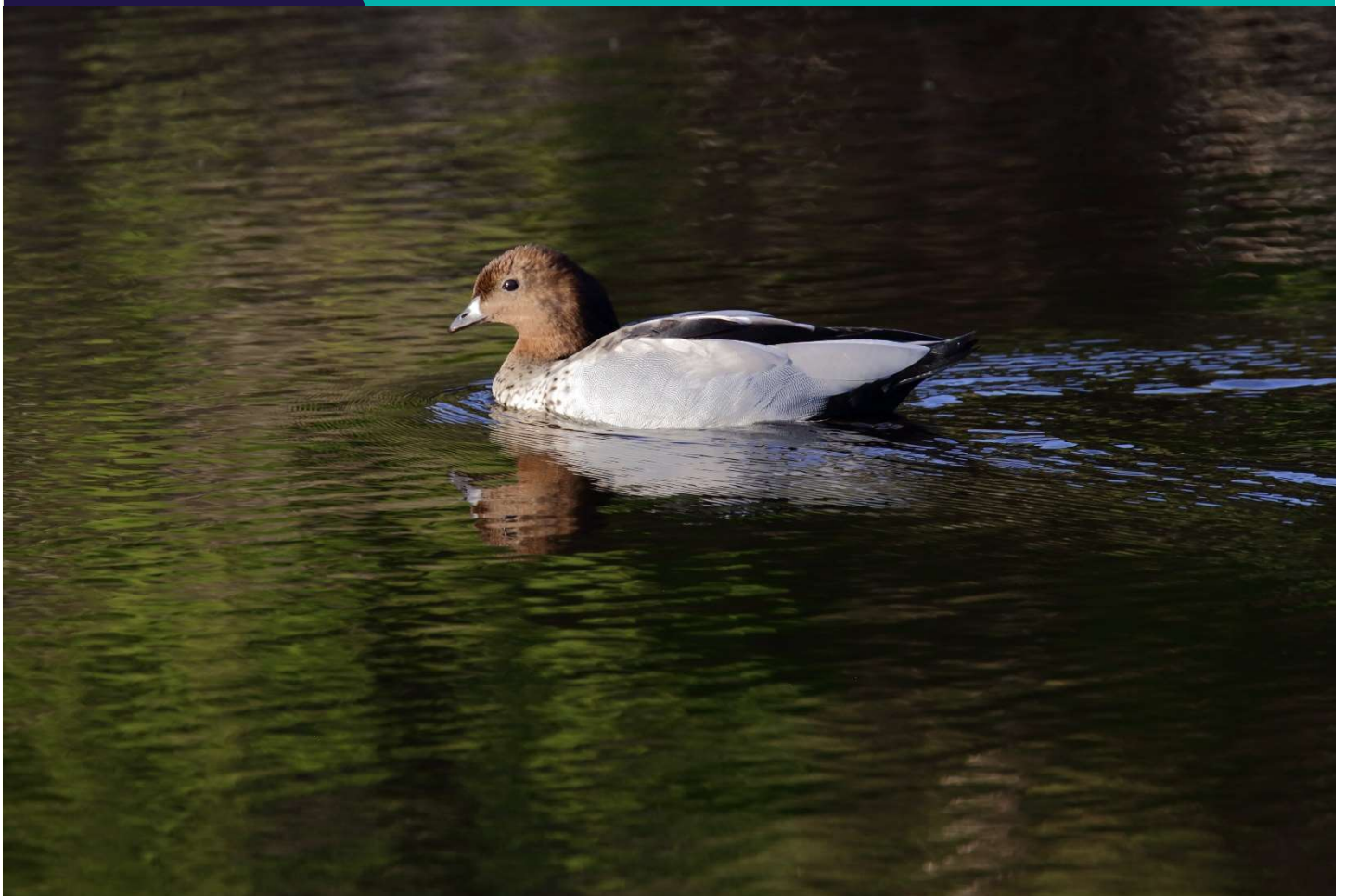




Victorian Duck Season Priority Waterbird Count, 2020

P. Menkhorst, K. Stamation and T.A.M. Eketone

June 2020



Arthur Rylah Institute for Environmental Research
Client Report

Acknowledgment

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it. We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

We are committed to genuinely partner, and meaningfully engage, with Victoria's Traditional Owners and Aboriginal communities to support the protection of Country, the maintenance of spiritual and cultural practices and their broader aspirations in the 21st century and beyond.



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Summary

Context

The Victorian Duck Season Priority Waterbird Count is a statewide survey of selected waterbird species on priority duck hunting wetlands. It is conducted each year in the lead up to the Victorian duck hunting season. The 2020 count was severely limited by travel restrictions enacted to help control the COVID-19 pandemic, and by uncertainty about whether a duck hunting season would be possible. The 2020 count also introduced a change in priority for non-game species of waterbird. Instead of counting eight focal non-game species, priority was given to 12 threatened species that are considered susceptible to misidentification and being inadvertently shot, or to undue disturbance during duck hunting.

Aims

The Duck Season Priority Waterbird Count gathers numerical, locational and breeding data about game ducks and threatened waterbirds to inform management decisions regarding the forthcoming duck hunting season. Specifically, the aims are:

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

Implementation

The start of the 2020 duck hunting season was delayed because of low game duck numbers and continued drought across large parts of eastern Australia which reduced habitat for waterbirds in Victoria. The season opened on 2 May rather than the third Saturday of March, however, opportunities for hunting were reduced by travel restrictions due to the COVID-19 pandemic. These travel restrictions also interfered with the capacity of departmental staff to survey wetlands. Consequently, only 59 (39%) of the 151 priority wetlands were visited. Twenty-seven (46%) of the counted wetlands were dry at the time of the count meaning that actual counts of waterbirds were made at only 32 wetlands.

Key results

In 2020, the total count of ducks belonging to the eight game species was 3,250, 1.6% of the 34-year mean. This aberrant level of coverage renders the data meaningless for use in analysis of long-term trends.

The finding of at least 25 Australasian Bitterns at Reedy Lake on 28 April 2020 represents one of the largest aggregations of this species reported in Victoria.

Based on data collected during the survey and on follow-up visits, extra management actions were enacted for five wetlands – two were closed to duck hunting and two were partially closed, while hunting from boats was prohibited at another.

Conclusions and implications

1. The 2020 Duck Season Priority Waterbird Count were severely affected by the unique circumstances caused by the COVID-19 pandemic. While useful for identifying some wetlands where extra management actions were considered necessary, the data have limited value to contribute to analyses of longer-term trends in waterbird populations.

Introduction

Project context

Annual counts of waterbirds in the lead-up to the opening of duck hunting season have been conducted at wetlands across Victoria since 1987. The counts were instigated following 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 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 counts 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. Data collected during the pre-duck season counts have also proven to be valuable for other purposes, including informing the development of management plans for Ramsar sites and individual wetlands, and monitoring population trends of individual species.

In 2015, a new approach was introduced that limited survey coverage to wetlands that have been historically important duck hunting sites on public land, or have a history of supporting threatened waterbird species, rather than including any wetland, regardless of hunting status. There has also been an increasing emphasis on broadening the focus of the surveys to include all threatened waterbirds, rather than only threatened duck species. This change reflects a concern that duck hunting could have more nuanced impacts on waterbirds apart from direct mortality (Menkhorst 2019). This changed approach is reflected in the list of target species, as well as the change of name of the count to Duck Season Priority Waterbird Count (DSPWC) and adjusting the layout of the field data sheet.

Thus, the objectives of the 2020 DSPWC were to:

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

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 these annual counts 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 reports (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, 2018, 2019).

Methods

Survey methods

Most wetlands were surveyed by staff from either the Department of Environment, Land, Water and Planning (DELWP) or the Game Management Authority, and a small number were independently surveyed (or partially surveyed) voluntarily by interested members of the public. 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 reference or nearest town as a guide), date, time, priority species present and number of individuals of each species. At each wetland, an estimate of water level was taken (as a percentage of its full supply level) and, if the entire wetland could not be surveyed, an estimate was sought of the proportion of the wetland that was surveyed. Observations of breeding by any waterbird species were also recorded, including numbers of broods or nests (and contents where appropriate). Wetlands that were found to be dry, or almost so, were generally not formally surveyed but were simply noted to be not supporting waterbirds.

Survey organisation

The count 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 has only one priority wetland (the Western Treatment Plant), no coordinator is 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, Blue-billed 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 possible. 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.

Count dates

The period over which the count is conducted has been reduced to 12 days with the end date being as close as possible to opening day of the duck season, while allowing sufficient time for a preliminary review of the data, followed by implementation of the legal mechanisms required for any proposed management actions. This timing helps 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 to implement legal mechanisms under the Victorian *Wildlife Act 1975*, was 21 days in 2020, an ample period for flocks of waterbirds to change location. To minimise the chance of errors due to waterbird movements, wetlands at which significant values (i.e. numbers of a threatened species above the threshold, or significant breeding activity) were identified during the count were monitored by GMA or DELWP staff prior to management decisions being finalised (i.e. in 2020, until publication in the *Victorian Government Gazette* of 12 May 2020) to ensure that the issue still existed at the site. Further targeted monitoring by GMA or DELWP staff took place throughout the duck hunting season to assess the need for further management intervention, such as further closures or re-openings.

The 2020 Victorian duck hunting season was shortened due to the on-going drought conditions which resulted in reduced habitat availability and low duck numbers in the State and throughout eastern Australia (https://www.gma.vic.gov.au/data/assets/pdf_file/0019/525007/2020-Duck-season-fact-sheet.pdf). The 2020 duck hunting season was originally announced to run from 2 May until 8 June. Thus,

this year's Duck Season Priority Waterbird Count was originally set for the period 30 March-12 April. However, travel restrictions imposed during the COVID-19 pandemic effectively meant that travel to wetlands for the purpose of recreational hunting was illegal. At the start of the season on 2 May, hunting could only occur on a hunter's own property. Therefore, there was considerable uncertainty about whether duck hunting could take place at all on public wetlands and waterways and whether or not a pre-season waterbird count was required. Consequently, some DELWP regions did not commit to a full count until it was deemed likely that COVID travel restrictions would be eased during the approved duck season period. COVID travel restrictions were ultimately eased on 13 May which meant that duck hunting could occur between 13 May and 8 June 2020, a period of four weeks.

A reduced waterbird count was conducted during the original period (first two weeks of April) and a preliminary report was distributed to key agency staff on 16 April. However, because there was no start to duck hunting on public lands on 2 May, the information contained in the first report became somewhat outdated because no hunting could occur on public lands until after 12 May when travel restrictions were relaxed. Therefore, a second round of surveys took place between 22 and 30 April, including revisiting sites identified in the first preliminary report as supporting bird populations of interest. This final report presents the results of both rounds of surveys.

Wetlands surveyed

The list of the 151 priority wetlands for 2020 is provided in Appendix 1. A list of other wetlands surveyed in 2020 is provided in Appendix 2.

Species counted and analysed

Under the revised priorities for the DSPWC, priority is given to counting the eight game species plus 12 rare or threatened non-game species that were identified as being particularly susceptible to the sorts of disturbance associated with duck hunting (Menkhorst 2019) (Table 1). Other waterbird species are also counted as time permits. This is a significant change from previous Summer Waterbird Counts which targeted the eight game species plus eight non-game species, including some abundant species such as Black Swan, Eurasian Coot and Hoary-headed Grebe.

Table 1. The priority species for the 2020 Duck Season Priority Waterbird Count. * Note that the Australasian Shoveler was a prohibited species during the 2020 duck hunting season.

	English name	Scientific name
Game species		
	Australian Shelduck	<i>Tadorna tadornoides</i>
	Australian Wood Duck	<i>Chenonetta jubata</i>
	Australasian Shoveler*	<i>Anas rhynchotis</i>
	Chestnut Teal	<i>Anas castanea</i>
	Grey Teal	<i>Anas gracilis</i>
	Hardhead	<i>Aythya australis</i>
	Pacific Black Duck	<i>Anas superciliosa</i>
	Pink-eared Duck	<i>Malacorhynchus membrabaceus</i>
Non-game species		
	Australian Painted-snipe	<i>Rostratula australis</i>
	Australasian Bittern	<i>Botaurus poiciloptilus</i>
	Blue-billed Duck	<i>Oxyura australis</i>
	Brolga	<i>Grus rubicunda</i>
	Curlew Sandpiper	<i>Calidris ferruginea</i>
	Freckled Duck	<i>Stictonetta naevosa</i>
	Great Egret	<i>Ardea alba</i>
	Intermediate Egret	<i>Egretta intermedia</i>
	Latham's Snipe	<i>Gallinago hardwickii</i>
	Little Egret	<i>Egretta garzetta</i>
	Magpie Goose	<i>Anseranas semipalmata</i>
	Musk Duck	<i>Biziura lobata</i>

Results

Number of wetlands counted

The 2020 DSPWC contributes to a dataset now spanning the 34 years from 1987. However, due to the complications imposed by the COVID-19 pandemic, the survey coverage achieved during 2020 was significantly reduced – only 59 (39%) of the 151 priority wetlands were visited (see Appendix 1). A further three non-priority wetlands were also surveyed (Appendix 2). Twenty-seven (46%) of the counted wetlands were dry at the time of the count meaning that actual counts of waterbirds were made at only 32 wetlands. A further 12 priority wetlands were known to be dry before the count began and therefore were not visited.

Table 2 provides the annual total count for each of the eight game and eight non-game waterbird species targeted in previous Summer Waterbird Counts, 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 144 wetlands (apart from 2020 which suffered from exceptional circumstances as discussed above).

The numbers of priority wetlands in each DELWP region and the number that were surveyed in 2020 are shown in Table 3. The DELWP Grampians Region did not participate in the survey, despite having the equal highest number of priority wetlands.

Game species

In 2020, the total count of ducks belonging to the eight game species was 3,250, 1.6% of the 34-year mean (Table 2). Given the poor coverage achieved there is little value in comparisons with previous years. Instead the relative proportions of game species counted are provided: four species made up 83% of the game ducks counted – Australian Shelduck (22.9%), Chestnut Teal (21.5%), Grey Teal (23.3%) and Pacific Black Duck (15.5). The remaining 17% was comprised of the other four game species (Australian Wood Duck, Australasian Shoveler, Hardhead and Pink-eared Duck).

Threatened waterbirds considered sensitive to disturbance

Australasian Bittern

The finding of at least 25 Australasian Bitterns at Reedy Lake on 28 April 2020 represents one of the largest aggregations of this species reported in Victoria. The Australasian Bittern is listed as threatened under the Victorian *Flora and Fauna Guarantee Act 1988* and endangered under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The birds were flushed during a 3 hr, 2.5 km wading transect along the western shore (Figures 1 and 2). All bitterns were flushed from a band of *Bolboschoenus caldwellii* growing in water of 20-50 cm depth (Figure 1). Reedy Lake had received an environmental water allocation during the 2019-2020 summer and this, combined with good autumn rainfall, is likely to have provided excellent habitat conditions for Australasian Bittern. There is also evidence of a coastward movement of Australasian Bitterns after the breeding season (October – February) (Herring et al. 2016). This behaviour increases the likelihood of bitterns being present at southern Victorian wetlands during duck hunting season.

Blue-billed Duck

The Blue-billed Duck is a non-game species that is of particular concern because it is listed as threatened under the *Flora and Fauna Guarantee Act 1988* and has been classified as Vulnerable (DSE 2013). As in previous years, large flocks of Blue-billed Duck were present at Lake Bolac (over 2000) with smaller numbers at Lake Lonsdale and Tower Hill State Game Reserve.



Figure 1. Australasian Bittern habitat, Reedy lake 28 April 2020. The bitterns were concentrated in a band of *Bolboschoenus caldwellii* – the lower, browner vegetation growing between the open water and the taller, denser *Phragmites australis* on the far right.



Figure 2. The route taken during the Australasian Bittern survey at Reedy lake, 28 April 2020, as mapped by the ebird app (courtesy of Guy Dutson). The entire route was flooded with water to a depth of 20-40 cm.

Brolga

In Victoria, the Brolga is listed as threatened under the Victorian *Flora and Fauna Guarantee Act 1988*. In south-eastern Australia, Brolgas breed as isolated pairs mostly between July and December. Following breeding, and as the shallow freshwater marshes dry in late summer-autumn, Brolgas gather at a few traditional wetlands (Sheldon 2005) as part of their pair bonding and social learning behaviour. These gatherings, which, in Victoria, can involve up to 100 individuals, are thought to be important in the social life of a regional Brolga population and should not be unduly disturbed. An aggregation of 36 Brolgas was present at Greens Swamp (near Glen Thompson) on 5 March 2020.

Freckled Duck

The Freckled Duck 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.

During the 2020 DSPWC, Freckled Duck were in very low numbers in Victoria and only one individual was counted, the lowest count in the 34-year history of pre-duck season counts (Table 4). Prior to the survey, on 24 March 2020, 52 Freckled Ducks, including 17 recently fledged juveniles, were counted at Middle Reedy Lake, Kerang (not available for duck shooting) including a group of juveniles that were barely able to fly and therefore can be assumed to have hatched on that wetland. There are very few records of Freckled Ducks breeding in Victoria, the previous most recent being in the 1980s (DSE 2004).

Breeding and moulting

The DSPWC 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 2020 DSPWC and the late starting date would make this even less likely than normal.

Further regulation of hunting activity

In 2020, information collected during the DSPWC contributed to decisions to further regulate hunting activity, including the complete closure of two wetlands to duck hunting and partial closure of two others due to the presence of significant numbers of threatened species. At one large wetland, hunting from boats was prohibited to provide refuge beyond the range of shore-based hunters for large numbers of Blue-billed Duck.

Table 2. Summary of Summer Waterbird Counts conducted in Victoria from 1987 to 2020

Year	Count period	Number of wetlands surveyed	Total count of game species	Total count of focal 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

Year	Count period	Number of wetlands surveyed	Total count of game species	Total count of focal non-game species
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
2019	11–22 February	135	225,733	85,889
2020	30 March–12 April; 22–30 April	62	3,250	10,093
Mean		284	201,183	112,930

Table 3. Coverage of priority wetlands in the 2020 Victorian Duck Season Priority Waterbird Count by DELWP region.

Note that the reason for not surveying many of the priority wetlands is that they were known to be dry.
 * the delayed starting date in 2020 meant that the Western Treatment Plant was counted outside the count period, in February, as required under the ARI contract with Melbourne Water.

DELWP region	Number of priority wetlands	Number of priority wetlands surveyed (%)	Number of non-priority wetlands surveyed
Barwon South West	34	4	0
Gippsland	15	3	1
Grampians	42	0	0
Hume	18	18	0
Loddon Mallee	42	34	2
Port Phillip	1	0*	0
All	152	59 (39)	3

Table 4. Numbers of Freckled Duck recorded during Summer Waterbird Counts, 1987–2020

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
2019	135	10	960
2020	62	1	1
Mean	288	8.9	364

Discussion

The summer and autumn of 2020 continued a run of very dry years and almost half of the visited wetlands were dry (during late March and April) and duck numbers were very low. Consequently, during the duck season waterbirds were concentrated on a smaller number of large, more permanent wetlands. This situation risks increasing the proportion of available birds harvested because hunters are concentrated on fewer wetlands.

Limitations and constraints

The limitations and constraints of the DSPWC 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 125–140 in recent years. The current level of survey effort renders meaningful statewide, year-by-year comparisons increasingly difficult. Further, regional organisers are encouraged to focus survey 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 (such as Hardhead, Blue-billed Duck, Eurasian Coot and Hoary-headed Grebe), and against those species that prefer shallower, ephemeral and more highly vegetated wetlands (such as teal, Pink-eared Duck and bitterns). Furthermore, as survey coverage decreases, the chances of the survey failing to record aggregations of significant species increases, which compromises the value of the DSPWC as a tool for informing the management of duck hunting.

The 2020 count was severely constrained by restrictions and uncertainties associated with the COVID-19 pandemic. Therefore, the results should be considered an aberration and not be included in any future long-term analyses.

The future

The original Summer Waterbird Count (now DSPWC) 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).

Long-term datasets are essential to tease out the relative importance of these climatic influences, compared to immediate human impacts, such as hunting and the provision of environmental water. 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 (EAAWS), 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>). However, the aerial census lines used in the EAAWS are widely spaced (2 degrees of latitude or approximately 168 km in Victoria) and thus many important Victorian wetlands are not covered.

The SWC (now DSPWC) adds a broad perspective to our understanding of waterbird numbers and distribution within Victoria, with data having been collected from a large number of wetlands (~125–140 annually, and approximately 1,500 altogether) between 1987 and 2020. The data summarised here add to the series that is used to assist decision making 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 or total species diversity. While the primary aim is to identify wetlands that warrant consideration for further regulation of hunting (objective 1), it also has value as an index of abundance for comparisons between years (objective 2), for example, Murray et al. (2012).

As well as informing the further regulation of hunting, SWC data have proved helpful in other waterfowl monitoring programs (e.g. Pacioni et al. 2017, and BirdLife Australia's Australian Waterbird Index project).

The switch from reporting on eight focal non-games species to 12 threatened species considered susceptible to disturbance is a pragmatic decision that reflects the declining capacity of DELWP to achieve adequate coverage for meaningful state-wide monitoring of waterbirds in general. Rather, it encourages the collection of data with immediate application to reducing the impacts of duck hunting on non-game species.

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Appendix 1: List of Priority Wetlands for the Victorian Duck Season Priority Waterbird Count 2020

DELWP region	Wetland name	Latitude	Longitude	Counted	Dry at Count
Barwon South West	Brown Swamp	-38.27	144.13	N	
Barwon South West	Bryans Swamp	-37.56	142.27	N	
Barwon South West	Bullrush Swamp	-37.77	142.23	N	
Barwon South West	Carter Swamp	-38.24	143.30	N	
Barwon South West	Cundare Pool	-38.09	143.59	N	
Barwon South West	Deep Lake (Nerrin Nerrin)	-37.79	143.04	N	
Barwon South West	Deep Lake (Derrinallum)	-37.93	143.17	N	
Barwon South West	Eurack Swamp	-38.13	143.70	N	
Barwon South West	Horse Poles Dam	?	?	N	
Barwon South West	Hospital Swamp	-38.23	144.41	N	
Barwon South West	Krause Swamp (e. of Bulrush Swamp)	-37.76	142.25	N	
Barwon South West	Lake Balkil Narra	-38.125	143.373	N	
Barwon South West	Lake Bookar	-38.13	143.12	N	
Barwon South West	Lake Colac	-38.30	143.59	N	
Barwon South West	Lake Colongulac	-38.17	143.16	N	
Barwon South West	Lake Connewarre	-38.23	144.45	N	
Barwon South West	Lake Coradgill	-38.11	143.36	N	
Barwon South West	Lake Elingamite	-38.35	143.01	N	
Barwon South West	Lake Gherang	-38.25	144.06	N	
Barwon South West	Lake Kariah	-38.17	143.21	N	
Barwon South West	Lake Koreetnung	-38.18	143.24	N	
Barwon South West	Lake Linlithgow	-37.75	142.22	Y	
Barwon South West	Lake Martin	-38.07	143.58	N	
Barwon South West	Lake Murdeduke	-38.17	143.89	N	
Barwon South West	Lake Pumpunal	?	?	N	
Barwon South West	Lake Rosine	-38.03	143.57	N	
Barwon South West	Lake Round	-38.13	143.21	N	
Barwon South West	Lake Struan	-38.01	143.42	Y	
Barwon South West	Lake Terang Goodwich	-38.12	143.37	N	
Barwon South West	Lake Terangpom	-38.13	143.32	N	
Barwon South West	Lake Weering	-38.08	143.68	N	
Barwon South West	Lough Calvert	-38.18	143.69	N	
Barwon South West	Reedy Lake (Geelong)	-38.21	144.42	Y	
Barwon South West	Tower Hill	-38.32	142.36	Y	

DELWP region	Wetland name	Latitude	Longitude	Counted	Dry at Count
Gippsland	Blond Bay SGR	-38.01	147.52	Y	
Gippsland	Clydebank Morass	-38.04	147.22	N	
Gippsland	Dowds Morass SGR	-38.14	147.23	N	
Gippsland	Freshwater Swamp SGR	-38.56	146.96	N	
Gippsland	Heart Morass	-38.12	147.20	N	
Gippsland	Hollands Landing (Lagoon)	-38.06	147.45	N	
Gippsland	Jack Smith SGR	-38.50	147.00	N	
Gippsland	Lake Coleman	-38.16	147.33	N	
Gippsland	Lake Corringale	-37.78	148.49	N	
Gippsland	Lake Curlip	-37.75	148.57	N	
Gippsland	Lake Kakydra	-38.07	147.20	N	
Gippsland	Lake Wat Wat	-37.76	148.52	Y	
Gippsland	Macleods Morass	-37.84	147.63	Y	
Gippsland	Morleys Swamp	-38.09	147.44	N	
Gippsland	Victoria Lagoon	-38.04	147.45	N	
Grampians	Black Swamp (Balmoral)	-37.22	141.83	N	
Grampians	Boorookpi Swamp	-36.73	141.22	N	
Grampians	Bradys Swamp	-37.59	142.45	N	
Grampians	Coghills Creek Dam	-37.39	143.75	N	
Grampians	Connan Swamp	-36.69	141.79	N	
Grampians	Dock Lake	-36.77	142.30	N	
Grampians	Greens Swamp Wildlife Reserve	-37.00	141.78	N	
Grampians	Harnath Swamp	?	?	N	
Grampians	Holdsworth Swamp	-37.70	143.01	N	
Grampians	Jacka Lake	-36.80	141.81	N	
Grampians	Lake Albacutya	-35.75	141.97	N	
Grampians	Lake Batyo Catyo	-36.52	142.94	N	
Grampians	Lake Bolac	-37.72	142.88	N	
Grampians	Lake Buninjon	-37.48	142.78	N	
Grampians	Lake Burrumbeet	-37.50	143.64	N	
Grampians	Lake Carpolac	-36.85	141.32	N	
Grampians	Lake Clarke	-36.87	141.86	N	
Grampians	Lake Coorong	-35.73	142.40	N	
Grampians	Lake Fyans	-37.14	142.63	N	
Grampians	Lake Goldsmith	-37.54	143.36	N	
Grampians	Lake Hancock	-36.54	142.93	N	
Grampians	Lake Hindmarsh	-36.04	141.91	N	

DELWP region	Wetland name	Latitude	Longitude	Counted	Dry at Count
Grampians	Lake Karnac	-36.83	141.51	N	
Grampians	Lake Kennedy	-37.77	142.18	N	
Grampians	Lake Koynock	-36.82	141.51	N	
Grampians	Lake Lonsdale	-37.03	142.63	N	
Grampians	Lake Muirhead	-37.49	142.61	N	
Grampians	Lake Natimuk	-36.70	141.94	N	
Grampians	Lake Oundell	-37.75	143.02	N	
Grampians	Lake Turangmoroke	-37.73	142.89	N	
Grampians	Lake Wongan	-37.61	143.15	N	
Grampians	McGlashins Swamp	-37.09	141.76	N	
Grampians	Merin Merin Swamp	-37.23	143.80	N	
Grampians	Pine Lake	-36.79	142.35	N	
Grampians	Shooters Swamp	-37.50	142.77	N	
Grampians	Taylors Swamp (nr. Lake Wongan)	-37.63	143.09	N	
Grampians	Toolondo Reservoir	-37.02	141.95	N	
Grampians	Walkers Swamp	-37.57	142.48	N	
Grampians	Wally Allans Swamp	-36.77	141.48	N	
Grampians	Waurin Swamp	-36.70	141.21	N	
Grampians	Winter Lake	-36.88	141.27	N	
Grampians	Yarrackigarra Swamp	-36.72	141.24	N	
Hume	Big Reedy Lagoon	-35.98	145.92	Y	Y
Hume	Black Swamp (Black Dog Creek)	-36.16	146.32	Y	Y
Hume	Black Swamp (Nine Mile Creek)	-36.14	145.45	Y	Y
Hume	Buffalo Dam	-36.71	146.66	Y	
Hume	Doctors Swamp	-36.62	145.18	Y	Y
Hume	Dowdle Swamp	-36.10	146.03	Y	Y
Hume	Jubilee Swamp	-36.57	145.76	Y	Y
Hume	Lake Moodemere	-36.05	146.39	Y	
Hume	Lake Nagambie	-36.78	145.14	Y	
Hume	Lehmann Swamp	-36.56	145.61	Y	Y
Hume	Loch Garry	-36.23	145.31	Y	Y
Hume	McBurney Swamp	-36.58	145.56	Y	Y
Hume	Moodie Swamp	-36.23	145.79	Y	Y
Hume	Morphett Swamp	-36.54	145.78	Y	Y
Hume	Reedy Lake (Nagambie)	-36.72	145.10	Y	
Hume	Reedy Swamp (Shepparton)	-36.34	145.36	Y	
Hume	Rowan Swamp	-36.29	145.98	Y	Y
Hume	Tungamah Swamp	-36.15	145.92	Y	Y

DELWP region	Wetland name	Latitude	Longitude	Counted	Dry at Count
Loddon Mallee	Browns Lake	-36.46	143.03	Y	Y
Loddon Mallee	First Marsh	-35.64	143.74	Y	Y
Loddon Mallee	Gaynors Swamp	-36.52	144.83	N	
Loddon Mallee	Green Lake (north of Lake Cooper)	-36.44	144.84	N	
Loddon Mallee	Heywoods Lake	-34.79	143.21	Y	Y
Loddon Mallee	Hird Swamp	-35.86	144.09	Y	Y
Loddon Mallee	Horseshoe Bend Billabong	-34.14	142.06	Y	
Loddon Mallee	Johnson's Swamp	-35.82	144.07	N	
Loddon Mallee	Lake Bael Bael	-35.69	143.74	Y	Y
Loddon Mallee	Lake Boort	-36.13	143.74	Y	Y
Loddon Mallee	Lake Buloke	-36.27	142.96	Y	Y
Loddon Mallee	Lake Carpul	-34.73	142.89	Y	Y
Loddon Mallee	Lake Cooper	-36.50	144.81	N	
Loddon Mallee	Lake Cullen	-35.64	143.77	Y	
Loddon Mallee	Lake Elizabeth	-35.70	143.82	Y	
Loddon Mallee	Lake Gil Gil	-36.33	143.04	Y	Y
Loddon Mallee	Lake Grassy	-36.46	143.06	Y	Y
Loddon Mallee	Lake Leaghur	-35.98	143.80	Y	Y
Loddon Mallee	Lake Meran	-35.88	143.81	Y	
Loddon Mallee	Lake Murphy	-35.81	143.87	Y	Y
Loddon Mallee	Lake Nurrumbet	-36.47	143.06	Y	Y
Loddon Mallee	Lake Powell	-34.70	142.88	Y	Y
Loddon Mallee	Lake Tutchewop	-35.51	143.75	Y	Y
Loddon Mallee	Lake Wallenjoe	-36.48	144.88	N	
Loddon Mallee	Lake Wandella	-35.74	143.88	Y	Y
Loddon Mallee	Lake Yando	-36.04	143.78	Y	Y
Loddon Mallee	Little Lake Buloke	-36.32	142.95	Y	Y
Loddon Mallee	Little Lake Meran	-35.85	143.82	Y	
Loddon Mallee	Mansfield Swamp	-36.44	144.88	N	
Loddon Mallee	McDonalds Swamp	-35.70	144.07	N	
Loddon Mallee	Meridian Basin	-34.26	141.98	Y	Y
Loddon Mallee	Racecourse Lake	-35.61	143.79	Y	
Loddon Mallee	Richardsons Lagoon	-36.03	144.57	Y	Y
Loddon Mallee	Round Lake 1 (west of Lake Boga)	-35.47	143.61	Y	
Loddon Mallee	Round Lake 2 (n. of Lake Meran)	-35.85	143.80	Y	
Loddon Mallee	Second Marsh	-35.62	143.74	Y	Y
Loddon Mallee	Third Marsh	-35.60	143.73	Y	Y

DELWP region	Wetland name	Latitude	Longitude	Counted	Dry at Count
Loddon Mallee	Tobacco Lake	-35.86	143.80	Y	Y
Loddon Mallee	Vinifera Billabong	-35.20	143.40	Y	Y
Loddon Mallee	Woolshed Swamp	-36.17	143.72	Y	Y
Loddon Mallee	Wooroonook Lake (Church)	-36.27	143.21	Y	Y
Loddon Mallee	Wooroonook Lake (Main)	-36.27	143.20	N	
Port Phillip	Western Treatment Plant	-37.99	144.60	N	

Appendix 2: Other Wetlands Surveyed During the Victorian Duck Season Priority Waterbird Count 2020

DELWP Region	Wetland Name
Gippsland	Newmerella Sewage Farm
Loddon Mallee	Lake Gilmour
Loddon Mallee	Walkers Lake

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