



Monitoring trends in waterfowl wounding 2025

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1 Executive Summary

The Victorian Sustainable Hunting Action Plan 2021 – 2024 (SHAP) committed to implementing a monitoring program to measure the success of management interventions to reduce waterfowl wounding in duck hunting. In 2022, the Game Management Authority (GMA) commenced a monitoring program using radiography (x-ray) to detect embedded shotgun pellets in ducks as an index of the incidence of wounding. This monitoring program continued in 2023, 2024 and 2025.

Following the 2025 duck season, game duck species were trapped at seven sites within four separate regions of Victoria. In total, 707 game ducks were captured and radiographed. Six species of game ducks were captured and examined: Grey Teal, Chestnut Teal, Pacific Black Duck, Australian Wood Duck, Australian Shelduck and Hardhead.

A total of 18 of the 707 game ducks that were examined were found to be carrying embedded pellets. Pellet infliction was observed in three species: Chestnut Teal, Grey Teal and Pacific Black Duck. In total, 2.5 per cent of the ducks were shown to be carrying embedded pellets. This was lower than the infliction rate of 4.8 per cent recorded in 2024 and 3.4 per cent recorded in 2022 and similar to the 2.4 per cent recorded in 2023. First year birds were found to have a higher infliction rate than adult birds (3.4 per cent vs 1.8 per cent, respectively). Pacific Black Ducks were found to have the highest rate of infliction, with 10.2 per cent of examined Pacific Black Ducks carrying embedded pellets.

The overall infliction rate of 2.5 per cent cannot be interpreted as the actual rate of wounding associated with duck hunting. This is because the birds sampled in this study are representative of the apparently small proportion that survive being wounded and are available for examination. The infliction rate can only be used as a proxy index to monitor trends in waterfowl wounding. Direct studies, such as observations of hunters in the field, should be used to determine the actual rate of wounding more accurately.

2 Background and purpose

Wounding can be an unintended consequence of duck hunting. A wounded bird is defined as one that is struck by shotgun pellets and not recovered by the hunter. Factors that can contribute to wounding include poor shooting skills, long-range shooting, incorrect equipment choices, shooting into flocks and the lack of an effective retrieval strategy (Roster 1998a; Roster 1998b; Clausen *et al.* 2017).

The SHAP committed to implementing a monitoring program to measure the success of management interventions to reduce waterfowl wounding in duck hunting. A strong-evidence base will help to ensure informed community discussion on waterfowl wounding, guide management actions and allow the success of actions to be reviewed.

The Danish Hunter's Association developed and implemented a program to monitor wounding by x-raying live trapped birds to identify the proportion carrying embedded shot (Noer *et al.* 2007). This has been used effectively to measure the success of a targeted plan to reduce waterfowl wounding caused by hunting in Denmark. In response to the SHAP commitment, an ongoing wounding monitoring program using radiography (x-rays) commenced in 2022. While this approach cannot be used to determine actual level or rate of wounding, it can be used as a proxy measure to monitor trends in the rates of wounding in a less resource intensive way than some other forms of monitoring (Clausen *et al.* 2017).

The wounding monitoring program commenced with a trial in June 2021 to test methods and techniques to capture and x-ray wild-caught game ducks. Learnings were then applied, and large-scale monitoring began in 2022 and has continued annually since then. Game ducks are trapped immediately

following the end of the duck season and radiographed to document the proportion of birds carrying embedded shotgun pellets (the infliction rate). Since 2023, additional capture sites have been added to increase geographic coverage of the state. All sites are located in areas where duck hunting generally occurs.

The monitoring program has a particular interest in immature (first year) birds, as they provide a more accurate measure of the incidence of wounding, as they have been exposed to a single season of hunting, compared to adult birds that can accumulate pellets over several hunting seasons (Norman 1976; Noer and Madsen 1996, Noer *et al.* 2007).

To raise awareness, ensure transparency and motivate hunters to act, findings of this monitoring program are reported annually on the GMA website. This is the fourth report on monitoring trends in waterfowl wounding in Victoria.

3 Methods

3.1 Target species

In Victoria, there are seven species of game ducks which may be hunted during the prescribed open season. These are: Grey Teal (*Anas gracilis*), Pacific Black Duck (*Anas superciliosa*), Australian Wood Duck (*Chenonetta jubata*), Chestnut Teal (*Anas castanea*), Australian Shelduck (*Tadorna tadornoides*), Pink-eared Duck (*Malacorhynchus membranaceus*) and Hardhead (*Aythya australis*). Although declared to be a game species, the Australasian Shoveler has a year-round closed season and may not be hunted. The de-listing of Hardhead as a threatened species allowed them to be hunted during the 2025 duck season.

3.2 Survey locations

All birds were wild caught at seven sites from four different regions in Victoria. Trapping locations can be generalised as the north-east (Benalla and Wangaratta), south (Lara and Point Wilson), north-west (Boort) and south-east (Kongwak and Sale). Trapping locations for 2025 are detailed in Figure 1.

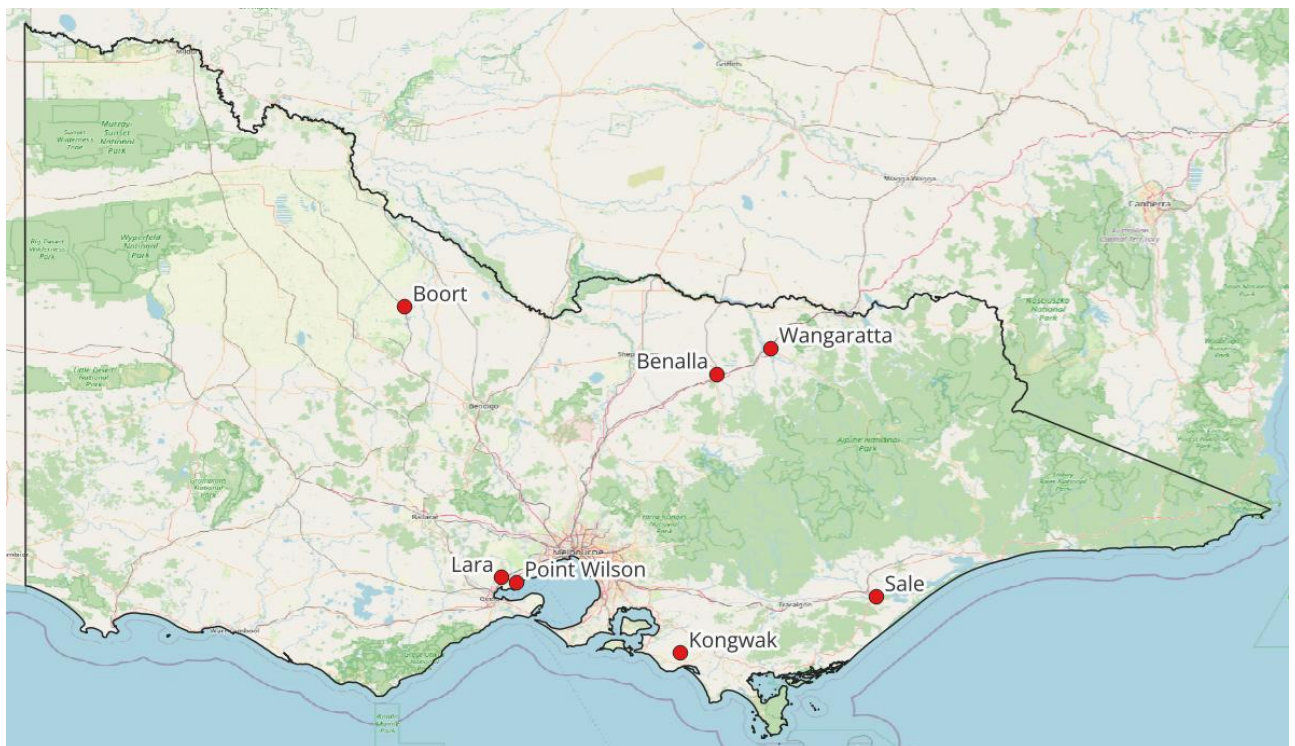


Figure 1: Locations of sites where trapping and radiography was conducted in 2025

3.3 Cage trapping

Sites for duck capture were selected based on access to secure trap sites and where large concentrations of ducks were observed and/or captured in 2022, 2023 and 2024. Trapping occurred immediately after the conclusion of the duck season to ensure that ageing of first-year (immature) birds from plumage characteristics was more achievable and while immature birds still retain certain plumage characteristics, prior to moulting into their adult plumage. Given trapped birds were approaching 12-months of age, this was not always possible and multiple characteristics were considered to determine age using Rogers *et al.* (2019) as a guide.

Trapping commenced in mid-June and was completed by the second week of September. Wire mesh cage traps were used to capture game ducks at all sites. Traps were baited with grain (corn or wheat) for up to two weeks prior to trapping, to familiarise ducks with the equipment and trapping site. Baiting continued throughout the trapping period. Once trapped, birds were extracted by hand or using a handheld net and were placed into poultry transport crates prior to processing. A detailed description of trap design and capture methods can be found in the [Monitoring trends in waterfowl wounding 2022](#) report, which is available on the GMA website www.gma.vic.gov.au

3.4 Determination of sex and age

Sex and age were determined where possible using plumage characteristics detailed in Rogers *et al.* (2019). Morphometric and weight measurements were collected as part of this process, which may assist in ageing and sexing birds once a sufficient body of data has been collected.

3.5 Radiography procedure

Radiography was undertaken to identify the presence/absence of embedded shotgun pellets. Upon removal from the poultry transport crates, each duck was contained in a breathable cotton pillow slip and placed in a clear plastic tub to minimize movement and keep the bird in the x-ray field. The duck and tub were then placed on a 25 x 30cm digital x-ray plate (Exprimer EVS 2430) and

radiographed with an Atomscope TR9020B portable veterinary x-ray unit suspended on a surveyor's tripod. Settings of 68 kV and 1.05 mAs, with a focal distance of approximately 50cm, were used. Each digital image was immediately viewed and, if necessary, subsequent radiographs were taken. Each radiograph was dorso-ventral in orientation as conscious animals will automatically 'right' themselves, eliminating the possibility of lateral images being taken without chemical or more stressful physical restraint methods being employed. All radiography was performed in a discrete area where personnel access was restricted and at least five metres away from other investigators.

The number and anatomical location of embedded pellets in each inflicted duck was recorded and will be used to monitor trends in wounding over time. Attempts were made to differentiate lead from steel shot by examining the shape of observed pellets. Pellets that were distorted in shape were presumed to be lead, whereas steel and tungsten shot will remain spherical. Fragmented shot was assumed to be bismuth.

3.6 Other procedures independent of wounding assessment

Researchers from Deakin University under its own authorisation banded birds and collected blood samples and buccal and vent swabs to screen for avian influenza and other diseases (e.g. Japanese Encephalitis) as a part of a long-term waterbird disease surveillance program. Deakin University researchers also deployed tracking devices on a subset of game ducks from each region as part of a GMA funded project to examine waterfowl movement and survivorship.

3.7 Relevant licenses, permits and approvals

This project, entitled '12.24 Monitoring the frequency of waterfowl wounding in Victoria', has been approved by the Wildlife and Small Institutions Animal Ethics Committee. A Department of Energy, Environment and Climate Action (DEECA) research authorisation permits the GMA to undertake this research under the *Wildlife Act 1975* (Permit No: 10011127). A scientific procedures fieldwork license (SPFL 20419) was also

granted to the Game Management Authority under section 21 of the *Prevention of Cruelty to Animals Act 1986*. An access agreement (AA-0001911) was also granted to the GMA, allowing work to be undertaken on land managed by Parks Victoria.

GMA staff operating the x-ray unit have been granted Radiation Use Licences under Section 43 of the *Radiation Act 2005* (Licence No. 100214596). The GMA was issued with a Radiation Management Licence under Section 5 of the *Radiation Act 2005* (Licence No. 300085326). A safe work plan detailed tasks, potential hazards, risks and control measures for relevant employees and volunteers.

4 Results

4.1 Total capture and demographics

A total of 707 ducks were captured and radiographed at seven sites from June to September 2025 (see Table 1). All ducks were caught using cage traps.

A small number of non-target waterbird species were captured at several sites. All non-target species were extracted and released immediately. The most captured non-target species was the Eurasian Coot (*Fulica atra*).

There were 176 ducks captured and radiographed at the southern sites (Point Wilson and Lara), 349 at the north-eastern sites (Benalla and Wangaratta), 15 at the south-eastern sites (Kongwak and Sale) and 167 at the north-western site (Boort). The breakdown of duck capture by site is shown in Table 1. Of the eight¹ game duck species, six were captured and radiographed in 2025: Chestnut Teal, Grey Teal, Pacific Black Duck, Australian Shelduck, Australian Wood Duck and Hardhead. No Australasian Shoveler or Pink-eared Duck were caught during trapping operations.

Species composition varied at each site. Grey Teal were the most captured species at the north-eastern and western sites. Chestnut Teal were the most captured species at the south-western sites. Lara and Benalla had the greatest diversity of ducks trapped, with four different species of game duck captured at each site.

There were higher numbers of adult birds (>1 year) captured compared to immature birds (<1 year). Adult birds represented 54.9 per cent of total catch and immature birds represented 45.1 per cent. There was some difficulty in distinguishing first (or hatch) year birds from adults given the timing of trapping (many were nearing 12-months of age) and their plumage began to resemble that of adults.

Higher numbers of males compared to females were captured for Chestnut Teal (73 vs 45) and Pacific Black Duck (34 vs 13). More female Australian Shelducks were captured compared to males (four vs two). Equal numbers of each sex were captured for Australian Wood Duck and Hardhead. It was not possible to sex Grey Teal given the plumage characteristics of males and females are similar. The breakdown of sex and age of ducks by species is shown in Table 2.

Table 1: Location, method of capture and number of game ducks radiographed in 2025

Region	Site	Method	Trap days	Dates of capture	Total birds	Average per day
South	Lara	Cage trap	6	10-13 June, 16, 19 June	68	11.3
South	Point Wilson	Cage trap	2	17-18 June	108	54
Northeast	Benalla	Cage trap	4	3-4 July, 21-22 July	213	53.2
Northeast	Wangaratta	Cage trap	2	2-3 July	136	68
Southeast	Kongwak	Cage trap	4	25-28 June	4	1
Southeast	Sale	Cage trap	4	16-17 July, 6-7 August	11	2.8
Northwest	Boort	Cage Trap	3	9-11 September	167	55.7
TOTAL					707	

¹ Noting that Australasian Shoveler are not available for recreational hunting due to a year-round closed season.

Table 2: Sex and age of game ducks captured across all sites in 2025

Species	Male	Female	Sex Unknown	Adult	Immature	Total
Chestnut Teal	74	45	3	97	25	123
Grey Teal	-	-	521 ²	242	279	521
Pacific Black Duck	34	13	2	36	13	49
Australian Shelduck	2	4	0	5	1	6
Hardhead	2	2	0	4	0	4
Australian Wood Duck	2	2	0	4	0	4

Table 3: Infliction rates by species

Species	Total captured	Number inflicted	% inflicted
Chestnut Teal	123	3	2.4
Grey Teal	521	10	1.9
Pacific Black Duck	49	5	10.2
Australian Shelduck	6	0	0.0
Hardhead	4	0	0.0
Australian Wood Duck	4	0	0.0

4.2 Pellet infliction by species, age and location

Of the 707 ducks captured and radiographed, 18 (2.5 per cent) were shown to have embedded shotgun pellets. Pellet infliction was observed in three species: Chestnut Teal, Grey Teal and Pacific Black Duck (Table 3). Pacific Black Ducks were found to have the highest rate of pellet infliction, with 10.2 per cent of birds (five of 49) carrying embedded pellets. All except one of the Pacific Black Ducks carrying embedded pellets were identified as males. A total of 1.9 per cent of Grey Teal (10 of 521) and 2.4 per cent of Chestnut Teal (three of 123) were found to carry embedded pellets. No other species captured in 2025 were found to be inflicted with shotgun pellets. A breakdown of pellet infliction by species, age and sex is shown in

Table 4.

Of the 18 inflicted birds, 11 (61 per cent) were immature (<1 year) and seven (39 per cent) were adult birds (Figure 2). From the total 319 immature birds examined, the eleven inflicted birds represented 3.4 per cent of the total number of immature birds. From the total 388 adult birds examined, the seven inflicted birds represented 1.8 per cent of the total number of adults. Therefore, immature birds had a 62 per cent higher infliction rate compared to adult birds. Thirteen of the inflicted birds had a single embedded pellet, three birds had two pellets, and one Pacific Black Duck and one Chestnut Teal carried five embedded pellets.

Embedded shotgun pellets were observed in different anatomical areas of the ducks, including the rump, breast, flank, back and wing. Figures 3 to 5 show indicative images of birds carrying embedded pellets.

² It is not possible to reliably age Grey Teal by plumage characteristics.

Table 4: Sex and age of game ducks carrying embedded shotgun pellets

Species	Male (<1 year)	Male (>1 year)	Female (<1 year)	Female (>1 year)	Unk. (<1 year)	Unk. (>1 year)	Total
Chestnut Teal	2	1	0	0	0	0	3
Grey Teal	-	-	-	-	8	2	10
Pacific Black Duck	0	4	1	0	0	0	5

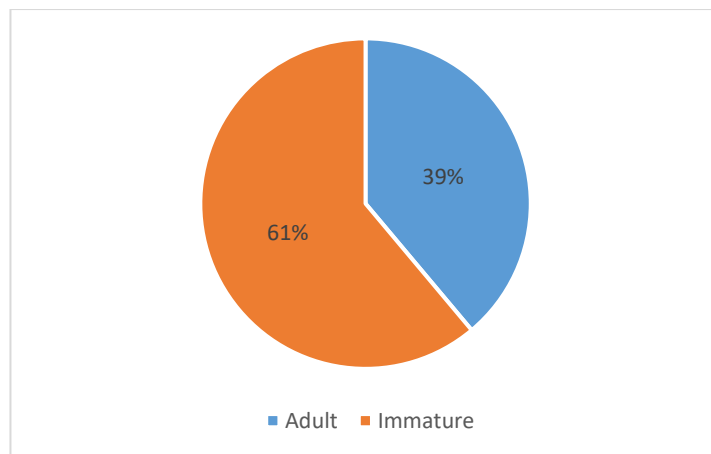


Figure 2: Percentage of inflicted birds by age class (n=18)



Figure 3: Grey Teal inflicted with a two different sized shotgun pellets



Figure 4: Pacific Black Duck inflicted with a single shotgun pellet



Figure 5: Pacific Black duck inflicted with five shotgun pellets, including pellets of different size, suggesting this bird may have been shot on more than one occasion

The percentage of ducks with embedded pellets varied between study sites. Sale had the highest infliction rate with 36 per cent (four of 11) of birds carrying embedded pellets. At Wangaratta, 0.7 per cent (one of 136) of ducks were inflicted with pellets. At Point Wilson, Benalla and Boort, the infliction rate ranged from 2.3 to 3.0 per cent. None of the ducks captured at Lara or Kongwak were found with embedded pellets. Infliction rates at each location are detailed in Table 5.

As shown in Figure 6, overall, the percentage of ducks carrying embedded pellets in 2025 (2.5 per cent) was lower than that observed in 2024 (4.8 per cent) and 2022 (3.4 per cent) and very close to the total in 2023 (2.4 per cent). In 2025, pellets were observed in three duck species: Pacific Black Duck, Grey Teal and Chestnut Teal.

Similar to 2024, 2023 and 2022, Pacific Black Duck were found to have the highest infliction rates (10.2 per cent this year, 19.5 per cent in 2024, 5 per cent in 2023 and 7.5 per cent in 2022).

This year, adult birds were found to have a lower infliction rate compared to immature birds (Figure 7). This is unexpected as adult birds can accumulate pellets over time and may be exposed to multiple duck hunting seasons. A higher infliction rate in immature birds was also observed in 2022.

Based on the shape of observed pellets, one from the 18 inflicted birds were judged to be inflicted with what appeared to be lead shot due to the malformation of the pellets. A single bird was also judged to be inflicted with bismuth shot.

Table 5: Infliction rates at different locations in Victoria

Location	Total examined	Number inflicted	% inflicted
Lara	68	0	0.0
Point Wilson	108	3	2.8
Benalla	213	5	2.3
Wangaratta	136	1	0.7
Boort	167	5	3.0
Kongwak	4	0	0.0
Sale	11	4	36.0

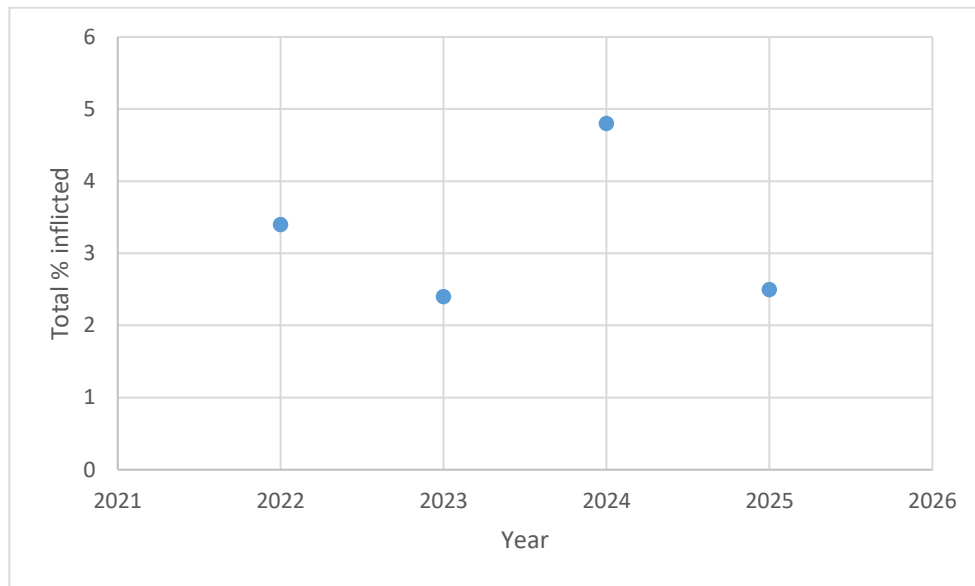


Figure 6: Total infliction rate from 2022 to 2025

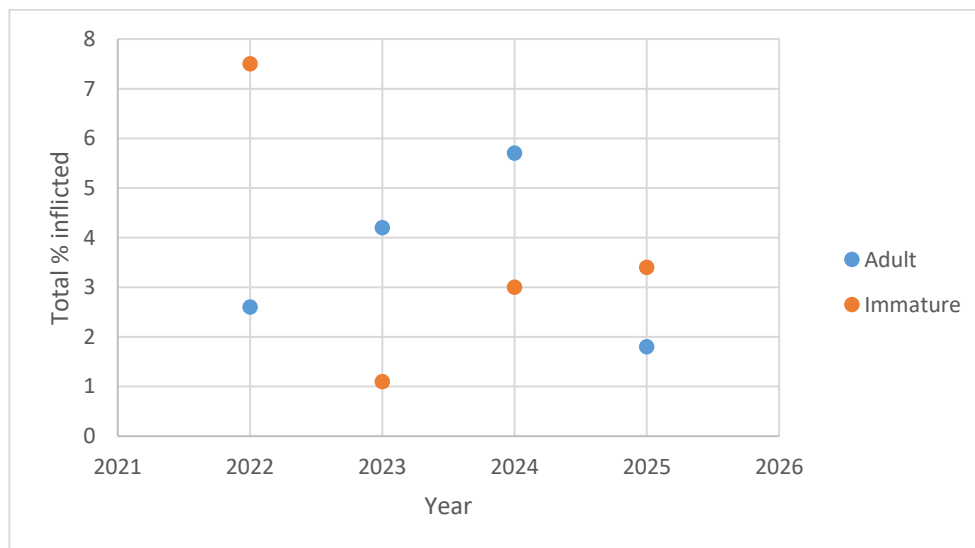


Figure 7: Total infliction rate of different age classes from 2022 to 2025

5 Discussion

This program is the first direct large-scale assessment of waterfowl wounding conducted in Victoria since the 1950-70s (Norman 1976). In 2025, 707 game ducks were examined for signs of wounding (embedded pellets) at seven sites in Victoria. This work is part of an ongoing monitoring program to track trends in waterfowl wounding over time and builds on the monitoring conducted annually since 2022.

The total number of game ducks captured in 2025 was the highest number since the monitoring program began in 2022. In addition, the variety of species captured was higher than previous years, with six game duck species captured (Grey Teal, Chestnut Teal, Pacific Black Duck, Australian Shelduck, Australian Wood Duck and Hardhead).

In total, 2.5 per cent (18) of the 707 ducks examined were shown to be carrying embedded pellets. This was lower than the infliction rates of 4.8 per cent recorded in 2024 and 3.4 per cent recorded in 2022 and similar to the 2.4 per cent recorded in 2023. A longer data series is required before being able to determine whether wounding is increasing, decreasing or stable.

Pellet infliction was limited to three species: Pacific Black Duck, Grey Teal and Chestnut Teal. Pacific Black Ducks were found to have the highest rate of pellet infliction, with 10.2 per cent of trapped birds carrying embedded pellets.

The higher infliction rate in Pacific Black Ducks compared to other species may be due to their larger size and increased resilience to wounding compared to smaller species (Norman 1976; Loyn 1989). Pacific Black Ducks are also highly sought after by recreational hunters and are regularly among the three most harvested species (Moloney and Flesch 2023). Therefore, they may have been more actively targeted by hunters.

Of the 707 ducks captured and radiographed, 319 were immature (first year) birds and had only been exposed to a single duck hunting season, providing a more accurate indication of the occurrence of wounding. The infliction rate in first year birds was found to be 3.4 per cent. Adult birds had a lower infliction rate

compared to immature birds (1.8 per cent). Due to difficulties in aging birds, these results should be interpreted with caution.

There was variation in the infliction rate by geographic region. Sale was found to have the highest infliction rate, however only eleven ducks were caught at that site in 2025. Historically, infliction rates at Sale have been higher than elsewhere, therefore the small sample size may have influenced the overall infliction rate. The reduction in trapping success at Sale may have been attributed to significant rainfall in the area immediately prior to trapping which dispersed ducks across the landscape. Large numbers of ducks were observed close to the trapping site, but it was difficult to draw them close to traps with the bait. This suggested there was plentiful food in the surrounding areas.

The number of ducks inflicted with pellets that appeared to be lead is lower than previous years (one out of 18 birds). Lead pellets can be differentiated from steel pellets in radiographs as, being softer than steel, they deform in the shotgun barrel upon firing and rarely remain uniformly spherical. Bismuth, which is also softer than steel, tends to fracture on impact rather than deform. There was one animal examined in 2025 that appeared to have embedded bismuth shot. The use of lead shot for recreational duck hunting has been banned in Victoria since 2003. There is a possibility that birds that were observed to be inflicted with lead pellets had travelled from other jurisdictions that allow the use of lead for pest mitigation programs.

The overall infliction rate of 2.5 per cent cannot be interpreted as the actual rate of wounding caused by waterfowl hunting. The method of assessment used here can only sample the portion of birds that are sub-lethally wounded and survive. Studies have shown that many wounded birds will die either directly or indirectly as a cause of their injuries and, consequently, are not available to be sampled (Van Dyke 1980; Kirby 1981). Also, radiographs can only detect those birds carrying embedded pellets but does not detect those animals that have been shot and pellets have passed through the body. Therefore, the infliction rate can only be used as a proxy index to monitor trends in wounding over time.

Only a small number of Australian Wood Ducks (four in total) were trapped and radiographed in 2025. Due to them being a commonly harvested species (regularly making up to 30% of the total seasonal harvest), it would be desirable to increase the number of birds examined. To capture more Australian Wood Ducks in the future, traps could be deployed specifically on farm dams or cannon netting undertaken in areas where the birds are likely to concentrate. Likewise, traps could be modified to capture more Australian Shelducks by increasing the size of trap entrances and placed in habitats more likely to be frequented by the species (e.g., farm paddocks). Alternatively, Australian Shelducks could be trapped when they concentrate during their annual major moult (November – January). However, it would not be possible to differentiate between adults and

immature birds if trapped at this time. Increasing the sample size of all game ducks will be beneficial to future monitoring efforts and increase the understanding of the incidence of wounding in these species.

6 Acknowledgements

Thank you to Melbourne Water, Parks Victoria, Northeast Water and private landowners for allowing access to their lands to conduct this study. Thank you also to the Victorian Wader Study Group for providing advice and assisting with data collection.

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