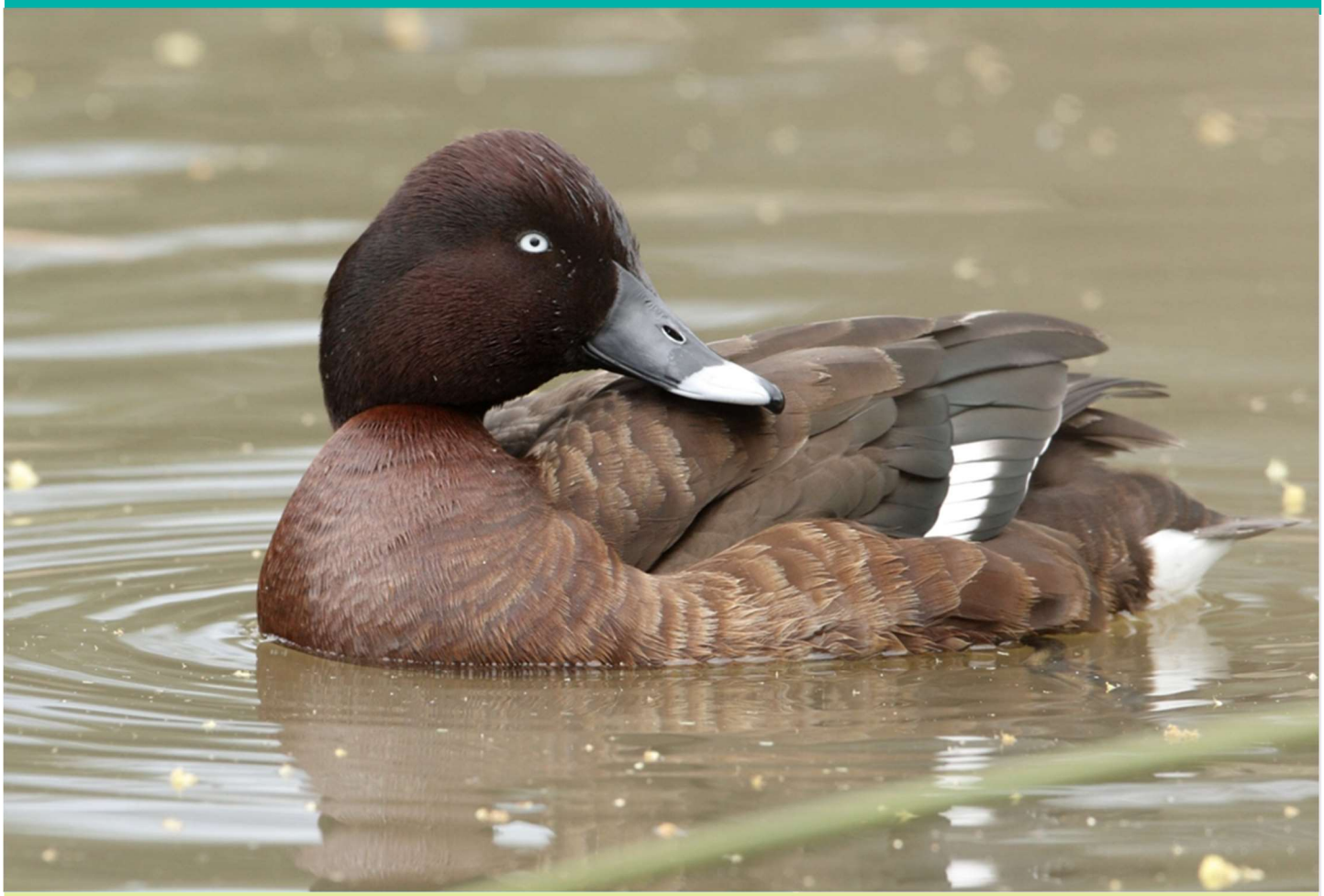
Hunters' Bag Survey:
2019 Victorian duck hunting season

P. Menkhorst, K. Stamation and G. Brown

August 2019



Arthur Rylah Institute for Environmental Research

Unpublished Report to Ecological Policy Section, DELWP

Arthur Rylah Institute for environmental research

VICTORIA State Government | Environment, Land, Water and Planning

Acknowledgements

Funding for preparation of this report was provided by the Ecological Policy Section of the Department of Environment, Land, Water and Planning. We are grateful to Kirsty Greengrass and Louise Thompson, Biodiversity Policy and Regulation for this support.

Thanks are due to those hunters who freely allowed inspection of their bags. The Hunters' Bag Survey is a collaborative effort involving staff from several Government agencies – the Victorian Game Management Authority, Department of Environment, Land, Water and Planning, and Department of Jobs, Precincts and Regions – we thank those agencies for their cooperation, and all staff involved.

Helpful comments on a draft were provided by Ashley Sparrow (ARI), Louise Thompson (DELWP Ecological Policy) and Zac Powell (GMA).

Report produced by:
Peter Menkhorst, Kasey Stamation and Geoff Brown
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., Stamation, K. and Brown, G. (2019) Hunters' Bag Survey: 2019 Victorian duck hunting season. Arthur Rylah Institute for Environmental Research. Unpublished Report to Ecological Policy Section, Department of Environment, Land, Water & Planning, Melbourne, Victoria

Front cover photo: A male Hardhead (photographer: P. Menkhorst)

Contents

Summary

Estimating the numbers of ducks taken by hunters is an important component of assessing the impact of the duck hunting season on populations of game species. One method of sampling the level of take by hunters is to conduct surveys of hunters' bags, that is, to examine carcasses in the possession of hunters after a hunting session. Such surveys have been conducted during opening weekend at Victorian wetlands in 41 of the 47 years since 1972 (the exceptions are mostly years in which no hunting season was declared). Hunters' bag surveys aim to determine both hunter success and the species, sex and age composition of birds shot during opening weekend. In addition to checking species in hunters' possession, whole wings and all tail feathers were collected from a sample of birds for later examination to estimate the frequency of wing moult (primary and secondary feathers), and to estimate the proportion of immature birds and the sex ratio of the sample.

Important improvements to survey design and instructions to surveyors were introduced for the 2019 survey and these are partially evaluated.

Key Findings

- Hunter success in the sample analysed across opening weekend was 1.1 birds per hunter, less than half the long-term mean bag size of 2.8 and the lowest success rate on record (n=40 years).
- The collection and retention of wings and tail feathers for later analysis was well-received by hunters. This approach resulted in much increased confidence in the resulting estimates of age class and sex ratio than was the case under the previous method of scoring these parameters in the field.
- There had clearly been successful breeding in the months prior to the season opening, with over one quarter of bagged birds being juvenile.
- Grey Teal and Pacific Black Duck were the most numerous species in hunters' bags during opening weekend of the 2019 duck hunting season, comprising 34.4% and 28.1% respectively of the 1154 birds examined. Two other species (Australian Wood Duck and Chestnut Teal) made up most of the remainder (35.4%). Together, these four species accounted for 97.9% of the bagged sample. The species composition in hunters' bags was similar to that of past seasons although the proportions of Chestnut Teal and Pacific Black Duck were above average.

Recommendations

- The annual Hunters' Bag Survey plays an important role in monitoring the impact of the duck season on game species because it is the only means of gathering biological data about the birds that are harvested.
- The new system of collecting wings and tail feathers for later analysis should be maintained but needs to be expanded if the new sampling protocols are to be met. Additional staff of DELWP and GMA should be trained in its use.
- The new state-wide sampling protocol will bring considerable benefits through ensuring a more representative and adequate sample, however, it will require greater resourcing than has been available in recent years.

1 Introduction

Duck hunting is provided for under the Victorian *Wildlife Act* 1975 and regulated under the Wildlife (Game) Regulations 2012. In Victoria, eight duck species are declared game species: Australasian Shoveler *Anas rhynchotis*, Australian Shelduck *Tadorna tadornoides*, Australian Wood Duck *Chenonetta jubata*, Chestnut Teal *Anas castanea*, Grey Teal *Anas gracilis*, Hardhead *Aythya australis*, Pink-eared Duck *Malacorhynchus membranaceus* and Pacific Black Duck *Anas superciliosa*.

Estimating the daily take by hunters is an important component of assessing the impact of an open season on populations of game species. One method of estimating the level of take by hunters is to conduct surveys of hunters' bags, i.e. to examine carcasses possessed by hunters as they return to their camp or vehicle after a hunt. Such surveys (hereafter called Hunters' Bag Surveys) have been conducted on opening weekend at Victorian wetlands in 41 of the 47 years since 1972 (5 of the 6 exceptions were years in which no open season was declared). The aims of the Hunters' Bag Survey are to:

- estimate the number of birds taken on opening weekend,
- estimate hunter success during opening weekend,
- determine the species, sex and age composition of birds shot during opening weekend,
- determine the incidence of birds actively moulting flight feathers at the time.

Moulting of flight feathers can be a management issue when flocks of flightless moulting birds may be vulnerable to over-harvesting. The Australian Shelduck, in particular, gathers to moult at specific locations in mid-summer (Frith 1982) and this is one reason for holding the hunting season during autumn when most birds have completed their moult.

Hunters' Bag Surveys are coordinated by the Victorian Game Management Authority (GMA) and are undertaken by staff of the GMA and the Victorian Department of Environment, Land, Water and Planning (DELWP).

A recent review of the proposed waterfowl adaptive harvest model (Ramsey et al. 2017) identified shortcomings in the survey design of past Hunters' Bag Surveys. These shortcomings mean that the data collected do not meet the requirements for use in the proposed adaptive harvest management of Victorian game ducks. Consequently, in 2019, decisions on wetlands to be targeted for Hunters' Bag Surveys were based on a sampling framework (D. Ramsey, ARI unpublished) that provides greater spatial representativeness and adequate sample sizes. Also introduced for the 2019 duck season was a Standard Operating Procedure (GMA 2019a) covering survey design, interactions with hunters, field data collection, and the handling and documentation of data and collected samples. These refinements are important steps towards achieving data of consistent quality and representativeness before implementation of the waterfowl conservation harvest model foreshadowed in the Sustainable Hunting Action Plan, 2016-2020 (DEDJTR 2016).

This report provides a summary of information obtained during the opening weekend of the 2019 duck hunting season. Its focus is to quantify opening weekend harvest, the species taken and any records of non-game waterbirds in the harvest. Further, a proportion of the duck carcasses examined had a wing and the tail feathers removed and stored for later scoring of sex, age class and moult status of the harvested birds. These demographic parameters assist decision making on the management of future duck hunting seasons (Ramsay et al. 2010). We also report on progress towards attaining the necessary sample size and geographic spread of samples to allow a meaningful analysis of these demographic parameters.

The 2019 hunting season and restrictions

As authorised by the Wildlife (Game) Regulations (2012), restrictions were applied to the 2019 duck hunting season in Victoria due to the dry conditions and relatively low numbers of ducks throughout eastern Australia. The duck hunting season was reduced to 65 days from 16 March to 19 May (instead of the usual 86 days) and later start times were applied during opening weekend (0900 hrs on the Saturday and 0800 hrs on the Sunday). Bag limits were also reduced to four ducks per day on opening weekend and five ducks per day thereafter. One game species, the Australasian Shoveler, was prohibited from being hunted for the 2019 duck hunting season.

2 Methods

Wetlands surveyed and sampling protocol

As recommended by Ramsey (unpublished), wetlands to be surveyed were distributed evenly in the four adaptive harvest model regions shown in Figure 1 (hereafter referred to as North, South, East and West regions). These regions are based on Catchment Management Authority boundaries to capture some of the regional variation in hydrology/water availability, and hence should reflect, to some degree, regional variation in wetland availability and game duck abundance (Ramsey unpublished).

Figure 1. Bioclimatic regions (North, South, East, West), used to stratify Hunters' Bag Surveys in 2019. Boundaries are aligned with Catchment Management Authority boundaries.

Under the protocol recommended by Ramsey (unpublished), three clusters of wetlands that are commonly used for duck hunting were identified in each region as targets for Hunters' Bag Surveys. Within each cluster, a target of 30-40 samples of each game species was set, resulting in a target of about 100 samples of each species from each region. A list of wetland clusters and the wetlands within each cluster that were targeted for sampling in each region in 2019 is provided in Appendix 1. In keeping with the switch to bioclimatic regions, this report differs from those of previous years in presenting the data sorted by bioclimatic region rather than by DELWP region.

The survey of hunters' bags and collection of wing and tail feathers took place on the Saturday and Sunday of the opening weekend (16th and 17th March 2019) at 26 wetlands spread across the four regions (Tables 1 and 2). Five of the 26 wetlands were surveyed on both days of opening weekend.

GMA staff were responsible for the administration and coordination of surveys according to standard operating procedures (GMA 2019a), including maintaining the accuracy and integrity of the data and samples collected. Field procedures closely followed those used in Victorian surveys since 1972 (Loyn 1991) with the exception that one wing and all tail feathers were collected and stored for future analysis, rather than being scored in the field. Characters used to classify wing and tail samples by sex and age class followed those of Rogers *et al*. (2019).

Standardised survey forms, instruction sheets and envelopes for wing and tail feathers were provided to surveyors. Surveyors interviewed individual hunters at wetlands between mid-morning and early afternoon, after most hunting had ceased for the day, although some hunters may have hunted again in the late afternoon. Interviewers preferentially sought information from individual hunters, though consolidated data from groups of hunters were acceptable if group size was recorded. Surveyors were asked to provide estimates of the total number of hunters present at each of the wetlands surveyed. Details regarding numbers and species of birds bagged, and the time birds were taken, were obtained during interviews. Hunters were also asked whether they had finished hunting for that day. A single wing and all tail feathers were removed from a sample of ducks in most bags and retained for later analysis. The same survey methods were repeated on the second survey day but usually at a different set of wetlands. Details regarding the shooting of non-game species were obtained by examination of bags.

Assessment of age class and primary moult

In 2017, a new procedure was introduced for the collection of data on the age of birds examined and their stage of wing-moult. When bags were examined, a wing and all tail feathers were removed and stored in a paper envelope for later analysis of sex and age. Details of the location, date and collector were recorded on the envelop at the time of collection.

In 2019, a wing and the tail feathers were retained from birds taken at 26 wetlands and comprised 40% of the 1154 birds examined (452 of 1154). GMA staff scored these samples for sex and age (adult or juvenile) based on aging characters (wing and tail) defined by Rogers *et al*. (2019). Each retained wing was then examined for the presence of wing (primary or secondary feather) moult.

3 Results

Survey coverage and effort

On opening day of the 2019 duck hunting season (Saturday, 16th March), 961 ducks were examined in 723 hunters' bags on 21 public wetlands. On Day 2 of opening weekend (Sunday, 17th March), 193 ducks were recorded in 295 hunters' bags on 10 public wetlands, five of which had also been surveyed on the

Saturday (Table 1). Survey effort (wetlands surveyed) varied regionally, being greatest in the North and East regions (8 and 9 wetlands respectively), and least in West and South regions (4 wetlands each) (Table 2).

Estimates of total hunters present were made at 17 of the 21 wetlands at which Hunters' Bag Surveys were conducted on opening day (Table 1). At these 17 wetlands, 496 hunters were interviewed, comprising 70% of the estimated 706 hunters present at those wetlands. On the Sunday at 6 wetlands, 172 of the estimated 209 hunters (82%) were interviewed.

Table 1. Wetlands at which Hunters' Bag Surveys were conducted on the opening weekend of the 2019 waterfowl hunting season in Victoria. * Wetlands surveyed on both days. Wetlands for which both a Hunters' Bag Survey on opening day (including an estimate of the number of hunters present) and a Summer Waterbird Count were conducted are shaded grey: in the past this cohort of wetlands was used to estimate the total harvest on opening day, but in recent years the sample size has been too small.

Day	Wetland name	Bioclimatic region	Bags counted	Estimated number of hunters present
16-Mar-19	Lake Bolac	South	40	50
16-Mar-19	Dans Reserve, Thompson Ck	South	10	6
16-Mar-19	Lake Corringle	East	13	15
16-Mar-19	Lake Curlip	East	9	20
16-Mar-19	Heart Morass	East	77	-
16-Mar-19	Lake Wat Wat	East	18	20
16-Mar-19	McLennan Strait	East	38	47
16-Mar-19	Spoon Bay	East	23	23
16-Mar-19	Toolondo Reservoir	West	104	150
16-Mar-19	Taylors	West	40	60
16-Mar-19	Mansfield Swamp	West	22	7
16-Mar-19	Racecourse Lake	West	11	30
16-Mar-19	Groves Weir	West	41	40
16-Mar-19	Lake Gilmour	West	9	9
16-Mar-19	Buffalo Dam	North	64	-
16-Mar-19	Lake Hume	North	59	70
16-Mar-19	Broken Creek	North	18	37
16-Mar-19	Parolas	North	75	-
16-Mar-19	Lake Eildon (Delatite Arm)	North	19	100
16-Mar-19	Lake Nagambie	North	11	-
16-Mar-19	Green Lake, Corop	North	22	22
Day 1 total			**723**	
17-Mar-19	Reedy Lake, Connewarre	South	5	7
17-Mar-19	Lake Bolac*	South	20	50
17-Mar-19	Dowd Morass	East	52	25
17-Mar-19	Heart Morass*	East	33	-
17-Mar-19	Lake Wellington	East	18	-
17-Mar-19	Black Swamp	West	11	-
17-Mar-19	Toolondo Reservoir*	West	63	60
17-Mar-19	Racecourse Lake	West	17	30
17-Mar-19	Broken Creek*	North	15	37
17-Mar-19	Parolas*	North	61	-
Day 2 total			**295**	

Table 2. Distribution of Hunters' Bag Survey effort across the two days of opening weekend and across the four bioclimatic regions, 2019.

Day	Bioclimatic region	Number of wetlands surveyed	Number of bags examined	Number of birds examined
Saturday 16 March	East	6	178	262
	North	10	371	470
	South	2	50	48
	West	3	124	181
Day total		**21**	**723**	**961**
Sunday 17 March	East	3	103	107
	North	3	87	38
	South	2	25	9
	West	2	80	39
Day total		**10**	**295**	**193**
Weekend total		**26 (5 counted both days)**	**1018**	**1154**

Species composition of bags

Grey Teal and Pacific Black Duck were the most numerous species in hunters' bags during opening weekend of the 2019 duck hunting season, comprising 34.4% and 28.1% respectively of the 1154 birds examined (Table 3). Two other species (Australian Wood Duck and Chestnut Teal) made up most of the remainder (35.4%) (Table 3). Together, these four species accounted for 97.9% of the bagged sample. Three species comprised the remaining 2% of the bagged sample – Australian Shelduck, Pink-eared Duck and Hardhead.

The species composition in bags on each day of the opening weekend was similar with the exception of Australian Wood Duck and Pacific Black Duck which formed a lower proportion of the take on the Sunday compared to the Saturday (Table 3).

Historically, Grey Teal has been by far the predominant species in hunters' bags in Victoria (annual mean frequency 36.4%) followed by Pacific Black Duck (19.4%) and Australian Wood Duck (19.5%) (Figure 2).

Table 3. Summary of mean bag size and individual game species found in hunters' bags on the opening weekend (16 and 17 March) of the 2019 duck hunting season.

Day and Region	Number of bags examined	Total ducks identified	Mean bag size	Aust Shelduck	Aust Wood Duck	Chestnut Teal	Grey Teal	Hardhead	Pacific Black Duck	Pink-eared Duck
Saturday										
East	178	262	1.47	4	0	103	90	0	65	0
North	371	470	1.27	2	187	14	89	2	180	0
South	50	48	0.96	1	1	16	20	0	10	0
West	124	181	1.46	2	33	0	115	0	23	8
Totals	**723**	**961**	**1.33**	**9**	**221**	**133**	**314**	**2**	**278**	**8**
% of daily total				0.9	23.0	13.8	32.7	0.2	28.9	0.8
Sunday										
East	103	107	1.04	1	0	37	48	1	20	0
North	87	38	0.44	1	13	1	3	0	20	0
South	25	9	0.36	0	0	0	7	0	2	0
West	80	39	0.48	0	4	0	30	0	4	1
Totals	**295**	**193**	**0.65**	**2**	**17**	**38**	**88**	**1**	**46**	**1**
% of daily total				0.6	5.8	12.9	29.8	0.3	15.6	0.3
Grand total	**1018**	**1154**	**1.13**	**11**	**238**	**171**	**402**	**3**	**324**	**9**
% of grand total				**0.9**	**20.6**	**14.8**	**34.4**	**0.3**	**28.1**	**0.8**

Hunter success

On opening day, the 723 bags examined had an average of 1.33 ducks per hunter (Table 3). Empty bags were held by 113 hunters (17% of hunters surveyed) at the time they were interviewed on opening day. The prescribed bag limit of four ducks had been reached by 50 hunters (7.5%).

On the Sunday, 295 hunters were found to have an average of 0.65 ducks (Table 3). Fifty-eight hunters (20%) held empty bags and eight hunters (2.7%) had reached the legal bag limit of four game ducks at the time they were interviewed.

Mean hunter success in the sample for the opening weekend was 1.13, less than half the long-term mean bag size of 2.77 and the lowest success rate on record (n=40 years) (Table 4, Figure 2). Mean bag size was highest on the Saturday and was similar between regions, with East being highest and South lowest on both days (Table 3).

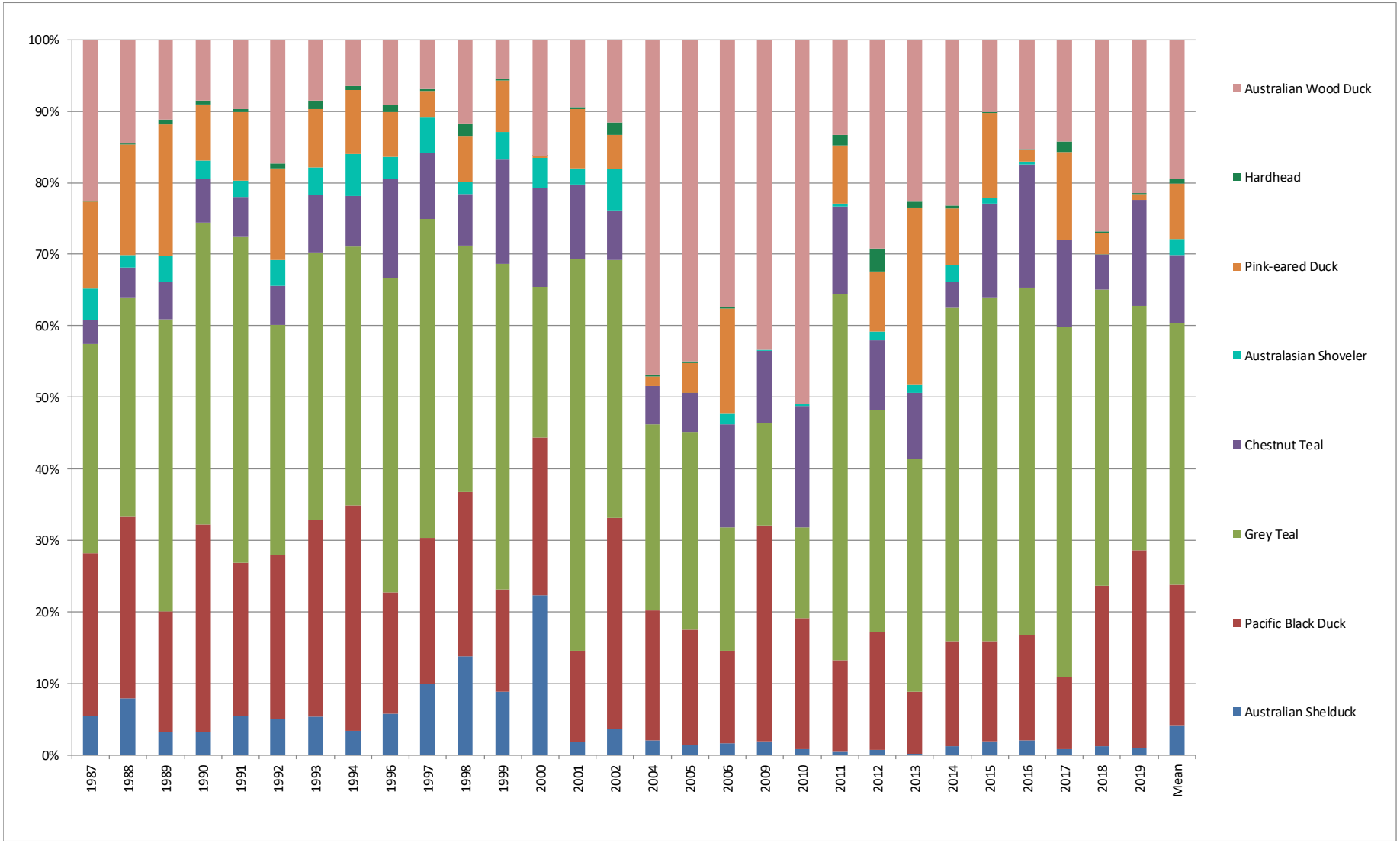


Figure 2.Species composition (% of birds examined) of hunters' bags on opening days or weekends of Victorian duck hunting seasons, 1987– 2019. Data from Holmes (1994, Table 10) for the years 1987-1992, and ARI databases subsequently. Species breakdowns for the years 1972 to 1987 are not available in a form suitable for analysis.

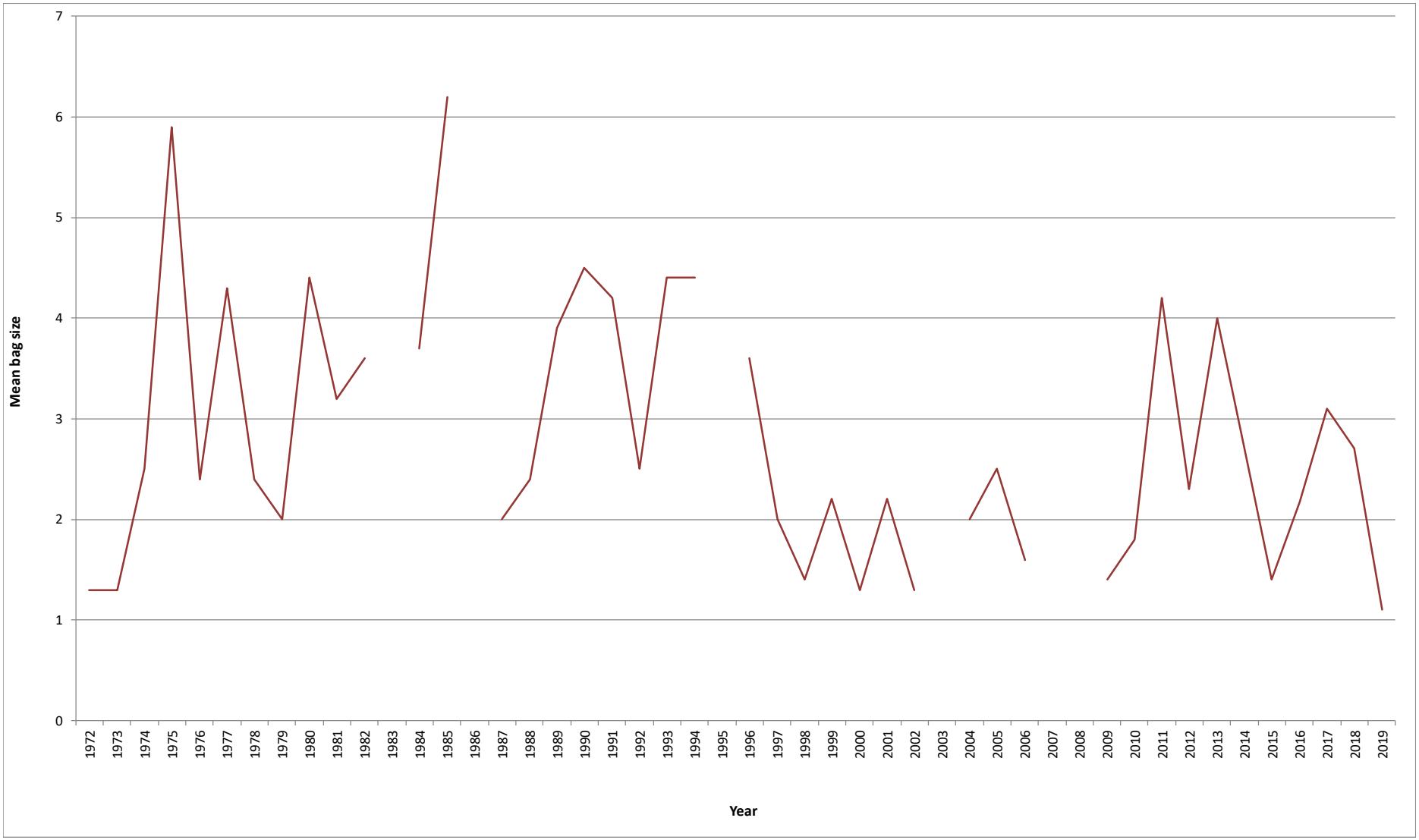


Figure 3.Mean bag size obtained by hunters on the opening day of the duck hunting season, 1972 to 2019. Gaps represent years in which no hunting season was declared except for 1986 when no Hunters' Bag Survey was conducted.

Table 4. Mean bag size obtained by hunters on the opening day of the duck hunting season, 1973 to 2019 (data from Norman and Nicholls (1991), Holmes (1994) and ARI database thereafter).

Year	Mean bag size	Year	Mean bag size
1973	1.3	1997	2.0
1974	2.5	1998	1.4
1975	5.9	1999	2.2
1976	2.4	2000	1.3
1977	4.3	2001	2.2
1978	2.4	2002	1.3
1979	2.0	2003	no season
1980	4.4	2004	2.0
1981	3.2	2005	2.5
1982	3.6	2006	1.6
1983	no season	2007	no season
1984	3.7	2008	no season
1985	6.2	2009	1.4
1986	no data	2010	1.8
1987	2.0	2011	4.2
1988	2.4	2012	2.3
1989	3.9	2013	4.0
1990	4.5	2014	2.7
1991	4.2	2015	1.4
1992	2.5	2016	2.2
1993	4.4	2017	3.1
1994	4.4	2018	2.7
1995	no season	2019	1.1
1996	3.6	**Mean (sd)**	**2.77 (1.27)**

Age classes of bagged birds

An entire wing and the tail feathers were collected from 452 (39%) of the ducks examined in hunters' bags and these were subsequently scored for age class and the presence of moulting flight feathers (Table 5). Juveniles were recorded in all species with more than a few individuals in the sample and comprised 27% of the total, reflecting a considerable level of breeding during the preceding six months or so. The proportion of juveniles was highest in Pacific Black Duck (44.4%) and was also high in Grey Teal (26.4%) and Pink-eared Duck (30.0%, though the sample size is small).

The incidence of primary moult

Moulting primary feathers were found in 14 of the 452 birds examined (3.1%) (Table 5), mostly in Pink-eared Duck and Grey Teal.

Table 5. Summary of age classes and primary moult status of ducks examined during the 2019 opening weekend Hunters' Bag Surveys (all sites combined).

Species	Sample size	Sex			Age class			Number of adults/juveniles showing primary moult (%)
		Male	Female	uncertain	Juvenile (%)	Adult (%)	Uncertain (%)	
Australian Shelduck	4	1	3	0	1 (25)	3 (75)	0	1 juv female
Australian Wood Duck	92	45	47	0	15 (16.3)	77 (83.7)	0	0
Chestnut Teal	89	35	43	11	13 (14.6)	76 (85.4)	0	1 juv female
Grey Teal	129	57	53	19	34 (26.4)	95 (73.6)	0	1 ad female, 3 ad unsexed
Hardhead	1	0	1	0	0	1	0	0
Pacific Black Duck	126	49	75	2	56 (44.4)	70 (55.5)	0	I ad female, 1 juv male
Pink-eared Duck	10	1	2	7	3 (30)	7 (70)	0	5 ad, 1 juv unsexed
Teal species	1	0	1	0	0	1	0	0
Totals	**452**				**122 (27.0)**	**330 (73)**	**0**	**14 (3.1)**

Estimates of harvest on opening weekend

There were six wetlands surveyed during the opening day of the 2019 Hunters' Bag Survey at which birds had been surveyed during the 2019 Summer Waterbird Count, and for which an estimate of the number of hunters present was also provide (Table 1): 2 in East region, 1 in South and 3 in West. In previous years, an estimate of the total harvest over opening day was made by extrapolating the mean bag size to the estimated number of hunters and comparing that total harvest estimate to the estimated number of game ducks present during the Summer Waterbird Count. However, in 2019, the necessary information was collected at only six wetlands and we have chosen to discontinue presenting this estimate in this report, as recommended by Menkhorst et al. (2017).

Breaches of bag limits and species-specific regulations

No breaches of bag size limits or the taking of prohibited species were apparent from the Hunters' bag Survey data sheets. No searches for wounded and retrieved ducks were reported on data sheets for the 2019 opening weekend.

4 Discussion

Survey design

In 2019, a new survey design was introduced in preparation for the future implementation of an adaptive harvest model to better manage duck hunting. The new sampling procedure aims to achieve a more balanced geographic spread and number of samples (see under Methods). Thus, the 2019 Hunters' bag Survey could be considered a trial of the new sampling procedure.

The sampling protocol aims to achieve 100 samples of each game species from each region, a total of 400 samples per species. Note that this target is likely to be unachievable for some rarer or less desirable game species in some years. Table 6 indicates that this target was not achieved for any species in any region in 2019, and for the best sampled species (Grey Teal) only one third of the desired sample was achieved. This failure to reach targets is partly due to the small bag sizes achieved (due to low duck numbers and reduced allowable bag sizes), however, had samples been collected from a greater proportion of ducks examined (only 40% of birds examined in bags had wing and tail feathers sampled) then the targets could have been reached in 5 of 28 species/region combinations (Table 7). This inability to reach the target sample sizes clearly highlights the magnitude of the task set by the new sampling protocols and indicates that increased effort and resources will be required to effectively implement a sustainable harvest model in the management of the Victorian ducking hunting season.

Another potential advantage of the new survey protocols is that the more representative coverage it achieves could benefit the Summer Waterfowl Count. This advantage would accrue if the Summer Waterbird Count was to target the wetland clusters identified for the Hunters' Bag Surveys (this would require the clusters to be determined prior to the Summer waterbird Count in the second half of February), thus ensuring a reasonable level of geographic coverage and a minimum sample size. This, combined with considered estimates of the number of hunters present on opening weekend at the wetlands selected for Hunters' Bag Surveys, would also add value to estimates of harvest rates over the opening weekend (see Menkhorst *et al*. 2017).

Table 6. Sample sizes achieved in 2019 for ageing and sexing ducks in hunters' bags for each bioclimatic region. The target was 100 birds of each species from each region, i.e. 400 of each species.

Species	Region				Total
	East	North	South	West	
Australian Shelduck	2	0	0	2	4
Australian Wood Duck	0	77	1	14	92
Chestnut Teal	74	0	15	0	89
Grey Teal	30	58	18	23	129
Hardhead	0	1	0	0	1
Pacific Black Duck	41	67	13	5	126
Pink-eared Duck	0	0	0	10	10
Teal species	1	0	0	0	1
Totals	**148**	**203**	**47**	**54**	**452**

Table 7. Species for which the target of 100 samples in a region would have been achieved had wing and tail feathers been sampled from all birds examined in hunters' bags (data from Table 3).

Species	Region			
	East	North	South	West
Australian Shelduck				
Australian Wood Duck		✓		
Chestnut Teal	✓			
Grey Teal	✓			✓
Hardhead				
Pacific Black Duck		✓		
Pink-eared Duck				

Estimates of harvest on opening weekend

The 2017 decision to cease estimating the proportion of birds present that were taken by hunters over opening weekend is that there is currently no means of determining this important measure of the sustainability of duck hunting. The Hunters' Bag Survey and the annual telephone survey of duck hunters provide information on the total take but cannot put that number in the context of the proportion of the available birds that are removed from the population. Moving to a properly-resourced sustainable harvest model to guide the regulation of the open season would help to overcome this shortcoming.

Species composition in hunters' bags

The annual survey of the contents of hunters' bags on opening weekend aims to provide an index of the annual estimated harvest of waterfowl in Victoria on opening weekend. It is intended to examine underlying trends in harvest size and in the representation of species and age classes within the harvested birds. The focus on opening weekend is arguably appropriate because about 30% of the annual harvest (and hunting effort) has been shown to occur then (e.g. Norman and Powell 1981, Loyn 1991, Moloney and Turnbull 2015).

The most numerous species in bags in 2019 were Grey Teal, Pacific Black Duck and Australian Wood Duck. Since 1987, these species have consistently been the primary game species in Victoria, with Pink-eared Duck and, to a lesser extent, Chestnut Teal, also important in some years (Figure 2).

Hunter success

The mean bag size for the 2019 opening weekend (1.1 ducks) was 39% of the long-term average of 2.8 (n=40) and was the lowest recorded since Hunters' Bag Surveys began in 1973. Figure 3 suggests an on-going decline in mean bag size – the effect of the 'millenium drought' between 1997 and 2009 is evident, as are the dry years since 2011 (although bag sizes during these years have also been affected by management interventions such as reduced allowable take of some species over opening weekend).

Age structure in the hunters' bag sample

The duck hunting season is timed to avoid the main breeding seasons of game species and most other waterbirds. The proportion of immature ducks in hunters' bags is the only current measure of recruitment from breeding events in the previous ~6 months, the period when notched tail feathers are retained by juvenile ducks (Rogers *et al*. 2019).

The new system for obtaining age class data introduced in 2017 again worked well in 2019 (H. Dunstan, GMA pers. comm.) with 100% of samples covering all species assigned an age class. This improvement was

largely due to the provision of detailed illustrated guides to sexing and ageing game species (Rogers *et al*. 2019, GMA 2019b). We recommend that the new system be maintained and that more staff of DELWP and GMA be trained in its use.

Sexing birds in the hunters' bag sample

Determining the sex of teal species and the Pink-eared Duck was difficult for those examining the collected samples. For Grey Teal this is unsurprising because sex must be determined by wing length and there is considerable overlap in this measure between the sexes, for both adults and immatures (Rogers *et al*. 2019). Sexing Grey Teal by external morphometrics will always be problematic. A similar situation exists for the Pink-eared Duck for which there is even greater overlap in wing length between the sexes, but there are subtle differences in colour pattern of the lesser underwing coverts (Rogers *et al*. 2019) which can be used by a trained technician. For Chestnut Teal, the uncertainty can be readily overcome by noting head and body plumage in the field at the time of sample collection and writing the sex on the envelop in which wing and tail feathers are stored, as recommended by Rogers *et al*. (2019).

Moult in the hunters' bag sample

Moulting was considered a significant management issue in the 1970s when duck hunting season sometimes opened as early as January (Loyn 1989), a time when moulting in some species is still taking place. However, with the season now opening later (3rd weekend in March), moult appears to be of little concern for adult birds because moulting of wing feathers is normally completed before the hunting season begins. This seems to have been the case in 2019 when 3.1% of the wing samples showed active primary moult. This result is remarkably like that from the previous two years (Menkhorst et al. 2017, 2018). Frequency of moulting flight feathers was highest in Pink-eared Duck (60% of a very small sample). Therefore, we conclude that it is unlikely that moult stage unduly influenced harvesting rate for any species (few Pink-eared Duck were harvested).

5 Conclusions

1. The mean bag size in the 2019 bag sample (1.1 ducks) was the lowest on record and only 39% of the long-term mean of 2.8, indicating a very poor return for hunters.
2. The species composition in hunters' bags was similar to that of past seasons although the proportions of Chestnut Teal and Pacific Black Duck were above average.
3. There had clearly been successful breeding in the months prior to the season opening, with over one quarter of bagged birds being juvenile.
4. The annual Hunters' Bag Survey plays an important role in monitoring the impact of the duck season on game species because it is the only means of gathering biological data about the birds that are harvested.
5. The system of collecting wings and tail feathers for later analysis should be maintained but needs to be expanded if the new sampling protocols are to be met. Additional staff of DELWP and GMA should be trained in its use.
6. The new sampling protocol will bring considerable benefits through ensuring a more representative and adequate sample, however, it will require greater resourcing than has been available in recent years.

6 References

DEDJTR (2016) *Sustainable Hunting Action Plan, 2016-2020*. Department of Economic Development, Jobs, Transport and Resources, Melbourne.

Frith, H.J. (1982) *Waterfowl in Australia*. 3rd edition. Angus & Robertson, Sydney.

GMA (2019a) Standard Operating Procedure; Hunter Bag Surveys. Game Management Authority, Melbourne.

GMA (2019b) A Field Guide for Ageing and Sexing Victorian Native Game Birds. Game Management Authority, Melbourne.

Holmes, J. (1994) *The 1992 Duck Season in Victoria*. Arthur Rylah Institute for Environmental Research Technical Report Series Number 132. Department of Sustainability and Environment, Heidelberg, Victoria.

Loyn, R.H. (1989) *The management of duck hunting in Victoria – a review*. Arthur Rylah Institute for Environmental Research Technical Report Series Number 70. Department of Sustainability and Environment, Heidelberg, Victoria.

Loyn, R.H. (1991) Assessing and managing the impact of duck hunting in Victoria – a new approach. *Wildfowl* 42, 155–161.

Menkhorst, P., Brown, G. and Stamation, K. (2017) *Hunter's Bag Survey: 2017 Victorian duck hunting season*. Unpublished Client Report produced by the Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

Menkhorst, P., Brown, G. and Stamation, K. (2018) *Hunter's Bag Survey: 2018 Victorian duck hunting season*. Unpublished Client Report produced by the Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

Moloney, P. D. and Turnbull, J. D. (2017) *Estimates of harvest for deer, duck and quail in Victoria: results from surveys of Victorian game Licence holders in 2016*. Unpublished Client Report produced by the: Arthur Rylah Institute for Environmental Research Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

Norman, F.I. and Nicholls, N. (1991) The Southern Oscillation and variations in waterfowl abundance in south eastern Australia. *Australian Journal of Ecology* 16, 485-490.

Norman, F.I. and Powell, D.G.M. (1981) Rates of recovery of bands, harvest patterns and estimates for black duck, chestnut teal, grey teal and mountain duck shot during Victorian open seasons, 1953–77. *Australian Wildlife Research* 8, 659–664.

Ramsey, D.S.L., Forsyth, D.M., Conroy, M.J., Hall, G.P., Kingsford, R.T., Mitchell, G., Roshier, D.A., Veltman, C.J., Webb, G. and Wintle, B.A. (2010) *Developing a sustainable harvest model for Victorian waterfowl*. Arthur Rylah Institute for Environmental Research Technical Report Series Number 195. Department of Sustainability and Environment, Heidelberg, Victoria.

Ramsey, D.S.L., Pacioni, C., McLeod, S. and Dundas, S. (2017) *Towards the implementation of adaptive harvest management of waterfowl in south-eastern Australia*. Arthur Rylah Institute for Environmental Research Technical Report Series Number 284. Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

Rogers, D., Davies, J. and Menkhorst (2019) *Ageing and sexing Victorian game bird species*. Arthur Rylah Institute for Environmental Research Technical Report Series Number 294. Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

Appendix 1

Wetlands prioritized for Hunters' Bags Surveys in 2019.

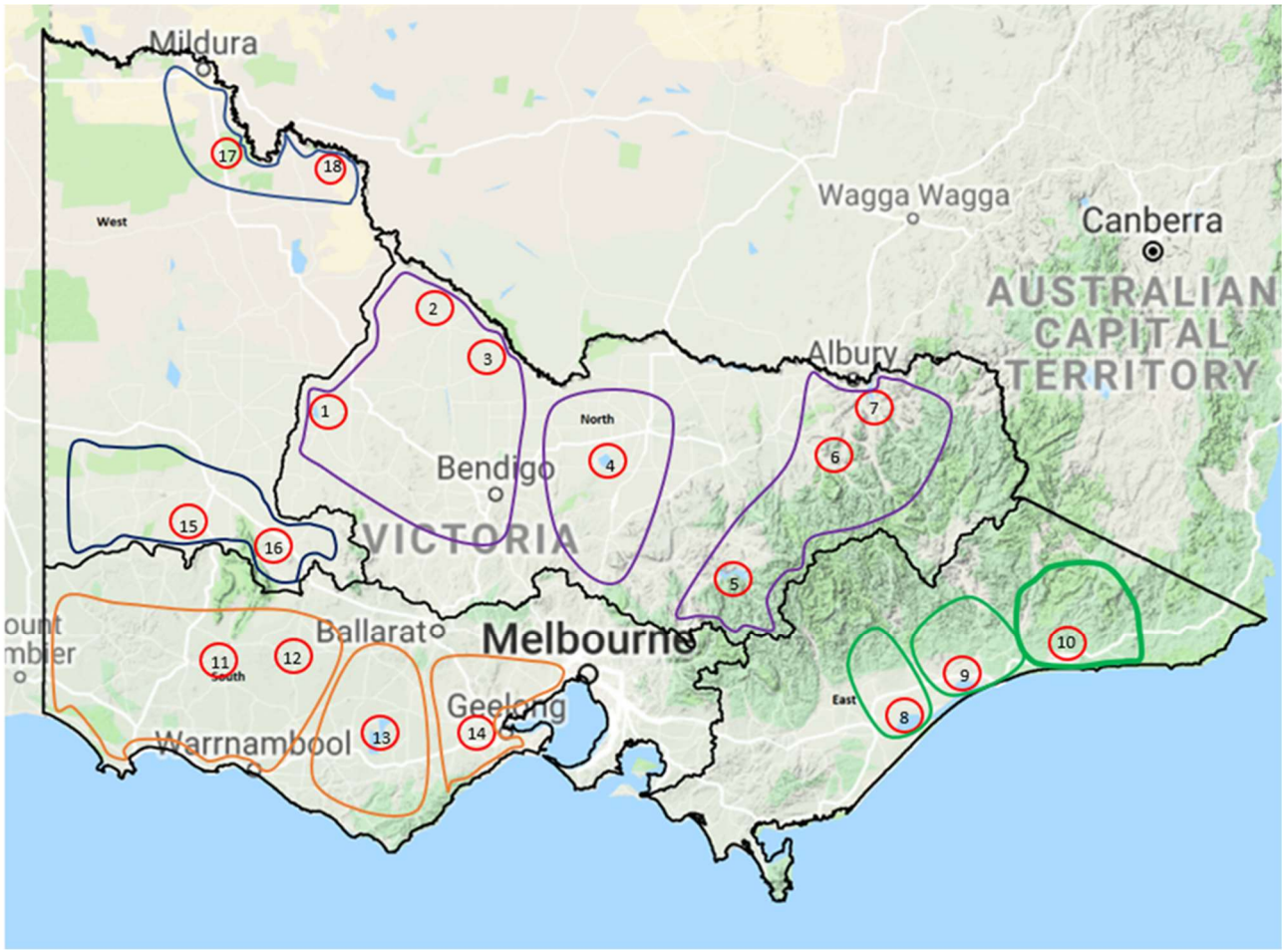


Figure 4. Wetland clusters and sub-clusters targettted for Hunters' Bag Surveys during the opening weekend of the 2019 duck hunting season.

East Region

Cluster	Sub-Cluster	Recommended Wetland(s)
Western	8	• Clydebank Morass W.R • Lake Kakydra • Freshwater Swamp (Ballong) • Jack Smith Lake • Lake Denison • Dowd Morass
Central	9	• Jones Bay W.R • Macleod Morass W.R • Blond Bay
Eastern	10	• Lake Curlip W.R • Lake Wat W.R • Lake Corringle W.R

North region

Cluster	Sub-Cluster	Recommended Wetlands
Western	1	• Lake Buloke
Western	2	• Little Lake Charm • Kangaroo Lake • Lake Cullen • Duck Lake W.R. • Koorangie W.R. • Tutchewop W.R.
Western	3	• Gunbower Creek • Taylor Creek • Upper Gunbower Creek • Longmore Lagoon
Central	4	• Waranga Basin • Greens Lake • Lake Cooper • Wallenjoe Swamp W.R. • Gaynor Swamp W.R. • Nagambie • Eppalock • Corop W.R.
Eastern	5	• Lake Eildon
Eastern	6	• Lake Buffalo
Eastern	7	• Lake Hume

South region

	Sub-Cluster	Recommended Wetland(s)
Western	11	• Lake Linlithgow • Krause Swamp W.R • Lake Bullrush • Lake Kennedy W.R
Western	12	• Lakes Turangmoroke, Yuangmania and Gunjale W.R • Lake Bolac
Central	13	• Lake Colac • Lake Corangamite • Lake Weeranganuk • Lake Kariah • Lake Colongulac • Lake Bookar W.R
Eastern	14	• Lake Connewarre W.R

West Region

Cluster	Sub-Cluster	Recommended Wetlands
Southern	15	• Lake Toolondo • Heard Lake W.R • Boundary Swamp W.R • Lake Clarke W.R • Bow Lake W.R • Lake Carchap W.R
Southern	16	• Lake Lonsdale • Pine Lake • Lake Taylor • Green Lake
Northern	17	• Lake Carpul • Heywoods Lake
Northern	18	• Lake Mournpall • Lake Bull • Lake Lockie • Lake Arawak • Lake Bitterang

www.delwp.vic.gov.au

www.ari.vic.gov.au