Hunters' Bag Survey:
2017 Victorian duck hunting season

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June 2017

Arthur Rylah Institute for Environmental Research

Unpublished Client Report for Ecological Policy Branch, Department of Environment, Land, Water and Planning

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State Government Victoria

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Citation: Menkhorst, P., Brown, G. and Stamation, K. (2017) Hunters' Bag Survey: 2017 Victorian duck hunting season. Arthur Rylah Institute for Environmental Research. Unpublished Client Report for Ecological Policy Branch, Department of Environment, Land, Water & Planning, Heidelberg, Victoria

Front cover photo: loafing Chestnut Teal. (Photo: P. Menkhorst)

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Acknowledgements

Funding for preparation of this report was provided by the Ecological Policy Section of the Department of Environment, Land, Water and Planning (DELWP). We are grateful to Jill McLean, Acting Director of Ecological Policy 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 Economic Development, Jobs, Transport and Resources – we thank those agencies for their cooperation, and all staff involved.

Helpful comments on drafts were provided by Jenny Nelson and Claire Moxham (Arthur Rylah Institute for Environmental Research), and Zachary Powel and Simon Toop (Game Management Authority).

Summary

Estimating the daily take 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. Such surveys have been conducted on opening weekend at Victorian wetlands in 38 of the 44 years since 1972 (the exceptions are mostly years in which no hunting season was declared). They aim to determine both hunter success and the species and age composition of birds shot during opening weekend.

In 2017 for the first time, whole wings and tail feathers were collected from a sample of bagged birds for later examination to estimate the frequency of wing (primary feather) moult, and to estimate the proportion of immature birds in the bagged sample.

On the 2017 opening weekend, Hunters' Bag Surveys were conducted at 21 public wetlands on Day 1 (Saturday, 18th March) and 18 wetlands on Day 2 (Sunday, 19th March), of which eight had also been surveyed on Day 1, giving a total of 31 wetlands with some level of coverage. Sixty percent of the estimated number of hunters present had their bag checked at these 31 wetlands.

Key Findings

- Hunter success across opening weekend was 3.1 birds per hunter, 7% above the long-term mean of 2.9 (N=38 years).
- The collection and retention of wings and tail feathers for later analysis was well-received by hunters and resulted in a much larger sample size, and confidence in the results, than the previous method of scoring these parameters in the field.
- Juveniles comprised about one third of the bagged sample and 54% of Pink-eared Ducks sampled.
- The species found in hunters' bags and their relative proportions were:

Species	Count (% of total bag count)	
	18 March (N=808 bags)	19 March (N=462 bags)
Grey Teal (*Anas gracilis*)	1,430 (47.1)	481 (55.2)
Australian Wood Duck (*Chenonetta jubata*)	455 (15.0)	98 (11.2)
Pink-eared Duck (*Malacorhynchus membranaceus*)	375 (12.3)	112 (12.8)
Chestnut Teal (*Anas castanea*)	417 (13.7)	57 (6.5)
Pacific Black Duck (*Anas superciliosa*)	289 (9.5)	102 (11.7)
Hardhead (*Aythya australis*)	51 (1.7)	9 (1.0)
Australian Shelduck (*Tadorna tadornoides*)	21 (0.7)	13 (1.5)
Total	**3,038**	**872**

Recommendations

1. The Hunters' Bag Survey needs to include a larger number of wetlands, more evenly spread across the State. Greater attention should be given to conducting the survey at wetlands covered in the Summer Waterbird Count and to estimating the number of hunters present on the wetland.

2. The new system of sampling wings and tail feathers for sexing and age estimation should be retained with the aim of developing a long-term dataset of these population parameters.

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 membanaceus* and Pacific Black Duck *Anas superciliosa*).

Estimating the daily take by hunters is an important component of assessing the impact of the 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 in possession of 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 39 of the 45 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 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 concentrations 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, Victorian Department of Environment, Land, Water and Planning (DELWP), and the Victorian Department of Economic Development, Jobs, Transport and Resources (DEDJTR).

This report provides a summary of information obtained during the opening weekend of the 2017 duck hunting season. Its focus is to quantify opening weekend harvest, the species taken and any records of non-game waterbirds in the harvest. Details of age class (i.e. juvenile vs adult) of a sample of birds harvested and the incidence of wing moult are also summarised. These are important demographic parameters that help to estimate the impact of opening weekend take on the populations of game species (Ramsay et al. 2010 p. 29).

1.1 The 2017 hunting season and restrictions

As prescribed in the Wildlife (Game) Regulations (2012), the 2017 duck hunting season in Victoria ran for 86 days from 18 March through to 12 June. One game species, the Australasian Shoveler, was prohibited from being hunted for the 2017 duck hunting season.

2. Methods

2.1 Hunter and wetland surveys

The survey of hunters' bags and collection of wing and tail feather samples took place on the Saturday and Sunday of the opening weekend (18th and 19th March) at 31 wetlands spread across five DELWP regions (Table 1). No Hunters' Bag Surveys were conducted in Port Phillip Region as it includes few public wetlands open to hunting. Eight of the 31 wetlands were surveyed on both days of opening weekend. Decisions on which wetlands would be targeted for Hunters' Bag Surveys are made by the GMA based on logistical and compliance needs, rather than statistical sampling requirements.

GMA staff were responsible for the administration and coordination of surveys according to standard operating procedures, including maintaining the accuracy and integrity of the data and samples collected. Sites where surveys had been undertaken previously were identified, and these 'long-term' sites were prioritised for surveys, as were some wetlands that had been surveyed in the preceding Summer Waterbird Count conducted in February. Procedures closely followed those used in Victorian surveys since 1972 (Loyn 1991) with the exception that wing and tail feather samples were collected and stored for future analysis, rather than being scored in the field. Staff from the Waterbirds and Wetlands Program at ARI provided training in the ageing and sexing of ducks based on wing and tail feather samples before the samples were scored by GMA staff.

Standardised survey forms, instruction sheets and collection envelopes were provided to surveyors. Surveyors interviewed individual hunters at wetlands between mid-morning and early afternoon, after most shooting had ceased for the day, although some hunters may have hunted again in the evening. Interviewers sought information from individual hunters where practical, though consolidated data from groups were acceptable if group size was recorded. Interviewers 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 a sample of tail feathers were removed from each duck in most bags and retained for later analysis. The same survey methods were repeated on the second survey day.

Details regarding the shooting of non-game species were obtained by examination of bags as well as by shoreline surveys where the water's edge was searched for unrecovered shot birds. Carcasses (or injured birds) were identified and, to avoid duplication, the place and method of disposal of such birds were recorded.

2.2 Assessment of age class and primary moult

In 2017 a new procedure was introduced for the collection of data on the age and stage of wing-moult of birds examined during the survey. When bags were examined, a wing and some tail feathers were removed from roughly one third of bagged birds. The retained tail feathers were later categorised as either adult or juvenile based on the presence or absence of notched tail feathers – notched tips, often with the bare shaft protruding, being an indication of a young duck still in juvenile plumage (Baker 1993 page 17). The wings of birds classified as adult were then examined for the presence of wing (primary feather) moult.

2.3 Estimates of opening–weekend harvest

Multiplying the mean bag size for a given wetland by the estimated number of hunters present gives a coarse estimate of the total take from that wetland over the opening weekend or part thereof. That figure can then be compared to the total number of game ducks recorded at that wetland during the preceding Summer Waterbird Count to give a rough estimate of the opening-weekend harvest for the wetland.

3. Results

3.1 Survey coverage and effort

On opening day of the 2017 duck hunting season (Saturday, 18th March), 2,950 ducks were examined in 795 hunters' bags on 21 public wetlands (Table 1). On Day 2 (Sunday, 19th March) of opening weekend, 960 ducks were recorded in 475 hunters' bags on 19 public wetlands, eight of which had also been surveyed on the Saturday (Table 1). Survey effort (wetlands surveyed) varied regionally, being greatest in the Gippsland, Grampians and Loddon Mallee Regions (8, 7 and 7 wetlands, respectively), and least in Barwon South West (3 wetlands) (Table 2).

Estimates of total hunters present were made at 16 wetlands at which Hunters' Bag Surveys were conducted on opening day. At these 16 wetlands, 486 hunters were interviewed, 55% of the estimated 888 hunters present at those wetlands. On Sunday at 12 wetlands, 339 of the estimated 448 hunters (76%) were interviewed. The proportion surveyed for the weekend was 62% of the estimated total hunters present on wetlands where surveys were carried out.

3.2 Species composition of bags

Grey Teal was by far the most numerous species in hunters' bags – 1,911 were recorded, representing 49% of the birds examined over the opening weekend (Table 3), with four other species (Australian Wood Duck, Pink-eared Duck, Pacific Black Duck and Chestnut Teal comprising most of the remainder (48.5%) (Table 3). Together, these five species accounted for 97.5% of the bagged sample. Two species comprised the remaining 2.5% of the bagged sample – Australian Shelduck and Hardhead.

The species composition in bags on each day of the opening weekend was similar (Table 3).

Historically, Grey Teal has been by far the predominant species in hunters' bags in Victoria (annual mean frequency 36.2%) followed by Pacific Black Duck (19.3%) and Australian Wood Duck (19.2%) (Table 4, Figure 1).

3.3 Hunter success

On opening day, the 795 hunters whose bags were examined had an average of 3.7 ducks per hunter (Table 3). Empty bags were held by 16 hunters (2% of hunters surveyed) at the time they were interviewed. The prescribed bag limit of 10 had been reached by 40 hunters (5.0%) from all regions except Barwon South West.

On the Sunday, 462 hunters were found to have an average of 2.1 ducks (Table 3). Twenty-three hunters (5%) held empty bags and 10 hunters (2%) had reached the legal bag limit of 10 game ducks, in the Grampians, North East and Loddon Mallee Regions.

Mean hunter success for the opening weekend was 3.1, a 7% increase over the long-term mean bag size of 2.9 (Table 5, Figure 2). Mean bag size was highest on the Saturday in the Grampians Region (4.8 ducks per hunter), and between 2.0 and 3.9 ducks per hunter in the other regions (Table 3). On the Sunday, hunter success was lower – between 3.3 and 0.6 ducks per hunter with a mean of 2.1 ducks.

Table 1. Wetlands at which Hunters' Bag Surveys were conducted on the opening weekend of the 2017 waterfowl hunting season in Victoria.

Data are shown for individual DELWP Regions, and as state-wide totals. * 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: these wetlands were used to estimate the total harvest on opening day.

Day	Wetland Name	DELWP Region	Bags Counted	Estimated number of hunters present	SWC conducted? (day 1 only)
18/03/2017	Hospital Swamp*	BSW	43	-	Y
18/03/2017	Dans Reserve, Thompson Creek	BSW	4	-	N
18/03/2017	Dowd Morass	Gippsland	156	-	Y
18/03/2017	Clydebank Morass	Gippsland	17	20	N
18/03/2017	Blonde Bay State Game Reserve	Gippsland	12	15	N
18/03/2017	Heart Morass*	Gippsland	71	-	N
18/03/2017	Lake Buninjon*	Grampians	34	100	Y
18/03/2017	Wally Allens Swamp	Grampians	21	30	Y
18/03/2017	Toolondo Reservoir	Grampians	22	50	Y
18/03/2017	Lake Kanagulk*	Grampians	6	20	N
18/03/2017	Leah Swamp	Grampians	6	8	N
18/03/2017	Loch Garry*	Hume	39	50	Y
18/03/2017	Buffalo Dam	Hume	68	68	Y
18/03/2017	Lake Hume*	Hume	86	130	N
18/03/2017	Lake Stewart	Hume	15	15	N
18/03/2017	Lake Buloke	Loddon Mallee	53	80	Y
18/03/2017	Lake Bael Bael	Loddon Mallee	17	84	N
18/03/2017	Second Marsh*	Loddon Mallee	35	-	Y
18/03/2017	Lake Cooper	Loddon Mallee	45	60	Y
18/03/2017	Green Lake	Loddon Mallee	6	8	Y
18/03/2017	Lake Lyndger*	Loddon Mallee	39	150	N
Day total			**795**		
19/03/2017	Lake Connewarre	BSW	6	--	
19/03/2017	Hospital Swamp	BSW	5	-	
19/03/2017	Jack Smith's Lake	Gippsland	2	-	
19/03/2017	Lake Coleman	Gippsland	10	-	
19/03/2017	Heart Morass	Gippsland	61	-	
19/03/2017	Freshwater Swamp State Game Reserve	Gippsland	7	7	
19/03/2017	Gippsland Lakes, Lakeside Tk	Gippsland	45	--	
19/03/2017	Lake Buninjon	Grampians	21	50	
19/03/2017	Lake Kanagulk	Grampians	13	20	
19/03/2017	Lake Koynock	Grampians	15	30	
19/03/2017	McGlashins Swamp	Grampians	7	12	
19/03/2017	Loch Garry	Hume	38	38	
19/03/2017	Dowdle Swamp	Hume	15	15	
19/03/2017	Lake Hume	Hume	64	50	
19/03/2017	Lower Ovens State Game Reserve	Hume	52	80	
19/03/2017	Lake Buloke	Loddon Mallee	29	29	
19/03/2017	First Marsh (The Marsh)	Loddon Mallee	28	44	
19/03/2017	Second Marsh (Middle Marsh)	Loddon Mallee	40	-	
19/03/2017	Lake Lyndger	Loddon Mallee	17	80	
Day total			**475**		

Table 2. Distribution of Hunters' Bag Survey effort across the two days of opening weekend by DELWP region. Note that there are no significant wetlands on public land in Port Phillip Region that are open to hunting.

Day	DELWP region	Number of wetlands surveyed	Number of bags examined (% of day total)	Number of birds examined
Saturday 18 March	Barwon South West	2	47 (5.9)	96
	Gippsland	4	256 (32.2)	916
	Grampians	5	89 (11.2)	431
	Hume	4	208 (26.2)	819
	Loddon Mallee	6	195 (24.5)	688
Day total		**21**	**795**	**2950**
Sunday 19 March	Barwon South West	2	11 (2.3)	7
	Gippsland	5	125 (26.3)	143
	Grampians	2	56 (11.8)	161
	Hume	4	169 (35.6)	277
	Loddon Mallee	4	114 (24.0)	372
Day total		**17**	**475**	**960**
Weekend total		**41**	**1270**	**3910**

3.4 Age classes of bagged birds

One thousand and sixty-one ducks from all seven game species were examined for age class and the presence of moulting primary feathers (Table 6). This sample size, representing 27% of all birds examined in bags, is much larger than that achieved in previous years and thus provides greater confidence in the results. Note that an unknown number of samples of wings and tails were discarded because they were too damaged or bloodied to allow satisfactory age and moult scoring.

Juveniles were recorded in all seven species in the bagged sample and comprised about one third of the sample, reflecting breeding by all species during the preceding six months or so. The proportion of juveniles was highest in Pink-eared Duck (54%) and lowest in Australian Wood Duck (16%) (Table 6).

3.5 The incidence of primary moult

Moulting primary feathers were found in 24 of the 681 birds classed as adult (3.5%) (Table 6). Of species for which a sample size of >20 was achieved, the frequency of primary moult was highest in Grey Teal (5.8%) and lowest in Pacific Black Duck (0) (Table 6).

3.6 Estimates of harvest on opening weekend

There were eight wetlands surveyed during the opening day of the 2017 Hunters' Bag Survey at which birds had been surveyed during the 2017 Summer Waterbird Count, and for which an estimate of the

number of hunters present was also provide (Table 1): four in Grampians Region (Toolondo Reservoir, Lake Buninjon, Wally Allens Swamp, Green Lake), two in Hume Region (Loch Garry, Buffalo Dam) and two in Loddon Mallee Region (Lake Buloke and Lake Cooper). At these wetlands, an estimate of the total harvest over opening day can be achieved 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. The estimated take using this method varied from 0.4% to 800% (Table 7), indicating that there is considerable uncertainty in the results. The mean rate of harvest across the seven wetlands was 9.2% and this may represent a more plausible estimate of the rate of harvest than those for individual wetlands.

3.7 Breaches of bag limits and species-specific regulations

No breaches of the game laws were documented on Hunters' Bag Survey datasheets in 2017.

3.8 Unrecovered and wounded birds

Searches for wounded and unretrieved ducks were conducted at two wetlands in each of the Grampians and Loddon Mallee Regions: Lake Cooper and Lake Lyndger, and Lake Buloke and First Marsh. A total of 18 waterbirds was found, comprising nine dead Black Swans, two dead Australian Pelicans, two dead Grey Teal, and single dead Pink-eared Duck, Pacific Black Duck and Australian Wood Duck. Single injured individuals of two species, Pink-eared Duck and Australian Wood Duck, were also recorded.

Table 3. Summary of individual game species found in hunters' bags on the opening weekend (18th and 19th March) of the 2017 duck hunting season in Victoria.
Data are shown for individual DELWP Regions and as state-wide totals. BSW = Barwon South West.

Day and region	No. bags examined	Species									Total identified	Mean bag size
		Australian Shelduck	Pacific Black Duck	Grey Teal	Chestnut Teal	Australasian Shoveler	Pink-eared Duck	Hardhead	Australian Wood Duck	Unidentified		
SATURDAY												
BSW	47	2	18	55	16	0	5	0	0	0	96	2.0
Gippsland	256	4	114	422	359	0	6	8	3	0	916	3.6
Grampians	89	7	51	309	11	0	16	3	29	0	426	4.8
Hume	208	1	68	301	27	0	30	1	391	0	819	3.9
Loddon Mallee	195	6	25	273	4	0	309	39	32	0	688	3.5
Totals	**795**	**20**	**276**	**1360**	**417**	**0**	**366**	**51**	**455**	**0**	**2945**	**3.7**
% of total		0.7	9.4	46.2	14.2	-	12.4	1.7	15.4	-		
SUNDAY												
BSW	11	0	3	4	0	0	0	0	0	0	7	0.6
Gippsland	125	1	23	61	56	0	1	1	0	0	143	1.1
Grampians	56	7	21	109	0	0	23	1	0	0	161	2.9
Hume	169	2	61	116	0	0	3	0	95	0	277	1.6
Loddon Mallee	114	4	7	261	1	0	89	7	3	0	372	3.3
Totals	**465**	**14**	**115**	**551**	**57**	**0**	**116**	**9**	**98**	**0**	**960**	**2.1**
% of total		1.5	12.0	57.4	5.9	-	12.1	0.9	10.2	-		
rand total	**1260**	**34**	**391**	**1911**	**474**	**0**	**482**	**60**	**553**	**0**	**3905**	**3.1**
% of total		0.9	10.0	48.9	12.1	-	12.3	1.5	14.2	-		

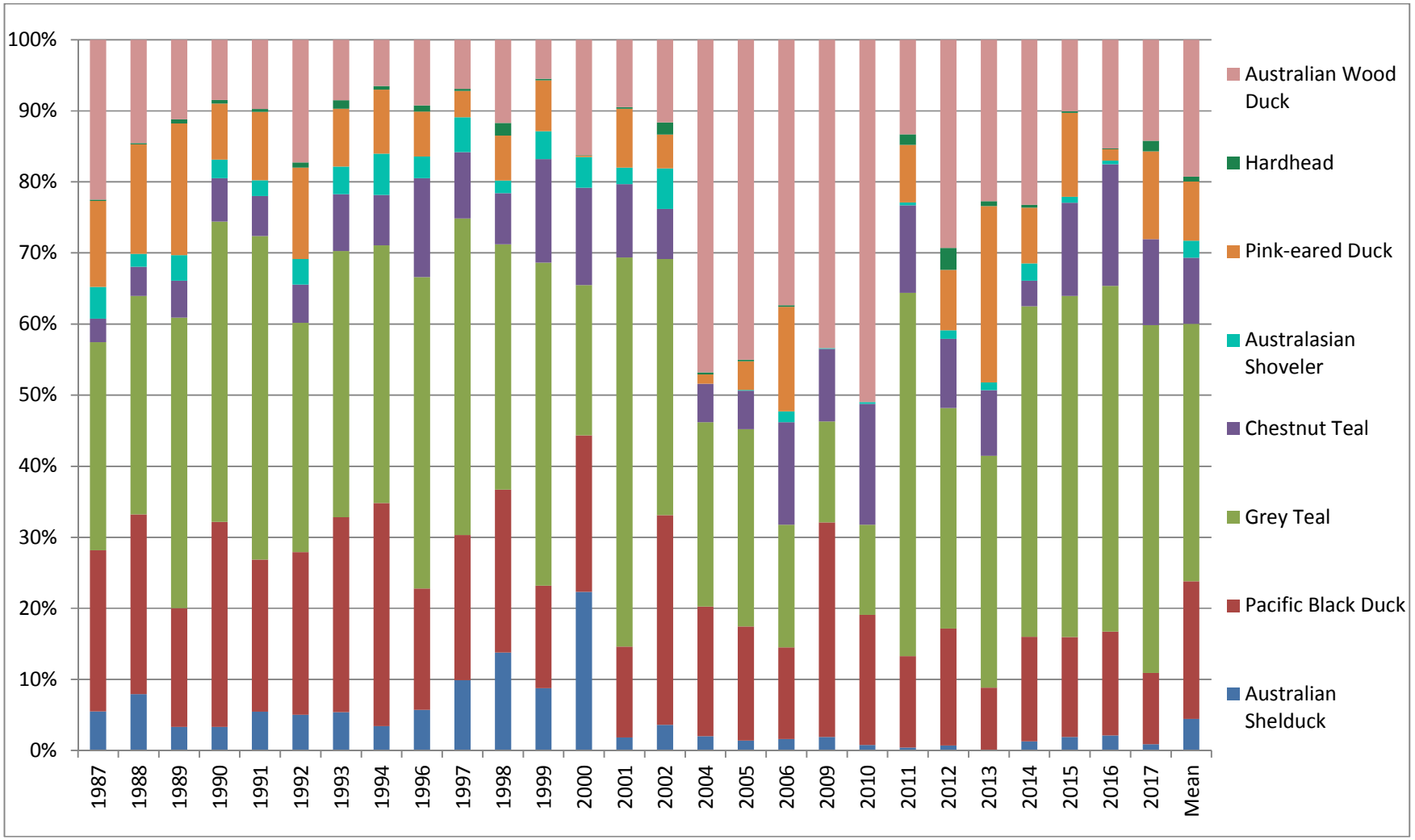

Figure 1. Species composition (% of birds examined) of hunters' bags on opening days or weekends of Victorian duck hunting seasons, 1987– 2017.
Data from Holmes (1994, Table 10) for the years 1987-1992, and ARI databases subsequently. The species breakdowns for the years 1972 to 1987 are not available in a form suitable for analysis.

Table 4. Species composition (% of birds examined) of hunters' bags on opening days or weekends of Victorian duck hunting seasons, 1987– 2015.
Data from Holmes (1994, Table 10) for the years 1987-1992, and ARI databases subsequently. The species breakdowns for the years 1972 to 1987 are not available in a form suitable for analysis. AShel – Australian Shelduck; PBD - Pacific Black Duck; GT – Grey Teal; CT – Chestnut Teal; AShov – Australasian Shoveler; PeD – Pink-eared Duck; H - Hardhead; AWD – Australian Wood Duck.

Species	Year																										Mean (sd)
	1987 [a]	1988 [a]	1989	1990	1991	1992	1993	1994	1996	1997	1998	1999	2000	2001	2002 [c]	2004 [d]	2005 [e]	2006	2009 [d]	2010	2011	2012	2013	2014	2015	2016	2017	
AShel	5.5	7.9	3.3	3.3	5.4	4.9	5.4	3.4	5.7	9.9	13.8	8.8	22.3	1.8	3.6	2	1.4	1.6	1.9	0.8	0.4	0.7	0.1	1.3	1.9	2.1	0.9	4.4 (4.84)
PBD	22.7	25.3	16.7	28.9	21.1	22.4	27.4	31.4	17	20.4	22.9	14.4	22	12.8	29.5	18.2	16.1	12.9	29.9	18.3	12.9	16.4	8.7	14.8	13.9	14.6	10.0	19.3 (6.37)
GT	29.3	30.7	40.9	42.3	44.9	31.6	37.4	36.2	43.7	44.5	34.5	45.5	21.1	54.7	36	25.9	27.8	17.2	14.1	12.7	51.1	31	32.6	46.9	47.6	48.6	48.9	36.2 (11.47)
CT	3.3	4.1	5.2	6.1	5.5	5.3	8	7.1	13.9	9.3	7.2	14.6	13.7	10.3	7	5.4	5.4	14.4	10.1	17	12.3	9.7	9.2	3.6	13	17.1	12.1	9.2 (4.06)
AShov	4.5	1.8	3.6	2.6	2.2	3.5	3.9	5.8	3	4.9	1.8	3.9	4.3	2.3	5.7	0	0.1	1.5	0.1	0.3	0.4	1.2	1.1	2.5	0.8	0.5	-	2.4 (1.79)
PeD	12.1	15.4	18.5	7.9	9.5	12.6	8.1	9	6.3	3.7	6.3	7.2	0.2	8.3	4.8	1.3	4.1	14.7	0	0	8.1	8.5	24.8	7.9	11.7	1.6	12.3	8.3 (5.90)
H	0.2	0.2	0.6	0.5	0.4	0.7	1.2	0.5	0.9	0.3	1.8	0.2	0.1	0.2	1.7	0.3	0.2	0.2	0	0	1.5	3.1	0.7	0.4	0.2	0.1	1.5	0.6 (0.72)
AWD	22.5	14.5	11.2	8.5	9.6	16.9	8.5	6.5	9.2	6.9	11.7	5.5	16.2	9.5	11.6	46.7	45.1	37.3	43	51	13.3	29.2	22.7	23.4	10	15.3	14.1	19.2 (13.70)

Hunting regulations

Data indicates opening Saturday unless otherwise stated;

a Opening weekend
b Legal possession regulations were varied considerably in this season
c An additional five Australian Wood Duck were allowed
d Only five game species (Hardhead, Pink-eared Duck and Australasian Shoveler excluded). Bag limited to two of any species, plus an additional three Australian Wood Duck per day, or five Wood Duck only per day
e Five game ducks plus five additional Australian Wood Duck per day during opening weekend

Table 5. Mean bag size obtained by hunters on the opening day of the duck hunting season, 1972 to 2017 (data from Norman and Nicholls (1991), Holmes (1994) and ARI database thereafter).

Year	Mean bag size	Year	Mean bag size
1973	1.3	1995	no season
1974	2.5	1996	3.6
1975	5.9	1997	2.0
1976	2.4	1998	1.4
1977	4.3	1999	2.2
1978	2.4	2000	1.3
1979	2.0	2001	2.2
1980	4.4	2002	1.3
1981	3.2	2003	no season
1982	3.6	2004	2.0
1983	no season	2005	2.5
1984	3.7	2006	1.6
1985	6.2	2007	no season
1986	no data	2008	no season
1987	2.0	2009	1.4
1988	2.4	2010	1.8
1989	3.9	2011	4.2
1990	4.5	2012	2.3
1991	4.2	2013	4.0
1992	2.5	2014	2.7
1993	4.4	2015	1.4
1994	4.4	2016	2.2
		2017	3.1
		Mean	**2.9**

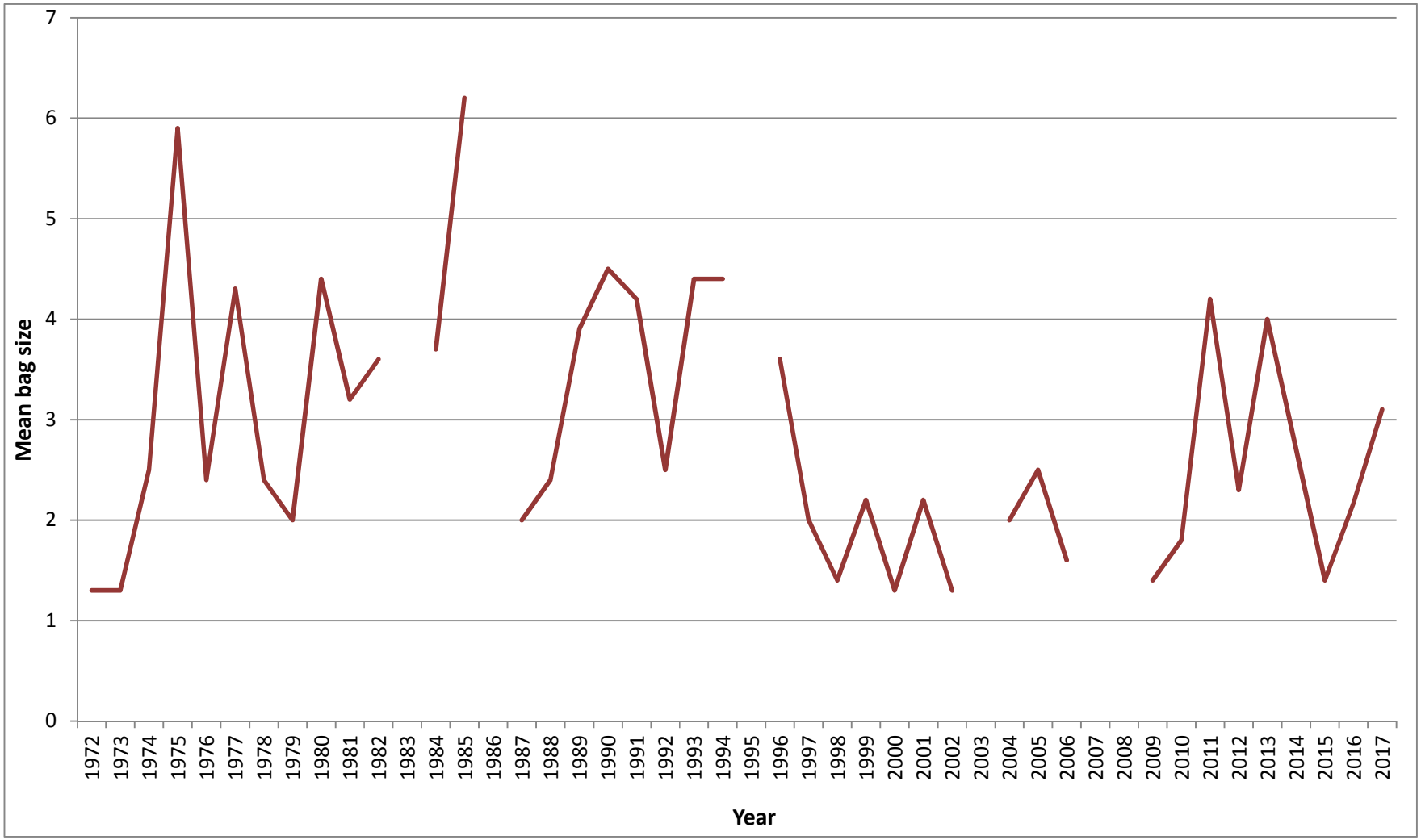

Figure 2. The data from Table 4 presented graphically – mean bag size obtained by hunters on the opening day of the duck hunting season, 1972 to 2017.
Gaps represent years in which no hunting season was declared except for 1986 when no Hunters' Bag Survey was conducted.

Table 6. Summary of age classes and primary moult status of ducks examined during the 2017 opening weekend Hunters' Bag Surveys (all sites combined).

Species	Sample size	Age class			Number of adults showing primary moult (%)
		Juvenile (%)	Adult (%)	Unsure (%)	
Australian Shelduck	12	4 (33)	8 (66)	0	0
Pacific Black Duck	108	31 (29)	69 (64)	8 (7)	0
Grey Teal	528	185 (35)	311 (59)	32 (6)	18 (3.4)
Chestnut Teal	154	30 (19)	123 (80)	1 (1)	1 (0.6)
Pink-eared Duck	80	43 (54)	37 (54)	1 (1)	1 (1.3)
Hardhead	27	16 (59)	11 (41)	0	1 (3.7)
Australian Wood Duck	151	24 (16)	122 (81)	5 (3)	3 (2.0)
Totals	**1061**	**333 (31)**	**681 (64)**	**47 (4)**	**24 (2.2)**

Table 7. Estimated harvest of game ducks on opening day of the 2017 duck hunting season derived from a comparison of the Summer Waterbird Count and the estimated take derived from the Hunters' Bag Survey for wetlands at which both surveys occurred in 2017.

Wetland	Estimate of game duck population from SWC (13-24 Feb 2017) (excludes Australasian Shoveler)	Estimated take from Hunters' Bag Survey (18 March 2017) (mean bag size x estimated number of hunters on the wetland)	Estimated harvest (percent of estimated population (from Summer Waterbird Count) that was estimated to have been shot on opening day)
Lake Buninjon	799	279.0	34.9%
Wally Allens Swamp	632	128.7	20.4%
Toolondo Reservoir	122	320.5	262.7%
Loch Garry	80	234.6	293.1%
Buffalo Dam	427	138.0	32.3%
Lake Buloke	7986	221.9	2.8%
Lake Cooper	4845	18.7	0.4%
Green Lake	3	24.0	800%
Overall	14891	1365.4	9.2%

4. Discussion

4.1 Survey effort

The original conception of the Hunters' Bag Survey was that it would be conducted widely across Victoria to provide an adequate sample to allow defensible estimates of the opening weekend take (Loyn 1989). For example, in 1992 Hunters' Bag Surveys were conducted at a total of 110 wetlands (108 on the Saturday and 25 on the Sunday including 2 not surveyed on the Saturday) (Holmes 1994). This is in stark contrast to the effort expended on Hunters' Bag Surveys in recent years; 14 wetlands surveyed in 2014, 21 in 2015 and 20 in 2016. In 2017, the number of wetlands covered increased to 31 and five DELWP regions were included. Despite this improved coverage, we still recommend that a statistical power analysis be conducted on the accumulated data to derive estimates of the sample sizes required to achieve a scientifically robust estimate of opening weekend harvest.

As well as seeking increased effort in undertaking Hunters' Bag Surveys, coordinators were requested to focus effort on wetlands that had been included in the preceding Summer Waterbird Count. During 2017, bag surveys were conducted on opening day at eight wetlands that had been included in the Summer Waterbird Count and for which an estimate of the number of hunters present on the wetland had been provided (Table 1). Again, this is a low number, further reducing confidence in the estimates of harvest levels over opening weekend (Table 7).

4.2 Species composition in hunters' bags and a comparison with previous years

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 it. 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 2017 were Grey Teal, Australian Wood Duck and Pink-eared Duck. Since 1987, the first two of 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 1). In 2017, Pacific Black Duck was relatively under-represented and Pink-eared Duck was more prevalent in the sample than usual (Figure 1).

4.3 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 (D. Rogers ARI pers. comm.). The new system for obtaining age class data introduced in 2017 worked well (J. Turnbull and H. Dunstan, GMA pers. comm.) with 1,061 samples covering all seven game species assigned an age class. However, sample sizes for the two species that were least common in bags – Australian Shelduck and Hardhead – were probably inadequate to provide robust estimates of age class distribution. Juveniles comprised over half the take of Pink-eared Duck and Hardhead, and roughly one third of Pacific Black Duck and Grey Teal. In

stark contrast, the proportion of birds identified as immature in 2016 was very low – 3.4% (Menkhorst and Purdey 2016). These results suggest that inland-breeding species had a reasonably successful breeding event within the six months preceding opening weekend. We recommend that the new system be maintained and that more staff of DELWP and GMA be trained in its use.

4.4 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), at 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 2017 when 2.2% of the 1,061 wing samples showed active primary moult. Frequency of moulting was highest in the Grey Teal – 3.4% of adults. Therefore, we conclude that it is unlikely that moult stage unduly influenced harvesting rate for any species.

4.5 Estimates of harvest on opening weekend

The wide variation between wetlands in the estimated harvest (0.4%-800%) highlights the lack of precision in this parameter. Likely sources of error include both structural issues and observer error. Structural issues were:

1. The one month time lag between the Summer Waterbird Count and the Hunters' Bag Survey – waterfowl numbers could change dramatically during the intervening period;
2. The small sample size – a mean of 9.4 wetlands over the last five years (range 5 to 14). Given the variation in the data, a much larger number of wetlands needs to be included in both surveys to allow any confidence in these results.

Major sources of observer error were:

1. Poor coverage of a wetland during Summer Waterbird Counts leading to a biased sample (for example, counters tend to focus on parts of a wetland that are likely to have the most birds or are easier of access, but may not be representative of the whole);
2. Poor estimates of the proportion of the wetland that was counted;
3. Poor estimates of the number of hunters active on a wetland over opening weekend (it is in the hunters' interest to be inconspicuous, so an unknown proportion is likely to go unnoticed).

In combination, these sources of error are likely to be significant, meaning that little confidence can be placed on the estimated harvest rates at individual wetlands. The effect of such errors can be minimised by calculating the overall harvest rate across the eight wetlands. This calculation gives a mean harvest rate across all eight wetlands of 9.2% (Table 7). Without a concerted effort to address these sources of error we do not recommend that these estimates are used for management purposes and they should be discontinued.

Conclusions

1. The mean bag size achieved in 2017 (3.1 ducks) was 7% above the long-term mean of 2.9, indicating a reasonably good return for hunters.
2. The species composition in hunters' bags was also in line with past seasons although the proportion of Pacific Black Duck was slightly lower.
3. There had clearly been successful breeding in the months prior to the season opening, with almost one third of bagged birds being juvenile.
4. A long-term dataset of recruitment and age-related survival is required to reliably assess the impact of hunting on game duck population trends.

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