

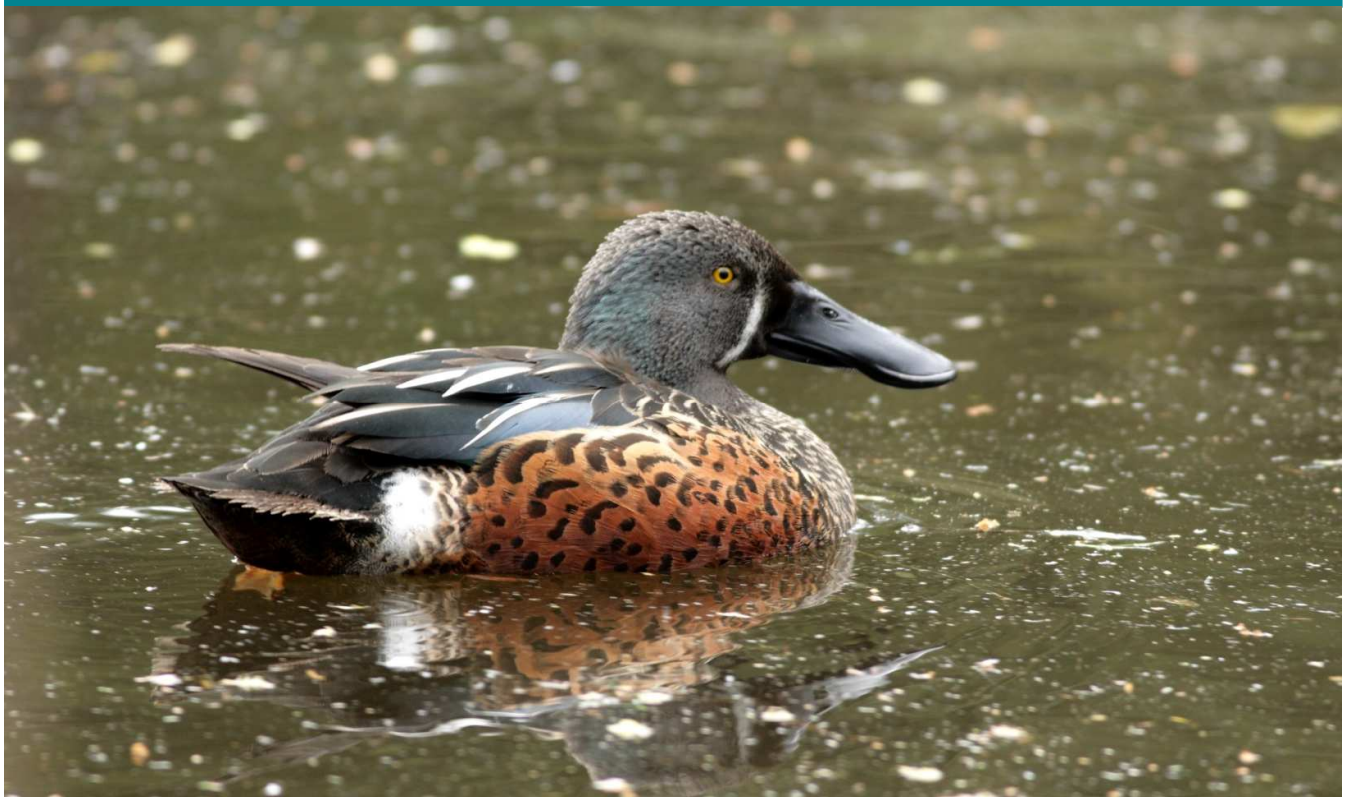
Hunter's Bag Survey: 2016 Victorian duck hunting season

Peter Menkhorst and Daniel Purdey

June 2016

Arthur Rylah Institute for Environmental Research

Unpublished Client Report for Ecological Policy Branch, Department of Environment, Land, Water and Planning



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Front cover photo: Male Australasian Shoveler, this species was declared a non-game species for the 2016 duck hunting season. Photographer P. Menkhorst

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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 hunter's bags (i.e. to examine the carcasses of waterbirds in the possession of a sample of hunters after they have finished shooting for the day, but before they depart the wetland at which the shooting took place). 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.

The opening weekend of Victoria's 2016 duck hunting season fell on Saturday 19 and Sunday 20 March. Surveyors interviewed individual hunters at wetlands after the main morning hunting period and recorded details of the numbers and species of dead birds in their possession. In addition, a sample of shot birds was examined for the presence of wing (primary feather) moult, and categorised as either adult or immature. Details regarding the shooting of protected species were obtained by examination of carcasses as well as by shoreline surveys.

On the 2016 opening weekend, Hunter's Bag Surveys were conducted at 15 public wetlands on Day 1 (Saturday, 19 March) and 10 wetlands on Day 2 (Sunday, 20 March), of which five had also been surveyed on Day 1, giving a total of 20 wetlands with some level of coverage. On Day 1, mean success rate was 1.92 ducks per hunter (N=738 bags, range 0-8) and on Day 2, 1.38 ducks per hunter (N=304 bags, range 0-8). The mean opening day take (1.76 birds) was 62% of the long-term mean of 2.9, (N=38 years), as would be expected from the low numbers of waterfowl recorded during the Summer Waterbird Count conducted in the second half of February 2016.

The species found in hunter's bags and their relative proportions were:

Species	Count (% of total bag count)	
	19 March N=738 bags	20 March N=304 bags
Grey Teal (<i>Anas gracilis</i>)	687 (48.6)	199 (46.4)
Australian Wood Duck (<i>Chenonetta jubata</i>)	217 (15.3)	79 (16.0)
Pacific Black Duck (<i>Anas superciliosa</i>)	207 (14.6)	71 (16.6)
Pink-eared Duck (<i>Malacorhynchus membranaceus</i>)	23 (1.6)	3 (0.7)
Chestnut Teal (<i>Anas castanea</i>)	242 (17.1)	65 (15.2)
Australasian Shoveler (<i>Anas rhynchos</i>)*	7 (0.5)	0
Australian Shelduck (<i>Tadorna tadornoides</i>)	29 (2.1)	10 (2.3)
Hardhead (<i>Aythya australis</i>)	2 (0.1)	0
Unidentified (e.g. plucked)	0	9 (2.1)
Total	1414	429

* a non-game species during the 2016 duck hunting species

The four most numerous species in bags (Grey Teal, Chestnut Teal, Australian Wood Duck, Pacific Black Duck) comprised 95.9% of ducks counted in hunter's bags over opening weekend.

Introduction

Duck hunting is provided for under the *Wildlife Act* (1975) and a hunting season is held annually between the third Saturday in March and the second Monday in June unless the responsible Ministers determine that there is a strong argument against declaring a hunting season. In Victoria, eight duck species are declared game species (Australasian Shoveler, Australian Shelduck, Australian Wood Duck, Chestnut Teal, Grey Teal, Hardhead, Pink-eared Duck and Pacific Black Duck). If environmental conditions require it, the responsible Ministers may further regulate duck hunting under the *Wildlife (Game) Regulations* (2012) to ensure that it remains sustainable (<http://www.gma.vic.gov.au/hunting/duck/arrangements-for-duck-season>). The regulations prescribe the wetlands open to hunting, the duration of the season, daily bag limits for each hunter, and allow declaration of one or more of the eight game species to be temporarily protected for that season.

Estimating the actual 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 hunter's bags, i.e. to examine carcasses in possession of hunters as they return to their camp or vehicle after a hunt. Such surveys have been conducted on opening weekend at Victorian wetlands in 38 of the 44 years since 1972 (5 of the 6 exceptions were years in which no open season was declared). They aim to estimate the number of birds taken on opening weekend, hunter success, the species and age composition of birds shot during opening weekend, and the incidence of birds actively moulting flight feathers at the time (Braithwaite and Norman 1974, Loyn 1989, Holmes 1994). Moulting of flight feathers can be a management issue when concentrations of flightless moulting adults may be vulnerable to overharvesting. The Australian Shelduck, in particular, gathers to moult at specific locations in mid-summer (Frith 1982).

Hunter's Bag Surveys are undertaken by staff of the Department of Environment, Land, Water and Planning (DELWP), the Victorian Game Management Authority and the Department of Economic Development, Jobs, Transport and Resources (DEDJTR).

This report provides a summary of information obtained during the opening weekend of the 2016 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. immature vs adult) of a sample of birds harvested and the incidence of wing moult are also summarised.

The 2016 hunting season and restrictions

As prescribed in the *Wildlife (Game) Regulations* (2012), the 2016 duck hunting season in Victoria ran for 86 days from 19 March through to 13 June. Due to prevailing dry conditions and low duck populations across much of Victoria, the allowable daily take was reduced to eight game ducks on opening day and four ducks per day thereafter. No Australasian Shoveler were to be taken.

Methods

Hunter and wetland surveys

The survey of hunter's bags took place on the Saturday and Sunday of the opening weekend (19 and 20 March) at 20 wetlands spread across four of the five DELWP regions (Table 1). Regional coordinators were responsible for the administration and coordination of local surveys. Regional coordinators allocated resources for executing surveys, trained staff (where appropriate), maintained the accuracy and integrity of the data collected, and ensured that data were submitted to the state-wide coordinator by a nominated date. Sites where surveys had been undertaken previously were identified, and coordinators were asked to ensure that hunters were surveyed at these 'long-term' sites, as well as at 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).

Standardised survey forms and instruction sheets were circulated to coordinators. 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 as long as group size was recorded. Interviewers were asked to provide estimates of the total number of hunters present at each wetland surveyed. Details regarding numbers and species of birds bagged, and the time birds were taken, were obtained during interviews. In addition, some bagged birds were examined for the presence of wing (primary feather) moult, and were categorised as either 'adult' or 'immature', based on the presence or absence of notched tail feathers – an indication of a young bird still in immature plumage. When interviewed, hunters were also asked whether they had finished hunting for that day. The same survey methods were to be 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 was recorded.

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.

Results

Survey coverage and effort

On opening day of the 2016 duck hunting season (Saturday, 19 March), 1414 ducks were examined in 738 hunter's bags on 15 public wetlands (Table 1). On Day 2 (Sunday, 20 March) of opening weekend, 429 ducks were recorded in 304 hunter's bags on 10 public wetlands, five of which had also been surveyed on the Saturday (Table 1). Survey effort varied regionally, being greatest in the Gippsland, Grampians and Hume Regions (combined total equals 96% of bags examined) (Table 2) with a low effort in Barwon South West Region (6%) and no Hunter's Bag Surveys undertaken in the Loddon Mallee Region. The intensity of survey effort across DELWP regions is detailed in Table 2.

Species composition of bags

Grey Teal was by far the most numerous species in hunter's bags – 687 were recorded, amounting to 49% of the open day harvest (Table 3), followed by Chestnut Teal (307, 16.7%), Australian Wood Duck (289, 15.8%) and Pacific Black Duck (278, 15.2%). Together, these four species accounted for 95.9% of the shot sample. Four species comprised the remaining 4% of the shot sample – Pink-eared Duck, Australasian Shoveler (a prohibited species for the 2016 season), 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 predominate species in hunter's bags in Victoria (annual mean frequency 33.9%) followed by Pacific Black Duck and Australian Wood Duck (19.1% and 18.9% respectively) (Table 4, Figure 1).

Hunter success

On opening day, the 738 hunters whose bags were examined had an average of 1.9 ducks per hunter (Table 3). Empty bags were held by 64 hunters (8.7% of hunters surveyed) at the time they were interviewed. The prescribed bag limit of 8 had been reached by 19 hunters (2.6%), at Reedy Lake (Barwon South West Region), Lake Curlip (Gippsland Region) and Lake Toolondo (Grampians Region).

On the Sunday, 304 hunters were found to have an average of 1.4 ducks (Table 3). Forty seven hunters (15.5%) held empty bags and 25 hunters had reached the legal bag limit of 4 game ducks, two at Lake Burrumbeet (Grampians Region), one at Lake Hume, four at Delatite Arm, Lake Eildon (Hume Region), three at Loch Sport Eel Farm and 15 at Hollands Landing (Gippsland Region).

Mean hunter success for the opening weekend was 1.8, 62% of the long-term mean bag size of 2.9 (Table 5, Figure 2). Mean bag size was highest in the Barwon South West Region (2.8 ducks per hunter), followed by the Grampians and Gippsland Regions (both 1.8) (Table 3).

Numbers of surveyed hunters against estimates of total hunters on wetlands

Estimates of total hunters present were made at all wetlands at which Hunter's Bag Surveys were conducted. At the 9 wetlands surveyed on the Saturday, 465 hunters were interviewed, 64% of the estimated 727 hunters present at wetlands where surveys were conducted. On Sunday at 7 wetlands, 201 of the estimated 267 hunters (75%) were interviewed. The proportion surveyed for the weekend was 67% of the estimated total hunters present on wetlands where surveys were carried out.

Table 1. Wetlands at which Hunter's Bag Surveys were conducted on the opening weekend of the 2016 waterfowl hunting season in Victoria. Data are shown for individual DELWP Regions, and as state-wide totals.

Day	Wetland Name	DELWP Region	Bags counted
Saturday	Reedy Lake	BSW	31
	Burrumbeet	Grampians	59
	Toolondoo Reservoir	Grampians	143
	Broken Creek	Hume	64
	Black Swamp (Nine mile Creek)	Hume	18
	Parolas	Hume	55
	Lake Hume	Hume	59
	Lake Eildon (Delatite arm)	Hume	27
	Nillacootie	Hume	9
	Lake Corringale	Gippsland	8
	Lake Curlip	Gippsland	28
	Dowds Morass	Gippsland	154
	Spoon Bay, Gippsland Lakes Coastal Park	Gippsland	29
	Heart Morass	Gippsland	47
	Gippsland Coastal Track (Lakeside Tk)	Gippsland	7
Day total			738
Sunday	Reedy Lake	BSW	7
	Burrumbeet	Grampians	13
	Toolondoo Reservoir	Grampians	79
	Campaspe River	Hume	10
	Lake Buffalo	Hume	48
	Lake Hume	Hume	26
	Lake Eildon (Delatite arm)	Hume	18
	Lake Curlip	Gippsland	11
	Loch Sport, Lake Victoria Eel Farm	Gippsland	54
	Near Hollands Landing	Gippsland	38
Day total			304

Table 2. Distribution of Hunter’s 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 total)	Number of birds examined
Saturday	Barwon South West	1	31 (4.2)	98
	Gippsland	6	273 (37.0)	468
	Grampians	2	202 (27.4)	471
	Hume	6	232 (31.4)	377
	Loddon Mallee	0	-	-
Day total		15	738	1414
Sunday	Barwon South West	1	7 (2.3)	11
	Gippsland	3	103 (33.9)	213
	Grampians	2	92 (30.3)	58
	Hume	4	102 (33.5)	147
	Loddon Mallee	0	-	-
Day total		10	304	429
Weekend total		20	1042	1843

Breaches of bag limits and species-specific regulations

Twelve breaches of the game laws were documented on Hunter’s Bag Survey datasheets: seven Australasian Shovelers were recorded in five hunter’s bags from Lake Burrumbeet on the Saturday, and one incidence of exceeding the bag limit was recorded at Toolondo Reservoir on the Saturday when a bag shared between two hunters contained 18 game ducks, two over the limit of eight birds each. Australasian Shoveler (also called Blue-winged Shoveler) was prohibited from hunting for the 2016 duck hunting season (Game Management Authority 2016).

On the Sunday at Loch Sport, two hunters had a bag containing 12 ducks, meaning each hunter had two over the limit. At Hollands landing on the same day a group of 15 hunters had 64 ducks, meaning four hunters had one too many.

Age classes of bagged birds

A total of 219 ducks from five game species were examined for age class (Table 6). Apart from being small (only 11.7% of non-plucked ducks examined), this sample was not representative of the species composition of all ducks examined. Chestnut Teal and Australian Wood Duck made up 63% of the aged sample but only 33% of the bagged birds examined. Conversely, Grey Teal, the most abundant species in the bags examined (48%), comprised less than 20% of the aged sample. These anomalies most probably relate to geographic bias in the collection of age data – it was only collected at three sites, Lake Hume (Hume Region), Reedy Lake (Barwon South West Region) and Dowds Morass (Gippsland Region). Consequently, the data do not provide a

representative sample of the birds shot on opening weekend and no conclusions can be drawn. Few immature birds were identified – two Pacific Black Ducks, five Grey Teal and three Chestnut Teal.

The incidence of moult

Of 214 adult birds examined for moult, only one adult Chestnut Teal was recorded as having active wing moult. Five of the eight immature birds were classified as being in wing moult, 2 Pacific Black Duck, 2 Chestnut Teal and 1 Grey Teal.

Estimates of harvest on opening weekend

There were eight wetlands surveyed during the 2016 Hunter's Bag Survey at which birds had been surveyed during the 2016 Summer Waterbird Count: one in Barwon South West Region (Reedy Lake), one in Hume Region (Black Swamp (Nine Mile Creek)), two in Grampians Region (Toolondo Reservoir and Lake Burrumbeet) and four in Gippsland Region (Dowds Morass, Heart Morass, Lake Curlip and Lake Corringale). At these wetlands an estimate of the total harvest over opening weekend can be achieved by extrapolating the mean bag size to the estimated number of hunters and comparing that total to the estimated number of game ducks present during the Summer Waterbird Count. Results of this comparison are presented in Table 7; the estimated take varied from 2% to 155%.

Unrecovered and wounded birds

Reports of wounded and unretrieved ducks came from Parolas, Reedy Lake and Toolondo Reservoir, involving a total of 38 ducks. Staff also collected 122 unretrieved, dead ducks from Lake Buffalo and Parolas. Survey staff at Parolas were informed by hunters that they had intended to retrieve these dead ducks later in the day using their retriever dogs. In addition, four wounded Banded Stilts were seen by Gippsland staff near Hollands Landing.

Table 3. Summary of individual game species found in hunter's bags on the opening weekend of the 2016 duck hunting season in Victoria. Data are shown for individual DELWP Regions and as state-wide totals. No surveys were undertaken in the Loddon Mallee Region.

Day and DELWP region	Number bags examined	Species									Total identified	Average bag size
		Australian Shelduck	Pacific Black Duck	Grey Teal	Chestnut Teal	Australasian Shoveler	Pink-eared Duck	Hardhead	Australian Wood Duck	Unidentified		
SATURDAY												
Gippsland	273	9	69	214	175	0	1	0	0	0	468	1.71
Hume	232	4	62	94	5	0	0	0	212	0	377	1.63
Grampians	202	16	39	379	1	7	22	2	5	0	471	2.33
BSW	31	0	37	0	61	0	0	0	0	0	98	3.16
Totals	738	29	207	687	242	7	23	2	217	0	1414	1.92
% of total identified		2.1%	14.6%	48.6%	17.1%	0.5%	1.6%	0.1%	15.3%	0.0%		
SUNDAY												
Gippsland	103	8	39	120	45	0	0	0	1	0	213	2.06
Hume	102	0	21	39	9	0	0	0	69	9	138	1.35
Grampians	92	2	11	39	1	0	3	0	2	0	58	0.63
BSW	7	0	0	1	10	0	0	0	0	0	11	1.57
Totals	304	10	71	199	65	0	3	0	72	9	420	1.38
% of total identified		2.4%	16.9%	47.4%	15.5%	0.0%	0.7%	0.0%	17.1%	2.1%		
Weekend total	1042	39	278	886	307	7	26	2	289	9	1834	1.76
% of total identified birds		2.1%	15.2%	48.3%	16.7%	0.4%	1.4%	0.1%	15.8%	0.5%		

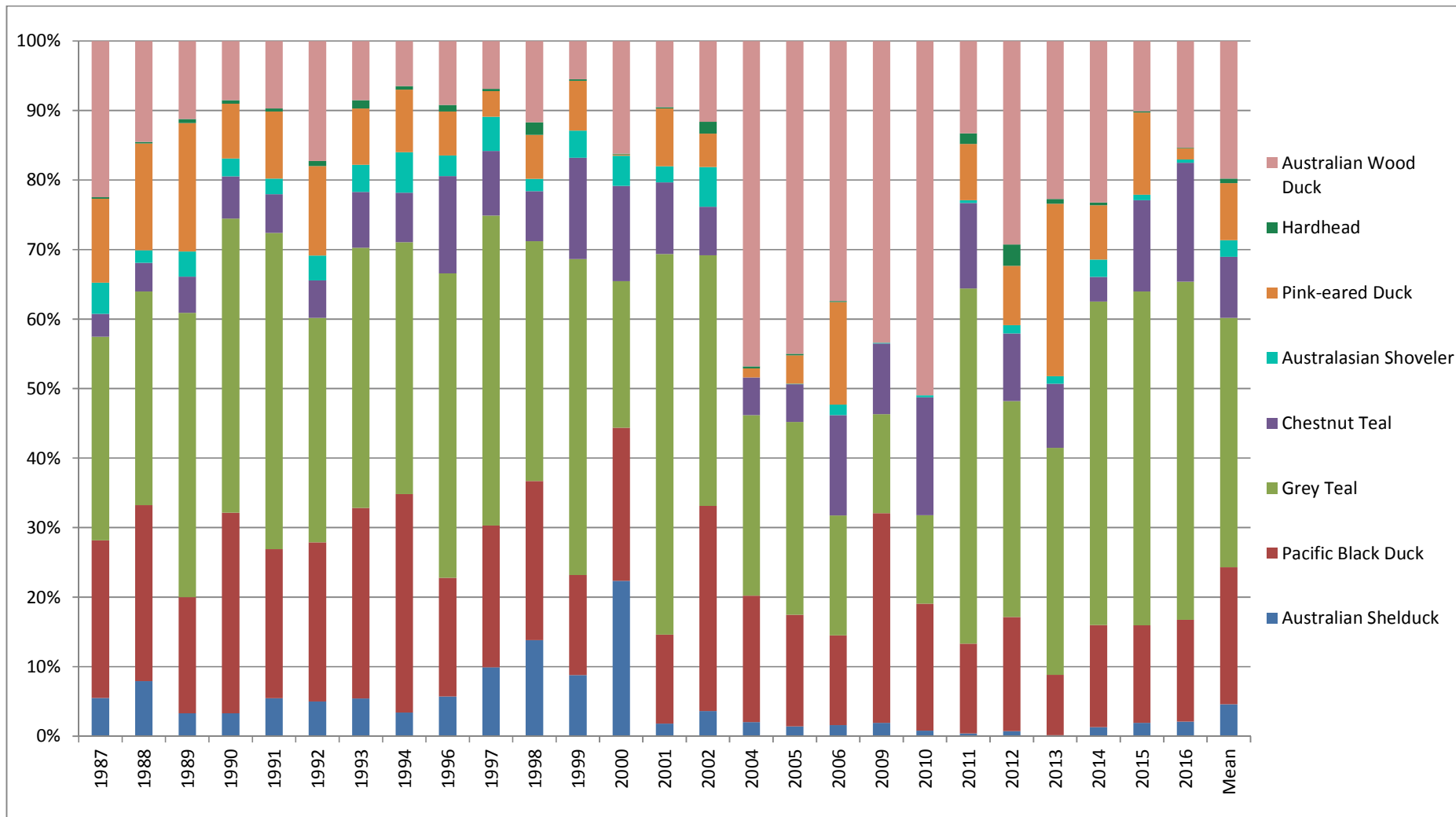


Figure 1. Species composition (% of birds examined) of hunter's bags on opening days or weekends of Victorian duck hunting seasons, 1987–2016. Data from Holmes (1994, Table 10) for the years 1987-1992, and ARI databases subsequently. The species breakdowns for the years 1972 to 1987 are not available in a form suitable for analysis.

Table 4. Species composition (% of birds examined) of hunter's 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.

Species	Year																										Mean
	1987 ^a	1988 ^b	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	
Australian Shelduck	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	4.5
Pacific Black Duck	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	19.1
Grey Teal	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	33.9
Chestnut Teal	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	8.5
Australasian Shoveler	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
Pink-eared Duck	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	8.1
Hardhead	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	0.6
Australian Wood Duck	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	18.9

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 2016 (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
		Mean	2.9

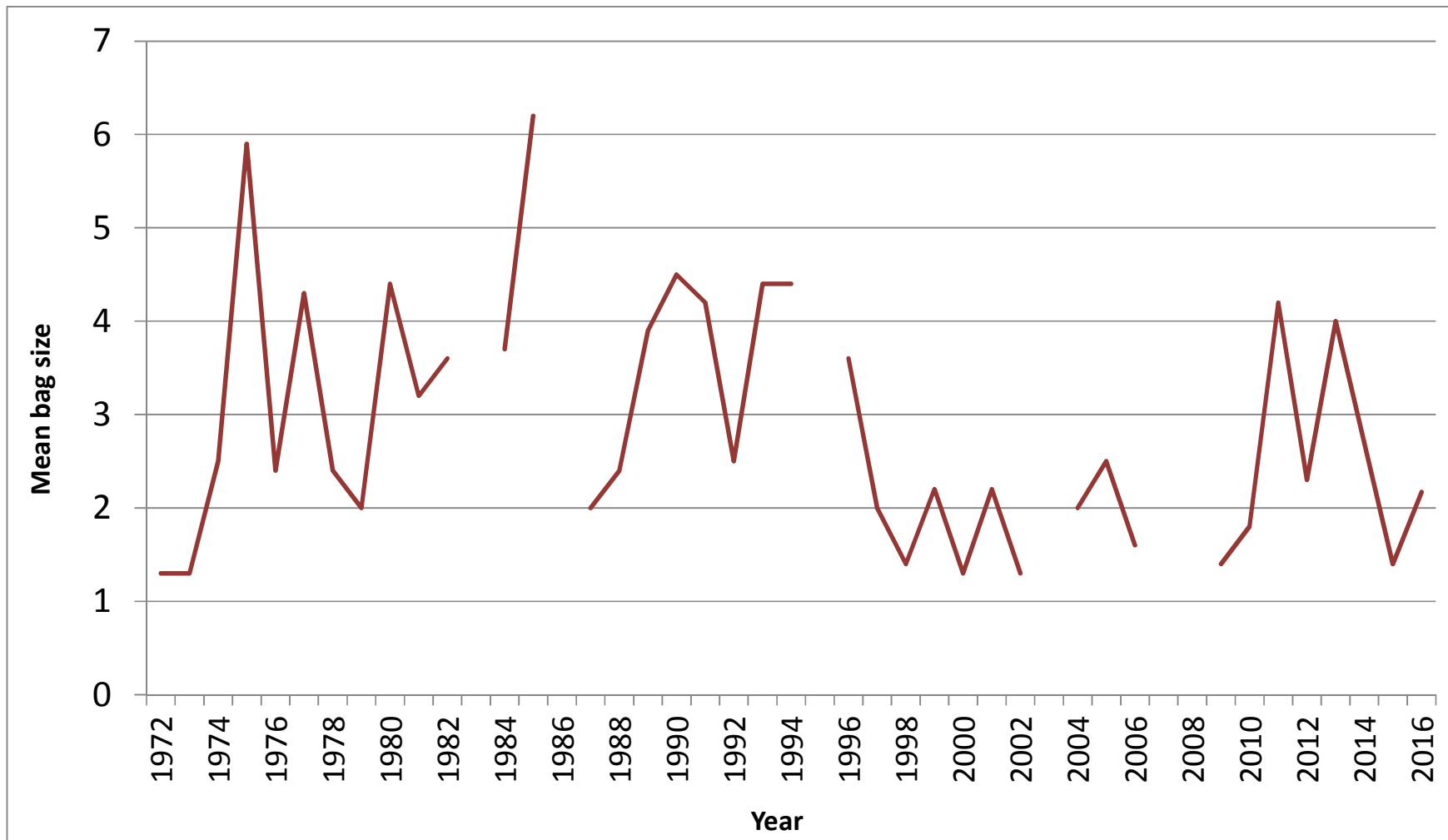


Figure 2. The data from Table 4 presented graphically – mean bag size obtained by hunters on the opening day of the duck hunting season, 1972 to 2016. Gaps represent years in which no hunting season was declared except for 1986 when no Hunter’s Bag Survey was conducted.

Table 6. Summary of age classes of ducks examined during the 2016 opening weekend Hunter's Bag Surveys (all sites combined).

Species	Total immature	Total adult	Unsure	Total	% immature	% adult
Australian Shelduck	0	1	0	1	0	100
Pacific Black Duck	2	36	0	38	5.3	94.7
Grey Teal	3	40	0	43	7.0	93.0
Chestnut Teal	3	74	0	77	3.9	96.1
Australasian Shoveler	0	0	0	0	0	0
Pink-eared Duck	0	0	0	0	0	0
Hardhead	0	0	0	0	0	0
Australian Wood Duck	0	60	0	60	0	100
Totals	8	211	0	219	3.6	96.3

Table 7. Estimated harvest of game ducks on opening weekend of the 2016 duck hunting season derived from a comparison of the Summer Waterbird Count and the estimated take derived from the Hunter's Bag Survey for wetlands at which both surveys occurred in 2016.

Wetland	Estimate of game duck population from SWC (15-26 Feb 2016)	Estimated take from Hunter's Bag Survey (19-20 March 2016)	Estimated harvest (percent of estimated population that was shot on opening weekend)
Reedy Lake	4176	616	15
Black Swamp	31	14	45
Toolondo Reservoir	343	531	155
Lake Burrumbeet	7320	177	2
Dowds Morass	2847	153	5
Heart Morass	330	177	54
Lake Corringle	46	65	141
Lake Curlip	158	137	87

Discussion

Survey effort

The original conception of the Hunter's 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 Hunter's 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 Hunter's Bag Surveys in recent years; 14 wetlands surveyed in 2014, 21 in 2015 and 20 in 2016. The limited data collected in recent years severely reduces the value of the Hunter's Bag Survey in assessing the impact of duck hunting on waterbird populations. We 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 Hunter's Bag Surveys in recent years, coordinators have been requested to focus effort on wetlands that had been included in the preceding Summer Waterbird Count. During 2016, bag surveys were conducted at eight wetlands that had been included in the Summer Waterbird Count, slightly below the mean number achieved over the last five years (9.4).

Species composition of the shot sample and a comparison with previous years

The annual survey of the contents of hunter's 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 at this time (e.g. Norman and Powell 1981, Loyn 1991, Moloney and Turnbull 2015).

The most numerous species in bags in 2016 were Grey Teal, Australian Wood Duck, Pacific Black Duck and Chestnut Teal. Since 1987, the first three 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).

Age structure in the shot sample

The duck hunting season is timed to avoid the main breeding seasons of game species and most waterbirds. The proportion of immature ducks in hunter's bags is the only current measure of annual production during the previous breeding season, and we emphasise that it is an imperfect measure. In 2016, the proportion of birds identified as immature was very low; 3.4% compared with an average of 50% in the 1980s when these measurements were made routinely at large numbers of wetlands (Loyn 1989). While this may suggest that the 2015/16 breeding season was poor, the sample sizes are low and geographically localised, providing little confidence in the estimate. Further, we are aware that expertise to undertake the age classification is no longer commonplace amongst DELWP and GMA staff.

Moult in the shot sample

Moulting was considered a significant management issue in the 1970s when duck hunting season sometimes opened as early as January (Loyn 1989) when moulting in some species is still taking place. However, with the season now opening later (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 2016 when only one

of 205 adult ducks examined for moult was recorded as having active moult. However, the situation for juveniles may differ; 5 of 8 juveniles assessed for moult were recorded as showing moult of flight feathers on opening weekend. This finding further highlights the vulnerability of ducks that are still in juvenile plumage (up to six months post fledging for game duck species) during the early part of the duck shooting season.

Estimates of harvest on opening weekend

The wide variation between wetlands in the estimated harvest highlights the lack of precision in this parameter. Likely sources of error include both structural issues and observer error. Structural issues are:

1. The one month time lag between the Summer Waterbird Count and the Hunter 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 need to be included in both surveys to allow any confidence in these results.

Major sources of observer error are:

1. Low 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 has been counted.
3. Poor estimates of the number of hunters active on a wetland over opening weekend (it is in the hunter's 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. Without a concerted effort to address these issues we do not recommend that these estimates are used for management purposes and they should be discontinued.

Conclusion

The 2016 harvest rate of 62% of the long-term mean, may indicate a reduction in state-wide duck numbers, commensurate with the dry conditions prevailing, however, it is based on a small sample of wetlands. More intensive monitoring at a much larger number of wetlands is required to provide a robust estimate of levels of take for game and protected species.

References

- Braithwaite, L.W. and Norman, F.I. (1974) The 1974 open season on waterfowl in south-eastern Australia. CSIRO Division of Wildlife Research Technical Paper Number 29. CSIRO, Canberra.
- Frith, H.J. (1982) *Waterfowl in Australia*. 3rd edition. Angus & Robertson, Sydney.
- Game Management Authority (2016). *Victorian Hunting Guide 2016*. 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.
- Moloney, P. D. and Turnbull, J. D. (2015) Estimates of harvest for deer, duck and quail in Victoria: results from surveys of Victorian game Licence holders in 2014. Unpublished Client Report produced by the: Arthur Rylah Institute for Environmental Research Department of Environment, Land, Water and Planning, PO Box 137, Heidelberg, Victoria.
- Norman, F.I. and Nicholls, N. (1991) The Southern Oscillation and variations in waterfowl abundance in south eastern Australia. *Aust. J. Ecol.* 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.

