National Vertebrate Pest Aerial Shooting Workshop Proceedings

20th & 21st February 2024

Anne Harding Conference Centre, University of Canberra, Australia

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Acknowledgements

Acronyms

ASOT	VIC Aerial Shooting Operation Team
CASA	Civil Aviation Safety Authority
COP	Code of Practice
CRM	Crew Resource Management
DAFF	Department of Agriculture, Fisheries and Forestry
DBCA	WA Department of Biodiversity, Conservation and Attractions
DEECA	VIC Department of Energy, Environment and Climate Action
DESI	QLD Department of Environment, Science and Innovation
DEW	SA Department of Environment and Water
DPIRD	WA Department of Primary Industries and Regional Development
FAAST	NSW Feral Animal Aerial Shooting Team
GPS	Global positioning system
JSA	Job Safety Analysis
LLS	NSW Local Land Services
NAILSMA	North Australia Indigenous Land and Sea Management Alliance
NPWS	NSW National Parks and Wildlife Service
NSW DPI	NSW Department of Primary Industries
PIRSA	SA Department of Primary Industries and Regions
PWS	TAS Parks and Wildlife Service
RAPT	Remote Area Projects & Training
SOP	Standard Operating Procedures
TAAC	Thermally Assisted Aerial Control
TWWHA	Tasmanian Wilderness World Heritage Area

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Logos of attending agencies, organisations, and groups.

Executive Summary

The National Vertebrate Pest Aerial Shooting Workshop brought operators and managers from across Australia together to share recent successes in aerial shooting operations, and consider improvements to effectiveness, welfare, and safety. Workshop discussions recommended:

- a working group be formed to develop minimum national standards for operations,
- more training and mentoring opportunities to build capacity and availability of shooters,
- logbooks developed to provide more transparent evidence of shooter competency,
- better program evaluation, research, and innovation to drive efficacy of operations, and improved humaneness.
- more networking, collaboration and knowledge sharing within the sector,
- a national audit of aerial shooting capacity and capability in an event of emergencies,
- building social licence in the community to value effective vertebrate pest control,
- better engagement with landholders to build support and land access for cross-tenure operations.

The workshop encouraged future collaborative efforts to focus on implementing these recommendations to ensure societal support, innovation and capacity can meet future control needs to counter growing pest populations, as well as disease surveillance and incursion response operations.

Introduction

Aerial shooting of vertebrate pests is conducted in all Australian states and territories to reduce their impacts to environmental, agricultural, and cultural assets. Aerial shooting is well suited for the management of vertebrate pests across vast landscapes, areas with limited ground access or with complex terrain, and/or where the management goals are to remove abundant pests rapidly. The effectiveness, efficiency and humaneness of best-practice aerial shooting operations has been demonstrated numerous times, however public scrutiny of aerial shooting, including some misconceptions, require managers and operators to justify, and effectively communicate, the rationale and nature of their operations.

This national workshop, held on 20-21 February 2024, brought together 81 attendees, representing 22 government agencies or departments and 22 non-government groups or private contractors from across Australia to share knowledge of their aerial shooting protocols and practices. Workshop attendees were a mix of operation managers (38%), shooters (24%), pilots (10%) and researchers (7%), and others (33%). The workshop considered the management of feral pigs, deer, horses, camels, cattle, donkeys, and goats, and addressed emerging management and monitoring technologies, research outcomes, landholder consent, building social license and

managing safety and animal welfare risks. Attendees supported the development of national minimum guidelines for aerial shooting to ensure that professionalism, humaneness, and safety are never compromised and to guide procurement activities.

This workshop aimed to develop a community of practice for aerial shooting of vertebrate pest species in Australia. A nation-wide summary of processes used to procure and manage pilots, helicopters, shooters, land access and communications was an additional outcome from the workshop. Areas for improvement that were identified included: greater standardisation of protocols, firearms and ammunition, options to improve training, mentoring and succession planning, and improved access to operational and planning documentation, and research outcomes.

Aerial shooting operations in Australia is governed by CASA, national and state SOPs and COPs, and by jurisdictional legislation and organisation policies relating to firearms, biosecurity, animal control and welfare. Within these frameworks, the diversity of aerial operations undertaken across Australia was discussed, together with the challenges and opportunities to improve the effectiveness and humaneness of aerial shooting for vertebrate pest management.

These proceedings provide a record of workshop content and discussion for attendees, and others who are interested in shared knowledge and evolution of aerial shooting of vertebrate pests in Australia.

Photo credit: NSW NPWS – NSW. FAAST helicopters used for vertebrate pest control.

Themes from the workshop

The workshop hosted presentations from 30 speakers (listed in Appendix 1) followed by audience and panel discussions that sought to share aspects of best practice, challenges, and opportunities. These are summarised below.

Refining best practice

Operations are more effective when pre-culling efforts and planning have achieved:
- clear and transparent priorities, with strategic goals that avoid 'business as usual' or approaches based on 'because it is the way we have always done it',
- sufficient resources (funding, operators, helicopter time) to ensure enough pests are removed each year to prevent remaining populations from recovering quickly,
- strong support from executives, ministers, agencies, stakeholders, community leaders, traditional owners and landholders,
- access to sufficient land area (via landholder consent or requirement by law) to meet pest removal goals.

Programs benefit when:
- all agencies and stakeholders align their messages and support,
- operations allocate dedicated engagement staff, who are technically proficient and skilled in stakeholder engagement and communications,
- operational contractors or staff are experienced, valued and respected,
- outcomes are effectively communicated to stakeholders and participating landholders,
- the return on investment of operations, and effectiveness (determined by research, data analysis or modelling) can be clearly communicated to ministers, corporate staff and communities,
- the program delivers what is promised to landholders and community,
- operators can access good training (which may need standards) and safety protocols,
- there is concurrent, coordinated and collaborative on-ground actions by land managers.

Planning for welfare and environmental risks should consider:
- avoiding non bonded lead bullets for large pests,
- the most effective ammunition, including specialty projectiles where feasible,
- setting criteria or protocols to minimise duration of pursuit where possible.

Challenges

The sector has uncertainties about:
- future funding for aerial operations,

- whether operational staff (agencies or contractors) could assist other jurisdictions to support an emergency animal disease response, and if there is capacity and skills to do so,
- current and future availability of ammunition (specialty and commonly used), shooters, pilots and helicopters (in some locations),
- options to centralise firearm and ammunition procurement to improve buying power (at national, or multi-jurisdictional levels),
- documentation needed to meet Category D firearm legislation across state borders,
- how to attract and support people wanting to enter the sector,
- reliance on a small team to conduct animal disease surveillance in northern Australia,
- unrealistic expectations of private landholders that governments will fund all local aerial operations.

The challenges of maintaining high standards of animal welfare include:
- researching feasible and effective ways to measure welfare outcomes,
- incorporating welfare assessments in the sector to maintain transparency and accountability.

The challenges of building social licence to maintain aerial shooting, include:
- finding effective ways to proactively engage with the media, without getting bogged down in 'bad faith' arguments,
- understanding public perceptions and messaging that will inform communications.

Opportunities

Accountability and transparency of aerial shooting operations could be increased by:
- expanding the use of real-time data systems and technologies to inform funding proposals, adapt operations, manage community concerns and engage landholders,
- facilitating shooters to use standardised logbooks, to enable program managers to assess their experience and competency, including across state borders,
- sharing expertise or criteria for testing and using ammunition for different pest species, firearms and situations, across state borders, quantifying effort-outcome relationships to inform the investment required, and stop-go points for likely success of local operations.
- building community engagement skills in all programs, by mentoring and networking,
- supporting private landholders who lead and fund aerial shooting operations to follow best practice, SOPs, guidelines and rules specified by law, CASA and state policies, and by encouraging them to collaborate with agency operations to achieve cross-tenure control.

The potential for thermal imaging technology to improve effectiveness could be explored by:
- developing and researching the technology, and communicating outcomes of trials,

- collaborating across the sector on ways to maintain safety while using thermal technology.

The demand for vertebrate pest aerial shooting is growing faster than the capacity of skilled operators, availability of helicopters and resources. By refining best practice, building on opportunities, and tackling these challenges, the sector can seek to meet these demands.

Outcomes

One of the primary goals of the workshop was to achieve greater consistency between aerial shooting programs through building transparency and awareness between agencies and operators and by proposing some aspects of National Minimum Standards. Attendees also discussed how communications and engagement can be improved nationally. Discussions led to nine recommendations for future development.

National Minimum Standards

The regulation of aerial shooting is governed by several legislative frameworks, including the CASA (Civil Aviation Safety Authority) through the Civil Aviation Safety Regulations (CASR) and relevant Manual of Standards (MOS), as well as state firearms, animal welfare, and biosecurity legislation. Therefore, any National Minimum Standards for Aerial Shooting of vertebrate pests must not impede existing national, state and territory regulations.

Any proposed standards will be voluntary and non-binding, setting a benchmark for minimum best practice. Such standards would provide guidance for jurisdictions and privately-managed operators commencing aerial shooting operations. Compliance with these standards would enhance transparency and accountability of operators and demonstrate a commitment to continuous improvement.

Prior to the workshop, 13 agencies and programs provided details of processes they use for operations, procurement, operators, and other guiding documents (Appendix 2). These standards varied among jurisdictions, agencies, programs, and target species. Some differences were helicopter and firearm types, accessories, crew types, landholder consent, mapping systems, the experience required for shooters and pilots, and accreditation for shooters.

Some aspects were largely consistent between programs, including in-flight data collection, species targeted (i.e. feral pigs, deer and goats), use of 0.308 semi-automatic rifles, pilot-in-command experience for pilots, re-accreditation for shooters and communication systems.

Similarities were used as a basis for discussions on minimum standards to guide activities and ensure that professionalism, humaneness and safety are not compromised (Recommendation 1).

Communications and Engagement

Aerial shooting is a widely used method in Australia for managing vertebrate pest populations in areas with challenging terrain or limited visibility. However, assuming continued acceptance as an effective and humane approach by the general community is risky, as awareness may be lacking, public perception could change quickly with a high-profile incident, or there may be high turn-over of land ownership to those who do not support aerial shooting.

To safeguard the reputation of aerial shooting, rigorous standard operating procedures must be established to mitigate risks and ensure optimal animal welfare. Clear communication is essential to educate stakeholders about the necessity and methods of aerial shooting, addressing misconceptions and highlighting the benefits in managing vertebrate pests.

Local scale
At the local scale, some land managers hesitate to engage in aerial shooting activities, choosing to rely on on-ground control methods. To encourage greater participation and expand coordinated, cross-tenure efforts, it is crucial to provide clear reasoning. This will include supporting local champions and advocates with effective messaging and materials to better engage land managers. By doing so, we aim to increase the area of land under collaborative management and eliminate 'refugia'; zones where vertebrate pests thrive, breed up and spread.

Photo credit: Mark Lane (RAPT) - Feral pigs in northern Australia.

Community scale

When engaging with the broader community, it is important that the different stakeholders are mapped and the key messages are tailored to each audience. Expert communications support may be required to develop appropriate messaging. Messaging is required from both a proactive position as well as from a reactive one. This will ensure that talking points are readily available to quickly deal with adverse media and/or stakeholder attention.

Effective strategies include:

- Framing invasive species management as a choice between action and inaction, or between protecting the values we love vs a future of increasing pest impacts.
- Focusing on impacts of invasive species on Australia's native flora and fauna.
- Showing empathy and acknowledgement that lethal management is a 'sad reality' but necessary.

When engaging with the media, it is recommended that closer, direct relationships are established with journalists to build connections and educate them about merits of aerial shooting to reduce impacts caused by vertebrate pests. This leads to the release of more balanced stories in the media and can also assist with exposing 'bad actors'.

By carefully and proactively 'selling our story' (including benefits, safety, professionalism and effectiveness), aerial shooting operators may be able to influence the public narrative that surrounds aerial shooting and avoid reactive responses to controversies. There was general agreement at the workshop that while an aircraft or firearms incident presents the greatest risk to operations in the short term, risks posed by dwindling community support are a major long-term threat.

Recommendations

The workshop discussions culminated in a suite of recommendations. Implementing some of these recommendations will require leadership and consultation with stakeholders, and may not be within the remit of the workshop organisers to enact. The following recommendations came from discussions at the workshop:

1. **Progress the development of National Minimum Standards**

Fourteen attendees from the below organisations nominated to form a working group to develop proposed national minimum standards for aerial shooting of vertebrate pests. A Terms of Reference for this group has been considered by the Terrestrial Vertebrate Working Group. Proposed member organisations include:

- Department of Biodiversity Conservation and Attractions (WA)

- Department of Primary Industries and Regional Development (WA)
- Parks Victoria (VIC)
- Department of Agriculture, Fisheries and Forestry (NAQS)
- Tasmania Parks and Wildlife Service (TAS)
- Department of Environment, Science and Innovation (QLD)
- Department for Environment and Water (SA)
- Department of Primary Industries and Regions (SA)
- INLOC (QLD)
- Wilchez Holdings (VIC)
- Vertebrate Pest Management Australia (WA)
- Seymour Out Bush (QLD)
- Remote Area Projects & Training Pty Ltd (QLD)
- Whitsunday Regional Council (QLD)

The proposed working group would build on workshop discussions to identify standards including, but not limited to, aircraft type and ancillaries (i.e. flight steps), firearms, ammunition, communication, helmets, and wire cutters. In addition, the group may investigate the requirement for shooter and pilot experience that is specific to the terrain, target animal and situation, standards for written approval from all participating properties, and the use of video recording in suitable situations.

2. **Conduct review of the training required for shooter accreditation.**

In general, two units of competency are required for aerial shooters (*AHCPMG311 – Use firearms for pest control activities from aircraft* and *AHCVPT203A – Use firearms to humanely destroy animals*). Attendees at the workshop recommended that the contents of the course be reviewed to ensure the learning outcomes are fit for purpose. In addition, some attendees expressed a desire for a review of the providers that offer the course.

3. **Develop a National Aerial Shooter Logbook**

Pilots are required to maintain a logbook which details the duration and nature or their work and allows for an auditable and transparent record of their experience. Workshop attendees suggested a similar system for aerial shooters, including the flight hours, aircraft type, target species, and

Photo credit: Mal Leeson (LLS NSW) - Feral deer in NSW

landscape. This would provide greater transparency for shooters, evidence of competency, and facilitate greater collaboration between jurisdictions in the event of a shared operation (i.e. Emergency Animal Disease outbreak)

4. Identify pathways for shooters to gain experience

In some jurisdictions, shooters are required to demonstrate experience performing aerial shooting before being eligible to assist with large programs, however there are limited opportunities for new shooters to gain this experience. Identification of a pathway for new shooters to build experience will assist in capacity building and ensure new shooters receive suitable mentoring.

5. Conduct a national aerial shooting capacity audit

In the event of a national Emergency Animal Disease, it is possible that the aerial shooting capacity of a single jurisdiction will be exceeded and that multiple states could be requested to provide support for joint operations. Most attendees were not aware of the capacity and expertise in other states, including planning, aircraft requirements, pilots, shooters and their ability/accreditation to operate in other states, and the availability of firearms and ammunition. Performing an audit at a national scale, with regular updates, and capacity building, will assist in a swift and effective response to an Emergency Animal Disease.

6. Improve metrics to assess efficacy of operations

Many aerial shooting operations report only on the number of animals removed and seek efficiency by maximising animals removed per unit effort. Programs should critically assess how effective aerial shooting operations have been relative to the management goal (e.g. eradication, impact reduction, or containment), and use this information during the planning process. Recent scientific publications have developed some options (Appendix 5).

7. Develop standardised welfare assessments and implement them in shooting operations

While there is an increasing body of literature assessing the welfare outcomes of aerial shooting, there is no standardised welfare assessments that managers can incorporate into their operations. A standard method would increase transparency and understanding in reporting welfare outcomes across programs, and help managers to continuously improve welfare.

8. Distribute aerial shooting news, documents, and research

Workshop attendees highlighted the need for greater distribution of aerial shooting news, documents, and research. This would allow people to stay up to date with new techniques and

technologies and increase collaboration and connectivity between jurisdictions. In part, this can be achieved through the national feral pig and deer coordinator newsletters and websites.

9.   **Share communication and engagement approaches**

Increasing landholder participation in aerial shooting programs, and building greater public support, is critical to the ongoing success of aerial shooting. Workshop attendees called for organisations to share 'lessons learnt' on effective communication and stakeholder engagement strategies.

Phot credit: Australian Feral Camel Management Project. Peter Watkins (DEW)

National Vertebrate Pest Aerial Shooting Workshop Proceedings

Thank you to the attendees of the 2024 National Vertebrate Pest Aerial Shooting Workshop.

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Appendices

Appendix 1

Summaries of each presentation are outlined as per the workshop agenda below.

	Talk title	Presenter
Session 1: Jurisdictional Highlights		
1	**Australian Feral Camel Management Project**	**Quentin Hart,** *NSW DPI,* NSW
2	**Aerial shooting programs in Western Australia**	**Simon Marwick** *DPIRD*, WA
3	**NSW Feral Animal Aerial Shooting Team (FAAST)**	**Grant Eccles,** *NSW NPWS,* NSW
4	**Aerial Shooting Program - Victoria**	**Sandra Robinson** *Parks Victoria,* VIC
5	**Tasmanian Aerial Shooting**	**Rob Buck** *TAS PWS,* TAS
6	**Overview of SA Aerial culling**	**Mike Stevens,** *Limestone Coast Landscape Board,* SA
7	**ACT Aerial shooting update**	**Mark Sweaney**, *Environment, Planning and Sustainable Development, ACT Govt*, ACT
8	**Overview of aerial culling by QPWS**	**Robby McLeod** *QLD DESI,* QLD
Session 2: Planning and management to improve effectiveness (breakout)		
9	**Planning across northern Australia**	**Mark Lane QLD** *RAPT,* QLD
10	**Planning across northern Australia**	**Justin Perry** *NAILSMA,* NT
11	**Planning large scale aerial shooting programs NSW**	**Mal Leeson** *NSW LLS,* NSW
12	**WA aerial shooting, the tyranny of distance**	**Corrin Everitt and Gary Edwards** *DBCA,* WA
13	**Planning for biodiversity outcomes using aerial shooting in Victoria**	**Stefan Kaiser** *DEECA,* VIC
14	**Ellerslie proof of concept eradication**	**Rod Baker** *Riverina LLS,* NSW
15	**Using cross-tenure engagement to improve effectiveness of operations SA**	**Myall Tarran** *PIRSA,* SA
65	**Demonstrating an app for aerial data – VIC**	**Iris Curran** *Parks Victoria,* VIC
Session 3: Operations to improve effectiveness (breakout)		
17	**Feral Animal Aerial Shooting Team - Ammunition**	**Grant Eccles** *NPWS,* NSW
18	**Things to consider when developing an aerial shooting program**	**Bren Fuller** *Whitsunday Regional Council,* QLD
19	**Training indigenous rangers in north Australia**	**Pat Carmody** *Paladin Firearms Solutions* **Andrew Munn** *INLOC*
20	**Indigenous capability and capacity development, priorities, and perspectives**	**Mark Hogno and Des Armstrong,** *Carpentaria Land Council Aboriginal Corporation,* QLD **Shaun Seymour,** *Seymour Out Bush,* QLD
21	**Pilot and flying techniques for maximising effectiveness of aerial shooters**	**Jack Poplawski** *Fortesque Helicopters,* WA
22	**Targeting feral pigs in northern Australia**	**Shaun Seymour** *Seymour Out Bush,* QLD
23	**Shareable recording and data platforms**	**Tim Kerlin** *DAFF Northern Australian Quarantine Strategy (NAQS)*
Session 4: Research and innovations		
24	**Aerial shooting research in NSW**	**Andrew Bengsen** *NSW DPI,* NSW
25	**Technology in the cockpit**	**Rob Matthews** *HeliSurveys* NSW
26	**Using thermal imaging equipment in aerial shooting programs**	**Tarnya Cox** *NSW DPI,* NSW
27	**Integrating aerial with other tools to target feral pigs on KI**	**Brad Page** *PIRSA,* SA
28	**Using judas donkeys for aerial control in WA**	**Lindsay Strange** *DPIRD* WA
29	**Measuring efficacy for feral animal control**	**Justin Perry** *NAILSMA,* QLD
Session 5: Risk management		
30	**Horse management in northern Australia**	**Mark Hogno & Des Armstrong**, QLD
31	**Lessons from the campaign to remove feral horses in the Alps**	**Jack Gough** *ISC,* NSW
32	**Assessing the animal welfare impacts of aerial shooting**	**Trudy Sharp & Quentin Hart** *NSW DPI,* NSW
33	**EAD Surveillance in Northern Australia**	**Joe Schmidt** *DAFF Northern Australian Quarantine Strategy,* NT

Session 1: Jurisdictional Highlights

Topic: This session included a keynote presentation about the [Australian Feral Camel Management Project](#) that operated across four states and territories between 2010-2013, and how subsequent aerial shooting operations have benefited and evolved from this project. A series of short (8 minute) presentations from jurisdictional agencies were then made, showcasing the diversity, challenges and recent advances in aerial shooting programs.

Keynote presentation

1. **Australian Feral Camel Management Project – what was achieved, learnt, and changed.**
Quentin Hart, *NSW DPI,* NSW

- This project focused on reducing impacts, rather than numbers, required strong collaborations across jurisdictions and land tenures, strong communication with stakeholders, welfare assessments and long-term capacity building.
- The project improved monitoring, operational protocols, understanding of effort required, and training for 500 Traditional Owners.
- 165,000 camels were removed in 3 years (85% via 50 aerial operations)
- Challenges included seasonal conditions, seeking landholder consent, international perceptions, and working with partners.
- Challenges that persist in other vertebrate pest programs today include insufficient funds, and many control efforts are *ad hoc*, not maintained, not frequent enough, not intense enough and not at an effective scale. Additional challenges are higher costs, more demand, public and organisational scrutiny.
- Today, the sector benefits from better technology, increased focus on welfare, improved understanding of required effort, integration with other management programs, and improved landholder engagement.

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2. **Aerial shooting programs in Western Australia**
Simon Marwick *DPIRD*, WA

- Aerial shooting is a feasible, effective way to control vertebrate pests in WA's remote and vast landscapes.
- DPIRD operates on a on many land tenures, predominantly private, to reduce environmental and agricultural impacts, generally on a fee-for-service basis. Conversely, DBCA delivers aerial control on public land.
- Challenges include: rates of landholder consent, changing priorities, social license and public perceptions, and restrictions on Category D firearms that are only accessible for government employees under WA firearm laws.
- Promoting the benefits of past programs may overcome some of these challenges.

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3. NSW Feral Animal Aerial Shooting Team (FAAST)
Grant Eccles, *NSW NPWS*, NSW

- FAAST is well resourced to meet biosecurity obligations in NSW by controlling pest populations and destroying livestock in natural disasters and disease outbreaks, via 2-3000 shooting hours/year.
- Participating agencies include NPWS (managing 10% of NSW), NSW DPI and LLS.
- FAAST's framework, developed over 30 years, includes a management structure, a manual, animal welfare practices, training requirements, accreditation for shooters, operators and pilots, standards for firearms, ammunition, helicopters, and research on use of thermal technologies, silencers, and ammunition.

4. Aerial Shooting Program - Victoria
Sandra Robinson *Parks Victoria*, VIC

- Parks Victoria has delivered aerial shooting on public land for over ten years, including emergency response, and protection for native species following bushfires.
- Programs include the removal of deer from Wilson's Promontory Sanctuary and many other parks.
- The Aerial Shooting Operations Team (ASOT) uses components of the FAAST framework. Training involves an aviation simulator, emergency response exercises and Crew Resource Management (CRM) training.

5. Tasmanian Aerial Shooting Presentation
Rob Buck *TAS PWS,* TAS

- The TWWHA Deer Project 2022-24 is the first aerial shooting operation in Tasmania to protect biodiversity and habitats from impacts of fallow deer.
- The program used thermal-assisted aerial control (TAAC) to remove 711 deer in 72 hours in 2023.
- The program's success is reliant on a strong executive level engagement and support, as well as the Tasmanian Wild Fallow Deer Management Plan 2022-27 (with an eradication zone), strong monitoring, and veterinarian advice and assessment to maximise welfare outcomes (minimum requirement for 3 shots per animal).
- Operations considered areas of different deer density and buffers around high-risk assets.
- Challenges include the protected status of deer in Tasmania, low community awareness and laws limiting firearm selection.

6. Overview of SA Aerial culling
Mike Stevens, *Limestone Coast Landscape Board*, SA

- SA has culled approximately 20,000 feral goats, 19,000 feral deer, 14,000 feral camels, 3000 feral pigs, donkeys and horses between 2018 to 2023 across public and private land.
- The SA Pest Control Steering Committee oversees aerial operational plans by DEW and PIRSA.
- SA Feral Deer Eradication Project relies on TAAC, shotguns, clear policy, cross-tenure landholder compliance, social license, collaboration, aligned messages and support from all levels (ministers, agencies, industry), sufficient intensity to counter pest growth.
- Challenges are long-term funding for in-house and contractor capacity and removing areas of pest harbor (through balancing social license, engagement and enforcement).

> **7.   ACT Aerial shooting update**
> **Mark Sweaney**, *Environment, Planning and Sustainable Development Directorate, ACT Govt*, ACT
> - ACT has used aerial shooting since 2019, and TAAC since 2021 in conservation areas.
> - 930 pests (primarily deer and feral pigs) were culled in 2023.
> - Programs rely on good political and agency support and funding, clear management objectives, good data/record keeping, skilled contractors, and low pest densities.
> - Challenges include managing safety, logistics and public perception near urban areas

> **8.   Overview of aerial culling by QPWS**
> **Robby McLeod** *QLD DESI*, QLD
> - QPWS manage more than 1000 parks (8.3% of Qld), many of which adjoin private land.
> - Operations primarily use R44 helicopters, as well as a rigorous process to select shooters and a heavy emphasis on pilot experience (requiring 3000 hours in-command, half of which is specific to the engine type), safety processes, use of simulators, and data collection by shooters.
> - QPWS manage and assess shooter competency on an ongoing basis.
> - Two aircraft are used where possible fitted with GPS tracking devices to maximise operational and psychological safety and manage landholder relations.
> - Challenges include limitations of firearm laws, and building shooter capacity while staff have other concurrent roles.

Session 2: Planning and management to improve effectiveness (breakout)

Topic: This session was comprised of eight short (8 minute) presentations from people who plan and manage large aerial shooting operations. The presentations highlighted diverse logistical, strategic and engagement planning considerations, opportunities, and challenges.

> **9.   Planning across northern Australia**
> **Mark Lane QLD** *RAPT,* QLD
> - RAPT uses four shooters who shoot about 300-500 shooting hours per year, for government and non-government programs with diverse requirements, as well as mentoring for junior shooters.
> - Challenges include auditing shooter competencies given a lack of industry logbooks, incident records, CASA instruments, and limitations on operating interstate with different firearm regulations.

> **10. Planning across northern Australia**
> **Justin Perry** *NAILSMA,* NT
> - Engagement needs to consider diverse Indigenous families as well as other land tenure types.
> - Programs that follow priorities and principles can ensure efforts are effective (e.g. map Indigenous tenures; quantify challenges for coordination; quantify factors for decision making in Indigenous organisations; and ensure skill resources are sufficient to meet program goals).

> **11. Planning large scale aerial shooting programs NSW**
> **Mal Leeson** *NSW LLS,* NSW
> - LLS uses the FAAST process for operational planning requiring written approvals from all landholders, approvals for and considerations of the project site, logistics, aircraft and shooter

procurement and availability, fatigue management and rostering, training, mapping, scheduling, data capture, risk management and reporting.
- FAAST forms include shoot plans, safety analysis and brief, daily briefs, flight following and manifest.
- Recent programs have benefitted from multiple culls (or passes) over the same area to minimise population recovery. Monitoring informs the number of culls required to keep pests suppressed.
- Programs benefit when land managers are better empowered to help themselves, when aerial shooting is normalised in the community, and when the public perceive that agencies have a professional, transparent culture.
- Challenges include: on-going funding to enable multi-year planning, keeping landholders engaged from one program to the next, and gaining sufficient access to meet pest reduction goals.

12. WA aerial shooting, the tyranny of distance
Corrin Everitt and Gary Edwards *DBCA,* WA
- DBCA controls vertebrate pests, mainly feral cattle on vast and remote public and unmanaged lands (116 million hectares).
- Remote sites have safety, search and rescue, welfare, logistics, communications (reception) and fuel transport challenges, often requiring two aircraft or protocols that make operations complex.
- WA aims for operations to become more cross-agency, cross-tenure and to build capacity for control, adapt to adopt new effective technology (may need firearm law reforms), as well as build social license and public support through stories of positive program outcomes for biodiversity.
- This is required to enable aerial control to remain an ongoing management tool.

13. Planning for biodiversity outcomes using aerial shooting in Victoria
Stefan Kaiser *DEECA,* VIC
- The Victorian Strategic Management Prospects is used to determine where resources are spent, what tools are used, and the effectiveness and review of operations on public land.
- Monitoring and pre-population estimates help deer programs decide whether reduction goals can be met with resources available.
- Victoria assessed the intensity of search effort needed at different sites to halve deer numbers.
- General recommendations are to undertake aerial shooting every 3 months, while searching along 1.4km of flight path per km^2 of habitat.
- Recent reviews of aerial operations found they are conducted safely and effectively, with areas of opportunity for more sustainable funding, strategic intent, and governance.

14. Ellerslie proof of concept eradication
Rod Baker *Riverina LLS,* NSW
- An aerial shooting exercise was conducted across a cross-tenure landscape in the Riverina region of NSW to assess the potential capacity to eradicate pest animals, should it be needed in a disease outbreak. A pseudo thermal-assisted aerial shooting method was more effective than a non-thermal method for feral goats, pigs and deer.
- Systematic search patterns (500m apart at height of 300ft) detected more pests including in unexpected areas (pine forest), than aerial hunting strategies.
- More feral pigs were shot than first detected via surveys.
- Some landholders were non-consenting, which prevented eradication attempts, but in a real disease emergency, compliance directions will increase access to more land for operations.

15. Using cross-tenure engagement to improve effectiveness of operations SA
Myall Tarran *PIRSA,* SA

- Aerial shooting operations that were part of eradication programs were used to demonstrate the level of land manager engagement required to access sufficient land to meet knockdown targets.
- Engagement over several months led to cross-tenure participation by 250 properties on KI (for feral pigs), and 500 properties on mainland South Australia (for feral deer in 2 priority regions), leaving few inaccessible properties.
- Engagement was dramatically improved by tapping into regional groups and diverse stakeholders.

16. Demonstrating an app for aerial data – VIC
Iris Curran *Parks Victoria,* VIC

- Data capture systems are important to obtain evidence to support funding proposals and to counter false accusations.
- Parks Victoria developed and use an in-operation app that is rapid, easy, informs on-ground strategies, gives live data on target animals seen and removed, and is efficient for reporting, which helps future funding and management planning.

Session 3: Operations to improve effectiveness (breakout)

Topic: This session included short (8 minute) presentations from operation managers, shooters, and pilots. Presentations focused on how operations are conducted, training needs, the collection of operation data and the importance of sharing expertise across programs to ensure that operations evolve and are sustainable.

17. Feral Animal Aerial Shooting Team - Ammunition
Grant Eccles *NPWS,* NSW

- Approved ammunition types are specified and used for different vertebrate pest species - FAAST shooters cannot step outside of this standardised process (fig. 1).
- FAAST staff have strong relationships with ammunition and firearm manufacturers.
- When selecting ammunition, FAAST staff consider:
  o availability to ensure access to a constant source.
  o functionality and projectile performance to optimise humaneness.
  o opportunities to centralise procurement of large volumes for buying power.
- Non-lead ammunition is being evaluated for different species to reduce lead contamination in sensitive areas in NSW.

18. Things to consider when developing an aerial shooting program- a local government perspective
Bren Fuller *Whitsunday Regional Council,* QLD

- Best practice aerial shooting programs have six key elements - safety, compliance with all relevant national and state legislation, humaneness, effectiveness, publicly acceptable and achievable.
- Programs select and work with people who are discrete with sensitive information, have experience operating different aircraft types, relevant CASA endorsements/licenses and can function as a team.

- Challenges for obtaining experience and minimum flight hours, include costs and access to mentors.
- Programs select aircraft based on requirements to perform the job safely, while considering the level of redundancy.
- Programs use documents that describe how and why animals will be humanely destroyed, including aerial shooting procedures, aerial shooting safety management plans, and fly back procedures.
- Records of aerial shooting operations demonstrate safety, transparency, and honesty to maintain public acceptance of this method.

19. Training indigenous rangers in north Australia
Pat Carmody *Paladin Firearms Solutions*
Andrew Munn *INLOC*
- Major training programs in NT and QLD are being run to build capacity and capability of Indigenous Rangers. Training covers all aspects of invasive animal and weed control, animal biology and welfare, use of thermal cameras and firearms training.
- Formal courses teach attendees content and theory, but not how to be a shooter. Ground training is critical for this. Coaching is provided over 6 months, supported by weekly training.
- Training builds on disease surveillance training to protect Australia's remote northern coastlines from exotic disease threats.
- Indigenous Rangers typically have a better hand-eye coordination than non-Indigenous shooters.
- Need national accreditation of ammunition and supply.

20. Indigenous capability and capacity development, priorities, and perspectives
Mark Hogno and Des Armstrong, *Carpentaria Land Council Aboriginal Corporation,* QLD
Shaun Seymour, *Seymour Out Bush,* QLD
- Impacts on cultural sites, story places and significant areas caused by vertebrate pests need to be seen by Traditional Owners and local community to enable their management to be approved and prioritised, and obtain support for capacity building of Indigenous Rangers
- All discussions are conducted on Country with sufficient time allocated to plan, incorporate local views, service delivery and assessment.
- Programs are sensitive and flexible to demands on time required by Traditional Owners and Indigenous Rangers for cultural needs, clan responsibilities, weather impacts, deaths and Land Council support.
- Programs incorporate Indigenous perspectives to help trainees understand the training. Training may take different paths between different groups to achieve the same result.
- Trainers are required to demonstrate extensive industry experience.
- Internal training capabilities of Indigenous Ranger organisations are actively encouraged to be self-sufficient and deliver competencies to required standards (e.g. AHCPMG311 – Use firearms for pest control activities from aircraft and AHCVPT203A – Use firearms to humanely destroy animals) as well as provide fee-for-service feral animal management to others. External trainers are being used only where needed e.g. to obtain firearm safety certificates.

21. Pilot and flying techniques for maximising effectiveness of aerial shooters
Jack Poplawski *Fortesque Helicopters,* WA
- Pilots must be able to read the land, look for damage within the landscape by the target pest, not just the animals.
- Local and/or landowner knowledge of impacted areas needs to be drawn upon, including positions of new bores/dams and known hotspots.

- Communication, trust, and a positive workplace culture in the cockpit are key - pilot and shooter must be able to work well together.
- Pilots must know how to keep a mob of animals together, modify flight to the preferred shooting angle of the shooter and work into the wind so that more power is available to the pilot and minimise animals hearing the chopper operating at 20-25 knots.

22. Targeting feral pigs in northern Australia
Shaun Seymour *Seymour Out Bush,* QLD

Major factors to optimise the effectiveness of feral pig management in northern Australia are:
- Shooter and pilot to plan the control program together.
- Location - protection of environmental assets in wetlands, beaches and floodplains, use of habitat by pest species.
- Seasonal conditions/timing - end of dry season with timing allowing for wet season build up.
- Aircraft selection and fuel availability - use the right aircraft type for the targeted animal and area noting that JetA1 is more available than avgas - critical to preplan to ensure sufficient fuel supplies.
- Cultural heritage - sit down with Traditional Owners and talk about what is proposed, obtain input.
- Standardisation of firearms - manage operational risks with firearm functionality and ability to swap parts.

23. Shareable recording and data platforms
Tim Kerlin *DAFF Northern Australian Quarantine Strategy (NAQS)*
- Communicating spatial data in an EAD response is a critical capability.
- NAQS utilise a purpose-built data platform (Geospatial Surveillance Information Management System (on an ESRI platform)) to capture helicopter movement, animal group observation and disease surveillance data
- Challenges with this system include cybersecurity walls for it to operate in a government environment, organisational expertise in operating GIS systems, connectivity in remote areas to upload data and potential issues with the use of data collection devices in harsh environments.
- System development and software updates must consider data shareability between different jurisdictions and agencies as well as its practicality and ease of use.

FAAST Approved Ammunition#

Approved Ammunition Types	Small animal (rabbit, fox, cat)	Goat	Dog	Chital deer	Fallow deer	Pig	Red deer	Rusa deer	Sambar deer	Cattle	Horse	Camel	Donkey
130gn hollow-point (Speer or Sako projectile)	Y	Y	Y	Y	Y	Y	Y	Y					
135gn hollow-point (Sierra projectile)	Y	Y	Y	Y	Y	Y	Y	Y					
130gn protected-point (Woodleigh projectile)	Y					Y	Y	Y	Y*				
150gn protected-hollow-point (Winchester power-max bonded)						Y	Y	Y	Y	Y	Y	Y	Y
150gn Powerhead Blade SAKO						Y	Y	Y	Y	Y	Y	Y	Y
150gn protected-point (Woodleigh projectile)									Y	Y		Y	Y
180gn protected-point (Woodleigh projectile)									Y*	Y		Y	Y
Shotgun pellets^ (only for use up to 30m)	AAA; BB; No.4	SG; SSG; (small goats: AAA; BB)	SG; SSG; AAA; BB			SG; SSG; (small pigs or piglets AAA; BB; No.4)							

#The above ammunition types are the currently approved ammunition for use by FAAST shooters. The table of species has been developed to assist shooters with their animal welfare responsibilities. While it is based on best available information the FAAST Committee acknowledges the flaw in specifying ammunition on species alone rather than the mass of individuals. When selecting ammunition from the approved list, the FAAST Committee urges shooters to select ammunition that is best suited to their situation and which is justifiable on animal welfare grounds.
The use of any alternative ammunition types is under control of the FAAST Management Committee and only allowed as part of agreed trialling procedures. No birdfrite (flashbang) ammunition is to be used.
^Shotgun pellets: appropriate selection should be made by the shooter based on the size of the target animal.

*Sambar deer: 180gn should only be used for large Sambar deer, 130gn protected point can be used on most animals but not very large individuals, whereas 150gn can be used on all size individuals.

December 2023

Figure 1. FAAST approved ammunition for different species (December 2023). From presentation by Grant Eccles, NSW NPWS. Note other states or programs have some different suites of approved ammunition for specific situations and animals.

Session 4: Research and innovations

Topic: This session included short (8 minute) presentations from researchers, operation managers and a pilot, to share new research and innovations that improve the effectiveness, efficiency, safety, and welfare outcomes of operations.

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24. Aerial shooting research in NSW
Andrew Bengsen *NSW DPI,* NSW

- DPI investigated the effectiveness of aerial control of fallow and chital deer. It was found that 11 hours of shooting per 1000 deer in population is required in order to cause 35% knockdown, which is the amount required to stop population growth(https://www.publish.csiro.au/WR/WR21069)
- Investigated the behavioral response to deer to aerial shooting. Deer showed an increase in activity during the operation, but did not leave their home range. This has implications for the response to an Emergency Animal Disease (EAD) incursion.
- Investigated the use of shotguns for aerial shooting of feral deer. The use of shotguns was comparable with .308 semi-automatic rifles. (https://www.publish.csiro.au/WR/WR21156)
- Investigating disease prevalence in feral deer and feral pigs from aerial shooting operations. Diseases being investigated are flaviviruses, leptospira (tarassovi), leptospira (pomona), brucellosis, Q fever, sarcocystis. Analysis is ongoing at this time.

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25. Technology in the cockpit
Rob Matthews *HeliSurveys* NSW

- The use of thermal imaging is dependent on weather conditions, and it is not always the best option.
- Generally, the use of thermal is limited to 2 hours in AM and 1.5 hours in PM. Sunlight, rather than heat, reduces thermal effectiveness. As such, overcast conditions are optimal.
- There are a few different configurations for use of thermal.
  1. Shooter equipped with thermal binoculars
  2. Dedicated camera operator (rear left seat)
  3. Dedicated camera operator + shooter on left
  4. Dedicated camera operator + two shooters
- Experience and training is required to use thermal imaging. The complexity of adding thermal imaging makes communication critical between the shooter and pilot.
- It is a valuable tool, particularly to identify and remove remnant populations, but requires careful consideration.

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26. Using thermal imaging equipment in aerial shooting programs
Tarnya Cox *NSW DPI,* NSW

- TAAC (Thermal Assisted Aerial Culling) – refers to shooter and thermal operator both sitting on left side of aircraft. The AS350 (Squirrel) is the preferred aircraft.
- DPI have trialed a hybrid configuration (fig 2.), with the thermal operator on rear left, shooter on rear right. This can be slightly clunky, but still shown to improve detection of animals.
  o Thermal sensors should be high frame rate and wide angle. A microbolometer size of 640 x 480 is most common for in handheld imagers, however a custom built 1920 x 1200 is largest available.
- Use of thermal imaging reduces likelihood of lost or wounded animals and increases percentage of culled animals.

- On a recent TAAC operation, 85% of animals were detected in dense habitat, which is typically where animals are hardest to detect.
- There are challenges to its implementation:
  - Need to overcome 'we've always done it this way' mantra.
  - Cost of technology for thermal technology is high.
  - Requires robust welfare assessments.

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27. Integrating aerial with other tools to target feral pigs on Kangaroo Island
Brad Page *PIRSA,* SA

- PIRSA used TAAC to eradicate feral pigs on Kangaroo Island (KI), supported by HOGGONE baiting and ground shooting. Automated imaging cameras are being used to identify feral pig locations and numbers present.
- Aerial control should not be conducted in isolation of other tools.
- The program has Ministerial and SA parliamentary support which has been vital to ongoing support and success of the eradication program. Flinders University modelled the likelihood of eradication and cost of impacts using 3 scenarios: current control techniques, doing no control, and adding TAAC.
- The program has now entered a two-year proof of freedom phase.

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28. Using judas donkeys for aerial control in WA
Lindsay Strange *DPIRD* WA

- The Judas technique involves selecting some individuals of a pest population to track, and locate groups during control operations. Generally, these tracked animals are left *in situ* for multiple control operations.
- The Judas donkey program reduces search time when the pest is in low density across large areas.
- The management area of the program is 270,000 km^2 across Pilbara and Kimberley
- Collar data also provides valuable information about home range and building ecological and behavioral understanding of the species.
- The donkey program is funded by community regional biosecurity groups. Species prioritisation and funding can change annually based on land manager priorities, which can limit long-term effectiveness.
- The continuous review of program effectiveness critical to identifying areas for improvement.
- Recent innovations include GPS collars, trial of CERES tags, and better 'in-aircraft' GPS systems, allowing for better data collection (fig 3.).

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29. Measuring efficacy for feral animal control
Justin Perry *NAILSMA,* QLD

- The effectiveness of aerial shooting programs needs to be measured against impact on a well-defined value
- In addition, other values need to be considered - social, cultural, environmental in addition to economic opportunities.
- Make data collection simple, so everyone does it every time, the same way.
- Use the data, define why it is collected, and include '*Where are they, how many are there, and what are they eating and drinking'*
- Developed visual portals for showing feral pig population increase under different control efforts, which makes it easy for stakeholders to understand the requirement for high investment.
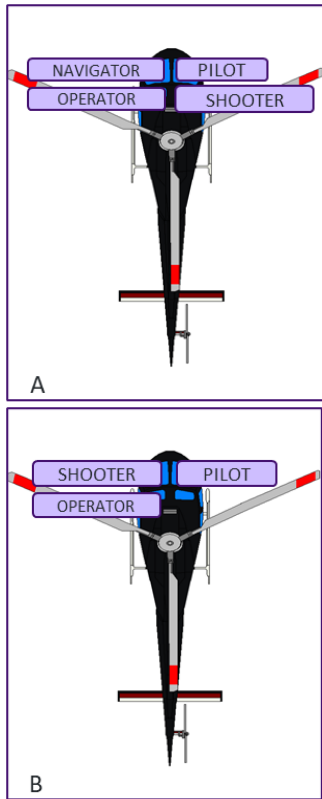
Figure 2: (left) Helicopter cockpit configuration for hybrid (A top) and TAAC (B bottom left) aerial shooting

Figure 3: (right) Aerial shooting operation using TAAC

Photo credit: DPIRD and HeliSurveys

Session 5: Risk management

Topic: This session included short (8 minute) presentations on strategies for managing the risks involved in aerial shooting operations, including public perceptions and welfare issues.

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30. Horse management in northern Australia
Mark Hogno & Des Armstrong, QLD

- The CLCAC has been performing horse management on Gangalidda Garawa country across 11,500 km^2 since 2012.
- Feral horses have clearly defined impacts in the area (impact vegetation and fire management, damage marine turtle nesting sites).
- Traditional Owner support and backing of the Ranger program, especially the feral animal management, is critical.
- In 2012, commenced training of Indigenous Rangers in aerial shooting. Veterinary inspections were carried out in 2012 to confirm shooter accuracy and efficacy.
- Currently using double helicopter operations with two rangers shooting from each helicopter.
- Building good relationships with surrounding landholders, and getting them involved will achieve better results.

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31. Lessons from the campaign to remove feral horses in the Australian Alps
Jack Gough *ISC,* NSW

- The 'sector' must defend use of aerial shooting as a pest management technique.
- Recreational shooting lobby and animal welfare lobby are mobilising and often play unfairly.
- There are gaps in public knowledge and understanding. For example:
  o Many people don't understand how herbivores cause damage.
  o Many people don't believe other options are used and explored.
  o Environmental groups often don't think about invasive animals and their impacts.
- ISC advises that managers meet with journalists to get them educated and activated.
- ISC has found that the following are ineffective:
  o Not communicating or keeping messages high level/operational.
  o Trying to appease groups who are bad faith actors.
  o Celebrating numbers shot.
  o Framing focused on economics, biosecurity and humour - these are ineffective.
  o Don't blame the animal for their actions.
- ISC has found that following message are effective:
  o Emphasise skilled and trained teams, obtain support of trusted voices e.g. CSIRO, RSPCA.
  o Engage directly with the media on your plans.
  o Frame invasive species management as a choice between action and inaction.
  o Consider elevating the voices of women or young people to connect more broadly.

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32. Assessing the animal welfare impacts of aerial shooting
Trudy Sharp & Quentin Hart (presenter) *NSW DPI,* NSW

- Aerial shooting requires proper welfare assessments.
- There are currently no agreed metrics for welfare assessment of aerial shooting.
- There are multiple key factors to measure:
  1. Suffering prior to shooting (pursuit time, group size)
  2. Suffering at point of shooting (time to death)
  3. Mechanism of death (level of suffering and length of suffering).

- The inclusion of veterinarian inspection of carcasses does not necessarily gain full picture. Need to considered lead up to death (group size, composition, chase or pursuit time, did animals escape, capture myopathy),
- Angular direction of shot appears to be more important than surface location on body in achieving a heart shot.
- Critically, every technique could be considered as conditionally acceptable; it is dependent on the operator, not just the method.

33. EAD Surveillance in Northern Australia

Joe Schmidt *DAFF Northern Australian Quarantine Strategy,* NT

- NAQS selectively shoots unwell animals and samples them for disease. NAQS do not undertake pest control activities. A team involves pilot, an observer, and vet, both of which may fill the role of data collector and shooter.
- NAQS samples pig, buffalo, bantang, horse, feral cattle, deer, goat, donkey, camels.
- Routine surveillance conducted on healthy animals for: African swine fever, Classical swine fever, Aujesky's disease, Surra (*Trypanosoma evansi*), Japanese encephalitis, Lumpy skin disease.
- NAQS often suffers from a lack of support from state agencies. In an emergency animal disease outbreak, it's likely that existing capacity will be exceeded.

Appendix 2

Tables 1 to 8 provide a summary of aerial shooting practices and procedures collated from 13 organisations and jurisdictional agencies before the workshop.

Note: This summary does not capture all components of aerial shooting procedures undertaken across Australia, only what was provided by invited organisations and agencies.

Aspects were ranked (high, medium, low) based on the number of responses received per question (up to a maximum of 13 organisations). High-response (green) aspects were initially considered in workshop discussions for potential inclusion in national minimum standards, because these aspects demonstrated some consistency across the sector.

Number of responses received per question		
HIGH	Medium	LOW
13 to 10	9 to 5	4 to 0

Table 1: Qualification requirements for pilots and shooters provided by some agencies and private contractors.

	Qualification requirement						
	For Pilot		For Shooter				
	CASA require-ments	CASA Low-level rating (CASA EX87/23)	Firearms licence	Dept / private org based aerial shooter accred.	Dept / private org based animal destruction accred.	CASA Instrument to carry and discharge firearms from aircraft	FAAST require ments
TOTAL RESPONSES	13	9	13	11	8	6	2
DAFF - NAQS	Y	Y	Y	Y	Y	Y	
Kakadu NP	Y	Y	Y	Y	Y	Y	Y
NSW FAAST	Y		Y		Y		Y
Parks VIC	Y	Y	Y			Y	
PIRSA	Y		Y	Y	Y		
QLD DESI	Y		Y	Y	Y		
Remote Area Projects & Training Pty Ltd	Y	Y	Y	Y	Y	Y	
SA DEW	Y	Y	Y	Y			
Seymour Out Bush	Y	Y	Y	Y	Y	Y	
TAS PWS	Y		Y	Y	Y		
WA DBCA	Y	Y	Y	Y			
WA DPIRD	Y	Y	Y	Y			
Whitsunday Regional Council	Y	Y	Y	Y	Y	Y	

Table 2: Experience requirements for pilots and shooters provided by some agencies and private contractors.

	Experience requirements						
	For Pilot					For Shooter	
	# Flight hrs completed in same aircraft type	# Low flying hrs completed	# Flight hrs completed for PIC	# Total flight hrs	Requalification requirements -	Requalification requirements	# Aerial shooting hrs completed
TOTAL RESPONSES	11	11	10	7	4	10	7
DAFF - NAQS	500	>2000	>2000	>2000		2 yrs refresher – 5 yr requal	10
Kakadu NP	500	250		2000		Aerial shooting 2yrs Firearms 5yrs	10
NSW FAAST	100	500	1500	1500	Annual	3 yrs	10/per yr
Parks VIC	500	500	1500	2000	CRM every 2 yrs	List of requirements	150
PIRSA	500	500	2000			After 2yrs absence	
QLD DESI	>1500	>500	>3000				
SA DEW	500	500	2000	2000			
Seymour Out Bush			1500	2000	50hrs in last 90 days - 10 hrs on aircraft type	Every 2 yrs if no shooting undertaken	10hrs under supervision
Remote Area Projects & Training Pty Ltd	500	500	1500	2000	50hrs in last 90 days - 10 hrs on aircraft type	Every 2 yrs if no shooting undertaken	10hrs 50hrs for Defence/Fed Gov/Mining land
TAS PWS						2yrs	15
WA DBCA	500	1000	1500			3 yrs	15/2yrs
WA DPIRD	100	500	1500		Min 50hr in previous yr	Every 3yrs	
Whitsunday Regional Council	500	500	3000-5000	3000-5000		Annually refresher + full requal every 5yrs	

Table 3: Helicopter and firearm requirements for pilots and shooters provided by some agencies and private contractors.

	Helicopter type			Firearm type used				
	Both	Turbine	Piston	.308 - Semi-auto	Shotgun - Semi-auto	Shotgun - Non semi-auto	Dart gun (tranquiliser)	.308 - Non semi-auto
TOTAL RESPOSNSES	7	4	2	13	7	2	1	0
DAFF - NAQS	Y			Y	Y		Y	
Kakadu NP		Y		Y				
NSW FAAST		Y		Y	Y			
Parks VIC		Y		Y				
PIRSA	Y			Y	Y			
QLD DESI	Y			Y		Y		
SA DEW	Y			Y				
Seymour Out Bush	Y			Y	Y			
Remote Area Projects & Training Pty Ltd	Y			Y	Y			
TAS PWS		Y		Y	Y			
WA DBCA			Y	Y				
WA DPIRD			Y	Y			Y	
Whitsunday RC	Y			Y	Y	Y		

National Vertebrate Pest Aerial Shooting Workshop Proceedings

Table 4: Species targeted by some agencies and private contractors.

	Species targeted						
	Pig	Deer	Horse	Goat	Camel	Donkey	Other – dog, cat, cattle, Buffalo, Fox
TOTAL RESPONSES	13	9	8	8	7	7	17 in total
DAFF - NAQS	Y	Y	Y	Y	Y	Y	3
Kakadu NP	Y		Y			Y	2
NSW FAAST	Y						
Parks VIC	Y	Y		Y			1
PIRSA	Y	Y					
QLD DESI	Y	Y	Y	Y			
SA DEW	Y	Y	Y	Y	Y	Y	
Seymour Out Bush	Y	Y	Y	Y	Y	Y	4
Remote Area Projects & Training Pty Ltd	Y	Y	Y	Y	Y	Y	4
TAS PWS	Y	Y		Y			
WA DBCA	Y		Y	Y	Y	Y	1
WA DPIRD	Y		Y		Y	Y	
Whitsunday RC	Y	Y					2

Table 5: Accessories used by shooters employed by some agencies and private contractors.

	Accessories used						
	Red dot scope	Thermal scope	Handheld thermal binoculars/ monocular	Thermal video imaging	Sound moderator	Standard video recording	Telescopic scope
TOTAL RESPONSES	13	8	8	5	4	2	2
DAFF - NAQS	Y						
Kakadu NP	Y						
NSW FAAST	Y	Y	Y	Y	Y		
Parks VIC	Y	Y	Y	Y	Y		Y
PIRSA	Y	Y	Y	Y	Y	Y	
QLD DESI	Y						
SA DEW	Y	Y	Y	Y			
Seymour Out Bush	Y	Y	Y				
Remote Area Projects & Training Pty Ltd	Y	Y	Y				
TAS PWS	Y	Y	Y	Y	Y	Y	Y
WA DBCA	Y						
WA DPIRD	Y						
Whitsunday RC	Y	Y	Y				

Table 6: Categories of personnel involved in aerial shooting operations conducted by some agencies and private contractors.

	Personnel used							
	Pilot - Contractor	Shooter - gov staff	Mission controller/ observer - gov staff	Thermo-grapher - contractor	Thermo-grapher - gov staff	Shooter - contractors	Pilot - gov staff only	Mission controller/ observer – contractor
TOTAL RESPONSES	12	10	8	4	2	3	1	2
DAFF - NAQS	Y	Y	Y					
Kakadu NP	Y	Y	Y					
NSW FAAST	Y	Y	Y		Y		Y	
Parks VIC	Y		Y			Y		
PIRSA	Y	Y		Y				
QLD DESI	Y	Y	Y					
Remote Area Projects & Training Pty Ltd	Y					Y		Y
SA DEW	Y	Y		Y				
Seymour Out Bush	Y					Y		Y
TAS PWS	Y	Y	Y	Y				
WA DBCA	Y	Y	Y					
WA DPIRD		Y	Y					
Whitsunday RC	Y	Y		Y	Y			

Table 7: Communication and tracking systems and use of in-flight data collection and mapping systems used in aerial shooting operations conducted by some agencies and private contractors.

	Comms / tracking used							In flight data collection / mapping			
	GPS	EPIRB	3rd party tracking software (eg. TracPlus, Spidertrack)	VHF	Satellite phone	UHF	SPOT Tracker	Mapping system used	Carcass waypoint collected (Y/N)	Who collects the data (Pilot, shooter, thermographer, observer)	Is data regularly analysed? In flight or after
TOTAL RESPONSES	13	13	12	11	11	10	7	N/A	12	4 – pilot 5 - Shooter 3 -Observer	Mostly after flight
DAFF - NAQS	Y	Y	Y		Y	Y		ESRI survey 123	Y	Observer	Inflight & after
Kakadu NP	Y	Y	Y	Y	Y			Avenza, Aus Runways	N	Shooter	After
NSW FAAST	Y	Y	Y	Y	Y	Y		Various	Y	Observer	Yes
Parks VIC	Y	Y	Y					Quick capture	Y	Mission Commander	Yes
PIRSA	Y	Y	Y	Y	Y	Y	Y	Orux	Y	Pilot	Yes
QLD DESI	Y	Y	Y	Y	Y	Y	Y			Shooter	
Remote Area Projects & Training Pty Ltd	Y	Y	Y	Y	Y	Y	Y	Memory maps	Y	Shooter	After
SA DEW	Y	Y	Y	Y	Y	Y	Y	Avenza software with GEO ref PDF map	Y	Primarily shooter, During TAAC pilot also	After
Seymour Out Bush	Y	Y	Y	Y	Y	Y	Y	Memory maps	Y	Shooter	After
TAS PWS	Y	Y		Y	Y			Tas Gov Internal Mapping	Y	Pilot	After
WA DBCA	Y	Y	Y	Y	Y	Y			Y	Pilot	After
WA DPIRD	Y	Y	Y	Y	Y	Y	Y	Fieldmaps	Y		
Whitsunday RC	Y	Y	Y	Y		Y	Y	Memory Maps	Y	Pilot	Annually

Table 8: Tenures covered by aerial shooting operations conducted by some agencies and private contractors and processes used to obtain consent from landholders.

	Type of tenure operating on			Landholder consent process							
	Public Land	Indigenous Land	Private Land	Written consent mandatory	Written consent optional	Verbal consent mandatory	Property visit optional	Public land only	Verbal consent optional	Community consultation meeting	Property visit mandatory
TOTAL RESPONSES	11	10	9	9	4	4	4	4	2	3	1
DAFF - NAQS	Y	Y	Y		Y	Y	Y				
Kakadu NP		Y				Y					Y
NSW FAAST	Y	Y	Y	Y	Y	Y			Y	Y	
Parks VIC	Y	Y		Y				Y			
PIRSA	Y	Y	Y	Y	Y		Y			Y	
QLD DESI	Y							Y			
Remote Area Projects & Training Pty Ltd	Y	Y	Y	Y							
SA DEW	Y	Y	Y	Y				Y			
Seymour Out Bush	Y	Y	Y	Y							
TAS PWS	Y		Y	Y							
WA DBCA	Y	Y		Y				Y			
WA DPIRD	Y	Y	Y	Y				Y	Y		
Whitsunday RC			Y		Y	Y	Y			Y	

Appendix 3.

Documents (COP's, SOP's, policies, and guidelines etc.) used by some organisations for aerial shooting operations. This is not an exclusive list.

Agency	Document Name
DAFF - NAQS	DAFF Baseline Risk Assessment: Operating Firearms & Aerial Animal Sampling activities
	DAFF Guideline: Aerial Sampling Operations – Northern Australia Quarantine Strategy (NAQS)
	DAFF Guideline: Governance, security, and usage of Northern Australia Quarantine Strategy firearms.
	DAFF National Firearms Policy
	DAFF Baseline Risk Assessment: Blood Sampling and Postmortem
	DAFF Work Instruction: Reporting animal welfare incidents
	DAFF Guideline: Management of field work safety for the Science and Surveillance Group
	DAFF Baseline Risk assessment: Working in remote and /or isolated circumstances
	Approach to Market - Helicopter services - Final 23 March 2023 (advertised through AusTender)
	The Basic Aviation Risk Standard for Animal Management V3
	International Air Transport Association
Kakadu NP	Operational Plan
	Aircraft Policy
	Firearms Policy
	Risk Assessment
	Feral Animal and Culling (aerial platform shooting) Safe Operating Procedure
	Firearms Equipment Operating Procedure
	Flight Helmet Use and Maintenance Safe Operating Procedure
	Flight Harness Use and Maintenance Safe Operating Procedure
NSW FAAST	FAAST Manual
Parks VIC	Parks Victoria Aerial Shooting Procedure
	Interagency Aviation Operating Procedures
PIRSA	National COP for the Effective and Humane Management of Feral and Wild Deer
	National SOP: Aerial shooting of feral and wild deer

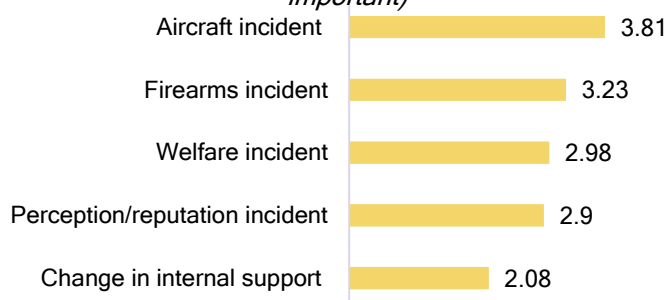|	
	PIRSA Thermal Assisted Aerial Culling SOP
	DEW Aerial Shooting of Feral Animals SOP (2021)
QLD DESI	Model code of practice for the welfare of animals - Feral livestock animals: Destruction or capture handling and marketing (CSIRO)
	Model codes of practice for each specific species
	DES Firearms Technical Manual
	Aerial Shoot Plan (internal)
Remote Area Projects & Training Pty Ltd	Internal Policies & Procedures (Firearms Policy; Aerial Shooting Policy; WHS Policy)
	Industry COP i.e. PIG002, HOR002
	Client-specific policies i.e. Downer Defence Aviation Standards
SA DEW	DEW managed aerial marksperson operations follow – DEW firearms and aerial shooting polices and procedures, SOPs, Job Safety Analysis.
	Relevant CASA guidelines/regulations and applicable state legislation to the work being undertaken.
	PestSmart aerial shooting COPs and SOPs for the applicable species.
Seymour Out Bush	SOB Risk assessment
	SOB SOA Aircraft
WA DBCA	DBCA Safety Management Plan 2019.
	DBCA SOP
	DBCA 200
WA DPIRD	DPIRD Aerial Work Safety Management Plan - Biosecurity
	Department of Agriculture (2003) Feral Animals - Code of Practice for the Capture and Marketing of Feral Animals in Western Australia. Published by the Department of Local Government and Regional Development, Western Australia, ISBN 7307 6322 6.
	DPIRD internal COP's and SOP's relating to aspects of aerial work – remote travel, working in the sun, transporting fuel, first aid.
	DPIRD internal firearms policy –key components from the WA Firearms Act and infield practices (transport, storage, and firearm use standards).
	Documentation/training of TAAC used for operations, involving thermal scopes, firearm use from squirrel helicopter, and the use of thermal spotter.
Whitsunday Regional Council	JSA and SOPs
	Aerial Shooting Safety Management Plan
	Aerial Shooting Procedure
	Aerial Shooting Fly Back Procedure

Appendix 4

## Attendee survey before the workshop

A survey (via a phone app called Slido) of the attendees at the start of the workshop quantified risks facing the sector, and the future viability of aerial shooting for vertebrate pest management.

Attendees thought aerial shooting operations were most at risk from incidents relating to aircraft or firearms, followed by those relating to welfare or reputation (fig. 4). They considered that the effectiveness of operations was mostly limited by funding, followed by the experience and skills of operators and access to equipment (fig. 5).

Figure 4. Average importance of risks to operations (ranked 1-5, where 5 = most important)

Aircraft incident	3.81
Firearms incident	3.23
Welfare incident	2.98
Perception/reputation incident	2.9
Change in internal support	2.08

Figure 5. Average importance of factors that limit the effectiveness of operations (ranked 1-5, where 5=most important)

Funding for operations	4.12
Experience and skills of operators	3.04
Access to equipment	2.9
Land access	2.88
Safety requirements	2.06
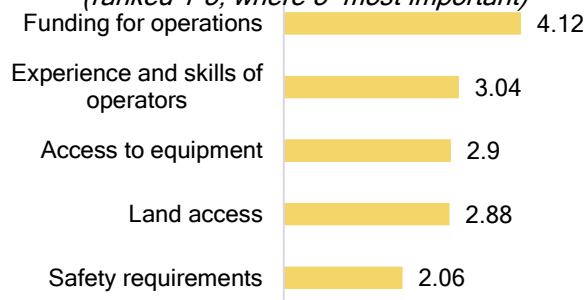
About half of the attendees (55%) indicated that their organisation only publicised operations to the local landholders, while others publicised operations to the broad community (28%) and some (17%) did not publicise operations at all to avoid a perceived risk of public backlash or concern about vertebrate pest issues. Most attendees (67%) thought aerial shooting will be performed differently in 10 years' time.

The survey indicated most attendees were interested in developing National Minimum Standards as an outcome of the workshop, as well as learning about management and monitoring innovations and increasing collaboration with others in the sector.

Attendee survey after the workshop

After the workshop, a survey indicated most attendees were keen for more standardisation and consistency between aerial shooting organisations and greater collaboration between providers in the future. The broad interest in the development and use of thermal imaging technology in aerial shooting operations garnered particular interest (figs 6 and 7). A separate evaluation survey at the end of the workshop indicated many attendees would like similar workshops every 1-3 years, joint operations with other organisations or secondments to other operations, and online

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forums. Attendees rated the usefulness of the workshop as 9/10 (averaged) and 97% found it valuable.
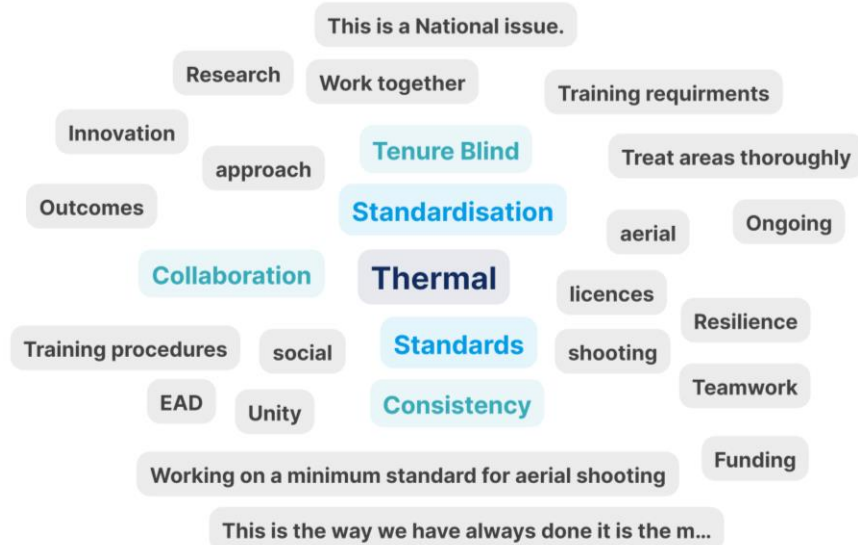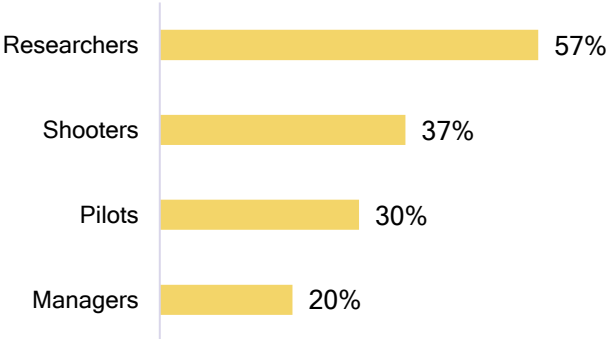

Figure 6. Word cloud created from anonymous responses in a mobile phone app ('Slido') to the question: '*What message will you take back to your teams*?'.
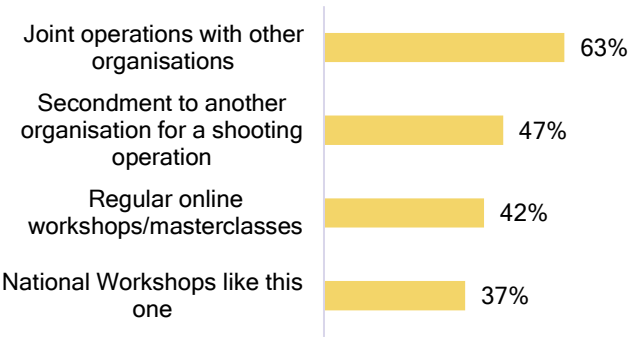

Figure 7. Word cloud created from anonymous responses in a mobile phone app (Slido) to the questions '*What is the most exciting development you have heard about at this forum?*'.

Most attendees wanted to hear more from researchers and shooters in the future (fig. 8). Attendees also ranked a suite of proposed opportunities for staff development, with joint operations with other organisations being the most popular option.

Figure 8. Percent of respondents who wanted to learn more from different sector

Sector	Percent
Researchers	57%
Shooters	37%
Pilots	30%
Managers	20%

Figure 9. Percent of respondents who said their staff would benefit from various opportunities

Opportunity	Percent
Joint operations with other organisations	63%
Secondment to another organisation for a shooting operation	47%
Regular online workshops/masterclasses	42%
National Workshops like this one	37%

Appendix 5

Scientific publication resources

1. Hampton, J.O., Edwards, G.P., Cowled, B.D., Forsyth, D.M., Hyndman, T.H., Perry, A.L., Miller, C.J., Adams, P.J. and Collins, T., 2017. Assessment of animal welfare for helicopter shooting of feral horses. Wildlife Research, 44(2), pp.97-105.
2. Hampton, J.O., Bengsen, A.J., Pople, A., Brennan, M., Leeson, M. and Forsyth, D.M., 2021. Animal welfare outcomes of helicopter-based shooting of deer in Australia. Wildlife Research, 49(3), pp.264-273.
3. Hampton, J.O., Cowled, B.D., Perry, A.L., Miller, C.J., Jones, B. and Hart, Q., 2014. Quantitative analysis of animal-welfare outcomes in helicopter shooting: a case study with feral dromedary camels (Camelus dromedarius). *Wildlife Research*, *41*(2), pp.127-135.
4. Hampton, J.O., Jones, B., Perry, A.L., Miller, C.J. and Hart, Q., 2016. Integrating animal welfare into wild herbivore management: lessons from the Australian Feral Camel Management Project. The Rangeland Journal, 38(2), pp.163-171.
5. Hampton, J.O., Robertson, H., Adams, P.J., Hyndman, T.H. and Collins, T., 2016. An animal welfare assessment framework for helicopter darting: a case study with a newly developed method for feral horses. Wildlife Research, 43(5), pp.429-437.
6. Latham, A.D.M., Davidson, B., Warburton, B., Yockney, I. and Hampton, J.O., 2019. Efficacy and animal welfare impacts of novel capture methods for two species of invasive wild mammals in New Zealand. Animals, 10(1), p.44.
7. Hampton, J.O., Eccles, G., Hunt, R., Bengsen, A.J., Perry, A.L., Parker, S., Miller, C.J., Joslyn, S.K., Stokke, S., Arnemo, J.M. and Hart, Q., 2021. A comparison of fragmenting lead-based and lead-free bullets for aerial shooting of wild pigs. Plos One, 16(3), p.e024778.
8. Ramsey, D.S., McMaster, D. and Thomas, E., 2023. The application of catch–effort models to estimate the efficacy of aerial shooting operations on sambar deer (Cervus unicolor). Wildlife Research, 50(9), pp.688-700.
9. Bengsen, A.J., Forsyth, D.M., Pople, A., Brennan, M., Amos, M., Leeson, M., Cox, T.E., Gray, B., Orgill, O., Hampton, J.O. and Crittle, T., 2022. Effectiveness and costs of helicopter-based shooting of deer. Wildlife Research, 50(9), pp.617-631.
10. Bayne, P., Harden, B., Pines, K. and Taylor, U., 2000. Controlling feral goats by shooting from a helicopter with and without the assistance of ground-based spotters. Wildlife Research, 27(5), pp.517-523
11. Cox, T., Matthews, R., Paine, D., O'Dwyer-Hall, E., Blumson, T., Florence, B., Fielder, K., Tarran, M., Korcz, M., Wiebkin, A. and Hamnett, P.W., 2022. Thermal-assisted aerial culling (TAAC) for the improved control of vertebrate pest animal populations. Scientific Reports, 13(1), pp.10063.
12. Bradshaw, C.J., Doube, A., Scanlon, A., Page, B., Tarran, M., Fielder, K., Andrews, L., Bourne, S., Stevens, M., Schulz, P. and Kloeden, T., 2023. Aerial culling invasive alien deer with shotguns improves efficiency and welfare outcomes. NeoBiota, 83, pp.109-129.