CENTRE FOR
INVASIVE SPECIES SOLUTIONS

BEHAVIOURALLY EFFECTIVE COMMUNICATION AND EDUCATION IN MANAGEMENT OF WILD DOGS

FINAL REPORT FOR PROJECT P01-E-001 PART 1

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BEHAVIOURALLY EFFECTIVE COMMUNICATION AND ENGAGEMENT IN THE MANAGEMENT OF WILD DOGS

FINAL PROJECT REPORT FOR P01-E-001, PART 1

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EXECUTIVE SUMMARY

Greater understanding of the capacity and motivations of rural communities to engage in vertebrate pest management is fundamental to delivering effective community led and coordinated control programs. The problem however is that as rural communities change and landownership is diversifying, it is often difficult to engage with or encourage participation in wild dog or other invasive management activities as these new landowners come from non-agricultural backgrounds or have not yet been impacted personally, and as such see no need to be involved. Additionally, those not involved in coordinated vertebrate pest management are referred to as non-participators. This infers that these stakeholders make a conscious decision to not be involved when often they are unaware of the program in place, the fact they have a biosecurity obligation or that they are impacting negatively on neighbours and other members of the community by not being involved.

This project aims to implement a sophisticated approach informed by the behavioural sciences and comprises of two components: 1) demonstrating the use of behavioural science and targeted engagement to accelerate sustainable participation in best practice wild dog management, and 2) to work with practitioners to build their capacity for best practice community engagement through learning network development and delivery of workshops and masterclasses.

COMPONENT 1: DEMONSTRATING THE USE OF BEHAVIOURAL SCIENCE AND TARGETED ENGAGEMENT TO ACCELERATE SUSTAINABLE PARTICIPATION IN BEST PRACTICE WILD DOG MANAGEMENT

Effective behavioural change is achieved by a systematic approach based on four guiding principles: 1) Focus on behaviour, 2) Know your audience, 3) Match interventions to the primary causes of behaviour, and 4) Evaluate, review and reflect.

This component commenced with a focus on wild dog management behaviours. Fourteen wild dog management experts were interviewed; a mixture of landholders, wild dog control coordinators, and representatives from government and non-government organisations. Five distinct behavioural goals to improve wild dog management outcomes (planning, co-ordinated preventative control, use of deterrents, targeted reactive control, and monitoring and reporting) were identified, along with 33 separate wild dog management behaviours that could be performed by rural landholders to achieve these goals.

To determine the most impactful behaviours to target an Impact-Likelihood matrix was constructed, using effectiveness ratings collected from the management experts, and information on landholders' current and likelihood of participation collected using a random phone survey. The top four behaviours identified were:

1. Participating in co-ordinated control efforts
2. Including wild dog management in annual property plan
3. Reporting wild dog sightings and impacts
4. Providing feedback to relevant agencies.

Three separate case studies were developed, each one focussed on a separate behaviour, and guided by the remaining three principles of behaviour change.

CASE STUDY 1: LANDHOLDER PARTICIPATION IN COORDINATED WILD DOG CONTROL ACTIVITIES

Using phone surveys of rural landholders this study:

- Identified two nonparticipating landholder segments; 1) landholders who had not conducted any control activities (*Non-controllers*) and, 2) landholders who conducted independent control activities (*Individual controllers*).
- Each of these segments were found to have their own COM (*capability, opportunity, motivation*) barrier/driver profile.
- Five general leverage points were identified for all nonparticipators (i.e. both *Non-controllers and Individual controllers*). These covered awareness of activities (*capability*), convenience and reduced social norm cues (*opportunity*), as well as dislike of baiting and low community attachment (*motivation*).
- A further five leverage points were identified for landholders who did no control (i.e. the *Non-controllers*). These covered awareness of the wild dog problem in their local area, and control skills (*capability*), reduced physical circumstances (*opportunity*), experiencing no wild dog problems on their property, and perceived inhumaneness and lack of specificity of control methods (*motivation*).

To complete this case study a persuasive message was developed which would engage the identified non-participating landholders, and encourage them to participate in coordinated activities. We evaluated the effectiveness of this persuasive message on landholders' willingness to participate in coordinated wild dog control activities using an online panel survey. Participants were randomly assigned to one of twelve messages which varied in: i) message framing (economic, social or environmental loss), ii) social norm (injunctive or descriptive), and iii) the control method options (baiting only, or negotiate own methods).

Result highlights:

- *Non-controllers* rated the persuasiveness and motivation of the message and the likelihood of participation in future coordinated activities consistently lower, than *Individual controllers*. Both were consistently lower than participating landholders.
- *Individual controllers* rated the persuasiveness and motivation of production frame the highest, whereas they had a negative reaction to the social frame.
- Both nonparticipating segments rated the wildlife frame as the least persuasive and motivational, despite both registering relatively high attachment to natural place.
- Injunctive norms, which described the landholders' legal biosecurity obligation to be involved in some kind of wild dog control activity, were the most motivational for *Individual controllers*.
- Descriptive norms, which described what other landholders were doing, significantly increased the intentions of *Non-controllers* to participate in future coordinated control activities.
- Offering landholders the chance to participate without having to bait was more persuasive and motivational than the baiting only option for *Non-controllers*. However this ploy was seen as manipulative by *Individual controllers*.
- Involvement with individual wild dog control activities was related to economic dependence on the property.
- Involvement with coordinated wild dog control activities was related to social belonging, trust in the community, and neighbour relationship.

Recommendations:

- These results highlight that nonparticipating landholders are not a homogenous group and that a 'one-size fits all' approach to messaging will not be effective. Messages to connect and engage with these audiences will need to be targeted, taking into consideration each groups' socio-economic and psychological profile.
- The use of a persuasive message by itself will not be very successful in encouraging participation in coordinated wild dog activities if the other types of barriers preventing participating are not also tackled.

CASE STUDY 2: LANDHOLDER REPORTING OF WILD DOGS AND THEIR IMPACTS

Using phone surveys of rural landholders this study:

- Identified two landholder segments that had not reported wild dogs and their impacts: 1) Landholders that had not reported, and were not likely to report in the future (*Non-reporters*), and 2) Landholders that had not reported, but were likely to report in the future (*Potential reporters*).
- Each segment had their own COM (*capability, opportunity, motivation*) driver / barrier profile.
- Both *Non-reporters* and *Potential reporters* perceived no problems with wild dogs, and considered current reporting methods were too time-consuming.
- In addition, *Non-reporters* were unsure of who to contact, considered reporting was too inconvenient, and did not know of anyone else who reported. They did not believe it was their responsibility to report, and believed the authorities did not act on the advice anyway. Many *Non-reporters* did not want anyone interfering with their property, and did not want to be made to do control. If there was a problem they would handle any problem themselves.

To complete this case study, instead of developing a new reporting intervention we evaluated a current reporting tool, Wild Dog Scan (WDS). A number of barrier and driver factors influencing WDS uptake were identified:

- Lack of skills and confidence to use the technology
- Perceived reduced opportunity owing to poor phone and / or internet coverage
- Spending time to learn how to use WDS, then remembering how to use it
- No perceived benefit over current methods
- Preference to have contact with other people
- Wild dogs were not currently a problem for them (they had nothing to report)
- Not motivated to report (regardless of their wild dog problems or the reporting tool).

Recommendations:

- Agencies need to build a culture of acknowledging landholders' efforts and earn their trust by demonstrating that reporting will lead to support and assistance with wild dog problems.
- A many faceted approach is required to educate, train and support landholders. Not only more targeted training opportunities, and provision of information to improve awareness and dispel any perceived misconceptions, but real-time support functions to ease the cognitive burden and save time.
- To increase WDS uptake, agencies and the developers need to promote, and demonstrate not only the benefits of its reporting functions, but those for planning and funding, as well as the social benefits.

CASE STUDY 3: WESTERN AUSTRALIA CLUSTER FENCE INITIATIVE

Cluster fencing initiatives were identified by the 17 experts interviewed as a key coordinated wild dog management behaviours in which landholders could participate. This case study was conducted as part of a Research Masters by Debbie Dowden in the Southern Rangelands of Western Australia. A mixed-methods approach was taken to focus on the community engagement aspect of the cell fence programs within this area, including detailed analysis of quantitative and qualitative data collected from surveys and interviews with landholders from the pastoral groups who have received funding for erecting cell fences on their properties, as well as landholders on properties adjacent to, but outside, the cell fences.

Two distinct components to the cell fence project were identified:

- The first was the construction of the dog proof fence and all of the effort required to complete project.
- The second component, considered to be the true measure of success, will be coordinating the sustained, landscape-scale eradication effort that will sufficiently reduce wild dog numbers within that cell fence and enable producers to return to running small stock once again.

The findings of this case study highlight:

- The biggest challenge for the community will be engaging those landholders who have low motivation, or are ideologically opposed to engaging in wild dog control on their properties.
- To manage wild dogs within such an immense structure will be beyond the capacity of the Regional Biosecurity Group alone.
- Part of the responsibility will need to lie with institutions. Good governance is a strong indicator of success and without solid national, state and local institutional support in the form of an engagement strategy, clear governance roles, appropriate funding, a compliance strategy and supported targeted research, the fence projects could struggle to succeed.
- Landholders will also need to carry an equal share of responsibility. Those within the fenced areas will need to significantly increase their level of wild dog control. They need to take personal responsibility for the problem, recognise their legal responsibilities to control wild dogs as declared pests, and exercise best practice, nil-tenure approach to work with all of their neighbours to maximise the chance of success.

COMPONENT 2: WORKING WITH PRACTITIONERS TO BUILD THEIR CAPACITY FOR BEST PRACTICE COMMUNITY ENGAGEMENT THROUGH LEARNING NETWORK DEVELOPMENT AND DELIVERY OF WORKSHOPS AND MASTERCLASSES

The main objectives of this component were to:

1. Establish and evaluate a ‘learning network’ for professional development of wild dog practitioners across the country (build upon the existing ‘community of practice’ led by the National Wild Dog Management Coordinator)
2. Deliver workshops and masterclasses to practitioners that outline the developed approaches and findings from component one of this project.

DEVELOPING AND MAINTAINING EFFECTIVE LEARNING NETWORKS IN INVASIVE SPECIES MANAGEMENT

It is vital that continuous learning and collaborative and adaptive processes are prioritised in all aspects of invasive species management, including research and practice. One way of learning and supporting collaborative effort is through a learning network. A learning network or ‘community of

practice' is a 'group of people who share a concern, a set of problems or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis'. Project teams, work units and multi-stakeholder groups can all form and behave as learning networks.

This research is important and timely. Historically, participants of teams, work units and learning networks have met face-to-face. Online interaction, team meetings and learning networks are, however, increasingly common because of globalisation, improved technology, and geographic dispersion of people. More recently, the Covid-19 pandemic has restricted movements and gatherings of people, with many people now interacting with others online.

This purpose of this research is to identify features, benefits and enablers of, and barriers and improvements to teams, work units and learning networks, with a focus on the wild dog learning network. The research outcomes are intended to yield practical benefits for existing and potential teams, work units and learning networks in invasive species management, through providing recommendations regarding key requirements for their successful establishment and maintenance.

Data was collected through individual hour-long Zoom interviews with thirteen participants of the wild dog network. This is a group of wild dog management facilitators, the National Wild Dog Management Coordinator and associated personnel from different jurisdictions around Australia. Members of the network previously developed strong working relationships through in-person meetings, conferences and associated social gatherings. They now attend monthly Zoom (video-conferencing) sessions. Data was augmented through individual Zoom interviews with seven key informants who work in different aspects of invasive species management. These interviews provided additional information regarding online versus in-person meetings, improvements to collaboration, multi-species approaches, and the features of effective work units and communities of practice. With consent, all interviews were video recorded and transcribed for data analysis. Lastly, Zoom and Echo360 transcription software, which are relatively new tools in qualitative research, were assessed in relation to their effectiveness for qualitative data collection and analysis.

Key findings and recommendations:

- When participants have previously developed strong relationships in-person, regular Zoom sessions provide valuable psychological/emotional support and social interaction and contribute to continuous learning. Regular sessions should continue.
- Zoom sessions are cheaper and more time effective than in-person events and gatherings. However, while they are a valuable adjunct, they are not a replacement for in-person interaction.
- In-person events and gatherings enhance the capacity for people to develop and maintain relationships, build networks, improve collaboration and create opportunities for further initiatives as well as providing deep and rich learning and psychological/emotional support. Such events and gatherings should be reinstated when possible.
- The human dimensions of invasive species management should continue to be prioritised. This may include further research into the features of effective and collaborative teams, work units and learning networks and practical application of findings. Additionally initiatives such as coaching and mentoring should be considered to ensure ongoing collaboration and effectiveness.
- Focus on integrated management of invasive species needs to continue.
- Conducting interviews by Zoom and recording videos for data analysis is an appropriate and cheaper alternative than in-person interviews if participants are located at great distances from the researcher and each other, and/or if there is not a further need to be on-site to collect additional research data.

DELIVERY OF WORKSHOPS AND MASTERCLASSES

Workshops and masterclasses are effective vehicles for teaching new theory and practice to practitioners to enhance their capacity. This project originally proposed to deliver at least two face-to-face workshops / masterclasses to practitioners. However with the uncertainty created by the Covid-19 pandemic, the delivery moved from face-to-face to the virtual space.

To obtain maximum benefit and create a legacy for years to come this project has developed:

- Three new online masterclass modules to be added to online Invasives Action Tool (https://actiontool.invasives.com.au/), which can be accessed at any time. Each module will have a companion practical manual covering:
    - Guidelines for practitioners to design an effective survey instrument
    - Guidelines for practitioners to develop behaviourally effective interventions
    - Guidelines for practitioners to develop effective evaluation plans.
- Workshop resources for four specific workshops which can be delivered either virtually, or face-to-face. These workshops will cover:
    - Designing effective survey instruments
    - Developing behaviourally effective interventions
    - Developing behaviourally effective communications
    - Developing effective evaluation plans.

KEY TAKEAWAYS

Following is a summary of the key takeaways identified throughout the document.

DEFINE BEHAVIOURAL GOALS & SPECIFY BEHAVIOURS

1. Five distinct behavioural goals were identified to improve wild dog management outcomes:
    i. planning
    ii. co-ordinated preventative control
    iii. use of deterrents
    iv. targeted reactive control
    v. monitoring and reporting
2. 33 separate wild dog management behaviours that could be performed by rural landholders to achieve these goals were identified.

SELECT TARGET BEHAVIOURS

Behaviours rated by key stakeholders as the most effective in reducing wild dog impacts were:

1. Participating in co-ordinated 1080 baiting
2. Planning annual wild dog control on your property
3. Participating in co-ordinated wild dog control activities (with groups)
4. Allowing access to property for aerial baiting programs.

Behaviours rated by key stakeholders as the least effective in reducing wild dog impacts were:

1. Independently PAPP ground baiting
2. Deploying ejectors independently

CURRENT PARTICIPATION IN WILD DOG MANAGEMENT BEHAVIOURS

Behaviours with the highest current participation rates were:

1. Shooting (41%)
2. Including wild dog control in annual property plan (38%).

Behaviours with the lowest current participation rates were:

1. Use of PAPP baits (0.3%)
2. Use of ejectors (0.8%).

Participation rates were significantly related to landholders' perception of wild dog problems on the property.

BEHAVIOUR PRIORITISATION

The most impactful behaviours to target are:

1. Including wild dog management in annual property plan
2. Participating in co-ordinated control efforts
3. Providing feedback to relevant agencies
4. Reporting wild dog sightings and impacts.

After consultation with research partners, the next stage of the project (i.e. Step 4 onwards) will focus on two of these behaviours - participating in coordinated control efforts and reporting wild dog sightings and impacts.

LIKELIHOOD OF ADOPTING KEY WILD DOG MANAGEMENT BEHAVIOURS

Behaviours with the highest likelihood of future participation are:

1. Shooting (40%)
2. Including wild dog control in annual property plan (35%).

Behaviours with the lowest likelihood of future participation are:

1. Use of ejectors (4%)
2. Allowing access for aerial baiting (9%).

CASE STUDY 1: PARTICIPATION IN COORDINATED CONTROL EFFORTS

There are two main segments that do not participate in coordinated control activities.

Primary barriers for participating in coordinated control activities (across both Individual controllers and Non-controllers) were:

1. Not aware when coordinated activities are occurring (i.e. lack knowledge - capability)
2. Inconvenient to participate at the required time (i.e. reduced opportunity)
3. Do not have support from family or friends (i.e. reduced social opportunity)
4. Do not have neighbours participating (i.e. reduced social opportunity)
5. Prefer to do own activities (i.e. lack motivation)
6. Do not want to help their community / neighbours (i.e. lack motivation)
7. Believe methods used in coordinated activities are ineffective (i.e. lack motivation)
8. Perceive activities involve baiting and they prefer not to bait (i.e. lack motivation)
9. Believe that the control activities will harm their working dogs (i.e. lack motivation)
10. Believe dogs should not be harmed (i.e. lack motivation).

Additional barriers for members in the Non-controllers segment were:

1. Wild dogs were not a problem on their property (i.e. lack motivation)
2. Not aware of wild dog problems in their area (i.e. lack knowledge - capability)
3. Do not know the best methods to use (i.e. reduced capability)
4. Self-conscious of low skill level (i.e. reduced capability)
5. Not confident in doing group activities or find them difficult (i.e. reduced capability)
6. Do not have the time to plan coordinated activities (i.e. reduced opportunity)
7. Feel participating is too costly (i.e. reduced opportunity)
8. Have properties that are close to other residences, making it difficult to participate (i.e. reduced opportunity)
9. Feel the methods used are inhumane (i.e. lack motivation)
10. Believe that the control activities will harm wildlife (i.e. lack motivation).

INTERVENTION DEVELOPMENT

Significant differences were found between the different dimensions of place attachment and landholder's participation in coordinated control activities.

Involvement with individual wild dog control activities was associated with:

1. Economic dependence on the property

Involvement with coordinated wild dog control activities was associated with:

1. Social belonging
2. Trust in the community
3. Neighbour relationship.

The proxy question 'Do you earn your main source of income from your property' may be a suitable measure of economic dependence. However the proxy questions measuring community involvement was not a suitable measure for social belonging.

EVALUATION OF MESSAGE COMPONENTS

The effectiveness of messages designed to encourage future participation in coordinated wild dog control activities were influenced by:

1. Landholders' current participation behaviour in wild dog control activities, both individual and coordinated
2. The framing of message – production and social framing were the most persuasive and motivational, although social framing was also viewed as manipulative, and when used landholders currently conducting only individual activities were more likely to want to avoid thinking about the problem
3. The social norms used in the message – injunctive norms describing the legal biosecurity obligation were the most motivational for landholders currently only conducting individual control activities. Descriptive norms, describing what other landholders were doing, were viewed as manipulative by this segment of landholders.

Participation in future coordinated activities was also influenced by:

1. Offering landholders the chance to participate without having to bait. This option was:
    i. More persuasive and motivational than the baiting only option for landholders currently not conducting any control activities
    ii. Seen as more manipulative by landholders currently only conducting individual activities.

INTENTION FOR FUTURE PARTICIPATION IN COORDINATED WILD DOG ACTIVITIES

- There was a small, but significant increase across all participation segments in their intention, after reading the message.
- Landholders in both the Non-controller and Individual controller segments however, were still only a slight chance of participating.
- The use of a descriptive norm in the message resulted in a significant increase in intention to participate in coordinated control activities of Non-controllers.

CASE STUDY 2: REPORTING WILD DOG SIGHTINGS & IMPACTS

The primary barriers to reporting wild dog sightings and impacts were:

1. Wild dogs were not causing a problem on their property (i.e. no motivation)
2. Current methods of reporting were too time-consuming.

Additional barriers to reporting wild dog sightings and impacts for non-reporters were:

1. They don't know who to contact (i.e. lack knowledge - capability)
2. Current methods of reporting were inconvenient (i.e. reduced opportunity)
3. They don't know anyone else who reports (i.e. lack of social opportunity)
4. There was a lack of motivation as they did not want other people interfering with their property, they preferred to handle the problem themselves, and they did not want to be made to conduct control activities that they perceived as costly, disagreeable, or which would harm their own dogs.
5. They felt it wasn't their responsibility, and the authorities would not act on their information anyway (i.e. further lack of motivation).

INTERVENTION DEVELOPMENT

The primary barriers to using Wild dog Scan were:

- Ability to use this tool – skill and confidence (reduced capability)
- Time availability – to learn new skills as well as to report (lack of opportunity)
- Access to compatible hardware (reduced opportunity)
- Perceived connection issues – phone and internet coverage (reduced opportunity)
- Don't see the benefits of Wild Dog Scan (not motivated)
- Prefer contact / conversations with people (not motivated)
- Non-reporters – either don't see the need, or too lazy (lack of motivation).

COMPONENT 2. BUILDING PRACTITIONER CAPACITY

EVALUATION OF WILD DOG LEARNING NETWORK

The researcher suggests that conducting interviews by Zoom and recording videos for data analysis (with informed consent) in future qualitative research is an appropriate and cheaper alternative than in-person interviews if participants a located at great distances from the researcher and each other, and/or if there is not a further need to be on-site to collect additional research data. The researcher suggests that consideration be given to the use of higher quality digital transcription software, if consistent with ethics approval.

COMPONENT 1

DEMONSTRATING THE USE OF BEHAVIOURAL SCIENCE AND TARGETED ENGAGEMENT TO ACCELERATE SUSTAINABLE PARTICIPATION IN BEST PRACTICE WILD DOG MANAGEMENT

INTRODUCTION

BACKGROUND

Scientists, in collaboration with State governments, livestock industry organisations and the Centre for Invasive Species Solutions (CISS) have developed an impressive set of technologies and recommended best practices for managing wild dogs. But experience shows that these proposed solutions will fail unless landholders are sufficiently empowered and motivated to change behaviours and adopt new approaches. Greater understanding of the capacity and motivations of rural communities to engage in wild dog management is fundamental to delivering effective community-led and coordinated control programs, a cornerstone of the National Wild Dog Action Plan (NWDCAP). A network of industry and government funded coordinators have been employed to implement the NWDCAP, and need evidence-based strategies to help them strategically focus their efforts to address non-participation in these coordinated, community-led wild dog management program. This project will work with key stakeholders in wild dog management to address this gap in current best practice.

Acceptance and implementation of best management practices for the control of wild dogs range across a continuum (Sjölander-Lindqvist, Johansson, & Sandström, 2015). At one end there are “adopters”, those who implement best practice on land that they manage and have reduced or minimised impact of wild dogs on their enterprise or environment. At the other end are “non-adopters” who, for a range of reasons, fail to implement best practice or participate in control programs (Binks, Kancans, & Stenekes, 2015). Additionally, rural communities continue to change in demographic and land use resulting in more diverse attitudes to wild dog management and the techniques used to control them. In some instances, landowners without agricultural backgrounds may not be aware they have legislative responsibility to control wild dogs on their properties. Non-participation can produce significant negative impacts beyond one’s own property given that wild dogs and many other vertebrate pest species are not generally constrained by property boundaries. Effective management of wild dogs requires on-going coordinated action by a diverse set of landholders who often possess a range of values, enterprise-interests, and skill sets (Fleming et al., 2014).

Best practice community engagement requires a combination of practical engagement skills for facilitating dialogue and designing equitable processes, with in-depth understanding of how barriers and benefits drive human behaviour to take action for wild dog management. Understanding the drivers and motivations of stakeholders to be involved in wild dog management is a key component of any engagement process. At present, wild dog coordinators have processes in place which are working effectively for those stakeholders who aware of the problem and willing to adopt best practice. However, there is a substantial number of nonparticipating landholders who appear to be either unaware of the problem or unreceptive to recommendations made by wild dog coordinators, or unable to respond for a host of other reasons. Wild dog coordinators need evidence-based methodologies for engaging in constructive interactions with these non-participators, jointly defining problems and co-developing solutions.

PROJECT GOALS AND OBJECTIVES

The goal of this project is to accelerate sustainable participation in best practice wild dog management using behavioural science and targeted engagement. Two key knowledge gaps will be addressed:

1. Determining the number and nature of non-participating landholder segments? Are all disengaged landholders essentially the same? Or are there different types who fail to participate for different reasons? And if there are several distinct segments, how many are there, and how do they differ from each other?

2. Determining the most effective strategies for engaging with each type of non-participant.

The project's objectives are:

1. Identify the different audience segments for wild dog management and develop tailored and targeted engagement approaches for those segments that are not currently taking action
2. Compare the effectiveness of these tailored and targeted approaches with existing approaches
3. Combine this knowledge of what works and with whom, to increase engagement across all targeted audience segments.

HUMAN BEHAVIOUR CHANGE: 10-STEP METHODOLOGY

Changing human behaviour, and sustaining these changes over time, is a difficult process. Educating people about the negative impacts of wild dogs and providing detailed management instructions is rarely enough to initiate and sustain practice change (Hine, McLeod, & Driver, 2019). Social research has shown that these proposed solutions will fail unless people are sufficiently motivated and empowered to change behaviours and adopt new approaches. Social psychology and behavioural economics have generated an array of intervention strategies and behaviour change techniques designed to increase audience understanding, engagement and ultimately, adoption of desired behaviours. To assist practitioners, a number of frameworks have been created, offering a methodical approach to develop effective interventions. Hine, McLeod and Driver (2019) have noted that although these frameworks may differ in structure and terminology may vary, most are guided by four main principles (Hine, McLeod & Driver, 2019):

PRINCIPLE 1: FOCUS ON HUMAN BEHAVIOUR

STEP 1: DEFINE THE GOALS IN BEHAVIOURAL TERMS

Before we can begin to understand the factors influencing best practice wild dog management we first need to systematically unpack the wild dog problem to determine its nature, and what exactly needs to be changed to fix it. In particular, four questions need to be considered:

1. What is the nature of the problem in ecological, economic, social and health terms?
2. Which human behaviours are making the problem worse?
3. Which human behaviours can help resolve the behaviour?
4. Who are the individuals whose behaviour needs to change?

STEP 2: SPECIFY THE TARGET BEHAVIOUR(S) NEEDED TO ACHIEVE THE GOALS

The next step is to define ‘best-practice’ wild dog management in precise behavioural terms, and generate a list of these behaviours that can bring a reduction in the wild dog problem. When constructing this list it is important to consider who needs to do what, when, where, how often and with whom (Michie, Atkins, & West, 2014).

STEP 3: SELECT THE TARGET BEHAVIOUR(S)

In complex problems such as the wild dog issue, there are usually many behaviours that have an impact on the problem. These behaviours are often linked and can be performed in a particular sequence, referred to as a behaviour chain (e.g. developing a wild dog management plan, contacting neighbours, collecting baits from the supplier, laying baits, checking baits and so on). Interventions often fail if they try and change the wrong behaviours, too many behaviours at once, or not focus on end-state behaviours (i.e. the behaviours that actually produce the desired outcome) (McKenzie-Mohr, 2011). To maximise impact, behaviour change interventions should target effective behaviours that have a high probability of being adopted and that are not already being performed by the target audience.

There are two techniques to assist selecting the most appropriate behaviour(s) to target:

1. The Behaviour Prioritisation Matrix (BPM) (McKenzie-Mohr, 2011), which ranks potential target behaviours from most impactful to least impactful based on the effectiveness of the behaviour in reducing negative impacts, the likelihood of adoption of the behaviour by the target population, and the proportion of the target population currently not engaged in the behaviour.
2. The Impact-Likelihood Matrix (ILM) (Kneebone, Smith, & Fielding, 2017), which maps the effectiveness of a behaviour and the likelihood of adoption on a grid, overlaid with data on current participation. Priority behaviours can then be identified by their location on the grid, while retaining other useful information such as how the behaviours relate to one another.

PRINCIPLE 2: KNOW YOUR AUDIENCE

STEP 4: DRIVER AND BARRIER (COM-B) ANALYSIS

Having selected the target behaviour(s), the next step is to understand what factors lead individuals to engage in the behaviour (drivers) or prevent them from engaging (barriers), i.e. what are the factors that distinguish between adopters and non-adopters, and to identify what needs to change in order to achieve best-practice spray application. A useful behavioural model to help understand these drivers and barriers is the Capability Opportunity Motivation-Behaviour (COM-B) model (Michie et al., 2014). According to this model behaviour factors determining behaviour can be classified into three groups:

1. Capability - Do individuals have the relevant knowledge, skills, and physical capacity to engage in the target behaviour? Do they know the best management strategies?
2. Opportunity - Are situational conditions present to support the behaviour? Are relevant laws and other support structures in place to support action? Are appropriate technologies readily available?
3. Motivation - Are individuals sufficiently motivated to take action? Are they aware there is a problem in their region? Do they possess the right combination of values, attitudes, and beliefs to inspire action?

STEP 5: AUDIENCE SEGMENTATION ANALYSIS

Audience segmentation involves dividing a target population into subgroupings called segments, usually based on some combination of demographics, values or behaviours. The fundamental idea underlying audience segmentation is that the targets of behaviour change interventions are generally not homogenous. Different groups of people will have different driver/barrier (COM-B) profiles. Thus, to maximise impact, interventions can be designed to best match the characteristics of specific segments, a process known as targeting. Messages can also be crafted for specific individuals, as opposed to larger segments. This is referred to as message tailoring, and is becoming increasing common with advances in Internet marketing. The primary goal of tailoring and targeting is to increase the persuasive and behavioural impact of interventions by matching intervention content to audience needs.

STEP 6: IDENTIFYING MAIN LEVERAGE POINTS

Once you have gained an understanding of what needs to change and the audience segments present in the target population, you are ready to identify the main leverage points, in particular three strategic decisions:

1. Who should be targeted? To maximise on-the-ground impact it may be better initially to target a large group of disengaged but receptive audience members, rather than focusing on a smaller group who are not interested, and who would require more time and money to engage.
2. How to best optimise interventions for each audience using their unique COM-B profiles?
3. How to ensure the audiences engage with the intervention? Different audience segments may have their own unique preferences for where they obtain information or who they trust to deliver that information. Not all audiences will perceive certain sources or communicators as credible and trustworthy.

PRINCIPLE 3: MATCH INTERVENTION TO PRIMARY CAUSE OF BEHAVIOUR

STEP 7: DEVELOP INTERVENTION PLAN

Having identified the main leverage points for initiating and sustaining behaviour change, the next phase is to develop the behaviour change intervention plan to increase the adoption of best practice within each selected target audience group(s). A broad range of behaviour change tools can be applied to facilitate the adoption of wild dog management. But, not all tools are equally well suited for all situations. Ensuring that the selected tools match the primary causes of behaviour you are attempting to change will increase efficiency and impact. For example, where the barriers are associated with an individual's Capability tools that educate, train or enable them to participate are most appropriate, whereas if the barriers are associated with external Opportunities to engage, tools that enable, restrict or restructure the physical or social environment are more appropriate. Where barriers are associated with an individual's Motivation to engage tools that persuade, educate, model the targeted behaviour, offer incentive or coerce should be used.

STEP 8: ASSESS FEASIBILITY AND PRACTICALITY OF NEW INTERVENTION PLANS

Once an intervention plan has been developed it is important to assess its practical feasibility. A first step may be to use the APEASE criteria developed by Michie and her colleagues, which looks at the affordability, practicality, cost effectiveness, acceptability, fairness and potential side effects of the intended intervention (Michie et al., 2014). Preliminary testing with audience focus groups or small pilot studies may be another way to ensure that engagement materials are optimally matched for each segment.

PRINCIPLE 4: EVALUATE, REVIEW AND REFLECT

STEP 9: EVALUATION

Evaluation is an important component in any intervention design (Rossi, Freeman, & Lipsey, 2004). There are two main types of evaluation:

1. **Formative** evaluations are conducted during the development of an intervention, and are useful if you want direction on how improve the design process. Examples include Needs assessment and Developmental / Process evaluation.
2. **Summative** evaluations are completed once an intervention has been implemented and will inform to what extent it is achieving its purpose. Examples include Outcome and Impact evaluations, Cost-Benefit and Cost-Effectiveness analysis.

Both quantitative and qualitative methods can be used during evaluations. The design of an effective outcome or impact evaluation plan should consider, where feasible, a randomised field experiments to assess the effectiveness of the interventions. This ensures that any changes in adoption rates can be causally attributed to the intervention, and not to uncontrolled factors. Qualitative interviews are useful to determine in more detail what aspects of the intervention were effective and ineffective.

STEP 10: REVIEW AND REFLECT

Changing people's behaviour, along with creating new solutions to complex problems such as spray drift, can be challenging. It is important to take a systematic, long-term approach, constantly reviewing and reflecting to identify what worked in what contexts, what did not, and how the process/methodology could be improved in the future. This commitment to continuous learning and improvement is necessary to maximise the effectiveness of human behavioural research.

DEFINE BEHAVIOURAL GOALS & SPECIFY BEHAVIOURS (STEPS 1 & 2)

METHODS

INDUSTRY EXPERT INTERVIEWS

A qualitative research design was adopted to understand the wild dog problem and identify the list of relevant wild dog management behaviours that could provide a solution. Fourteen wild dog management experts were interviewed; a mixture of landholders, wild dog control coordinators, and representatives from research, government and community organisations. The interviews followed a semi-structured format (Appendix 1), and were conducted either by phone or face-to-face. Semi-structured interviews were used for two reasons: 1) this methodology is well suited explore the perceptions and opinions of respondents regarding complex issues, and enables probing for more information and clarification of answers, and 2) the professional, educational and personal histories of the sample group were diverse, which precluded the use of a standardised interview schedule (Barriball & While, 1994).

The interviews, which lasted between 30 to 60 minutes, were conducted in accordance with the ethical standards of the Human Research Ethics Committee of the University of New England (Approval No. HE18-182). They were recorded (by consent) and later transcribed and summarised for further basic thematic analysis in NVivo v10 (QSR International, 2012). This involved coding the responses to identify common themes to gain an understanding of the wild dog issue and identify relevant goals and behaviours as well as factors that impede or drive best-practice wild dog management behaviour (Braun & Clarke, 2006).

RESULTS

STEP 1: DEFINE THE GOALS IN BEHAVIOURAL TERMS

The results from the analysis of the stakeholder interviews for behavioural goals required to reduce the problems caused by wild dogs are shown in Table 1.1. Five distinct behavioural goals were identified around: 1) planning, 2) co-ordinated preventative control, 3) use of deterrents, 4) targeted reactive control, and 5) monitoring and reporting.

Table 1: The behavioural goals required to reduce wild dog impacts as identified by the 14 interviewed stakeholders.

What behaviour goals?	Where does it occur?	Who is involved?
1. Incorporate wild dog control activities as part of regular property management routines	rural areas across Australia	rural landholders
2. Carry out co-ordinated wild dog control using approved local best practice techniques	rural areas across Australia	rural landholders
3. Discourage wild dogs using approved local best practice techniques	rural areas across Australia	rural landholders
4. When attacks occur carry out extra wild dog control using approved local best practice techniques	rural areas across Australia	rural landholders
5. Regularly monitor and report on wild dog activity, attacks and control actions	peri-urban and rural areas across Australia	community members / rural landholders

STEP 2: SPECIFY THE TARGET BEHAVIOUR(S) NEEDED TO ACHIEVE THE GOALS

The results from the expert interviews, along with a review of the literature, were used to populate a list of 33 candidate behaviours covering the five identified behavioural goals. These behaviour groups are listed in Tables 1.2, along with a description of who needs to do what, when, where, how often and with whom. Those control behaviours that could be performed either alone, or as part of a coordinated effort (e.g. baiting) where counted as two separate behaviours.

Key takeaways

1. Five distinct behavioural goals were identified to improve wild dog management outcomes:
    i. planning
    ii. co-ordinated preventative control
    iii. use of deterrents
    iv. targeted reactive control
    v. monitoring and reporting
2. 33 separate wild dog management behaviours that could be performed by rural landholders to achieve these goals were identified.

Table 2: Identified wild dog management behaviours

What	Goal	Who	When	Where	How often	With whom
Wild dog control activities part of annual plan	1	landholder	start of each year	on their property	annually	group / coordinator
Co-ordinate control activities with local wild dog control group / neighbours	1	landholder	every year	local area	when required	group /neighbours
Place a muzzle on working dogs	1	landholder	baits are around	on their property	all the time dogs are in the paddocks	alone
Ground bait (1080 meat bait) at approved standard	2,4	landholder	problem wild dogs / spring and autumn	on their property	monitor uptake, repeat if required	alone or with group/neighbours
Ground bait (1080 manufactured bait) at approved standard	2,4	landholder	problem wild dogs / spring and autumn	on their property	monitor uptake, repeat if required	alone or with group/neighbours
Ground bait (PAPP bait) at approved standard	2,4	landholder	problem wild dogs / spring and autumn	on their property	monitor uptake, repeat if required	alone or with group/neighbours
Allow access for aerial baiting	2	landholder	when appropriate	on their property	as required	group / agency
Deploy ejectors at suitable standard	2,4	landholder	can be all year round	on their property	monitor uptake, repeat if required	alone or with group/neighbours
Leg-hold trapping at approved standard	2,4	landholder	problem wild dogs / spring and autumn	on their property	twice a year	alone or with group/neighbours
Allow access for professional trapper	2,4	landholder	problem wild dogs	on their property	as required	alone or with group/neighbours
Construct dog-proof fence	3	landholder neighbours		on their property	once	alone / neighbours
Inspect fences for holes or breaches	3	landholder	all year round	on their property	regularly	alone / neighbours
Deploy guard animals to protect stock	3	landholder	all year round	on their property	constantly	alone
Opportunistic shooting at best standard	3,4	landholder	wild dog sighted	on their property	all year round	alone
Allow access for professional shooters	2,4	landholder	problem wild dogs	on their property	as required	alone or with group/neighbours

What	Goal	Who	When	Where	How often	With whom
Dispose of dead animals promptly	3	landholder	all year round	on their property	as required	alone
Clean up potential sites for dens	3	landholder	all year round	on their property	as required	alone
Keep accurate record of livestock numbers	5	landholder	all year round	on their property	as work with stock	alone
Be vigilant for wild dog signs	5	landholder	all year round	on their property	on regular basis	alone
Install and monitor cameras	5	landholder	all year round	on their property	on regular basis	alone
Inspect for injury to stock / deaths	5	landholder	all year round	on their property	on regular basis	alone
Regular reporting of activities to agency	1,5	landholder	when requested	on their property	ongoing	alone
Promptly report wild dog sightings	5	landholder general public	all year round	on their property / all areas	promptly when occurs	alone
Promptly report wild dog damage	5	landholder general public	all year round	on their property / all areas	promptly when occurs	alone

SELECT TARGET BEHAVIOURS (STEP 3)

METHODS

A quantitative research approach was adopted to measure the effectiveness, current adoption and the likelihood of adoption of the behaviours proposed by the experts in the preliminary semi-structured interviews. After consulting with research partners, 15 key behaviours were chosen from the list of 33 identified behaviours, to make the next step more manageable and relevant (Note, fencing will be dealt with separately in Case Study 3). These 15 key behaviours were:

- Wild dog control activities part of annual plan
- Co-ordinate control activities with local group / neighbours
- Ground baiting with 1080 as part of a coordinated control strategy
- Ground baiting with 1080 independently
- Ground baiting with PAPP as part of a coordinated control strategy
- Ground baiting with PAPP independently
- Using ejectors as part of a coordinated control strategy
- Using ejectors independently
- Providing access for aerial wild dog baiting to occur
- Setting leg-hold traps as part of a coordinated control strategy
- Setting leg-hold traps independently
- Allowing a professional trapper to set leg-hold traps
- Using shooting as a method to remove wild dogs
- Reporting the presence of wild dogs and damage to the appropriate agencies
- Providing regular feedback of stock records and wild dog management activities when asked by a wild dog control agency

Two surveys were then conducted, an ‘expert’ survey to measure the effectiveness of these 15 key behaviours, and a ‘landholder’ survey to measure current adoption and likelihood of future adoption.

EXPERT SURVEY TO RATE BEHAVIOUR EFFECTIVENESS

The expert group consisted of the 14 participants who were initially interviewed, as well as three additional participants who had been unavailable for the interviews. All experts completed an online survey to rate the effectiveness of 15 key behaviours in reducing the negative impacts of wild dogs. Their ratings were on a 10 point scale, where 0 = not at all effective and 9 = extremely effective. Participants were also requested to provide any further suggestions, if any, and rate these as well (Appendix 2).

LANDHOLDER SURVEY

The landholders group consisted of 356 participants (58% male, average age 55 years) who lived in areas of New South Wales (NSW: N=119), Queensland (Qld: N=119) and Victoria (Vic: N=118) known to have wild dog problems. This was conducted as a telephone survey, with participants selected randomly from a list of supplied landline and mobile numbers (Human Ethics Approval HE18-301). Participants were asked how often they had undertaken the identified wild dog management behaviours in the past year, as well as to rate the likelihood of adopting in the upcoming year (using a

10 point scale where 1 = not at all likely and 10 = very likely). The survey also consisted of questions to collect the landholder's perception of the wild dog problem on their property, why they thought people would be reluctant to adopt these behaviours (barriers), and sociodemographic information including age, gender, location, property size and main property uses (Appendix 3).

RESULTS

WILD DOG MANAGEMENT BEHAVIOUR IMPACT

Seventeen invited industry experts rated the effectiveness of each of the 15 key behaviours on a 10 point scale (0= not at all effective, 9= extremely effective). Results are shown in Table 1.3.

Table 3: The effectiveness for each behaviour in reducing the impact of wild dogs as rated by 17 industry experts (Scale: 0=not at all effective, 9=extremely effective).

Behaviour	Mean	Standard deviation	Range
Participate in co-ordinated 1080 ground baiting	7.82	1.33	4 - 9
Wild dog control activities part of annual plan	7.35	1.97	3 - 9
Co-ordinate wild dog control effort	7.24	1.75	3 - 9
Allow access for aerial baiting	7.19	1.64	3 - 9
Allow access for professional trapper	6.82	1.55	3 - 9
Leg-hold trapping as part of group effort	6.47	1.46	3 - 9
Provide damage / control feedback to relevant agency	6.41	1.66	4 - 8
Deploy ejectors as part of group effort	6.29	2.05	1 - 9
Report wild dog sightings / damage	6.12	2.42	2 - 9
Leg-hold trapping independently	5.35	2.18	1 - 8
Participate in co-ordinated PAPP ground baiting	5.18	2.56	1 - 9
Shooting	5.12	2.42	2 - 9
Independent 1080 ground baiting	4.12	1.90	2 - 8
Deploy ejectors independently	3.94	2.11	1 - 8
Independent PAPP ground baiting	3.35	1.97	1 - 7

Key takeaways

Behaviours rated by key stakeholders as the most effective in reducing wild dog impacts were:

1. Participating in co-ordinated 1080 baiting
2. Planning annual wild dog control on your property
3. Participating in co-ordinated wild dog control activities (with groups)
4. Allowing access to property for aerial baiting programs.

Behaviours rated by key stakeholders as the least effective in reducing wild dog impacts were:

1. Independently PAPP ground baiting
2. Deploying ejectors independently

CURRENT PARTICIPATION IN WILD DOG MANAGEMENT BEHAVIOURS

The 356 respondents came from:

- six Local Land Services areas in NSW (N=119): Hunter (N=48), North Coast (N=29), Northern Tablelands & North West (N=15), South East (N=26), Western (N=1),
- seven Shire regions in Qld (N=119): Balonne (N=20), Barcaldine (N=7), Bulloo (N=3), Longreach (N=13), Maranoa (N=64), Murweh (N=6), Western Downs (N=6),
- ten shires in Vic (N=118): Alpine (N=11), Baw Baw (N=9), Benalla (N=6), East Gippsland (N=23), Indigo (N=5), Mansfield (N=4), Murrindindi (n=4), Towong (N=37), Wangaratta (N=12), Wellington (N=7).

The average property size was 4048 Ha (range 0.8 to 150,000 Ha), and the average time spent on their property was 27 years (range 1 to 86).

One hundred and sixty four (46%) earned their main income from their property. One hundred and forty-six (41%) ran only cattle on their properties, 76 (21%) identified as lifestyle / hobby blocks with no major enterprises, 38 (11%) ran both cattle and sheep enterprises, 36 (10%) ran other livestock such as horses, goats, pigs deer and poultry, 24 (7%) ran only sheep, 21 (6%) had mixed farming enterprises (crops and livestock), and 16 (4%) ran other enterprises not involving animals such as cropping , horticulture, tourism, and other non-agricultural businesses.

When asked if wild dogs were a problem on their property, 44 (12%) reported that wild dogs were a serious problem, 64 (18%) reported a moderate problem, 68 (19%) reported a minor problem, 84 (24%) reported no problem, and 96 (27%) reported they had no dogs in their area. Landholders who reported wild dog problems were more likely to have a larger property size, run livestock, and more likely to earn their main income from their property.

Results for current rates of participation in the key wild dog management behaviours are summarised in Figure 1. Respondents participated most frequently with shooting (41%). Only three respondents had used ejectors (one in a coordinated effort and two independently), and only one respondent had used PAPP baits (an independent baiting). There were no group efforts using this toxin recorded.

Current participation rates were significantly related to the landholders' perception of wild dog problems on their properties. Landholders who reported serious and moderate problems were more likely to be participating in all key behaviours (except PAPP baiting and use of ejectors) than those who reported no dogs in their area, or no problems with dogs on their property. Results are summarised in Figure 2.

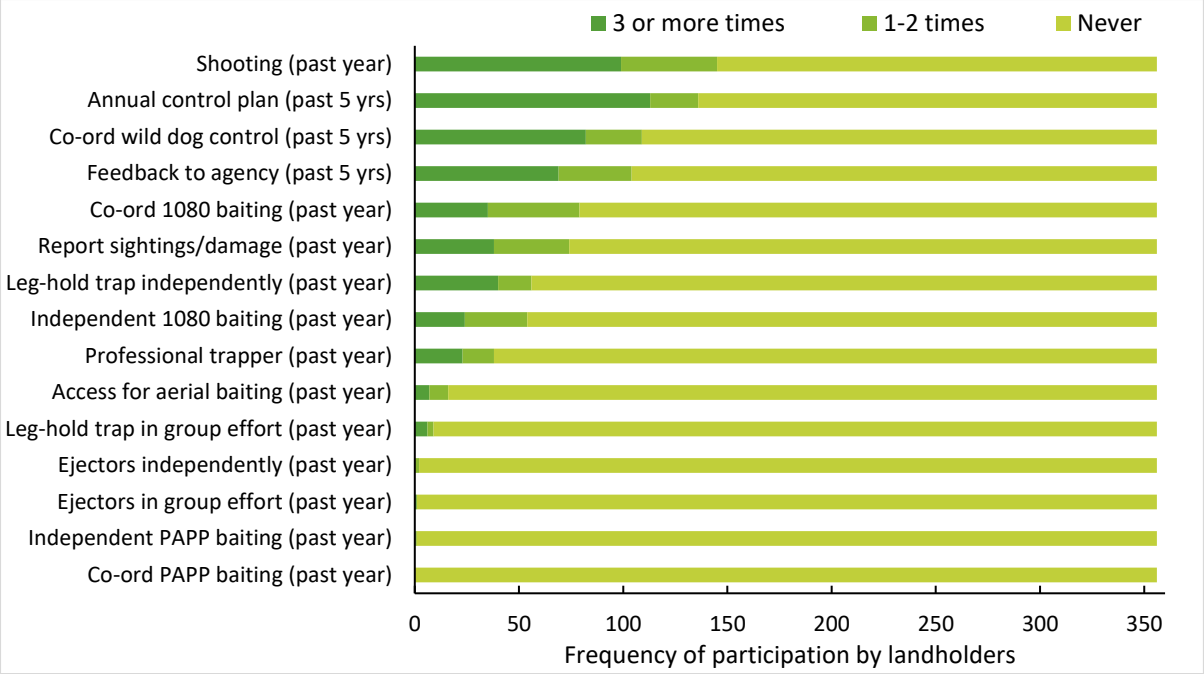

Figure 1: How often surveyed landholders have conducted each key wild dog management behaviour (N = 356)

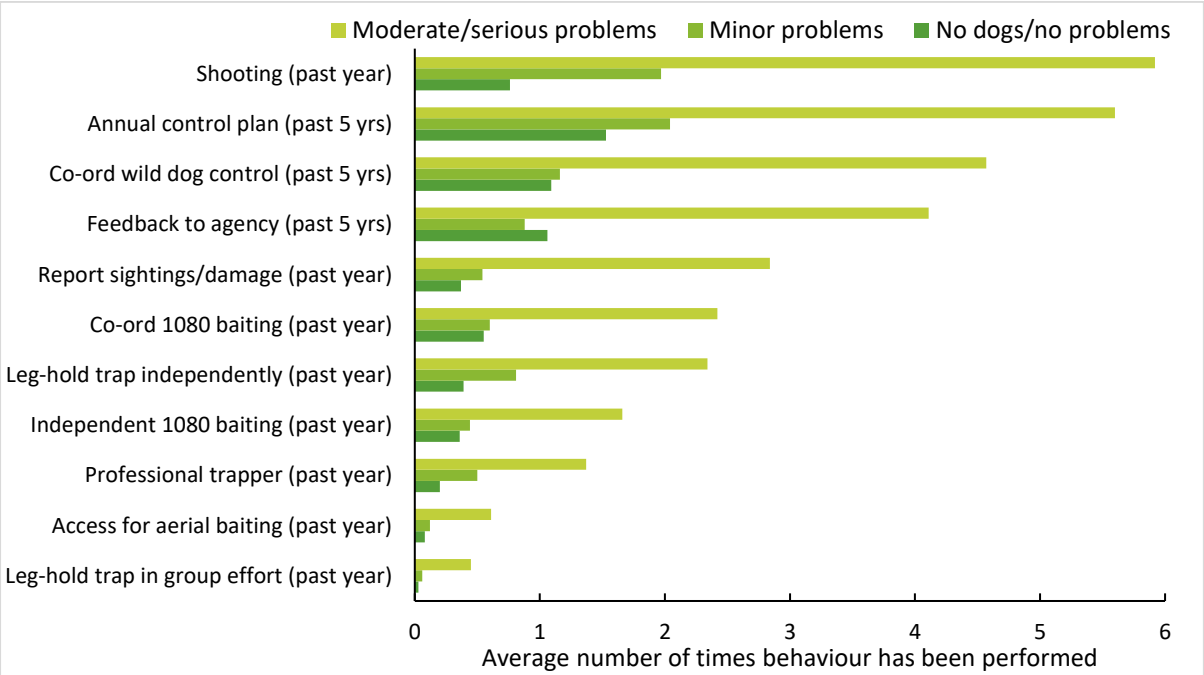

Figure 2: Landholders perception of wild dog problems on their properties and participation in key wild dog management behaviours (N = 356).

Key takeaways

Behaviours with the highest current participation rates were:

1. Shooting (41%)
2. Including wild dog control in annual property plan (38%).

Behaviours with the lowest current participation rates were:

1. Use of PAPP baits (0.3%)
2. Use of ejectors (0.8%).

Participation rates were significantly related to landholders' perception of wild dog problems on the property.

LIKELIHOOD OF ADOPTING KEY WILD DOG MANAGEMENT BEHAVIOURS

Landholders were also asked to rate the likelihood of future participation in the key wild dog management behaviours. Results are summarised in Figure 3.

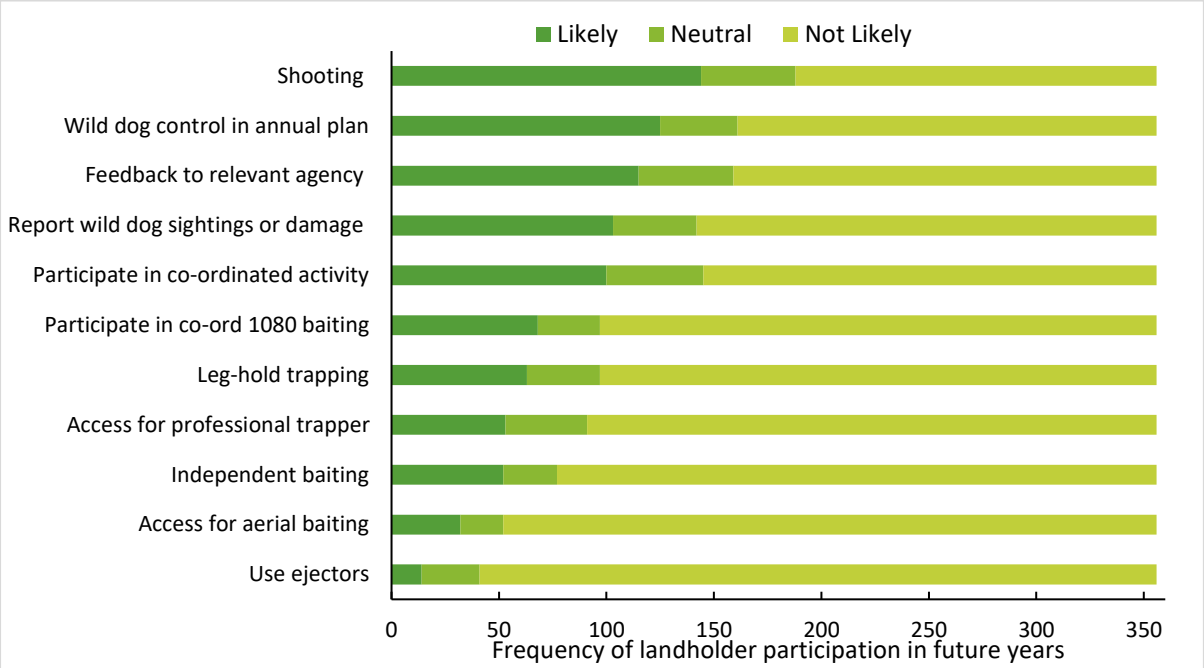

Figure 3: Likelihood of future participation in wild dog management behaviours (N = 365).

Key takeaways

Behaviours with the highest likelihood of future participation are:

1. Shooting (40%)
2. Including wild dog control in annual property plan (35%).

Behaviours with the lowest likelihood of future participation are:

1. Use of ejectors (4%)
2. Allowing access for aerial baiting (9%).

BEHAVIOUR PRIORITISATION

The behaviour impact data collected from the industry experts, along with the likelihood of behaviour adoption and current adoption data collected from the landholders were used to construct a Behaviour Prioritisation Matrix (McKenzie-Mohr, 2011). The results are shown in Table 1.4.

Table 4: Behaviour prioritisation matrix ranking key wild dog management behaviours from most to least impactful (based on McKenzie-Mohr, 2011).

Behaviour	Current participation (0-5)	Likelihood of adoption (1-10)	Effectiveness (1-10)	Weighted index[1]	Group rank
Wild dog control in annual plan	1.59	4.59	7.35	115.0	1
Feedback to relevant agency	1.05	4.50	6.41	113.9	2
Coordinate wild dog control effort	1.18	4.04	7.24	111.7	3
Report wild dog sightings or damage	0.62	4.16	5.97	108.8	4
Participate in co-ordinated baiting	0.60	3.08	7.82	106.0	5
Access for professional trapper	0.34	2.86	6.82	90.9	6
Shooting	1.46	5.14	4.71	85.6	7
Leg-hold trapping	0.68	3.01	5.91	76.9	8
Access for aerial baiting	0.13	2.06	7.19	72.1	9
Independent baiting	0.41	2.64	3.74	45.3	10
Use of ejectors	0.02	1.69	5.12	43.1	11

[1] Weighted index = (5-current practice) x likelihood of adoption x effectiveness.

This can also be depicted in a matrix where likelihood of adoption is plotted against the effectiveness rating of each behaviour, with bubble size indicating the proportion of the population NOT currently participating, i.e. the larger the bubble, the more potential to get landholders involved (see Figure 4).

The matrix, which is based on the methods of Kneebone, Smith & Fielding (2017), can be interrupted by:

- First priority for a behaviour to target is one that is highly effective and a high likelihood of adoption, because it is relatively easy to adopt and is effective in addressing the issue.
- Behaviours that are highly effective but a lower likelihood of adoption may provide potential targets, because they tend to have low current participation rate, but will require more work and resources to be adopted.
- Behaviours with lower effectiveness but still a high likelihood of adoption lack impact on the issue, but because they are easy to adopt, might act as a catalyst to encourage more difficult behaviours in the future.
- Behaviours with lower effectiveness and low likelihood of adoption are low priority. They achieve little to address the issue and are hard to adopt.

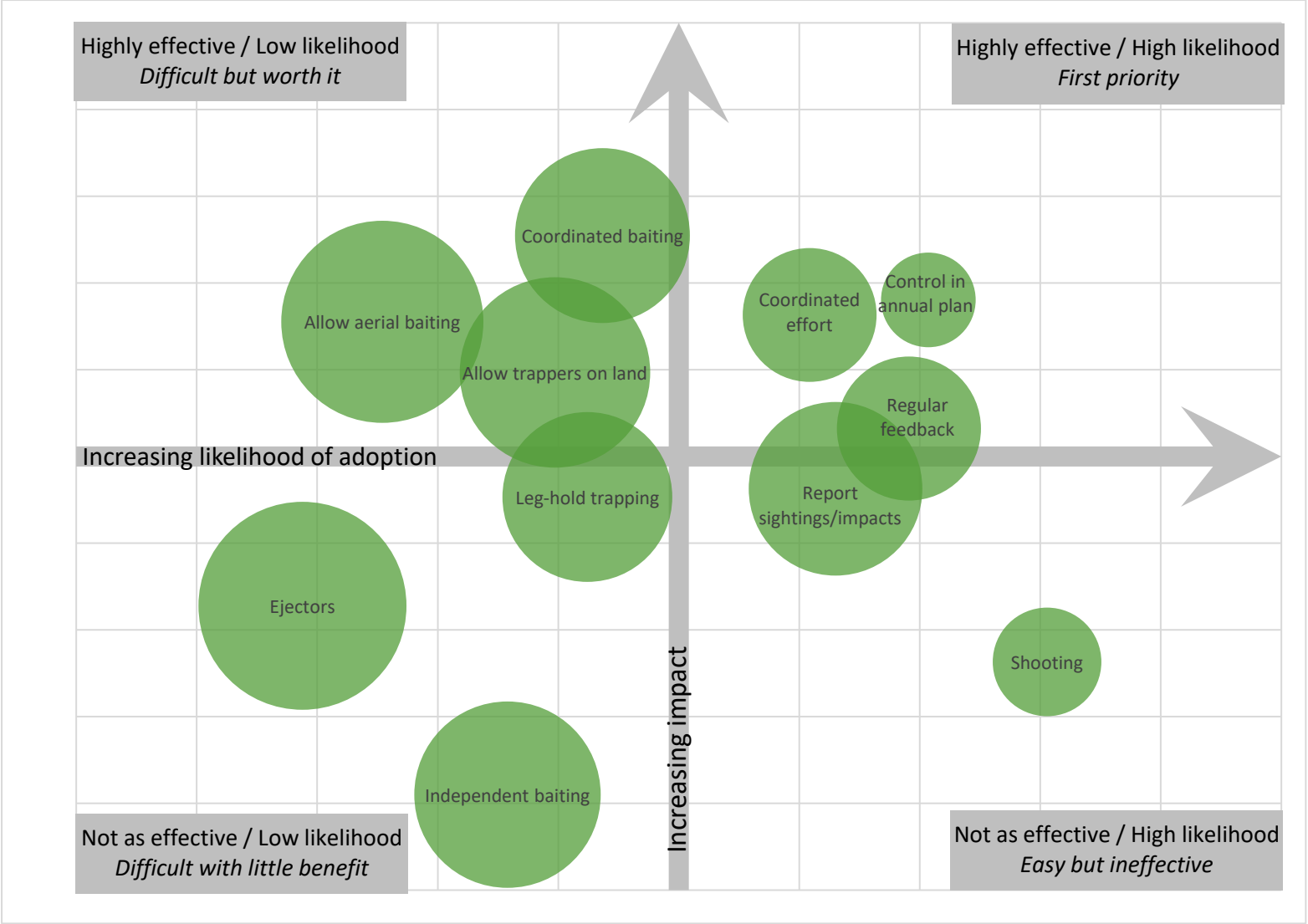

Figure 4: Effectiveness-likelihood matrix ranking behaviours based on standardised values (after Kneebone, Smith & Fielding, 2017). Size of bubbles indicate proportion of population not currently adopting the behaviour.

Key takeaways

The most impactful behaviours to target are:

1. Including wild dog management in annual property plan
2. Participating in co-ordinated control efforts
3. Providing feedback to relevant agencies
4. Reporting wild dog sightings and impacts.

After consultation with research partners, the next stage of the project (i.e. Step 4 onwards) will focus on two of these behaviours - participating in coordinated control efforts and reporting wild dog sightings and impacts.

CASE STUDY 1: PARTICIPATION IN COORDINATED CONTROL EFFORTS

COM-B ANALYSIS AND AUDIENCE SEGMENTATION (STEPS 4 & 5)

METHODS

LANDHOLDER BARRIER / DRIVER (COM-B) SURVEY

A random digit phone survey was completed to assess potential drivers and barriers that may influence landholders participating in coordinated wild dog control activities (N=198). This survey was conducted in accordance with the ethical standards of the Human Research Ethics Committee of the University of New England (Approval No. HE19-241). This survey was originally planned to target landholders who lived in the Northern NSW (North Coast, Northern Tablelands and North West Local Land Services), however owing to major bushfires in the area at the time, the survey was extended to other areas of NSW known to have wild dog problems (NSW Department of Industry, 2017). Information about the landholders' perceptions of the wild dog problem on their property, and participation in the key behaviours was collected, along with the use of guard animals or and fencing on their property. Situational and demographic information, including location, property size, main property uses, years of residence and age was captured. Respondents were also asked to rate their agreement (on a 5-point Likert scale) to 23 pre-identified *capability*, *opportunity*, and *motivation* (COM) variables (i.e. drivers and barriers). These factors had been identified from:

1. the semi-structured interviews of stakeholders,
2. the open-ended questions posed in the first landholder survey, and
3. previous research (Binks et al., 2015; Ecker, Aslin, Zobel-Zubrzycka, & Binks, 2015; Fenton, 2009; Fitzgerald, 2009; Howard, Thompson, Alter, & Frumento, 2016; Southwell, Boero, Mewett, McCowen, & Hennecke, 2013).

The survey questions are presented in Appendix 4.

ANALYSES

Latent profile analysis (LPA) was implemented in MPlus 8.3 (Muthén & Muthén, 2019) to classify landholders into homogenous segments based on their responses to participation in wild dog management questions. Relative model fit was assessed using the Bayesian information criteria (BIC; Schwartz, 1978) relative entropy (Ramaswamy, Desarbo, Reistein, & Robinson, 1993) and the Lo–Mendell–Rubin likelihood ratio test (LMR; Lo, Mendell, & Rubin, 2001). A significant p value from the LMR test ($p = 0.05$) indicated that the given profile solution fitted the data significantly better than the solution with one fewer profile groups. Differences between identified participation segments and COM variables, control behaviours, situational and demographic variables were tested using either a one-way ANOVA or Pearson's chi-squared test. All procedures except the LPA were conducted using SPSS 26 (IBM, 2019).

RESULTS

LANDHOLDER DETAILS

The average age of the 198 survey respondents was 60 years (range 18 to 93), which is slightly older than the average age (54 years) recorded for the NSW Regional adult population (Australian Bureau of Statistics, 2018). Over a third of the respondents were in the North Coast Local Land Services (LLS) (N=69), a quarter came from the Hunter LLS (N=53) and the remaining were spread across the Northern Tablelands LLS (N=44), North West (N=9), South East (N=11), Riverina (N=5), Murray (N=5), Western (N=2).The average property size of respondents was 880 Ha (range 8 to 47,000), and the average years of residence was 27 years (range 1 to 83).

Eighty-two of the respondents (41%) earned their main income from their property. Over three quarters of the respondents (151) had some type of livestock enterprise on their property, mainly cattle, small livestock (such as sheep or goats), or horses. Thirty seven (19%) respondents categorised their property as lifestyle or hobby, and the remaining ten (5%) ran enterprises, that did not involve livestock, such as horticulture, forestry, and providing public camping facilities.

A third of the respondents (66) were not aware of wild dogs in their area. A further third (66) reported being aware of wild dogs in their area, but not having experiencing any problems on their properties. The remaining third of respondents reported wild dog problems on their property. Of these, 17 (9%) rated their problem as serious, 17 (9%) moderate, and 32 (16%) minor (Figure 5).

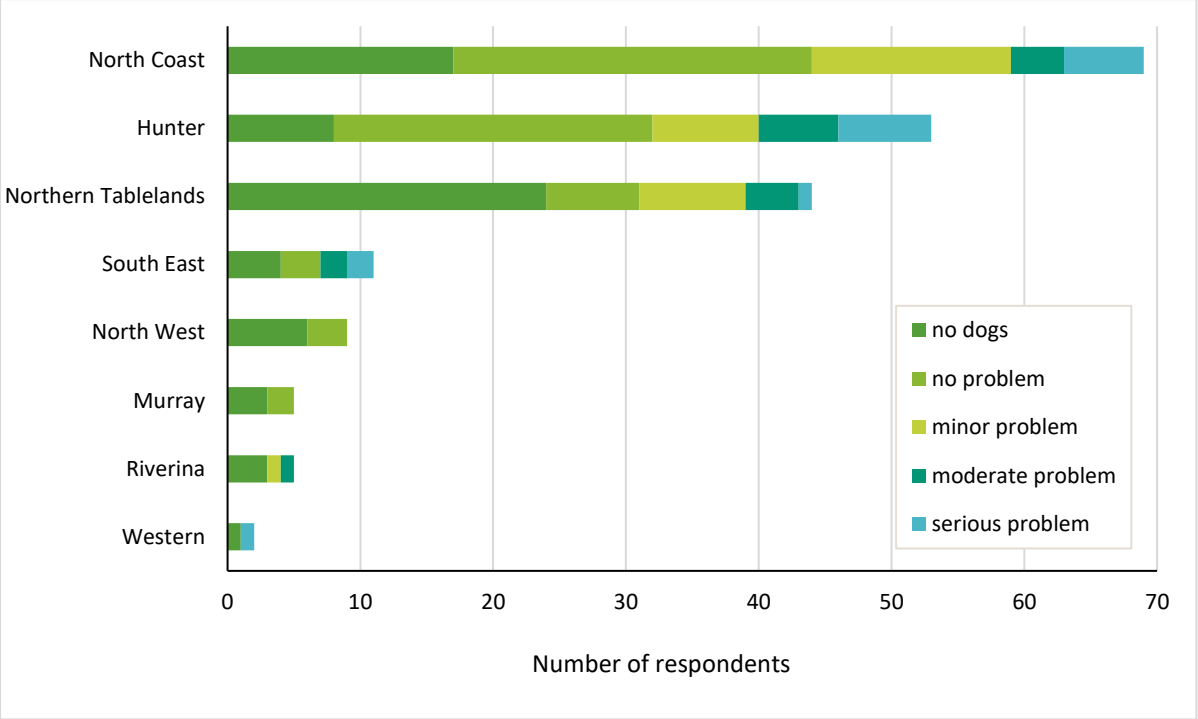

Figure 5: Perceived wild dog problem by respondents, categorised by their Local Land Service area.

Seventy-six respondents (38%) indicated they had conducted wild dog management activities in the past three years. Those that had participated were more likely to have conducted independent shooting (43, 22%), followed by coordinated baiting (34, 17%) and independent baiting (21, 11%) (Figure 6).

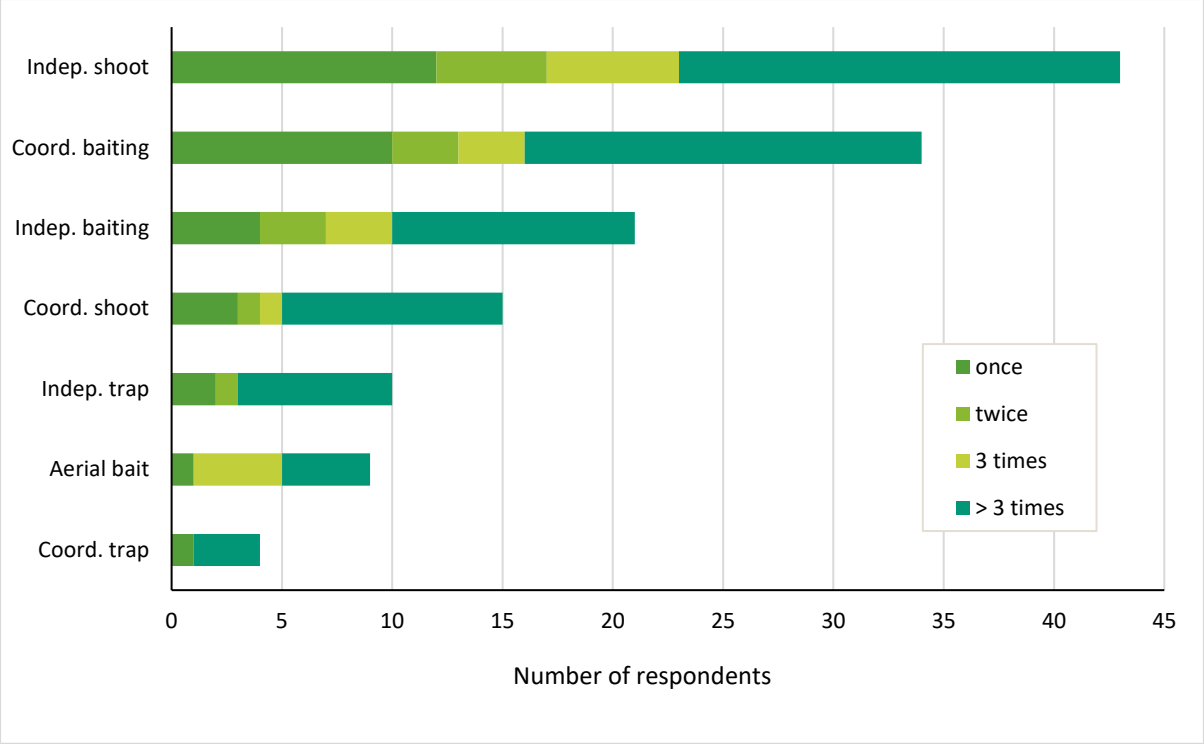

Figure 6: Participation in wild dog management activities in past three years.

AUDIENCE SEGMENTATION

The results from the LPA indicated that respondents could be classified into four segments according to their current participation in management activities (BIC = 902.44, Entropy = 0.993, see Figure 7). Demographic and behavioural characteristics for each of landholder segment are shown in Table 2.1.

The profiling analysis produced four distinct groups:

1. *Non-controllers* (N=122, 62%) had rarely participated in any wild dog management activities in the previous three years. They tended to be landholders who did not earn their main income from their property, and had reported not experiencing any wild dog problems. They mainly identified as life-stylers or hobby farmers.
2. *Individual controllers* (N=30, 15%) had conducted independent management activities, but rarely participated in coordinated programs with other landholders. They tended to have experienced minor or serious wild dog problems, and less likely to have identified as life-stylers or hobby farmers. Along with *Non-controllers*, they had resided on their property the least number of years. Shooting was the most commonly used control method, and members were more likely to rely on fencing on their property and guard animals for constant protection.
3. *Coordinated controllers* (N=22, 11%) had regularly participated in coordinated management activities such as baiting and shooting, and rarely did any activities by themselves.
4. *Dual controllers* (N=24, 12%) participated in both coordinated management activities (mainly baiting), as well as conducted baiting, trapping and shooting activities by themselves. A small number also used fencing for constant protection. They tended to have experienced minor to serious wild dog problems, and along with *Coordinated controllers* had resided on their property the greatest number of years.

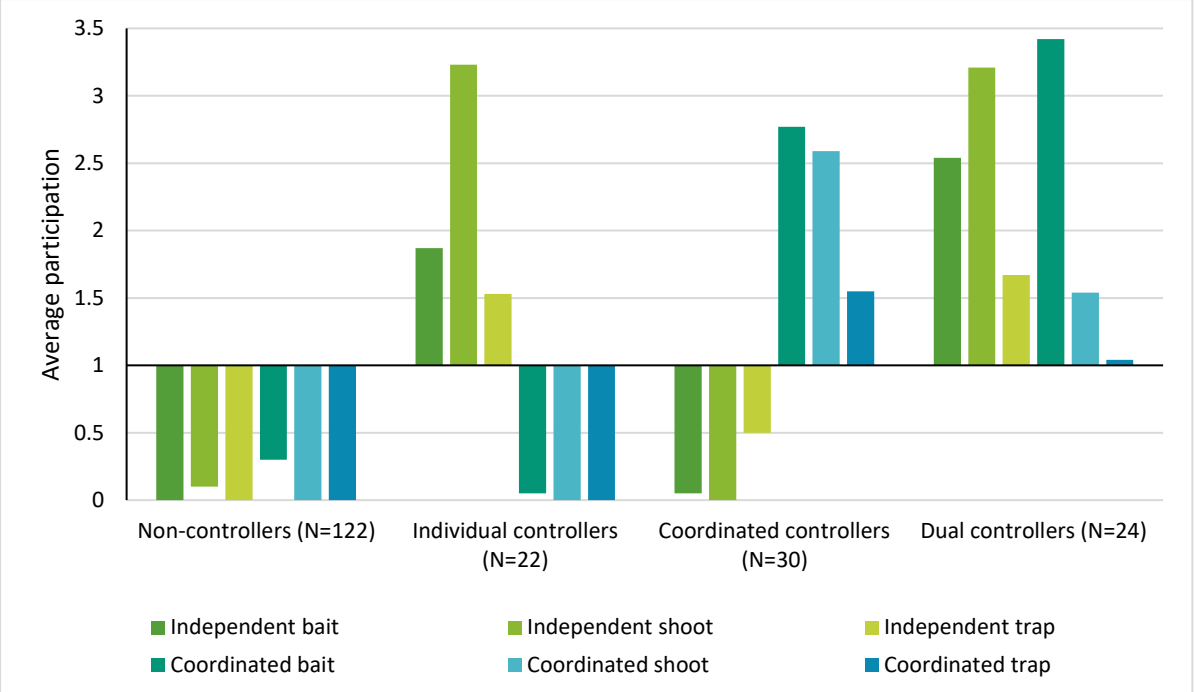

Figure 7: Four landholder segments based on participation in independent and coordinated control activities in the past 3 years. Participation scale: 0=never, 1= once, 2= twice, 3= 3 times, 4= more than 3 times.

Table 5: Wild dog management practices in the past three years, situational and demographic characteristics of the landholder segments.

	Non-controllers (N=122)		Individual controllers (N=30)		Coordinated controller (N=22)		Dual controllers (N=24)		Segment differences	
Wild dog management[1]	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**F**	**r**
Independent 1080 baiting	0.0[a]	0.0	0.9[b]	1.4	0.0[a]	0.0	1.5[c]	1.9	27.6***	0.5
Independent shooting	0.0[a]	0.0	2.2[b]	1.7	0.0[a]	0.0	2.2[b]	1.6	90.0***	0.7
Independent trapping	0.0[a]	0.0	0.5[b]	1.3	0.0[a]	0.0	0.7[b]	1.5	9.2***	0.3
Group ground 1080 baiting	0.0[a]	0.0	0.0[a]	0.0	1.8[b]	1.7	2.4[c]	1.7	81.9***	0.5
Aerial baiting	0.1[a]	0.5	0.1[a]	0.7	0.2[ab]	0.9	0.5[b]	1.3	3.2*	0.2
Group shooting	0.0[a]	0.0	0.0[a]	0.0	1.6[c]	1.8	0.5[b]	1.4	29.2***	0.2
Group trapping	0.0[a]	0.0	0.0[a]	0.0	0.6[c]	1.4	0.1[b]	0.2	8.7***	0.1
Fencing	0.0[a]	0.1	0.1[b]	0.3	0.0[a]	0.0	0.1[b]	0.3	4.7**	0.2
Guard animals	0.0	0.1	0.1	0.3	0.0	0.0	0.0	0.0	2.2	-
Demographic variable										
Age	61.3	13.5	60.7	13.2	61.0	15.1	60.0	15.8	.06	-
Situational variables										
Property size (ha)	655.5	3482.2	1072.4	3099.3	1917.4	8530.3	546.3	569.5	.72	-
Years of residence	24.5[ab]	17.9	24.3[a]	21.2	31.4[b]	25.1	38.1[b]	25.7	3.4*	0.2
	N (%)	Z_{Resid}	N (%)	Z_{Resid}	N (%)	Z_{Resid}	N (%)	Z_{Resid}	$\chi 2$ (df)	r
Reported wild dog issue:									92.3***(12)	0.6
No dogs in area	60 (49)	6.0	0 (0)	-4.2	4 (18)	-1.6	2 (8)	-2.8		

	Non-controllers (N=122)		Individual controllers (N=30)		Coordinated controller (N=22)		Dual controllers (N=24)		Segment differences	
Wild dog management[1]	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**F**	**r**
Dogs but not a problem	49 (40)	2.6	9 (30)	-0.4	7 (32)	-0.2	1 (4)	-3.2		
Minor problem	8 (7)	-4.7	10 (33)	2.8	3 (14)	-0.3	11 (46)	4.2		
Moderate problem	4 (3)	-3.4	5 (17)	1.7	3 (14)	0.9	5 (21)	2.3		
Serious problem	1 (1)	-4.9	6 (20)	2.4	5 (22)	2.5	5 (21)	2.3		
Main income source:									8.0* (3)	0.2
Property	41 (34)	-2.8	16 (53)	1.4	12 (55)	1.3	13 (54)	1.4		
Other (off property)	81 (66)	2.8	14 (47)	-1.4	10 (45)	-1.3	11 (46)	-1.4		
Property enterprises:									22.8* (12)	0.2
Cattle only	57 (47)	-2.3	22 (74)	2.4	12 (55)	0.2	14 (58)	0.6		
Small livestock only	14 (11)	1.1	3 (10)	0.1	1 (4)	-0.9	1 (4)	-1.0		
Mixed livestock	13 (11)	-1.3	4 (13)	0.0	3 (14)	0.1	6 (25)	1.8		
Farming - no livestock	7 (6)	1.0	0 (0)	-1.3	2 (9)	1.1	0 (0)	-1.1		
Lifestyle / hobby	31 (25)	2.6	1(3)	-2.4	4 (18)	-0.2	3 (13)	-0.9		

Notes: [1] Mean scores for management participation using scale: 0=never, 1= once, 2= twice, 3= 3 times, 4= more than 3 times. *p < 0.05, **p < 0.01, ***p < 0.001. Means with different subscripts (in rows) differ significantly at p < 0.05 Tukey HSD. r = Pearson's correlation coefficient; r ≥ 0.5 indicates strong effect size, r = 0.3 indicates medium effect size, r = 0.1 indicates small effect size (Cohen, 1988). Z_{Resid} = Adjusted standardised residual, where $Z_{Resid} > |2|$ is significant at p < 0.05

COM-B PREDICTOR VARIABLES

There were two landholder segments, *Non-controllers* and *Individual controllers*, whose members did not participate in coordinated activities. To identify the specific barriers and drivers, we compared the participants' responses to the 23 COM variables across the four segments. Results are presented in Table 2.2. We found significant differences between participators (i.e., *Coordinated* and *Dual controllers*) and non-participators (*Non-controllers* and *Individual controllers*) across 22 of the 23 COM variables. There was agreement across members of all four segments that it was not the Government's responsibility to manage wild dogs in their area.

A range of barriers and drivers were identified for participation in coordinated activities for wild dog control. Relative to participators, non-participators (i.e., *Non-controllers* and *Individual controllers)* reported significantly lower awareness of when the coordinated activities were occurring. From a motivational perspective, they were more likely to believe that wild dogs should not be harmed and coordinated activities were not effective. They also indicated a preference for individual autonomy, and were less inclined toward community-beneficial actions. Non-participators also expressed a dislike for baiting, particularly as it posed a risk to their farm dogs.

In terms of opportunity, non-participators in coordinated action, relative to participators, experienced weaker social pressure to engage in such activities; their neighbours were significantly less likely to participate, and they reported that most of their family and close friends did not support such activities. They also reported that engaging in coordinated action to control wild dogs was less convenient than landholders who participated in such activities.

Importantly, we also identified heterogeneity amongst non-participators with respect to their responses on several COM factors. *Non-controllers* relative to *Individual controllers*, were significantly less likely to perceive wild dogs as posing a problem on their property, and were less aware of wild dog problems in their local area. They also were less supportive of common methods used to control wild dogs (e.g., traps and baits), viewing them inhumane and harmful to wildlife. *Non-controllers*, relative to members of other segments, also tended to report lower levels of capability (e.g., lack of knowledge regarding the best methods to use, low skill level, lack of confidence and ability to work with a coordinated group). High perceived costs, lack of time and closeness to other local residences constituted important opportunity barriers for *Non-controllers*.

Table 6: Differences between COM driver and barrier variables and the four identified landholder segments.

	Non-controllers (N=122)		Individual controllers (N=30)		Coordinated controllers (N=22)		Dual controllers (N=24)		Segment differences	
COM Variables	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**F**	**r**
Capabilities										
Not aware of wild dog problems in the area	2.5[a]	1.6	1.5[b]	0.3	1.1[b]	0.7	1.2[b]	1.0	11.7***	0.3
Don't know when group activities occur	3.0[a]	1.5	2.9[a]	1.3	1.8[b]	1.4	2.0[b]	1.6	6.5***	0.2
Do not know best methods to use	2.6[a]	1.3	1.7[b]	1.2	1.8[b]	0.8	1.3[b]	0.9	12.4***	0.4
Self-conscious of low skill level	2.4[a]	1.2	1.7[b]	1.1	1.6[b]	1.0	1.3[b]	0.6	11.0***	0.4
Not confident in doing group activities	2.9[a]	1.3	2.1[b]	1.7	2.3[b]	1.1	2.0[b]	1.5	10.3**	0.3
Find cooperation too difficult	2.3[a]	1.1	1.9[b]	0.6	1.3[c]	1.1	1.8[b]	1.2	7.0***	0.2
Opportunities - physical										
Perceive participating as costly	2.6[a]	1.0	1.9[b]	1.1	1.7[b]	1.0	1.8[b]	1.1	9.0***	0.3
No time to plan group activities	3.0[a]	1.2	2.3[ab]	1.2	2.0[b]	1.3	1.7[b]	1.0	11.9***	0.4
Inconvenient to do at specified time	2.8[a]	1.0	2.7[a]	1.2	1.9[b]	1.2	1.8[b]	0.9	8.8***	0.3
Too close to other private residences	2.2[a]	1.1	2.0[ab]	1.2	1.8[b]	1.1	1.5[b]	1.0	2.9*	0.2
Opportunities - social										
Family and friends support participation	3.8[b]	1.1	3.9[b]	1.0	4.3[a]	1.2	4.3[a]	1.2	3.0*	0.2
Neighbours don't participate	2.6[a]	1.0	2.3[a]	0.9	1.4[b]	1.3	1.7[b]	1.1	10.3***	0.3
Motivations										
Perceive no wild dog problem on property	3.3[a]	1.3	1.7[b]	1.1	1.6[b]	0.8	1.5[b]	1.1	28.9***	0.5

COM Variables	Non-controllers (N=122)		Individual controllers (N=30)		Coordinated controllers (N=22)		Dual controllers (N=24)		Segment differences	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	F	r
Believe dogs should not be harmed	1.9[a]	1.1	1.9[a]	0.4	1.1[b]	1.2	1.3[b]	0.9	5.6**	0.2
Believe methods used are inhumane	2.2[a]	1.2	1.9[ab]	0.6	1.3[b]	1.1	1.4[b]	0.5	6.2***	0.3
Prefer not to use baits	2.7[a]	1.4	2.7[a]	1.3	1.8[bc]	1.6	1.4[c]	0.8	8.3***	0.2
Believe activities may harm working dogs	2.8[a]	1.2	2.9[a]	1.4	2.1[ab]	1.5	1.8[b]	1.3	5.7**	0.2
Believe activities may harm wildlife	2.8[a]	1.4	2.3[ab]	1.4	2.1[ab]	1.2	1.7[b]	1.0	5.6**	0.3
Prefer to do own control activities	2.6[a]	1.0	3.0[a]	1.0	1.5[b]	1.3	1.7[b]	1.1	13.3***	0.2
Believe group methods not effective	2.3[a]	1.0	2.3[a]	0.7	1.4[b]	1.3	1.4[b]	0.5	10.5***	0.3
Believe control is government responsibility	2.2	1.2	2.2	1.4	1.9	1.2	1.9	1.2	0.9	-
Want to help the community	3.2[b]	1.3	3.6[b]	1.4	4.6[a]	1.2	4.7[a]	0.7	15.5***	0.4
If asked would agree without much thought	2.6[b]	1.3	3.1[ab]	1.4	3.4[a]	1.4	3.4[a]	1.5	3.7*	0.2

Notes: Mean agreement scores for COM variable rating using scale: 1 = strongly disagree, 5 = strongly agree. *p < 0.05, **p < 0.01, ***p < 0.001. Means with different subscripts (in rows) differ significantly at p < 0.05 Tukey HSD. r = Pearson's correlation coefficient; r ≥ 0.5 indicates strong effect size, r = 0.3 indicates medium effect size, r = 0.1 indicates small effect size (Cohen, 1988).

Key takeaways

There are two main segments that do not participate in coordinated control activities.

Primary barriers for participating in coordinated control activities (across both Individual controllers and Non-controllers) were:

1. Not aware when coordinated activities are occurring (i.e. lack knowledge - capability)
2. Inconvenient to participate at the required time (i.e. reduced opportunity)
3. Do not have support from family or friends (i.e. reduced social opportunity)
4. Do not have neighbours participating (i.e. reduced social opportunity)
5. Prefer to do own activities (i.e. lack motivation)
6. Do not want to help their community / neighbours (i.e. lack motivation)
7. Believe methods used in coordinated activities are ineffective (i.e. lack motivation)
8. Perceive activities involve baiting and they prefer not to bait (i.e. lack motivation)
9. Believe that the control activities will harm their working dogs (i.e. lack motivation)
10. Believe dogs should not be harmed (i.e. lack motivation).

Additional barriers for members in the Non-controllers segment were:

1. Wild dogs were not a problem on their property (i.e. lack motivation)
2. Not aware of wild dog problems in their area (i.e. lack knowledge - capability)
3. Do not know the best methods to use (i.e. reduced capability)
4. Self-conscious of low skill level (i.e. reduced capability)
5. Not confident in doing group activities or find them difficult (i.e. reduced capability)
6. Do not have the time to plan coordinated activities (i.e. reduced opportunity)
7. Feel participating is too costly (i.e. reduced opportunity)
8. Have properties that are close to other residences, making it difficult to participate (i.e. reduced opportunity)
9. Feel the methods used are inhumane (i.e. lack motivation)
10. Believe that the control activities will harm wildlife (i.e. lack motivation).

INTERVENTION DEVELOPMENT (STEPS 6, 7 & 8)

Our results have identified the main drivers and barriers to participation in coordinated wild dog management activities. This next step is to identify the main leverage points and the specific behaviour change techniques that will target these barriers and achieve maximum on-ground outcomes.

IDENTIFY MAIN LEVERAGE POINTS (STEP 6)

Two main nonparticipating landholder segments have been identified, each with their own COM (*capability, opportunity, motivation*) profile. Five general leverage points were identified for all nonparticipators (i.e. Both *Non-controllers and Individual controllers*). These covered awareness of activities (*capability*), convenience and reduced social norm cues (*opportunity*), as well as dislike of baiting and community attachment (*motivation*). In addition, we identified a further five leverage points amongst those landholders who did no control (i.e. just the *Non-controllers*). These covered awareness of the wild dog problem in their local area, and control skills (*capability*), reduced physical circumstances (*opportunity*), experiencing no problems on their property, and perceived inhumaneness and lack of specificity of control methods (*motivation*).

These results highlight the complexity of non-participation, and that a 'one-size fits all' approach to encourage participation will not be effective. However by categorising the drivers and barriers using the COM model makes it easy to identify what exactly needs to change to increase the likelihood of participation in coordinated activities, and to select the best behaviour change tool for the job. Suggestions for each identified COM factor are shown in Table 2.3.

INTERVENTION DEVELOPMENT AND FEASIBILITY (STEPS 7 & 8)

With consultation with our research partners it was decided to focus this intervention on increasing motivation to participate in wild dog coordinated activities. Persuasive communication is an important tool used to address this COM factor (McKenzie-Mohr, 2011). Therefore it was decided to focus on developing a persuasive message which would engage our identified non-participating landholders, and encourage them to participate in coordinated activities. Important elements of persuasive communication that would be relevant (as identified in Table 2.3) are message framing and use of social norms (Hine, Please, McLeod, & Driver, 2015).

Wild dogs have economic and social impacts on individual landholders and their communities, along with general environmental impacts. Coordinated wild dog control activities need to engage individuals who are not only suffering direct impacts, but also those who may suffer indirect impacts, or who perceive no impacts (i.e. many of our *Non-controllers)*. It is assumed that individuals who are suffering direct impacts make a rational (economic) decision to participate. For those other individuals, participation is usually garnered through appeals to either their 'social' (neighbour / community) or 'environmental' values, using appropriate messaging framing.

Table 7: Linking identified COM drivers and barriers to appropriate behaviour change techniques to promote participation in coordinated wild dog control activities (after Hine et al., 2019).

COM Factor	Focus of intervention	Recommended behaviour change techniques
Capability		
Awareness of local wild dog problems	Promote awareness of wild dog problems and promote the role that coordinated control activities play in resolving the problem.	Provide factual information on wild dog problems in the local area, as well as feedback from people already participating and the outcomes that have been achieved.
Awareness of activities	Promote awareness of when activities were happening	Provide information advertising upcoming coordinated activities and how people can be involved.
Skills	Establish and improve physical skills, support and improve cognitive skills.	Provide targeted training material and workshops on how to conduct the various control methods used. Offer advice and support participation in coordinated activities.
Opportunity		
Convenience	Modify the environment to make it easy and less time-consuming to participate.	Increase the flexibility for participation. Minimise time commitments and paperwork. Provide timely prompts to encourage participation.
Physical circumstances	Encourage participation by making it more affordable and advantageous to participate	Increase the availability of required resources. Make new technology and methods available and affordable.
Social norm cues	Align objectives and communications with the preferences of a community.	Develop solutions that are socially acceptable in consultation with the community. Frame information so it is consistent with social values. Use credible sources that people associate with and trust. Provide information about what 'important others' think about participation.
Motivation		
Perception of problem	Improve awareness of the local wild dog problem and endorse the benefits of coordinated control activities. Build upon displayed general values (such as altruism, environmental concern, animal welfare) to encourage participation.	Provide information about problem using credible local sources that people associate with and trust. Adopt a deliberate perspective targeted to their values. Provide information on other similar people's experiences and participation. Draw attention to discrepancies between values and current behaviour to create discomfort.

COM Factor	Focus of intervention	Recommended behaviour change techniques
Dislike of baiting	Offer alternative coordinated actions. Highlight the positive aspects of this method, and dispel any underlying misconceptions.	Inform about all options so that people can compare and participate in a way they are comfortable with. Frame the information to emphasis the positive aspects of the participation (the 'feel good factor'). Clearly emphasis correct facts.
Perceived inhumaneness & lack of specificity of methods	Increase understanding of methods and their impacts. Endorse benefits and dispel any underlying misconceptions.	Provide transparent information about method options and consequences so people can compare and make an informed choice. Emphasis correct facts. Provide feedback on other local people's performance and experiences.
Community attachment	Promote awareness of the landscape and community consequences of the wild dog problem, and enhance personal responsibility in their resolution.	Provide information about what other local people think about the coordinated activities, and give feedback about other people's experience performance. Use credible community sources that the individual can associate with and trust. Offer advice, encourage and support participation in a social setting. Adopt a perspective that is linked to the individual's community values. Provide incentives or reward the group as a whole for performing desired behaviour.

Social norms influence people's behaviour based on how others behave. They help people determine what is expected or correct. There are two types of social norms; 1) descriptive norms that describe how others are behaving, and 2) injunctive norms that tell us the likely social approval or non-approval for a particular behaviour (Cialdini, Reno, & Kallgren, 1990). Behavioural science research has shown, that in most cases, descriptive norms are more persuasive than injunctive ones (e.g. Cialdini et al., 1990; Nolan, Schultz, Cialdini, Goldstein, & Griskevicius, 2008; Schultz, Khazian, & Zaleski, 2008). Were landholders more likely to participate in coordinated control activities if they knew their peers were doing likewise, rather than through the government regulations?

Both our non-participating segments (i.e. *Non-controllers and Individual controllers*) were disengaged with the coordinated activities due to the type of control method promoted (mainly baiting). Baiting is considered to be one of the most cost-effective control methods available, and is commonly used in coordinated programs, either through ground-baiting or aerial distribution. However, as is demonstrated in our results, many landholders do not like using baits (in particular baits containing the toxin 1080) for a variety of reasons including its impact on other animals, the perceived inhumaneness of its action, and its effectiveness. Would landholders be more open to participating in coordinated activities if other options were available?

It seems 'common sense' that willingness to be involved in social activities would be linked to an individual's attachment to their home and community. However research in other fields has shown that this can be mediated or moderated by many factors such as the type of attachment (e.g. natural vs social), the relationships and trust among people (social capital), as well as the actual social norms within the community and an individual's willingness to adopt those norms (e.g. rural vs amenity landholder) (Brehm, Eisenhauer, & Krannich, 2006; Jorgensen & Stedman, 2006; Lewicka, 2011; Scannell & Gifford, 2010; Williams & Vaske, 2003). It is unknown how an individual landholder's place attachment impacts on their decision to participate in coordinated wild dog control activities. Evaluating this intervention would also allow the opportunity to explore this concept further.

The practical feasibility of this intervention was assessed by our research partners, using the APEASE criteria developed by Michie et al. (2014). It was affordable, practical, cost effectiveness, acceptable, and fair. No potential side effects could be identified. Once developed, the effectiveness of the message would be piloted and evaluated on NSW landholders.

EVALUATION (STEP 9)

When assessing the success of an intervention, it is very important that you can attribute, with a high degree of certainty, that it was the intervention that caused the change in the measured outcomes (*e.g. the increase in participation in coordinated activities*), and not some other independent factors. When piloting a new intervention on a small scale it is important to conduct an impact evaluation to demonstrate if that intervention actually has the intended effects. Refinement after a smaller pilot study is less difficult and expensive than for a larger project. The objectives of this evaluation are to:

1. Measure the effect of three components within a persuasive message on landholders' willingness to participate in coordinated wild dog control activities: i) the type of framing (economic, social or environmental loss), ii) the type of social norm (injunctive or descriptive) communicated, and iii) the control method options (baiting only, and negotiate own mix of lethal / non-lethal methods).
2. Investigate how the different dimensions of place attachment relate to a landholder's willingness to participate in coordinated control activities.

METHODS

LANDHOLDER SURVEY

An online survey was developed to assess impact of the three message components on the willingness to participate in coordinated group wild dog control activities. A between subject design was used, whereby each participant was randomly allocated to one of the twelve available messages (see Table 2.4). The wording of each component was taken from current PestSmart wild dog FAQ sheets (https://pestsmart.org.au/toolkits/wild-dogs/) and the NSW Local Land Services website (https://www.lls.nsw.gov.au/help-and-advice/pests,-weeds-and-diseases), except for 'negotiate commitment', which was a novel concept. All landholders surveyed were sourced from an online panel company, and lived in areas known to be impacted by wild dogs within NSW, Queensland and Victoria. This survey was approved by the University of New England Human Research Ethics Committee (HE20-099).

Before the landholder was presented with their messages, information was collected on their current participation in wild dog control activities (both individual and coordinated), past wild dog problems, type of activities conducted (bait, shoot, trap, fence, guard animals), awareness of their biosecurity obligation, and likelihood of participating in a coordinated activity in the coming year. Situational and demographic information, including location, property size, main property uses and age was also captured.

Place attachment was measured using a number of variables: 1) Bondedness (social attachment to place) – i) Belonging (four variables; 5-point Likert agreement scale), ii) Familiarity with neighbours (two proxy variables) and iii) Community ties (two variables; 5-point Likert agreement scale and one proxy variable); 2) Rootedness (physical attachment to place) – i) Attachment to natural environment (four variables; 5-point Likert agreement scale), ii) Length of residence (two proxy variables), and 3) Place dependence – i) Economic dependence (two variables; 5-point Likert agreement scale and one proxy variable) and ii) Recreational dependence (two variables; 5-point Likert agreement scale).

Table 8: Each presented message comprised of one selection from each of the three components (3x2x2 combinations).

Loss framing	Social norms	Method
Economic: Wild dogs can cause significant damage to livestock production enterprises through predation and disease transfer. Maintaining a viable sheep and goat enterprise is almost impossible when wild dogs are present. Wild dogs can also be economically costly for cattle industries, transmission of disease and parasites, and predation of calves, weaners and vulnerable adult cattle.	**Injunctive**: In NSW all landowners have a responsibility to control wild dogs on their land and prevent them from causing problems on neighbouring lands. And the most effective method of doing this is to join a coordinated group control program.	**Non-negotiated commitment**: Each year your (*relevant State organisation*) coordinates group programs using a variety of control methods including baiting, trapping and shooting. To find out more about group control programs in your area, contact your (*relevant State organisation*).
Environmental: Wild dogs prey on native wildlife and have been implicated in the decline of several species. This impact on local wildlife can be worsened when wild dog densities are higher than normal, and particularly if that species is suffering from other threatening processes, such as habitat fragmentation, drought or bushfires. Some individual dogs can also become specialist predators of a particular native species and can at times persecute a small population until there are few left in that locality.	**Descriptive**: The most effective method of controlling wild dog damage across NSW landscapes is to work together with your neighbours in a coordinated effort. *"I am very pleased to participate in my local wild dog program. I have an occasional problem with wild dogs, however I know my neighbours have suffered sheep losses in the past," said Peter, a landholder near* (*relevant State location*).	**Negotiate commitment**: Each year your Local Land Services coordinates group programs and encourages all landholders to participate in whatever capacity they are able. To find out more about group control programs in your area, and negotiate how you can be involved, contact (*relevant State organisation*).
Social: Wild dog attacks on livestock and domestic pets are extremely distressing. Many landholders who are faced with the constant threat of wild dogs can become depressed, impacting their family life. Rural communities also suffer as a result of forced enterprise changes including diminished employment opportunities, loss of businesses and services, and subsequent population decline in rural towns.		

After reading the message landholders were asked to rate different aspects through a series of eight question (using a 5pt Likert extent scale). They were also asked again about their likelihood of participating in a coordinated activity in the coming year. A copy of the survey can be found in Appendix 5.

ANALYSES

Latent profile analysis (LPA) was implemented in MPlus 8.3 (Muthén & Muthén, 2019) to classify landholders into homogenous segments based on their responses to participation in wild dog management questions. Relative model fit was assessed using the Bayesian information criteria (BIC; Schwartz, 1978) relative entropy (Ramaswamy et al., 1993) and the Lo–Mendell–Rubin likelihood ratio test (LMR; Lo et al., 2001). A significant *p* value from the LMR test ($p = 0.05$) indicated that the given profile solution fitted the data significantly better than the solution with one fewer profile groups.

A Cronbach alpha test was used to test the internal consistency of the place attachment variables and evaluation questions. Differences between identified participation segments and control behaviours, place attachment, situational and demographic variables were tested using either a one-way ANOVA or Pearson's chi-squared test. The components of the message were evaluated using a Factorial ANOVA. A Repeated Measures ANOVA was used to test the influence of the message on future intentions to participate. All procedures except the LPA were conducted using SPSS 26 (IBM, 2019).

RESULTS

LANDHOLDER DETAILS

The average age of the 307 survey respondents was 51.7 years (range 22 to 80), which is slightly younger than the average age (54 years) recorded for the Regional adult population (Australian Bureau of Statistics, 2018). Just under a half (46%) of the respondents were from NSW (N=142), just over a third (37%) came from the Queensland (N=107) and the remaining Victoria (N=58).The average property size of respondents was 1741 Ha (range 1 to 110,000), and the average years of residence was 16 years (range 1 to 60).

One hundred and thirty seven of the respondents (45%) earned their main income from their property. Sixty percent of the respondents (184) had some type of livestock enterprise on their property, mainly cattle, or small livestock (such as sheep or goats). A third of respondents (99) categorised their property as lifestyle or hobby, and the remaining 24 (8%) ran enterprises, that did not involve livestock, such as cropping and horticulture.

Eight seven of the respondents (28%) were not aware of wild dogs in their area. A further 66 respondents (22%) reported being aware of wild dogs in their area, but not having experiencing any problems on their properties. The remaining respondents reported wild dog problems on their property. Of these, 58 (19%) rated their problem as minor, 54 (17%) moderate, and 42 (14%) serious.

AUDIENCE SEGMENTATION

The results from the LPA indicated that respondents could be classified into four segments according to their current participation in management activities (BIC = 91053.06, Entropy = 0.974, see Figure 8). Differences between the demographic and behavioural characteristics for each landholder participation segment, tested using either a one-way ANOVA or Pearson's chi-squared test, are shown in Table 2.5.

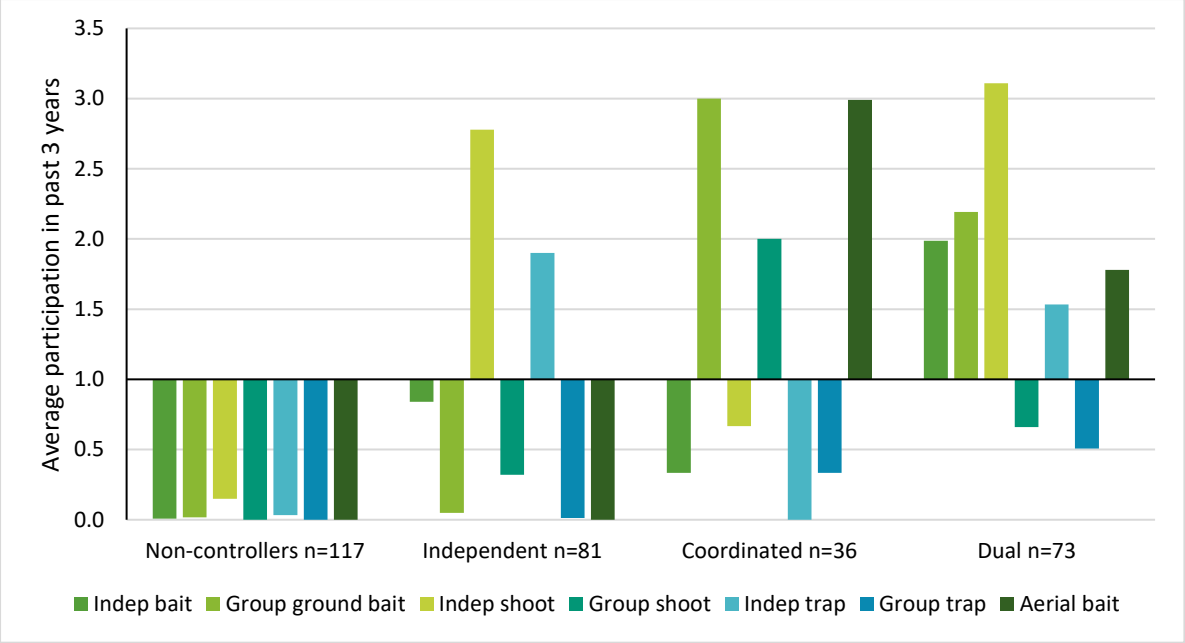

Figure 8: Four landholder segments based on participation in independent and coordinated control activities in the past 3 years. Participation scale: 0=never, 1= once, 2= twice, 3= 3 times, 4= more than 3 times.

Below is a description of the four segments:

1. *Non-controllers* (N=117, 38%) had rarely participated in any wild dog management activities in the previous three years, and were unlikely to participate in any future coordinated activities. They tended to be landholders who had not experienced any wild dog problems, and mainly identified as life-stylers or hobby farmers. Around a third were not aware of their biosecurity obligations.

2. *Individual controllers* (N=81, 15%) had conducted independent management activities, but rarely participated in coordinated programs with other landholders. They were unlikely to participate in any future coordinated activities. They tended to have experienced moderate wild dog problems, and run cattle and mixed lifestyle enterprises. They tended to be older than the other profiles. Shooting and trapping were the most commonly used control methods.

3. *Coordinated controllers* (N=36, 11%) had regularly participated in coordinated management activities such as baiting and shooting, and rarely did any activities by themselves. They were highly likely to participate in any future coordinated activities.

4. *Dual controllers* (N=73, 12%) averaged the youngest of the profiles, and participated in both coordinated management activities (mainly baiting), as well as conducting baiting and shooting activities by themselves. A small number, along with *Individual controllers*, used fencing for constant protection. They tended to have experienced minor to serious wild dog problems, and along with *Coordinated controllers* had resided on their property the greatest number of years, and were the most likely to participate in future coordinated activities. They had the largest properties, and run mainly cattle and mixed lifestyle enterprises. They were highly likely to participate in any future coordinated activities.

Table 9: Wild dog management practices in the past three years, situational and demographic characteristics of the landholder segments.

	Non-controllers (N=118)		**Individual controllers (N=81)**		**Coordinated controller (N=36)**		**Dual controllers (N=73)**		**Segment differences**	
Wild dog management[1]	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**F**	r
Independent 1080 baiting	0.0[a]	0.1	0.8[b]	1.2	0.3[a]	0.5	2.0[c]	1.0	91.0***	0.6
Independent shooting	0.2[a]	0.4	2.8[c]	0.8	0.7[b]	0.5	3.1[d]	1.0	371.4***	0.7
Independent trapping	0.0[a]	0.2	1.9[b]	0.8	0.0[a]	0.0	1.5[b]	1.4	116.4***	0.4
Group ground 1080 baiting	0.0[a]	0.2	0.1[a]	0.3	3.2[c]	0.3	2.2[b]	1.0	549.6***	0.8
Aerial baiting	0.0[a]	0.0	0.0[a]	0.0	2.5[c]	0.5	1.8[b]	1.2	365.6***	0.7
Group shooting	0.0[a]	0.0	0.3[ab]	0.5	2.0[c]	1.7	0.7[b]	1.0	60.8***	0.4
Group trapping	0.0[a]	0.0	0.0[a]	0.1	0.3[b]	0.5	0.5[b]	0.8	24.9***	0.4
Fencing	0.2[a]	0.4	0.6[b]	0.5	0.3[a]	0.5	0.6[b]	0.5	22.7***	0.3
Guard animals	0.1	0.2	0.1	0.2	0.1	0.3	0.0	0.1	1.7	-
Future participation[2] (pre)	1.3[a]	0.5	1.5[a]	0.8	3.7[b]	1.7	4.0[c]	0.8	292.7***	0.8
Demographic variable:										
Age	52.6[ab]	12.9	53.7[b]	10.4	50.9[ab]	4.5	48.2[a]	8.9	4.05**	0.2
Situational variables:										
Property size (ha)	144[a]	319	2225[ab]	12202	386[a]	193	4433[b]	11976	4.14**	0.2
	N (%)	Z_{Resid}	N (%)	Z_{Resid}	N (%)	Z_{Resid}	N (%)	Z_{Resid}	$\chi 2$	r
Reported wild dog issue:									211.8***	0.6
No dogs in area	57 (49)	6.2	14 (17)	-2.6	12 (33)	0.7	4 (6)	-5.0		
Dogs but not a problem	40 (34)	4.2	13 (16)	-1.4	12 (33)	1.9	1 (1)	-4.8		

	Non-controllers (N=118)		Individual controllers (N=81)		Coordinated controller (N=36)		Dual controllers (N=73)		Segment differences	
Wild dog management[1]	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**F**	r
Minor problem	17 (14)	-1.5	16 (20)	0.2	1 (3)	-3.1	25 (34)	3.9		
Moderate problem	2 (2)	-5.7	38 (47)	8.1	0 (0)	-2.9	14 (19)	0.4		
Serious problem	1 (1)	-5.1	0 (0)	-4.2	11 (31)	3.7	29 (40)	7.4		
Property enterprises:									235.2***	0.6
Cattle only	14 (12)	-3.6	26 (32)	2.3	1 (3)	-3.5	30 (41)	4.3		
Small livestock only	3 (3)	-4.5	13 (16)	0.6	12 (33)	3.6	15 (21)	1.9		
Mixed livestock	2 (2)	-7.0	29 (36)	3.2	11 (31)	1.6	28 (38)	3.6		
Farming - no livestock	12 (10)	1.8	0 (0)	-3.1	10 (28)	5.9	0 (0)	-2.9		
Lifestyle / hobby	86 (73)	12.1	13 (16)	-3.6	2 (5)	-4.4	0 (0)	-6.7		
Biosecurity obligation:									62.7***	0.3
Aware	75 (66)	-7.6	79 (100)	4.0	36 (100)	2.6	68 (96)	2.5		
Not aware	38 (34)	7.6	0 (0)	-4.0	0 (0)	-2.6	3 (4)	-2.5		

Notes: [1] Mean scores for management participation using scale: 0=never, 1= once, 2= twice, 3= 3 times, 4= more than 3 times. [2] Mean scores for future participation (before access to message) using scale: 1= not at all, 2= slight chance, 3=moderate chance, 4= likely, 5=highly likely. ** $p < 0.01$, *** $p < 0.001$. Means with different subscripts (in rows) differ significantly at $p < 0.05$ Tukey HSD. r = Pearson's correlation coefficient; r ≥ 0.5 indicates strong effect size, r = 0.3 indicates medium effect size, r = 0.1 indicates small effect size (Cohen, 1988). Z_{Resid} = Adjusted standardised residual, where $Z_{Resid} > |2|$ is significant at $p < 0.05$

PLACE ATTACHMENT

Multiple variables measuring the same concept were tested for internal consistency. Results are shown in Table 2.6. All tests produced Cronbach alpha values that were acceptable, or higher (George & Mallery, 2019), thus the variables were combined to form a single variable for each of these concepts.

Table 10: Results of internal consistency tests of multiple variables measuring the same concept.

Concept	**No. of variables**	**Cronbach α[1]**
Belonging	4	0.95
Attachment to natural environment	4	0.92
Place dependence – economic	2	0.86
Place dependence – recreational	2	0.74

1 Interpretation: α ≥0.9 excellent, 0.9> α ≥0.8 good, 0.8> α ≥0.7 acceptable (George & Mallory, 2019).

Each of the four segments displayed its unique place attachment profile (Figure 9 and Table 2.7).

1. Non-controllers (N=117, 38%) scored the lowest on both natural and social attachment, as well as community involvement. They were the more likely not to be a member of a community group. They were the least economically dependent on their property, more likely to earn their main income from off-property sources. They had resided on their property for the least number of years, and had the lowest expectation of living on their property in a further five years.

2. Individual controllers (N=81, 15%) scored the lowest on trusting their community decisions. They showed high economical dependency on their property, with two thirds indicating it was the source of their main income. They were less likely to know all of their neighbours by name than the other profiles.

3. Coordinated controllers (N=36, 11%) scored the highest in social belonging and involvement with their community. They scored the lowest on recreational dependency, as well as attachment to the natural environment (along with Non-controllers). They had resided on their property the least number of years (similar to Non-controllers), however they had the highest expectation of living on their property in a further five years. Members in this profile tended to have acted with their neighbours a greater number of times than the other profiles.

4. Dual controllers (N=73, 12%) scored the highest on economical dependency on their property, with 96% indicating it was the source of their main income. Members in this group scored the highest (along with Individual controllers) on attachment to the natural environment. Despite scoring the second highest on social belonging, the scored the lowest (along with Non-controllers) on community involvement. As with Non-controllers, Dual controllers were also more likely not to be a member of a community group.

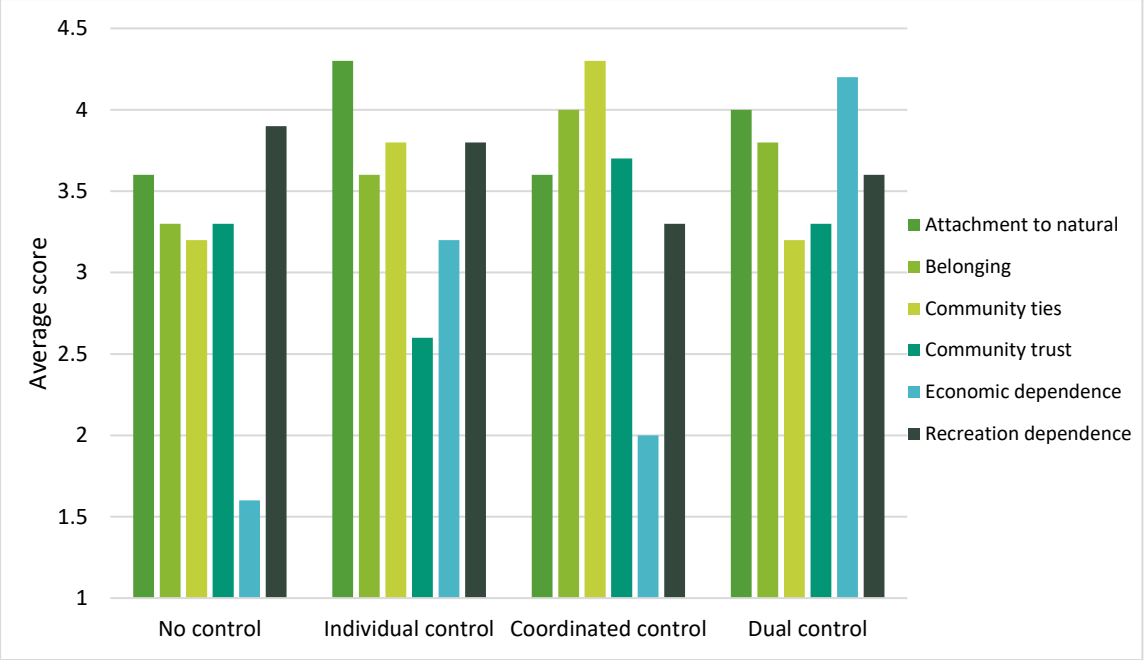

Figure 9: The average score for six place attachment concepts (1=low, 5=high) across the four identified wild dog control participation segments.

Table 11: Differences between the place attachment characteristics of the four landholder participation segments.

	Non-controllers (N=118)		**Individual controllers (N=81)**		**Coordinated controller (N=36)**		**Dual controllers (N=73)**		**Segment differences**	
Variables	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**F**	r
Attachment to natural environ[1]	14.3[a]	4.7	17.3[b]	2.6	14.3[a]	2.9	16.3[b]	2.1	14.3***	0.2
Social belonging[1]	13.1[a]	3.7	14.4[ab]	3.9	16.3[c]	3.9	15.3[bc]	3.7	9.5***	0.3
Involvement with community[2]	3.2[a]	1.1	3.8[b]	0.9	4.3[c]	0.5	3.2[a]	1.2	15.4***	0.1
Trust in community decisions[2]	3.4[b]	1.0	2.6[a]	1.1	3.7[b]	1.3	3.3[b]	1.0	11.2***	0.1
Recreational dependence[3]	7.9[b]	2.0	7.7[b]	1.9	6.7[a]	0.5	7.2[ab]	1.0	6.7***	0.2
Economic dependence[3]	3.2[a]	1.2	6.4[b]	2.7	4.0[a]	2.9	8.4[c]	1.2	122.6***	0.6
Years of residence	10.0[a]	9.9	22.2[b]	15.1	13.4[a]	5.7	18.7[b]	11.0	21.0***	0.2
Likelihood residing in future[4]	3.5[a]	0.9	4.1[bc]	0.6	4.3[c]	0.5	4.0[b]	0.6	19.5***	0.3
	N (%)	Z_{Resid}	N (%)	Z_{Resid}	N (%)	Z_{Resid}	N (%)	Z_{Resid}	$\chi 2$	r
Main income source: Property	1 (1)	-12.1	54 (67)	4.7	12 (33)	1.4	70 (96)	10.1	186.1***	0.7
Other (off property)	116 (99)	12.1	27 (33)	-4.7	24 (67)	-1.4	3 (4)	-10.1		
Neighbours known by name:									48.6***	<0.1
None	1 (1)	0.3	0 (0)	-0.8	0 (0)	-0.5	1 (1)	0.9		
Less than half	2 (2)	-4.5	25 (31)	5.7	0 (0)	-2.4	12 (16)	1.1		
More than half	45 (38)	1.9	25 (31)	-0.2	12 (33)	0.2	16 (22)	-2.1		
All of them	69 (59)	1.2	31 (38)	-3.5	24 (67)	1.5	44 (60)	1.1		

	Non-controllers (N=118)		Individual controllers (N=81)		Coordinated controller (N=36)		Dual controllers (N=73)		Segment differences	
Variables	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**F**	r
Taken actions with neighbours:									173.9***	0.2
Never	21 (18)	0.6	15 (19)	0.6	0 (0)	-2.8	14 (19)	0.8		
Once	40 (34)	4.2	13 (16)	-1.4	2 (6)	-3.3	13 (18)	-0.9		
2-3 times	30 (26)	-2.7	37 (46)	2.3	10 (28)	-0.2	29 (40)	0.9		
4-6 times	25 (21)	1.5	14 (17)	0.0	3 (8)	-2.4	14 (19)	0.5		
>6 times	1 (1)	-4.1	2 (2)	-2.6	21 (58)	12.2	3 (4)	-1.9		
Community group membership:									41.7***	0.1
No groups	20 (17)	2.3	1 (1)	-3.4	0 (0)	-2.3	15 (21)	2.7		
1-2 groups	56 (48)	-3.5	64 (79)	4.0	23 (64)	0.8	41 (56)	-0.8		
3-4 groups	41 (35)	2.6	14 (17)	-2.2	12 (33)	1.0	15 (21)	-1.4		
5-6 groups	0 (0)	-1.4	1 (1)	0.3	1 (3)	-0.6	2 (3)	1.8		
>6 groups	0 (0)	-0.8	1 (1)	1.7	0 (0)	-0.4	0 (0)	-0.6		

Notes: 1 Mean scores for scale ranging from 4-very low and 20-very high. 2 Mean scores for scale ranging from 1-very low and 5-very high. 3 Mean scores for scale ranging from 2-very low and 10-very high. 4 Mean scores using scale: 1= definitely not, 2= probably not, 3=uncertain, 4= probably yes, 5=definitely yes. ***p < 0.001. Means with different subscripts (in rows) differ significantly at p < 0.05 Tukey HSD. r = Pearson's correlation coefficient; r ≥ 0.5 indicates strong effect size, r = 0.3 indicates medium effect size, r = 0.1 indicates small effect size (Cohen, 1988). ZResid = Adjusted standardised residual, where ZResid > |2| is significant at p < 0.05

Key takeaways

Significant differences were found between the different dimensions of place attachment and landholder's participation in coordinated control activities.

Involvement with individual wild dog control activities was associated with:

1. Economic dependence on the property

Involvement with coordinated wild dog control activities was associated with:

1. Social belonging
2. Trust in the community
3. Neighbour relationship.

The proxy question 'Do you earn your main source of income from your property' may be a suitable measure of economic dependence. However the proxy questions measuring community involvement was not a suitable measure for social belonging.

EVALUATION OF MESSAGE COMPONENTS

Results from multiple questions that evaluated the same concept were tested for internal consistency. Results are shown in Table 2.8. The tests for the concepts of 'Persuasiveness' and 'Motivation to act' produced acceptable Cronbach alpha values (George & Mallory, 2019), and hence the responses to these questions were combined to form a single concept variable.

Table 12: Results of internal consistency tests of multiple questions measuring the same concept.

Concept	No. of questions	Cronbach alpha
Persuasiveness	3	0.83
Motivation to act	3	0.81

1 Interpretation: 0.9> α ≥0.8 good (George & Mallory, 2019).

The message evaluation ratings for four concepts 'Persuasiveness', 'Motivation to act', 'Manipulation', and 'Avoidance' were compared across the four participation segments. Each of the four segment displayed its unique evaluation profile (Figure 10 and Table 2.9). Those segments already involved in coordinated programs (i.e. *Coordinated control and Dual control*) rated the 'Persuasiveness', and 'Motivation to act' significantly higher than the other segments. Those segments not involved in coordinated programs (i.e. *No control and Individual control*) felt the message was more 'Manipulative', and were less likely to participate in future activities. After reading the message, *Dual controllers* wanted to avoid thinking about wild dog control to a higher degree than the other segments.

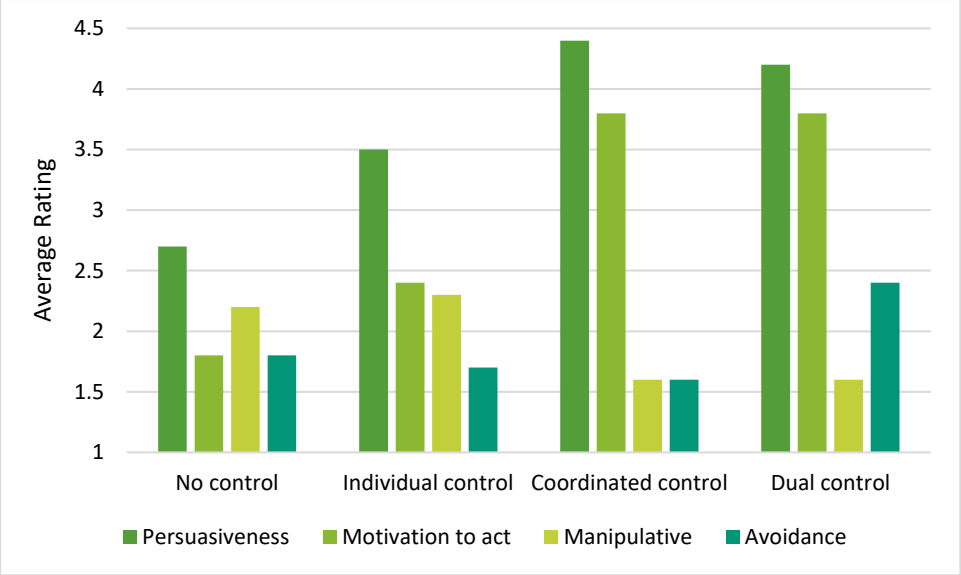

Figure 10: The average evaluation rating of viewed messages across the four identified wild dog control participation segments. Rating scores: 1= not at all, 2= slightly, 3=moderately, 4= very, 5=extremely.

Table 13: Differences between the four landholder participation segments and i) the message evaluation ratings, and ii) intentions to participate in future coordinated actions (post-message).

	Non-controllers (N=118)		Individual controllers (N=81)		Coordinated controller (N=36)		Dual controllers (N=73)		Segment differences	
Evaluation concepts[1]	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**F**	**r**
Persuasiveness	2.7[a]	0.6	3.6[b]	0.5	4.4[c]	0.5	4.2[c]	0.6	138.5***	0.7
Motivation to act	2.2[a]	0.5	2.9[b]	0.6	3.8[c]	0.6	3.9[c]	0.6	241.1***	0.8
Manipulation	2.2[b]	0.7	2.3[b]	1.0	1.6[a]	0.5	1.6[a]	0.6	19.6***	0.4
Avoidance	1.8[a]	0.6	1.7[a]	0.6	1.6[a]	0.9	2.4[b]	1.4	10.5***	0.2
Future participation[2] (post)	2.0[a]	1.0	2.2[a]	0.9	4.1[b]	0.8	4.2[b]	0.7	126.1***	0.7

Notes: [1] Mean scores using extent scale: 1= not at all, 2= slightly, 3=moderately, 4= very, 5=extremely. [2] Mean scores for future participation (after reading message) using scale: 1= not at all, 2= slight chance, 3=moderate chance, 4= likely, 5=highly likely. ***p < 0.001. Means with different subscripts (in rows) differ significantly at p < 0.05 Tukey HSD. r = Pearson's correlation coefficient; r ≥ 0.5 indicates strong effect size, r = 0.3 indicates medium effect size, r = 0.1 indicates small effect size (Cohen, 1988).

The components of the message were evaluated using a Factorial ANOVA, with ‘Frame’, ‘Social norm’ and ‘Option’ as fixed factors, and the responses to the evaluation questions as dependent variables (Persuasion, Motivation, Manipulation, and Avoidance). Owing to the significant difference between current participation in both individual and coordinated activities, and their intentions to participate in future coordinated activities (Tables 2.5 & 2.9), ‘Current individual (independent) participation’ and ‘Current coordinated (group) participation’ were added as covariates. The results are summarised in Table 2.10.

Message framing had a significant impact on the ratings of all four measures. Wildlife framing was rated the least persuasive and motivational frame by all participation segments (Figure 11). Those currently involved in coordinated control (*Coordinated* and *Dual controllers*) rated the social frame more manipulative than the other frames. Those currently involved in individual control (*Individual* and *Dual controllers*) rated felt the social frame made them want to avoid thinking about wild dog control, more so than the other frames.

Table 14: Differences between the ratings of persuasiveness, motivation, manipulation and avoidance and message components (framing, norms and control options).

	Difference		**Message Frame**			**Social Norm**		**Control Option**	
	F	**η^2**	**Production mean (SD)**	**Social mean (SD)**	**Wildlife mean (SD)**	**Injunctive mean (SD)**	**Descriptive mean (SD)**	**Baiting mean (SD)**	**Negotiate mean (SD)**
Persuasive	29.9***	.57							
Individual[1]	60.3***	.17							
Group[1]	185.9***	.39							
Frame[2]	18.8***	.11	3.6^{b} (0.1)	3.7^{b} (0.1)	3.2^{a} (0.1)	-	-	-	-
Social norm[2]	0.1	.00	-	-	-	3.5 (0.1)	3.5 (0.1)	-	-
Control option[2]	6.2*	.02	-	-	-	-	-	3.4^{a} (0.1)	3.6^{b} (0.1)
Motivation	38.7***	.63							
Independent	81.8***	.22							
Group	244.6***	.46							
Frame	20.6***	.12	3.1^{b} (0.1)	3.1^{b} (0.1)	2.7^{a} (0.1)	-	-	-	-
Social norm	6.3*	.02	-	-	-	3.1^{b} (0.1)	2.9^{a} (0.1)	-	-
Control option	5.6*	.02	-	-	-	-	-	2.9^{a} (0.1)	3.0^{b} (0.1)
Manipulation	10.8***	.32							
Independent	0.1	.00							
Group	55.6***	.16							
Frame	3.1*	.02	1.9^{a} (0.1)	2.1^{b} (0.1)	2.0^{ab}(0.1)	-	-	-	-
Social norm	19.7***	.06	-	-	-	1.8^{a} (0.1)	2.2^{b} (0.1)	-	-
Control option	13.6***	.04	-	-	-	-	-	1.9^{a} (0.1)	2.2^{b} (0.1)
Avoidance	6.5***	.22							
Independent	4.5***	.02							
Group	0.1	.00							
Frame	4.3*	.03	1.9^{ab} (0.1)	2.1^{b} (0.1)	1.8^{a} (0.1)	-	-	-	-
Social norm	1.4	.01	-	-	-	2.0 (0.1)	1.8 (0.1)	-	-
Control option	4.6*	.02	-	-	-	-	-	2.0^{b} (0.1)	1.8^{a} (0.1)

Notes: 1 Covariates appearing in the model are evaluated at the values: Independent = 3.21, Group = 2.31. 2 Mean using extent scale: 1= not at all, 2= slightly, 3=moderately, 4= very, 5=extremely. *p = 0.05 ***p < 0.001. Means with different subscripts (in rows) differ significantly at p < 0.05 Tukey HSD, with the lowest significant mean ratings highlighted.

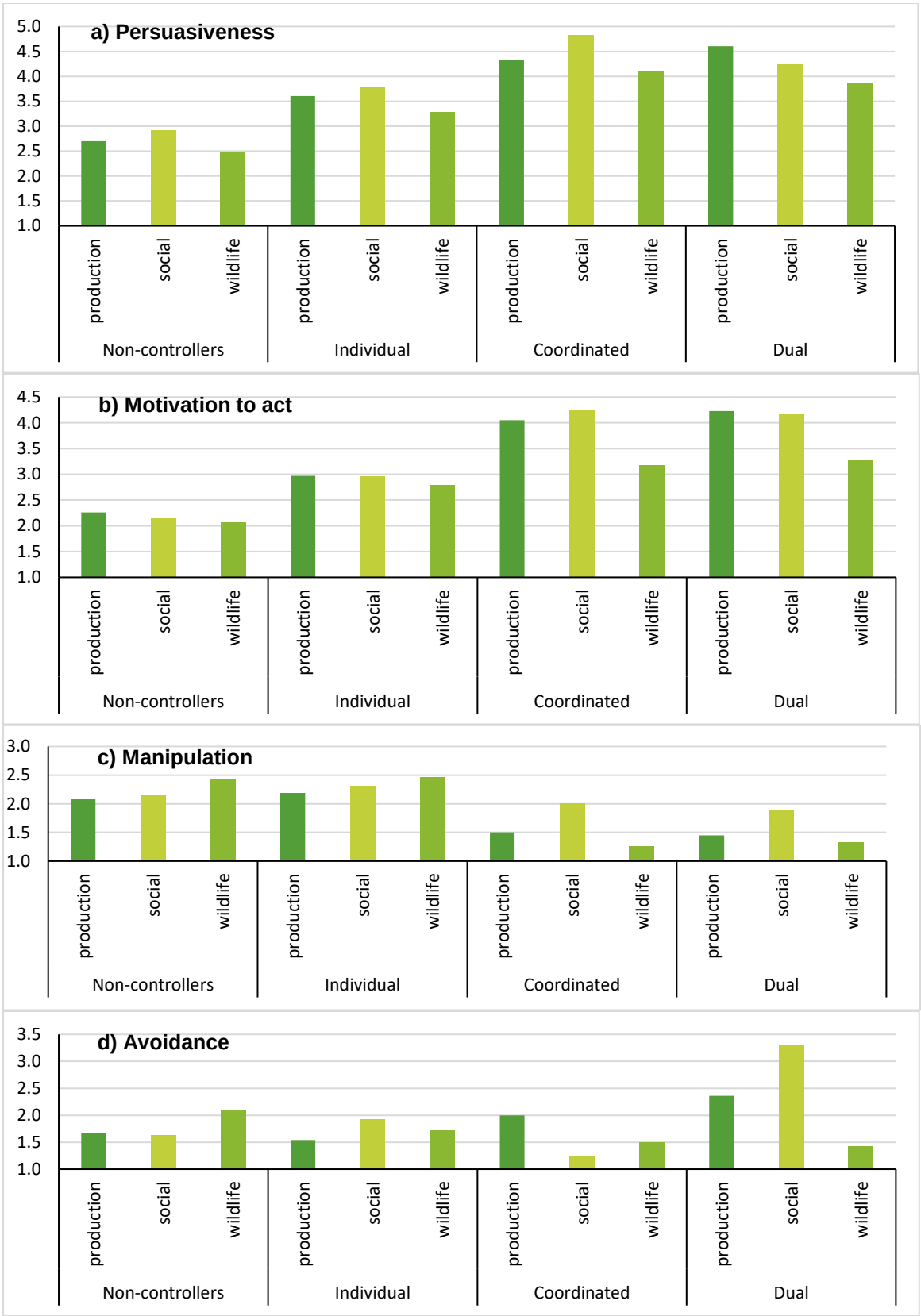

Figure 11: The average a) persuasiveness, b) motivation, c) manipulation and d) avoidance ratings given by each landholder participation segment, for messages containing three different frames.

For *Individual controllers* the use of a descriptive norm (describing what other landholders were doing) was rated as less motivational, relative to the injunctive norm (legal biosecurity obligation). This landholder segment also viewed the descriptive norm as more manipulative than the injunctive norm (Figure 12).

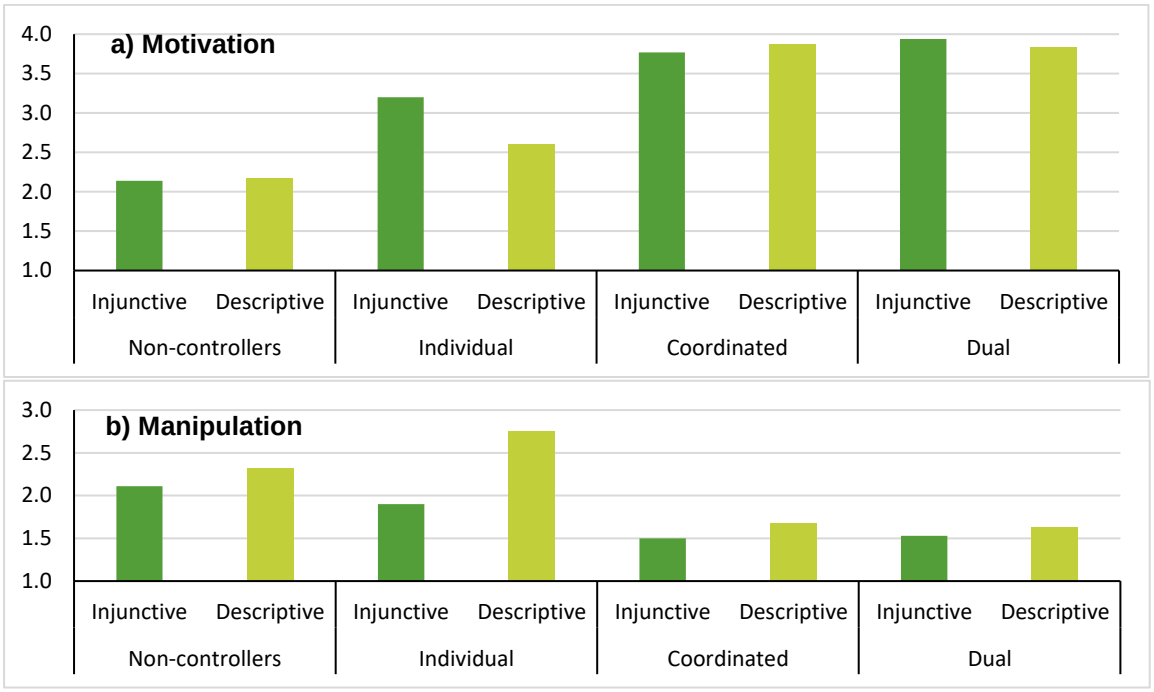

Figure 12: The average a) motivational, and b) manipulation ratings given by each landholder participation segment, for messages containing two different social norms.

Giving the landholders the opportunity to negotiate their involvement in the coordinated activities, as opposed to only offering a baiting option, was viewed as a slightly more persuasive and motivational option for participation by the *Non-controllers*. However this option was viewed as manipulative by the *Individual controllers*, who were more likely to want to avoid thinking about coordinated wild dog control activities with this option. The other three segments were more likely to want to avoid thinking about coordinated wild dog control activities when offered the baiting option (Figure 13).

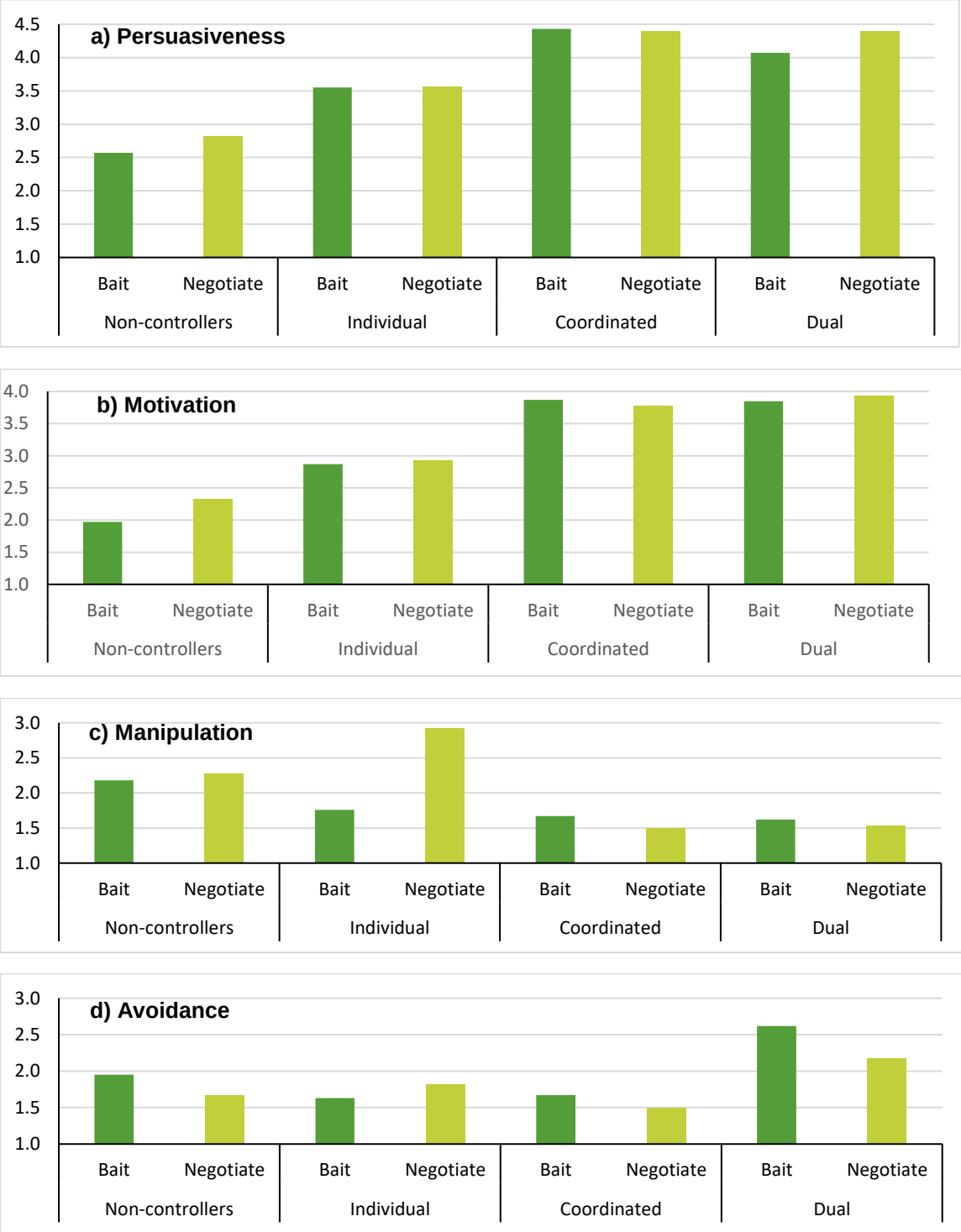

Figure 13: The average a) persuasiveness, b) motivation, c) manipulation and d) avoidance ratings given by each landholder participation segment, for messages containing two different participation options.

Key takeaways

The effectiveness of messages designed to encourage future participation in coordinated wild dog control activities were influenced by:

1. Landholders' current participation behaviour in wild dog control activities, both individual and coordinated
2. The framing of message – production and social framing were the most persuasive and motivational, although social framing was also viewed as manipulative, and when used landholders currently conducting only individual activities were more likely to want to avoid thinking about the problem
3. The social norms used in the message – injunctive norms describing the legal biosecurity obligation were the most motivational for landholders currently only conducting individual control activities. Descriptive norms, describing what other landholders were doing, were viewed as manipulative by this segment of landholders.

Participation in future coordinated activities was also influenced by:

1. Offering landholders the chance to participate without having to bait. This option was:
    i. More persuasive and motivational than the baiting only option for landholders currently not conducting any control activities
    ii. Seen as more manipulative by landholders currently only conducting individual activities.

INTENTION FOR FUTURE PARTICIPATION IN COORDINATED WILD DOG ACTIVITIES

Respondents were asked their likelihood of future participation in coordinated activities before they were shown the message (pre), then again after they has read the message (post). Any changes in these intentions were evaluated using a Repeated measure ANOVA. To investigate whether any of the message components had an impact, 'Frame', 'Social norm' and 'Option' were added as fixed factors, and 'Current individual (independent) participation' and 'Current coordinated (group) participation' as covariates.

All landholders segments showed a small, significant increase in intention to participate after reading the message (Figure 14). However those landholders who were not currently participating in coordinated activities (*No controllers and Individual controllers*) were still only a slight chance of participating, whereas those landholders currently participating (*Coordinated and Dual controllers*) were more likely to participate.

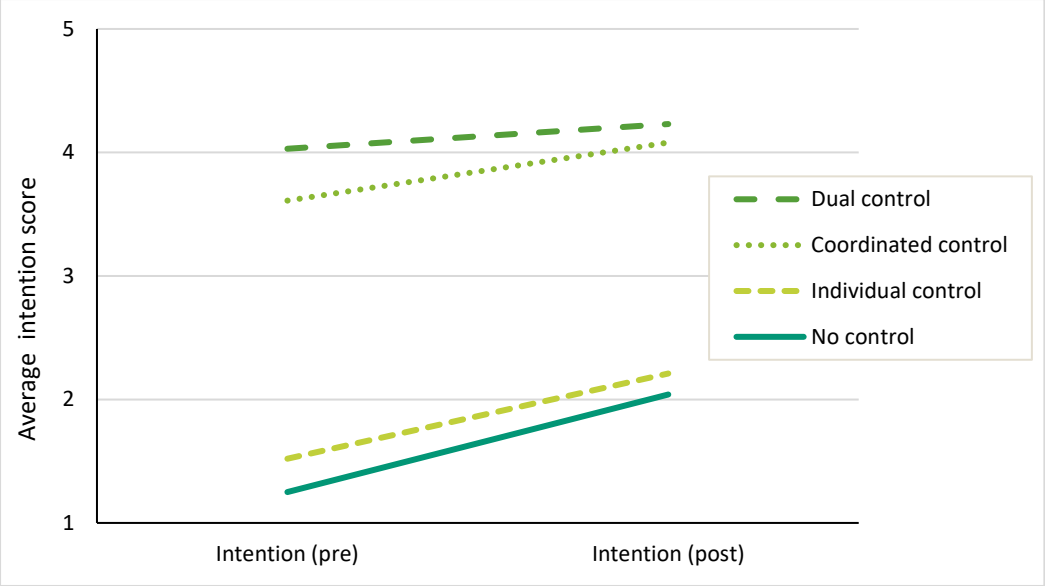

Figure 14: The change in the likelihood of participating in future coordinated wild dog control activities measured before reading the message (pre) and after (post), for across the four identified landholder current participation segments. Intention scale: 1= not at all, 2= slight chance, 3=moderate chance, 4= likely, 5=highly likely.

Results from the Repeated Measures ANOVA (Table 2.11) indicate there was a significant change in intention after reading the message and significance between the message components, however these were qualified by significant interactions. Approximately 59% of the variability in the change of intention was attributable to current participation in coordinated activities, and 15% to current participation in individual control activities. The use of a descriptive norm in the message resulted in a small significant increase in intention of landholders who were not currently conduction any control activities (i.e. *Non-controllers*) (Figure 15).

Table 15: Change in intention before and after reading the message and the message components (framing, norms and control options).

	Difference		Message Frame			Social Norm		Control Option	
	F	**η^2**	**Production mean (SD)**	**Social mean (SD)**	**Wildlife mean (SD)**	**Injunctive mean (SD)**	**Descriptive mean (SD)**	**Baiting mean (SD)**	**Negotiate mean (SD)**
Within subject									
Intention change	131.4***	.31							
IC[1] x Independent	1.0	.01							
IC x Group	9.3**	.03							
IC x Frame	3.2*	.02							
IC x Social norm	8.8**	.03							
IC x Option	0.7	.00							
Between subject									
Independent[2]	50.4***	.15							
Group[2]	415.7***	.59							
Frame[3]	0.2	.00	2.6 (0.8)	2.5 (0.8)	2.5 (0.8)				
Social norm[3]	4.1*	.01				2.4[a] (0.6)	2.6[b] (0.6)		
Control option[3]	0.1	.00						2.5 (0.6)	2.6 (0.6)

Notes: [1] IC intention change. [2] Covariates appearing in the model are evaluated at the values: Independent = 3.21, Group = 2.31. [3] Mean using extent scale: 1= not at all, 2= slightly, 3=moderately, 4= very, 5=extremely. *p = 0.05 **p = 0.01 ***p < 0.001. Means with different subscripts (in rows) differ significantly at p < 0.05 Tukey HSD, with the lowest significant mean ratings highlighted.

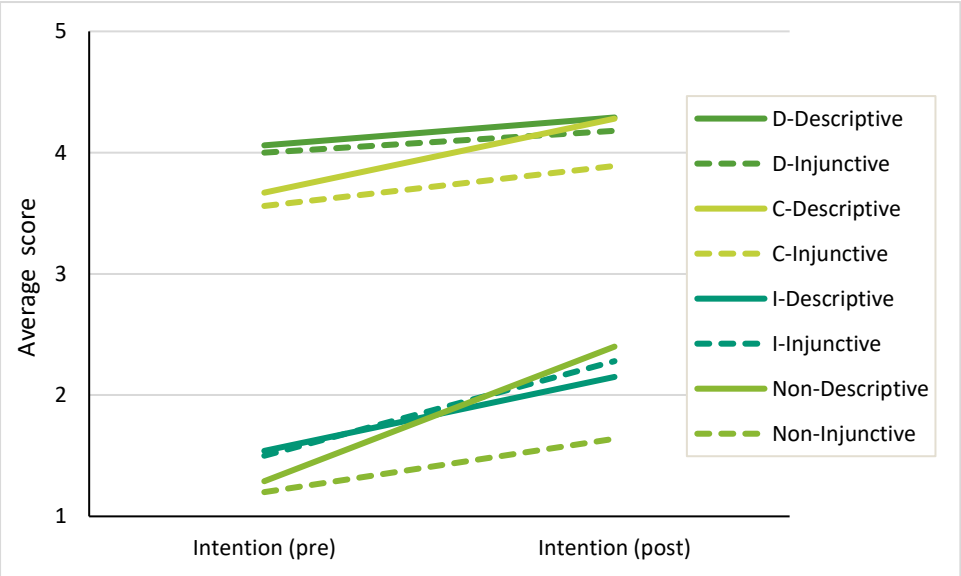

Figure 15: The change in the likelihood of participating in future coordinated wild dog control activities, measured before reading the message (pre) and after (post), for landholders presented with a message containing either an injunctive or descriptive norm. Landholders are further divided into the four identified participation segments; those who are not currently participating in any wild dog control (Non), those who are conducting only individual control activities (I), those participating in coordinated activities (C) and those conducting both individual and coordinated activities (D). Intention scale: 1= not at all, 2= slight chance, 3=moderate chance, 4= likely, 5=highly likely.

KEY TAKEAWAYS

- There was a small, but significant increase across all participation segments in their intention, after reading the message.
- Landholders in both the Non-controller and Individual controller segments however, were still only a slight chance of participating.
- The use of a descriptive norm in the message resulted in a significant increase in intention to participate in coordinated control activities of Non-controllers.

REVIEW AND REFLECT (STEP 10)

This case study was conducted to investigate landholder participation in coordinated wild dog control activities. It aimed to:

1. Identify landholders segments that are not participating in coordinated wild dog control activities
2. Assess potential drivers and barriers that may influence landholders' participation in coordinated wild dog control activities
3. Identify main leverage points within the identified segments and specific behaviour change tools that may be useful for targeting interventions
4. Develop and evaluate a pilot intervention based on these findings.

We identified four landholder participation segments; 1) landholders who didn't conduct any control activities (Non-controllers), 2) those that controlled by themselves (Individual controllers), 3) those that only controlled in coordinated activities (Coordinated controllers), and 4) those that did a combination of both individual and coordinated control (Dual controllers). These findings replicate those from a previous study conducted in Western Australian (McLeod & Hine, 2019), which investigated landholder's management of a number of invasive animals covering wild dogs, foxes, feral pigs, feral cats and rabbits. While our study only focussed on wild dogs, it suggests the usefulness of these landholder segments for a range of invasive management issues, across varying geographic areas.

Each of the identified participation segments had their own socio-demographic profile:

- *Non-controllers* had rarely participated in any wild dog management activities. They tended to be landholders who did not earn their main income from their property, had not experienced wild dog problems, and were not aware of their biosecurity obligations. They mainly identified as life-stylers or hobby farmers.
- *Individual controllers* had conducted independent management activities, but had rarely participated in coordinated programs with other landholders. They tended to have experienced wild dog problems, and be economically dependent on their property. Shooting was the most commonly used control method, and members were more likely to rely on fencing on their property and guard animals for constant protection. Along with *Non-controllers*, they had resided on their property the least number of years.
- *Coordinated controllers* had regularly participated in coordinated management activities such as baiting and shooting, and rarely did any activities by themselves. They had not necessarily experienced wild dog problems, or earn their main income from their property, but had resided on their property longer than *Non-controllers* and *Individual controllers*, and showed a higher level of social belonging, trust in their community and good neighbourly relations.
- *Dual controllers* participated in both coordinated management activities (mainly baiting), as well as conducted baiting, trapping and shooting activities by themselves. A small number also used fencing for constant protection. They tended to have experienced wild dog problems, and were economically dependent on their property. Along with *Coordinated controllers* they had resided on their property the greatest number of years, and showed a high level of social belonging, community trust and good neighbourly relations.

Landholders who were not participating in coordinated activities (both Non-controllers and Individual controllers) each had their own COM (capability, opportunity, motivation) driver / barrier profile. We identified five general driver/barrier themes amongst these nonparticipators, covering awareness, convenience, reduced social norm cues, dislike of baiting and community attachment. In addition, Non-controllers exhibited their own unique set of attributes, compared to Individual controllers. We identified a further four themes amongst these landholders, covering perception of the importance of

the wild dog problem, skills, reduced physical opportunity and perceived inhumaneness and lack of specificity of control methods. These results highlight the complexity of non-participation, and that a 'one-size fits all' approach to encourage participation will not be effective.

By categorising the drivers and barriers using the COM model we were able to identify a range of behaviour change tools that could be used to increase the likelihood of participation in coordinated activities (see Table 2.3). For the next phase of this case study we focussed on developing a persuasive message which would engage the non-participating landholders, and motivating them to participate in coordinated activities.

We hypothesised that those non-participating landholders suffering economic impacts, would be encouraged by a 'loss of 'production' framing of the problem, whereas landholders not suffering direct impacts would be swayed by appeals to either their 'social' or 'environmental' values, using appropriate messaging framing; a) non-participating landholders with a strong attachment to their natural 'place' would be encourage by an environmental framing of the problem, and b) non-participating landholders with a high sense of social attachment would be encouraged by a social framing of the problem. We were also interested in exploring whether landholders were more likely to participate in coordinated control activities if they knew their peers were doing likewise (a descriptive norm), rather than through the government regulations (injunctive norm). As both our non-participating segments were disengaged with the coordinated activities due to the common type of control method promoted (i.e. baiting), we also investigated whether these landholders would be more open to participating in coordinated activities if other options were available.

Landholders' current participation behaviour in wild dog control activities, both individual and coordinated had a significant impact on their reaction to the message, and their intentions to participate in any future coordinated control activities. Non-controllers rated the persuasiveness and motivation of the message and the likelihood of participation in future coordinated control activities consistently lower, than Individual controllers, who were consistently lower than both Coordinated and Dual controllers.

With respect to the message components, and our non-participating landholders:

- *Individual controllers* rated the persuasiveness and motivation of production frame the highest, whereas they had a negative reaction to the social frame.
- Both non-participating segments rated the wildlife frame the least persuasive and motivational, despite both registering relatively high attachment to natural place scores.
- Injunctive norms, which described the landholders' legal biosecurity obligation to be involved in some kind of wild dog control activity, were the most motivational for *Individual controllers*.
- Descriptive norms which described what other landholders were doing, significantly increased the intentions of *Non-controllers* to participate in future coordinated control activities.
- Offering landholders the chance to participate without having to bait was more persuasive and motivational than the baiting only option for *Non-controllers*. However this ploy was seen as manipulative by *Individual controllers*.

The results highlight that non-participating landholders are not a homogenous group. The development of messages to connect and engage with these audiences will need to take into consideration each groups' socio-economic and psychological profile to be effective. A persuasive message by itself will not be very successful in encouraging participation in coordinated wild dog activities if the other types of barriers preventing participating are not also tackled with appropriate tools (e.g. training and support to enhance *Non-controllers* capabilities, providing timely prompts to improve awareness, and increasing the opportunity to be in involved).

CASE STUDY 2: REPORTING WILD DOG SIGHTINGS & IMPACTS

COM-B ANALYSIS AND AUDIENCE SEGMENTATION (STEPS 4 & 5)

METHODS

LANDHOLDER BARRIER / DRIVER (COM-B) SURVEY

A random digit phone survey was completed to assess potential barriers that may prevent landholders reporting wild dog sightings and impacts (N=186). This survey was conducted in accordance with the ethical standards of the Human Research Ethics Committee of the University of New England (Approval No. HE19-221). These surveys originally were planned to target landholders who lived in the Northern NSW (North Coast, Northern Tablelands and North West Local Land Services), however owing to major bushfires in the area at the time, the survey was extended to other areas of NSW known to have wild dog problems. Information about the landholders' perceptions of the wild dog problem on their property, and participation in reporting, as well as sociodemographic information including age, gender, location, property size and main property uses was collected. Respondents were asked to rate their agreement (on a 5-point Likert scale) to 15 pre-identified capability, opportunity, and motivation behavioural (COM) variables to measure the predictability of these factors. These factors had been identified from:

1. the semi-structured interviews of stakeholders, and
2. the open-ended questions posed in the first landholder survey

The survey questions are presented in Appendix 6.

ANALYSES

Latent profile analysis (LPA) was implemented in MPlus 8.3 (Muthén & Muthén, 2019) to classify landholders into homogenous segments based on their responses to participation in wild dog management questions. Relative model fit was assessed using the Bayesian information criteria (BIC; Schwartz, 1978) relative entropy (Ramaswamy et al., 1993) and the Lo–Mendell–Rubin likelihood ratio test (LMR; Lo et al., 2001). A significant *p* value from the LMR test ($p = 0.05$) indicated that the given profile solution fitted the data significantly better than the solution with one fewer profile groups. Differences between identified participation segments and COM variables, control behaviours, situational and demographic variables were tested using either a one-way ANOVA or Pearson's chi-squared test. All procedures except the LPA were conducted using SPSS 26 (IBM, 2019).

RESULTS

RESPONDENT DETAILS

The average age of the 186 survey respondents (58% male) was 58 years (range 18 to 85), which is slightly older than the average age (54 years) recorded for the NSW Regional adult population (Australian Bureau of Statistics, 2018). Respondents came from the Northern Tablelands Local Land Services (LLS) (N=51), North Coast LLS (N=45), South East (N=31), North West (N=24), Murray (N=22), Riverina (N=11), Western (N=2). The average property size of respondents was 1381 Ha (range 2 to 60,000), and the average years of residence was 28 years (range 1 to 82).

Over half of the respondents (97, 52%) earned their main income from their property. Over three quarters of the respondents (141, 76%) had some type of livestock enterprise on their property, mainly cattle, small livestock (such as sheep or goats), or horses. Thirty one (17%) respondents categorised their property as lifestyle or hobby, and the remaining 14 (7%) ran enterprises, that did not involve livestock, such as cropping, horticulture, and timber.

Half of the respondents (94, 50%) were not aware of wild dogs in their area. A further 18% (33) reported being aware of wild dogs in their area, but not having experiencing any problems on their properties. The remaining respondents (39%) reported wild dog problems on their property. Of these, 12 (7%) rated their problem as serious, 29 (16%) moderate, and 29 (16%) minor (Figure 16).

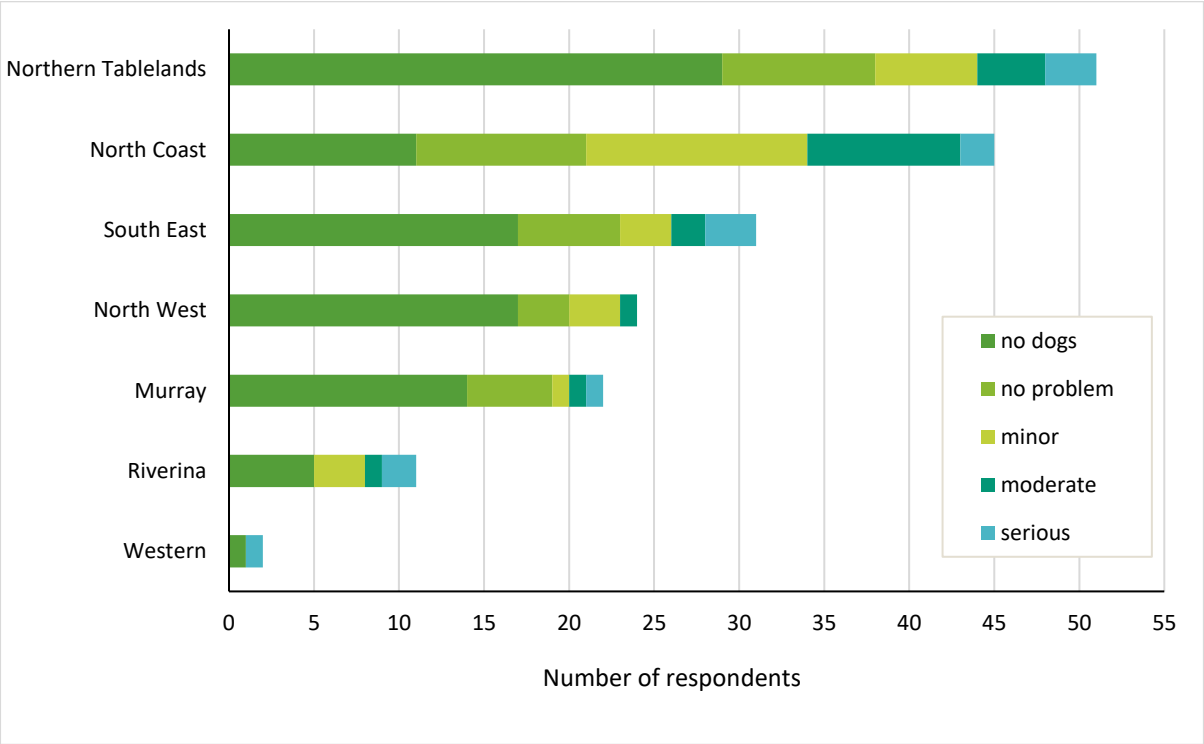

Figure 16: Perceived wild dog problem by respondents, categorised by their Local Land Service area.

Forty-four respondents (24%) indicated they had reported wild dog sightings and impacts in the past five years. Respondents who currently have a serious wild dog problem were significantly more likely to have reported 5 times or more in the past 5 years, however there were some of these respondents who had not reported at all (Figure 17). Respondents who currently have no dogs in the area, were significantly more likely to have never reported in the past 5 years. These reports were most commonly reported to the LLS (26 respondents), or neighbours (15 respondents). Other organisations / people that respondents mentioned included the Council (4), Regional wild dog coordinator (4), wild dog groups (4), National Parks (3), and Forestry (1). Respondents preferred to ring (36) or report in-person (20). Two respondents indicated they would ring, followed up by an email, and one respondent texted. Only one respondent (from the North Coast LLS) indicated they had used Wild Dog Scan.

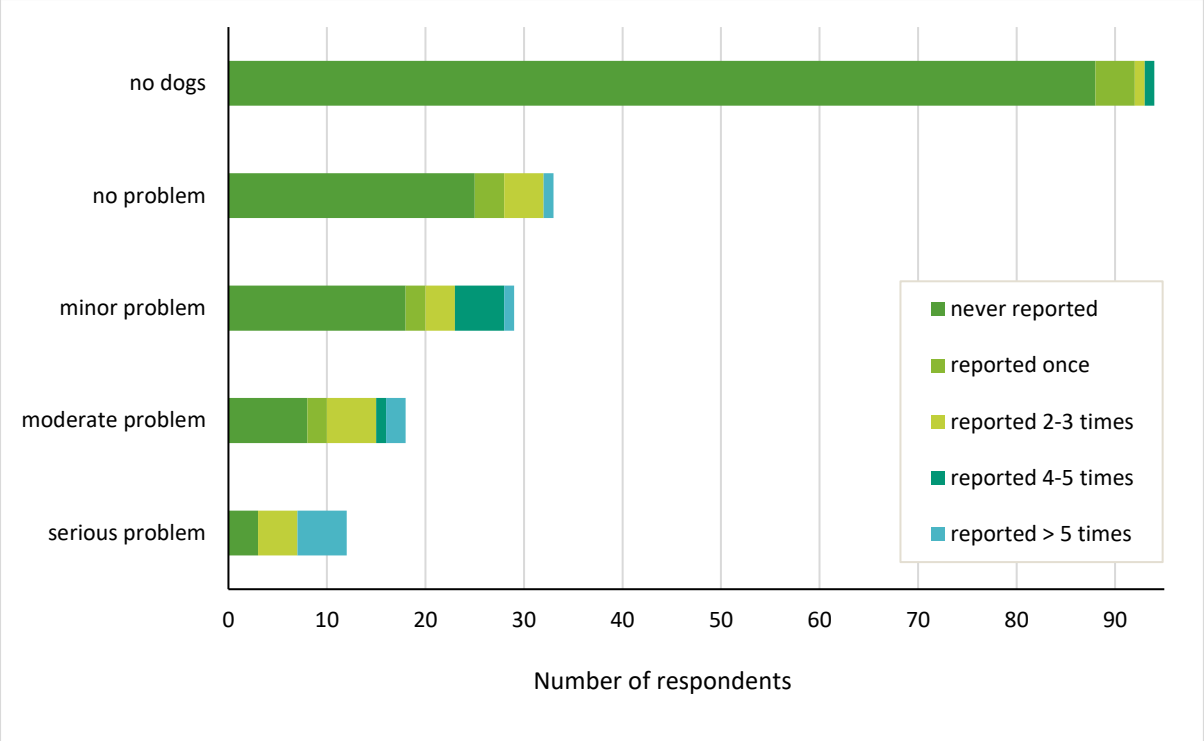

Figure 17: The reporting behaviour of the respondents over the past five years, categorised on their perceived wild dog problem.

Respondents were also asked how likely they were to report if they encountered wild dogs or their impacts in the future: 54% were very likely, 17% likely, 7% not committed, 6% unlikely and 17% very unlikely. Nearly half indicated their first preference would be to report to the LLS (86, 46%), followed by their neighbours (21%), the Council (12%) and the police (5%). Neighbours and LLS were the most frequent response for the respondent's second reporting preference (Figure 18). Respondents preferred to ring (175) or report in-person (56). Six respondents indicated they would ring, followed up by an email, and one respondent would use the internet. No respondents indicated they would use Wild Dog Scan.

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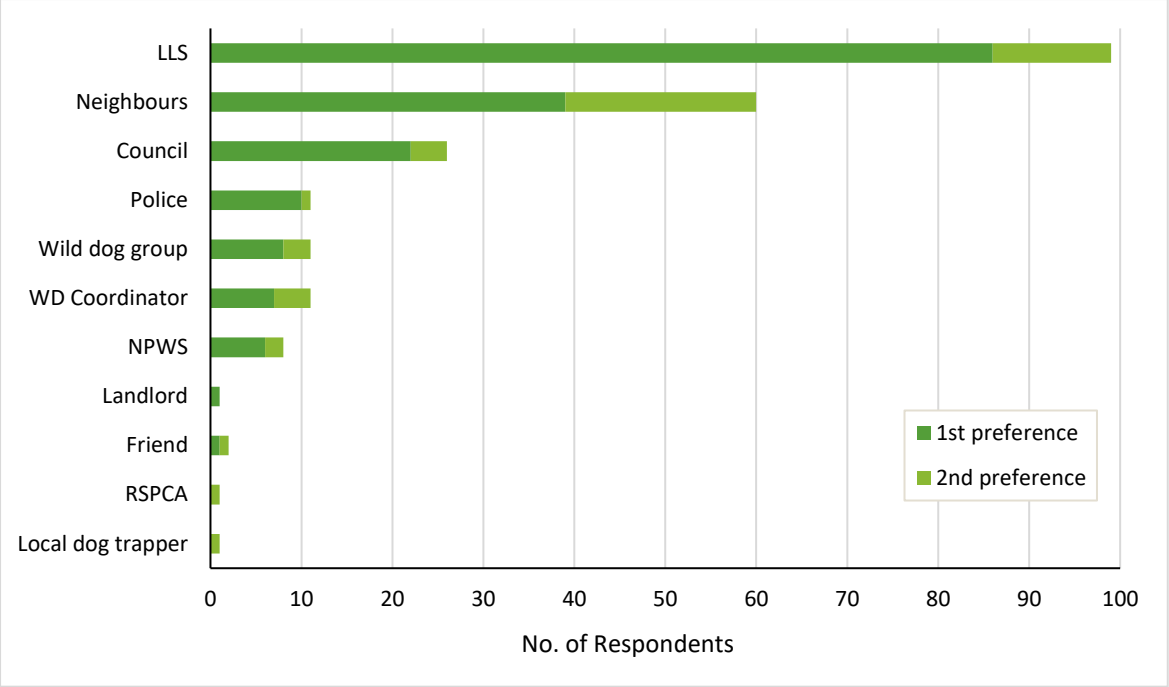

Figure 18: Respondents preference for any future reporting of wild dog sightings or impacts.

AUDIENCE SEGMENTATION

The results from the profiling analysis applied to the reporting of wild dog sightings and impacts are presented in Figure 19. Demographic and situational characteristics for each of landholder segment are shown in Table 3.1.

The profiling analysis produced 3 distinct groups:

1. *Non-reporters* (N=42) had rarely reported in the past, and were unlikely to report in the future. Members were a mixture of those that had experienced problems with wild dogs, and those that had not. They tended to be younger in age, and had resided on the properties for a shorter period than the other profiles.

2. *Potential reporters* (N=112) had rarely reported in the past. They are more likely not to have experienced any problems with wild dogs, however they are likely to report wild dogs and their impacts if they encounter them in the future. Members tended not to run small livestock on their property.

3. *Reporters* (N=32) commonly reported in the past, and were likely to report in the future. They are more likely to have experienced problems with wild dogs, and more likely to be running small livestock on their property.

Table 16: Situational and demographic characteristics of the landholder segments.

	Non-reporters (N=42)		Potential reporters (N=112)		Reporters (N=32)		Segment differences	
Variables	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**F**	**r**
Age	52.9[a]	16.7	61.1[b]	14.7	59.7[ab]	15.6	4.4*	0.1
Property size (ha)	418	647	1284	4328	2983	10553	2.0	-
Years of residence	20.9[a]	15.8	29.5[ab]	20.1	32.0[b]	23.1	3.7*	0.2
	N (%)	Z_{Resid}	N (%)	Z_{Resid}	N (%)	Z_{Resid}	$\chi 2$ (df)	r
Perceived wild dog issue:							60.4***(8)	0.5
No dogs in area	21	-0.1	71	4.3	2	-5.5		
Dogs but not a problem	7	-0.2	21	0.4	5	-0.3		
Minor problem	4	-1.2	16	-0.6	9	2.1		
Moderate problem	8	2.3	2	-4.5	8	3.2		
Serious problem	2	-0.5	2	-3.2	8	4.7		
Main income source:							2.8 (2)	-
Property	21	-0.3	55	-1.0	21	1.7		
Other (off property)	21	0.3	57	1.0	11	-1.7		
Property enterprises:							15.6* (8)	0.2
Cattle only	16	0.1	41	-0.4	13	0.4		
Small livestock only	6	-0.4	13	-2.1	11	3.1		
Mixed livestock	8	-0.4	27	1.1	5	-0.9		
Farming - no livestock	6	1.7	9	0.0	0	-1.8		
Lifestyle / hobby	6	-0.5	22	1.3	3	-1.2		

*p < 0.05, **p < 0.01, ***p < 0.001. Means with different subscripts (in rows) differ significantly at p < 0.05 Tukey HSD. r = Pearson's correlation coefficient; r ≥ 0.5 indicates strong effect size, r = 0.3 indicates medium effect size, r = 0.1 indicates small effect size (Cohen, 1988). Z_{Resid} = Adjusted standardised residual, where $Z_{Resid} > |2|$ is significant at p < 0.05

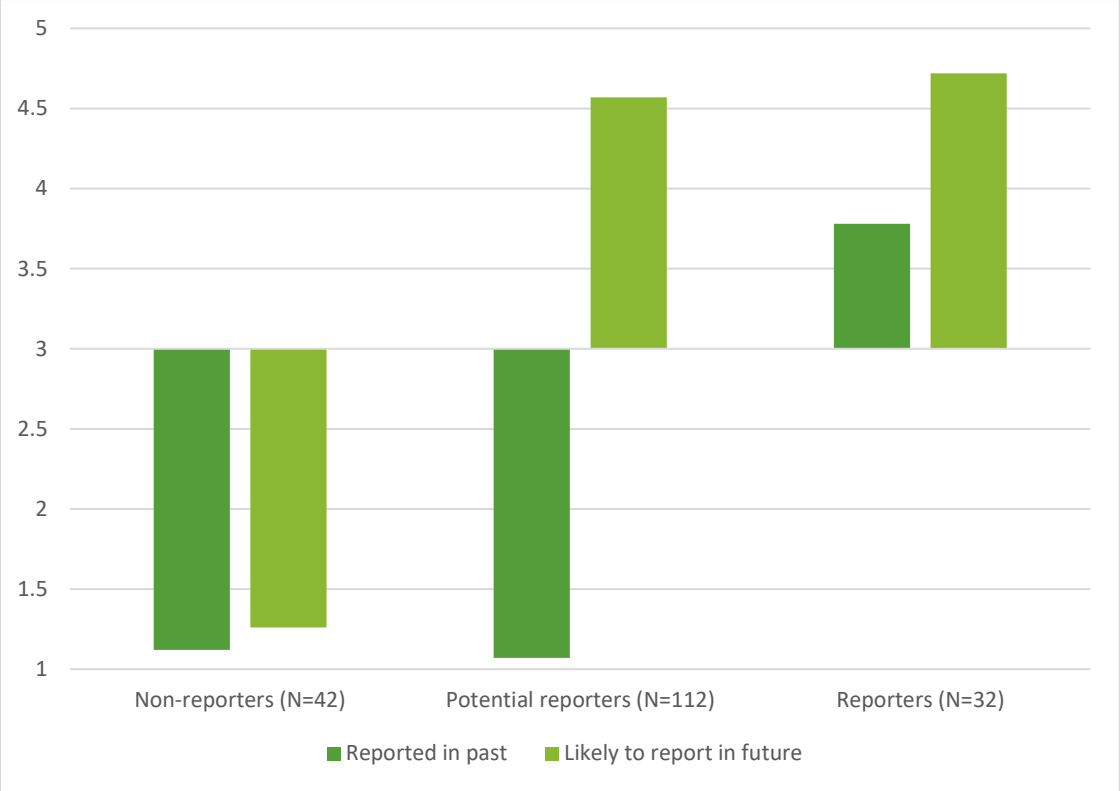

Figure 19: Three landholder segments based on reporting of wild dog sightings and impacts. Reporting scale: 1=never, 5=always.

COM-B PREDICTOR VARIABLES

To identify the specific barriers and drivers for reporting, we compared the respondents' responses to the 15 COM variables across the three segments. Results are presented in Table 2.2. We found significant differences between *Reporters, Potential reporters* and *Non-reporters* across 12 of the 15 COM variables.

There were two segments, *Non-reporters* and *Potential reporters*, whose members had not reported wild dog sightings or their impacts in the previous five years. Relative to *Reporters*, both these segments who had not reported wild dogs or their impacts, lacked the motivation as they tended not to have experienced wild dog problems on their properties, and the opportunity, as they perceived that reporting was too time-consuming. The main difference between *Potential reporters* and *Non-reporters* was that the former segment was more likely to report any wild dog sightings or impacts if they encountered them in the future.

Table 17: Differences between COM driver and barrier variables and the three identified landholder segments.

	Non-reporters (N=42)		Potential reporters (N=112)		Reporters (N=32)		Segment differences	
COM Variables	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**F**	**r**
Capabilities								
Have difficulty identifying a wild dog	2.2	1.5	2.4	1.4	1.9	1.1	2.1	-
Do not know who to contact	3.1[a]	1.7	1.9[b]	1.2	1.7[b]	1.0	15.1***	0.1
Opportunities - physical								
Too time-consuming	2.6[a]	1.2	2.5[ab]	1.0	2.0[b]	1.1	6.8**	0.1
Methods of reporting not convenient	2.7[a]	1.1	2.2[b]	0.9	1.9[b]	1.1	10.3**	0.1
Opportunities - social								
No-one they know reports	3.1[a]	1.5	2.4[b]	1.2	1.8[c]	1.1	10.7***	0.1
Motivations								
Perceive no wild dog problem on property	3.7[a]	1.5	4.2[a]	1.2	2.3[b]	1.3	30.5***	0.5
Believe wild dogs should not be harmed	1.5	0.9	1.5	0.7	1.4	0.6	0.3	-
Prefer to handle the problem themselves	3.8[a]	1.4	2.5[b]	1.3	2.0[b]	1.2	19.2***	0.1
Don't want strangers on their property	3.0[a]	1.6	2.1[b]	1.1	1.9[b]	1.0	8.5***	0.1
Believe they will be made to do costly control	3.0[a]	1.4	2.5[b]	1.0	1.9[c]	1.1	8.0***	0.1
Will be forced to use disagreeable methods	2.6[a]	1.4	2.0[b]	1.0	1.8[b]	1.1	5.0**	0.1
Believe control will harm their dogs	3.4[a]	1.6	2.5[b]	1.3	2.3[b]	1.2	8.4***	0.1
Believe authorities will not act anyway	3.1[a]	1.4	2.3[b]	1.1	2.5[b]	1.4	6.3**	0.1
Believe not their responsibility	2.4[a]	1.3	1.7[b]	0.9	1.5[b]	0.8	10.5***	0.1
Do not want to be perceived as a bad manager	1.5	0.8	1.6	0.7	1.5	0.7	0.2	-

Notes: Mean agreement scores for COM variable rating using scale: 1 = strongly disagree, 5 = strongly agree. *p < 0.05, **p < 0.01, ***p < 0.001. Means with different subscripts (in rows) differ significantly at p < 0.05 Tukey HSD. r = Pearson's correlation coefficient; r ≥ 0.5 indicates strong effect size, r = 0.3 indicates medium effect size, r = 0.1 indicates small effect size (Cohen, 1988).

From a motivational perspective, *Non-reporters* did not want other people interfering with their property. They preferred to handle the problem themselves, and they did not want to be made to conduct control activities that they perceived as costly, disagreeable, or would harm their own dogs. These *Non-reporters* did not believe it was their responsibility to report wild dogs or their impacts to the authorities. These authorities were perceived as not acting on the information provided anyway.

In terms of opportunity, *Non-reporters* perceived current methods of reporting as too time-consuming and inconvenient. They may not receive the social cues to report as they don't know anyone else who performs this behaviour. *Non-reporters* also identified that they lacked the knowledge about who to contact.

KEY TAKEAWAYS

The primary barriers to reporting wild dog sightings and impacts were:

1. Wild dogs were not causing a problem on their property (i.e. no motivation)
2. Current methods of reporting were too time-consuming.

Additional barriers to reporting wild dog sightings and impacts for non-reporters were:

1. They don't know who to contact (i.e. lack knowledge - capability)
2. Current methods of reporting were inconvenient (i.e. reduced opportunity)
3. They don't know anyone else who reports (i.e. lack of social opportunity)
4. There was a lack of motivation as they did not want other people interfering with their property, they preferred to handle the problem themselves, and they did not want to be made to conduct control activities that they perceived as costly, disagreeable, or which would harm their own dogs.
5. They felt it wasn't their responsibility, and the authorities would not act on their information anyway (i.e. further lack of motivation).

INTERVENTION DEVELOPMENT (STEPS 6, 7 & 8)

Our results have identified the main drivers and barriers to the reporting of wild dog impacts to the appropriate authorities. This next step is to identify the main leverage points and the specific behaviour change techniques that will target these barriers and achieve maximum on-ground outcomes.

IDENTIFY MAIN LEVERAGE POINTS (STEP 6)

Two segments of landholders whose members had not reported wild dog sightings or their impacts in the previous five years have been identified, each with their own COM (*capability, opportunity, motivation*) profile. Relative to *Reporters*, these two segments (*Non-reporters* and *Potential reporters*), lacked the motivation to report as they tended not to have experienced wild dog problems on their properties. They perceived current reporting methods as too time consuming.

In addition *Non-reporters* did not know who to contact, perceived current methods of reporting were inconvenient, and they did not know anyone else who reported. They indicated they were unlikely to report any wild dog sightings or impacts if they encountered them in the future as they did not believe it was their responsibility to report to the authorities, and the authorities would not acting on the information provided anyway. They did not want other people interfering with their property as they preferred to handle the problem themselves. They also did not want to be made to conduct control activities that were disagreeable, or would harm their own dogs. Suggestions for each of these identified COM factors are shown in Table 3.3.

INTERVENTION DEVELOPMENT AND FEASIBILITY (STEPS 7 & 8)

With consultation with our research partners it was decided to focus the intervention on addressing the physical opportunity barriers identified by both segments, i.e. that current methods are too time-consuming and inconvenient, as well as the social barrier, i.e. the lack of social cues for reporting. However, instead of developing a new reporting tool, it was decided to evaluate current methods, and identify areas of improvement that would allow them to be perceived as more convenient, and less time consuming, as well as demonstrate to landholders that other landholders value reporting, and also participate.

A popular method of reporting is the online tool Wild Dog Scan™ (WDS). WDS is a free resource (available as a website or mobile App) for landholders, community groups and pest controllers. It has been developed through the Centre for Invasive Species Solutions as part of the FeralScan suite of citizen surveillance tools (https://www.feralscan.org.au/), and allows users not only to map wild dog activities, and document wild dog problems, but inform neighbours and local biosecurity authorities, and identify priority areas for control. Many authorities involved in wild dog management support and promote the use of WDS in their jurisdictions.

The practical feasibility of evaluating this tool was assessed by our research partners, using the APEASE criteria developed by Michie et al. (2014). It was affordable, practical, cost effectiveness, acceptable, and fair. No potential side effects could be identified.

Table 18: Linking identified COM drivers and barriers to appropriate behaviour change techniques to promote the reporting of wild dog impacts (after Hine et al., 2019).

COM factor	Focus of intervention	Recommended behaviour change techniques
Capability		
Know whom to report	Awareness, instruction and training (if required)	Advise and instruct on how to report, as well as target training material and workshops on how to use preferred reporting tools (if required).
Opportunity		
Convenience / time-consuming	Modify the environment to make it easy and less time-consuming to report.	Make reporting methods easy and less-time consuming to access. Increase the flexibility of reporting. Provide incentives to report.
Social norm cues	Align objectives and communications with the preferences of the community.	Develop solutions that are socially acceptable in consultation with the community. Use credible sources that people associate with and trust. Provide feedback from 'important others' reporting behaviour.
Motivation		
Perception of problem	Improve awareness of wild dog problems experienced by others in their community. Build upon displayed general values (such as altruism, environmental concern, animal welfare) to encourage participation.	Provide information about problem using credible local sources that people associate with and trust. Adopt a deliberate perspective targeted to their values. Provide information on other similar people's experiences and participation. Draw attention to discrepancies between values and current behaviour to create discomfort.
Handle problem themselves, no outside interference	Highlight the positive aspects of reporting and the benefits of handling the problem as a group. Dispel any underlying misconceptions.	Frame information to emphasis the positive aspects of reporting. Use credible sources that people associate with and trust. Provide feedback from 'important others' on their experiences with reporting and the benefits achieved.
Made to do control that is costly, disagreeable or harmful	Dispel any underlying misconceptions, and convince people that reporting will produce positive outcomes for them and their community.	Improve awareness of reporting and its benefits by explaining misinformation and emphasising correct facts. Provide information and feedback from other people's experiences and benefits achieved.
Responsibility	Promote awareness of the consequences of actions on others and enhance personal responsibility for them	Adopt a perspective linked with their perceived social role to provide information linked to the consequences of not reporting. Use credible sources that people associate with and trust.
Authorities don't act	Dispel any underlying misconceptions. Promote awareness of the ways the authority does act.	Provide information about how the authority acts on the information, as well as feedback from other people's experiences and benefits achieved.

EVALUATION (STEP 9)

Wild dogs pose a problem across much of the Northern Tablelands Local Land Service (NT LLS) region. As part of their wild dog management plan, 38 Wild Dog Control Associations (WDCA), comprising landholders and key stakeholders from a range of government, non-government and industry organisations, have been formed to coordinate wild dog management activities. The NT LLS has been promoting the use of Wild Dog Scan (WDS) by these WDCA's and their members as the main recording and planning tool. WDS is a free resource (available as a website or mobile App) for landholders, community groups and pest controllers. It has been developed as part of the FeralScan suite of citizen surveillance tools (https://www.feralscan.org.au/), and allows users to map wild dog activities, document wild dog problems, inform neighbours and local biosecurity authorities, and identify priority areas for control.

The objectives of this project are to:

1. Measure the current uptake of WDS as a reporting tool in the NT LLS
2. To gain a better understanding of the factors influencing the adoption of WDS within this LLS region
3. To assist NT LLS and the designers of WDS to improve their promotional, educational and support services for WDS.

METHODS

A mixed methods approach was used for this evaluation.

- The WDS database was interrogated to gain an understanding of the use of WDS by NT LLS landholders.
- NT LLS landholders were surveyed using an online questionnaire (Appendix 7) to measure their self-reported use of WDS, and the factors that are influencing their adoption or non-adoption of this reporting tool (i.e. drivers and barriers).
- A small number of landholders from selected WDCAs and LLS staff were interviewed to allow for a further detailed exploration of the identified drivers and barriers. The selected WDCAs were a mixture of those that currently embraced WDS, those who only sometimes used WDS, and those who have not adopted the technology. Interviews, which lasted between 30 to 60 minutes, were conducted in accordance with the ethical standards of the Human Research Ethics Committee of the University of New England (Approval No. HE20-166) (Appendix 8).

ANALYSIS

For the online survey data, the differences between respondent groups and behaviours, COM variables, situational and demographic variables were tested using either a one-way ANOVA (for continuous variables) or Pearson's chi-squared test (for categorical data). All tests were conducted using SPSS 26 (IBM, 2019). Open ended responses were coded to classify emerging COM themes, and identify any new factors not previously considered.

The interviews were recorded (by consent) and later transcribed and summarised for further thematic analysis. This involved systematically coding the responses to identify common themes to gain a better understanding of the factors that impede or drive both reporting behaviour in general as well as the use of WDS.

RESULTS

WDS DATABASE RECORDS

WDS was launched in the NT LLS in late 2015. Since then the number of wild dog sightings, damage and control efforts entries, along with the number of individual contributors have been increasing, (Figure 20). Currently there are 23,436 registered users (plus between 4 and 5,000 non-registered users) across Australia.

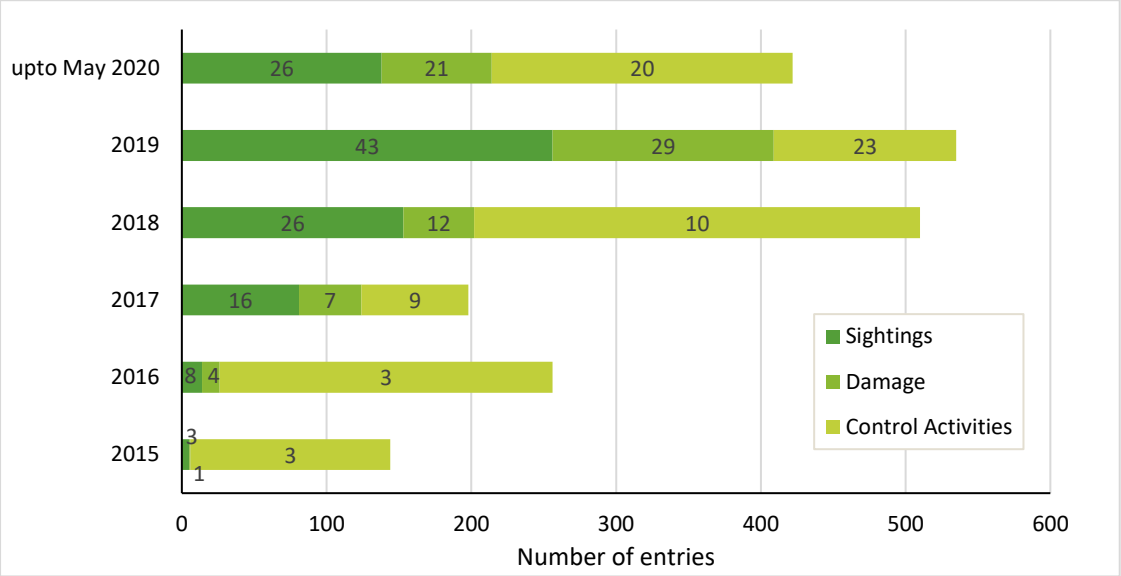

Figure 20: The total number of entries for wild dog sightings, damage and control activities entered in Wild dog Scan since 2015 from the Northern Tablelands Local Lands Services region. The data labels represent the number of individual contributors.

LANDHOLDER ONLINE QUESTIONNAIRE

One hundred and eighteen responses to the online survey were received, however 29 were not able to be used in the analysis due to inadequate completion of the questions, or obvious incorrect answers and 'flat-liner' responses. The average age of the 89 completed survey respondents was 57.7 years (SD 12.0; range 20 to 77), which is slightly older than the average age (54 years) recorded for the Regional adult population (Australian Bureau of Statistics, 2018). Sixty five respondents were male (73%), 24 female. The average property size of respondents was 1014 Ha (SD 1332; range 6 to 7,000 Ha), and the average years of residence was 26.1 years (SD 21.7; range 1 to 77). Eight three respondents owned their property, one leased, two managed the property, and two were employees, along with one dog trapper who worked across several properties.

Respondents were spread across 22 different WDCAs (Figure 21). Four respondents were unsure which WDCA they fell under. Fifty one of the respondents (57%) earned their main income from their property. Seventy four of the respondents (84%) had some type of livestock enterprise on their property, mainly cattle only (44%), mixed (24%) or small livestock, such as sheep or goats, only (16%). Ten respondents (11%) categorised their property as lifestyle or hobby, and the remaining 5 (6%) ran enterprises, that did not involve livestock.

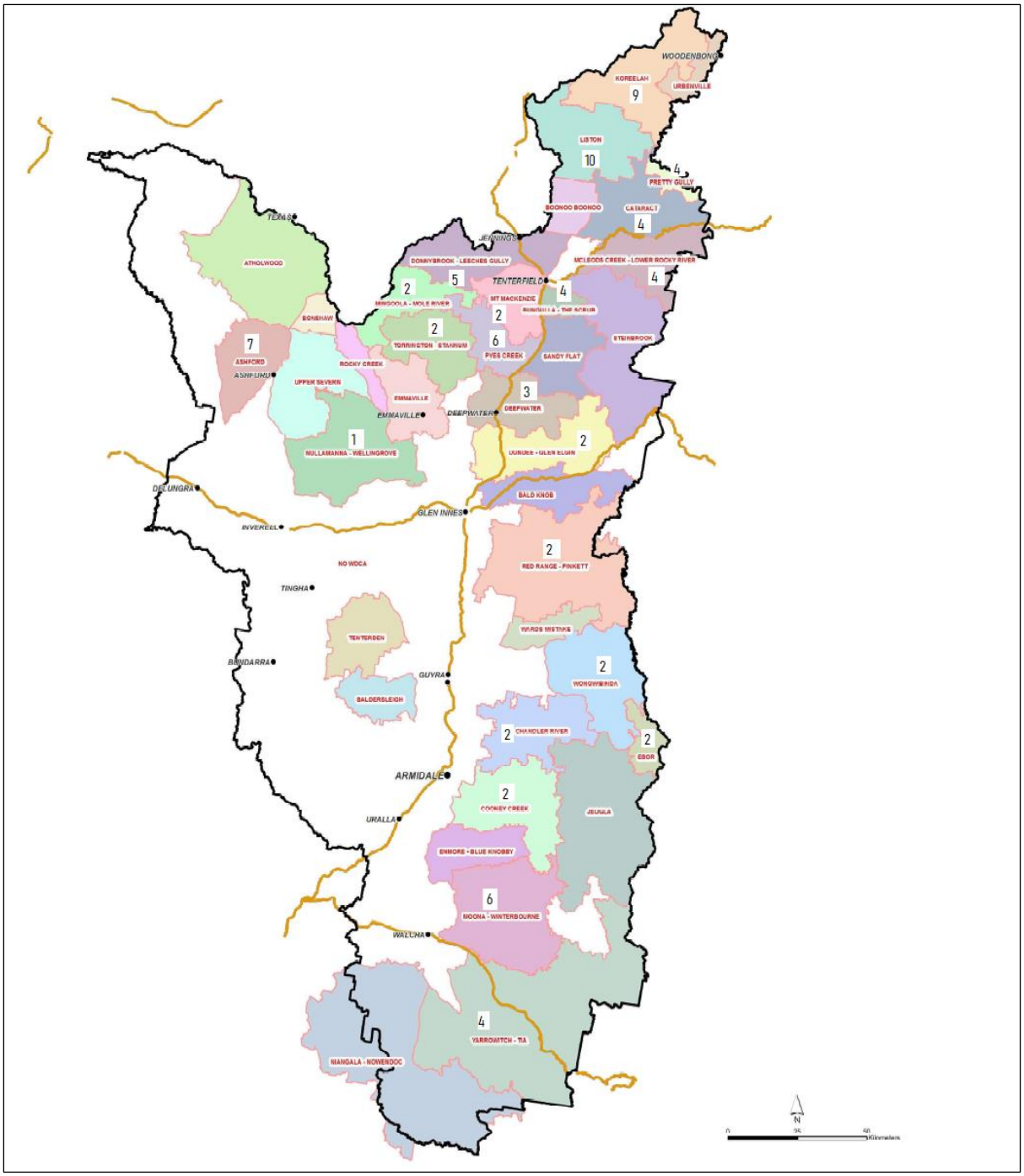

Figure 21: The number of responses received from each of the Northern Tablelands Local Lands Services Wild dog control Associations (Map courtesy of Pest Animals Team, NT LLS).

Thirteen of the respondents (15%) were not aware of wild dogs in their area. A further 6 respondents (7%) reported being aware of wild dogs in their area, but not having experienced any problems on their properties. The remaining respondents reported wild dog problems on their property. Of these, 12 (13%) rated their problem as minor, 30 (34%) moderate, and 28 (31%) serious.

Seventeen (19%) respondents had never reported wild dog problems (despite four of them having experienced minor – serious wild dog problems). Six respondents who had not experienced any direct problems on their properties, had reported sightings.

REPORTING USING WILD DOG SCAN

Three respondents were not aware of WDS, with the majority (97%) having heard of this reporting tool. Just over half (45) of respondents said they had used WDS to report wild dog sightings and impacts on at least one occasion. Respondent's use of WDS was significantly related to the seriousness of wild dog problems on their property, their main enterprise type, and their participation in aerial baiting programs (Table 3.4). Respondents in the Cataract River, Donnybrooke, and Pretty Gully WDCA were more likely to use WDS, whereas those from the Winterbourne and Yarrowitch-Tia WDCA were less likely to use WDS. There was no statistical difference in the use of WDS between respondent's age, gender, source of main income, awareness of WDS and participation in ground baiting, trapping and shooting control activities.

Although there was over half of the respondents reporting using the WDS tool, there was some confusion as to whom they were actually reporting (Figure 22). Nearly three quarters (33) believed their WDCA was one of the organisations that received the information, with six of these believing only their WDCA received the information. Just over half (26) believed the LLS was one of the organisations that received the information, with two believing they were reporting solely to the LLS. Twenty three believed they their neighbours were among the people receiving the information, with six of these believing this information went only to their neighbours. Thirteen believed the regional wild dog Coordinator also received the information. Three respondents believed that other organisations / people received the information, along with the LLS, WDCA and neighbours. Three respondents were not sure who received their wild dog report information.

Table 19: Differences between demographic and situational variables, and participation in wild dog control activities of respondents and their use of the Wild dog Scan reporting tool.

Variables	**Use Wild dog Scan (N=45)**		**Do not use Wild dog Scan (N=44)**		**Differences**	
Wild dog management[1]	**Mean**	**SD**	**Mean**	**SD**	**F**	**r**
Independent baiting	1.9	1.8	1.4	1.7	1.7	-
Group ground baiting	2.1	1.8	1.7	1.6	1.3	-
Aerial baiting	1.9[b]	1.8	1.0[a]	1.6	6.4**	0.3
Shooting	2.2	1.7	2.1	1.7	0.1	-
Trapping	1.9	1.8	1.3	1.8	2.4	-
Demographic variables						
Age	55.6	10.7	59.9	13.2	2.9	-
Situational variables						
Property size (ha)	954	1098	1076	1550	0.2	-
Years of residence	29.3	20.6	22.9	22.5	1.9	-
Wild dog problem[2]	3.0[b]	1.1	2.3[a]	1.6	6.2*	0.3
	N (%)	Z_{Resid}	N (%)	Z_{Resid}	$\chi 2$	r
Wild dog management					1.0	-
Fencing:						
Yes	19	1.0	14	-1.0		

Variables	Use Wild dog Scan (N=45)		Do not use Wild dog Scan (N=44)		Differences	
Wild dog management[1]	**Mean**	**SD**	**Mean**	**SD**	**F**	**r**
No	26	-1.0	30	1.0		
Guard animals:					1.3	-
Yes	5	1.2	2	-1.2		
No	40	-1.2	42	1.2		
Demographic variable						
Gender:					0.2	-
Male	32	-0.4	33	0.4		
Female	13	0.4	11	-0.4		
Situational variables						
Main income source:					0.9	-
Property	28	0.9	23	-0.9		
Other (off property)	17	-0.9	21	0.9		
Property enterprises:					19.8***	0.4
Cattle only	10	-4.2	29	4.2		
Small livestock only	8	0.5	6	-0.5		
Mixed livestock	17	3.2	4	-3.2		
Farming - no livestock	4	1.4	1	-1.4		
Lifestyle / hobby	6	0.6	4	-0.6		
Wild Dog Scan aware:					3.18	-
Yes	45	1.8	41	-1.8		
No	0	-1.8	3	1.8		
Wild dog Associations[3]:					48.9***	0.3
Cataract River	4	2.0	0	-2.0		
Donnybrooke	5	2.3	0	-2.3		
Pretty Gully	4	2.0	0	-2.0		
Winterbourne	0	-2.6	6	2.6		
Yarrowitch-Tia	0	-2.1	4	2.1		

Notes: 1 Mean scores for management participation using scale: 0=never, 1= once, 2= twice, 3= 3 times, 4= more than 3 times. 2 Wild dog problem scale: 0=no problem, 4=serious problem. 3Only WDCA showing significant differences are listed. *p < 0.05, **p < 0.01, ***p < 0.001. Means with different subscripts (in rows) differ significantly at p < 0.05 Tukey HSD. r = Pearson's correlation coefficient; r ≥ 0.5 indicates strong effect size, r = 0.3 indicates medium effect size, r = 0.1 indicates small effect size Cohen (1988). ZResid = Adjusted standardised residual, where ZResid > |2| is significant at p < 0.05

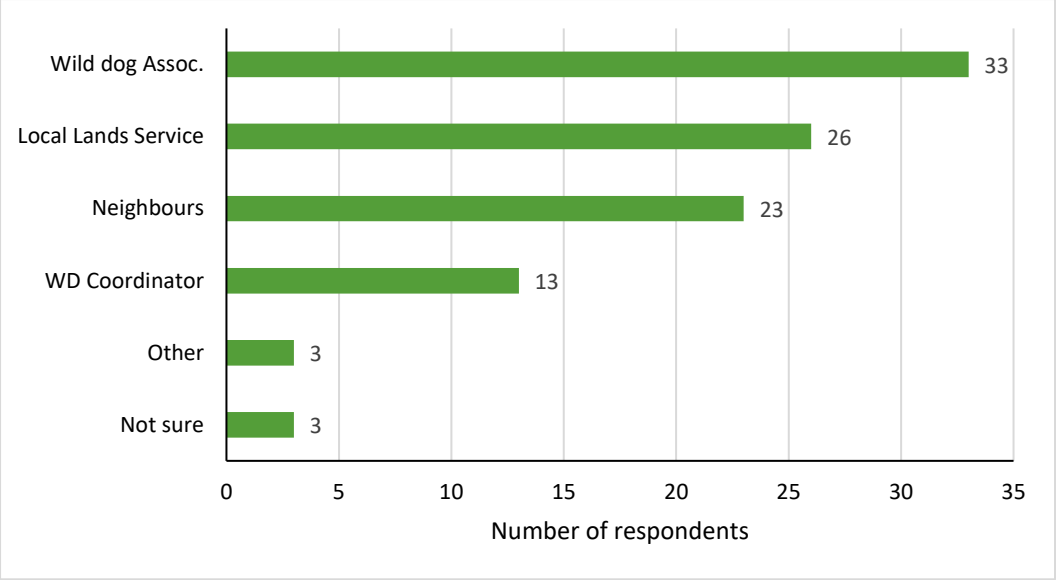

Figure 22: The organisations / groups users of Wild Dog Scan assumed to be receiving their reports of wild dog sightings and impacts.

A third of the respondents (15) who used WDS did so exclusively (i.e. they did not use any other reporting methods). The remaining users, along with other respondents relied on a combination of reporting methods. Half of the respondents (45) said they had used phone calls, a third (29) had made in-person reports, 12 had used emails and 5 had used other unspecified methods to contact neighbours, their WDCA, the LLS and the regional Wild dog Coordinator (Figure 23).

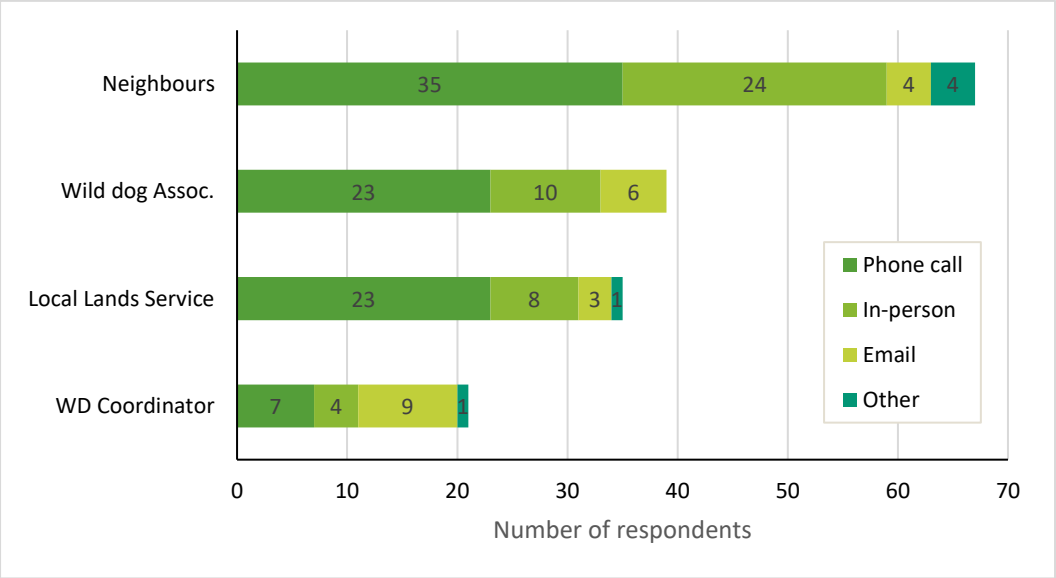

Figure 23: Methods, other than Wild dog Scan, used to report wild dog impacts.

BARRIER AND DRIVER FACTORS TO WDS ADOPTION

Respondents were asked to rate their agreement with eight driver / barrier questions relating to the use of WDS. Respondents who currently do not use WDS were significantly more likely to be unsure how to use this tool, found it difficult to use, reported they did not have the means to use the reporting tool, and prefer to have a conversation with someone about wild dogs. These respondents are less likely to want to report wild dog activities on their property, and don't see the benefits of using WDS (Table 3.5).

Table 20: Differences of reporting behaviour and agreement with eight COM-B driver and barrier variables between respondents who use Wild dog Scan and those that do not.

	Use Wild dog Scan (N=45)		Do not use Wild dog Scan (N=44)		Differences	
COM Variables[1]	**Mean**	**SD**	**Mean**	**SD**	**F**	**r**
Capability						
Unsure how to use WDS	1.4[a]	0.7	2.0[b]	1.5	6.7**	0.3
WDS difficult to use	1.4[a]	0.8	2.1[b]	1.3	9.7**	0.3
Opportunity-physical						
No means to use WDS	1.2[a]	0.8	1.8[b]	1.3	6.1*	0.3
Opportunity - social						
Know no-one who uses WDS	1.6	1.0	1.6	1.0	0.1	-
Motivation						
Don't trust data safety	1.3	0.9	1.4	0.8	0.1	-
Don't want to report	1.0[a]	0.3	1.5[b]	1.1	8.4**	0.3
Prefer conversation	2.0[a]	1.2	2.8[b]	1.5	6.7**	0.3
Don't see the benefits	1.1[a]	0.5	1.4[b]	0.8	5.2*	0.3
Reporting over past 5 years[2]	3.2[a]	1.1	1.6[b]	1.7	27.3***	0.5
Future reporting intention[3]	4.8[b]	0.4	4.5[a]	1.1	4.2*	0.2

Notes: 1 Mean agreement scores for COM variables using scale: 0=do not agree, 1=slightly, 2=moderately, 3=agree, 4=highly agree. 2report scale: 0=never, 1=once, 2=2-3 times, 3=4-5 times, 4=>5times. 3Intention scale: 0=not likely, 1=slightly, 2=somewhat, 3=likely, 4=highly likely. *p < 0.05, **p < 0.01, ***p < 0.001. Means with different subscripts (in rows) differ significantly at p < 0.05 Tukey HSD. r = Pearson's correlation coefficient; r ≥ 0.5 indicates strong effect size, r = 0.3 indicates medium effect size, r = 0.1 indicates small effect size Cohen (1988).

Identified themes from the open-ended responses to the question "why they thought other landholders may be keen or hesitant to use WDS' are shown in Table 3.6. Emerging COM themes were very similar to the ones already know, and found to differ between users and non-users (Table 3.5), i.e. unsure how to use WDS, finding it difficult to use, limited means to access it, not wanting to report, preference for personal contact, and not perceiving the benefits. Respondents commonly referred to 'older' landholders when raising the hesitancy in using WDS or lack of 'tech savvy'. In our comparisons we found no statistical difference in the age between our sample of users and non-users of WDS (see Table 3.4), however this data was collected using an online sample, so there may be some bias toward the 'tech savvy'. Data privacy issues or lack of social cues were not suggested by any of the respondents as factors preventing landholders from using WDS. There were no new types of factors suggested.

Table 21: Results from the thematic analysis of the open-ended survey question.

Barriers to using Wild dog Scan	
Capability	• Lack of confidence in using new technology • Lack of computer skills
Opportunity	• Other priorities • Time consuming • Don't have access to smartphone / computer • Poor phone and / or internet coverage
Motivation	• No wild dog problems / no perceived impact of wild dogs • Remembering to use it • Lack of instant feedback & support evident when making personal contact • Couldn't be bothered to report / laziness • Don't see the need to report • Receive no feedback • Don't perceive the greater benefit
Benefits of using Wild dog Scan	
• Instant access to information • Good way to track wild dog activity - a good perspective of the whole area • Can contact many people / groups with one action • Don't need everyone's contact details • Benefits all stakeholders / group members • Easy to use • Informed even when not on site	

LANDHOLDERS AND LLS STAFF INTERVIEWS

Ten interviews were conducted to further explore the factors driving or impeding the adoption of WDS by landholders. Four LLS staff and six landholders (three from WDCA that currently embraced WDS, two from WDCA that only sometimes used WDS, and one from a WDCA who have not adopted the technology) took part in the interviews. Further discussion of these factors is presented below.

LANDHOLDER CAPABILITY

Two common barriers to using WDS were landholder skills using the technology as well as their confidence in using it.

"I had a crack at it first up and had difficulty completing. I am sure that it was my lack of computer skills and not the fault of the program" (L5).

"I hadn't used it for a while, and it took me some time to remember what to do" (L1).

"I have the wild dog scan on my laptop but have had trouble using it" (L4).

"My daughter helped me set it up. She's the main user but I am gaining more confidence. Now our neighbours call me, and we enter the data for them" (L2).

The main interventions to assist with these kind of barriers include education, training and providing support. Three of the landholders had attended WDS training sessions offered by their WDCA, one 4-5 years previously and the others more recently. The other three where members of WDCA that had not offered any training. One landholder suggested that entering 'live data' during the training sessions, and demonstrating how it works in their own backyard would be more beneficial than "*slides*

on a screen". Another thought that having pop-up help functions "similar to a cooking recipe" that steps them through the procedure would be of great assistance when they were unsure or could not remember what to do.

LANDHOLDER OPPORTUNITY

Not having access to a smartphone and / or computer are commonly expressed barriers to the use of WDS. However one landholder acknowledged that even though there may be "*a limited number of technophobes"* amongst his fellow landholders, in his experience most landholders did now own a smartphone, but were *"still overwhelmed by the amount of technology"* (L1), and *"probably not using it to the full capacity – I mean downloading apps and the like"* (S2).

Having poor mobile and / or internet coverage was another commonly perceived barrier. "Even when we explain that they can put in the information in when there is no coverage, they still use their poor mobile coverage as an excuse" (S3). Another problem that the LLS staff encountered was that the landholders would wait until they got back to the house to enter their data – hence the locations were registered as "in their lounge-room instead of out in the paddock".

Time was another major barrier, landholders had many priorities and generally considered themselves as 'time-poor'. They perceived little opportunity to spend time learning how to use WDS, as well as then using it to report, particularly when they were not confident using it, so it seemed to take *"more time than it was supposedly saving"* (L4).

LANDHOLDER MOTIVATION

There are many benefits that WDS offers, including:

- Notifying multiple stakeholders with one action – "Good way of alerting people in the area who you don't know or have contact for" (L3), "Reduces having to contact everyone, one notification instead of ten" (S2).
- Instant access to information about wild dog activity in the local area – "It is the only way some of us know about dog activity" (L3).

However not all landholders *"see the dollar value straightaway, and it's hard to tell them"* (S1). One landholder thought WDS was *"brilliant and simple"* (L1) and was not sure why the uptake was so poor, but acknowledged that before the addition of the feedback alerts *"it was a hard sell"* to other members in his WDCA - they couldn't see *"what they got out of it"*. With the alert feedback everyone is *"keen when they use and then see results"* (S4).

An "excellent tool to keep track of what is happening in my area" (L2).

Although the alerts were an important way of informing landholders, they could not be the sole source of information.

"They (landholders) are overwhelmed by so much information these days, they don't look at it (the information)" (S2).

"Neighbour networks are an important source of information as well" (S1).

Some landholders were still unsure about their privacy.

"One landholder didn't want to report control measures for fear of reprisal, being judged" (S3).

"They (the landholders) don't understand fully about closed groups" (S4).

One of the biggest barriers discussed was not actually with the WDS per se, but with reporting in general. Several of the landholders mentioned that they had neighbours who "*believe it* (reporting) *was not necessary*" as they either were not affected by dogs, or took care of things themselves.

"Some landholders are not aware of or haven't experienced wild dog problems so there is no resonance to report or participate" (S1).

“My neighbours have fences to protect their stock” (L2).

The perceived lack of action by LLS or previous bad experiences also were seen as reasons not to report.

“I have placed numerous sighting reports etc and kills on wild dog scan there is enough data now to indicated serious problems with dogs, however I am the one chasing LLS to inform them, then get bait out, place traps and everything. I do it to try and protect my lively hood, but it seems all one way traffic” (L4).

“Some landholders feel that LLS doesn’t act on the information” (S1).

For others there appeared to be more personal reasons.

“Some landholders are good at reporting, others see the benefits but still don’t (report)” (S3).

“Some don’t even tell neighbours they are having attacks” (S1).

“One landholder didn’t want to decrease the price of their land” (S2).

Suggested ways to encourage uptake of WDS included:

- Promoting the “benefits, and building a case to increase the funding for their area” (S2).
- Increase the understanding and build a culture within LLS that reporting will lead to support and assistance with control. *“Many landholders expect control or support but don’t report, need a way to get this to resonate with them”* (L1).
- “LLS needs to get the word out, keep momentum especially when (landholders) are not suffering predation” (S2).

Key takeaways

The primary barriers to using Wild dog Scan were:

- Ability to use this tool – skill and confidence (reduced capability)
- Time availability – to learn new skills as well as to report (lack of opportunity)
- Access to compatible hardware (reduced opportunity)
- Perceived connection issues – phone and internet coverage (reduced opportunity)
- Don’t see the benefits of Wild Dog Scan (not motivated)
- Prefer contact / conversations with people (not motivated)
- Non-reporters – either don’t see the need, or too lazy (lack of motivation).

Suggestions how to tackle these barriers are shown in Table 3.7.

Table 22: Linking identified COM drivers and barriers to appropriate behaviour change techniques to promote the uptake of Wild Dog Scan (after Hine et al., 2019).

COM Factor	Focus of intervention	Recommended behaviour change techniques
Capability		
Unsure how to use WDS Find it difficult to use	Awareness, instruction, training and support	Advise and instruct on how to use WDS, as well as targeted training material and workshops. Create built-in support to guide users, as well provide one-to-one support options.
Opportunity		
Time-poor	Make it easy and less time-consuming to learn and report.	Provide information on time-saving benefits of WDS. Combine training sessions with other activities to reduce time commitment. Provide incentives to use WDS.
Access to technology	Improve access to technology	Improve awareness of the required technology and its use, dispel any perceived misconceptions. Demonstrate and provide feedback from other credible users.
Motivation		
No wild dog problems	Promote awareness of other WDS functions aside from reporting.	Promote the benefits of being part of the group to keep up with latest developments.
Don't see the benefits	Highlight the positive aspects of WDS and the benefits of handling the problem as a group. Dispel any underlying misconceptions.	Frame information to emphasis the positive aspects of WDS. Use credible sources that people associate with and trust. Provide feedback from 'important others' on their experiences with WDS and the benefits achieved.
Don't want to report	Dispel any underlying misconceptions, and persuade people that reporting will produce positive outcomes for them and their community.	Improve awareness of reporting and its benefits by explaining misinformation and emphasising correct facts. Provide information and feedback from other people's experiences and benefits achieved.
Prefer one-on-one conversations	Provide feedback and support	Acknowledge reports and offer support to users, e.g. follow up reports with phone call.

REVIEW AND REFLECT (STEP 10)

This case study was conducted to investigate landholders' reporting of wild dogs and their impacts. It aimed to:

1. Identify landholders segments that are not reporting wild dogs and their impacts
2. Assess potential drivers and barriers that may influence landholders' reporting behaviour
3. Identify main leverage points within the identified segments and specific behaviour change tools that may be useful for targeting interventions
4. Guided by these findings, evaluate the current reporting tool Wild Dog Scan.

We identified three landholder reporting segments:

1. *Non-reporters* had rarely reported in the past, and were unlikely to report in the future. Members were a mixture of those that had experienced problems with wild dogs, and those that had not. They tended to be younger in age, and had resided on the properties for a shorter period than the other segments.
2. *Potential reporters* had rarely reported in the past. They were more likely not to have experienced any problems with wild dogs, however they were likely to report wild dogs and their impacts if encountered. Members tended not to run small livestock on their property.
3. *Reporters* commonly reported and were likely to report in the future. They were more likely to have experienced problems with wild dogs, and more likely to be running small livestock on their property.

Landholders who had not reported in the past three years (both Non-reporters and Potential reporters) each had their own COM (capability, opportunity, motivation) driver / barrier profile. Both Non-reporters and Potential reporters perceived no problems with wild dogs, and considered current reporting methods were too time-consuming. In addition, Non-reporters were unsure of who to contact, considered reporting was too inconvenient, and did not know of anyone else who reported. They did not believe it was their responsibility to report, and believed the authorities did not act on the advice anyway. Many Non-reporters did not want anyone interfering with their property, and did not want to be made to do control. If there was a problem they would handle any problem themselves.

By categorising the drivers and barriers using the COM model we were able to identify a range of behaviour change tools that could be used to increase the likelihood of reporting (summarised in Table 3.3). For the next phase of this case study instead of developing a new reporting tool, we focussed on evaluating a current one, Wild Dog Scan, to gain a better understanding of the factors influencing its uptake, and identify ways uptake could be improved. We selected the Northern Tablelands Local Lands Service (NT LLS) area within NSW as the study site.

We identified a number of COM barrier and driver factors influencing WDS uptake. Landholders' skill and confidence using the technology was a common barrier, along with the perceived reduced opportunity owing to poor phone and / or internet coverage. Spending time to learn how to use WDS, then remembering how to use it was also seen as a challenge for some landholders. Landholders were not motivated to use WDS as they did not perceive the benefit over their current methods, with many preferring to have contact with other people. However, two of the biggest barriers was not specifically targeted at the WDS tool per se, but at reporting in general. Wild dogs were not posing a problem for many landholders, so they had nothing to report. Other landholders were just not motivated to report (for the many reasons already discussed above), regardless of their wild dog problems or the reporting tool.

Wild Dog Scan is more than a reporting tool, and to increase its uptake, agencies and the developers need to promote, and demonstrate not only the benefits of its reporting functions, but those for planning and funding, as well as the social benefits. A many faceted approach is required to educate, train and support landholders. Not only more targeted training opportunities, and provision of

information to improve awareness and dispel any perceived misconceptions, but real-time support functions to ease the cognitive burden and save time.

Reporting is a two way process, and to expect landholders' cooperation, agencies need to earn their trust. These agencies need to build a culture of acknowledging landholders' efforts and demonstrate that reporting will lead to support and assistance with wild dog problems.

CASE STUDY 3: PARTICIPATION IN CELL FENCING IN WA

Cluster fencing initiatives were identified by the 17 experts interviewed as a key coordinated wild dog management behaviours in which landholders could participate. This case study, conducted by a Research Masters student (Ms Debbie Dowden) in the Southern Rangelands of Western Australia, focuses on the community engagement aspect of the cell fence programs within this area. The full results can be found in Debbie's thesis – 'HOW BIG IS TOO BIG? Wild Dogs, Fences and People in the Southern Rangelands of Western Australia'. A summary of her findings are detailed here.

BACKGROUND

In Western Australia, wild dog predation on livestock represents a significant economic threat to livestock producers, with flow-on effects to associated industries such as transport and shearing. The Rangelands Cell Fencing Program was launched in February 2018 as a trial to determine if cell fencing is a cost-effective approach for protecting and renewing small livestock enterprises. Four Rangelands pastoral groups were granted funding to erect cell fences on their properties and assess their impacts on wild dog predation, and a range of other economic and ecological indicators: Kalgoorlie Pastoral Alliance Cell, Carnarvon Rangelands Barrier Fence; Murchison Regional Vermin Cell, and Murchison Hub Cell (see Figure 24).

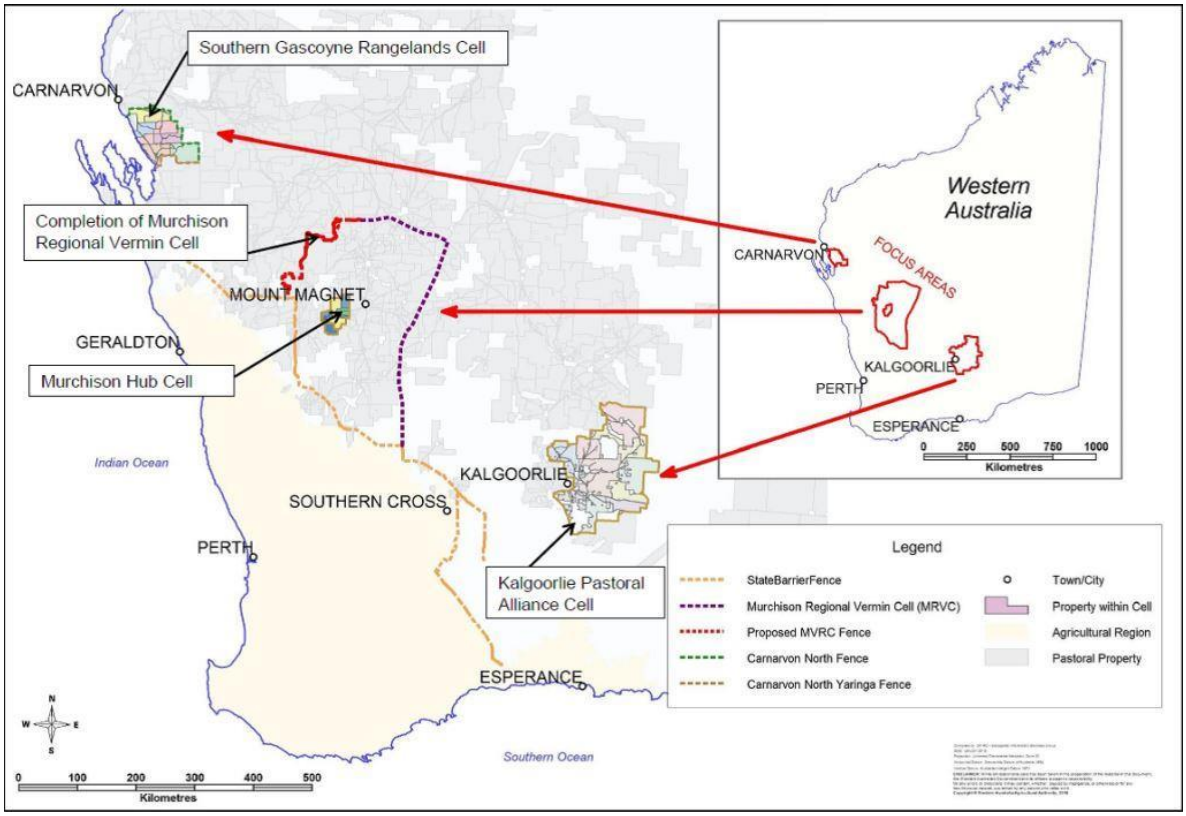

Figure 24: The four proposed Rangelands Cell Fencing projects in (Department of Primary Industries and Regional Development, 2019).

CASE STUDY OBJECTIVES

This project investigated the community engagement aspect of the cell fence program, focussing primarily on the Murchison Regional Vermin Council (MRVC) cell fence. The main objectives of the project are to:

1. Document landholder motivations for participating in the cell fence program, and assess the variability of motivations within each pastoral group, also across groups.
2. Document challenges that arise during the rollout of the project for landholders inside and outside of the fences.
3. Assess overall levels of project effectiveness (in collaboration with DIPIRD), and identify factors that distinguish between more successful and less successful rollouts.
4. Make recommendations for improving future cell fence initiatives in WA.

METHODS

A mixed-methods approach was taken, including detailed analysis of quantitative and qualitative data collected from surveys and interviews with landholders from the pastoral groups who have received funding for erecting cell fences on their properties, as well as landholders on properties adjacent to, but outside, the cell fences.

INTERVIEWS

Face-to-face interviews were conducted between July and September 2019. This method was chosen as it is more likely to elicit thorough replies and allows the observation of non-verbal cues to validate responses (Barriball & While, 1994). The interviews followed a semi-structured format, allowing the exploration of the perceptions and opinions of respondents regarding complex and sometimes sensitive issues (Bolderston, 2012). The interviews were conducted in accordance with the ethical standards of the Human Research Ethics Committee of the University of New England (Approval No. HE19-055)

Participants were chosen in consultation with the Department of Primary Industries and Regional Development (DPIRD) in Western Australia to represent a cross-section of interests. To obtain robust data, subjects with a good understanding of the Murchison Regional Vermin Cell fence project were targeted rather than those with little or no knowledge of the subject. Nineteen stakeholders participated in the interviews out of twenty-three who were approached. Three of the people approached were unable to commit to an interview time and one was unable to see the value of the project.

PASTORALISTS SURVEY

An online survey of pastoralists from within the Southern Rangelands was conducted between November 16th and December 18th 2020 (Ethics Approval HE20-132). Pastoralists were invited via an email which was distributed through their Recognised Biosecurity Groups by the executive officers. A link to the survey, consisting of 30 questions, was emailed along with a letter requesting landholder participation. A link was also posted on the Southern WA Rangelands Pastoralists Facebook page along with an invitation to participate. Two reminders were sent. 46 valid responses were received.

OVERVIEW OF RESULTS AND DISCUSSION

This research documented landholder motivations for participating in a Western Australian Cell Fence project. Using a mixed methods approach and spanning more than two years, it represents a comprehensive study of people, dogs and fences in the Southern Rangelands. It reveals some of the complexities of human behaviour and how significantly they can affect the success of an invasive species management project. This study reported that there are two components to the project. The first, building a dog proof fence to protect small stock, has been the goal for producers for many

years, and all of their efforts have been focused on the completion of this fence project. However, finishing the fence will not be the true measure of success. The second component of the project is coordinating a sustained, landscape-scale eradication effort that will sufficiently reduce wild dog numbers within that cell fence and enable producers to return to running small stock once again. If stakeholders can work together as a community and achieve their second goal, then the cell fence projects can be declared a success.

This study revealed that landholders involved with cell fence projects have a pragmatic approach to wild dog control. They are realistic about the fact that it will be extremely difficult to control all of the wild dogs within a seven and a half million hectare cell. They understand that everybody is going to have to work together to achieve the goal. They know that there needs to be a significant increase in wild dog control efforts by all stakeholders within the cells. They know the current MRVC cell is too big, but many see it as a starting point and hope to build smaller, more manageable cells, like the Murchison Hub, within its perimeter.

Overcoming long term financial hardship to be able to increase wild dog control efforts and build more exclusion fences, along with repairing infrastructure, is a barrier to the success of the project. However, the high market value of sheep and goats, coupled with the injection of funds into some pastoral businesses from Human Induced Regeneration carbon projects may enable some pastoral businesses to be in a position to make further investment in wild dog control.

Through semi-structured interviews, an anonymous landholder survey and collation of S7 poison distribution figures, data has been collected that reveals some of the human behaviour behind these projects. Human behaviour is incredibly complex and this study reveals some of the important factors that could be considered by anybody wishing to use fences to control invasive species at a landscape level. Applying ad-hoc approaches to behaviour change has been superseded by the application of scientifically based models of behaviour change. Applying Michie's COM-B model of behaviour change allows us to better categorise and understand human behaviour, and develop targeted interventions.

This research identified the drivers and barriers for wild dog control both inside and outside the fences and discovered that there is an enormous diversity of attitudes, ranging from highly committed small stock producers to stakeholders who wish to preserve the wild dog population. It has revealed that landholders who run small stock, have a high economic dependence on their property, and believe that 1080 baiting is effective, will be the most committed to conducting wild dog control. The Recognised Biosecurity Groups can deliver practical interventions, like providing easier to access tools and delivering tailored training and information sessions. They could use techniques like modelling behaviour and positive social pressure to encourage their fellow landholders to increase participation in wild dog control, but that alone is unlikely to encourage all stakeholders to participate.

Without the support of a deeper understanding of behavioural science, it will be a challenge for the biosecurity group to engage recalcitrant stakeholders in increased wild dog control over such an enormous tract of land. The biggest challenge for the community will be engaging those landholders who have low motivation, or are ideologically opposed to engaging in wild dog control on their properties. This research reveals that it is beyond the capacity of the RBG alone to manage wild dogs within such an immense structure. The efforts of the community are hindered by multiple social and institutional impediments. Part of the responsibility lies with institutions. Good governance is a strong indicator of success and without solid national, state and local institutional support in the form of an engagement strategy, clear governance roles, appropriate funding, a compliance strategy and supported targeted research, the fence projects could struggle to succeed.

Landholders need to carry an equal share of responsibility for the success or failure of the projects. Those within the fenced areas need to significantly increase their level of wild dog control, both at a community and individual level. They need to take personal responsibility for the problem, recognise their legal responsibilities to control wild dogs as declared pests, and exercise best practice, nil-tenure approach to work with all of their neighbours to maximise the chance of success.

Landholders could turn their attention to the Murchison Hub pilot project to determine if creating smaller cells could result in wild dogs being controlled sufficiently to allow the return to small stock. Smaller cells comprised of landholders with a strong shared vision on wild dog control, modelled on the cell fence projects in Queensland, should be considered.

Wild dog control remains a key challenge for the Southern Rangelands in Western Australia. The duty of controlling them is a shared responsibility between all stakeholders who are supported by the government. Understanding how human behaviour can affect the projects is not a panacea, but having a deeper understanding of it in the context of wild dog management can have a positive impact on this and future projects.

FUTURE RESEARCH

Greater engagement in wild dog control from beef producers would improve the success of the cell fence projects. The cost of wild dog predation upon the cattle industry in the Southern Rangelands is largely unknown. Research using the latest satellite eartag monitoring technology with movement alerts could provide valuable data about wild dog attacks on calves. Access to abattoir data could reveal the cost of wild dog attacks on sale beef cattle, as bite marks show up on carcasses. Research that could reveal the dollar value to industry may motivate more cattle producers to participate in wild dog control.

Rigorous scientific research could explore the efficacy and debunk the myths of some of the polarising management practices that are beginning to make their way into popular culture. Modelling the effect that a property conducting positive predator management can have on the wild dog population within the region would provide landholders with a deeper understanding of whether their decisions have a positive or negative impact on the wider environment, economy and community. Buffer zones have been offered by conservation properties as solutions to neighbourly conflict about wild dog control. Research into the efficacy of buffer zones in the Southern Rangelands would determine if these are an effective strategy for preventing wild dogs on conservation reserves from encroaching onto surrounding pastoral properties.

Engaging all landholders in wild dog exclusion fencing projects could divide the cells into a mosaic of smaller parcels which will facilitate wild dog control. More research should be conducted into the conservation co-benefits that exclusion fencing can offer in the Southern Rangelands. Exploring the opportunities for wildlife conservation for properties within cell fenced areas could offer some unexpected advantages for threatened fauna recovery and alleviate some tensions between community members.

Economic modelling demonstrating financial returns to landholders who might return to running small stock could demonstrate whether a positive financial return could be achieved over time that makes it viable to invest in increased wild dog control. Not every landholder is motivated by money alone, but in the Southern Rangelands, low economic returns over long periods of time have affected many pastoralists' ability to be viable. Modelling could be supported by the results of the Murchison Hub cell fence pilot project. It should include some options for erecting more fences around a single property or a group of like-minded neighbours. If economic modelling indicates a positive return on investment to landholders, then they will be more likely to fully engage in wild dog control.

There is some potential to further explore the relationship between place attachment and wild dog control in the Southern Rangelands. This is an emerging area of research in invasive species management, and the broad social-emotional attachment of this community the landscape and its relationship to wild dog control to could warrant further investigation.

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Note: bold references indicate project outputs. Other CISS and IA CRC publications are marked with an *

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COMPONENT 2.

BUILDING PRACTITIONER CAPACITY

INTRODUCTION

BACKGROUND

One of the long-term outcomes of Project PO1-E-001 is to establish a culture of collaborative, science-based continuous learning in the human dimensions of invasive species management within the state governments and industry partners. To achieve this outcome, this project is enhancing current practitioner capacity for best practice engagement and application of behaviour change interventions in two components. The first component used research to demonstrate the benefits of behavioural science and targeted engagement to accelerate sustainable participation in best practice wild dog management. This second component will work with practitioners, those people involved with implementing and facilitating wild dog management programs, to enhance their capacity through the establishment of a practitioner learning network, and the delivery of workshops and masterclasses. This enhanced capacity will have the potential to improve delivery of coordinated management programs and adoption of best practice management techniques, not only for wild dogs, but for a range of vertebrate invasive species, leading to reduced impacts by these species on agricultural and environmental assets.

PROJECT OBJECTIVES

The main objectives of this component are to:

1. Establish and evaluate a ‘learning network’ for professional development of wild dog practitioners across the country (build upon the existing ‘community of practice’ led by the National Wild Dog Management Coordinator)
2. Deliver workshops and masterclasses to practitioners that outline the developed approaches and findings from component one of this project.

LEARNING NETWORK

INTRODUCTION

BACKGROUND

The aim of a learning network is to increase knowledge and capacity of participants, thereby helping them to improve what they do. An alternative term, 'community of practice' refers to a group of 'people who share a concern, a set of problems or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis' (Wenger, McDermott and Snyder, 2002 p.4). Belonging to a learning network allows people to correspond easily and informally with people working in similar disciplines. It may help them to share information and ideas, work together on common initiatives, ask for assistance, prevent duplication of activities, and learn about and potentially avoid errors. Belonging to a learning network may also provide social and psychological benefits through the development of interpersonal relationships, and may help people feel less geographically and socially isolated.

Participants of learning networks usually meet face-to-face. Past research into communities of practice has therefore tended to focus on people who can and do meet in person. Online (or 'virtual') learning networks are, however, increasingly common because of globalisation, improved technology, and geographic dispersion of people. More recently, Covid-19 has restricted movements and gatherings of people across Australia and the world, with many people now working virtually from home, and interacting with others online. This research, which is investigating online rather than face-to-face learning networks, is therefore important and timely, and the findings will contribute to a relatively new and increasingly significant research gap.

PROJECT OBJECTIVES

The project objectives are to:

1. Build upon the existing 'community of practice' led by the National Wild Dog Management Coordinator, and establish a 'Wild Dog Learning Network' for professional development of wild dog practitioners across the country.
2. Evaluate the early stages of operation of the Wild Dog Learning Network, to identify any underpinning success factors and any areas of improvement. In particular:
    i. What are the features, enablers and benefits of, and barriers and improvements to the wild dog learning network?
    ii. What additional information can be gained from participants involved in invasive species research and facilitation about teams, co-located work units and other learning networks?
    iii. What are the experiences and perceptions of researchers and participants of the use of Zoom as a qualitative data collection and analysis tool, and Echo360 as a transcription tool?

ESTABLISHMENT OF WILD DOG LEARNING NETWORK

The Wild Dog Learning Network builds upon the existing 'community of practice' led by the National Wild Dog Management Coordinator (NWDMC). An informal needs assessment conducted at the Wild dog coordinators workshop in September 2018 and a model for the network included scheduling regular discussion groups, practitioner forums and peer-mentoring events. In collaboration with AWI, the online platform Slack was chosen to facilitate sharing of resources and learning opportunities. A 'human dimension' channel was added to this platform, and a variety of documents including results from ongoing research was shared, participants, however uptake was slow.

A schedule of regular wild dog coordinator monthly meetings, organised by the NWDMC commenced in June 2020. This meeting allows the coordinators to share information and experiences, and the opportunity for guest presentations by researchers and other persons of interest. These meetings are conducted using Zoom, and recorded so they could be uploaded to the Slack platform and shared with people who were unable to attend the meeting.

EVALUATION OF WILD DOG LEARNING NETWORK

Below is a summary of the findings of this study, conducted by Dr Katrina Dickson. Full details can be found in the separate report 'Developing and maintaining effective learning networks in invasive species management'.

METHODS

Nineteen individual semi-structured interviews were conducted via Zoom. Thirteen participants where directly associated with the wild dog learning network, including wild dog management co-ordinators, the NWDMC and associated personnel from different jurisdictions of Australia. The additional six key informants were all involved in various aspects of invasive species management including facilitation and research. Participants were drawn from state government agencies, industry bodies, research institutes and non-government organisations and involved in a range of species, including wild dogs, cats, deer, pigs and rabbits.

RESULTS

FEATURES, BENEFITS OF, BARRIERS AND IMPROVEMENTS TO THE WILD DOG LEARNING NETWORK

Results indicate that the wild dog group is functioning very effectively and learning, social and psychological/emotional needs of participants are being met through the group. A number of key findings have been identified.

Key Finding 1: The wild dog management group is a highly cohesive network who most of all value the support of each other because of their isolated, conflicted and at times traumatic working lives. They enjoy engaging with each other and are highly supportive of the monthly Zoom sessions that were initiated in early 2020. Their banter and chat indicates the high level of psychological safety that is necessary for open and relaxed conversation and expression of diverse opinions.

Key Finding 2: Participants value learning from each other and from researchers who are often scheduled to present during the Zoom sessions. They also value the research reports that are distributed amongst the group. This enables them to be conduits of information to community members.

Key Finding 3: Possible improvements to the Zoom sessions to be considered by the group include a regular schedule for the year; how to approach schedule changes if NWDMC or participants are unavailable; an intention for each meeting; presentations from coordinators; widening the scope to other invasive species; a reflective learning approach; and, training in conflict management and other human dimensions.

Key Finding 4: Participants place high value on in-person interaction at conferences and meetings and the associated social connection and informal learning. In-person interaction contributes to relationship-building, psychological/emotional support and deep, broad and rich learning. Participants identified reinstating in-person events and gatherings as a key priority when the Covid pandemic, that has curtailed travel and congregating, permits. While many benefits accrue from the regular Zoom sessions, Zoom sessions are viewed as a augmenting but not replacing in-person gatherings.

Self-determination theory (Ryan & Deci, 2017) may be applied to the results that have emerged from the study of the wild dog network. The following comments are made:

- The results indicate that the network plays a key role in providing the needs for social connection (Key Findings 1 and 4).
- Individuals' need for autonomy is primarily met within their individual work roles, however a greater need for certainty regarding the intention for each Zoom session was suggested by some participants (Key Finding 3). Nevertheless, it is important that the existing flexibility and highly valued informal aspects of the sessions are not jeopardised by any increase in formality because this may be to the detriment of social connection and enjoyment.
- The results further indicate that the network plays a key role in the need for competence through providing knowledge and information through learning from researchers and from each other (Key Findings 2 and 4).

It is suggested that while the human need for autonomy may be met without the network, the needs for social connection and competence require the network to be maintained through an appropriate combination of in-person and online interaction.

ADDITIONAL INFORMATION FROM PARTICIPANTS INVOLVED IN INVASIVE SPECIES RESEARCH AND FACILITATION

Interviews with the seven participants who work in the research or facilitation fields of invasive species management extended the findings of the case study in the wild dog management network and identified some further areas of research and practical application, including pursuing an integrated approach to invasive species management. The difficulties in online interaction in building relationships were noted. There was strong support for regular in-person meetings and associated social gatherings when possible. Suggestions regarding improvements to collaboration were raised and the key features and benefits of co-located work units and in-person communities of practice experienced by participants were identified. It is recommended that these are considered for further research and implementation in other situations and contexts where improvements to engagement, collaboration, job motivation, performance and outcomes are desirable.

EXPERIENCES AND PERCEPTIONS OF RESEARCHERS AND PARTICIPANTS OF THE USE OF ZOOM

The huge cost savings of conducting interviews with Zoom compared with in-person interviews, combined with the easy access to video recordings for data analysis meant that the research process was extremely rich, effective and efficient.

Common practice prior to the Covid pandemic was to conduct interviews in-person and digitally record these. However the pandemic has restricted travel and in-person meetings, and the use of video-conferencing has become the 'new normal' across the workplace and society. The use of video-conferencing software for qualitative data collection and analysis is a new and emerging research method, with little past literature to draw upon. Recent articles supporting the approach include Archibald, Ambagtsheer, Casey & Lawless (2019), Andrejuk (2020) and Lobe, Morgan and Hoffman (2020).

Key findings

The researcher suggests that conducting interviews by Zoom and recording videos for data analysis (with informed consent) in future qualitative research is an appropriate and cheaper alternative than in-person interviews if participants a located at great distances from the researcher and each other, and/or if there is not a further need to be on-site to collect additional research data. The researcher suggests that consideration be given to the use of higher quality digital transcription software, if consistent with ethics approval.

RECOMMENDATIONS

RESEARCH WITH WILD DOG NETWORK (SECTION 1)

SUMMARY

1. The wild dog management network is a highly cohesive network, members of which value the support of each other because of their isolated, conflicted and at times traumatic working lives. The network is built on strong relationships and friendships that developed through in-person interactions during conferences, meetings and associated social activities over approximately the past eight years. They enjoy engaging with each other and are highly supportive of the monthly Zoom sessions that were initiated in early 2020.
2. The existing features of the Zoom sessions are well-supported by participants, and are likely to engender the network's ongoing interaction.
3. Participants' strong existing relationships that have developed through past in-person formal and informal interactions were identified as paramount to the success of the online interactions.
4. Their strong relationships have contributed to a high level of psychological safety and trust in the group that is necessary for open and relaxed conversation and expression of diverse opinions. Psychological safety and trust are augmented by and demonstrated by their capacity for banter, chat and fun during informal interaction
5. Participants value learning from each other and from researchers who are often scheduled to present during the Zoom sessions. They also value the research reports that are distributed amongst the group.
6. While learning from each other and from researchers is important to participants, the social aspects and psychological/emotional support of the group are equally as important.
7. Strong relationships and connections are linked to job satisfaction, enjoyment and commitment and the transfer of tacit knowledge.
8. It is important that staff continue to be supported given their high levels of tacit knowledge, the years it takes to form positive working relationships within their communities, and the isolated, conflicted and often traumatic nature of their jobs.

RECOMMENDATIONS

Note: the following include recommendations/suggestions for the wild dog management network, CISS, funders and other groups

1. Continue with the regular Zoom sessions, including time within each session for informal discussions and banter. These are of high value to participants and contribute to psychological/emotional wellbeing, social interaction, job motivation and job satisfaction, while also enhancing learning.
2. Possible improvements to the Zoom sessions to be considered by the group include a regular schedule for the year; how to approach schedule changes if NWDMC or participants are unavailable; an intention for each meeting; and an enhanced reflective learning approach.
3. Online groups need effective facilitation and ground-rules and these may be specific to being online.
4. Continue and expand discussions on how a multi-species management approach may be implemented, including how wild dog coordinators may work within this expanded framework. Include a broader range of researchers in Zoom sessions.

5. Consider having two groups, a broader group for when researchers present and smaller group for less informal discussion. One way of doing this would be a big group for research presentations while maintaining the smaller species-specific groups for less formal interactions.

6. Schedule sessions where the focus is on one coordinator or one jurisdiction and their activities, initiatives or innovations.

7. Reconsider what social media and other tech applications will be supported and include an accessible and searchable repository of research papers and recordings.

8. Implement training in conflict management and other human dimensions, consider re-running a Muresk-type event.

9. Continue funding of baits for producers and delivery by coordinators.

10. More widespread use of video-conferencing presents an opportunity for researchers, facilitators, producers and others involved in invasive species management. At the same time it is important to acknowledge the downsides of overuse of Zoom, and to consider Zoom as an additional and beneficial tool, that supplements in-person meetings.

11. Participants identified reinstating in-person events and gatherings as a key priority when the Covid pandemic, w has curtailed travel and congregating permits. While many benefits accrue from the regular Zoom sessions, Zoom sessions are viewed as augmenting rather that replacing in-person gatherings. In-person formal and informal interactions are identified as crucial to building and maintaining ongoing social relationships, supporting psychological/emotional wellbeing and enabling deep, broad and rich learning.

RESEARCH WITH OTHER KEY INFORMANTS

SUMMARY

1. In-person meetings and conferences are viewed as superior to online meetings through their enhanced capacity for developing and maintaining relationships, building networks, improving collaboration and creating opportunities for further initiatives. However, meeting through Zoom is far cheaper and time effective than travelling to meetings in-person when this is not necessary. Zoom is viewed as superior to phone and may assist in maintaining relationships and collaborations that have been established in-person.

2. Collaboration is challenging when publishing, funding and challenges of working together are inherently competitive.

3. When work units function effectively, this leads to greater job satisfaction and performance and improved collaborative and community outcomes.

4. Effective communities of practice can enhance the experiences and learning of participants which is likely to lead to improved on-ground collaboration and outcomes in relation to invasive species management.

RECOMMENDATIONS

1. Prioritise in-person meetings and conferences and associated informal activities over online meetings, and establish online interaction as a valuable adjunct, but not a replacement for in-person meetings.

2. When initiating a new project, project teams meet in-person for the first meeting, at least. Project leaders and team members may benefit from coaching in how to work well together to successfully achieve outcomes.

3. Consider, research and implement key activities and initiatives, such as mentoring and/or coaching that improve collaboration, for example rewarding collaboration, identifying the

barriers to collaboration and fostering connections through in-person meetings and conferences to improve collaborative efforts, and ultimately invasive species outcomes.

4. Consider, research and implement an integrated approach to invasive species management, including ongoing improvements to coordination and management within and across species and jurisdictions; consistent monitoring of numbers and impacts; different options for investment; and instigating longer-term vision.
5. Consider, research and implement key activities and initiatives, such as mentoring and/or coaching that will help improve the effectiveness of work units and team, including creating a supportive work environment that fosters collaboration, motivation, performance, and ultimately achieves improved invasive species outcomes. It is recommended that this is supported by ongoing research, implementation and mentoring/coaching.
6. Consider, research and implement key activities and initiatives, such as mentoring and/or coaching that will help improve the effectiveness of communities of practice that are established and maintained to improve the management of invasive species through a collaborative, multi-stakeholder approach.

ZOOM AND ECHO360 FOR DATA COLLECTION AND ANALYSIS (SECTION 3)

SUMMARY

1. Participants reported the interview being conducted by Zoom was better than had it been conducted by phone. It was perceived as just as good as being conducted in-person, and superior when considering time and cost-savings.
2. The researcher reports the interview being conducted by Zoom was better than had it been conducted by phone. It was just as good as being conducted in-person, and superior when considering time and cost-savings.
3. The researcher reports that the use of Zoom video-recordings for data analysis was superior to using audio-recordings.
4. Improvements could be made in the transcription software

RECOMMENDATIONS

1. The researcher suggests that conducting interviews by Zoom and recording videos for data analysis (with informed consent) in future qualitative research is an appropriate and cheaper alternative than in-person interviews if participants are located at great distances from the researcher and each other, and/or if there is not a further need to be on-site to collect additional research data.
2. Automatic transcription is a viable and much faster and cheaper alternative than transcription by a person providing the quality is satisfactory.

CONCLUDING REMARKS

Australia has a poor track record in conserving its ecosystems and maintaining biodiversity. Invasive species, such as wild dogs, pigs, goats, cats, deer and rabbits, cause extensive damage to natural ecosystems and agricultural production systems, are a key threat to biodiversity, and a major cause of extinction of native flora and fauna. As well as having significant environmental impacts, invasive species continue to result in high economic, social and human costs. The management of invasive species, control of which may be highly conflicted and traumatic, requires innovative solutions, and the involvement of a wide range of stakeholders and diverse perspectives.

It is vital that continuous learning and collaborative and adaptive processes are prioritised in all aspects of invasive species management, including research and practice, if innovative responses to these wicked social-ecological challenges are to continue to emerge. Moreover, those who work in facilitation and co-ordination roles continue to need ongoing and strong support, particularly when their roles are isolated, conflicted and often traumatic. It is expected that ongoing support, including through regular in-person and online interaction, will continue to contribute to maintaining their motivation, job satisfaction, performance and long-term commitment to their roles, each other and their stakeholders, thereby improving invasive species outcomes.

The research findings highlight the continuing need for in-person events that enable rich learning, social interaction and psychological/emotional support. In-person gatherings can be augmented with, but not replaced by the ongoing and potentially increased use of video-conferencing, such as Zoom. Further research, implementation and collaboration between researchers, coordinators and other personnel is recommended and an integrated approach to multi-species considered. Human dimensions must continue to be prioritised. This may include further research, and implementation of initiatives such as coaching and mentoring to improve team, work unit and learning network effectiveness which will ultimately improve invasive species outcomes.

PROFESSIONAL WORKSHOPS & MASTERCLASSES

INTRODUCTION

Workshops and masterclasses are effective vehicles for teaching new theory and practice to practitioners to enhance their capacity. Workshops are usually brief, intensive specialty classes, and learning objectives are achieved through lecture, discussion, and practice, with a focus on techniques and skills in a particular field. Masterclasses are also specialty classes, however learning objectives are achieved through more detailed instruction and in-depth practice.

This project originally proposed to deliver at least two face-to-face workshops / masterclasses to practitioners. However with the uncertainty created by the Covid-19 pandemic, the delivery moved from face-to-face to the virtual space. To obtain maximum benefit and create a legacy for years to come we have developed online masterclasses which can be accessed at any time, as well as the resources for four specific workshops which can be delivered either virtually, or face-to-face.

ONLINE MASTERCLASSES

The online Invasives Action Tool (https://actiontool.invasives.com.au/) was created as a result of the research under Program 4 of the Invasive Animals Cooperative Research Centre (IA CRC) to provide practitioners with a free resource where they could learn about engagement and behaviour change best-practice principles at a time and place that fitted their work schedule. Currently this tool has five modules, covering a range of engagement and communication principles (Figure 25). Each module consists of functional lessons, each with its own learning goals and practical exercises. Individuals can complete the lessons themselves or collaborate with a group to complete each task.

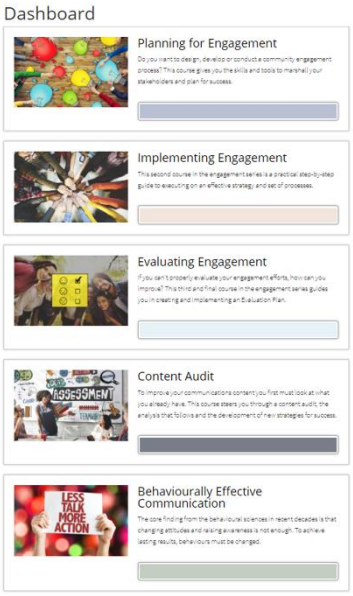

Figure 25: Dashboard of the Invasives Action Tool showing the five modules already developed by Program 4 of the IA CRC.

This project will add three new modules, along with a companion practical manual from the approaches refined by component one of this project. They will cover:

1. Guidelines for practitioners to design an effective survey instrument
2. Guidelines for practitioners to develop behaviourally effective interventions
3. Guidelines for practitioners to develop effective evaluation plans.

WORKSHOP TRAINING RESOURCES

In addition to the online modules in the Invasive Action Tool, training resources for four workshops will be produced. These workshops will cover:

1. Designing effective survey instruments
2. Developing behaviourally effective interventions
3. Developing behaviourally effective communications
4. Developing effective evaluation plans.

These resources will include teaching materials / notes, presentation slides (Powerpoint and Keynote), and individuals and group activities, covering the content that is provided in the modules and manuals. This material will allow competent NRM practitioners to train the next cohort of practitioners, either face-to-face on in a virtual setting.

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Most importantly a big thank you to all the landholders, stakeholders and experts who participated in our many interviews and surveys.

APPENDICES

APPENDIX 1: SEMI-STRUCTURED INTERVIEW QUESTIONS FOR KEY STAKEHOLDERS

Introduction: We (Lynette McLeod or Huw Nolan) are conducting research into improving participation rates in wild dog management. This project is funded through the Centre for Invasive Species Solutions (CISS). The aims of our project are to develop a greater understanding of the capacity, opportunity and motivations of rural communities to engage in wild dog management, so we can develop better engagement strategies and messaging, and assist you in your task of delivering effective community-led and coordinated management programs. The first step in our approach, which is informed by behavioural sciences, is to identify those specific landholder behaviours and actions which are important for effective wild dog management in your area. Your perspective can help us understand the complex behavioural factors associated with this issue. In addition we would like to know how best we can keep in touch with you to provide effective and timely assistance when required.

Before we begin I would like to affirm your consent to participate please (record replies):

Have you read the information contained in the Information Sheet for Participants and any questions asked have been answered to you satisfaction? Yes/No

Do you agree to participate in this activity, realising that you may withdraw at any time? Yes/No

Do you agree that research data gathered may be quoted and published using a pseudonym? Yes/No

Do you agree to having the interview audio recorded and transcribed? Yes/No

Are you older than 18 years of age? Yes/No

Interview questions	Behavioural questions	Prompts/notes	Analysis
1. Tell me about the area in which you work?		How long have you been working on wild dog issues in this area? How many groups do you coordinate? How severe is the wild dog problem? Proportion of participants/ non-participants?	Background information, potential segmentation categories
2. What behaviours or actions do you see as important for landholders or community members to undertake to reduce wild dog impacts (economic, public health, environmental and psycho-social) in your area?	What can landholders and/ or community members do to reduce wild dog impacts Are there any actions they should stop doing?	Prompt to uncover behaviours: What do you see as important/not important? Attending meetings, regular monitoring, reporting sightings, controlling at particular times, using guardian animals, building fences (individual or in groups), responsible dog ownership, pig hunting dogs regulations, others?	Identification of what behaviours underpin the local wild dog issue and who is responsible
3. We wish to create a working learning network, so all the wild dog managers can stay in touch and can communicate new research outcomes as they occur. Have you ever been part of an online network that worked?		What worked/ didn't work in the past? Is there any online medium you will not use (facebook/email/ new software)?	
Would you like to be a part of an online learning network?		What do you anticipate as being the major barriers to a successful learning network? (Experience with technology, time, too much irrelevant information etc.)	

APPENDIX 2: KEY STAKEHOLDER ONLINE SURVEY TO MEASURE BEHAVIOUR IMPACT

Thank you for taking the time to complete this questionnaire.

You will be presented with a range of different behaviours that can be undertaken by landholders to reduce wild dog impacts in rural areas. In your role as wild dog management experts we would like you to evaluate the effectiveness of each of the listed behaviours in reducing adverse negative wild dog impacts in your area.

Rate the effectiveness of each behaviour on a 10 point scale (0= not at all effective in reducing impacts, 9= extremely effective in reducing impacts).

In evaluating the impacts of the listed behaviours assume that a critical mass of individuals change their behaviour.

Q1. How many years have you been working on wild dog issues?

Q2. What is your position?

Behaviour	Not at all effective 0	1	2	3	4	5	6	7	8	Extremely effective 9
Q3. Rate the effectiveness of landholders being part of a local wild dog control group	○	○	○	○	○	○	○	○	○	○
Q4. Rate the effectiveness of landholders incorporating annual wild dog control as part of their property management plan	○	○	○	○	○	○	○	○	○	○
Q5. Rate the effectiveness of landholders laying 1080 baits (using good baiting practice) on their property in coordinated effort with their neighbours and/or local wild dog group.	○	○	○	○	○	○	○	○	○	○
Q6. Rate the effectiveness of landholders laying PAPP baits (using good baiting practice) on their property in coordinated effort with their neighbours and/or local wild dog group.	○	○	○	○	○	○	○	○	○	○
Q7. Rate the effectiveness of landholders allowing access to their property for aerial baiting activities to occur.	○	○	○	○	○	○	○	○	○	○
Q8. Rate the effectiveness of landholders deploying ejectors on their properties (at a suitable standard) during coordinated efforts with neighbours and / or local wild dog group.	○	○	○	○	○	○	○	○	○	○
Q9.Rate the effectiveness of landholders laying 1080 baits on their property (using good baiting practice) whenever wild dogs are sighted or attacks occur in their local area (i.e. reactive baiting).	○	○	○	○	○	○	○	○	○	○
Q10. Rate the effectiveness of landholders setting leg-hold traps on their property (using	○	○	○	○	○	○	○	○	○	○

Behaviour	Not at all effective 0	1	2	3	4	5	6	7	8	Extremely effective 9
good trapping practice) whenever wild dogs are sighted or attacks occur in their local area.										
Q11. Rate the effectiveness of landholders giving access for professional trappers to work on their property when wild dogs are sighted or attacks occur in their local area.	○	○	○	○	○	○	○	○	○	○
Q12. Rate the effectiveness of landholders shooting wild dogs whenever they see them on their property.	○	○	○	○	○	○	○	○	○	○
Q13. Rate the effectiveness of landholders allowing access for professional shooters to work on their property when wild dogs are sighted or attacks occur in their local area.	○	○	○	○	○	○	○	○	○	○
Q14. Rate the effectiveness of landholders promptly reporting the presence of wild dogs on the property (detected by sightings, signs, cameras) to their relevant agency/ wild dog group by a pre-determined method(s) (e.g. phone, email, Wild Dog Scan).	○	○	○	○	○	○	○	○	○	○
Q15. Rate the effectiveness of landholders promptly reporting any wild dog attacks to relevant agency / wild dog group by pre-determined method(s) (e.g. designated hotline, Wild Dog Scan).	○	○	○	○	○	○	○	○	○	○
Q16. Rate the effectiveness of landholders regularly providing information on wild dog damage, livestock production figures, control activity information etc when requested by	○	○	○	○	○	○	○	○	○	○

Behaviour	Not at all effective 0	1	2	3	4	5	6	7	8	Extremely effective 9
relevant agency by pre-determined method(s) (e.g. mail, email, Wild Dog Scan).										
Q17. Have we missed anything important? If yes, please add in the text box provided and rate its effectiveness _____	○	○	○	○	○	○	○	○	○	○

Thank you very much for taking the time to fill in this questionnaire. Please click on the next button to ensure your responses are saved correctly and have a great day!

APPENDIX 3: LANDHOLDER PHONE SURVEY 1 - BASELINE PARTICIPATION

Q1. What is your postcode? _____

Q2. What is your nearest town? _____

Q3. And what is the size of your property? _____ hectares _____ acres

(close if under 2 hectares or 5 acres)

Q4. How long have you lived on this property (total in years)? _____

Q5. What is your property used for? *(may be multiple)*

Cattle (beef or diary)	1	Sheep (wool or meat)	2
Other livestock (specify)	3		
Cropping	4	Horticulture	5
Other (specify)	6		
Hobby farm	7	No enterprise (lifestyle block)	8

Q6. Do you earn your main source of income from your property? Yes 1 No 2

Q7. Which of the following statements best describe the current situation regarding wild dogs on your property?

I do not have any wild dogs on my property	1
Wild dogs are present, but do not pose a problem on my property	2
Wild dogs are a minor problem on my property	3
Wild dogs are a moderate problem on my property	4
Wild dogs are a serious problem on my property	5

I'm going to read out a list of activities that landholders use to manage wild dogs on their property. I'll be asking you how often you have undertaken these activities in the past, and how likely in the next 12 months?

(a coordinated control strategy is when a group of landholders decide to conduct control activities for wild dogs at the same time, usually overseen by a local wild dog control coordinator or similar)

Scales: how often scale = 0, 1, 2, 3, 4, 5+ times

how likely scale 1 – 10, where 10 = very likely, 5 = undecided, 1 = not at all likely

	how often?	**how likely?**
Q8. In how many of the previous 5 years, have you participated in a coordinated control strategy for wild dogs?		
Q9. In how many of the previous 5 years, have you included wild dog control activities as part of your annual property management plan?		
Q10. During the past 12 months how often have you laid dog baits on your property as part of **a coordinated control strategy**? *(explain as necessary – refer above)*		
Q10a. *(If 1 – 5+ times)* What type of baits did you lay? *(circle bait used)*	1080 PAPP Unsure	
Q11. During the past 12 months how often have you **independently** laid dog baits on your property at a time that suits you (i.e. **NOT as part of a coordinated control strategy**)?		
Q11a. *(If 1 – 5+ times)* What type of baits did you lay? *(circle bait used)*	1080 PAPP Unsure	
Q12. During the past 12 months how often have you used ejectors on your property?		
Q12a. *(If 1 – 5+ times)* Was it part of a **coordinated control strategy**, or set independently?	Co-ord Alone Unsure	
Q13. During the past 12 months how often have you provided access to your property for aerial wild dog baiting to occur?		
Q14. During the past 12 months how often have set leg-hold traps on your property?		
Q14a. *(If 1 – 5+ times)* Was it part of a **coordinated control strategy**, or set independently?	Co-ord Alone Unsure	
Q15. During the past 12 months how often have you allowed a professional trapper to set leg-hold traps on your property?		
Q16. During the past 12 months how often have you used shooting (either yourself or someone else) as a method to remove wild dogs when you have seen them on your property?		
Q17. During the past 12 months how often have you reported the presence of wild dogs on your property, or any impacts they have caused to the appropriate agencies?		
Q18. Many wild dog control agencies require regular feedback from landholders about dog presence, number of dogs removed, stock attacks, etc so they can allocate their resources and plan their future control activities. In the past 5 years, how often have you provided this type of feedback?		

Q20. Why do you think people might be reluctant to undertake the following practices?

	Reason 1	**Reason 2**	**Reason 3**
a) participate in a coordinated control strategy for wild dogs			
b) include wild dog control activities as part of their annual property management plan?			
c) lay dog baits on their property as part of a coordinated control strategy			
d) independently lay dog baits on their property at a time that suits me			
e) use ejectors on their property			
f) allow access for aerial baiting on their property			
g) set leg-hold traps on their property			
h) allow professionals to set leg-hold traps on their property			
i) use shooting as a method to remove wild dogs when they see them on their property			
j) report the presence of wild dogs, or any impacts to the appropriate agencies			
k) provide feedback to agencies about the number of dogs removed, stock attacks, etc			

Q21. What was your age at last birthday? _____

Q22. Gender Male 1 Female 2

APPENDIX 4: LANDHOLDER SURVEY - BARRIERS AND DRIVERS TO CONDUCTING COORDINATED WILD DOG CONTROL EFFORTS

Q1. What is your postcode? _____

Q2. What is your nearest town? _____

Q3. And what is the size of your property? _____ hectares _____ acres

(close if under 10 hectares or 25 acres)

Q4. How long have you lived on this property (total in years)? _____

Q5. What is your property used for? *(may be multiple)*

Cattle (beef or diary)	1	Sheep (wool or meat)	2
Other livestock (specify)	3		
Cropping	4	Horticulture	5
Other (specify)	6		
Hobby farm	7	No enterprise (lifestyle block)	8

Q6. Do you earn your main source of income from your property? Yes 1 No 2

Q7a. Which of the following statements best describe the current situation regarding wild dogs on your property?

I do not have any wild dogs on my property	1
Wild dogs are present, but do not pose a problem on my property	2
Wild dogs are a minor problem on my property	3
Wild dogs are a moderate problem on my property	4
Wild dogs are a serious problem on my property	5

Q7b. *(if response code 3, 4 or 5)* What type of problem? _____

Q8. Which of the following statements best describe your current approach to wild dog management on your property?

I do not conduct any wild dog control activities	1
I only conduct control activities when wild dogs are spotted and / or cause damage	2
I conduct control activities every year, whether dogs have been active or not	3
I conduct control activities every year, and further activities if damage occurs	4
I rely on fencing to provide constant protection	5
I rely on guard animals to provide constant protection	6
Other ……..	7

Q9a. Control activities for wild dogs can be conducted independently by a landholders at a time that suits them, or as part of a coordinated group effort (i.e. control activities conducted at the same time as neighbouring landholders, usually overseen by a local wild dog control coordinator or similar).

In the past 3 years how often have you conducted the following control activities on your property, either independently or as part of a coordinated action?

		Never	Once	Twice	3 times	> 3 times
a. Ground baiting (1080 or PAPP)	i) Independently	1	2	3	4	5
	ii) As part of coordinated action	1	2*	3*	4*	5*
b. Shooting	i) Independently	1	2	3	4	5
	ii) As part of coordinated action	1	2*	3*	4*	5*
c. Trapping	i) Independently	1	2	3	4	5
	ii) As part of coordinated action	1	2*	3*	4*	5*
d. Aerial baiting		1	2*	3*	4*	5*

(if once or more often for a ii, b ii, c ii and/or d above)

Q9b. Who is most likely to contact you to be part of this wild dog coordinated action?

	a ii	**b ii**	**c ii**	**d**
A neighbour	1	1	1	1
Someone from the local wild dog group	2	2	2	2
An employee from the Local Land Services (LLS)	3	3	3	3
The regional wild dog coordinator (DW or BD)	4	4	4	4
No one has ever contacted me about participating	5	5	5	5
Not sure / can't remember	6	6	6	6
Other	7	7	7	7

Q10. People give many reasons why they do or do not conduct coordinated wild dog control activities on their property (such as baiting, trapping and shooting). I am going to read out a list of these reasons. Please tell me to what extent you agree or disagree with each statement as it applies to you – on a scale of 1 to 5, where 1=strongly disagree and 5 = strongly agree *(dk = don't know/not sure) (rotate statements a - r, mark first mention)*

	disagree				**agree**	
a. I am not aware of wild dog problems in my area	1	2	3	4	5	dk
b. I do not know when the coordinated wild dog control activities are happening	1	2	3	4	5	dk
c. I do not know the best methods to control wild dogs on my property	1	2	3	4	5	dk
d. I am not confident that I can successfully engage in coordinated wild dog control activities	1	2	3	4	5	dk
e. I do not find it easy to cooperate with the other members of a group	1	2	3	4	5	dk
f. Participating in coordinated wild dog control activities is too costly	1	2	3	4	5	dk
g. I do not have the time to plan coordinated wild dog control activities	1	2	3	4	5	dk
h. It is not convenient to carry out coordinated wild dog control activities at the same time as the rest of the group	1	2	3	4	5	dk
i. I am reluctant to engage in coordinated wild dog control activities because my property is close to residential areas	1	2	3	4	5	dk
j. My family and close friends would be supportive if I engaged in coordinated wild dog control activities	1	2	3	4	5	dk
k. Most of my neighbours do not participate in coordinated wild dog control activities, so why should I?	1	2	3	4	5	dk
l. I don't participate in coordinated wild dog control activities because I believe wild dogs should not be harmed	1	2	3	4	5	dk
m. I usually avoid participating in coordinated wild dog control activities because I am self-conscious about my low level of knowledge and skills	1	2	3	4	5	dk
n. I don't participate in coordinated wild dog control activities because I believe the methods are inhumane	1	2	3	4	5	dk
o. I am reluctant to engage in coordinated wild dog control activities because it is the government's responsibility	1	2	3	4	5	dk
p. I am reluctant to engage in coordinated wild dog control activities because wild dogs are not a problem on my property	1	2	3	4	5	dk
q. I usually avoid participating in coordinated wild dog control activities because I prefer to conduct wild dog control activities by myself	1	2	3	4	5	dk
r. I usually avoid participating in coordinated wild dog control activities because I prefer not to bait	1	2	3	4	5	dk
s. I engage with coordinated wild dog control activities as I want to help my community manage their wild dog problems	1	2	3	4	5	dk

	disagree			**agree**		
t. I don't participate in coordinated wild dog control activities as I worry about the harm it may cause other animals	1	2	3	4	5	dk
u. I don't participate in coordinated wild dog control activities because they are not effective	1	2	3	4	5	dk
v. I'm reluctant to engage in coordinated wild dog control activities because they have can harm my working dogs	1	2	3	4	5	dk
w. When asked to participate in coordinated wild dog control activities, I usually say yes without giving it much thought.	1	2	3	4	5	dk

Q11a. What was your age at last birthday? …… *declined 99*

Q11b. Gender Male 1Female 2 Other 3 *declined 99*

APPENDIX 5: LANDHOLDER ONLINE PANEL SURVEY – MESSAGE EVALUATION

These first four questions will collect some background information about you.

What is your gender?

○ Male ○ Female ○ Other ○ Prefer not to say

What is your current age? _____

What is your postcode? _____

What is the name of your nearest town? _____

This next set of questions will collect some background information about your property

What is the size of your property (in hectares) _____

How long have you lived on this property (in years)? _____

Do you own or rent your property?

○ Own ○ Rent ○ Other (please specify) _____

Please indicate the types of enterprise(s) you have on your property (multiple selections allowed)

☐ Cattle (beef or dairy)

☐ Sheep (wool or meat)

☐ Other types of livestock (please specify) _____

☐ Cropping

☐ Horticulture

☐ Other (please specify) _____

☐ Hobby farm

☐ No enterprise (lifestyle block)

Do you earn your main source of income from your property?

○ No ○ Yes

Do you expect to be living on your property 5 years from now?

○ Definitely not ○ Probably not ○ Might or might not ○ Probably yes ○ Definitely yes

Please rate your agreement to the following statements.

(these statements will be randomized)	Do not agree	Slightly agree	Moderately agree	Agree	Strongly agree
My property is a good place for my family to earn a living	○	○	○	○	○
My property provides economic opportunities for my family	○	○	○	○	○
My property is a good place for my family to relax and enjoy themselves	○	○	○	○	○
My property provides recreation opportunities for my family and friends	○	○	○	○	○
I feel connected to the natural landscape of the local area	○	○	○	○	○
I feel a part of the land, it is not just a place to live	○	○	○	○	○
I miss my property when I am away from it for too long	○	○	○	○	○
My property reflects who I am	○	○	○	○	○

This next set of questions is about your connection with your local community.

Are you a member of any local groups (this can include interest groups, sporting clubs, Landcare etc)?

○ None of them ○ Less than half of them ○ Half of them ○ More than half of them ○ All of them

How many of your immediate neighbours do you know?

None of them ○ Less than half of them ○ Half of them ○ More than half of them ○ All of them

How often in the last 3 years have you gathered with your neighbours to take action on a local problem?

○ Never ○ Once ○ 2-3 times ○ 4-6 times More than 6 times

Please rate your agreement with the following statements.

(these statements will be randomized)	Do not agree	Slightly agree	Moderately agree	Agree	Strongly agree
I feel connected to my local community	○	○	○	○	○
I feel part of my local community, it is not just a place to live	○	○	○	○	○
I miss my community when I am away from it too long	○	○	○	○	○
My local community reflects who I am	○	○	○	○	○
I trust my community to take the best action for local problems	○	○	○	○	○
I have many opportunities to be involved in community activities	○	○	○	○	○

These next set of questions will be focused on wild dogs.

To what extent do you consider wild dogs to be a problem on your property?

○ I do not have any wild dogs on my property

- ○ Wild dogs are present, but do not pose a problem on my property
- ○ Wild dogs are a minor problem on my property
- ○ Wild dogs are a moderate problem on my property
- ○ Wild dogs are a serious problem on my property

Do you use fencing or guard animals for protection against wild dog damage?

- ○ No, I do not use either of these techniques
- ○ Yes, fencing only
- ○ Yes, guard animals only
- ○ Yes both fencing and guard animals

Control activities for wild dogs can be conducted independently by a landholders at a time that suits them, or as part of a coordinated group (i.e. control activities are conducted at the same time as neighbouring landholders, usually overseen by a local wild dog group coordinator).

In the past 3 years how often have you conducted the following wild dog control activities on your property, either independently or as part of a coordinated action?

	Never	Once	Twice	Three times	More than three times
Ground baiting (1080 or PAPP toxin) - independently	○	○	○	○	○
Ground baiting (1080 or PAPP toxin) - as part of coordinated action	○	○	○	○	○
Shooting - independently	○	○	○	○	○
Shooting - as part of coordinated action	○	○	○	○	○
Trapping - independently	○	○	○	○	○
Trapping - as part of coordinated action	○	○	○	○	○
Aerial baiting	○	○	○	○	○

How likely are you to participate in a coordinated control activity for wild dogs in the coming year?

○ Not at all ○ Slight chance ○ Moderately ○ Very ○ Extremely

Are you aware that under the ***NSW Biosecurity Act (2015)*** (***QLD Biosecurity Act (2014)***) all landholders have a responsibility to control wild dogs on their land, and prevent them causing problems on neighbouring properties?

○ No

○ Yes

We will now show you a typical message advertising for landholders to be involved in a wild dog group control activity. Please read it. We will then ask you to rate various aspects of the message.

Randomly selected message will contain one of each of these categories

Loss Framing	Social Norm	Method
Wild dogs can cause significant damage to livestock production enterprises through predation and disease transfer. Maintaining a viable sheep and goat enterprise is almost impossible when wild dogs are present. Wild dogs can also be economically costly for cattle producers through transmission of disease and parasites and predation of calves, weaners and vulnerable adult cattle.	In NSW (QLD) all landowners have a responsibility to control wild dogs on their land and prevent them from causing problems on neighbouring lands. The most effective method of doing this is to join a coordinated group control program.	Each year your local LLS (Shire Council) coordinates group programs using a variety of control methods including baiting, trapping and shooting. To find out more about group control programs in your area, contact your local LLS (Shire Council).
Wild dogs prey on native wildlife and have been implicated in the decline of several species. This impact on local wildlife can be worsened when wild dog densities are higher than normal, and particularly if that species is suffering from other threatening processes, such as habitat fragmentation, drought or bushfires. Some individual dogs can also become specialist predators of a particular native species, and can persecute a small population until there are very few left in that locality.	The most effective method of controlling wild dog damage across NSW (QLD) landscapes is to work together with your neighbours in a coordinated effort. "*I am very pleased to participate in my local wild dog program. I have an occasional problem with wild dogs, however I know my neighbours have suffered sheep losses in the past*", said Peter, a landholder near Walcha, NSW.	Each year your local LLS (Shire Council) coordinates group programs and encourage all landholders to participate in whatever capacity they are able. To find out more about group control programs in your area, and negotiate how you can be involved, contact your local LLS (Shire Council).
Wild dog attacks on livestock and domestic pets are extremely distressing. Many landholders who are faced with the constant threat of wild dogs can become depressed, impacting their family life. Rural communities also suffer as a result of forces enterprise changes, including diminished employment opportunities, loss of businesses and services, and subsequent population decline in rural towns.		

To what extent did the message persuade you that wild dogs are a serious threat?

Not at all Slightly Moderately Very Extremely

To what extent did the message persuade you that managing wild dogs is an important issue?

Not at all Slightly Moderately Very Extremely

To what extent did the message persuade you that wild dog control is something you should be doing on your property?

Not at all Slightly Moderately Very Extremely

To what extent did the message motivate you to participate in a coordinated wild dog control activity?

Not at all Slightly Moderately Very Extremely

To what extent did the message make you want to avoid thinking about wild dog control?

Not at all Slightly Moderately Very Extremely

To what extent did the message provide you with useful information about coordinated wild dog control activities?

Not at all Slightly Moderately Very Extremely

To what extent did you feel the message tried to manipulate your views?

Not at all Slightly Moderately Very Extremely

To what extent did the message motivate you to contact the LLS (local Shire Council) to find out more information?

Not at all Slightly Moderately Very Extremely

What would be your preferred method to contact the LLS (local Shire Council) to find out more information?

LLS (local Shire Council) phone number so I can ring

- ○ Email address so I can send an email inquiry
- ○ Website address so I can read further information before contacting the LLS (local Shire Council)
- ○ Other (please specify) _____
- ○ I am not interested in contacting the LLS (local Shire Council) to find out further information

After reading this message, what is your willingness to participate in a coordinated wild dog control activity?

- ○ None at all
- ○ Slight chance
- ○ Moderate chance
- ○ Likely
- ○ Very likely

APPENDIX 6: LANDHOLDER PHONE SURVEY - BARRIERS AND DRIVERS TO REPORTING WILD DOG SIGHTINGS AND IMPACTS

Q1. What is your postcode? _____

Q2. What is your nearest town? _____

Q3. And what is the size of your property? _____ hectares _____ acres

(close if under 10 hectares or 25 acres)

Q4. How long have you lived on this property (total in years)? _____

Q5. What is your property used for? *(may be multiple)*

Cattle (beef or diary)	1	Sheep (wool or meat)	2
Other livestock (specify)	3		
Cropping	4	Horticulture	5
Other (specify)	6		
Hobby farm	7	No enterprise (lifestyle block)	8

Q6. Do you earn your main source of income from your property? Yes 1 No 2

Q7a. Which of the following statements best describe the current situation regarding wild dogs on your property?

I do not have any wild dogs on my property	1
Wild dogs are present, but do not pose a problem on my property	2
Wild dogs are a minor problem on my property	3
Wild dogs are a moderate problem on my property	4
Wild dogs are a serious problem on my property	5

Q7b. *(if response code 3, 4 or 5)* What type of problem? _____

Q8. In the past 5 years, how often have you reported wild dogs or wild dog impacts?

never (go to Q10a)	just once	2 – 3 times	4 – 5 times	more than 5 times

Q9a. Who did you report this to?

9a. Who	9b. How
My neighbour/s My local wild dog group Local Land Services Regional wild dog co-ordinator (Dave Worsley or Bruce Duncan) Local council Not sure/can't remember Other (specify)	

Q9b. (for those reported to) And how did you report this? (may be multiple)

Phone (ring)	1	Email	4
Wild Dog Scan	2	Smartphone mobile app	5
Online reporting form	3	In person	6
Other (specify)	7		

Q10a. If you encountered wild dogs, or saw impacts of wild dogs in the future, what is the likelihood you would report this – on a scale of 1 to 5, where 5 = very likely, 1 = very unlikely? 1 2 3 4 5 dk/not sure

Q10b. If you were to report this, who would you be most likely to report to?

10b. Who	10c. How
My neighbour/s My local wild dog group Local Land Services The regional wild dog co-ordinator (Dave Worsley or Bruce Duncan) Local council Not sure/can't remember Other (specify)	

Q10c. (for those reported to) And how did you report this? (may be multiple)

Phone (ring)	1	Email	4
Wild Dog Scan	2	Smartphone mobile app	5
Online reporting form	3	In person	6
Other (specify)	7		

Q11a. What one thing that you think would make people more likely to report wild dog sightings and/or impacts in the future?

Q11b. And what one thing that you think would make people less likely to report wild dog sightings and/or impacts in the future?

Q12. People give many reasons why they don't report wild dogs or their impacts when they see them. I am going to read out a list of these reasons.

Please tell me to what extent you agree or disagree with each statement – using the scale 1 = strongly disagree to 5 = strongly agree *(dk = don't know)*

		Disagree			Agree		
a	I often have a hard time telling the difference between a wild dog and a domestic dog	1	2	3	4	5	dk
b	Wild dogs are not a serious problem on my property	1	2	3	4	5	dk
c	There is no need to report to authorities as I handle the problem myself	1	2	3	4	5	dk
d	I do not know who to contact if I see a wild dog or impacts of wild dogs	1	2	3	4	5	dk
e	If I report wild dogs on my property, the authorities will require me to implement expensive control methods	1	2	3	4	5	dk
f	Current reporting methods are too time-consuming	1	2	3	4	5	dk
g	Current reporting methods are too inconvenient	1	2	3	4	5	dk
h	No-one I know reports wild dogs or their impacts	1	2	3	4	5	dk
i	I do not want the authorities coming onto my property	1	2	3	4	5	dk
j	There is no point reporting as the authorities do not act anyway	1	2	3	4	5	dk
k	It is not my responsibility to report wild dog sightings or impacts	1	2	3	4	5	dk
l	I am worried that any control activities that are implemented could harm my own dogs	1	2	3	4	5	dk
m	I am reluctant to report because I do not want the wild dogs to be hurt or killed	1	2	3	4	5	dk
n	If I report wild dogs on my property, people will think I'm not a good land manager	1	2	3	4	5	dk
o	I am reluctant to report because I will be forced to implement control activities I do not like	1	2	3	4	5	dk

Q13a. What was your age at last birthday? *declined 99*

Q13b. Gender Male 1 Female 2 Other 3 *declined 99*

APPENDIX 7: ONLINE LANDHOLDER SURVEY QUESTIONS – WILD DOG SCAN EVALUATION

These first four questions will collect some background information about you.

What is your gender?

- ○ Male
- ○ Female
- ○ Other
- ○ Prefer not to say

What is your current age? _____

What is your postcode? _____

With which Wild Dog Association (WDA) are you mainly affiliated?

▼ Not sure ... None of the above

This next set of questions will collect some background information about your property

What is the size of your property (in hectares)_____

How long have you lived on this property (in years)?_____

Do you own or lease your property?

- ○ Own
- ○ Lease
- ○ Other (please specify) _____

Please indicate the types of enterprise(s) you have on your property (multiple selections allowed)

- ☐ Cattle (beef or dairy)
- ☐ Sheep (wool or meat)
- ☐ Other types of livestock (please specify) _____
- ☐ Cropping
- ☐ Horticulture
- ☐ Other (please specify) _____

- [ ] Hobby farm
- [ ] No enterprise (lifestyle block)

Do you earn your main source of income from your property?

- ○ No
- ○ Yes

Do you expect to be living on your property 5 years from now?

- ○ Definitely not
- ○ Probably not
- ○ Might or might not
- ○ Probably yes
- ○ Definitely yes

These next set of questions will be focused on wild dogs.

To what extent do you consider wild dogs to be a problem on your property (select the option that best suits your situation)?

- ○ I do not have any wild dogs on my property
- ○ Wild dogs are present, but do not pose a problem on my property
- ○ Wild dogs are a minor problem on my property
- ○ Wild dogs are a moderate problem on my property
- ○ Wild dogs are a serious problem on my property

Do you use fencing or guard animals for protection against wild dog damage?

- ○ No, I do not use either of these techniques
- ○ Yes, fencing only
- ○ Yes, guard animals only
- ○ Yes both fencing and guard animals

Control activities for wild dogs can be conducted independently by a landholder at a time that suits them, or as part of a coordinated group (i.e. control activities are conducted at the same time as neighbouring landholders, usually overseen by a local wild dog group coordinator).

In the past 3 years how often have you conducted the following wild dog control activities on your property, either independently or as part of a coordinated action? Please give a response for all activities.

	Never	Once	Twice	Three times	More than three times
Ground baiting (1080 or PAPP toxin) - independently	○	○	○	○	○
Ground baiting (1080 or PAPP toxin) - as part of coordinated action	○	○	○	○	○
Shooting - independently	○	○	○	○	○
Shooting - as part of coordinated action	○	○	○	○	○
Trapping - independently	○	○	○	○	○
Trapping - as part of coordinated action	○	○	○	○	○
Aerial baiting	○	○	○	○	○

These next set of questions will ask about the reporting of wild dog sightings and wild dog damage.

In the past 5 years how often have you reported wild dog sightings and / or their damage?

- ○ Never
- ○ Once only
- ○ 2-3 times
- ○ 4-5 times
- ○ More than 5 times

a) Who did you report this to, and b) how did you report this (multiple responses allowed)?

	Phone (ring)	In person	Using Wild dog Scan	Email	Other
Neighbours	☐	☐	☐	☐	☐
Local Wild dog Association	☐	☐	☐	☐	☐
Local Land Services	☐	☐	☐	☐	☐
Regional Wild dog Coordinator (Dave Worsley)	☐	☐	☐	☐	☐
Not sure / Can't remember	☐	☐	☐	☐	☐
Other (please specify)	☐	☐	☐	☐	☐

If you encounter a wild dog or saw damage caused by wild dogs in the next 12 months, how likely are you to report it?

- ○ Not at all likely
- ○ Slight likely
- ○ Somewhat likely
- ○ Likely
- ○ Very likely

a) Who would you report this to, and b) what is the most likely method of reporting (multiple responses allowed)?

	Phone (ring)	In person	Using Wild dog Scan	Email	Other
Neighbours	☐	☐	☐	☐	☐
Local Wild dog Association	☐	☐	☐	☐	☐
Local Land Services	☐	☐	☐	☐	☐
Regional Wild dog Coordinator (Dave Worsley)	☐	☐	☐	☐	☐
Not sure / Can't remember	☐	☐	☐	☐	☐
Other (please specify)	☐	☐	☐	☐	☐

Wild dog Scan is part of the Feral Scan suite of free community tools for the recording and planning of pest animal management activities.

The Northern Tablelands Local Lands Services is promoting the use of Wild dog Scan as their main tool for reporting wild dog sightings and their damage in the region.

Have you heard of Wild dog Scan before today?

- ○ No
- ○ Unsure
- ○ Yes

Please rate your agreement to the following questions about the use of Wild dog scan.

	Do not agree at all	Slightly agree	Somewhat agree	Agree	Highly agree	Don't know
I am unsure how to use Wild dog Scan	○	○	○	○	○	○
I don't know anyone else who uses Wild dog Scan	○	○	○	○	○	○
I don't trust what happens to the information once it is in Wild dog Scan	○	○	○	○	○	○
I don't have the means to use Wild dog Scan (i.e. no access to a computer or smartphone)	○	○	○	○	○	○
I just don't want to report wild dog activities on my property	○	○	○	○	○	○
I prefer to have a conversation with someone about wild dog sightings and / or damage	○	○	○	○	○	○
I don't see any benefits of using Wild dog Scan	○	○	○	○	○	○
Wild dog Scan is difficult to use	○	○	○	○	○	○

Why do you think landholders may be keen or hesitant to use Wild dog Scan?

_____

_____

_____

_____

_____

Are you interested in finding out more about Wild dog Scan?

- ○ No thank you, I am not interested
- ○ No thank you, I already know enough about Wild dog Scan
- ○ Yes, please direct me to the website once I have completed this survey
- ○ Yes, I would be happy for someone to contact me (please add best contact details)

_____

APPENDIX 8: SEMI-STRUCTURED INTERVIEW QUESTIONS FOR WILD DOG SCAN EVALUATION

Introduction: We (*Researcher name*) are conducting research to explore landholders' uptake of 'Wild dog Scan' (WDS), and to understand the potential benefits and barriers of its use. This information will assist the Northern Tablelands Local Land Services and the designers of 'Wild dog Scan' improve their promotion, education and support services for this tool. This project is funded through the Centre for Invasive Species Solutions (CISS). Your perspective as a member of a Wild dog Association can help us understand the complex behavioural factors associated with this issue.

Before we begin I would like to affirm your consent to participate please (record replies):

- Have you read the information contained in the Information Sheet for Participants that was sent to you (*time & means*) and any questions asked have been answered to you satisfaction? Yes/No
- Do you agree to participate in this study, with the understanding that:
    - Your participation is voluntary,
    - Your contribution is anonymous
    - The information concerning your identity will not be collected, and
    - You may withdraw at any time without consequences & without follow-up? Yes/No
- Do you agree that the anonymous research data collected for the study will form part of a final report and may be published, or presented at conferences as a later date? Yes/No
- You agree that you may be quoted using a pseudonym? Yes/No
- Do you agree to the interview being audio recorded and transcribed? Yes/No
- You are 18 years of age or over? Yes/No

Topic	Interview questions	Prompts/notes	Analysis
1. Wild dog Association background	a) Can I start by confirming your role in your WDA? b) Does your WDA actively promote the use of WDS?	a) Committee member or not, how long they have been involved. b) Do they talk about it, held training sessions for their members?	Verifying background information, potential segmentation categories. Capturing importance of social motivation on WDS use.
2. Current use of WDS	a) When did you join up to WDS? b) How do you use WDS? c) Do you receive email alerts from WDS (when someone else reports in their WDA)? If so, how do you use this information?	a) As individual or through group – attended any training sessions? b) Do they enter sightings, damage, control efforts, images? How often? c) Are they not receiving them / in junk folder, just not reading them, reading but taking no action?	a) Identifying social / individual motivation factors. Influence of training sessions and feedback. b) Verifying reliability with database c) Evaluate the use the alert system (the major feedback mechanism of WDS).
3. Benefits and barriers of WDS	a) What do you see as the benefits of using WDS? b) What do you see as the disadvantages of using WDS? c) Best way to encourage others to use WDS more?	Prompt for personal as well as WDA / community benefits / disadvantages.	Add nuance to barrier and driver information collected in online survey.

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