	205	64	22,018
Port Phillip	14,444	16	51	31,097	137	9,451	4,027	414	59,637
2017 total (%)	**63,239 (48.4%)**	**284 (0.22%)**	**2,765 (2.1%)**	**33,556 (25.7%)**	**1,658 (1.3%)**	**20,673 (15.8%)**	**7,748 (5.9%)**	**839 (0.6%)**	**130,762 (100%)**
2016 total (% difference, 2017–2016)	**36,455 (73.5%)**	**33 (760.6%)**	**14,261 (–80.6%)**	**31,046 (8.1%)**	**447 (270.9%)**	**28,831 (28.3%)**	**2,873 (169.7%)**	**517 (62.3%)**	**114,463 (14.2%)**

Table 5. Comparison of the numbers of game and selected non-game species counted statewide and at the Western Treatment Plant (WTP) in 2018

Species	Total count	WTP count	WTP %
Game species			
Australian Shelduck	52,120	41,545	80%
Australian Wood Duck	1,594	9	1%
Australasian Shoveler	11,555	7,315	63%
Chestnut Teal	22,697	9,294	41%
Grey Teal	90,779	15,066	17%
Hardhead	24,473	21,655	88%
Pacific Black Duck	6,408	2,743	43%
Pink-eared Duck	52,771	22,891	43%
Game species total	**262,397**	**120,518**	**46%**
Non-game species			
Australasian Grebe	2,765	51	2%
Black Swan	20,673	9,451	46%
Blue-billed Duck	7,748	4,027	52%
Eurasian Coot	63,239	14,444	23%
Freckled Duck	1,658	137	8%
Great Crested Grebe	284	16	6%
Hoary-headed Grebe	33,556	31,097	49%
Musk Duck	839	414	49%

Table 6. Numbers of Freckled Duck recorded during Summer Waterbird Counts, Victoria, 1987–2018.

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	1056
2014	166	18	2803
2015	126	9	258
2016	130	4	174
2017	126	20	447
2018	144	13	1658
Mean	**302**	**8.9 (se 1.1)**	**345 (se 103.6)**

Table 7. Five most populous wetlands (for the eight game and eight non-game species) in each DELWP Region in 2018.

DELWP Region	Wetland	Count
Barwon South West	Lake Kennedy	17,778
	Lake Bolac	17,756
	Lake Linlithgow	15,344
	Lake Martin	13,157
	Lake Tooliorook	9950
Gippsland	Jones Bay	9418
	Loch Sport causeway	2283
	Lake Corringle	1063
	McLeod Morass	634
	Dowd Morass	314
Grampians	Lake Buninjon	6999
	Lake Lonsdale	5365
	Booroopki Swamp	4061
	Pine Lake	4017
	Lake Fyans	2459
Hume	Racecourse wetland	2356
	Cnr Two Tree and Girgarre-Rushworth	1140
	Lake Buffalo	863
	Lake Nagambie	457
	Loch Garry	90
Loddon Mallee	Lake Bael Bael	26,254
	Lake Cullen	12,126
	First Marsh	7674
	Brickworks Billabong	5434
	Lake Elizabeth	2961
Port Phillip	Werribee Treatment Plant	180,633

Table 8. Wetland closures for the 2018 duck hunting season that were based on results of the 2018 Summer Waterbird Count.

Wetland	Trigger for closure – presence of:	Comments
Lake Linlithgow	Freckled Duck	
Lake Lonsdale	Freckled Duck	
Koorangie SGR	Freckled Duck plus Blue-billed Duck	
Browns Lake	Freckled Duck	
Lake Muirhead SGR	Flocking Brolga	
Private wetland south of Stanhope	Freckled Duck	
Lake Martin	Curlew Sandpiper	Opening weekend only
Hird Swamp SGR	Australasian Bittern	Opening weekend and western side only
Tower Hill SGR	Blue-billed Duck	Opening weekend and western side
Lake Bolac	Blue-billed Duck	Hunting from motor boats

4 Discussion

4.1 Limitations and constraints

The limitations and constraints of the SWC need to 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 declined from a peak of 786 wetlands in 1991, to 130–140 in recent years. The current level of survey effort renders meaningful statewide, year-by-year comparisons increasingly difficult. Staff are encouraged to focus available effort on those wetlands that are on public land, are open to hunting and which consistently hold large numbers of game species. This biases the data towards waterbird species that prefer large 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, which detracts from the value of the SWC as a tool for managing duck hunting.

The period over which the SWC is conducted has been reduced to 12 days in the second half of February, in order to have the counts conducted as close as possible to opening day so as to minimise error due to waterbird movements between the count and opening day. Even so, the period between the count and opening day, which is necessitated by requirements within the Victorian *Wildlife Act 1975*, was 21 days in 2018, an ample period for flocks of waterbirds to move location. This time lag remains a shortcoming in the decision-making process as it is currently structured. To minimise errors occurring, wetlands at which significant values (above-threshold numbers of threatened species, or breeding activity) were identified during the SWC were monitored by GMA or DELWP staff prior to management decisions being finalised to ensure that the issue still existed at the site.

4.2 The future

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

1. to locate flocks of threatened waterfowl or breeding aggregations of waterbirds that may warrant additional management during the coming 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 datasets are essential. Such datasets 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 WTP has been intensively monitored since 2000 (Loyn et al. 2014). On a much broader scale, the Eastern Australian Aerial 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 1500 altogether) between 1987 and 2016. The data summarised here add to the series that is used to assist future decisions about duck hunting and wetland management in the state, as envisaged by 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 further regulation of 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. SWC data have provided helpful contextual information for the interpretation of other waterfowl monitoring programs (see e.g. 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 methods adopted to assess the impact of the Victorian duck hunting season on populations of both game and non-game species.

References

DSE. (2013). *Advisory List of Threatened Vertebrate Fauna in Victoria*. Department of Sustainability and Environment, Melbourne.

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*. Arthur Rylah Institute of Environmental Research Technical Series No. 70. Department of Conservation, Forests and Lands, Melbourne.

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. *Australian 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.

Menkhorst, P., Brown, G. and Stamation, K. (2017). Victorian Summer Waterbird Count 2017. Arthur Rylah Institute for Environmental Research. Unpublished Client Report. Department of Environment, Land, Water & Planning, Heidelberg, Victoria.

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.

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 1996 Summer Waterfowl Count in Victoria*. Unpublished Report, Parks, Flora and Fauna Branch.

Norman, F.I. (1997). *A report on some results of the 1997 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, Department of Conservation and Natural Resources, Melbourne.

Pert, P. (1995). *Results of the 1995 Summer Waterfowl Count in Victoria.* Unpublished Report, Arthur Rylah Institute for Environmental Research, Department of Conservation and Natural Resources, Melbourne.

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

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

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

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

Price, R. (1993). 1993 *Summer Waterfowl Count*. Unpublished Report, Arthur Rylah Institute for Environmental Research, Department of Conservation and Natural Resources, Melbourne.

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, Department of Sustainability and Environment, Heidelberg, Victoria.

Purdey, D.C. and Loyn, R.H. (2009). *The 2009 Summer Waterbird Count in Victoria*. Unpublished Report, Biodiversity and Natural Resources Branch, Department of Sustainability and Environment, Heidelberg, Victoria.

Purdey, D.C. and Loyn, R.H. (2010). *The 2010 Summer Waterbird Count in Victoria*. Unpublished Report, Biodiversity and Natural Resources Branch, Department of Sustainability and Environment, Heidelberg, Victoria.

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, Victoria.

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 the Ecological Policy Branch, Department of Environment, Land, Water and Planning. Arthur Rylah Institute for Environmental Research, Heidelberg, Victoria.

Appendix 1: List of priority wetlands

DELWP region	Wetland name
Barwon South West	Bradys Swamp
Barwon South West	Brown Swamp
Barwon South West	Bryans Swamp
Barwon South West	Bullrush Swamp
Barwon South West	Carter Swamp
Barwon South West	Deep Lake
Barwon South West	Eurack Swamp
Barwon South West	Holdsworth Swamp
Barwon South West	Horse Poles Dam
Barwon South West	Hospital Swamp
Barwon South West	Lake Balkil Narra
Barwon South West	Lake Bolac
Barwon South West	Lake Bookar
Barwon South West	Lake Buninjon
Barwon South West	Lake Colac
Barwon South West	Lake Colongulac
Barwon South West	Lake Connewarre
Barwon South West	Lake Coradgill
Barwon South West	Lake Elingamite
Barwon South West	Lake Forest
Barwon South West	Lake Gherang
Barwon South West	Lake Kariah
Barwon South West	Lake Kennedy
Barwon South West	Lake Koreetnuug
Barwon South West	Lake Linlithgow
Barwon South West	Lake Martin
Barwon South West	Lake Muirhead
Barwon South West	Lake Murdeduke
Barwon South West	Lake Oundell
Barwon South West	Lake Pumpunal

Barwon South West	Lake Rosine
Barwon South West	Lake Round
Barwon South West	Lake Struan
Barwon South West	Lake Terang Goodwich
Barwon South West	Lake Terangpom
Barwon South West	Lake Tooliorook
Barwon South West	Lake Turangmoroke
Barwon South West	Lake Weering
Barwon South West	Lough Calvert
Barwon South West	Reedy Lake
Barwon South West	Tower Hill
Barwon South West	Walkers Swamp
Gippsland	Blond Bay SGR
Gippsland	Clydebank Morass
Gippsland	Dowds Morass SGR
Gippsland	Freshwater Swamp SGR
Gippsland	Heart Morass
Gippsland	Hollands Landing (Lagoon)
Gippsland	Jack Smith SGR
Gippsland	Lake Coleman
Gippsland	Lake Corringle
Gippsland	Lake Curlip
Gippsland	Lake Kakydra
Gippsland	Macleods Morass
Gippsland	Morleys Swamp
Gippsland	Victoria Lagoon
Grampians	Black Swamp
Grampians	Booroopki Swam
Grampians	Coghills Creek Dam
Grampians	Connan Swamp
Grampians	Dock Lake
Grampians	Harnath Swamp
Grampians	Jacka Lake
Grampians	Krause Swamp

Grampians	Lake Albacutya
Grampians	Lake Bolac
Grampians	Lake Buninjon
Grampians	Lake Burrumbeet
Grampians	Lake Carpolac
Grampians	Lake Clarke
Grampians	Lake Fyans
Grampians	Lake Goldsmith
Grampians	Lake Hindmarsh
Grampians	Lake Karnac
Grampians	Lake Kennedy
Grampians	Lake Koynock
Grampians	Lake Linlithgow
Grampians	Lake Lonsdale
Grampians	Lake Muirhead
Grampians	Lake Natimuk
Grampians	Lake Oundell
Grampians	Lake Taylor
Grampians	Lake Wongan
Grampians	McGlashins Swamp
Grampians	Merin Merin Swamp
Grampians	Pine Lake
Grampians	Shooters Swamp
Grampians	Taylors
Grampians	Toolondo Reservoir
Grampians	Wally Allans Swamp
Grampians	Waurn Swamp
Grampians	Winter Lake
Grampians	Yarrackigarra Swamp
Hume	Big Reedy Lagoon
Hume	Black Swamp (Black Dog Creek)
Hume	Black Swamp (Nine Mile Creek)
Hume	Buffalo Dam
Hume	Dowdle Swamp

Hume	Jubilee Swamp
Hume	Lake Moodemere
Hume	Lake Nagambie
Hume	Lehmann Swamp
Hume	Loch Garry
Hume	McBurney Swamp
Hume	Moodie Swamp
Hume	Morphett Swamp
Hume	Murchison Swamp
Hume	Reedy Lake Nagambie
Hume	Rowan Swamp
Hume	Tungamah Swamp
Loddon Mallee	Lake Wandella
Loddon Mallee	Browns Lake
Loddon Mallee	First Marsh
Loddon Mallee	Gaynors Swamp
Loddon Mallee	Gil Gil
Loddon Mallee	Green Lake
Loddon Mallee	Heywoods Lake
Loddon Mallee	Hird Swamp
Loddon Mallee	Horseshoe Bend Billabong
Loddon Mallee	Johnson's Swamp
Loddon Mallee	Lake Bael Bael
Loddon Mallee	Lake Batyo Catyo
Loddon Mallee	Lake Boort
Loddon Mallee	Lake Buloke
Loddon Mallee	Lake Carpul
Loddon Mallee	Lake Cooper
Loddon Mallee	Lake Coorong
Loddon Mallee	Lake Cullen
Loddon Mallee	Lake Elizabeth
Loddon Mallee	Lake Grassy
Loddon Mallee	Lake Hancock
Loddon Mallee	Lake Leaghur

Loddon Mallee	Lake Meran
Loddon Mallee	Lake Murphy
Loddon Mallee	Lake Nurrumbeet
Loddon Mallee	Lake Powell
Loddon Mallee	Lake Tutchewop
Loddon Mallee	Lake Yando
Loddon Mallee	Little Lake Buloke
Loddon Mallee	Mansfield Swamp
Loddon Mallee	McDonalds Swamp
Loddon Mallee	Meridian Basin
Loddon Mallee	Racecourse Lake
Loddon Mallee	Richardsons Lagoon
Loddon Mallee	Round Lake
Loddon Mallee	Second Marsh
Loddon Mallee	Third Marsh
Loddon Mallee	Tobacco Lake
Loddon Mallee	Walkers Lake
Loddon Mallee	Wallenjoe
Loddon Mallee	Woolshed Swamp
Loddon Mallee	Wooroonook Lake (Church)
Loddon Mallee	Wooroonook Lake (Main)
Port Phillip	Western Treatment Plant

Appendix 2: Other wetlands surveyed

DELWP region	**Wetland name**
Gippsland	Loch Sport
Gippsland	Mitchell River silt jetty
Grampians	Freshwater Lake, Dunkeld
Grampians	Clear Lake
Grampians	Unnamed SW of Kiora Lane & Maroona Rd junction
Hume	Unnamed cnr Two Tree Rd and Girgarre–Rushworth Rd
Loddon Mallee	Brickworks Billabong