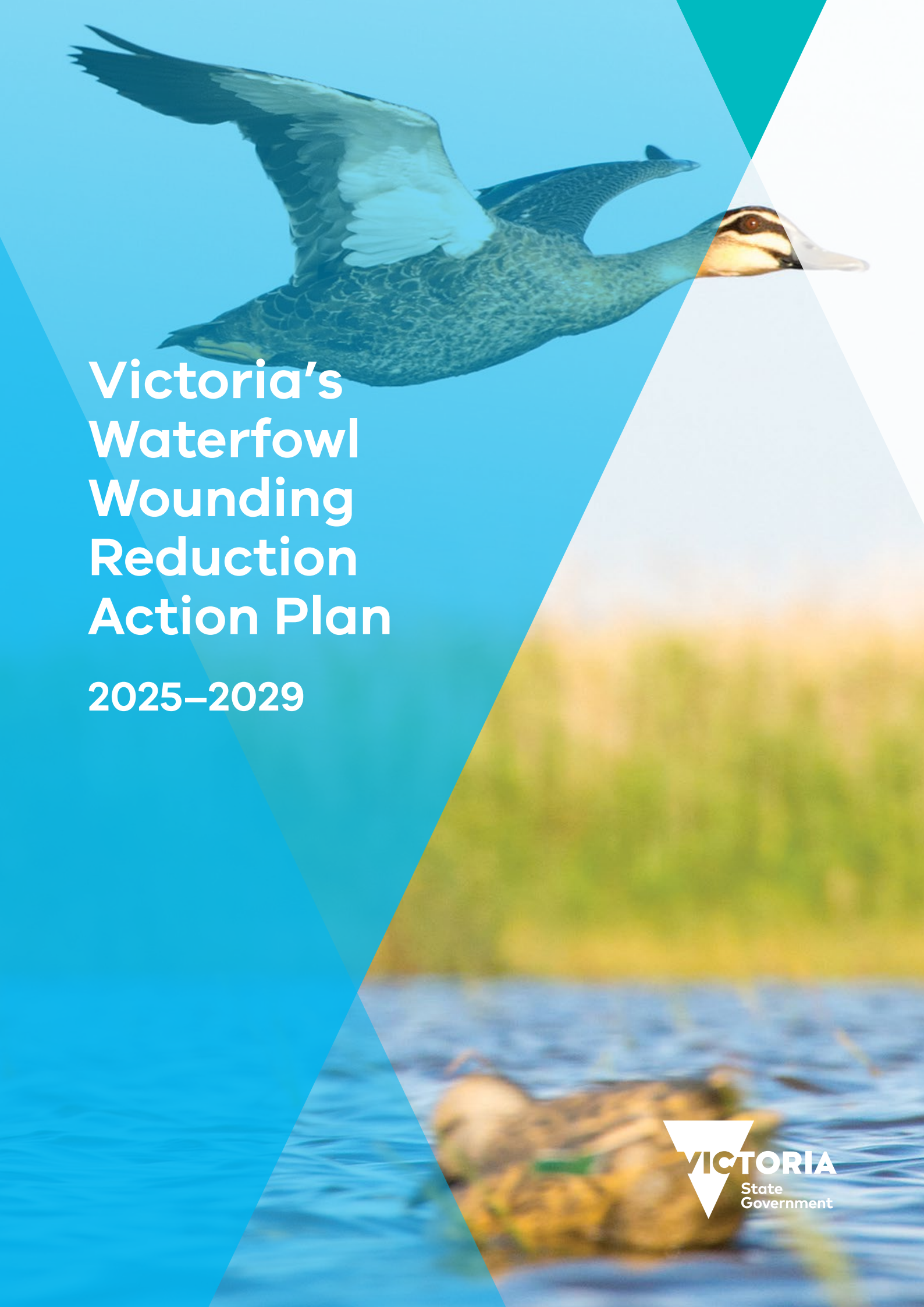

Victoria's Waterfowl Wounding Reduction Action Plan

2025–2029

VICTORIA
State Government

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MINISTER'S FOREWORD

Recreational hunting is a legitimate activity that matters to thousands of Victorians who love the great outdoors.

This government supports safe, responsible and sustainable hunting. We recognise the social and economic benefits that it brings to our rural communities and the opportunities for developing partnerships and greater recognition of Traditional Owners' knowledge of hunting and land management.

Wounding as a consequence of recreational hunting is concerning to both the hunting and broader communities. Waterfowl wounding can be addressed by the hunting community with the support of government.

Through its commitment in the Sustainable Hunting Action Plan 2021-2024, Victoria's Waterfowl Wounding Reduction Action Plan is a key part of how this government is making important improvements to the practice of hunting to ensure it remains safe, sustainable and responsible.

For the action plan to be successful and to ensure duck hunting continues, it is incumbent on every duck hunter to actively reduce wounding through improving and maintaining their hunting skills and eliminating wounding-type behaviours and practices.

The Waterfowl Wounding Reduction Action Plan represents a clear commitment to improving animal welfare outcomes and draws upon experiences from around the world, including Denmark, the USA and England.

The Waterfowl Wounding Reduction Action Plan is a result of work by the Game Management Authority (GMA) and the Wounding Reduction Working Group. The Wounding Reduction Working Group, comprising representatives from hunting organisations, industry and animal welfare advocacy, provided expert advice throughout the development of this plan.

The Working Group was chaired by the late Professor Andrew Fisher. Professor Fisher was highly respected in the field of animal welfare and was the Director of the Animal Welfare Science Centre at the University of Melbourne. We are most grateful to Professor Fisher for his experience and expertise.

I commend the efforts of the GMA, the Wounding Reduction Working Group and Professor Fisher in developing this comprehensive plan.

Steve Dimopoulos
Minister for Outdoor Recreation

A MESSAGE FROM THE CHAIRPERSON

The Waterfowl Wounding Reduction Working Group comprised members from the duck hunting community, hunting industry, as well as animal welfare advocacy.

I commenced the role of Chairperson of the Wounding Reduction Working Group in September 2024, following the passing of the inaugural Chairperson, Professor Andrew Fisher, in February 2024. Andrew provided valued leadership and guidance to the working group throughout the development of this Action Plan.

Prior to his passing, Andrew noted that while there were very different perspectives in the working group regarding the practice of hunting itself, all the members were committed to the animal welfare and sustainability benefits of reducing wounding rates arising from duck hunting where it occurs. The working group held six formal meetings over the period of development of the Waterfowl Wounding Reduction Action Plan (WWRAP), as well as undertaking intersessional reviewing and background work. Andrew was thankful to members of the WWRAP working group for their dedication and commitment to the task, and believed that this document has benefited greatly from members' input and the background expertise of the bodies they represented.

The Waterfowl Wounding Reduction Action Plan represents a structured and comprehensive set of actions to drive down wounding rates arising from hunting, and thus to enable improvements in animal welfare. I am pleased to continue the work that Andrew began, and to support the working group and community in the successful implementation of this plan.

Associate Professor David Beggs
Chairperson
Wounding Reduction Working Group

A NOTE FROM THE WORLD LEADERS IN WOUNDING REDUCTION

Professor Jesper Madsen

In Denmark, hunting is a popular recreational activity enjoyed by more than 200,000 hunters.

In the early 1990s, we started x-raying live geese caught for marking and we discovered a high prevalence of birds carrying shotgun pellets in their tissues. As a result, a national plan to reduce wounding of game was launched by the Ministry of Environment, including a suite of initiatives such as awareness raising, training and sharpening of proficiency tests. The plan also included research to fill knowledge gaps in the understanding of causes and extent of wounding as well as monitoring of the progress in the fulfillment of objectives in the plan.

The plan was unanimously endorsed by the Danish Wildlife Council (stakeholder council advisory to the Minister of Environment), but putting emphasis on Danish hunters to improve. The Danish Hunters' Association immediately accepted the challenge and took a leading role in the implementation of the plan.

Since implementation in 1997, we have found evidence of improvements, with reduced wounding rates in geese. Wounding rates have continued to decline in geese and other game, and this has been attributed to a change in hunting practises and behaviour of hunters. The Danish success to reduce wounding has been achieved by a strong science-based, decision-making process and implementation of a plan with clear messages. Adjusting tools and repeating awareness campaigns as new evidence became available were important to keep momentum. Most important was that Danish hunters took responsibility for reducing wounding.

I want to congratulate the Victorian Government for its proactive initiative to reduce waterfowl wounding by shotgun shooting. The new Victoria's Waterfowl Wounding Reduction Action Plan includes strong measures and a strong scientific component which is critical to understand the causes of wounding and monitoring success of the plan. The involvement of hunters is a key focus in the plan and this is the most important approach to achieve success.

Jesper Madsen
Professor
Aarhus University, Denmark

Niels Søndergaard

Hunters are solely responsible for ethical, safe and sustainable hunting.

Therefore, it is hunters who must take responsibility when issues arise that are objectionable and not sustainable. The social acceptance of hunting is essential for the future of hunting. If hunters do not have the acceptance of their communities, it is difficult to justify recreational hunting.

In 1996, Danish hunters were facing unacceptably high levels of shotgun pellets in game from shotgun hunting. Our research found that one-third of older Pink-footed Geese and Eider ducks carried pellets, which meant that for every bird shot, one was wounded. From both an animal welfare and a hunting perspective, this was unacceptable. If hunting results in high levels of wounding, this diminishes the rewards associated with being a skilled hunter and using the meat as food poses a risk to human health. It is crucial that hunters hunt in a sustainable way, with consideration for animal welfare, and that they can use game meat for consumption.

The Danish Hunters' Association faced the problem with wounding and took a leadership role to reduce it. We did not question the issue of wounding, and we accepted the fact that we had a problem and needed to change.

We participated in mapping the key factors that were contributing to wounding: poor shooting, poor distance assessment, shooting beyond personal ability and unsuitable equipment and ammunition choices.

After recognizing the extent of wounding, we identified the best ways to solve the problem:

1. take ownership and recognize that wounding is every hunters' problem
2. build confidence in the available shotgun shells, emphasising that wounding is not a matter of the capability of the equipment
3. achieve ownership; we recognised that without ownership of the problem, there would be no real will to change behaviour
4. develop simple guidelines and best practice standards to reduce wounding
5. good co-operation with researchers, authorities and manufacturers of ammunition.

Self-regulation among hunters is probably the key to efficiently solving the challenges associated with wounding. There must also be full transparency and wounding levels must be closely monitored.

On behalf of the Danish hunters, I would like to congratulate the hunters in Victoria and the Victorian Government for this very important and proactive action towards reducing wounding of waterfowl. Best of luck, and we are always interested in sharing knowledge with fellow hunters. We look forward to following the implementation of the action plan and the associated initiatives, to learn from your future experiences.

Niels Søndergaard
Director of Advice and Education
Danish Hunters' Association

INTRODUCTION

Waterfowl wounding is a hunting-related problem and one that hunters in partnership with government have the ability to address and reduce. By requiring a minimum standard of hunter skill, raising awareness of the causes of wounding and educating and training hunters on solutions, significant reductions in waterfowl wounding can be made. This will reduce negative animal welfare outcomes, reduce waste, contribute to sustainability and give the community confidence that duck hunting is conducted responsibly.

In Victoria, hunting is permitted for a number of game species, including deer, ducks and quail.

Seven species of native waterfowl may be hunted during the prescribed open season according to daily bag limits and hunting methods. As of January 2025, Victoria has approximately 22,000 licensed duck hunters who harvest approximately 324,500[1] ducks each year.

Wounding is an unintended consequence of hunting. It is important to reduce wounding to improve animal welfare outcomes, reduce waste, and ensure duck hunting in Victoria remains sustainable and responsible.

1 Average harvest between 2009–2024. Includes 2020 and 2021 where hunting participation was restricted due to movement restrictions caused by the COVID-19 pandemic. Between 2009–2019 (pre-COVID-19), the average annual harvest of game ducks was approximately 373,000.

VICTORIA'S WATERFOWL WOUNDING REDUCTION ACTION PLAN

Victoria's Sustainable Hunting Action Plan 2021–2024 commits to improve animal welfare associated with duck hunting by establishing a Wounding Reduction Working Group (working group) responsible for developing and implementing a wounding reduction action plan for waterfowl and quail in Victoria[2]. It also commits to implementing a monitoring program to measure the success of the Waterfowl Wounding Reduction Action Plan (action plan)[3].

The Victorian Government in consultation with the working group has developed this action plan. It contains a vision, goal and six action areas, each with a series of actions considered necessary to reduce the level of wounding associated with duck hunting. Program evaluation, review and revision is also included.

The action plan builds on previous efforts between the hunting community and government to reduce wounding (see information box). It adopts an incremental improvement strategy to achieve a trend of continual reduction in wounding rates and is similar to the successful strategy employed in Denmark. It has been shown that incremental improvement strategies are more likely to be successful in achieving behavioural change[4].

VICTORIA'S PAST APPROACH TO WOUNDING REDUCTION

Victoria has a highly regarded education program, which has been in place since 2006, to raise hunter awareness and provide advice on techniques and behaviours to improve hunter performance and reduce wounding. Developed in consultation with the Cooperative North American Shotgunning Education Program (CONSEP), Field and Game Australia (FGA) and Sporting Shooters Association of Australia (Victoria) (SSAA), theoretical written materials (e.g. **Be a better gamebird hunter**) have been produced. Some have been mailed directly to hunters and are available on the Game Management Authority website or on DVD (e.g. *Duck WISE* DVD). A voluntary, practical in-field training program (known as the Gamebird Hunting Essentials Masterclass) was developed and implemented in 2015. A number of trainers from FGA and SSAA were trained by US ballistics expert Dr Tom Roster of CONSEP to deliver the Masterclass. The theoretical materials and practical programs came under the banner of Victoria's Shotgunning Education Program.

2 Recommendation 1.4.
3 Recommendation 3.1.
4 Mellor and Stafford 2001; Mellor *et al.* 2008.

Victoria's Waterfowl Wounding Reduction Action Plan will be delivered collaboratively by key stakeholders, including hunting and animal welfare organisations and government, with Victoria's duck hunting community taking responsibility for establishing a culture of no tolerance for engaging in wounding-type behaviours.

The goal for all animal welfare initiatives is to minimise any unnecessary adverse impacts as far as practicable. International experience has shown that significant reductions in waterfowl wounding caused by hunting can be achieved with a mix of practical and theoretical actions[5] (see case study), ensuring that duck hunting remains a sustainable activity, while minimising adverse animal welfare outcomes.

Definition of wounding

In duck hunting, birds can be hit by pellets and not retrieved by the hunter. This is the definition of 'wounding' (i.e. wounded = struck but not retrieved). Many terms have been used to describe wounding (e.g. crippling) but all mean birds that have been struck and not recovered, or 'bagged', by the hunter.

The wounding issue

Wounding causes unnecessary pain and suffering to injured birds and affects individual survival rates. Sub-lethally injured birds will survive whereas severely wounded birds will die, either due to the injuries suffered or the impact on their ability to feed, avoid predators or thermoregulate (maintain body temperature at the required level).[6] It has been estimated that the majority of wounded waterfowl will ultimately die (see **Appendix 1**).[7]

While wounding is an obvious animal welfare issue, it is also a sustainability issue as wounding losses are not currently incorporated into estimates of the total mortalities of game ducks caused by hunting.[8] Also, wounded birds are not collected and utilised by hunters and are, in effect, wasted.

The extent of wounding

Waterfowl wounding studies have been conducted in North America and Europe since the 1950s[9]. Wounding was researched during the 1970s and 80s in Australia as part of harvest monitoring (see **Appendix 3**), however, there has been little research into the issue since then.

Determining the extent of wounding is difficult and there is no perfect method for quantifying wounding rates (see **Appendix 2**). Estimates of wounding vary between studies, with hunter-reported studies generally recording lower rates and trained observer studies (considered more accurate) higher[10].

Internationally, hunting-related wounding estimates have ranged between approximately 10–60 per cent[11]. In Australia, historic wounding rates have varied between different reporting methods, ranging from 6–40 per cent. Depending on the scale of the annual harvest, this can translate into tens of thousands of birds in a season. There is an obvious need to undertake research today to determine the current rate of wounding and implement a monitoring program to track changes in wounding levels in response to management actions.

5 Noer *et al.* 2007; Clausen *et al.* 2017
6 Kirby *et al.* 1981; Van Dyke 1981
7 Kirby *et al.* 1981; Van Dyke 1981
8 Norton and Thomas 1994
9 E.g. See Bellrose 1953
10 Norton and Thomas 1994
11 Examples include Bellrose 1953; Norman 1976; Anderson and Sanderson 1979; Humburg *et al.* 1982; Briggs *et al.* 1985; Nieman *et al.* 1987; Noer and Madsen 1996; Szymanski and Afton 2005; Noer *et al.* 2007

Case study – Denmark: a world-leader in wounding reduction

A number of countries have implemented programs to raise hunter awareness and improve hunting effectiveness in order to reduce wounding in duck hunting (e.g. the Cooperative North American Shotgunning Education Program in USA and Respect for Quarry in Britain). One of the most successful programs has been implemented in Denmark and has achieved significant, measurable reductions in waterfowl wounding.

Denmark provides an example of how a combination of targeted interventions can modify hunter behaviour, improve skills and performance and significantly reduce waterfowl wounding associated with hunting.

Danish x-ray investigations in the 1990s detected shotgun pellets in 36 per cent of wild-trapped pink-footed geese and 34 per cent in the common eider.[12] It was extrapolated that almost one pink-footed goose was wounded for every bird bagged.[13] These results were considered unacceptable by the Danish government, hunting community and the broader Danish community, and a national wounding action plan was developed in 1997 by the Danish Wildlife Management Council (an advisory body to government).

The action plan included elements of targeted awareness and education, training hunters to estimate distances, mandatory testing (written and practical), encouragement to practice shooting under realistic conditions, the mandatory use of retrieving dogs, encouraging the use of more effective hunting practices (e.g. decoys and calls to bring birds within effective range), the retrieval of downed birds and introduction of a code of ethics. These actions promoted shooting at shorter distances, safer and more accurate shots and hence better chances of harvesting birds without wounding. Messaging to the hunting community was clear and to-the-point.[14]

Hunters took ownership of this issue and used peer pressure, cultural change and standards of behaviour to ensure that hunters self-regulated and adhered to the requirements of the action plan and good hunting practice. Importantly, an ongoing wounding monitoring program was introduced to measure the success of the management interventions.

Since the wounding problem was identified in the mid-1990s and the action plan was put in place, substantial progress has been made, with both duck and goose wounding rates declining significantly over time. The crippling (wounding) ratio (number of geese wounded for each goose bagged) of juvenile birds dropped from 1.00 in 1992 to 0.11 in 2016, corresponding to an 89 per cent reduction in wounding. Among adult birds (that may have accumulated pellets over multiple seasons), the ratio dropped from 9.75 in 1992 to 1.99 in 2016, a reduction of 80 per cent.[15]

The Danes consider that there is still room for improvement in continuing to lower the wounding rates and they continue to reassess the action plan, promote a responsible hunting culture, raise awareness and provide training courses for hunters.[16] The Danish experience has shown that monitoring the outcome of this management program is an important element in ensuring the measures introduced to manage waterfowl hunting are socially defensible and the policies and programs in place are having the desired effect.

12 Noer and Madsen 1996; Holm and Haugaard 2013; Holm *et al.* 2017
13 Madsen and Noer 1996; Noer *et al.* 2007
14 Holm *et al.* 2017
15 Clausen *et al.* 2017
16 Holm *et al.* 2017

Causes of wounding

Wounding can be caused by a number of factors, including:

- poor shooting skills
- shooting at birds at long distances (i.e. in excess of 30 metres)
- hunters shooting beyond their maximum shooting skills distance or capability of technology (e.g. firearms and technology)
- use of suboptimal load and choke choices for the species being hunted
- shooting into flocks and sub-lethally striking non-target birds
- dropping birds in heavy cover where they can't be retrieved
- failure to have an effective retrieval strategy in place, including the use of a well-trained retriever dog[17].

All of these factors relate to hunter behaviours or capabilities.

Obligations

The *Wildlife Act 1975, Prevention of Cruelty to Animals Act 1986, Game Management Authority Act 2014* and Victoria's Animal Welfare Action Plan require that wounding in waterfowl hunting is minimised.

Victoria currently addresses wounding through its voluntary Shotgunning Education Program, which aims to raise awareness, improve hunter performance and reduce the level of wounding associated with duck hunting. However, the government recognises that a more proactive approach is required and should contain a mix of regulatory and non-regulatory actions to continually reduce wounding. This action plan seeks to achieve this.

17 Mikula *et al.* 1977; Roster 1998a; Roster 1998b; Mondain-Monval *et al.* 2015; AEWA 2016; GMA 2016; Clausen *et al.* 2017

VISION, GOAL AND ACTION AREAS

Vision

Licensed duck hunters are skilled, knowledgeable and employ good hunting practices to minimise waterfowl wounding and improve animal welfare outcomes, reduce waste, contribute to sustainability and give the community confidence that duck hunting is conducted responsibly.

Goal

There is a continuing decline in the monitored level of wounding in duck hunting in Victoria.

Action areas

To achieve the vision and goal, the action plan identifies six action areas to reduce waterfowl wounding:

- Leadership and culture
- Raising hunter awareness
- Ensuring hunter knowledge and proficiency
- Sustainability – Accounting for wounding losses in harvest arrangements
- Monitoring wounding
- Evaluation and revision

Each action area sets out actions to reduce waterfowl wounding and continue the good work already undertaken by the hunting community in partnership with government. The individual action areas are not intended to operate in isolation: in combination they will help to achieve a continuing decline in the monitored level of wounding in duck hunting.

Timing

This action plan will be in place for five years (2025–2029). Towards the end of this period, progress in delivering the actions and achieving a decline in waterfowl wounding will be assessed and the plan revised as required. It may take a period of time to see a significant reduction in wounding rates as occurred in Denmark, however, progress is expected during the life of this action plan. Denmark already had a well-established mandatory program of testing and training, which was revised to incorporate elements on wounding reduction.

This action plan will become part of the ongoing management program to ensure responsibility and sustainability in duck hunting[18].

18 When such programs ceased in Denmark after their initial introduction in 1997–2005, a slight increase in wounding rates of pink-footed geese during 2009–2011 triggered the need for recommencing these initiatives and a second round of now ongoing campaigns was introduced in 2012.

ACTIONS AREAS TO ACHIEVE THE GOAL

1. Leadership and culture

Outcome: A strong culture of leadership and no tolerance for engaging in wounding-type behaviours and practices across Victoria's duck hunting community

Waterfowl wounding is a hunting problem that can be addressed by the hunting community with the support of government. For this action plan to be successful, the hunting community accepts there is a need for action, will take a leadership role in embracing and driving change and foster a culture of no tolerance for engaging in wounding-type behaviours and practices.

International research[19] suggests that wounding can result from personality characteristics of individual hunters, including a lack of concern for animal welfare or laziness. Alternatively, it has been suggested that it may be more a function of situational factors and social influence[20]. High hunter density, competition with other hunters, a lack of use of retriever dogs, hunting behaviours and practices that make birds fly higher, and hunters mimicking long-distance shooting by others can all cause hunters to shoot at excessive ranges that are likely to elevate wounding[21]. If the majority of hunters collectively operate to a higher standard and don't engage in wounding-type behaviours and practices, those around them are likely to also.

Other factors, such as a lack of concentration, fatigue and environmental conditions (e.g. hunting in strong winds making accurate shooting and retrieval difficult) can also affect hunter efficiency leading to high numbers of shots expended to bag birds and, consequently, higher wounding rates[22].

Distractions from animal activists may cause hunters to rush shots, lose concentration or hinder recovery, which can contribute to wounding.

Hunting organisations and leaders in the hunting community have the greatest influence in establishing a culture of no tolerance for wounding behaviours. Behaviours and practices of peers in the field, conversations around the campfire and at hunting organisation meetings and writings in the popular hunting literature will be critical in influencing the culture, standards of behaviour and hunter etiquette and conventions. While education and training programs can teach the necessary theoretical and practical skills to reduce wounding, social norms and standards of behaviour will dictate whether they are practised in the field. Hunting organisations must take the lead in setting and promoting these cultural standards.

Hunters who show restraint by not taking long shots, let birds come within a 30-metre range, use decoys and callers, pass-up risky shots, don't fire "in hope" or who call out those who engage in wounding behaviours and practices, should be respected. Hunters should consider whether taking a shot is more likely to result in a bagged bird or a wounded one. Hunters who employ good hunting practices will fire fewer shots, bag more birds and wound less[23].

19 Causey 1989
20 Kuentzel and Heberlein 1998; Wheeler and Hunt 1994
21 Kuentzel and Heberlein 1998
22 Mondain-Monval *et al.* 2015
23 Noer *et al.* 2006; GMA 2016

This action plan sets the standards and expectations for the duck hunting community in addressing waterfowl wounding. As the lead regulator of duck hunting, the Game Management Authority will promote these standards and report on progress in achieving the action plan's goal.

ACTION		WHO	TIMEFRAME
1.1	Hunting organisations and government promote the release of this action plan through their communications channels (e.g. social media, websites, magazines, newsletters) to raise awareness and institute a culture of non-acceptance of wounding behaviours and continuous improvement.	Key duck hunting organisations, industry, broader hunting community, GMA	2025 and ongoing
1.2	Develop a code of ethics for duck hunters which focusses on continuous improvement and committing to practice behaviours that reduce the chances of wounding[24].	WWRAP working group	2025
1.3	The code of ethics is endorsed and promoted by FGA and SSAA, and other shotgunning organisations are invited to endorse the code.	Duck hunting organisations	2025
1.4	Acknowledge good hunting practice in the field through peer recognition and reward.	Hunting organisations, general duck hunting community	2025 and ongoing
1.5	Conduct social research into the attitudes, perceptions and behaviours of Victorian duck hunters to identify factors that may contribute to wounding.	GMA	2026
1.6	Promote the standards required to achieve the action plan's goal.	GMA, hunting organisations	2025 and ongoing

24 Loyn 1989, BASC 2010 and Madsen *et al.* 2015 provide useful guides.

2. Raising hunter awareness

Outcome: Hunters are aware of the causes, solutions and scale of wounding and have access to quality education materials

Information and education campaigns have been critical in achieving reduced waterfowl wounding rates elsewhere in the world.[25] Many hunters are unaware of the scale and causes of wounding, that their actions could cause wounding, whether wounding has occurred, the consequences of wounding and the actions required to address it. Education and testing initiatives will address these knowledge gaps and promote an increased sense of moral responsibility. If aware of the impact and implications, hunters will be more receptive to change and less likely to make unethical decisions.[26]

Victoria's current education program provides a wealth of detailed material. For example, the *Be a Better Gamebird Hunter* booklet is an excellent resource for hunters developed in collaboration between the hunting community and government and provides a lot of information on the how to address the causes of wounding. However, there is a need for more succinct and targeted key messages that highlight the causes of wounding and key actions that hunters can take to reduce it. For example, in Denmark, simple messaging focusses primarily on reducing the distance of shot to 30 metres for ducks.[27] Simplicity in the messages and focussing on addressing key factors that cause wounding will be important to raise awareness, alter hunter behaviour and change attitudes towards wounding.

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25 Noer *et al.* 2007 and Clausen *et al.* 2017

26 Norton and Thomas 1994

27 The experience in Denmark (e.g. Noer *et al.* 2006; Noer *et al.* 2007) and in studies in the USA in the 1970s and 80s to compare the performance of lead shot vs steel have shown that the overall proportion of geese or ducks hit to those killed decreases with increasing range (e.g. Mikula *et al.* 1977; Anderson and Sanderson 1979; Humburg *et al.* 1982). A study on common eider hunting showed that the probability of instantly killing a bird decreased with range, to almost zero for ranges above 40 metres (Noer *et al.* 2006 cited in Noer *et al.* 2007). A key factor for success in Denmark has been the very strong message to reduce the distance that birds are shot at (Noer *et al.* 2007; Clausen *et al.* 2017).

ACTION		WHO	TIMEFRAME
2.1	Review current educational materials and identify any gaps.	WWRAP working group	2025
2.2	Develop simple, direct and targeted communication and education tools for hunters to raise awareness and encourage behaviour change to address the key causes of wounding.	WWRAP working group	2025–26
2.3	Review and promote the dispatch guide to raise awareness of how to humanely destroy recovered birds.	WWRAP working group	2025
2.4	Authorised officers to continue to actively enforce game hunting regulations which require hunters to immediately recover downed birds before continuing to hunt.	Government Authorised Officers	Ongoing
2.5	Regularly promote consistent and simple key messages on how to reduce wounding through various communications and marketing channels.	Industry, hunting organisations, GMA	2025 and ongoing

3. Ensuring hunter knowledge and proficiency

Outcome: A skilled and knowledgeable duck hunting community reduces wounding

To reduce wounding losses, hunters must achieve and maintain a minimum level of shooting skill and understand good hunting practice. Attaining these skills and knowledge has been recommended as a prerequisite to obtaining a hunting licence.[28] Research has shown that wounding decreases with relevant training, practice and experience.[29]

CAUSES OF WOUNDING

Wounding can be caused by a number of factors, including:

- poor shooting skills
- shooting at birds at too long ranges (shooting at no more than 30 metres recommended for ducks)
- hunters shooting beyond their maximum shooting skills distance
- use of suboptimal load and choke choices for the species being hunted
- shooting into flocks and sub-lethally striking non-target birds
- dropping birds in heavy cover where they can't be retrieved
- failure to have in place an effective retrieval strategy, including the use of a retriever dog[30].

28 Norton and Thomas 1994

29 Nieman *et al.* 1987, Noer *et al.* 2007, Mondain-Monval *et al.* 2015 and Clausen *et al.* 2017 for waterfowl hunting and Aebischer *et al.* 2014 and Hampton *et al.* 2022 for deer hunting/culling.

30 Roster 1998a; Roster 1998b; Mondain-Monval *et al.* 2015; AEWA 2016; GMA 2016; Clausen *et al.* 2017

HUNTER ACTIONS TO AVOID WOUNDING

Proficient hunters avoid wounding by:

- regularly practicing shooting at clay targets that simulate flight speeds and angles of ducks (e.g. skeet or bespoke layouts, simulated field/sporting clays) to attain and maintain a minimum standard of skills
- practicing estimating distance under field-type conditions
- selecting the right choke and load combinations for the species and distances being hunted
- only shooting at ducks within the recommended 30 metre distance and never into flocks
- effectively using decoys and callers to bring ducks within range
- implementing an effective retrieval strategy, including the use of a well-trained retriever dog
- avoiding hunting in areas where retrieval is difficult
- consider environmental conditions (e.g. high winds, fog) and modify hunting practices accordingly[31].

All of these factors relate to hunting behaviours or capabilities. Education, training and testing programs should cover these topics.

Many countries throughout the world require mandatory knowledge and proficiency testing before being allowed to participate in hunting[32]. In Australia, New South Wales (NSW) requires private land duck hunters and public land deer and pest animal hunters to pass a knowledge test before being allowed to hunt. NSW, Victoria, South Australia and Tasmania require hunters to pass a waterfowl identification test before being allowed to hunt ducks, however, this test does not extend to awareness of hunting laws or good hunting practices.

Required testing may be seen by some in the hunting community as negative and a barrier to entry which could drive hunter numbers down. While testing does require prospective hunters to pay a fee and invest time to practice, prepare, learn and undertake a test, the positives are often overlooked. Those who successfully complete necessary training and testing are more aware of their legal requirements, which protects them against inadvertent non-compliance, they are more proficient and successful hunters and have at least a basic understanding of hunting methods and effective practices and strategies[33] (see information box).

Demonstrating to the public that hunters have these skills and knowledge gives the community greater confidence that game hunting can be conducted safely and sustainably and minimises adverse animal welfare outcomes.

31 Roster 1998a; Roster 1998b; Mondain-Monval *et al.* 2015; AEWA 2016; GMA 2016; Clausen *et al.* 2017

32 Deer Commission for Scotland 2008

33 Nieman *et al.* 1987, Noer *et al.* 2007, Mondain-Monval *et al.* 2015 and Clausen *et al.* 2017 for waterfowl hunting and Aebischer *et al.* 2014 and Hampton *et al.* 2022 for deer hunting

TRAINING CAN REDUCE WOUNDING

In 2008 and 2012 as part of Victoria's Shotgunning Education Program, representatives from Field and Game Australia and Sporting Shooters' Association of Australia (Vic) were selected and trained to be instructors to deliver theoretical and practical training to hunters to improve their hunting skills and knowledge in order to reduce wounding. Trainees were taken to a free-range game bird farm in Tasmania where they undertook intensive training by US ballistics expert Dr Tom Roster over a period of six days. Training included theory classes, a four-hour written exam, many hours of shooting training and pattern testing and a field-based shooting test. Prior to training, trainees were required to hunt a free-ranging introduced gamebird to determine their level of wounding using trained field observers. They recorded 29 per cent and 33 per cent wounding rates respectively (average 31 per cent). Following training and testing, wounding rates were reduced to five per cent and seven per cent respectively (average 6 per cent). This showed that with targeted theoretical and practical training and testing, substantially reduced wounding rates can be achieved.

Theoretical knowledge

To ensure hunters have a minimum level of knowledge of game hunting laws and good hunting practice, including ways to reducing wounding, it is intended to introduce a Game Licence test for all native game bird hunters, including duck hunters. Existing education materials will be reviewed to ensure they are adequate, and testing will be conducted online. The test will be developed in consultation with hunting organisations and regulatory reform will be required to introduce the test.

Practical proficiency

By maintaining the required level of shooting skill, modifying behaviour and practicing self-restraint in the field (e.g. no shooting beyond 30 metres, allowing birds to come within range and using decoys and callers effectively), significant reductions in wounding can be achieved[34].

The merits of training hunters to achieve the required level of skill and testing hunters' shooting proficiency (i.e. their ability to hit clay targets simulating the flight angles and speed of ducks commonly experienced in the field) will be explored. A practical training and proficiency assessment pilot will be conducted to better understand the potential benefits and burdens of such a program. Advice on the outcome of the trial will be presented to the Minister and will consider the potential benefits of practical training as well as any barriers to entry for mandatory proficiency testing.

The use of gundogs

The use of a well-trained gundog can increase recovery rates for downed game birds and reduce wounding losses[35]. Conversely, the use of a poorly trained dog can cause distraction to the handler and other hunters and could contribute to wounding losses.

Providing easily accessible and expert training for gundogs and their handlers with incentives to attend could increase the number of dogs in the field with good obedience and retrieval skills and help to reduce wounding.

34 Noer *et al.* 2007, Clausen *et al.* 2017

35 Roster 1998b

ACTION		WHO	TIMEFRAME
3.1	Commencing in 2025, all prospective (i.e. new) native game bird hunters (including duck hunters) must undertake online theory training and pass an online test which covers hunting laws and good hunting practice[36] including reducing wounding, before they can obtain a Game Licence to hunt duck and Stubble Quail. Note: regulations are required.	Responsible Ministers, DJSIR, DEECA, GMA, prospective Game Licence holders	2025 for new applicants
3.2	From 2026, all existing duck and Stubble Quail hunters must undertake the same theory training and testing as described in 3.1 but this will be on renewal of a Game Licence or reapplication if previous licences have lapsed.	Responsible Ministers, DJSIR, DEECA, GMA, existing / previous Game Licence holders	From 2026
3.3	Review existing education materials to ensure they are adequate to assist hunters to pass the theory test. Revise existing or develop new materials as required.	WWRAP working group, hunting organisations, GMA	2025-26
3.4	Conduct a proficiency training pilot. Consider the costs and benefits of introducing mandatory training and/or testing. Provide advice to the Minister on the outcome of the trial by August 2025 for consideration.	GMA	2025-26
3.5	Hunting organisations with shooting ranges should make them easily accessible, including to non-members, and establish pattern testing facilities and realistic clay target shooting opportunities that represent flight angles and speeds of ducks to simulate field situations, and distance estimation training facilities.	Hunting organisations with shooting ranges	2025 and ongoing
3.6	Hunting organisations and third-party providers to develop and provide easily accessible retriever training programs for gundogs.	Hunting organisations, gundog training providers	2025 and ongoing
3.7	Encourage hunting and dog training clubs to offer the services of trained gundogs to accompany hunters in the field to increase recovery rates of downed birds and provide field experience for gundogs.	Hunting organisations, gundog training providers	2025 and ongoing

36 Cultural awareness will also be included in this knowledge test. This was a commitment by government in response to the Parliamentary Inquiry into native game bird hunting arrangements in Victoria.

4. Sustainability - Accounting for wounding losses in harvest arrangements

Outcome: Wounding rates are determined and factored into setting sustainable hunting season arrangements

Data collected in Australia in the 1960s–80s reported wounding rates of anywhere between 6–40 per cent and varied significantly depending on the monitoring technique employed (e.g. fluoroscope, hunter-reported) (see **Appendix 3**).

Since that time, there have been advances in hunting equipment technology and changes in regulatory requirements in Victoria (e.g. a prohibition on the use of semi-automatic shotguns and firearms with large magazine capacity, prohibition on the use of lead shot for duck hunting) which may have had an impact on wounding levels, the extent to which is unknown. Wounding rates in the 20–40 per cent range continue to appear in the contemporary literature elsewhere in the world where similar technological and regulatory changes have occurred[37].

In Victoria, wounding losses are not factored into determining harvest arrangements for duck hunting. In order to do this, contemporary data on wounding levels in Victoria are required. Improving our understanding of the extent of wounding and the contribution it makes to total losses caused by duck hunting will allow them to be factored in when establishing sustainable harvest setting arrangements (also see **section 5** regarding crippling ratio).

ACTION		WHO	TIMEFRAME
4.1	Determine, in consultation with experts, appropriate experimental designs to measure wounding rates.	GMA	2025
4.2	Conduct research to determine the current wounding rate.	GMA	2026 to 2028 and periodically thereafter
4.3	In conjunction with the move to adaptive harvest management for waterfowl harvest setting, incorporate wounding losses in order to determine the total annual harvest level and subsequent hunting arrangements. An appropriate proxy rate will be used until research establishes the Victorian rate.	GMA	2025 and ongoing

37 For example, Noer and Madsen 1996, CONSEP 2002

5. Monitoring wounding

Outcome: The success of the action plan in reducing wounding can be assessed

A strong-evidence base will help to ensure informed community dialogue on waterfowl wounding, guide management actions and allow the success of this action plan to be evaluated. An ongoing wounding monitoring program will be introduced to allow this to occur.

Denmark has instituted a program to monitor wounding by x-raying live trapped birds to identify the proportion carrying embedded shot. Such a program was also conducted in Victoria between 1957 – 1973[38]. While this approach cannot be used to determine actual wounding rates, it can be used as a proxy measure to monitor trends in the rates of wounding[39] in a less resource intensive way than some other forms of monitoring (e.g. direct observations of active hunters in the field).

This approach will again be employed in Victoria. Ducks will be trapped and x-rayed to measure the proportion of birds carrying embedded shotgun pellets. First-year birds will be the focus as they provide a more accurate measure of the incidence of wounding compared to adult birds that can accumulate pellets over several hunting seasons[40].

To raise awareness, ensure transparency and motivate hunters to act, findings will be published annually on the Game Management Authority's website and will be an important tool to assist in program evaluation.

To fully understand the extent of the wounding problem, it is necessary to also have knowledge of total game duck harvest and total population size to determine the wounding ratio (number of birds wounded for each bird bagged). Wounding levels are usually reported as a 'wounding rate', defined as the percentage of birds x-rayed with embedded shotgun pellets[41]. While this measure is a valid proxy for the level of wounding, it is also very sensitive to changes in the harvest rate (declared harvest / population size prior to harvest). A rise in the proportion of a population being shot given an unchanged frequency of wounding will lead to an increase in the wounding rate[42]. Therefore, the wounding rate cannot be used as a direct measure of hunter performance.

In order to assess hunter performance in a way that accounts for changes in harvest rate, "crippling ratio" can be used. The crippling (or wounding) ratio is expressed as wounding rate / harvest rate. This will allow hunter performance to be evaluated in a way that accounts for differences in population size and harvest pressure and which can therefore be used to evaluate initiatives introduced to reduce wounding[43]. Victoria has good data on harvest levels and, with the introduction of adaptive harvest management, will be able to estimate the total population size of important game duck species.

38 Norman 1976
39 Clausen *et al.* 2017
40 Norman 1976, Noer and Madsen 1996
41 Clausen *et al.* 2017
42 Clausen *et al.* 2017
43 Clausen *et al.* 2017

ACTION		WHO	TIMEFRAME
5.1	Introduce a wounding monitoring program which uses x-ray to measure pellet infliction (embedded pellet) rates.	GMA	Commenced. Ongoing
5.2	Explore other approaches to wounding monitoring, such as hunter surveys or machine learning.	GMA	2025
5.3	Following the introduction of adaptive harvest management for game ducks, determine the "crippling (wounding) ratio" as a measure of the effectiveness of interventions in this action plan.	GMA	2026
5.4	Annually publish the results of wounding monitoring programs on the GMA website.	GMA	Commenced. Ongoing

6. Evaluation and revision

Outcome: Management actions are targeted and effective in reducing wounding

It is important to track the effectiveness of this action plan to ensure it is achieving a reduction in waterfowl wounding. A working group has been established with key stakeholder groups to:

- assist in the development of this plan
- further develop and implement actions identified in this action plan
- monitor the timeliness of delivery
- review all elements of the action plan for effectiveness
- provide advice to the Game Management Authority on progress and areas for improvement.

The working group consists of representatives from the following:

- Sporting Shooters Association of Australia (Vic)
- Field and Game Australia
- RSPCA
- Wildlife Victoria
- A representative from the Shotgun Education Program trained trainers
- A representative from the firearms and ammunition industry.

Representatives from the Game Management Authority, Department of Jobs, Skills, Industry and Regions and Department of Energy, Environment and Climate Action will attend working group meetings in an advisory capacity.

The working group will be chaired by a suitably qualified and independent person appointed by the Game Management Authority. The GMA will provide secretariat assistance to the working group.

ACTION		WHO	TIMEFRAME
6.1	Establish a Wounding Reduction Working Group consisting of relevant stakeholders and an independent chair to further develop aspects of the action plan, monitor its effectiveness and provide advice to the GMA on progress towards achieving the action plan vision and goal.	Identified key stakeholders	Commenced
6.2	The working group should meet every six months during the life of the action plan and at other times as required.	WWRAP working group	Commenced
6.3	Review the action plan at the end of its five-year period and provide advice to the GMA on performance, achievements and areas for improvement	WWRAP working group	2029

ACTION PLAN TIMELINE

The following diagram summarises the action plan actions and time frame for commencement.

2025

- **1.1** Commence and promote action plan
- **1.2** Develop code of ethics
- **1.3** Code of ethics is endorsed by hunting organisations
- **1.4** Acknowledge non-wounding behaviours in the field
- **1.6** Promote standards to achieve goal
- **2.1** Review education material
- **2.2** Simple, targetted communications
- **2.3** Review dispatch guide
- **2.4** Officers continue to enforce regulations
- **2.5** Regularly promote key messages
- **3.1** Commence knowledge testing for new hunters
- **3.3** Review education materials to support knowledge test
- **3.4** Conduct proficiency training pilot
- **3.5** Alter shooting ranges for better practice and improve accessibility
- **3.6** Develop and provide retriever dog training programs
- **3.7** Dog training clubs offer gundogs to hunters to increase recovery
- **4.1** Design wounding rate research
- **4.3** Include wounding losses into harvest arrangements
- **5.1** Commence x-ray wounding monitoring
- **5.2** Explore other forms of wounding monitoring
- **5.4** Publish monitoring program results
- **6.2** Working group to meet every six months and as required

2026

- **1.5** Social research into hunter attitudes
- **3.2** Commence knowledge testing for existing hunters upon licence renewal
- **4.2** Implement wounding rate research
- **5.3** Determine crippling ratio

2027

2028

2029

- **6.3** Review action plan performance
- Revise and re-introduce action plan

LIST OF ACRONYMS

CONSEP	Cooperative North American Shotgunning Education Program
DEECA	Department of Energy, Environment and Climate Action
DJSIR	Department of Jobs, Skills, Industry and Regions
FGA	Field and Game Australia
GMA	Game Management Authority
RSPCA	Royal Society for the Prevention of Cruelty to Animals
SSAA	Sporting Shooters Association of Australia (Vic)
WWRAP	Waterfowl Wounding Reduction Action Plan

REFERENCES

Aebischer, N. J., Wheatley, C. J., and Rose, H. R. (2014). Factors associated with shooting accuracy and wounding rate of four managed wild deer species in the UK, based on anonymous field records from deer stalkers. *PLoS ONE* **9**, e109698.

Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) International Working Group for the pink-footed goose webpage: **http://pinkfootedgoose.aewa.info/node/194** accessed 16/06/2020.

Alison, R. (2001). 'The Ones That Almost Got Away – Unseen Victims of Waterfowl Hunters.' (The Humane Society of the United States: Washington D.C., USA).

Anderson, W. L., and Sanderson, G. C. (1979). Effectiveness of steel shot in 3-inch, 12-gauge shells for hunting Canada geese. *Wildlife Society Bulletin* **7**, 213–220.

Bellrose, F. C. (1953). A preliminary evaluation of cripple loss in waterfowl. *Transactions of the 18th North American Wildlife Conference*. **18**, 337–360.

Braithwaite, L. W., and Norman, F. I. (1974). The 1972 Open Season on Waterfowl in South-Eastern Australia. *CSIRO Division of Wildlife Research Technical Paper No. 29*. (CSIRO: Melbourne, Australia).

Braithwaite, L. W., and Norman, F. I. (1976). The 1973 And 1974 Open Seasons on Waterfowl in Southeastern Australia. *CSIRO Division of Wildlife Research Technical Paper No. 11*. (CSIRO: Melbourne, Australia).

Braithwaite, L. W., and Norman, F. I. (1977). The 1975 And 1976 Open Seasons on Waterfowl in Southeastern Australia. *CSIRO Division of Wildlife Research Technical Paper No. 13*. (CSIRO: Melbourne, Australia).

Braithwaite, L.W., and Norman, F.I. (1981). The 1977 and 1978 open seasons on waterfowl in south-eastern Australia. CSIRO Division of Wildlife Research Technical Paper No. 15. (CSIRO: Melbourne, Australia).

Briggs, S. V., Maher, M. T. and Davey, C. C. (1985). Hunter activity and waterfowl harvests in New South Wales, 1977–82. *Australian Wildlife Research* **12**, 515–522.

British Association for Shooting and Conservation (BASC) (2010). *Respect for Quarry*. Marford Mill, Rossett, Wrexham, England.

Carney, S. M., and Smart, G. (1964). '*Comparisons Between Hunters' Reports and Spy-Blind Observations During the 196–62, 1962–63 and 1963–64 Hunting Seasons. Administrative Report No. 44.*' (U.S. Department of the Interior, Bureau of Sport, Fisheries and Wildlife Branch of Wildlife Research, Migratory Bird Populations Station: Laurel, USA).

Causey, A. (1989). On the morality of hunting. *Environmental Ethics* **11**, 327–343.

Clausen, K. K., Holm, T. E., Haugaard, L., and Madsen, J. (2017). Crippling ratio: a novel approach to assess hunting-induced wounding of wild animals. *Ecological Indicators* **80**, 242–246.

Cochrane, R. L. (1976). Crippling effects of lead, steel, and copper shot on experimental mallards. *Wildlife Monographs* **51**, 7–19.

Cooperative North American Shotgunning Education Program (CONSEP). (2002). *Waterfowl Wounding Losses Problem Statement*. Pierre, South Dakota.

Deer Commission for Scotland (2008). A review of options to assess competence in other countries.

Elder, W. H. (1950). Measurement of hunting pressure in waterfowl by means of X-ray. *Transactions of the 15th North American Wildlife Conference* **15**, 490–504.

Elder, W.H. (1955a). Fluoroscopic measurements of shooting pressure on pink-footed and greylag geese. *Wildfowl Trust Annual Report* **7**, 123–126.

Elder, W. H. (1955b). Fluoroscopic measures of hunting pressure in Europe and North America. *Transactions of the 20th North American Wildlife Conference* 20, 298–321.

Fraser, D., and MacRae, A. M. (2011). Four types of activities that affect animals: implications for animal welfare science and animal ethics philosophy. *Animal Welfare* 20, 581–590.

Game Management Authority (2016). *Be a better game bird hunter. Shotgunning Education Program Handbook 2nd edition.* (Melbourne, Australia).

Grieb, J. R. (1970). The shortgrass prairie Canada goose population. *Wildlife Monographs* 22, 1–47.

Hampton, J.O., MacKenzie, D.I. and Forsyth, D.M. (2022). Animal welfare outcomes of professional vehicle-based shooting of peri-urban rusa deer in Australia. *CSIRO Wildlife Research*.

Holm, T. E. and Madsen, J. (2013). Incidence of embedded shotgun pellets and inferred hunting kill amongst Russian/Baltic barnacle geese Branta leucopsis. *European Journal of Wildlife Research* 59, 77-80.

Holm, T. E. and Haugaard, L. (2013). Effects of a Danish action plan on reducing shotgun wounding of Common Eider *Somateria mollissima*. *Bird Study* **60**, 131-134.

Holm, T. E., Clausen, K., Haugaard, L., and Madsen, J. (2017). '*Wounding of Game by Shotgun Hunting.*' (Aarhus University: Aarhus, Denmark).

Hopper, R.M., Geis, A.D., Grieb, J.R. and Nelson, L. (1975). Experimental duck hunting seasons, San Luis Valley, Colorado, 1963-1970. Wildlife Monographs 46: 1-68.

Humburg, D. D., Sheriff, S. L., Geissler, P. H. and Roster, T. (1982). Shotshell and shooter effectiveness. Lead vs. steel shot for duck hunting. *Wildlife Society Bulletin* **10**, 121–126.

Jönsson B., Karlsson J., Svensson S. (1985). Incidence of lead shot in tissues of the bean goose (*Anser fabalis*) wintering in South Sweden. *Swedish Wildlife Research* 13, 259–271

Kirby, R. E., Riechman, J. H., and Schoenfelder, T. W. (1981). Recuperation from crippling in ducks. *Wildlife Society Bulletin* **9**, 150–151.

Kuentzel, W. F. and Heberlein, T. A. (1998). Why do hunters skybust? Person disposition or social influence. *Human Willdife Dimensions* **3** (1), 1-15.

Loyn, R. H. (1989). '*The Management of Duck Hunting in Victoria: A Review. Technical Report Series No. 70.*' (Department of Conservation, Forests and Lands: Melbourne, Australia).

Madsen, J. and Noer, H. (1996). Decreased survival of pink-footed goose *Anser brachyrhynchus* carrying shotgun pellets. *Wildlife Biology* **2**, 75-82.

Madsen, J., Bunnefeld, N., Nagy, S., Griffin, C., Defos du Rau, P., Mondain-Monval, J.Y., Hearn, R., Czajkowski, A., Grauer, A., Merkel, F.R., Williams, J.H., Alhainen, M., Guillemain, M., Middleton, A., Christensen, T.K. & Noe, O. (2015). *'Guidelines on Sustainable Harvest of Migratory Waterbirds. AEWA Conservation Guidelines No. 5.'* (AEWA Technical Series No. 62. Bonn, Germany).

Mellor, D. and Stafford, K. (2001). Integrating practical, regulatory and ethical strategies for enhancing farm animal welfare. *Australian Veterinary Journal* **79**, 762–768.

Mellor, D. J., Campbell, A., and Bayvel, D. (2008). New Zealand's inclusive science-based system for setting animal welfare standards. *Applied Animal Behaviour Science* **113**, 313–329.

Mikula, E. J., Martz, G.F. and Ryel, L.A. (1977). A comparison of lead and steel shot for waterfowl hunting. *Wildlife Society Bulletin* **5**:3-8.

Moloney, P.D. and Powell, Z. (2019). *Estimate of duck and Stubble Quail harvest in Victoria for 2019: Results from surveys of Victorian Game Licence holders in 2019.* (Unpublished Client Report for the Game Management Authority. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria).

Mondain-Monval, J., Du Rau, P.D., Guillemain, M. and Oliver, A. (2015). Switch to non-toxic shot in Camargue, France: effect on waterbird contamination and hunter effectiveness. *European Journal of Wildlife Research* **61,** 271-283.

Nieman, D. J., Hochbaum, G. S., Caswell, F. D., and Turner, B. C. (1987). Monitoring hunter performance in prairie Canada. *Transactions of the North American Wildlife and Natural Resources Conference* **52**, 233–245.

Noer, H., and Madsen, J. (1996). Shotgun pellet loads and infliction rates in pink-footed goose *Anser brachyrhynchus*. *Wildlife Biology* **2**, 65–73.

Noer, H., Madsen, J., Strandgaard, H., and Hartmann, P. (1996). '*Anskydning Af Vildt (Wounding of Game). NERI Thematic Report no. 8.*' (National Environmental Research Institute: Rønde, Denmark).

Noer, H., Hartmann, P. and Madsen, J. (2006). '*Anskydning Afvildt: Konklusioner Påundersøgelser 1997–2005 (Wounding of Game: Conclusions from Investigations 1997–2005). NERI Technical Report, No. 569.*' (National Environmental Research Institute of Denmark: Rønde, Denmark).

Noer, H., Madsen, J. and Hartmann, P. (2007). Reducing wounding of game by shotgun hunting: effects of a Danish action plan on pink-footed geese. *Journal of Applied Ecology* **44**, 653-662.

Norman, F. I. (1976). The incidence of lead shotgun pellets in waterfowl (Anatidae and Rallidae) examined in South-Eastern Australia between 1957 and 1973. *Australian Wildlife Research* **3**, 61–71.

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.

Norman, F. I., Briggs, S. V. and Braithwaite, L. W. (1984). '*Some Results From the 1979, 1980, and 1981 Opening Day Surveys of Waterfowl Hunters in New South Wales and Victoria.' CSIRO Division of Wildlife and Rangelands Research Technical Paper No. 20.'* (CSIRO: Melbourne, Australia).

Norton, M. R., and Thomas, V. G. (1994). Economic analyses of 'crippling losses' of North American waterfowl and their policy implications for management. *Environmental Conservation* **21**, 347–353.

Pierce, B. L., Roster, T. A., Frisbie, M. C., Mason, C. D., and Roberson, J. A. (2015). A comparison of lead and steel shot loads for harvesting mourning doves. *Wildlife Society Bulletin* **39**, 103–115.

Purdey, D. and Menkhorst, P. (2015). '*Hunter's Bag Surveys: 2014 and 2015 Victorian Duck Hunting Seasons*.' (Department of Environment, Land, Water and Planning: Melbourne, Australia).

Roster, T. (1998a). Behaviours which cause wounding losses. (Cooperative North American Shotgunning Education Program: South Dakota, USA).

Roster, T. (1998b). Behaviours which can reduce wounding losses. (Cooperative North American Shotgunning Education Program: South Dakota, USA).

Roster, T. (1998c). Patterns vs penetration: Part 1. (Sporting Clays Magazine: Ohio, USA).

Roster, T. (1999). Patterns vs penetration: Part 2. (Sporting Clays Magazine: Ohio, USA).

RSPCA Australia. (2019). '*What Are the Wounding Rates Associated with Duck Hunting?*' (RSPCA Australia: Canberra, Australia.)

Russell, G. (1994). Shotgun wounding characteristics. In '*Maple Tech: Maple in Mathematics and the Sciences (Special Issue)*' pp. 17–23. (Birkhauser: Boston, USA).

Sharley, T. (2011). '*The Facts About Crippling and Wounding Rates in Waterfowl in Australia.*' (Sporting Shooters Association of Australia: Melbourne, Australia).

Stokes, K. J. (1990). *'Report of the Task Force enquiring into Duck Hunting in South Australia.'* (Ministry of Lands: Adelaide, Australia).

Szymanski. L. and Afton, A. A. (2005) Effects of spinning-wing decoys on flock behaviour and hunting vulnerability of Mallards in Minnesota. *Wildlife Society Bulletin* **33(3)**, 993-1001.

Theede, B. S. (2005). Use, efficiency and hunter opinions of motion-wing decoys at Neosho Wildlife Area. Master's Thesis. (Emporia State University: Emporia, USA).

Van Dyke, F. (1981). Mortality in crippled mallards. *Journal of Wildlife Management* **45**, 444–453.

Wheeler, W.E. and Hunt, R.A. (1994) *Canada Goose population and harvest characteristics at the Grand River Marsh Wildlife Area, 1977 – 1981. Research Report 164.* (Wisconsin Department of Natural Resources).

APPENDIX 1 – MORTALITY IN WOUNDED BIRDS

There are few data on the proportion of downed, unretrieved birds that survive being wounded (Kirby *et al.* 1981; Noer *et al.* 2007). While Bellrose (1953) estimated that only 10–20 per cent of wounded waterfowl would recover in the field, at that time, the survival of wounded ducks in the field had not been directly investigated (Van Dyke 1981). Bellrose (1953) showed that the most common injury sustained by waterfowl during duck hunting was a broken wing. In light of this, Van Dyke (1981) followed the fate of radio tagged mallards with surgically broken wings to determine their rate of survival under field conditions.. He showed that only three per cent of these birds survived with death caused by starvation (i.e. weight loss), predation by avian or mammalian predators or exposure to freezing winter conditions. Similarly, Kirby *et al.* (1981), as part of a wider telemetry study, observed the fate of struck and unretrieved radio-tagged waterfowl. Of those birds that were not killed outright, 73 per cent ultimately died and 27 per cent survived. Of those that died, the cause of death was attributed to emaciation or increased vulnerability to predation. Both of these studies tracked the fate of radio-tagged wounded waterfowl and showed that the vast majority died (73–97 per cent), not necessarily directly from gunshot wounds but from the indirect consequences of their injuries, which saw them succumb to starvation, predation or extreme cold weather conditions.

APPENDIX 2 – MEASURING THE EXTENT OF WOUNDING

Measuring the actual extent of wounding is difficult and a range of methods have been employed to attempt to do so. All may provide reliable metrics that are indicative of wounding trends, but they are likely to under-estimate the true extent of wounding.

Hunter reporting

Many studies have relied on hunters self-reporting via interviews, surveys or questionnaires. Self-reporting methods can be unreliable due to the embarrassment of having to report wounded birds, recall bias, intentionally under-reporting, not being able to recognise the signs of wounding or hunters being unaware that birds had been struck, particularly as a consequence of recoil following a shot (Nieman *et al.* 1987; Alison 2001). While obvious signs include laboured or changed flight characteristics, erratic gliding, hanging legs, drifting feathers or birds falling from the sky, other injuries may not be readily observable or immediately debilitating (e.g. pellets that do not break bones or penetrate internal organs) but may nevertheless result in death (Alison 2001). For these reasons, hunter estimates of the frequency of wounding are considered to under-estimate actual wounding rates. Nieman *et al.* (1987) conducted a study which simultaneously compared hunter-reported wounding rates versus those of field observers and showed that hunters "grossly under-estimated or were reluctant to report actual losses." Hunters reported wounding rates of 6-18 per cent, whereas observations of hunters recorded estimates of 20-45 per cent. Nieman *et al* (1987) concluded that hunter interviews were not accurate enough for use in assessing waterfowl hunting mortality. A similar study by Hopper *et al.* (1975) showed hunter-reported wounding of 11–16 per cent while observers recorded a 9–23 per cent wounding rate.

Field observers

As an alternative to self-reporting, trained field observers have been used to monitor hunters and record data parameters such as distance of shot, species of birds encountered, numbers of birds bagged or wounded, hunting methods and breaches of the laws. These observers, sometimes referred to as "spy-blind" observers, either played the role of hunters, remaining concealed until hunting concluded or accompanied hunters in their hunting locations (e.g. Nieman *et al.* 1987; Humburg *et al.* 1982; Szymanski and Afton 2005). This method has also been applied to upland game bird species such as mourning doves (*Zenaida macroura*) in the USA (Pierce *et al.* 2015). In many of these studies, observers undertook significant training in recognising the signs that birds had been wounded (e.g. Humburg *et al.* 1982, Pierce *et al.* 2015).

Nieman *et al.* (1987) compared methods of direct observation with hunter self-reporting. Hunters reported unretrieved losses of 6–18 per cent in interviews compared to direct observation of those hunters' behaviour estimated wounding losses of 20–45 per cent of all birds shot. Carney and Smart (1964) used field observers to record wounding and then immediately interviewed hunters following the hunt to record their perceived level of wounding. Hunters reported a wounding rate of 26 per cent compared with the field observers ratio of 0.47 wounded bird per bagged bird, or 47 per cent.

While considered more accurate than hunter-reporting, direct observation of hunters may still underestimate wounding rates. Such observations are necessarily subjective and can underestimate the actual frequency of wounding because, without after-the-fact necropsy, many types of subtle wounding cannot be determined (Alison 2001). However, in an unpublished study on this issue, Roster (pers. comm.) in a Cooperative North American Shotgunning Education Program (CONSEP) study used flighted farm mallards (*Anas platyrhynchos*) shot at by hunters to measure wounding rates. Each bird was banded and it was known which bird was shot at by which hunter and which trained observer was recording the result. All birds were recovered after shooting (either shot and recovered or returned to the farm barn) and examined. It was shown that trained observers did not see (or missed) 10–15 per cent of actual wounding (Roster pers. comm.; Theede 2005). Nonetheless, field observation of hunters provides some indication of a minimum frequency of wounding (Alison 2001).

X-ray / fluoroscope

Evaluating the extent of wounding among waterfowl species (and other hunted wildlife) can also be done by x-raying (radiography) or fluoroscoping individual birds to identify shotgun pellets embedded in their bodies (**Figure 1**) (e.g. Elder 1950, 1955a, b; Grieb 1970; Jönsson *et al.* 1985; Noer and Madsen 1996; Norman 1976; Holm and Madsen 2013).

These birds represent those that are non-lethally wounded and survive being shot, and do not include the following categories: a) birds that are killed outright but not collected by hunters, b) birds that die directly as a result of their injuries soon after being struck, c) birds that die indirectly as a result of their injuries long after being struck (Noer *et al.* 2007), and birds that are non-fatally struck but where pellets "pass-through" instead of embedding in tissues. Therefore, studies using x-ray / fluoroscope to detect birds with embedded shot and the percentage of inflicted birds identified vastly underestimate the real extent of wounding (Norman 1976; Loyn 1989; Noer and Madsen 1996; Noer *et al.* 2007; Clausen *et al.* 2017) as this method is only able to detect a small sub-set of wounding outcomes. For example, Noer and Madsen (1996) identified 25 per cent and 36 per cent of first-year and adult pink-footed geese *Anser brachyrhynchus* respectively carrying embedded shot and Madsen and Noer (1996) estimated that equated to one bird being wounded for every bird bagged (Noer *et al.* 2007). While x-ray / fluoroscope cannot be used to determine actual wounding rates, they can be used as a proxy measure to monitor trends in the rates of wounding (Clausen *et al.* 2017).

Figure 1. Pink-footed goose being x-rayed to identify the presence of embedded shot. The image on the bottom shows a bird wounded with 12 shotgun pellets (x-rayed April 30, 2016, NordTrøndelag, Norway). A steel leg band can also be seen on one leg. Photos: Department of Bioscience, Aarhus University, Denmark.

Wetland searches

Searches of wetlands for wounded birds after active hunting has ceased has also been conducted in parts of Australia, including Victoria and South Australia (Loyn 1989; Stokes 1990; Purdey and Menkhorst 2015) and has been proposed to provide inference regarding the frequency of wounding. These birds represent only those birds that are: a) non-lethally wounded, b) immediately incapacitated, and c) move to wetland fringes. It does not include the following categories: a) birds that are killed outright but not collected by hunters, b) birds that are non-fatally wounded and immediately incapacitated but that do not move to wetland fringes, and c) all non-fatally wounded birds that maintain the ability to fly (Noer *et al.* 2007). Wetland searches in Australia have either been conducted by government agency staff or volunteers (Loyn 1989; Stokes 1990) and can be labour-intensive. Search effort can be variable depending on resource availability and is often a low priority for agency staff given other management and enforcement demands. Wounded birds can be difficult to locate as they seek seclusion and heavy cover (Van Dyke 1981; Loyn 1989) and many wounded birds will fly from the wetland where they were struck. Given these challenges, wetland searches do not provide cost-effective or reliable estimates or indicators of the extent of wounding.

Mathematical modelling

There has been limited use of mathematical modelling to estimate wounding rates. Russell (1994) using shotgun characteristics, waterfowl morphology, and ballistic data, ran computer simulations that estimated, based on assumptions, probability and shot pellet characteristics, that 33–66 per cent of all ducks shot are wounded. Noer and Madsen (1996) applied a simple theoretical model using frequencies of pellet carriers in different age classes, adult survival and the annual rate at which pellets are inflicted upon pink-footed geese in Denmark. While recognising the limitations of the model and using different parameters, Noer and Madsen (1996) estimated that the minimum ratio of wounded to bagged birds was likely to be higher than 0.5 and closer to 1:1 (Madsen and Noer 1996).

APPENDIX 3 – THE EXTENT OF WOUNDING IN AUSTRALIA – A HISTORICAL PERSPECTIVE

As discussed in **Appendix 1**, there is no gold-standard method for estimating the frequency of wounding that is considered to allow accurate quantification. As such, there is considerable uncertainty attached to any estimate derived from imperfect detection methods. Nonetheless, evidence from around the world shows that substantial numbers of waterfowl are wounded by hunting at some time during their lifespan (Noer *et al.* 2007). Estimates of wounding vary between studies, with hunter-reported studies generally recording lower rates and trained observer studies (considered more accurate) higher (Norton and Thomas 1994). Estimates have ranged between approximately 10–60 per cent (e.g. Bellrose 1953; Norman 1976; Anderson and Sanderson 1979; Humburg *et al.* 1982; Briggs *et al.* 1985; Nieman *et al.* 1987; Noer and Madsen 1996; Noer *et al.* 2007).

For those studies recording the incidence of embedded shot detected using x-ray / fluoroscope techniques, 28–62 per cent of x-rayed geese have been found to contain embedded shot, while for sea and other duck species, proportions of 25–35 per cent have been reported (see Noer *et al.* 2007 for references).

Wounding in south-eastern Australia

Studies on wounding were conducted in Australia in the 1960s–1980s, but there has been little research into this issue since. Methods for estimating wounding have varied between face-to-face interviews or mail surveys of hunters, fluoroscope examination, field observations and shoreline searches of wetlands. Reported wounding rates have varied between the methods and sites.

HUNTER-REPORTED WOUNDING RATES

Between 1972–1981, Braithwaite and Norman (1974, 1976, 1977 and 1981) and Norman *et al.* (1984) conducted face-to-face in-field interviews of south-eastern Australian hunters [Victoria, New South Wales and South Australia (South Australia 1972–1978 only)] and asked them to provide information on their retrieved harvest (bagged) and shot but unretrieved losses. A summary of this information is included in **Table 1**.

For 1972–1978 in Victoria, New South Wales and South Australia, on average, hunters reportedly wounded 0.3 birds for every bird bagged. In other words, for every 10 birds brought to bag (recovered), three birds were struck but not retrieved, a wounding rate of 30 per cent.

For 1979–1981 in Victoria and New South Wales, on average, hunters reportedly wounded 0.2 birds for every bird bagged. In other words, for every 10 birds brought to bag, two birds were struck but not retrieved, a wounding rate of 20 per cent.

Table 1. Hunter-reported (interview) wounding ratios for duck hunting in south-eastern Australia (Victoria, New South Wales and South Australia) 1972–1981 (Braithwaite and Norman 1974, 1976, 1977, 1981; Norman *et al.* 1984).

REFERENCE	YEAR	STATE	MEAN BAG SIZE (RETRIEVED)	MEAN WOUNDING LOSS (UNRETRIEVED)	RATIO OF BAGGED TO WOUNDED
Braithwaite and Norman 1974	1972	Vic, NSW, SA	3.1	1.3	1:0.4
Braithwaite and Norman 1976	1973	Vic, NSW, SA	2.5	0.8	1:0.3
	1974	Vic, NSW, SA	2.9	0.9	1:0.3
Braithwaite and Norman 1977	1975	Vic, NSW, SA	8.6	2.7	1:0.3
	1976	Vic, NSW, SA	2.9	0.8	1:0.3
Braithwaite and Norman 1981	1977	Vic, NSW, SA	6.12	1.24	1:0.2
	1978	Vic, NSW, SA	4.88	1.15	1:0.2
		Average	**4.43**	**1.27**	**1:0.3**
		Range	**2.5–6.12**	**0.8–2.7**	**1:0.2 – 1:0.4**
Norman *et al.* 1984	1979	Vic	2.2	0.2	1:0.1
		NSW	6.4	1.8	1:0.3
	1980	Vic	4.6	1.0	1:0.2
		NSW	5.6	1.0	1:0.2
	1981	Vic	3.2	0.7	1:0.2
		NSW	4.7	0.8	1:0.2
		Average	**4.45**	**1.0**	**1:0.2**
		Range	**2.2–6.4**	**0.8–1.8**	**1:0.1–1:0.3**

Norman and Powell (1981) reviewed Victorian waterfowl harvests between 1972–1977 and recorded a hunter-reported average wounding ratio of 0.2 birds for every bird bagged (see **Table 2**). Therefore, for every 10 birds brought to bag, two birds were struck but not retrieved, a wounding rate of 20 per cent.

Table 2. Hunter-reported (interview) wounding ratios for duck hunting in Victoria 1972–1977 (Norman and Powell 1981).

REFERENCE	YEAR	STATE	MEAN BAG SIZE (RETRIEVED)	MEAN WOUNDING LOSS (UNRETRIEVED)	RATIO OF BAGGED TO WOUNDED (ROUNDED)
Norman and Powell 1981	1972	Victoria	1.71	0.58	1:0.3
	1973	Victoria	1.08	0.18	1:0.2
	1974	Victoria	2.06	0.50	1:0.2
	1975	Victoria	6.62	0.95	1:0.1
	1976	Victoria	1.95	0.53	1:0.3
	1977	Victoria	4.32	0.86	1:0.2
		Average	**2.96**	**0.60**	**1:0.2**
		Range	**1.08–6.62**	**0.18–0.86**	**1:0.1–1:0.3**

Briggs *et al.* (1985) reviewed waterfowl harvests in New South Wales between 1977–1982, including wounding rates. No detailed breakdown of average bag to wounding losses was provided, however, the total recorded hunter-reported wounding rate over the six-year period was 10 per cent. This equates to 0.1 bird struck but not retrieved for every bird bagged, or one bird wounded for every 10 birds bagged. Briggs *et al.* (1985) noted that this wounding rate constituted a smaller percentage than reported by Braithwaite and Norman (1974, 1976, 1977, 1981) and Norman *et al.* (1984) (see **Table 1**) and may have been caused by the difference in survey method. Briggs *et al.* (1985) used pre-paid mail survey cards which were provided to hunters when they purchased their licences and then voluntarily returned at a later date while Braithwaite and Norman (1974, 1976, 1977, 1981) and Norman *et al.* (1984) used face-to-face interviews in the field on the day of hunting. Briggs *et al.* (1985) considered that interviews may have been a more accurate method of data collection than mail surveys. Despite the difference in hunter-reported wounding rates, Briggs *et al.* (1985) stated that "all data suggests that cripple loss is a component of the waterfowl harvest which should not be ignored by managers."

In a 1990 review of duck hunting in South Australia, Stokes (1990) reported that hunter interviews from 1982–1988 showed a level of 1.5–2 ducks wounded for every 10 ducks bagged (15–20 per cent wounding rate), with this declining to one duck wounded for every 10 bagged (10 per cent) in 1988. Stokes combined this data with that collected by Braithwaite and Norman (1974, 1977) for the years 1972, 1975 and 1976 to show a decline in the wounding rate from 1972–1988. However, Stokes (1990) noted that increased public scrutiny of duck hunting in the 1980s may have biased downwards the level of wounding reported by hunters, but still considered there to be a decline over time. Stokes (1990) concluded that the lower level of wounding that could be achieved by duck hunters would be in the vicinity of two birds for every 10 birds bagged (20 per cent).

Loyn (1989) in a review of duck hunting in Victoria in 1989 also noted the difficultly in interpreting hunter-reported wounding rates, including under or over-reporting and hunters who include picked-up birds that had been shot by others and not retrieved.

In summary, approaches to estimating hunter-reported wounding rates have used face-to-face in-field interviews or mail surveys. In-field interviews typically recorded higher rates of wounding compared to mail surveys. Hunter-reported wounding rates for south-eastern Australian states (Victoria, New South Wales and South Australia) ranged from approximately 10–30 per cent, with an average of 20 per cent (see **Table 3**). When considering these figures, it should be remembered that hunter-reported wounding rates are considered to underestimate the actual level of wounding.

Table 3. Summary of hunter-reported wounding ratios for duck hunting in south-eastern Australia 1972–1982.

REFERENCE*	YEAR	STATE	EST. WOUNDING RATE
Braithwaite and Norman 1974, 1976, 1977, 1981	1972–1978	Vic, NSW, SA	30%
Norman and Powell 1981	1972–1977	Vic	20%
Norman et al. 1984	1979–1981	Vic, NSW	20%
Briggs et al. 1985	1977–1982	NSW	10%

* Stokes excluded due to a lack of detail but reported a range of 10–20 per cent.

FLUOROSCOPIC DETECTION OF EMBEDDED SHOT

A study by Norman (1976) in Victoria fluoroscoped over 45,000 live-trapped game ducks between 1957–1973 and found between 6–19 per cent of birds were carrying embedded shot. Smaller birds (chestnut teal, grey teal; 6–9 per cent) were found to show lower levels of infliction when compared to medium (hardhead, wood duck, black duck; 11–14 per cent) and larger birds (mountain duck; 19 per cent). Of the 45,210 black duck, chestnut teal, grey teal, hardhead, mountain duck and wood duck sampled, approximately 4,180 (9 per cent) were found to be carrying embedded shot.

Harper and Storr (unpublished, cited in Stokes 1990) fluoroscoped 727 ducks caught at Bool Lagoon, South Australia, in 1987 and found that, on average, 12 per cent of birds were carrying embedded shot (range 8–17 per cent). Stokes (1990) cites a study by Norman (1971) at Yalkuri, South Australia, in 1961 where 575 black duck and grey teal were fluoroscoped. A combined average of eight per cent of birds carried embedded shot (11 per cent and five per cent, respectively).

When comparing these three studies, Stokes (1990) observed a consistent percentage of birds within a species carrying pellets regardless of locality and date and that the percentage of birds carrying pellets increased from the smaller to larger species. It would seem that larger species are more likely to survive being shot than smaller species (Loyn 1989).

FIELD OBSERVER WOUNDING RATES

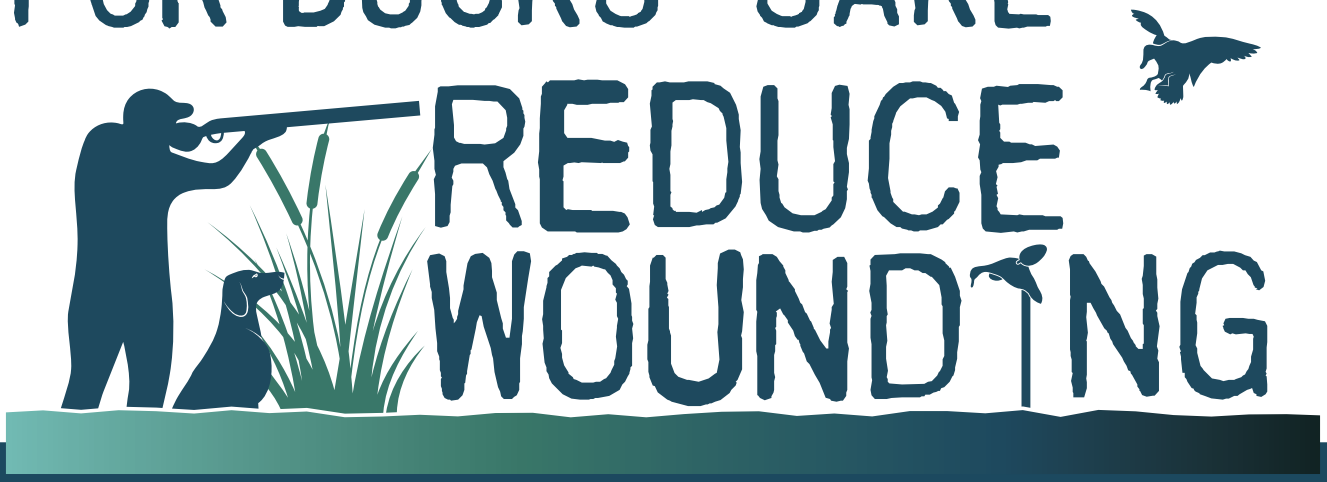
A small-scale informal study conducted by the Victorian Department of Sustainability and Environment in Tasmania in 2008 and 2012 using trained field observers showed that hunters wounded chukar partridge (being used as a proxy for waterfowl) at 29 per cent and 33 per cent respectively (average 31 per cent) (unpublished data). This level of wounding is consistent with the findings of other international field observer studies for waterfowl. CONSEP (2002) stated that "Numerous U.S. and Canadian research studies have been published involving trained observers witnessing and recording the harvest efficiency of thousands of duck hunters in the field. These studies repeatedly document wounding loss rates of over 30 per cent on ducks" (CONSEP 2002).

Summary – South-eastern Australian recorded wounding rates

In Australia, wounding rates have varied between different reporting methods, ranging from 6–40 per cent. Understandably, fluoroscopic examinations generally recorded the lowest level of wounding, followed by hunter-reported and then field observer rates. Fluoroscopic examination can only detect the evidence of wounding (embedded pellets) in the proportion of waterfowl that survive being wounded and in which pellets embed (Kirby *et al.* 1981; Van Dyke 1981; Noer *et al.* 2007). Therefore, fluoroscopic examination has its greatest value in monitoring trends in embedded shot infliction rates (Clausen *et al.* 2017). Hunter-reported wounding rates range from 10 per cent to 40 per cent (average 20 per cent) and the limited field observer studies recorded wounding rates of approximately 30 per cent.

With the exception of the observer reports in 2008 and 2012, reported wounding rates in Australia are historical and date back to the 1970–80s. Some may argue that circumstances have changed with improved technologies and prohibition on the use of semi-automatic shotguns for duck hunting. However, wounding rates in the 20–40 per cent range continue to appear in the contemporary literature elsewhere in the world where similar technological and regulatory changes have occurred. Denmark is a case in point where waterfowl wounding has been intensively studied since the 1990s. There, hunters have a maximum firearm capacity of two shots, only non-toxic shot is permitted for waterfowl hunting (as is the case in Victoria) and new ammunition and firearms technology is continuously becoming available. However, wounding rates (before the introduction of a wounding action plan in 1997) were consistent with those reported from previous decades and numerous authors. CONSEP, in a 'problem statement' on waterfowl wounding, stated that the hunter-reported wounding "rate has gone virtually unchanged for nearly seventy years regardless of the shot type and shotgun or shotshell technology brought to the field" (CONSEP 2002).

FOR DUCKS' SAKE



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