

Monitoring trends in waterfowl wounding 2024





Acknowledgment

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

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



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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 and 2024.

Following the 2024 duck season, trapping was conducted at seven sites within four separate regions of Victoria. In total, 413 game ducks were captured and radiographed. Four species of game ducks were captured and examined: Australian Shelduck, Grey Teal, Chestnut Teal and Pacific Black Duck.

Two of the six game duck species that were examined (Pacific Black Duck and Grey Teal) were found to be carrying embedded pellets. In total, 4.8 per cent (20) of the ducks were shown to be carrying embedded pellets. This was higher than the infliction rate of 2.4 per cent recorded in 2023 and 3.4 per cent recorded in 2022. Adult birds had approximately double the infliction rate of first year birds (5.7 per cent vs 3.0 per cent, respectively). Pacific Black Ducks were found to have the highest rate of infliction, with 19.4 per cent of trapped Pacific Black Ducks carrying embedded pellets.

The overall infliction rate of 4.8 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. In 2023, the monitoring program continued, with ducks trapped immediately following the end of the duck season and radiographed to document the proportion of birds carrying embedded shotgun pellets (the infliction rate). In 2024, additional capture sites were added to increase geographic coverage of the state and were located in general areas where duck hunting 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 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 third report on monitoring trends in waterfowl wounding in Victoria.

3 Methods

3.1 Targeted species

In Victoria, there are eight species of game ducks which may be hunted during the prescribed open season. These are: Grey Teal (*Anas gracilis*), Australasian Shoveler (*Spatula rhynchotis*), 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*). Restrictions preventing the hunting of Australasian Shoveler and Hardhead were imposed for the 2024 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 (Milawa, Thoona and Eldorado), south (Lara and Point Wilson), west (Donald) and east (Sale). Ducks were trapped on private property using cage traps on small dams (< one hectare) at Thoona, Milawa, Eldorado and Donald. In the south, cannon-netting was carried out at a wetland at Point Wilson and cage trapping was conducted at a wetland at Lara. Cage trapping and cannon netting was conducted on private property at Sale. Site locations are shown in Figure 1.



Figure 1: Locations of sites where trapping and radiography was conducted in 2024

3.3 Capture systems and methods

3.3.1 Cage traps

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 and 2023. 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 12months 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 first week of August. Wire mesh cage traps were used to capture game ducks at Lara, Thoona, Milawa, Eldorado, Sale and Donald. 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 with the use of a game feeder and with grain placed directly in and around the traps by hand. The feeder was programmed to automatically dispense a small amount of grain at times that coincided with duck feeding activity and when trapping was planned to be undertaken (generally earlymorning and late-afternoon). Once trapped, birds were extracted by hand or using a handheld net and were placed into poultry transport crates prior to processing.

3.3.2 Cannon netting

Cannon-netting is a technique widely used to capture live birds and other animals and can capture many birds in a single event. The GMA commissioned the Victorian Wader Study Group (VWSG) to use cannon netting to capture ducks at Point Wilson and Sale in 2024. As with cage trapping, roosting locations were observed at potential capture sites and pre-baited with grain for two weeks prior to the planned day of capture with a programmable game feeder and by hand. When sufficient birds had congregated in the 'catch zone', the cannons were deployed and a large net cast over the birds. Investigators then extracted the ducks and placed them into poultry transport crates before being moved a short distance to be processed. 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.

3.4 Determination of sex and age

Sex was 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

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 xray 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 their own authorization banded birds and collected blood samples and buccal and vent swabs to screen for avian influenza as a part of a long-term waterbird disease surveillance program.

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.

The Principal Investigator involved was issued a Radiation Use License issued 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 413 ducks were captured and radiographed at seven sites from 12 June to 7 August 2024. Of these, 164 ducks were caught using cannon-netting and 249 were caught in cage traps. Cannon-netting accounted for approximately 40 per cent of the total number of ducks captured and cage traps accounted for 60 per cent of total catch.

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

There were 198 ducks captured and radiographed at the southern sites (Point Wilson and Lara), 61 at the north-eastern sites (Thoona, Milawa and Eldorado), 117 at the south-eastern site (Sale) and 37 at the western site (Donald). The breakdown of duck capture by site is shown in Table 1. Of the eight game duck species, four species were captured and radiographed in 2024: Chestnut Teal, Grey Teal, Pacific Black Duck and Australian Shelduck. No Australasian Shoveler, Pinkeared Duck, Hardhead or Wood Duck were caught during trapping operations. A single Pacific Black Duck – Chestnut Teal hybrid was captured at Point Wilson.

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 southern sites. The north-eastern sites had the greatest diversity of ducks trapped, with Pacific Black Duck, Grey Teal, Chestnut Teal and Australian Shelduck all captured.

There were higher numbers of adult birds (>1 year) captured compared to immature birds (<1 year). Adult birds represented 67.8 per cent of total catch and immature birds represented 32.2 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 (89 vs 47), Pacific Black Duck (57 vs 7) and Australian Shelduck (9 vs 7). It was not possible to sex Grey Teal. The breakdown of sex and age of ducks by species is shown in Table 2.

Region	Site	Method	Trap days	Dates of capture	Total	Average per day
South	Lara	Cage trap	4	12-14 June, 20 June	79	19.8
South	Point Wilson	Cannon net	2	18 June, 25 June	119	59.5
Northeast	Milawa	Cage trap	3	4-5 July, 25 July	22	7.3
Northeast	Thoona	Cage trap	2	4 July, 25 July	37	18.5
Northeast	Eldorado	Cage trap	1	25-26 July	2	2
East	Sale	Cage trap and cannon net	3	17-19 July	117	39
West	Donald	Cage Trap	2	6-7 August	37	18.5

 Table 1: Location, method of capture and number of game ducks radiographed in 2024

 Table 2: Sex and age of game ducks captured across all sites in 2024

Species	Male	Female	Unknown	Adult	Immature	Total
Chestnut Teal	89	47	1	105	32	137
Grey Teal	-	-	191	117	74	191
Pacific Black Duck	57	7	3	46	21	67
Australian Shelduck	9	7	1	11	6	17
Pacific Black Duck /Chestnut Teal hybrid	1	0	0	1	0	1
						413

4.2 Pellet infliction by species, age and location

Of the 413 ducks captured and radiographed, 20 (4.8 per cent) were shown to have embedded shotgun pellets. Pacific Black Ducks were the species found to have the highest rate of pellet infliction, with 19.4 per cent of birds (13 of 67) carrying embedded pellets. All of the Pacific Black Ducks carrying embedded pellets were identified as males. A total of 3.7 per cent of Grey Teal (7 of 191) were found to carry embedded pellets. No other species captured in 2024 were found to be carrying embedded pellets. A breakdown of pellet infliction by species, age and sex is shown in Table 3.

Of the 20 inflicted birds, four (20 per cent) were immature (<1 year) and 16 (80 per cent) were adult birds (Figure 2). From the total 133 immature birds examined, the four inflicted birds represented 3 per cent of the total number of immature animals. From the total 280 adult birds examined, the 16 inflicted birds represented 5.7 per cent of the total number of adults. Therefore, adult birds had almost double the infliction rate of immature birds. Thirteen of the inflicted birds had a single embedded pellet, two birds had two pellets, four birds had three pellets and one Pacific Black Duck carried six embedded pellets.

Embedded shotgun pellets were observed in different anatomical areas of the ducks. Pellets were observed in the rump, breast, head and back. Figures 3 to 6 show indicative images of birds carrying embedded pellets, including a Pacific Black Duck carrying shot presumed to be lead.



Figure 2: Percentage of inflicted birds by age class (n=20)

Species	Male (<1)	Male (>1)	Female (<1)	Female (>1)	Unk. (<1)	Unk. (>1)	Total
Grey Teal	0	0	0	0	2	5	7
Pacific Black Duck	2	11	0	0	0	0	13

Table 3: Sex and age of game ducks carrying embedded shotgun pellets





Figure 3: Grey Teal inflicted with a single shotgun pellet (note the aluminium band on the left leg)



Figure 4: Pacific Black Duck inflicted with a single shotgun pellet (note the aluminium band on the left leg)





Figure 6: Pacific Black Duck inflicted with lead shot (top left shows closeup of pellet)



The percentage of ducks with embedded pellets varied between study sites. Sale had the greatest number of inflicted birds with 14.5 per cent (17 of 117) of birds carrying embedded pellets. At both Donald and Thoona, 2.7 per cent (1 of 37) of ducks were inflicted with pellets. A total of 1.3 per cent (1 of 79) of birds from Lara carried embedded pellets. None of the ducks captured at Point Wilson, Milawa or Eldorado were found with embedded pellets. Infliction rates at each location are detailed in Table 4.

As shown in Figure 7, overall, the percentage of ducks carrying embedded pellets in 2024 (4.8 per cent) was higher than that observed in 2023 (2.4 per cent) and 2022 (3.4 per cent). Similar to 2023, in 2024 pellets were only observed in two duck species; Pacific Black Duck and Grey Teal (pellets were also observed in Chestnut Teal in 2022). In 2024, Pacific Black Duck were again found to have the highest infliction rates (19.5 per cent in 2024, 5 per cent in 2023 and 7.5 per cent in 2022). Similar to 2023, adult birds were found to have a higher infliction rate than immature birds (Figure 8), which is expected as birds can accumulate pellets over time and may be exposed to multiple duck hunting seasons.

Based on the shape of observed pellets, a total of six from the 20 inflicted birds were judged to be inflicted with what appeared to be lead shot due to the malformation of the pellets.

Table 4: Infliction rates at different locations in Victoria

Location	Total catch	Number inflicted	% inflicted
Lara	79	1	1.3
Point Wilson	119	0	0.0
Milawa	22	0	0.0
Thoona	37	1	2.7
Eldorado	2	0	0.0
Sale	117	17	14.5
Donald	37	1	2.7





Figure 7: Total infliction rate from 2022 to 2024



Figure 8: Total infliction rate of different age classes from 2022 to 2024



5 Discussion

This program is the first direct large-scale assessment of waterfowl wounding conducted in Victoria since the 1950-70s (Norman 1976). In 2024, 413 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 in 2022 and 2023.

Fewer game ducks were trapped in total during 2024 compared to 2023 (413 vs 632) and 2022 (413 vs 596). In addition, the variety of species captured was lower, with only four game duck species captured (Grey Teal, Chestnut Teal, Pacific Black Duck and Australian Shelduck). No Australian Wood Duck, Hardhead, Pink-eared Duck or Australasian Shoveler were successfully captured and radiographed.

Cannon netting was more successful in 2024 compared to 2023 (164 vs 64) despite again catching fewer birds than cage traps. The use of a pneumatic cannon net for future trapping is being investigated and may improve trapping success.

In total, 4.8 per cent (20) of the 413 ducks examined were shown to be carrying embedded pellets. Pellet infliction was limited to two species: Pacific Black Duck and Grey Teal. Pacific Black Ducks were found to have the highest rate of pellet infliction, with 19.4 per cent of trapped birds carrying embedded pellets. This infliction rate is nearly four times higher than that observed in 2023.

The higher infliction rate in Pacific Black Ducks 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). And may have been more actively targeted by hunters. Of the 413 ducks captured and radiographed, 133 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 three per cent. Adult birds had a higher infliction rate compared to immature birds (5.7 per cent).

There was variation in the infliction rate by geographic region, with the proximity to popular duck hunting areas not always correlating with the presence of shotgun pellets. Only single ducks captured in the north-east (Thoona, Milawa, Eldorado) west (Donald) and south (Lara) had embedded pellets, despite being popular duck hunting locations. Conversely, 14.5 per cent of ducks captured and radiographed at Sale (also a popular duck hunting area) were shown to be inflicted with pellets.

The number of ducks inflicted with pellets that appeared to be lead is higher than previous years (six out of 20 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 captured in 2024 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 shot had travelled from other jurisdictions that allow the use of lead for pest mitigation programs.



The overall infliction rate of 4.8 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. A limited number of 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. Direct studies, such as observations of hunters in the field, should be used to determine the actual rate of wounding more accurately.

No Australian Wood Ducks were trapped and radiographed in 2024. 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 with high densities of the species. 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.

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