WHAT ARE THE CARP VIRUS BIOCONTROL RISKS AND HOW CAN THEY BE MANAGED?

NATIONAL CARP CONTROL PLAN

The socio-economic impact assessment and stakeholder engagement

APPENDIX 1: Getting the National Carp Control Plan right:
Ensuring the plan addresses community and stakeholder needs, interests and concerns

This suite of documents contains those listed below.

NCCP TECHNICAL PAPERS

1. Carp biocontrol background
2. Epidemiology and release strategies
3. Carp biocontrol and water quality
4. Carp virus species specificity
5. Potential socio-economic impacts of carp biocontrol
6. NCCP implementation
7. NCCP engagement report
8. NCCP Murray and Murrumbidgee case study
9. NCCP Lachlan case study

NCCP RESEARCH (peer reviewed)

Will carp virus biocontrol be effective?

1. 2016-153: Preparing for Cyprinid herpesvirus 3: A carp biomass estimate for eastern Australia
2. 2018-120: Population dynamics and carp biomass estimates for Australia
3. 2017-148: Exploring genetic biocontrol options that could work synergistically with the carp virus
4. 2016-170: Development of hydrological, ecological and epidemiological modelling
5. 2017-135: Essential studies on Cyprinid herpesvirus 3 (CyHV-3) prior to release of the virus in Australian waters
6. 2020-104: Evaluating the role of direct fish-to-fish contact on horizontal transmission of koi herpesvirus
7. 2019-163 Understanding the genetics and genomics of carp strains and susceptibility to CyHV-3
8. 2017-094: Review of carp control via commercial exploitation

What are the carp virus biocontrol risks and how can they be managed?

9. 2017-055 and 2017-056: Water-quality risk assessment of carp biocontrol for Australian waterways
10. 2016-183: Cyprinid herpesvirus 3 and its relevance to humans
11. 2017-127: Defining best practice for viral susceptibility testing of non-target species to Cyprinid herpesvirus 3
12. 2019-176: Determination of the susceptibility of Silver Perch, Murray Cod and Rainbow Trout to infection with CyHV-3
13. 2016-152 and 2018-189: The socio-economic impact assessment and stakeholder engagement
    Appendix 1: Getting the National Carp Control Plan right: Ensuring the plan addresses community and stakeholder needs, interests and concerns
    Appendix 2: Findings of community attitude surveys
    Appendix 3: Socio-economic impact assessment — commercial carp fishers
    Appendix 4: Socio-economic impact assessment — tourism sector
    Appendix 5: Stakeholder interviews
    Appendix 6: Socio-economic impact assessment — native fish breeders and growers
    Appendix 7: Socio-economic impact assessment — recreational fishing sector
    Appendix 8: Socio-economic impact assessment — koi hobbyists and businesses
    Appendix 9: Engaging with the NCCP: Summary of a stakeholder workshop
14. 2017-237: Risks, costs and water industry response
15. 2017-054: Social, economic and ecological risk assessment for use of Cyprinid herpesvirus 3 (CyHV-3) for carp biocontrol in Australia
    Volume 1: Review of the literature, outbreak scenarios, exposure pathways and case studies
    Volume 2: Assessment of risks to Matters of National Environmental Significance
    Volume 3: Assessment of social risks
16. 2016-158: Development of strategies to optimise release and clean-up strategies
17. 2016-180: Assessment of options for utilisation of virus-infected carp
18. 2017-104: The likely medium- to long-term ecological outcomes of major carp population reductions
19. 2016-132: Expected benefits and costs associated with carp control in the Murray-Darling Basin

NCCP PLANNING INVESTIGATIONS

1. 2018-112: Carp questionnaire survey and community mapping tool
2. 2018-190: Biosecurity strategy for the koi (*Cyprinus carpio*) industry
3. 2017-222: Engineering options for the NCCP
4. NCCP Lachlan case study (in house) (refer to Technical Paper 9)
5. 2018-209: Various NCCP operations case studies for the Murray and Murrumbidgee river systems (refer to Technical Paper 8)

Getting the National Carp Control Plan right: Ensuring the plan addresses community and stakeholder needs, interests and concerns

Report 1 of the 'Carp Control: Understanding community and stakeholder attitudes and assessing social effects' project

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SUMMARY

Background

- The level of support of stakeholders and the broader community for the National Carp Control Plan (Plan) will depend in large part on how well the process of developing the Plan and its eventual content address their different needs, concerns, and goals
- This report identifies (i) initial views about carp control (which are likely to change as the Plan is developed), and (ii) the topics, issues and concerns that need to be addressed in the Plan if it is to achieve support from stakeholders and communities

Key findings

- Interviews were conducted with 23 representatives of stakeholder groups with differing interests in carp control (including environmental groups, commercial carp fishers, Traditional Owners, farming groups, koi organisations, water providers, native fish breeders, recreational fishing organisations, tourism businesses, animal welfare organisations, and freshwater scientists)
- These stakeholders typically have a high level of existing knowledge about carp and/or management of freshwater and estuarine ecosystems
- At this early stage in its development, most stakeholder groups expressed *conditional support* for the Plan, meaning they will support the eventual Plan if the process of developing it and its content adequately addresses their key questions and concerns
- A smaller number of stakeholders actively opposed the Plan, and a similarly small number unconditionally supported the Plan
- Stakeholders expect to see the following included in development of the Plan if it is to receive their support:
    - The inclusion of multiple measures to control carp
    - Identification of how to best integrate carp control with other actions to improve environmental health in freshwater and estuary areas
    - Development of detailed guidance on the planned timing and management of carp control actions, particularly virus release
    - Clear identification of risks and how they will be managed and mitigated, including planning for worst-case scenarios
    - Identification of potential social and economic impacts of carp control on specific groups and development of appropriate mitigation and management measures, particularly commercial carp fishers, native fish breeders, the tourism industry, koi enthusiasts, and recreational water users
    - Appropriate involvement of different groups in decision making processes
    - Sound governance, including clear commitment of funding and other resources to carp control and identification of responsibilities of different agencies

    - Development of appropriate monitoring and evaluation strategies to ensure outcomes can be identified.
- While most stakeholders did not expect to be directly involved in the development of the Plan, they wanted clear opportunities both to have input, ensuring their knowledge is drawn on, and to have more detailed input on aspects of the Plan that could directly affect them or to which they could contribute their knowledge
- Most stakeholders expected to be provided detailed and evidence-based information setting out benefits, costs and risks of different approaches; and opportunity to comment on the proposed content of the Plan
- Views of the broader community were different to those of key stakeholders: amongst the general community, there is often limited awareness of carp invasion and associated problems, and hence current judgments about acceptability are made for the most part based on very limited information and knowledge
- In a survey of 12,000 people conducted in spring 2016, 53% of Australians living in rural and regional areas (regional Australians) considered release of the carp virus acceptable, 16% considered virus release unacceptable, while 30% were unsure or considered virus release neither acceptable or unacceptable
- Survey participants were told that carp were a pest fish species, but given no other information provided on the issues caused by carp, or about the virus and its release
- Amongst the general community, people were more likely to find release of the carp virus acceptable if they lived in areas experiencing carp invasion; were male; were older; were born in Australia; were farmers; were recreational fishers; and if they had high confidence in the capacity of their community to successfully manage change
- The survey responses suggest that amongst the general community there is likely to be initially low complexity of thinking about carp: low *integrative complexity* is associated with making more 'extreme' judgments about finding an action acceptable or unacceptable, and may be associated with rapid changes in opinion.

Conclusions and recommendations

- Initial responses to the idea of the National Carp Control Plan are moderately positive, however highly conditional on the way the Plan is subsequently developed, and on the type of information people engage with about carp and carp control
- The development of the Plan needs to address the needs and expectations of two very different groups: stakeholders with strong existing interest in and knowledge about carp control (including a diverse range of groups); and the broader community, who often have only limited awareness of carp or carp control
- Stakeholders with strong existing interest in and knowledge about carp control require detailed information and opportunities to have meaningful input into development of the Plan so their knowledge, needs and concerns can be shared and addressed

- There is also a need to invest in identifying potential impacts of the Plan on the livelihoods and activities of particular groups, particularly commercial carp fishers, native fish breeders, koi enthusiasts and associated businesses, and tourism businesses
- In the broader community, low levels of awareness about carp and carp control, and signs of low integrative complexity, suggest a need to invest in increasing awareness about the extent of carp invasion, the problems associated with carp invasion in Australia, and the complexities of carp control; this can support public dialogue about carp control that better engages with these complexities and reduces reliance on overly simplified arguments either for or against particular forms of carp control.

EXECUTIVE SUMMARY

Background

Successfully developing and implementing the National Carp Control Plan requires achieving widespread acceptance of proposed actions from stakeholder groups who depend on or have an interest in freshwater health and carp, and from the communities affected by carp invasion. Researchers at the University of Canberra have been commissioned to assess community attitudes to carp control measures and potential socio-economic impacts of these measures. This study is producing several reports, of which this is the first.

Objectives of this report

This first report focuses on identifying the topics, issues and concerns that need to be addressed as part of the development of the National Carp Control Plan (Plan) if it is to be supported by a wide range of stakeholder groups and by the broader community. This was done through examining the initial views and expectations of key stakeholders, and views of the broader community. These initial views are likely to change over time as discussion about carp control continues.

These initial views of two very different types of groups were examined. The first were the stakeholder groups who already have a strong interest in, and often very high levels of knowledge about carp and carp control. These groups include both the people most likely to be directly affected by carp control actions proposed in the Plan, and those likely to engage in discussion and dialogue about the Plan which, in turn, influences the views of the broader community. The second is the broader community, who will often have less direct knowledge of or interest in carp, but will form opinions about the Plan and, in the case of those living or spending time in regions with carp populations, will experience the positive and negative impacts of actions to control carp.

Subsequent reports will examine in more detail the factors that influence social acceptability of carp control measures, how to design the Plan to maximise positive and minimise negative socio-economic impacts, the level of support for specific measures proposed in the Plan, and design of longer-term monitoring and evaluation of social and economic impacts.

Why examine initial views, stakeholder expectations and awareness of carp invasion?

This report focuses on a relatively simple topic: understanding initial views and expectations of interested stakeholders and the broader community about carp control. This is important to examine at an early stage in the development of the Plan, as it provides insight into how best to ensure the process of developing the Plan successfully addresses the key needs, concerns and issues of different groups. Doing this increases the likelihood that the Plan will be supported by a wide range of groups and amongst the broader community.

The need to understand initial views, stakeholder expectations and awareness about the challenge of carp invasion is clear from past studies and processes attempting to address complex environmental challenges. The extensive literature on collaborative and participatory approaches to natural resource management (NRM) emphasises that a first key step in successful NRM processes is to ensure the needs, concerns and expectations of *all* key stakeholders are understood. A smaller number of studies examining the role of scientific evidence in complex NRM issues have identified that an important step is identifying the types of scientific evidence and information stakeholders need to engage with and expect to see in order to decide whether or not to support an action. Studies examining how best to reduce potential for conflict about proposed actions, and how to promote achieving a 'social license' for proposed activities, emphasise the importance of ensuring communication and engagement that meets the expectations, needs and concerns of different groups. Studies on communication about complex issues emphasise a need to understand expectations regarding the type and nature of information to be made available, and to match information to the expectations, interests and needs of different groups.

Across these different areas, there is a clear and common identification of the importance of ensuring that processes such as development of the Plan carefully identify the needs, interests and concerns of stakeholders. This is a necessary first step that then helps enable these needs, interests and concerns to be actively considered and addressed throughout the process of developing the Plan, for example, through ensuring issues identified as important are thoroughly assessed, ensuring information is made available about different topics identified as of high interest and importance, and ensuring stakeholders have the opportunity to meaningfully inform development of aspects of the Plan important to them.

Methods

This report is based on two data sources: (i) interviews conducted with a number of stakeholders who represented different interests relevant to carp control, conducted in 2017, and (ii) data from a survey of just over 12,000 Australians conducted in spring 2016 (the Regional Wellbeing Survey), which asked a small number of questions about carp control and pest fish invasion more generally. In both cases, the objectives were to (i) understand initial views about proposed carp control, and (ii) identify what needs, concerns and topics need to be addressed in development of the Plan to increase support for the eventual content of the Plan.

Initial views of key stakeholder groups

Interviews were conducted with 23 representatives of key stakeholder groups, with further interviews to be conducted in subsequent stages of this study. The 23 people interviewed were selected to represent a wide range of stakeholder interests and views about carp control. They included representatives from environmental groups, commercial carp fishers,

Traditional Owners, farming groups, koi organisations, water providers (irrigation and domestic), native fish breeders, recreational fishing organisations, tourism businesses, animal welfare organisations, and freshwater scientists.

The majority of these stakeholders had high levels of knowledge about carp and carp control, and about environmental management in freshwater and estuarine areas more generally. They typically described arguments both for and against different approaches to carp control, and discussed these in some detail.

Of the 23, a small number were opposed to the Plan in any form; a similarly small number unconditionally supported the Plan. The majority expressed conditional support for the concept of the Plan. This means that while they are supportive of the concept of carp control, their eventual decision about whether they support the Plan will be determined based on assessing whether the content of the Plan appropriately addresses their key questions and concerns around issues such as managing virus release or implementing actions to support ecological recovery after reducing carp numbers.

For these stakeholders, support for the Plan requires engaging meaningfully with their existing high levels of knowledge, in particular through drawing on this knowledge to inform development of the Plan, and providing detailed information that is targeted to their already high level of understanding of carp control and which provides additional evidence to assist them in making decisions about whether or not they would support different actions proposed for inclusion in the Plan.. It also requires creating constructive spaces in which debate, dialogue and disagreement can be expressed, activities that can increase the complexity of thinking about carp control and generate constructive ways forward that have support from a wide range of groups.

Key topics the Plan needs to address for these highly engaged and informed stakeholders to assess whether they support the Plan include the following, each described further below:

- The carp control measures to be used
- Integrating carp control with other measures to improve health of freshwater ecosystems
- Detail on planning, timing and management of carp control measures
- Identification of risks and associated management and mitigation strategies
- Assessment of social and economic impacts and strategies to manage and mitigate these
- Inclusion of strategies to support longer term ecological recovery
- Demonstration of sound consultation and decision making processes
- Strong governance and commitment of funding for the actions proposed; and
- Development of monitoring and evaluation strategies.

When discussing carp control measures, many stakeholders specified they felt the Plan should focus on development of an integrated set of control measures rather than solely on virus release, and in particular wanted to be provided information on the full suite of measures to be used and how these will be integrated. There was particularly strong support for ongoing investment in daughterless carp technology in addition to use of virus release.

Release of the carp virus was supported in principle by most, but not all, of the stakeholders interviewed. Amongt those who conditionally supported virus release, that support was conditional on the Plan including mechanisms for appropriately managing virus release. Those who supported virus release typically did so because they believed the virus to be the only practicable means of achieving a large-scale initial reduction in numbers of carp, and also believed that longer term benefits would outweigh shorter term negative impacts likely from virus release. However, they expected to be provided with further evidence regarding the short- and long-term benefits versus costs of virus release, which would be used to make their ultimate decisions about whether or not to support virus release if it is recommended as part of the Plan.

Those who opposed virus release typically did not trust available evidence regarding issues such as transmissibility of the virus, and were not confident that issues such as clean-up of dead carp could be successfully managed. Higher levels of engagement of these stakeholders in discussions with researchers who are generating new evidence is one method for potentially increasing trust.

Overall, support for virus release was typically conditional on evaluating the processes proposed in the Plan for timing and tailoring release to local conditions, managing clean up, managing welfare of carp and other species, managing impacts, and implementing other carp control measures and ecological restoration actions. In particular, stakeholders wanted the Plan to provide detailed information on how carp control measures – specifically, release of the carp herpes virus – will occur, including whether virus release will be tested in a small case study before any widespread release, whether and how release would be staged, how release would be targeted to local conditions such as water temperature and flows and local water uses, how dead carp would be managed, and who would manage and fund clean up. Clean-up of dead carp was the issue most commonly discussed as a challenge by interviewees, with all wanting detailed information on management options.

Most interviewees specified that they would be much more likely to support the Plan if it included suitable planning for ‘worst case’ scenarios, such as (i) the potential effect of unexpected weather conditions such as large floods or extended drought after virus release, (ii) managing all possible scenarios of timing and volume of dead carp to be cleaned-up, (iii) managing water quality problems if they occurred, (iv) managing animal welfare risks, and (v) managing unplanned spread of the virus (intentional or unintentional).

Some (but not all) interviewees felt it was important to appropriately balance risk with benefits, and specifically felt that the consequences of not implementing measures to address carp would likely be worse than implementing measures such as virus release with some associated negative impacts.

As part of understanding risk versus benefit, several interviewees identified a need for the Plan to provide detail on strategies for managing potential negative impacts of carp control, and for promoting positive impacts, for groups including commercial carp fishers, native fish breeders, koi enthusiasts and koi-related businesses, the tourism industry, recreational water users, Traditional Owners, and water providers and their customers (domestic and irrigated agriculture). To do this requires explicit assessment of potential impacts of carp control actions proposed in the Plan on these groups, and identification of strategies for preventing and/or mitigation negative impacts, as well as for promoting positive impacts where this is feasible. This should ideally be done with active involvement of these groups in assessments and in development of actions to manage and mitigate impacts. Active engagement of potentially impacted groups in development of strategies is important as it ensures their extensive knowledge is drawn on when developing strategies for preventing, managing and mitigating impacts, and can also increase trust in the process and the resulting recommended actions by the groups most directly affected by them.

All interviewees viewed the principle objective of reducing carp populations as being improving environmental health. Given this, almost all stated that they expect the Plan to explicitly identify how carp control will be integrated with other actions to improve freshwater ecosystem health. Most felt the Plan needed to be developed with a long-term focus that included explicit strategies for investing in and supporting long-term ecological restoration in freshwater ecosystems where carp control occurred. Some expressed concern that focusing on carp control risks reducing attention given to other causes of environmental degradation in freshwater and estuarine ecosystems.

Overall, engaging regularly and meaningfully with stakeholders who are already highly interested in and knowledge about carp control is critical to achieving eventual support for the Plan. These stakeholders are also likely to be highly influential in public discussions and dialogue about carp control, and their views will be critical to the formation of views about the Plan in the broader community.

Initial views of the broader community

In spring 2016, 12,000 people were asked a small number of questions about carp control as part of the Regional Wellbeing Survey. These data were collected at a point in time at which the National Carp Control Plan had been announced but no detailed information on how the Plan might be implemented was available. The views collected provide insight into initial responses to the concept of controlling carp using the carp virus, the level of initial

knowledge of carp and carp control, and the initial complexity of thinking about carp control.

These views are likely to shift over time as more detailed information about the proposed Plan is developed and communicated. The data collected predominantly reflect the views of people living in rural and regional areas and further work is needed to better identify the views of Australians living in large cities.

When asked how acceptable or unacceptable they would find release of the carp herpes virus if it occurred in their local area, 53% of Australians living in rural and regional areas (regional Australians) considered release of the carp virus acceptable; more than half of this 53% rated virus release as being 'very acceptable'; 16% considered virus release unacceptable, while 30% were unsure or considered virus release neither acceptable or unacceptable. These initial results suggest relatively high initial support for virus release. However, as noted earlier, these initial views are likely to change as more public discussion about carp control continues. The high proportion of people indicating very high levels of acceptability, as well as low levels of awareness of pest fish invasion by many of those surveyed, suggests views are being formed based on relatively limited knowledge, and is indicative of low 'integrative complexity' when forming opinions about carp control. These views may be readily shifted by exposure to new information. The high proportion of people who were unsure also indicates high potential for views to change as further information becomes available on proposed virus release.

People were much more likely to find release of the carp virus acceptable if they:

- Considered pest fish invasion to be a significant problem in their local area, or lived in areas experiencing carp invasion such as the Murray-Darling Basin (Basin)
- Were male (77% of male residents living in the Basin supported virus release compared to 63% of female Basin residents)
- Were older (42% of Basin residents aged under 25 found virus release acceptable, increasing to 54% of those aged 25-34, and reaching a high of 75% for those aged 65 to 74)
- Were born in Australia rather than in another country
- Had good health and high household income, indicating that those with good access to resources that support resilience (ability to cope with change) are more likely to support virus release
- Were farmers, with 76% of dryland farmers and 78% of irrigators living in the Basin supporting release compared to 62% of those with no involvement in agriculture
- Spent time recreational fishing: in the Basin 65% to 69% of fishers supported virus release compared to 54% of non-fishers; however, those who fished most frequently in freshwater areas of the Basin were somewhat less likely to support virus release than those who fished less often

- Had high confidence in the capacity of their community to successfully manage change (community resilience), particularly in local decision-making institutions.

Of the recreational fishers who participated in the survey, a majority (73% in the Basin) reported that carp numbers were growing in some or all places they fished. Almost half felt the size of native fish they caught was declining over time (46% of Basin fishers), although almost half considered the health of native fish in their local rivers and lakes to be 'pretty good' (46% in the Basin compared to 35% who did not considered health to be good).

These findings suggest that increasing awareness of the problems associated with carp invasion amongst the broader community can increase likely support for taking action to control carp. They also highlight that acceptability of the Plan will depend not only on the process of developing the Plan and its eventual content, but also on external factors such as confidence in local institutions to successfully implement carp control actions.

While key stakeholder groups have very high knowledge about carp and carp control, there is an ongoing need to invest in increasing awareness of carp invasion and its impacts, and carp control, amongst the general community. Survey participants were asked how they preferred to receive information about land and water management issues: websites were preferred by 57% of people, email by 44%, TV by 43%, local newspapers by 42%, ABC radio by 41%, mailed letters/flyers by 37%, Facebook by 31%, local radio other than ABC by 28%, notices in local businesses/shops by 28%, local NRM or conservation groups by 20%, farming organisations by 11%, Twitter by 5% and other methods by 4%. Social media, particularly Facebook, was more commonly preferred by women and younger people, and less often by older people and farmers. Those with less formal education and lower incomes were more likely to prefer information to be delivered via traditional media and direct mailing of letters/flyers. NRM/conservation groups and farming organisations were a preferred information source for many farmers, but not for large numbers of other people.

Overall, the findings suggest that initial communication about the Plan with the broader community should focus on improving general levels of awareness about the extent of carp invasion, problems associated with carp invasion, and the complexity of achieving effective carp control. Increasing the complexity of thinking about carp in this way has potential to reduce the presence of strongly polarised views in future, by enabling members of the broader community to form views that consider arguments both for and against different actions. Promoting 'integrative complexity' (the ability to understand the costs, benefits and risks of proposed action) will likely result in views that are less extreme (less likely to very strongly oppose *or* to very strong support) and more likely to be moderate in nature (more likely to moderately support carp control while recognising it may have some risks and impacts as well as benefits). Achieving this integrative complexity can reduce rapid shifts in opinion in response to overly simplified communication of information either for or against particular approaches to carp control. This type of shift has been observed in relation to use

of other NRM practices such as use of prescribed burning, where overall support for the practice is high, but based on a relatively high understanding that burning will result in some negative effects such as smoke haze. Designing communication content to suit several levels of complexity of thinking and engagement with the topic is important, as is using communication mediums that support engaging at these different levels.

Discussion and conclusions

Overall, this report identified that most stakeholders with a strong interest in freshwater health and carp, and a small majority of the broader community, conditionally support proposals to control carp, including with use of the carp herpes virus. However, this conditional support is not universal, with some stakeholder groups (particularly koi enthusiasts and some native fish breeders and recreational fishers) opposed to virus release being used to control carp, as were almost one in five rural and regional Australians. For those who support the concept of carp control and the potential use of the carp virus, that support is conditional on whether the eventual content of the Plan adequately answers the questions and concerns documented in this report.

To achieve a high level of acceptance by both stakeholders with a strong interest in carp control and the broader community, there is a need to engage with both the stakeholders who already have high knowledge and strong interest in carp control, and with the broader community. The needs of each group are very different. Amongst stakeholder groups, there is a need to engage at the level of their already high level of knowledge about carp and carp control: this means both providing opportunities for these groups to have meaningful input into development of the Plan, and ensuring they have access to detailed information that addresses the complexities of current knowledge about carp control and of developing actions to control carp. This can assist both in ensuring the Plan addresses key needs, concerns and topics raised by these groups, and that it further builds their detailed and complex knowledge through encouraging dialogue about the pros and cons of different types of action and strategies to control carp. Amongst the broader community, knowledge needs are very different: there is often little to no awareness of carp invasion and associated problems, and as a result initial views are likely being formed on relatively limited information, are more likely to be 'extreme' (in the case of initial views, most often in the form of high levels of support), and are likely to be highly changeable in response to new information. The information delivered should be aimed not at achieving uninformed support for the Plan, as this is more likely to result in polarisation of views and conflict, but at developing an appropriate level of understanding that increases awareness the extent of the problem of carp invasion, and enables engagement in discussions about the arguments for and against controlling carp. This does not require high levels of technical information, but does require that in the process of developing the Plan, information provided to the general public includes discussion of benefits, costs and the arguments for and against taking different types of action. This can better enable people to develop informed opinions

that integrate these different forms of information, and can reduce risk of subsequent conflict.

CONTENTS

FIGURES

TABLES

1. INTRODUCTION

THE NATIONAL CARP CONTROL PLAN

The National Carp Control Plan (Plan) is using research, stakeholder consultation and community consultation *to identify a smart, safe, effective and integrated suite of measures to control carp impacts* (NCCP 2017). There is a particular focus on the potential use of biocontrol in the form of the carp herpes virus. Once developed, the Plan will be submitted to the Australian Government, who will make a decision about whether to implement the measures recommended in the Plan.

STAKEHOLDER AND COMMUNITY SUPPORT

The carp control measures developed in the Plan, if approved, will be delivered over a large geographic area and in waterways and waterbodies that are both critical to Australia's agricultural industry and used by millions of recreational users each year. Critical to the success of the Plan is having widespread support from (i) the diverse range of stakeholder groups who depend on or have an interest in freshwater health and carp, and (ii) people living and spending time in the regions affected by carp invasion and in which carp control measures will be implemented.

Support for the Plan will depend on a wide range of factors, including[1]:

- The extent to which to which people believe investing in carp control is an appropriate and effective way of improving environmental health
- Expected benefits versus costs of the Plan for particular groups or communities
- Trust in the processes and evidence used to develop the Plan, and in the agencies tasked with implementing the actions proposed in the Plan, and
- The perceived environmental, economic and/or social risks of the Plan.

In general, people are unlikely to support actions they feel are unnecessary, likely to be ineffective, have costs for them, or are highly risky. They are more likely to support actions they feel are necessary, likely to be implemented successfully, likely to be effective, for which they believe benefits will outweigh costs, and which they believe have an acceptable level of risk.

UNDERSTANDING COMMUNITY AND STAKEHOLDER ATTITUDES AND ASSESSING SOCIAL EFFECTS – PROJECT OVERVIEW

As part of development of the Plan, researchers at the University of Canberra have been commissioned to assess community and stakeholder attitudes to carp control, and potential

[1] Note: The second report from this project will include more detailed discussion of the factors known to affect social acceptability of large-scale actions to address environmental problems such as carp invasion.

socio-economic impacts of measures proposed to control carp. Overall, this project aims to support development of a Plan that will have support from communities and stakeholder groups, through ensuring the Plan appropriately addresses their needs, concerns and interests. This means that this project is not focused on measuring sentiment about carp control and communication (although these are important and examined as part of the project), but rather focuses on building support for the eventual Plan through:

- Identifying and understanding stakeholder and community needs, concerns and expectations regarding carp control, so these can be acted on throughout development of the Plan and addressed in the content of the Plan
- Identifying how best to ensure processes used to develop the Plan meet stakeholder needs and expectations
- Identifying potential socio-economic impacts of carp control for different stakeholder groups and communities, and potential measures to reduce negative and maximise positive socio-economic impacts
- Understanding the types of information, consultation and engagement needed by different stakeholders in the process of developing the Plan.

This work will inform both the process used to develop the Plan (including communication, consultation and engagement with stakeholders and communities) and the eventual content of the Plan (particularly design of strategies for minimising negative and maximising positive impacts of the carp control actions proposed in the Plan).

This project will also develop a framework for ongoing monitoring and evaluation of socio-economic impacts and community attitudes into the future beyond the life of this project, ensuring it is possible to rapidly identify where action is needed to address community concerns during any future implementation of the recommendations made in the Plan.

PROJECT REPORTS

This project will produce several reports:

- Report 1 (This report) Getting the National Carp Control Plan right: Ensuring the Plan addresses community and stakeholder needs, interests and concerns
- Report 2 Ensuring carp control is socially acceptable: Understanding key factors likely to influence social acceptability of carp control measures
- Report 3 Stakeholder engagement recommendations for the National Carp Control Plan
- Report 4: Socio-economic impact assessment: potential impacts and impact mitigation strategies for (i) tourism-dependent businesses, (ii) commercial/contract carp fishers, (iii) native fish breeders and hatcheries, and (iv) the koi industry
- Report 5: Social acceptability of actions proposed for inclusion in the National Carp Control Plan

- Report 6: Monitoring socio-economic impacts and community attitudes: A framework for ongoing monitoring of the National Carp Control Plan.

THIS REPORT

The overall goal of this project is to help those designing the National Carp Control Plan achieve stakeholder and community support for the actions in the Plan. Achieving this has many components: amongst other things, it requires understanding potential impacts of proposed carp control actions on different groups, designing strategies to address these, ensuring appropriate engagement and inclusion of stakeholders in the process of developing the Plan, and informing communication about the Plan.

A key first step is to identify the topics, issues and concerns that need to be addressed in the National Carp Control Plan if it is to achieve the support of a wide range of stakeholder groups and by the broader community. This information is needed early in the development of the Plan to ensure that resources are directed to addressing issues identified as of high importance by the stakeholders and communities potentially impacted by the Plan.

The first part of this project therefore focused on understanding (i) the initial views of different stakeholder groups and communities about carp control, and (ii) the topics, issues and concerns that need to be addressed as part of developing the Plan to achieve support for the Plan from key stakeholder groups and the broader community.

It is important to note that the initial views documented in this report represent a 'baseline', or starting point, which reflect how stakeholders and communities viewed carp control at a point in time at which the National Carp Control Plan was in very early stages of development. At this point, information on the likely actions to be included in the Plan was not yet developed, and hence views about carp control were formed based on overall views and prior knowledge of issues related to carp. The views of stakeholder groups and communities will change as the Plan is developed, and changes in views and in key topics, issues and concerns raised about carp control, will be documented in subsequent reports from this project. As noted above, subsequent reports from this project will examine in more detail whether, when and why the specific actions and strategies proposed as part of the development of the Plan are acceptable to different groups and communities.

Report overview

The report first briefly explains why this project began by examining initial views, needs, issues and concerns and documenting these in this report. This is followed by discussion of the methods used in this assessment of initial views of stakeholders and communities about carp control. Findings are then presented, focusing on results from (i) interviews with representatives of a range of stakeholder groups, and (ii) a large-scale survey of Australians which in 2016 asked a small number of questions about carp control. Recommendations are

then made about key actions to be taken in development of the National Carp Control Plan in response to these initial views.

2. ACCEPTABILITY OF CARP CONTROL: WHY EXAMINE INITIAL VIEWS, STAKEHOLDER EXPECTATIONS, AND KNOWLEDGE ABOUT CARP?

This report focuses on understanding initial views about the concept of carp control, identifying key needs, issues and concerns of stakeholders who have an existing high level of interest in or potential to be affected by actions taken to control carp, and understanding initial levels of awareness of and knowledge about carp and carp control.

The rationale for doing this is simple: the Plan is more likely to succeed, and more likely to be accepted by a wide range of groups and the broader community, if its development addresses the needs, issues and concerns of both the people most directly affected by and interested in carp control, and of the broader community. Social acceptance is critical: social considerations often determine whether a proposed action is actually implemented (Miller and Hobbs 2007). To achieve social acceptance, it is helpful to begin by understanding initial views, needs, issues, concerns and levels of awareness and knowledge of different stakeholders and groups. In particular, it is helpful to examine these things in relation to the proposal to release the carp herpes virus, with invasive species management generally, and use of viruses and biological control agents more specifically, often associated with acceptability concerns (Thresher and Kuris 2004, Larson et al. 2011). The views of different stakeholders about costs, benefits, risks and acceptability of different actions to control invasive species often differ substantially, making it particularly important to identify where there is convergence of views versus difference (García-Llorente et al. 2008).

This report is not the only way in which stakeholder needs, issues, concerns and awareness are being assessed. Consultation processes and a number of research projects being conducted as part of developing the Plan will provide a range of insights into these issues. However, it is helpful to document key needs, issues and concerns early in the process of developing the Plan. Doing this provides an information base to inform the processes used to develop the Plan, and to help guide investment in things such as assessing potential effects of the Plan on different groups.

At this early stage of development of the Plan, it was not feasible to identify the full range of factors likely to affect whether an individual person finds engaging in different actions to control carp acceptable, in part because information on the types of actions likely to be considered for inclusion in the Plan, and the benefits, costs and risks of these actions, were not yet developed.

Instead, at this stage, it is important to identify *what* needs to be incorporated in the Plan if it is to achieve support – in other words, how best to ensure the processes of developing the Plan address the needs, issues, concerns and expectations of different groups. This is an essential step to achieving eventual support for the Plan, as it ensures the development of

the Plan considers issues important to the wide range of stakeholders with an interest in carp control.

This section first explains why it is important to understand initial views about carp control. This is followed by examining what the goals of 'social acceptability' should be through the development of the Plan. This is followed by a brief review of what key bodies of work suggest is important in early stages of developing a plan of action to address a complex environmental challenge such as carp invasion. Past studies examining processes of engaging with complex environmental and NRM issues are drawn on to examine what is useful to examine at early stages of development of the Plan in relation to (i) communication about carp and carp control, (ii) knowledge and information needs, and (iii) engagement needs.

THE IMPORTANCE OF UNDERSTANDING 'INITIAL VIEWS'

Prior to announcement of the National Carp Control Plan, public discussions about carp typically focused on issues such as attempts to control carp in specific areas, community fishing events such as the Carp Muster which aim to raise awareness of the problem of carp and help reduce carp numbers in localised areas, and communication of scientific evidence regarding the spread of carp, their environmental impacts, and options for control[2]. While this discourse included some debate about the exact impacts of carp and best ways of controlling carp, there was no significant public disagreement. The public discussions were also typically quite limited, predominantly to scientific organisations, NRM organisations (government and non-government), recreational fishing websites and groups, and commercial carp businesses. This suggests that awareness of carp invasion is likely to be relatively low outside the stakeholder groups who have had an interest in carp prior to announcement of the Plan.

If these assumptions are correct (that public awareness about carp invasion is relatively low, and that prior to announcement of the Plan public discourse was generally limited to discussion of carp control efforts), the Plan will provide a platform for the development of new and different discussion and debate about carp. The process of developing the Plan is likely to trigger formation of new views and attitudes amongst many groups. The way the Plan is developed will play an important role in how these views and attitudes develop: in particular, the extent to which there is development of shared views about the best approaches to carp control that have support from a wide range of groups, versus the extent to which polarisation of views and conflict about proposed carp control measures develop.

[2] This claim is based on a google search of the terms 'carp' on Australian websites, and examination of communications occurring prior to announcement of the carp control plan.

This is an unusual situation. In many NRM situations, actions and policies are developed in a context of an existing well-developed discussion, often involving polarised views. For example, processes developing new approaches to managing water resources in the Murray-Darling Basin (the Murray-Darling Basin Plan), and to identify how best to manage publicly-owned forests (such as the Tasmanian forest peace process), have been undertaken in contexts in which there is existing widespread debates and often conflict about the environmental/NRM issue (Schirmer 2018). In these situations, the discussion is often about how to best bring together stakeholders who are in a situation of disagreement or conflict to attempt to achieve some resolution, rather than about how best to lead a process in which new evidence is generated, new actions proposed, and new attitudes and views are formed by large numbers of people.

The development of the National Carp Control Plan is therefore both an opportunity to develop shared understanding of the best ways forward for controlling carp, and a challenge as it will create new spaces for dialogue that may also generate debate, disagreement and conflict.

To make the best of this opportunity, it is important to understand the 'starting point' – what are the initial views, needs and concerns of stakeholders who have an existing interest in carp, and what are the initial views of the broader public who may not previously have been aware that carp invasion was an issue in many Australian regions? Understanding the starting point enables testing of assumptions such as those described on the previous page (Is there low awareness of pest fish invasion amongst the broader community? Do stakeholders with an interest in carp in general agree there is a need to invest in carp control?). It then enables identification of what is needed in the development of the Plan in order to facilitate constructive dialogue, build shared understanding of the most appropriate approaches to controlling carp, and ultimately achieve acceptance of proposed actions by a wide range of groups and communities.

Multiple previous studies examining best practice approaches to engaging stakeholders in NRM processes, how to prevent conflict about proposed environmental management practices (or resolve existing conflict), and how to achieve a 'social license', also emphasises the importance of assessing initial views. The extensive literature on collaborative and participatory approaches to natural resource management (NRM) emphasises that a first key step in successful NRM processes is to ensure the needs, concerns and expectations of *all* key stakeholders are understood at the outset (Gopnik et al. 2012; Fox et al. 2013; Mease et al. 2018). This enables the objectives and nature of the process to be informed by this understanding (Brown Gaddis et al. 2010). This should be followed by ongoing identification of how these needs, concerns and expectations change through a process of developing a plan of action (or policy, program or other intervention) (Mease et al. 2018).

UNDERSTANDING 'SOCIAL ACCEPTABILITY' AND 'SOCIAL LICENSE'

This project aims to assist in identifying the processes and actions needed in the development of the Plan if it is to achieve 'social acceptance', something also often referred to as a 'social license to operate' (SLO).

As pointed out by Wüstenhagen et al. (2007), definitions of social acceptance are rarely given in the extensive literature examining the concept. The definitions that have been given are typically focused on *types* of acceptance: for example, Wüstenhagen et al. (2007) argue that socio-political acceptance, community acceptance and market acceptance are three interdependent types of social acceptance. In this definition, socio-political acceptance is acceptability of a technology, policy or practice by policy makers, the public and key stakeholders. Acceptance by communities refers more to acceptance of local communities and stakeholders residing in regions where a technology, policy or practice is implemented, and often focuses on concepts of justice and trust as predictors of acceptability. Market acceptance focuses on the acceptance of particular practices or policies by investors, consumers and the supply chain.

Dare et al. (2014) extended this, arguing that social license is achieved through negotiation of a range of licences, rather than a singular 'social license': they argued that evidence suggests the need to negotiate social acceptability on a continuum that range from micro-scale acceptance in local communities affected by an action, through representatives of organisations and groups operating at regional level, to socio-political approval operating at state and national scales. They also pointed out that understanding that social license (or social acceptability) is not a singular concept is important as it recognises that there can be contradictions between regions and groups: what is considered acceptable by one group may not be acceptable to another. They pointed to the need to understand what type of social license is being sought at different points, and the potential influence of gaining social license at one scale on likelihood of achieving it at other scales.

This provides a first step in considering what type of acceptance are needed for carp control: both socio-political and community acceptance are important. At the community scale, a large number of people reside in and near carp-affected areas, highlighting the need to address community acceptance of proposed actions. Within socio-political acceptance at the regional and societal scale, a wide range of stakeholder groups will be important, including both the state and Federal government agencies likely to be involved in implementing carp control actions, and a number of peak stakeholder groups who influence public discussion and policy development, from commercial carp fishers, native fish breeders, koi enthusiasts, recreational fishers and users of carp-invaded areas, to scientists, NRM professionals, farming organisations, water managers and others. The views of the broader public are also essential to socio-political acceptance, meaning it is important to understand not only the views of the key stakeholder groups, and those living in carp-affected regions, but also the views of the broader Australian population.

Therefore achieving 'social acceptance' requires differentiating the needs of different groups, rather than attempting to achieve a global social license across all groups using the same methods. Different groups will have differing needs that need to be met appropriately before they can grant a social license by accepting or approving a proposed activity; they will also often require different types of information and expect differing levels and types of engagement (Dare et al. 2014). In this report, an initial differentiation is made between (i) stakeholders with an existing strong interest, and (ii) the broader community. These two groups were identified as past work has identified how critical both are to achieving social acceptance of proposed policies: for example, an agreement reached between interested stakeholders regarding management of Tasmania's forests almost achieved socio-political acceptance, but did not fully achieve it in part because there was failure to also achieve acceptance from the broader community of the proposed agreement (Schirmer et al. 2016).

However, definitions of *types* of social acceptance do not provide insight into what social acceptance is. The emerging literature on social license – a closely related concept usually used to describe whether particular industries have a social license to operate – provides better insight into this question. Much of this literature argues that there are levels or stages of social support that entail giving different levels of social license to act. Using this approach, 'social acceptability', broadly defined, simply means that a person does not oppose an action, activity or intervention. Acceptance can be passive (the absence of opposition), and does not necessarily mean the person has strong or active support for the action: acceptance can range from a person 'tolerating' a particular activity to approving the activity or, in ideal situations, identifying with and actively supporting the activity and having very high trust in those who undertake it (Barben 2010, Thomson and Boutilier 2011, Anderson et al. 2012), as shown in Figure 1 (derived from Thomson and Boutilier 2011). The inverse of acceptance can be understood as ranging from lack of support to active opposition.

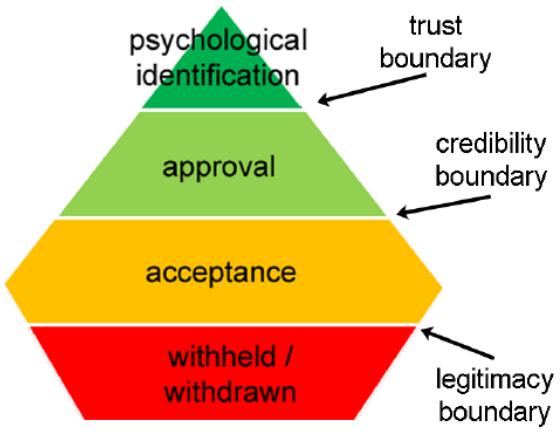

Figure 1 Model of 'social license to operate' (replicated from Thomson and Boutilier 2011)

Acceptance, or social license, are also not static: they are dynamic and often change over time (Eltham et al. 2008, Anderson et al. 2012). This is particularly relevant to the Plan, which is a process of developing a new proposal for action; it should be expected that views and attitudes will change as the Plan is developed and specific actions and means of implementing them are proposed.

Overall, the objective of this project is to ensure the needs of different groups are understood and addressed in the development of the Plan, in order to increase the likelihood of the actions proposed in the Plan achieving social acceptance, or ideally active approval, by a wide range of groups and communities.

A large body of work has examined the many factors that influence whether a person finds a particular action, activity or intervention 'acceptable'. Our second report will examine the extent to which a number of factors identified in past studies as often affecting social acceptability or social license predict views about acceptability of carp control. This will be followed by a further report (Report 3 from this study) that examines processes of consultation and engagement and how these can be designed to meet the needs, and address the issues and concerns, identified in this report.

This report focuses on identifying the issues and needs that should be addressed in the process of developing the Plan. This is an important first step to achieving social acceptance of the eventual Plan, in a number of ways. In particular, it can help in identifying the actions needed in terms of stakeholder engagement, research and assessment, and communication, as part of development of the Plan. Each of these is described briefly below, drawing on studies that have examined *how* to achieve social acceptance, social license, and successful collaborative natural resource management processes.

STAKEHOLDER ENGAGEMENT NEEDS

A large number of studies emphasise that achieving social acceptance or social license to operate relies on stakeholders having trust in the processes used to develop a proposed action or intervention (Gross 2007), as well as in the people and organisations involved in developing that action of intervention (Dare et al. 2014). This in turn often depends in large part on the quality of interactions stakeholders have with proponents of an action – in other words, on the quality of the stakeholder engagement processes that occur. For example, Moffat and Zhang (2014) found that perceptions of procedural fairness and quality of stakeholder contact predicted trust in proponents of an activity and acceptance and approval of that activity, in addition to percreptions of the social impacts of the activity[3].

[3] While research on SLO has predominantly focused on stakeholder engagement needs in situations in which an industry (such as mining) is engaging with stakeholders in local communities in which

Research on environmental conflict prevention and resolution has shown that a common factor influencing success of efforts is the effectiveness of stakeholder engagement techniques used (Emerson et al. 2009). In general, designing effective stakeholder engagement processes is argued to contribute to building trust and support for proposed actions.

The National Carp Control Plan is a new entity which will need to build trust through the development of the Plan. Effective and appropriate stakeholder engagement is an important part of building trust in both the processes used to develop the Plan, the organisation tasked with developing it, and the content of the Plan. However, not all stakeholders will seek the same level of engagement in the Plan: understanding expectations regarding engagement is important to achieving a successful process. So is building stakeholder capacity to engage: it should not be assumed that stakehlders have the knowledge or capacity to successfully engage, and in some cases stakeholders may need support to build capacity to engage with a process (Anderson et al. 2012).

Best practices approaches to stakeholder engagement will be examined further in the third report of this project, but broadly speaking require ensuring principles of inclusiveness, transparency, accessibility, timeliness, fairness, capacity to engage, respect and flexibility are addressed (Anderson et al. 2012).

By identifying the topics, issues and concerns that need to be addressed in the National Carp Control Plan if it is to achieve the support of a wide range of stakeholder groups and by the broader community, this report contributes to informing development of stakeholder engagement processes that will meaningfully address these topics, and through this assist in developing the trust in the process and eventual content of the Plan necessary to achieve social acceptance.

SCIENTIFIC EVIDENCE, RESEARCH AND ASSESSMENT

Like many processes seeking to address challenging environmental problems, the Plan has a strong focus on producing evidence and information that will be used to inform the recommendations made in the Plan for carp control. Many stakeholders, particularly those with a strong interest in carp control, are likely to make judgments about the acceptability of proposed actions based in part on their views about the relevance and quality of the scientific evidence drawn on to recommend these actions, and on whether the evidence produced addresses areas of interest to them. Acceptance will also likely depend in part on whether stakeholder feel they have sufficient access to scientific information in forms they

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their activities occur, the lessons of SLO studies are highly relevant to the situation of engaging stakeholders in development of the National Carp Control Plan, even though SLO principles has relatively rarely been applied to gaining social acceptance of a specific natural resource management intervention aimed at addressing an environmental problem.

can readily understand and interpret; this affects perceptions of fairness and trust in the process and the decisions arising from it (Opotow and Weiss 2000). If stakeholders feel excluded due to lacking access to evidence, feel that science is being used as a 'shield' or tool of persuasion rather than as an independent assessment of evidence, or feel they are being asked to trust the interpretations of scientists without having the ability to check those interpretations, this can increase likelihood of conflict emerging about proposed actions (Ozawa 1996, Opotow and Weiss 2000, Schirmer 2013, Schirmer 2018).

Previous studies have identified that to increase the likelihood that scientific evidence is relevant, agreed on, and assists in producing consensus rather than conflict, a broader range of stakeholders need to have input into identifying the types of evidence needed, and into interpreting that evidence and developing recommendations from it (Ozawa 1996, Schirmer 2013). This is consistent with calls for critical thinking about how to design effective evidence-based policy, which argue that there is a need to ensure any process integrates different forms of knowledge, including traditional scientific evidence, knowledge of different stakeholders with on-ground understanding and experience, and policy knowledge (Head 2008, Schirmer 2013).

The relatively small number of studies examining the role of scientific evidence in complex NRM issues have identified that an important first step is identifying the types of scientific evidence and information stakeholders need to engage with, and expect to see, in order to decide whether or not to support an action (Ozawa 1996, Schirmer 2013). This is ideally followed by developing processes in which stakeholders are able to engage with this scientific evidence, and interpret it using the lenses of the experiential knowledge they have (Schirmer 2013).

This report begins to address this need through identifying the types of information and evidence a diverse range of interested stakeholder groups expect and wish to see. This can assist in identifying whether existing investment in research in the National Carp Control Plan is addressing the key areas identified by different stakeholders, and any gap areas in which further investment is likely to be needed to address key issues.

COMMUNICATION

A common approach to attempting to achieving social license to operate or social acceptability is to design communication products aimed at promoting the benefits of a proposed action. However, a focus on communications that aim to convince people of a particular 'side' can be counter productive, particularly when communicating about complex NRM issues such as carp control. This is evident in past experiences of environmental conflict, in which communication approaches perceived as biased or one-sided have been identified as triggering conflict and contention (e.g. Ozawa 1996, Opotow and Weiss 2000, Schirmer 2018).

Communication approaches therefore need to think carefully about how to contribute to achieving social acceptance and social license. Past studies examining how best to prevent and resolve environmental conflict, achieve social license, and conduct effective collaborative NRM, all suggest a need to ensure communication is targeted to providing fair representation of all evidence and different views on an issue. This is critical to achieving trust by stakeholders in the organisations who are responsible for developing specific actions, such as the National Carp Control Plan. It is particularly important in development of the Plan, in which the process is expected to involve fair and appropriate review of evidence, including weighing up benefits, costs and risks.

To be effective, communication needs to meet the expectations, needs and concerns of different groups: identifying these expectations, needs and concerns in this report can assist in ensuring communication is designed to address these issues and to support discussion about them. Studies on communication about complex issues also emphasise a need to understand expectations regarding the type and nature of information to be made available, and to match information to the expectations, interests and needs of different groups (Ozawa 1996).

Conflict resolution theory emphasises the importance of not attempting to reach agreement, but rather of creating positive and safe spaces in which differing points of view can be raised, discussed and used to identify strategies that can successfully address differences (see for example Bingham 1986, Worchel et al. 1993, Walker and Daniels 1997, Opotow and Weiss 2000). In other words, when developing the Plan, disagreement should not be viewed as an inherently 'bad' thing, but instead as something that can and should be encouraged so differing points of view can be considered and use to contribute to development of the Plan. This suggests that the goal of communications about carp control during the development of the Plan – a period during which the Plan should be developed based on considering the full range of evidence and knowledge about potential benefits, costs and risk of different approaches to carp control - should not be to promote particular points of view, but instead to create an environment of constructive dialogue and discussion about differing interests, views and needs.

Integrative Complexity Theory (ICT) provides further insights into the importance of communication that is designed to promote constructive dialogue. ICT aims to better understand how a person thinks about an issue, with a focusing on understanding the *structure* of their thoughts rather than their specific opinions. The theory argues that people who have higher *integrative complexity* (IC) are those who can acknowledge multiple aspects of an issue, rather than only one (described as being able to differentiate between different points of view), and who can make connections between different aspects of an issue (integration of differing points of view) (Bright and Barro 2000, Carroll and Bright 2010, Mylek and Schirmer *in review*). Studies of IC in multiple circumstances, including international conflicts, views about contentious issues such as use of nuclear weapons, and

views about environmental and NRM issues such as plant and wildlife protection, have shown that people with higher IC tend to have more moderate views and less extreme attitudes (Mylek and Schirmer in review). More moderate views are associated with lower levels of conflict and higher levels of constructive dialogue about issues, suggesting that promoting integrative complexity is a useful objective when designing communication and engagement about a topic. This means shifting from having an objective of promoting a particular point of view, to designing communication to build the capacity of people to both understand different aspects of an issue and be able to weigh these up to make overall judgments about the issue (Mylek and Schirmer in review).

Promoting higher IC is particularly useful for complex issues such as carp control which have many aspects to consider, and can assist in enabling stakeholders to have meaningful input into the Plan. Achieving higher IC can in turn promote constructive dialogue, identification of shared positions and supported strategies that address the needs of a wider range of stakeholders, and as a result a higher likelihood of achieving social acceptance of the resulting actions. This is supported by evidence from the extensive literature on public participation processes, which has identified that 'a community's capacity to comprehend the complexities of a project impacts on its ability to participate in public meetings; to conduct meaningful dialogue with the proponent … and ultimately to influence the decision-making process of a project' (Anderson et al. 2012, p. 692). It is similarly supported by findings of studies on environmental conflict resolution, which identified that processes that assist people to share differing views in positive ways have positive outcomes even where they do not achieve consensus (Dukes 2004), and by review of experiences of best practice approaches to resolving and avoiding social conflicts related to invasive species management (Estevez et al. 2014).

Given these goals, it is important to understand the level of complexity at which different groups are thinking about carp control, and the extent to which they integrate different views in their discussions about carp control, as well as the needs, issues and concerns about which there is a need to create space for constructive dialogue. This is done in this report principally through stakeholder interviews, and to a lesser extent through examining views of the broader public via survey data.

3. METHODS

To assess initial views, needs, issues and concerns about carp control, two methods were used. First, interviews were conducted with a range of stakeholders representing different groups and organisations with a strong interest in carp control. This is essential as overall support for the Plan will in large part depend on how the Plan is viewed by those who are most directly affected by and interested in it. These interviews provided detailed data about the types of questions, concerns, needs and interests that the National Carp Control Plan will need to address if it is to be supported by the groups who have the strongest interests in carp control.

Second, the initial 'baseline' views of the broader community about carp control were examined, using data collected as part of the 2016 Regional Wellbeing Survey, an annual survey of rural and regional Australians and a limited number of city residents. In spring 2016, just over 12,000 people provided their views about the extent to which pest fish were a problem in their area, and about the acceptability of releasing the carp herpes virus. This provides an initial snapshot of community views across Australia about carp and carp control.

Each type of data collection is described in more detail below.

STAKEHOLDER INTERVIEWS

Interviews were conducted with a total of 23 people by phone or face-to-face (one person provided written answers to questions rather than being directly interviewed). The purpose of the interviews was to identify initial views about carp control and carp, and specifically to identify perceptions about potential benefits and costs of carp control and about what is needed in the National Carp Control Plan to ensure benefits and to prevent, minimise or mitigate negative impacts.

INTERVIEW TOPICS

The full list of interview questions is provided in Appendix 2. The overall topics examined in the interviews were:

1) The aspects of freshwater management, freshwater ecosystems, and/or carp control of interest for the person being interviewed and any organisations they represented
2) Views about current effects of carp in Australia's waterways
3) Views about measures that should should be implemented to help control carp in Australia
4) Views about the potential release of the carp herpes virus, including (i) current extent of support or opposition to release and reasons for this, (ii) views about potential positive and negative outcomes of virus release and strategies that could be used to increase

positive and reduce negative outcomes, and (iii) further information and evidence the interviewees would like access to about the virus and its potential release

5) Views about other carp control measures, including (i) current extent of support or opposition to each measure the person wished to discuss and reasons for this, (ii) views about potential positive and negative outcomes of each measure and strategies that could be used to increase positive and reduce negative outcomes, and (iii) further information and evidence the interviewees would like access to about different carp control measures
6) Views about systems, processes, and governance that should be put in place for developing the Plan and for carp control activities
7) Any other aspects of carp control the interviewee wished to discuss.

INTERVIEW SAMPLE

The goal in interviews was to interview stakeholders with an existing strong interest in carp and/or carp control, and/or potential to be affected by implementation of carp control actions. The interview sample was developed with a goal of ensuring the full range of interests in and views about carp control was represented in interviews. This was achieved by first developing a 'theoretical sample' that identified the range of potential interests in carp control identified based on (i) identifying the different stakeholders commenting publicly on carp control in both the traditional and social media, and (ii) identifying types of stakeholders likely to be interested in or affected by implementation of carp control, including those who have not yet made public statements about carp control. This 'theoretical sample' involved identifying different types of 'interests' people may have in carp control, and then identifying groups and organisations who represented this range of interests. In total, a list of 210 representatives of groups and organisations was identified who may represent the different interests identified. The goal was not to interview all 210, but rather to interview a sample that reflected the full range of views about carp control. To do this, the 210 contacts were organised based on the type of interests they represented. A random sample from each type of interest was then drawn for interview. Interviews with each type of interest group continued where possible until no new themes were emerging, although some types of interest were not represented in interviews, and it is likely new interests and views will emerge as the Plan is developed. The views examined in this report therefore represent a useful picture of views, needs and concerns of many, but not all, of the key groups interested in and potentially affected by carp control.

Table 1 summarises the different groups/interests identified, and the number of people interviewed who represented each type of interest. It also notes where fewer people were interviewed than desired, usually due to difficulty identifying representatives of the group willing to be interviewed.

Table 1 Interview sample

Theoretical sample: type of interest	Total number interviewed	Notes on number of interviews conducted
Traditional Owners	2	Interviews were with representatives of Traditional Owner organisations.
Water users – farmers	3	Interviews were with representatives of farmer organisations.
Water users – domestic consumers, water providers managing domestic supply	2	Interviews were with businesses managing both domestic drinking water and irrigation water supply.
Recreational fishers – non-carp and carp	3	Interviews included both recreational fishing organisations and commercial fishing guide businesses (3). In addition, a further 4 interviewees described themselves as recreational fishers
Environmental non-government organisations	2	
Ecologists, biologists, other scientists with expertise in freshwater and/or carp	2	
Tourism businesses in regions with carp invasion	2	Future work will expand the number of representatives of this group interviewed.
Recreational water users – other e.g. kayaking, boating, water skiing	0	Several hobby organisations were contacted; all declined to be interviewed as they felt this issue was outside their area of interest. Further work will be done to increase contact with these groups in future stages of this study to increase representation of their view.
Commercial businesses using carp/ commercial carp fishers	2	Future work will expand the number of representatives of this group interviewed.
Natural resource management organisations	3	
Animal welfare organisations	1	
Koi enthusiasts, pet industry organisations and aquatic pet businesses	3	Future work will expand the number of representatives of this group interviewed.
Carp consumers	0	Carp consumers are a challenging group to find representatives of: subsequent stages of this study will identify views of carp consumers about carp control.
Native fish breeders/hatcheries	2	Future work will expand the number of representatives of this group interviewed.
Total interviewed	**23**	

DATA ANALYSIS

All but two interviews were recorded with permission of the interviewee. Interview data were transcribed. Transcripts were then thematically coded, with themes focused on identifying factors influencing support or opposition to potential carp control measures, potential positive and negative effects of carp control, and views about systems, processes and governance of carp control. These coded themes were then analysed to identify (i)

initial views about carp control, (ii) expectations regarding the process and content of the Plan, and (iii) the level of knowledge and level of integrative complexity demonstrated when discussing carp control. This analysis was used to identify recommendations for development of the National Carp Control Plan to ensure it addresses key needs, interests and concerns of people with different interests in carp control.

INITIAL VIEWS OF THE BROADER COMMUNITY

The annual Regional Wellbeing Survey (RWS) was launched in 2013 to examine the wellbeing and resilience of people living in rural and regional areas of Australia, and how these residents view and experience a wide range of changes occurring in their communities. Each year, between 8,000 and 13,000 people are surveyed across Australia.

In 2016 the RWS included a small number of questions about views on carp and carp control. These were analysed to identify initial views of the broader community about the proposal to use a virus to control carp, to identify which groups had differing views about this, and where feasible to identify current levels of knowledge about pest fish and environmental problems associated with pest fish, likely levels of integrative complexity, and a small number of factors potentially affecting views about acceptability of using the carp virus to control carp. As these data were collected prior to this research project being commissioned, they were not specifically designed to assess the full range of factors affecting social acceptability of carp control, and should be understood to represent a snapshot of initial views that is not highly detailed.

SURVEY CONTENT

All RWS questions are designed using a multiple-step process involving (i) drafting of survey items, (ii) initial focus group testing, (iii) review by content and method experts, (iv) formal pilot testing. This process ensures that survey questions are designed to both meet the needs of those who will use the data (content experts), meet best practice standards of survey design (method experts), and are able to be easily understood and answered by survey participants (focus groups and pilot testing).

The specific survey items from the 2016 RWS analysed in this report are listed in Appendix 1, including the specific wording of the question and response options. Table 2 summarises the topics analysed from the survey for this report, and the types of analysis conducted.

Table 2 Relevant topics included in the 2016 Regional Wellbeing Survey

Survey topic	How data from this topic were analysed in this report
Acceptability of 'reducing numbers of carp (a pest fish) by releasing the carp herpes virus'	Analysed to identify which people and groups find this less and more acceptable.
Acceptability of range of land and water management practices and changes, from environmental watering to growing genetically modified crops (asked in same set of items asking about acceptability of releasing the carp herpes virus).	Compared acceptability of carp herpes virus release to acceptability of other land and water practices.
Perception of pest fish as an environmental health problem.	Analysed to identify which people and groups are more and less likely to consider carp a problem for health of the environment in their local region.
Perception of the extent to which a range of issues are problems for the health of the environment in the region the survey respondent lives in, ranging from salinity to water quality problems, invasive weeds, loss of vegetation and declining numbers of native fish.	Compared perceptions of pest fish problems to perceptions of other environmental problems.
Fishing activities. Several questions examined whether the survey respondent was a fisher. If they were a fisher, they were asked if they fished in freshwater locations, how often they fished, types of fish targeted, and views about native fish and carp numbers in the places they fish in.	Identified views of fishers about native fish health and numbers and carp numbers. Compare views of fishers and non-fishers about pest fish invasion and carp control.
Accessing information about land and water management. A subset of survey respondents were asked how they preferred to access information about land and water management in their region.	Identified preferences for receiving information about freshwater management and carp control.
Individual characteristics. Socio-demographic characteristics of each respondents, including age, gender, education, income, wellbeing, work, and cultural background.	Views of respondents with differing socio-demographic characteristics were compared to identify any differences in views about carp and carp control.
Geographic location. The location in which respondents lived was geo-coded.	Views of respondents living in different geographic locations were compared.
Community characteristics. Views of respondents about their community, including the effectiveness of local governance and leadership, quality of life and liveability, social interaction, and access to services and infrastructure.	Views of respondents about carp and carp control were compared for those with differing views about their community's overall resilience and liveablity, to identify if the characteristics of a community are associated with differences in views about acceptability of carp control.

SURVEY METHODS AND RESPONSE

The Regional Wellbeing Survey collects data principally from residents living in rural and regional areas outside the capital cities of Sydney, Melbourne, Brisbane, Adelaide, Perth and Canberra. A small comparison sample is also collected from these large urban areas, but is not highly representative of residents of the 'big six' cities.

In 2016, data were collected during October and November, and a total of 12,081 of the 13,300 participants answered one or more questions related to carp and control. Of these

participants, 11,736 lived in rural and regional areas outside Australia's six largest cities, while 345 lived in the six largest capital cities.

Participants could complete the survey online (8,245 of those who answered questions about carp) or on a paper form (3,836 people). Those completing the online survey could elect to complete a shorter or longer version of the survey. Questions about acceptability of carp herpes virus release were asked of all participants, while questions about whether pest fish were a problem locally were asked only of those who elected to complete the longer version of the online survey (participants could elect to complete a short or long version of the survey).

Participants were recruited by (i) delivering flyers or printed surveys to a stratified random sample of letterboxes across Australia, with the sample stratified to achieve higher responses from specific regions and from farmers, (ii) email promotion, including inviting previous RWS participants to complete the 2016 survey, and asking rural and regional organisations to promote the survey through their networks, and (iii) Facebook advertisements encouraging participation. In addition, some media outlets promoted the survey via interviews with the researchers. A prize draw was offered to survey participants as further incentive for completing the survey.

This process resulted in recruitment of a large number of survey participants, with deliberate over-sampling of (i) farmers and (ii) some geographic regions, particularly more remote regions with smaller populations. In addition to the deliberate over-sampling, unintentional oversampling occurred, with women and older people more likely to complete the survey than men and younger people. Both intentional and unintentional over-sampling were addressed in data analysis through the use of data weighting, described in the next section.

DATA ANALYSIS

Prior to data analysis, Regional Wellbeing Survey data were processed and cleaned. This involved entering data from paper surveys, formatted and coding survey data, and removing invalid survey responses. Data were then analysed using Microsoft Excel and the Statistical Package for Social Sciences.

When analysing data, responses were weighted whenever the purpose of the analysis was the make a statement about the views of a particular group or population. 'Weighting' refers to a statistical process in which known biases in the responses received are corrected for. Weighting was used to correct for both intentional over-sampling (of farmers and some regions), and non-intentional biases (the bias towards female and older respondents). The weighting of responses involves adjusting the relative contribution each survey respondent makes to the whole when analysing survey results, so analysis of the sample more accurately represents the population from which it was drawn (in this case, people living in

rural and regional Australia). Weighting doesn't change the answers people gave to survey items.

Data were weighted using GREGWT, a generalised regression weighting procedure developed by the Australian Bureau of Statistics (Bell, 2000). GREGWT is a SAS macro that generates survey weights so that survey estimates agree with external benchmarks, which were obtained from the 2011 Australian Bureau of Statistics (ABS) *Census of Population and Housing*. For the 2016 Regional Wellbeing Survey, the benchmarks used were age (15-39, 40-49, 50-54, 55-69, 70+), gender (female, male), agricultural occupation (farmer, not-farmer), and geographical location (35 geographic regions were defined across Australia in which sampling intensity varied, and each included as a benchmark, enabling different sampling intensities to be corrected as part of the weighting process). In a small number of more urbanised regions, the agricultural occupation criteria were not used due to the very low numbers of farmers living in the region. Weighting has been applied to all analyses in this report, unless otherwise specified.

Due to the way GREGWT calculates weights, a small number of respondents were allocated unrealistically high weights. This was a consequence of having a small number of observations corresponding to a particular benchmark category (Central Statistics Office 2001). To control for extreme weights, weights were Winsorised at the 95th percentile, thus limiting the effect of unrealistically high weights. Winsorisation was considered an appropriate method of adjusting the data as (i) the source of data bias was known, and (ii) comparison of Winsorised and non-Winsorised datasets against independent benchmarks for key variables showed that the Winsorised data better reflects distributions seen in other datasets. Independent benchmarks were taken in all cases from the Australian Bureau of Statistics 2011 *Census of Population and Housing.*

ETHICS

The *2016 Regional Wellbeing Survey* was approved by the University of Canberra Human Research Ethics Committee, protocol number HREC 12-186. Data collected via interviews was approved by the University of Canberra Human Research Ethics Committee, protocol number HREC 17-152. Future surveys, workshops and interviews to be conducted as part of this project have been approved by the University of Canberra Human Research Ethics Committee, protocol number HREC 17-152.

4. KEY STAKEHOLDER NEEDS, ISSUES AND CONCERNS: STAKEHOLDER INTERVIEW FINDINGS

This section reports initial themes emerging from stakeholder interviews conducted in during September to December 2017. These interviews were conducted with representatives of groups and organisations who met one or more of the following characteristics:

- Has a strong interest in freshwater management for any of a wide range of reasons (wide range of groups including Traditional Owners, commercial and recreational users of freshwater areas, advocates for different aspects of freshwater management)
- Likely to be directly impacted by implementation of carp control measures (e.g. manages a business dependent on carp, engaged in activities such as irrigation or tourism in freshwater areas affected by carp, carp consumers, and people engaged in keeping koi or in businesses dependent on koi)
- Advocates on issues relevant to freshwater and carp control and likely to be opinion leaders in public discussions on carp control (e.g. freshwater scientists, farming organisations, environmental NGOs, animal welfare organisations, native fish organisations).

Initially, 23 interviews were conducted. This section reports key themes emerging from these first 23 interviews. Further interviews will be conducted as this study continues, and analysis will be updated in subsequent reports to include new and emerging themes not captured in this initial report. The analysis in this report focused on identifying the questions, concerns and issues that National Carp Control Plan needs to address in order for key stakeholders to assess their level of support for the Plan. This focus emerged both from identification of the importance of assessing this early in development of the Plan, and also as a result of the emphasis placed by almost all interviewees on discussing the types of questions they had about the likely content of the Plan and how the Plan might operate in practice.

INITIAL VIEWS OF KEY STAKEHOLDERS

A first point of assessment was to understand the initial views of key stakeholders: were they starting from a position of opposition or support, and what was this opposition or support conditional on? Of the 23 interviewees, most stated they conditionally supported the concept of the National Carp Control Plan, with their support contingent on seeing that the content of the Plan addressed key issues, questions and concerns. This type of view was typically expressed in a similar manner to that of the Canberra Fisherman's Club in 2016, who stated on their website that at a General Meeting in May 2016:

> *"…the members voted in favour of the Club supporting the release of the Koi Herpes Virus (subject to the Government adequately funding the clean-up of waterways of dead and dying Carp, habitat restoration and restocking of native fish)." - https://www.canberrafishos.com/news-and-articles/312-koi-herpes-virus-q-a Accessed 10 October 2017*

In other words, most stakeholders interviewed were supportive of the concept of the carp control plan in general, and virus release in particular, but only if the Plan (i) contains what they consider to be adequate measures to manage virus release and other carp control measures and their consequences, and (ii) focuses on achieving positive ecological outcomes:

> *Well, in relation to the carp virus, I have to admit, I personally see it as an exciting opportunity. I mean, I feel like, from the information that's been put before me, I feel fairly confident that there's been adequate research and testing of the virus itself and its target species. It does appear to be well researched biocontrol. I acknowledge that there's some big unknowns still in terms of not the virus itself impacting non-target species but it's more the amount of dead fish and the impact on non-target species. Now, I realize that there are some unknowns, and I would personally see that we can work through those unknowns. I believe it's worth working through those unknowns. – NRM representative*

> *We couldn't give it a green light yet 'cause we don't have that comprehensive plan, but at the same time we think it's a really good opportunity. … If a minister wrote me tomorrow saying should I release it [the virus] tomorrow we'd probably say we don't quite have enough information to back you on that. – Farming representative*

> *I'm firmly in the camp of this needs to be addressed for the long-term health of the river, without a doubt. … Because I actually believe that from a tourism perspective we must have healthy environment … and without a doubt, the actual carp do an incredible amount of damage to that waterway. It needs to be dealt with. … there will be short-term pain, for long-term gain. I say that on all levels, whether that be for the tourism industry as an industry, for business, and even socially for the community. … in terms of major concerns I have … it's actually going to be how it's actually rolled out and how it's handled on the ground. – Tourism representative*

Many described themselves as undecided while having an overall favourable view of the idea of carp control if it could be undertaken successfully and with minimal impact, exemplifying the conditional support typically expressed:

> *I guess, I, at this stage, without further information, [organization] would be undecided, and I'd feel that we would need to consult with the [tourism] industry that we represent, who have members along the river as well. … Ultimately, yes getting rid of them [carp] will be great, because they're not natural to the system, but, I guess, at what cost that is gonna happen and how will that impact on the businesses that use the river and the wetlands and all of that? So, we have to factor in, "Yes we all probably want them gone, but at what expense?" – Tourism representative*

A small number of stakeholders unconditionally supported the Plan, and a similarly small number were explicitly opposed to the Plan, although even amongst these, all specified that they supported the concept of controlling carp, but felt the focus on virus release in initial discussions of the Plan was inappropriate.

The conditionality of support described by almost all stakeholders reinforces the importance at this early stage of development of the Plan of capturing the elements that need to be addressed in the Plan in order to enable different stakeholder to assess whether they support it.

When interviews were analysed, the following broad groups of questions were identified that interviewees wanted the Plan to address for them to be able to assess whether they could give their support to it:

- **Carp control measures to be used**: What set of measures will be proposed for carp control?
- **Integrating carp control with other environmental health actions**: How will carp control measures be integrated with other measures to improve environmental health?
- **Planning, timing and management of carp control, particularly virus release:** How will carp control actions be planned and managed, and over what time frames will they be implemented?
- **Risk identification, management and mitigation**: What are the risks associated with different carp control measures and how will they be managed or mitigated? This includes specific risks associated with virus release in particular.
- **Social and economic impacts:** How will social and economic impacts of carp control on specific groups be assessed, managed and mitigated?
- **Ecological recovery:** What actions are needed to encourage positive ecological response to reduction in carp numbers?
- **Consultation and decision making:** How will different groups be involved in decision making processes?
- **Governance and funding commitment:** How will carp control be managed, by which organisations, and who will be responsible both for implementing action, committing to funding in the short- and long-term, and for responding to unintended effects
- **Evaluation of the Plan:** How will the plan be evaluated, what will success look like?

Each of these is discussed in the following sections, identifying the specific questions, issues and concerns different stakeholders would like to see addressed in the Plan. In each part, issues around evidence, knowledge, communication and engagement are identified.

CARP CONTROL MEASURES TO BE USED

Almost every interviewee wanted the Plan to include detailed description of (i) the different carp control measures to be used and (ii) how these different measures will be integrated. This included a focus on ensuring the Plan integrates a range of measures to control carp and achieve ecological restoration, and ensuring there is investment in an appropriate range

of measures. This was associated with a strong expectation that evidence would be produced underpinning recommendations made in the plan, particularly evidence on the expected effects of these measures on carp populations. Several expressed concern that the timeframe for the Plan may not enable production of evidence, particularly through lacking time required to investigate issues such as epidemiology of the virus under different conditions, or conducting trials of different carp control measures.

THE NEED FOR INTEGRATION OF MULTIPLE MEASURES

Many interviewees used the word 'integration' when describing what they believed the Plan should include: specifically, that the Plan should focus on identifying how best to integrate a range of measures to control carp, rather than focusing only or predominantly on release of the carp herpes virus. Almost every interviewee, irrespective of their views on the appropriateness of virus release, specified that the support the Plan they needed to first see evidence that an appropriate set of integrated carp control measures was being proposed and would be used. This was viewed as essential to achieve meaningful long-term reductions on carp populations, with many interviewees stating that they did not feel using any single measure on its own could be effective in achieving long-term carp control.

> *We were strong supporters of this whole strategy coming to being. … we've also acknowledged that [virus release] is not going to be the only solution either and that we shouldn't stop pursuing some of the other opportunities like daughterless carp and those sorts of things because there will be residual [carp] populations that are immune to the herpes virus and so the release of the virus is really the first step in what would need to be integrated long-term control if we're gonna suppress carp for a long time. And that's been one of the real concerns, in the focus being solely on the herpes virus, is that some of those other technologies are, the research into them potentially reduced. … Assuming the virus is released, what needs to happen in concept to maximize success … some of that's around the clean up but some of it's around what other elements of native fish habitats should we focus on so that they have the greatest chance of filling that void, rather than residual carp populations exploding and we end up with a huge expensive mess to clean up and no real outcome. – Farmer representative*[4]

> *All of it has to be integrated. … And I know that's not easy and it's very easy to say that, but I think if you ignore it, you'll have this amazing short term impact and then 10, 20 years down the track, we're talking about what we're going to do about carp again? – NRM representative*

> *…as with any biological control, it's really dangerous just to rely on a single strategy. So, we've been great advocates of the herpes virus, so I think it's probably one of the quickest ways to get a fairly significant knockdown but... if you rely on that strategy as [the only] strategy it'll fall over. So, we think it's a very key plank in the strategy but it's not the only one. It needs to be backed up with things like daughterless carp in the process, and also restocking the river systems to backfill with native so that*

[4] Interviewees are described only by the type of group they represented. Being a 'representative' here does not mean a person always formally represented the views of a particular group: instead, it means they were a part of that group, or represented an organisation that was a part of that group.

you might be able to at least outcompete carp … We think it needs a multiple pronged approach to get management of them [carp], and I understand it won't be eradication, so it really is long-term management of that species. – Water manager representative

The types of measures to be integrated varied, but depending on the interviewee included virus release, daughterless carp, exclusion screens and traps, increasing commercial and non-commercial catch, and increasing water flows, amongst others. These are described in the next sections, with the exception of increased water flow, which was discussed by few interviewees.

VIRUS RELEASE

Most (but not all) interviewees felt that release of the carp herpes virus was an important part of a package of carp control measures, although most expressed a desire to see detailed information on how the virus release would be managed before deciding whether they would actively support it. Some were undecided, not yet able to identify if their groups would conditionally support or oppose virus release, and a smaller number were opposed to release of the virus:

I think there's a bit of ambivalence within our membership around, for example, around whether the herpes virus should be released. On the one hand, there's a strong recognition that they want to see carp numbers reduced. They want to see something put in place to do that, but there's also a lot of trepidation about the potential for a herpes virus or other virus to affect the environment in other ways. Whether that's jumping into other species and affecting other species, or whatever. The example of the cane toad is often referred to, so people might say, "It sounds just like the cane toad. You stuffed the waterways up already," and I guess this is sort of reflecting on like, white, non-Aboriginal, European people's river management practices. You know, "You've stuffed it up already and now you're going to try and fix it by adding another thing, which is maybe going to make it worse." … There's certainly a lot of trepidation about that and I think there's probably a 50/50 split around people that want to see it implemented and people - I think generally, people are quite concerned about it, but they're also concerned about what carp is doing. – Traditional Owner representative

I think I'm pro-virus, actually. I think a well-managed release of the virus could be incredibly effective. I haven't yet seen the evidence that makes me think we're ready a well-managed release, but I believe it could be done. – Freshwater scientist representative

We support the release of the virus. ... I know there will be other factors going into it, but the main reason to support the release of a virus is, from all of the information the I've seen and presentations we've had from the national carp control program, it is probably the single biggest factor that will help get populations down to a manageable level, where we can do other things ... Best management practice from pest control would suggest you need a primary and secondary control measure to effectively control any pest species … why it's really important to have something like this virus is, to effectively reduce the breeding cycle you need to knock over at least 52% of the population of the pest, at least. So, this virus, from all of the theories, says it will knock over more than that. That will give us the best opportunity we've probably ever had to really restrict numbers breeding up again. You're really seriously disrupting the breeding scale, breeding cycle on a very quick massive scale. – NRM representative

Those who supported the use of the virus gave the following reasons for supporting release of the virus:

- They felt that the virus was the only practicable means of achieving a large-scale initial reduction in numbers of carp, which may then provide opportunity to more effectively use other measures
- They felt research on the virus showed it would not be transmissible to humans, animals or native fish species
- They felt the long-term benefits would outweight short-term negative impacts of virus release such as large volumes of dead fish and any associated water quality problems
- They felt that the short-term negative impacts of virus release could be effectively managed, with many citing the experiences of blackwater events in recent years as evidence that negative consequences could be managed

To me it seems that the measures that have been tried in the past haven't been successful in the long-term. Electro-fishing, netting, whatever we've tried, doesn't make a long-term difference. I think something like the carp virus, genetically altering them, I think is potentially another option too. They're certainly worth looking at into the future. That probably leads me to saying, "Am I in favour of the carp virus?" Yes I am. I have some reservations about that, but overall, and sort of taking a risk-based approach, looking at the risks that are there against the potential benefits, generally I'm in favour of that. – Recreational fishing representative

…given their reproductive capacity or their ability to generate massive volumes of biomass in the very short space of time and out-compete native species, the virus seems to be an appropriate tool to be able to knock them [carp] on the head long enough to give the natives a chance to recover and then compete. I completely understand that it is not going to kill 100 percent on day one. But this is as good a chance as we've ever had at managing them effectively for longer term. – Farmer representative

Support was typically conditional on evaluating the processes proposed in the Plan for timing and tailoring release to local conditions, managing clean up, managing welfare of carp and other species, managing impacts and for implementing other measures such as other carp control measures and ecological restoration actions to maximise effectiveness of use of the virus to improve health of freshwater areas, and to prevent population rebound after initial release of the virus. Stakeholders expected to see detailed information providing evidence-based rationales for the actions recommended.

Those who opposed virus release gave the following reasons:

- They felt that other measures could potentially be used to control carp populations
- They felt that research on the virus had not proven there was no risk of transmission to other species and that the risk of virus mutation, even if very small, was one that should not be taken
- They felt that negative impacts of virus release would be significant, particularly for water quality, and did not have confidence this could be managed effectively

- They felt virus release would have negative impacts on groups such as koi breeders or native fish breeders.

One of the problems is that this disease [the carp virus] was only discovered in '98, and so it's obviously mutated from something else. I'm not saying it will but if it mutates and takes to our native fish the way that it wipes carp out it could make some of our native fish extinct. That's a very big worry. – Aquactulture/native fish breeding representative

The stakeholders who opposed virus release, as well as several of those who conditionally supported release, felt existing research had not sufficiently investigated potential for negative outcomes in the short-term and long-term. Not all were aware of the research examining these issues being undertaken as part of developing the Plan.

DAUGHTERLESS CARP

Almost all interviewees expressed a specific desire to see continued investment into development of 'daughterless' carp, and several expressed concern that implementing virus release might reduce longer term investment into this area of carp control. There was strong agreement amongst interviewees that they wished to see a plan for continued investment in developing daughterless carp as a longer-term carp control measure, and concern about a perceived lack of continued investment in this carp control approach. Several interviewees stated that they felt releasing the virus would reduce carp populations to the extent that a technology such as daughterless carp may then be able to be successfully implemented to reduce carp populations. These interviewees typically felt that daughterless carp on its own would be a measure that took an extremely long time to be effective, and that it would be most useful if it followed a significant reduction in carp population achieved via virus release. A smaller number – those who opposed virus release - viewed daughterless carp as a useful strategy that could be used instead of virus release, rather than as a complement to it.

I've wondered to myself, and obviously, with the complete absence of any science background, is genetic modification an option in those areas where the virus might not be effective. I'm probably thinking, "Let's not put all our eggs in a single carp virus basket" – Recreational fishing representative

You need to look at potential biological control other than a virus, say things like the daughterless carp project – NRM representative

…if I go back three to five years, there was discussion of KHV [carp herpes virus], there was also a discussion of the gene technology way of going about things. … the daughterless carp stuff. And when I looked at the two, and the one that was likely to have the best long-term control and the least negative impact on the environment, the daughterless carp technology appealed a lot more than the KHV technology. … [For] daughterless carp, I don't see any negatives, and the big advantage is that it is a slow process. You're not going to get that massive die-off, and the dissolved oxygen, and the blackwater episodes…. this daughterless technology seem to have been pushed to the side the last couple of years, but then it's suddenly brought out as, "Well, we'll use that as a follow-up treatment." Well for me, let's get the research done and make it as a more mainstream solution – Aquatic pet industry representative

Overall, there was a strong desire for the Plan to include a clear strategy for continued investment in research into developing daughterless carp or similar gene-based technologies for long-term carp control, and ideally a commitment to using this approach in future.

JUDAS CARP, CATCHING, TRAPPING AND EXCLUSION TRAPS/SCREENS

The use of control measures involving catching and trapping carp, and/or using 'Judas carp' that are sterilised and have a transmitter attached before being released so they can help pinpoint aggregations of carp, was discussed by most interviewees. Most felt that these measures on their own could be effective in small discrete water bodies (such as the Tasmanian lakes in which some of these methods are already occurring) but could not be effective in large inter-connected catchments with large volumes of carp. These measures were viewed as important to use in areas where there were environments of high environmental significance or where there were other significant values, and in areas which could be readily segregated from other freshwater areas using methods such as carp exclusion traps and screens.

> *Physical barriers to the movement of carp and, certainly I'm no fish expert, but I have read bits and pieces about how there are situations where you can change the way the systems operated to be more friendly to native fish and less friendly to carp and then that helps restore some of the balance, because we're running more like a natural system than a channel, which is more inclined to produce carp. – NRM representative*

> *I think a lot of the measures like the carp traps, Judas carp, possibly looking at the daughterless carp … There are things we will still need to be investing in post-virus, because the virus isn't going to knock everything out, and if we want to keep onto it then we need to be able to have the technologies paddling along as well. – Environmental NGO representative*

> *…carp barriers are really important, particularly around areas that we environmentally water, where we're sucking water out of a channel and putting it into wetlands. Just not letting the carp in there, that is really important – Freshwater scientist representative*

> *Yep, so Judas carp, I think is quite useful for then being able to find where the populations hang out. They do tend to have favourite spots, or hotspots. So, I think they're quite a useful strategy if you've managed to reduce a lot of the population, and then you've still got your Judas carp tagged, then I think that would be a really effective follow-up strategy. -Environmental NGO representative*

> *The traps down in South Australia at Loch 1and things like that are absolutely, fantastically efficient and successful. … my view is that there's a real need for an investment into some traps into specific areas and stuff like that. I think it's really efficient, it is easy to manage and it's a relatively inexpensive process by which you get really discernible data and information. – Commercial carp representative*

COMMERCIAL AND RECREATIONAL HARVEST

Creating more commercial markets for carp-based products was raised by several interviewees as a potential carp control measure (note this refers to longer term markets, rather than to markets for use of dead carp resulting from virus release, discussed further in subsequent sections). Most felt that there was little potential for this, citing factors such as:

- Low price of carp and high relative cost of catching and transporting carp in Australia making catch and export to markets in other countries uneconomic
- Low demand for carp as a fish for consumption in the Australian fish consumption market, with existing campaigns that have encouraged greater consumption of carp having very little if any effect on consumer preferences. Australian consumers were described as having good access to other fish for which they had a strong preference compared to carp for which most Australians had a strong aversion to consumption
- Low economic viability of harvesting carp for other economic uses such as fertiliser, with existing businesses meeting current demand and little scope to expand demand. Again, high costs of catch and transport reduced ablity to expand significantly beyond existing businesses
- Limited ability to make a significant impact on carp populations, with most feeling even substantially increased commercial harvesting would have only a very small impact on carp numbers, too small to provide an effective means of control.

> *…Removal of biomass, which occurs on a reasonable scale around the Murray, yeah, I think it may have some effect, probably not much. They tend to be … basically, there's a bunch of medium-sized carp who will become large-sized carp if you take the big ones out. Whether that's effective, it's pretty mixed. … There's not really strong evidence that has a positive ecological effect. – Freshwater scientist representative*

A small number of interviewees (four) felt that more investment in commercial activities could provide enough demand to use this as a way of controlling carp numbers. These felt strongly that there has not been sufficient investigation of developing larger markets and into creating more enabling environments that could better support a larger industry. In particular, concerns were raised about limiting regulations that they felt have constrained development of a commercial carp industry due to limiting ability to regularly supply markets.

> *I have fishermen who can take Murray River carp, clean them in a way, and turn them into Murray River fish balls, which is a fabulous thing to eat. And I haven't explored the level of innovation that sits along the river in terms of fishermen and chefs and food technologists. … There would be much more social and economic outcomes and less risk out of another control mechanism [such as commercial use]. Or at least to be able to say we explored this, or we did this first for two years and it didn't make a difference. – Tourism/community development representative*

I do believe carp need to be controlled, but I'm telling you now, that there has been no serious consideration given to - by any successive state or federal government - in a harvesting solution – Commercial carp business representative

I'd be encouraging more commercial carp fishing. To me, it's a resource that we could actually capitalise on. I know there's already, you know, the Charlie Carp man that produces fertilizer, but I'm sure there could be markets overseas where it could be sold as a food commodity, or even increasingly used in, say, cat food. I'm sure there's lots of ways that this resource can be used. If we put [00:05:30] sufficient fishing pressure on it to remove the carp from the waterways, I think that could make a massive difference. – Aquatic pet industry representative

…a lot of those waterways where they need to get in and clean out carp from, they've got to put in an application four weeks [ahead] - it takes up to four weeks to be approved. If you get rung up and get told there's a lot of carp in a particular waterway, but it's drying out or something and before the carp move back into the main channel - because as the water drops the carp will move out of that area - they'll put an application in to get in and net the carp out of there and if it takes four weeks for an approval, they're gone. - Commercial carp business representative

The strong differences in view expressed about this issue suggest a need for investigation of this issue, in collaboration with stakeholders who hold differing views about it, to better identify whether and under what circumstances commercial fishing has a role. There is also a need, discussed subsequently, to assess the potential impacts of carp control on those businesses who currently engage in commercial harvest, processing and sale of carp products.

RECREATIONAL EVENTS

Recreational events such as carp musters were viewed as a useful means of raising awareness of carp problems, but most interviewees felt they were not effective means of controlling carp populations. Those who discussed these (six of 23 interviewees) felt these events should be encouraged and continue over time as part of the suite of carp control measures. Two suggested that these could be shifted to become citizen science efforts that track change in carp populations over time.

In terms of carp control measures … All the ones that I've been familiar with like engineering ones and those sorts of things have been ... there have been some claimed successes, but those successes have either been wiped out by their capacity to reproduce so massively and so quickly, or they are hard to detect. The physical, catching of carp, carp musters and those sorts of things probably still have a place, especially when the populations gets down, and its harder to catch carp. – Farmer representative

REDUCING FURTHER SPREAD OF CARP

One interviewee identified that the Plan should include strategies for preventing spread of carp to areas that are currently free of carp.

INTEGRATING CARP CONTROL WITH OTHER ENVIRONMENTAL HEALTH ACTIONS

The principle benefit interviewees anticipated would occur as a result of reducing carp numbers was an improvement in the health of freshwater ecosystems, particularly in aspects such as numbers and health of native fish, reducing water turbidity, and increasing aquatic flora. Given this, most interviewees expected the Plan to include detailed information on strategies that would be put in place to ensure maximum environmental benefit from actions to reduce carp.

Specifically, almost all interviewees (15 of 23) placed a strong emphasis on the importance of ensuring the Plan explicitly integrates both carp control and other actions to improve environmental health.

> *…the risk, as we have seen with other viral control agents in other species, is that they will remove all their investment from other control measures and investing heavily in the viral control. And then are poorly positioned to take advantage of the reduction in numbers, and then the numbers bounce … Ideally, what you would do is have combined sets of control measures at the same time. You don't want to spend all your money on the virus and, say, pull your money out of [other carp control efforts]. Actually, you want to do both. – Freshwater scientist representative*

> *I'm very wary of silver bullets. I've been around natural systems long enough to know that really know that silver bullet don't exist or work as well as everyone expects they will. I think the best results I've witnessed in any sort of management of natural systems has come from an integrated link of different measures, that share the one single goal, that may not be getting rid of carp, but it may be improving the environment for the long term. - Farming representative*

> *I don't think there's a silver bullet and I don't think it's going to be solution that's going to, in any way, shape or form eradicate the problem. I think the measures need to be integrated. Certainly the carp virus is a crucial part of that, but it's not going to ... If you just release a virus and it kills 100% of the carp, that's great, but there's going to be other areas that then need to be managed and what I mean by that is, it's going to have to control the reintroduction of carp, because it won't kill them all. There needs to be another longer-term plan to help control or eradicate carp, then there'll requirements to improve the habitat, particularly from the damage that carp has caused, while some of that will regenerate naturally, there will be a lot of work required to bring the system back up to scratch. – NRM representative*

This was often associated with interviewees stating that carp were only one of many factors influencing health of freshwater areas, and that removing carp is not a 'silver bullet' to achieving improved freshwater health.

> *I think it's accepted that carp are causing a problem. How much that is a problem that's initially caused by carp, or it's just made worse by carp is up for debate. – Other interviewee*

Many of those who supported use of carp control felt that the Plan need to include specific actions for maximising positive ecological response to reduction in carp numbers, in order to get the 'best bang for buck' from investing in carp reduction. Most interviewees wanted the Plan to include specific actions to improve freshwater and estuarine health in conjunction with reducing carp numbers.

I think a key positive is a potential to greatly improve the ecology of the river, so that we restore it back to something towards a natural balance of native fish in the river. I would love to see much greater, stronger stocks of natives in the rivers, and self-sustaining stocks as well. I think that's got its own challenges too. I'm not sure that removing carp on its own will enable self-sustaining stocks of fish in good numbers. … the virus [is] not a complete answer on its own to rebuilding the ecology of the river, because it's not just about the larger species that recreational fishers target, it's about the entire ecology of the river. … In my mind, the plan would need to address not just the release of the virus and the removal of the carp, the recovery of the river, the ecology of the river as well. – Recreational fishing representative

The expectation was not that the Plan would be responsible for these actions, but that it would be explicitly designed to complement or to work in conjunction with other investments already occurring in restoring the health of freshwater and estuarine ecosystems.

A small number of interviewees expressed concern that investing in carp control might be associated with reduced investment in other measures to improve environmental health, and wanted reassurance that this would not be the case. In particular, two of those who opposed use of some carp control measures such as virus release expressed the view that the same funds would achieve greater improvements in freshwater health if invested in actions other than carp control, and that there was a risk of over-emphasising the potential ecological benefits of removing carp given the multiple other factors contributing to Australia's river health problems. This view was also expressed by some of those who conditionally supported the Plan. Particular concern was expressed that investment in carp control might be used as a rationale for reducing the volume of water made available for environmental flows in the Murray-Darling Basin:

I guess the other concern [is] about … that approach to achieving an environmental outcome being put forward as a substitute for restoring the health of waterways through proper environmental flows, for example. … there's a concern about the … way carp control may be positioned as a complimentary measure that can be used in place of water recovery. … complementary measures are just that. They should be complementary to real water recovery – Traditional Owner representative

Others also discussed the Murray-Darling Basin Plan, feeling that it has contributed to growth in carp populations:

The implementation of the Murray-Darling Basin Plan is in many ways the introduction of a carp breeding program into lots and lots of areas associated with the Plan. ... If you take a [commercial carp] business like ours … as the Millennium Drought increased in its gravity, we had to go further and further away to access our fish. … as the rivers dried up and those fish that were naturally attuned to surviving in a diminished water environment were the native fish. … Then the moment the drought broke and everything sort of came back, it wasn't the yellow belly and the cod and bits and pieces that came back in a sort of disproportionate numbers, it was the carp. Now, what they're saying now is that they're going to continue to provide a larger number of environmental flows on a more regular basis [as part of the Murray-Darling Basin Plan], in a changed environmental waterway and the major beneficiaries will unequivocally be carp. I think most people that have some practical and hands-on experience that would agree with that I feel. – Commercial carp representative

Some felt that arguments about the environmental impacts of carp were not correct, and that many of the problems attributed to carp were consequences of broader environmental issues (some of which also created conditions favourable to carp). Amongst these interviewees, this view was associated with lower support for controlling carp:

> *… [carp] have obviously had a major detrimental impact, however … I think that a lot of the environmental impact is man-made, and by that I'm talking about reduced water flows, because we're pulling out so much for irrigation, and general environmental degradation, overfishing of native populations by recreational anglers. I think there's been a lot of things that have really heavily contributed to the decline of our freshwater aquatic environment, of which carp are part of. But my concern is with this major campaign to eradicate carp, is that they are seen as, "If we get rid of the carp, everything else will be fixed," and that's garbage. – Aquatic pet industry representative*

Others also viewed carp as only one part of a broader range of causes of environmental problems, but felt that reducing carp numbers had potential to increase the effectiveness of current work aiming to achieve improvements in health of freshwater ecosystems, and strongly supported carp control because of this potential for positive synergies with existing work:

> *We are [currently] doing all this riparian restoration work and the carp are just undermining this so badly – ENGO representative*
>
> *…there's a cumulative amount of different things you can do to try and improve native fish populations and I think carp control probably fits in as one of the major ones. – Freshwater scientist representative*
>
> *In essence, the objective is about … making rivers a healthier place. … this has long been focused on increasing flow and volumes of water, and they generally come from productive irrigation, so the view that [farming organization] holds is that there needs to be more done to improve the health other than just take water, because we can continue to take more and more water and still not see the sort of magnitude of improvement that might be possible if other complementary measures are taken to improve the health of rivers. Carp being one of the biggest pests in the system and one of the biggest barriers to healthy native fish populations, addressing carp is key. – Farming organisation representative*
>
> *The big problem that we generally have with any kind of focused plan like this that it has a finite lifetime, that once it's done, there's not necessarily the steps that are needed to maintain that beneficial state, if that's achieved. – Other interviewee*

Overall, support for the Plan for many stakeholders is contingent on the Plan including a clear strategy for ensuring reduction in carp is complemented by other measures to improve freshwater health. These do not need to be implemented by those managing the Plan, but could involve collaboration and ensure complementary of actions undertaken as part of the Plan and by organisations involved in ecosystem restoration.

PLANNING, TIMING AND MANAGEMENT OF CARP CONTROL, PARTICULARLY VIRUS RELEASE

All interviewees wanted the Plan to provide detailed information on how carp control measures – specifically, release of the carp herpes virus – will be implemented. While

interviewees described a need for detailed information on staging, timing and management of all measures to be included in the Plan, most focused their comments on discussing the information needed about release of the virus if it occurs. These identified an expectation for detailed information about how virus release would be tested, staged, targeted to local conditions, how carp kills would occur and would be managed, how potential for rebound in carp populations would be managed, and the need for contingency planning. These are described below. In all cases, interviewees described an expectation for evidence-based approaches with access to the evidence used to make recommendations.

> *I suppose more clear, more detailed information about how those kinds of ... How the process is going to be managed in terms of release, clean up, monitoring, risk management. Some more solid detail on how those aspects are going to be managed, would probably be good. I think people want to really, really know that it's not going to jump across to another native fish species. – Traditional Owner representative*

POTENTIAL FOR 'CASE STUDY TEST' OF VIRUS RELEASE

Several interviewees wanted a 'test case' of virus release to occur in a small, isolated water body prior to any large-scale release. This type of test was viewed as providing the evidence needs to evaluate things such as volumes of carp, effectiveness of clean-up strategies and effects on water quality. Several interviewees felt this would provide the evidence needed to build confidence in and support for a broader release of the virus. Interviewees typically suggested isolated water bodies as potential test areas for release.

> *From my understanding, obviously you would want to test. Do a pilot in some sort of controlled or contained environment. If there is a particular waterway or a lake or something that you can confidently quarantine and release the virus to see if that happens. … that would have to be really well thought through as well. Maybe there's a lot of risk associated with that, as it would be the first test run. – Traditional Owner representative*

> *So, obviously there will be some detriment in some areas but I think it can be managed with some communications, some initial trial work in some areas where [the virus is] a little bit easier to contain. So you might pick some spots where the spread can be restricted relatively easy so it could be, so in a backwater that's not connected to the river system, or the like, and just understand how it functions and what happens first up. – Water manager representative*

> *[We need] strong information on rates of spread, particularly rates of spread upstream. Not just model-described. I think a pilot study in a suitable isolated system … And experience of actually removing the amount biomass that would be generated. The modelling we have done suggests that if the virus spreads on the rate that it's claimed to spread at, the blackwater event you would generate from carp biomass would be 3,000 kilometres long. … [we need to know] real world rates of spread, because if the modelling rates of spread are right, it actually can't be managed. It'll spread so fast that it would generate a huge biomass of dead carp we can't manage. … The risk is high. Now I don't believe the model rates of spread. That is [why we need real-world pilot tests] because … we don't know of any counter rates for individuals, nor do we know transmission efficacy in the field. – Freshwater scientist representative*

…there needs to be a controlled release of the virus into an area of some tangible quantity or tangible size or something like that. That just gives everybody some comfort that we know what the outcome would be. – Commercial carp representative

STAGING OF VIRUS RELEASE

Some interviewees wanted information on whether virus release could occur in several stages. By releasing the virus in specific catchments or parts of catchments in a staged manner over time, they felt it would be possible to better manage clean-up, including things such as logistics of shifting specialised clean-up equipment between locations. Several wanted information on whether the virus could be first released in disconnected catchments such as the Wimmera or Lachlan, or downstream in other catchments, to ensure the rate of spread was manageable. All wanted information on the plan for staging of release.

TARGETING VIRUS RELEASE TO LOCAL CONDITIONS

Interviewees wanted to know how virus release would be staged to consider issues such as maximising effectiveness of virus release through timing releasing based on factors including water temperature and water flow; protecting other species by timing release to reduce any potential impacts on breeding or other key needs of freshwater species; and protecting social and economic interests by avoiding releasing the virus during peak water use times for irrigation and recreational users. For example, one manager of water used for irrigation stated that their preference would be for virus release to occur at time of year when irrigation water use demand was not high, to increase their ability to manage issues such as clearing carp from pipes while limiting potential negative consequences if dead carp did cause problems for delivery of irrigation water. Several specified that they wanted to see locally-specific plans for virus release that included plans for protecting key sites, managing impacts on local river users and on local species, and which were developed in collaboration with water managers to ensure they could manage things such as dam water releases to maximise effectiveness of virus release.

… there's carp in the Tumut River, obviously, loads of carp in that area. I'm not sure what temperature the water is that comes out of Blowering [Dam] and Burrinjuck [Dam]? Pretty damn cold, so does that mean we have stretches of river where the virus isn't effective? So, we knock out carp for, maybe 12 months, and then they just spread back down the rivers anyway. How do we manage that? … That raises things like, water curtains for key dams I think, especially in those higher catchment areas. And, who funds those? Are they in scope for the project at all? Because I think there's elements of carp control project, and you can do everything you can to get rid of the carp reasonably, but without some other infrastructure changes- Potentially without other infrastructure changes, the benefits might not be long lasting. – Recreational fishing representative

MANAGING DEAD CARP

All interviewees wanted the Plan to include specific and detailed estimates of upper and lower estimates of likely volumes of fish kill, and likely timeframes for fish kill if the virus is released. All interviewees discussed questions around how dead carp would be managed. A view that managing the volumes of dead carp was not logistically feasible was a key factor driving opposition to virus release for those who did oppose release. Amongst those who conditionally supported virus release, many also expressed concern that it would be difficult to find feasible options for cleaning up dead carp. Others felt more confident, predominantly those who felt that clean-up would typically involve strategic investment in clean-up at some sites while not engaging in clean-up in other locations. Views expressed included:

- Concern about public statements that clean-up of dead carp could be managed by volunteers, with many interviewees feeling this is an unrealistic strategy and expressing a lack of support for clean-up strategies that rely largely on volunteers. However, most felt that some involvement of volunteers was useful as long as this was carefully managed and not relied on as a sole strategy for clean-up.
- Discussion of where and when clean-up would be needed versus when it may be better to have dead carp remain in place. In particular, some felt that in very remote areas with low population and difficult access, there may be a need to strategically decide where clean up will occur versus choosing to leave dead carp in place. Some felt that all dead carp should be removed to prevent risk of negative impacts such as smell and risk of blackwater events, while others felt that these short-term impacts would be tolerable and appropriate given the longer-term benefits to be achieved.
- Animal welfare concerns about clean-up, particularly whether methods of removing dead carp might cause pain or suffering to carp that were not yet dead, or to other species.
- A desire to see feasibility studies regarding the potential for commercial use of dead carp
- A desire to see details regarding how dead carp would be removed and assess any potential for causing ecological damage in the removal process
- Several felt that clean-up required investment of funding into people whose work would be dedicated to clean-up of dead carp. There was support for funding of clean-up by groups including current carp fishers and carp-dependent businesses, for creating jobs for groups such as Indigenous Rangers that include clean-up and ecological restoration duties. Several expressed a desire to ensure local employment opportunities were created
- Some wanted information on how important sites would be protected during release and clean up

"... I mean, there will be some costs in terms of, short-term declines in water quality, and we're a bit unclear on … what the recovery efforts might look like. Whether they're going to involve draining wetlands, whether they're going to involve use of large machinery, for example. … there might be bulldozers involved. There might be large nets and that's talking about a large number of ... large quantity of the fish that have to be moved somewhere else, and we need to ensure … they're not doing some other damage. … it's the short-term damage we might have to live with to get a long-term benefit." – ENGO representative

Who knows whether we're going to create blackwater in places and strip the oxygen out of the water and kill native fish. That's a possibility. The smell is going to be unbelievable. Clean-up is just humongous. … There's creeks and small rivers in Australia that you won't get boats [into]. They've [got] forests that you won't get access to. The clean-up is impossible. It's virtually impossible. If they do it they're probably better off not cleaning up and just putting up with the consequences, because they'll have to put up with the consequences anyway. They will never be able to clean it up. – Aquaculture/native fish breeder representative

I think, the carp has no friends. If you want to put it that way. Everybody wants to be rid of the things. So I think it's a matter of just knowing where different people sit. From an irrigator's perspective, are there issues there with water quality, I don't think people are worried about it because they have been living with them that long, and they've all had events where … when [channels or water bodies] dry out they end up with a big pile of dead carp in a water hole, and they know what that looks like, so they are not terribly distressed about them. … I think it's probably fair to say also as far as black water events and those sorts of things … it's just something that has to be managed and needs to be part of the planning and the management of the whole thing. These things will happen, there will be problems crop up … and it's just going to be a matter of the coordination being good enough to be able to say look, we look like we're at risk of generating a black water in here, the flow's aren't what we thought it would be or whatever it is, and be prepared for that, so if we can have a very quick flush [of water through a regulatory river system] go through to sort those issues, just those sorts of things. – Farmer representative

…of course, the logical question that follows is, "So, if they all die in such a short period of time, and you've got all these rotting dead carp and of course you've got [local government] looking at it from an amenities perspective. They've got river frontage that's relatively sheltered that collects debris. They're going have that concern right at the forefront. That's relatively easy to control the aesthetic part of that directly. But then you start looking at the other areas … You know, you're looking at thousands of hectares' worth of shallow, often inaccessible, muddy, sticky areas that you can't even get boats into. So, of course, a lot of the community groups that we deal with are asking, "Well, how on earth would they clean up carp in there?" And I can't really see it being logistically or financially feasible to clean it up. So, then it leads on, to a flow of questions. For example, what can you do to make it less? In my team of colleagues, we talk about back-up options, so if you plan for worst-case scenario, what would that look like? Like, with our small-bodied threatened fish … a number of them will be able to tolerate fairly poor water quality for a relatively decent amount of time. But what about those that aren't so tolerant? So, can you create some back-up populations and for quite a lot of them, you could. It would be logistically challenging, but you could. … But for the most part, certainly those that I come across, while they're still nervous about what the impacts to water quality might be, they're really supportive of seeing a biological control for carp. – NRM representative

MANAGING POTENTIAL FOR CARP POPULATION REBOUND

Some interviewees wanted information on how likely it was that there would be a largely rebound of carp populations after an initial knock-down by the virus, and what measures would be put in place to reduce the extent of carp population recovery. This was associated with the view that the Plan should include an integrated set of carp control measures, rather than focusing solely on virus release (described previously).

RISK IDENTIFICATION, MANAGEMENT AND MITIGATION

The need for the Plan to identify and assess risks, and to include management and mitigation strategies for these risks, is identified in many of the actions discussed in this report. Several interviewees specified that they expected the Plan to include contingency plans for 'worst case' scenarios, including (i) the potential effect of unexpected weather conditions such as large floods or extended drought after virus release, (ii) managing all possible scenarios of timing and volume of dead carp to be cleaned-up, (iii) managing water quality problems if they occurred, (iv) managing animal welfare risks, and (v) managing unplanned spread of the virus (intentional or unintentional).

> *…if I was explaining anything I would probably ask the researchers to do their best guess, plus add a worse guess, and plus add a double disaster guess. Then you can talk to the community about actually we think it's going to be this, but if it's not this then it's more then here is our contingency plan, and if it's not that and it's even more here's our next level contingency plan. Because I think there's a level of scepticism in the community … that the researchers always have it right, because these people have been the brunt of research not being right. But to overcome it, just say, "We think it's our best guess, but do you know what, we're going to double it, use the contingency plan, and if we double it, again use the contingency plan." And then you will resolve the debate over how big. Because I always hear the moment about, "Oh no, it's much bigger than that." – Tourism/community development representative*

Some who discussed this emphasised that they felt it was important that there was risk planning, but that identification of risks was not used as a reason to not act, with some stating that they felt not acting risked worse outcomes than taking action even where there is uncertainty and risk:

> *…as the virus gets released, things might not quite as we predicted, so there might need to be some flexibility to change the plan on the run … if there's greater deaths, or less deaths, what are we going to do then? Or if carp are affected in different places to what we expected. Or if suddenly, there's a consequence to another species we didn't predict. We have to just be really careful that... we've thought about that and got a clear response. … a bit of contingency planning. … However, because the consequences are so large here, the positive consequences, then we have to sometimes be a little bit riskier for a big benefit. ... we've got to take into account risk, but we can't be overly protective. – ENGO representative*

RISK OF VIRUS TRANSMISSION TO OTHER SPECIES

All those who conditionally or unconditionally supported release of the carp herpes virus felt that research to date has demonstrated that the carp herpes virus will not be transmissible to other species, including other native fish species, animals or humans. This meant that a majority of those interviewed felt reasonably confident the virus could be released safely without risk of transmission to other species. It is important to note that this was the view expressed by a group of highly interested and relatively well-informed stakeholders: this is likely to be very different to the views of members of the general public. This view was most often expressed by those who had attended presentations and discussions with National Carp Control Program staff:

> *I guess from what I've seen, initially the potential negatives you'd sort of talk about well, "Can a virus transfer to other species?" And all of that sort of stuff and from the sessions that we have with people like Matt Barwick, it seems there's been pretty rigorous testing around that, so I don't have that concern anymore. – NRM representative*

> *I don't have any fears that it's going to spread to any other fish and that sort of ... I don't think that. I think they've done a really good job of covering off on that. I don't know if they've quite communicated that well enough. I've seen some Facebook forums and things where people are still convinced that they can jump species, or get into our drinking water and we'll all contract hard herpes virus and that sort of thing, so ... the communication side of things … I just think that pub talk goes a long way on some of this stuff – Freshwater scientist representative*

However, some interviewees expressed some concerns about current evidence or felt that there was a risk of virus mutation.

> *Now I know there's been no trials that have shown that this does affect people, and I understand about Herpes Virus being fairly host-specific. But you still get a sudden huge dose of virus ingested, anything is possible. … there's no way I, as a person, would eat a carp that I knew was infected with [the carp herpes virus], because of that one million chance that something could go wrong…. I know there's been some work done with native fish, but as I understand it the numbers that have been tested are very low. … I think there certainly has to be further research and testing done along those lines to be 100% sure that native fish are not impacted. And as I've said, even then there's always that risk, in a wild environment, that the situation will occur that you get a jump from one species to another. That's how all these viruses happen in the first place. – Aquatic pet industry representative*

Some felt that past research has not adequately explained the causes of death of some of the native fish involved in the trials, despite identifying that they did not die from carp herpes virus. These people wanted more information on the causes of native fish deaths in these trials, and any future trials to consult people such as Australian native fish breeders, to improve confidence in how the trials were undertaken and ensure thorough assessment of the causes of death of any fish that died in trials even if death was not caused by the virus.

> *The information that I have been able to see, hasn't been strongly convincing in terms of the testing around the impact of the virus on other species. Looking at some of the data that I could find on the*

websites it indicated some mortality of native fish associated with the testing, but it wasn't clear if that was because of the carp virus, or some other factor of the testing outcome – Recreational fishing representative

We've seen some of the tests they've done on the native fish with this disease [the carp herpes virus]. They have clarified that our native fish will carry this disease, but they don't seem to think that it'll affect them. That's a very big worry. Some of the tests that we're done we've been told about that the native fish died anyway. They didn't think that they died from the disease, but any test that's done like that it should be repeated, and if it dies it's a concern. … If the native fish are dying have they got the experience to handle native fish to do the test? It's very hard to say, you know, because we weren't involved in the tests. Look I've been handling fish for [a large number of] years and there's several other guys that have been going longer. We didn't even know they're doing them tests. You'd think they would come and at least get some point of views. – Aquaculture/native fish breeder representative

A small number believed that the risk of the virus mutating in future was small, but that the consequences if it did mutate to affect other species were so high that they could not support virus release. These interviewees were not convinced by available evidence suggesting very low likelihood of virus mutations, and one felt that the virus had mutated to affect carp at the point where outbreaks began occurring in other countries, and therefore could mutate again[5].

Others felt that while they generally trusted the research, they felt there was still a need to investigate the quality and comprehensiveness of the published research in this area:

Well, there's always the unknown elements that scientists, we like to think that we can predict things, but we're not historically very good at that. So, making sure that due diligence has been done to ensure that all of the lessons that we should have learned from the past have been taken onboard. Obviously the question of, "Could this affect other species?" That, I haven't looked in depth at how good that research has been. We have to have a certain level of trust that enough resources have been put into that. That's kind of our main concern. – Other interviewee

Those who felt evidence to date was convincing felt that there needed to be ongoing, easy to understand communication of the research conducted to date on virus transmissibility, to ensure there was good public understanding of the findings.

…the question I always get asked when I'm out in the field talking to people out in the country is, what is the potential for it to impact other native species amongst other things. I don't have that technical information. It would be good to say well, here's a stack of studies which have been done that shows that it's completely harmless to Cod and to Yellow Belly and anything else, but, the best I can do is say

[5] Note that in this report we do not attempt to assess the scientific evidence for and against different points of view. Further information on some of the concerns raised related to virus mutation can be found at http://ksakoi.com/home/?p=359 (accessed 10th October 2017), as can responses to these concerns at http://ksakoi.com/home/wp-content/uploads/2017/07/Rural-and-Regional-Affairs-and-Transport-Legislation-Committee_2017_05_25_5045.pdf. These documents provide an indication of the types of discussion occurring around this issue.

"well scientists tell us it looks pretty good". …I expect that would be on the list of things to do leading up to any use of the virus. I think it [communication] would need to be targeted. The people that most keenly interested in that are obviously the fisherman and those sorts of people. And the Indigenous people as well – Farmer representative

CONTINGENCY PLANNING FOR CLEAN-UP OF DEAD CARP

Several interviewees wanted contingency planning for 'best case' and 'worst case' scenarios of virus release and associated carp clean up. This was particularly important to several who felt that there would always be high uncertainty about exact volumes of dead carp likely to occur, and that the best way of addressing this is to ensure the Plan includes planning for the full range of possible outcomes. This included planning for different volumes of dead carp, in a range of locations and configurations in water systems, at different times of year when there would be a range of differing recreational and commercial water uses occurring.

CONTINGENCY PLANNING FOR WATER QUALITY IMPACTS

Associated with planning for differing scenarios of carp death, a need to plan for different potential impacts of virus release on water quality was discussed by some interviewees. Levels of concern about the potential for carp kill to lead to blackwater events or other water quality problems varied substantially amongst interviewees. Some - particularly those directly engaged in water management in rural areas – felt confident they could manage consequences of water quality impacts relatively easily, given they have managed multiple events such as blackwater events with associated large fish kills and algal blooms in the past. Others, typically those in occupations not directly engaged in water management, expressed higher levels of concern.

I'm not sure it would be any worse than the blackwater events that we've had that have come back from the flood plains. We've had dead fish as well as hypoxic and coloured water, so, you know, like I said, I'm not sure whether it would be that bad because obviously those fish take a fair time to decompose as well. … the issue, I think, in those sort of things is [being] forewarned makes management of it easier. So you know if it's going to occur, roughly when it's going to occur, and knowing how long it's going to last. … It affects different people differently. So, for most of the irrigation customers it's not an issue. So, you know, the water will still be viable on the crops. … it's more of an impact on their households and household use. As we said, we tend to let people know that it's coming to make sure that they've got any reserves, tanks or tank water filled up, and to be using that in their property now. That can go for a month or two. When it goes longer than that then generally those supplies run out and I've got to get it back on to the ... onto the blackwater. And that creates some issues, bath and kids, washing, all that sort of stuff. … I think the other thing not to forget is, as I said is, if people can see some benefit at the end of it, that's a whole different ballgame too. We want to make sure that if you run through the process you can publicize, well, here's the short-term pain you're going to go through but the long-term benefit of this will be X. – Water manager representative

This reinforces the need to assess the likelihood of carp virus release leading to water quality problems (a key area of research funded as part of the Plan), and identification of

whether potential short-term water quality problems associated with dead carp are similar to those experienced in past events such as blackwater events associated with floods in 2016, or are likely to differ. Learning from the experiences of past events involving poor water quality and fish kill could provide 'real world' evidence that enables stakeholders to better assess both the risk involved, recovery times, and the management strategies available in the event carp kill has negative short-term impacts on water quality.

A smaller number highlighted that improved water quality was a key potential long-term benefit of controlling carp:

> *I absolutely have no doubt whatsoever that if there was a marked improvement in the quality of water not necessarily the volume of water, the social and economic benefits from that would be massive and way beyond what people could comprehend. … and this is where the carp again have a really significant impact on it. The carp do deteriorate, do adversely affect the water quality. … [If water quality was improved due to carp control], I just think that all of a sudden, a whole range of sort of tourism and commercial outcomes in the region. If you look at the ... Simply just look at the size of the Murray-Darling Basin, the sheer size, and the sheer quantity. All of a sudden, areas like the Macquarie Marshes and again Koondrook Perricoota forest, the whole range of these things actually become really, really potentially outstanding destinations. But because we're unable to promote the inland river systems as anything much more than sort of houseboats and water skiing, the demographic that the basin appeals [to] is somewhat limited. I actually think that if you think open up the appeal of those areas, then all of a sudden, a whole range of things will spin off from there. … [but] … it has to be a far more sophisticated and logical argument than saying that if you take the red gum loggers out of the forest at Mathoura, 100,000 visitors will come and visit that area. – Commercial carp representative*

MANAGING ANIMAL WELFARE RISKS

A small number of interviewees explicitly identified animal welfare considerations as an area to be addressed in the Plan. In particular, they identified a need for explicit assessment of the likely animal welfare implications, both for carp and for other species, as well as strategies that can be implemented to minimise animal suffering.

> *If you're going to be killing animals because they're a pest, you've got to have established why they're causing a problem in the first place. You've got to make sure that what you're attempting to do is actually going to solve those problems, and you also need to make sure that what you're doing is humane. … basically anything that involves capturing and killing fish, unless you are going down the route of something that's quite labour intensive, it generally involves fish suffering – Other interviewee*

MANAGING UNPLANNED SPREAD OF THE VIRUS

Several interviewees felt it was essential to have contingency plans for unplanned virus spread. This unplanned spread could be unintentional (for example, more rapid virus transmission than initially estimated), or intentional (intentional spread of the virus by humans). These contingency plans included considering the potential for unintended spread when planning for carp clean-up and potential water quality problems, and also planning to reduce the risk of unplanned spread. Some mentioned the experience of unplanned release

of the rabbit calisi virus as an example of the need to have clear and well developed contingency planning that could be implemented rapidly in the event of unplanned release of the virus in areas where release was not yet intended to occur.

> *One of my concerns is that people will intentionally, or inadvertently, transmit the virus from waterway to waterway. So instead of having a nice, neatly staged release that's manageable, and we have resources to remove the carp in whatever way, instead … if someone intentionally drops it up in the headwaters of a river, rather than starting down the bottom … you can have very quickly, a massive amount of carp die across a very wide geographical area, which would be very difficult, I think, to remove the carp. I guess there's an understanding too that needs to be had of how big a consequence that might be. So that's a concern for me. – Recreational fishing representative*

Three interviewees expressed the view that clear and strong communication, particularly with recreational fishers, was necessary to reduce the risk of intentional virus spread by humans. They felt that good communication that explained why unplanned virus release in new locations would reduce potential to achieve positive outcomes such as increased native fish populations would be effective in ensuring fishers did not seek to actively spread the virus once it was released in an initial location.

> *I think [a] positive communication campaign about the importance of not doing that [intentionally spreading infected fish], would have a really positive impact. I've seen, over my lifetime, a huge change in inland fishers, in how they go about their fishing. When I was growing up, if people caught a large Murray cod, they killed it, with a 100% certainty. These days… even taking a cod within the slot limit is a bit, "Mm, do you really need to do that?" So there's been a real culture change in sustainability and preserving those stocks of fish. … if we can get out that message that it's important that the release of the virus happens in a coordinated way, so that we can manage the removal of the dead biomass where we need to. I think that's your best hope. I think that could work. … I think, to support that message, that goes to the importance of having public access to some sort of project plan at a reasonable level of detail. … Just so that people can have a sense of, "This is how it's going to happen." And even talk about the risks of unintended release. – Recreational fishing representative*

SOCIAL AND ECONOMIC IMPACTS

Most interviewees would support carp control only if they were confident that potential social and economic impacts were effectively addressed, either through reducing the potential for negative impacts or including clear actions to mitigate impacts where they may occur. Several also felt that the Plan should clear assess and identify actions to maximise potential positive impacts, both in the short-term and long-term.

Specific types of social and economic impact discussed were impacts on:

- Traditional Owners
- Irrigation water providers and their customers
- Domestic water providers and their customers
- Native fish breeders
- Commercial carp businesses
- Koi enthusiasts and businesses associated with koi breeding, keeping and management

- Freshwater tourism businesses
- Recreational water users
- Communities
- Organisations who may have short-term opportunities related to clean-up.

The findings suggest a need to ensure there is explicit assessment of potential social and economic impacts on different groups, particularly those where there is potential for carp control to impact their livelihood or key activities they engage in. Specific assessment of these impacts with development of appropriate prevention and mitigation strategies to address negative impacts, and identification of strategies for maximising positive impacts, is essential to achieve social acceptance of the Plan from a range of stakeholder groups.

TRADITIONAL OWNERS

Interviewees from organisations representing Traditional Owners identified that it is important to identify how implementation of carp control actions, and associated actions aimed at restoring ecological health, may impact on cultural activities and on- country activities. Those interviewed identified that there was potential to develop positive opportunities for Indigenous people as part of the Plan, but that this requires investment in appropriate consultation and involvement of Traditional Owners in informing the development of the Plan.

> *Obviously, the impacts of carp, particularly around water quality and impacts on other native fish are a key concern of our membership. Our members, many of them maintain or continue what are cultural traditions of fishing, and have both cultural totemic connections to certain native fish such as Murray Cod, for example. And also ongoing practical use of those species for food and to share with family, and as a cultural practice. Certainly a lot of concern about the impact of carp in their waterways. – Traditional Owner representative*

> *…there's certainly a strong aspiration - one of the key things that our membership has recognised is that … whatever the Carp Control Plan is and how it's implemented, they want to be involved and they want to explore the opportunity for positive outcomes for Aboriginal communities, in terms of employment, capacity building, working on Country to implement and to monitor the outcome of any kind of control measures that are put in place. So a really strong aspiration to do that. ... another aspiration would be to be able to be involved in, and benefit from, any kind of clean up that has to happen as well. … particularly if there's a whole bunch of funding that's going to go into this and it's over a long time span, there's a fantastic opportunity for a pathway to capacity building for Nations involved in waterway management, you know, over the time span of that project being rolled out. – Traditional Owner representative*

IRRIGATED AGRICULTURE – WATER PROVIDERS AND CUSTOMERS

Water providers who supplied irrigators, as well as organisations representing irrigators, discussed their views on the potential effects of carp management on water supply for irrigation and irrigators more generally. These interviewees identified that potential impacts included:

- Negative impacts on pumping infrastructure if large amounts of dead carp blocked intake pipes or filters. All felt this could be managed as long as there was forward knowledge of the likelihood of large numbers of dead fish, enabling them to planned ahead of time how what measures they would implement to protect infrastructure.
- Negative impacts on water quality. Those who discussed this felt this could be managed in the same way as blackwater events and algal blooms have been in the past: past experiences of maintaining irrigated water supply during such events meant there was high confidence this could be managed appropriately and effectively using protocols already in place for these events. This assumed the impacts on water quality lasted for less than two to three months, the period existing management processes typically successfully manage.
- Positive long-term impacts on infrastructure and water quality. Some felt that long term improvements in water quality would have positive impacts for irrigated agriculture in terms of providing safe water with reduced water filtering requirements.

> *From a water management perspective … if you have massive fish kills, they will block regulators. They will potentially cause overflow and flooding. … Now, in a river system, depending on where that flood is, if it's into a wetland, it's probably not so bad. If it's a water management system, an irrigation system it will flood neighbouring properties and they tend to get rather upset about that. Rightfully so. … water managers in this day and age, they've got pretty smart, sophisticated systems that you can control the height on an automated system and it'll change the height on the regulator and let more or less water flow through, but that works well when it's a known scenario, but if it was a scenario where there was a massive fish kill quickly and the system couldn't respond quickly enough, you're going to have to have surveillance and have people pulling the carp out … or have a smart system in the river where it just channels the carp into the side of the river and they can be easily pulled out, but it lets the flow down the middle still go. It can be managed, but I think it's something that has to be thought through – Water manager representative*

If feasible, timing virus release to occur outside times of peak consumption of water for irrigation would assist irrigation water providers in managing any impacts. Water managers expected to be highly engaged in discussions about the Plan, in particular production of recommendations about managing water supply and regulated water systems with virus release.

> *I think it is about consultation and engagement up front [with water managers]. Giving them enough information to say, "This is what the likely biomass of carp in your system is. This is where it's likely to cause issues." And then they'll have the smarts to figure out how to deal with that. – Water manager representative*

> *So, for us, a [virus] release that had an impact, a significant impact over winter periods probably better for us. … Our biggest periods of [irrigation and domestic water] extraction are November, December, January, February. So, that time is where everything is running at full tilt, and so, if there's a lot of dead fish in that time … that probably impacts on us. … If the major impact occurs through*

winter months we very rarely draw much at all. That can be managed in that sort of vein. – Water manager representative

DOMESTIC WATER SUPPLY AND CONSUMPTION

Domestic water suppliers had similar views to those who provided water to irrigators, with one exception: concern about public perceptions. Both domestic water providers, and others who commented on water quality issues, felt that strong communication was needed to the public about the safety of water supplies during virus release to reduce potential opposition.

NATIVE FISH BREEDERS

The native fish breeding industry has grown rapidly in recent years, and multiple native fish hatcheries operate throughout regions where carp invasion has occurred. These native fish hatcheries have developed substantial expertise on native fish aquaculture and restocking. Native fish breeders interviewed identified multiple questions they wanted answered in the Plan, including:

- If virus release occurs, how will this affect exports? Several hatcheries export fish to other countries, and were concerned that they may no longer be permitted to send fish to some countries if a notifiable virus is released in Australia. Native fish breeding businesses wanted detailed information on the implications of virus release for their export and domestic trade.
- Will compensation or structural adjustment be provided if there are negative impacts? Businesses wanted the Plan to specify the nature of any compensation/adjustment and the criteria for providing assistance, to ensure that any negative impacts occurring as a result of virus release would be addressed.
- What demand will there be for businesses to hatch fingerlings to restock freshwater areas after virus release? Fish breeders wanted to be closely engaged in development of plans for any restocking, particularly in the management of associated logistics. Some, particularly in NSW, expressed concern about current management of stocking programs and had low confidence in future stocking as a result. Others, particularly in Victoria and South Australia, felt current stocking programs were managed well.
- A need for support in terms of communicating with customers was identified, with a need to prevent consumer concern about the virus in order to maintain business for hatcheries. There was concern that domestic consumers may have some hesitation in consuming native fish bred in areas where virus release has occurred, and a need for an associated communication campaign to maintain consumer confidence.

Another concern I have is what it does for … export markets. If those countries [native fish hatchery and aquaculture businesses export to] find out that we've released a notifiable disease there is a very big chance that they will block the exports of any fish. The way they work, especially in China, they won't give

you a reason. If they want to block something, they'll just block it. … If it stops the export of … fish, which [native fish businesses have] been encouraged to do by the Australian government, what compensation is in place? – Aquaculture/native fish breeder representative

More broadly, native fish breeders felt they had expertise and knowledge that should be drawn on when developing the Plan, particularly with regard to the logistics of stocking freshwater areas with fingerlings and research into native fish behavior and ecology. For example, some discussed a need to identify how to ensure adequate food sources for Murray Cod, which often feed on small carp, post any release of the virus.

COMMERCIAL CARP BUSINESSES

Commercial carp businesses including commercial carp fishers and businesses who process and sell carp-derived products. The people interviewed from this group of businesses raised similar topics to native fish breeders, particularly focused around what types of assistance would be provided to those who currently rely on carp for their business. Some expressed a desire to be directly engaged in activities such as clean-up and provided opportunities where possible, particularly given potential longer-term impacts on their businesses. Others felt that being offered opportunities to participate in clean-up would not be sufficient to address potential impacts on their business. They wanted detailed information on assistance measures to be provided to enable their businesses to adapt to changing availability of carp if virus release occurred. As they expected virus release would not completely eradicate carp, most felt their business would have potential to continue in some form if virus release occurred, but only if support was provided to enable them to adjust.

> *I don't want to be told by someone that our compensation for losing our fishery is we can clean up a few tons of stinky carp. That's not helpful. – Commercial carp business representative*

As noted earlier, some felt that not enough had been done to establish and support commercial harvest of carp as a carp control method. Some raised concerns about lack of an enabling environmental for commercial carp businesses, which they felt in turn reduced their ability to both use commercial carp harvest as a control method, and to adapt their business if carp control measures such as virus release are implemented. In particular, high levels of regulation were a concern:

> *There are more regulations around catching carp than there is for any other fish species that I know of. Simply because they don't want fishermen targeting the natives at the same time. So they've actually got more stringent rules and regulations around carp fishing than they have about anything else. – Commercial carp business representative*

There is a need to better assess the potential impacts of carp control on these businesses, and to identify methods for preventing and mitigating potential negative impacts while ideally also providing opportunities for commercial carp businesses to have positive outcome. This group has detailed and in-depth knowledge of carp which can contribute substantially to the development of the Plan.

KOI ENTHUSIASTS AND ASSOCIATED BUSINESSES

Koi are kept as pets by many people across Australia, estimated to be in the order of several thousand people by koi enthusiasts. Koi are susceptible to the carp herpes virus. Both koi enthusiasts, and the businesses that support the koi industry such as suppliers of koi-related feed and infrastructure, and aquatic vets, can be impacted by release of the carp herpes virus. A number of koi enthusiasts have publicly stated opposition to release of the carp herpes virus, citing concerns about issues such as potential for mutation. Concerns about impacts on areas other than the koi industry are reported in other parts of this report.

People engaged in koi keeping or in koi-related businesses were asked to discuss potential impacts of carp control on koi, and specifically virus release. Questions, concerns and issues raised included:

- A desire for specific plans for biocontrol measures that can effectively protect koi from the virus and enable important activities such as koi shows to be held with confidence. Some of those interviewed did not believe biocontrol was feasible, feeling that there was high risk of virus spread from actions such as birds carrying virus-laden material between sites and hence infecting koi ponds that were otherwise isolated. This highlights a need for presentation of evidence underpinning biocontrol recommendations, including evidence on effectiveness of biocontrol measures in other countries that do not use vaccination.
- Assessment of the specific social and economic costs if there are negative impacts on koi industries. This would include assessment of effects on businesses that depend on koi, as well as on enthusiasts who keep koi.
- Development of a plan for treatment of koi, for example whether imports of koi will be permitted to replace stocks affected by the virus.
- Some requested reconsideration of the stated position that a carp herpes virus vaccine would not be made available in Australia.

> *…most of them [koi enthusiasts] would've invested anywhere between $10,000 and a $100,000 on their koi farm ponds. Like these are, in most cases, exquisite, beautiful garden features, and the koi are quite expensive. It's easy to just say, "Have good bio security measures," and you can do that with shows and things like that, but you can't stop the bird flying over dropping a partly digested koi inadvertently into your pond. Once it [the carp virus] is in the domestic koi population, it will spread quite easily. As it's done overseas, and decimated the koi industry in many parts of the world. – Aquatic pet industry representative*

> *These guys really value their koi. It's a big thing, they have meetings … they have shows. It's not a huge industry, but it's an industry about which they are very, very passionate, and it seems to have been completely dismissed in the conversation so far. - Aquatic pet industry representative*

FRESHWATER TOURISM BUSINESSES AND RECREATIONAL WATER USERS

Freshwater tourism businesses interviewed included businesses that acted as commercial fishing guides, and in providing houseboat accommodation, as well as representatives of the

broader tourism industry. These interviewees varied substantially in their views about the potential impacts of carp control. All felt there was potential for short-term reduction in business during periods in which there were large numbers of dead carp. While some felt this could be managed readily as they had experienced past events – specifically, blue-green algal outbreaks and blackwater events – that had affected their business, and their business planning included contingencies for these events – others were less certain.

All felt uncertain about issues including how long their businesses might be affected by carp control activities, whether there would be new business opportunities (such as providing accommodation to clean-up crews), and expressed a desire for ongoing consultation to help identify potential impacts and design strategies to minimize negative impacts and maximise positive impacts. Some identified potential for some potential actions to have unintentional impacts on tourism businesses reliant on fish stocking, for example:

> *Do we restock fish into river systems? Is that a state issue? Is that a State obligation, rather than a Commonwealth issue? Have the States committed to do that? So that's another concern for me. I think that will have to happen. There'll have to be some significant restocking of fish into the river, and on a very large scale. A scale much larger than what we have now potentially. Would that impact in any way on for example, some of the guides who operate in the Snowy Mountains, who rely on trout fishing, if for instance New South Wales fisheries only have X amount of dollars to grow fingerlings out, and the pressure's on to restock on natives, do they remove funding from the effort they would normally make on trout fishing? And that has an adverse impact on guides and recreational fishers who fish in trout streams. – Recreational fishing representative*

> *But I guess probably the biggest impact would be through tourism, and those related industries. And again, some of that can be done at times where those industries, with discussions with those industries, at times where there are peak loadings either so you can minimize the impact on those sorts of environments. … just understanding what it might mean and can we take preventative action for it or can it be done in a manner where it might not, or might have minimal impact – Water manager representative*

> *But I guess the thing is, is the information. We'd need to know timeframes, what the impact is, all those things that would actually be of concern to our operators. Whether they have to be out of business, or whether it's gonna impact on their business, and for what timeframe, and when it's gonna happen, or plan to happen, and how long, what's the cycle of the disease actually taking effect, and is it anticipated to happen from start to finish? … If a business is not able to operate properly for a period of time, there may need to be some level of compensation for that business for them to close down for so many months a year, or whatever it takes. – Tourism representative*

In particular, a need was identified to manage public perceptions about impacts of carp control on tourist destinations. This was needed to address a key risk to tourism businesses: the potential for development of strong community perceptions that people should not visit tourism areas due to the effects of carp control activities (e.g. smell, dead carp), with this perception likely to significantly impact tourism activity irrespective of whether there are in fact issues of smell or dead carp. Interviewees identified a need to develop specific communication strategies to reduce this risk.

Local community is worried about clean-up. They had a smattering of fish kill in the black water and so you've already got them nervous about what that means. That's a major battle of perception and … the Murray River, you know, it makes significant revenue in terms of houseboat holidays, we don't want it to damage that industry while we're going through the carp control. – Tourism/community development representative

… if the virus was introduced, whether that will have some impact on the system from people visiting and experiencing activities there, that's probably a main concern for operators, because they would have to run tours, or boat cruises, or whatever and if there's dead floating fish on top of the water then that would naturally raise concern. … And probably the timeframe that it would take and how long it is. I mean if it's fairly controlled and it happens over a shorter period of time in say, winter or something like that, and there's less people in the river, or using the river, it probably might not be as noticeable I guess. But, if it takes a whole year to happen… You would hate the lakes to be full of all these dead fish floating up top for months on end, or whatever. That probably would be the concern, I would say, from a tourism perspective, because I know obviously, when river levels were low, there was lots of impact that actually had. Now this would have a similar type of impact, if you know what I mean. – Tourism representative

… one of the things from a tourism perspective is the lag of perception, consumer perception. … which is what in tourism and tourism marketing we rely on so heavily. We could have a lag, or a lag in terms of visitation and positive thought processing and the broad community understanding for 10 years. I base that comment on what we've seen happen when we were in drought. It absolutely devastated the tourism industry in our area, and it is, in some parts of our industry they're still actually recovering even though we've had … a high flow event, at the end of last year. In terms of the damage that was done because the media and consumer perception wasn't actively managed, it had a devastating effect. … a broad consumer campaign is going to be very, very important … I certainly think partnering with Tourism Australia and the state bodies … that would be really key, because at the end of the day they obviously have significant communication channels with consumers who have expressed an interest in travel of some description. … I think those sorts of things will be important, to have them as part of that conversation into the future. Probably, realistically a working group around that I would imagine into the future. – Tourism representative

…clearly [economic impact] will be significant, and tourism will be one of those that will be significantly impacted by this. That's not going to be fully mitigated, there's no way that can occur, it will be impacted, there's no doubt, and it will be negatively impacted. But it's how that's managed so that that is reduced as much as it can be. For example, one of the things that we did during the high flows, towards the end of last year, on the river, we ran quite significant campaigns … we had an all of government approach … and … compared to previous high flows or droughts, we had significantly positive media around it. We were able to focus the media on the innovative stories that came out of it, tourism operators being innovative. Be Safe, Be Curious, Come and Visit, that kind of messaging, so it was very much that communication plan was crucial. This will be no different, I mean obviously the messages are different, but it will still be crucial. – Tourism representative

Representatives of recreational fishing organisations generally expressed support for carp control measures in general, and virus release in particular, feeling that this would in the long-run improve fishing conditions. However, support was conditional on being able to review how carp control measures would be implemented to assess if they were satisfied that the approach taken was appropriate.

I think, if the carp were removed from the river, and we had a more representative, whatever the river can hold in native fish, there'd be more people actually interested in going fishing. People would be more interested in participating in recreational fishing on the whole. - Recreational fishing representative

The different responses suggest a need to evaluate the extent to which past events which have similarities to the potential effects of carp virus release have affected tourism businesses and recreational user of rivers, and the costs of any impacts. This examination of past similar events can provide a useful assessment of potential impacts of carp control, particularly virus release, based on assessing recent experiences of events such as blackwater and algal blooms which may have similar effects on these activities as would the presence of large volumes of dead carp or associated water quality issues.

COMMUNITIES

Some interviewees identified potential impacts on local areas. In particular, some who lived in areas that were experiencing stress due to factors other than the proposed control of carp felt that even small negative impacts from carp control could cause substantial problems in their community, due to high levels of existing stress in those communities.

As most quotes given on this issue would be highly identifiable, no direct quotes are included in this section. However, the highest concern about impacts was expressed by stakeholders living in the South Australian Lakes and Coorong region, who felt that multiple changes had impacted local towns including changes to fisheries and extended drought with associated impacts on fishing, tourism and farming. They were particularly concerned about the potential for carp control actions to add additional stress in their communities. Similar concerns were raised by stakeholders regarding communities in other parts of the Murray-Darling Basin that they believed had experienced significant stress in recent years as a result of changes in access to water for irrigated agriculture, drought, or agricultural market downturn.

This highlights the importance of understanding the capacity of different communities to cope with implementation of carp control actions as part of developing the Plan.

ORGANISATIONS ENGAGED IN CARP CLEAN-UP AND UTILISATION

Some interviewees felt it was important the Plan provide specific opportunities for local businesses to become engaged in both clean up of dead carp and in broader freshwater ecological restoration projects, and saw this as providing new economic opportunities, particularly in areas experiencing economic challenges.

ECOLOGICAL IMPACTS AND ENCOURAGING ECOLOGICAL RECOVERY

Several interviewees stated that their support for the Plan would be conditional on the Plan including commitments to invest in actions to improve and restore freshwater health after carp control measures were implemented.

Many of these interviewees expressed concerns that there was potential for a reduction in carp populations to be followed by another pest species (with redfin commonly mentioned) that would 'fill the gap' left by carp. They felt that it was essential to implement measures that would support growth in native fish populations, which may include stocking of fingerlings, or investing in improving habitat such as bank restoration and restoration of aquatic flora, amongst others. Some interviewees also discussed issues including managing cold water pollution, managing environmental water releases to have best effect, and managing sediment entering freshwater systems. These interviewees wanted the Plan to identify what ecological restoration actions would be invested in to maximise the positive outcomes of reducing carp numbers, and who would be responsible for them.

> *I'm also concerned about the potential for ... so we remove the carp, there's this huge hole in the environment that carp used to fill, will redfin take over that very quickly, rather than the native fish that we would all love to see back? So, do we remove one problem and just create a massive opportunity? – Recreational fishing representative*

> *…this is why we actually need really, really good and sophisticated scientific and empirical data to properly answer that question. My view is very strong on this matter. That is, if we get rid of the carp and we get it down to a biomass level that's acceptable to everybody, I have little or no doubt that it would not be a native fish that restores the natural balance into the river system … it would be some other introduced species that will take advantage of a different environment that is more suited to their proliferation than the carp … Now, we may get an increase in cod numbers and we may get an increase in yellow belly numbers and we may get an increase in crays and all sort of things and it may be that. But to me, it may be redfin or it could be a whole range of other smaller invasive fishes that we're all acutely aware of that are in the system at the moment but don't garner much publicity. But again, I'm very happy to be wrong on that as well. – Commercial carp representative*

> *The potential negatives we don't understand, I think, are the removal of carp as a food source for native birds and native fish. … [and] there is a concern of okay, if it's not carp in the system, is it natives that replace that biomass? Because we have a whole range of really effective invasive species that have just been showing up in small numbers through the catchment. We can't assume the natives are going to be the wins if we take the carp out. For instance, Tilapia are present in some places. Tilapia probably would do well without competing with carp. Goldfish are immune to the virus, but the same niche of being a large-bodies bottom feeding fish. The Weather loach, which are an Asian species of bottom feeding fish that's probably in competition with carp. Redfin perch, which are probably being predated on by carp, during the larvae stage. There's a bunch of potential winners that aren't natives, and I know these systems pretty well and I can't predict who is going win everywhere in the system. It's the worry. The worry is 'Right, we're going to have huge Murray cod breeding events', and we don't. We have a huge redfin perch breeding event. – Freshwater scientist representative*

Some interviewees also wanted specific assessment of potential impacts of virus release on native fish, particularly on Murray Cod which were described as often feeding on small carp. They wanted to see both evidence on potential impacts and plans to reduce any potential negative impacts of removing carp as a food source, or other negative impacts on native species and freshwater systems.

COMMUNICATION AND CONSULTATION

Most interviewees discussed the need for clear and ongoing communication and consultation to multiple groups throughout the development of the Plan. In particular, discussion focused on identifying how to manage public expectations and ensure that the evidence on which decisions are based is well communicated and trusted. Examples discussed included a need to ensure there was understanding about impacts on drinking water supplies and trust in measures undertaken to ensure safety of those supplies, and to ensure there was understanding of why dead carp might not always need removal where the system was assessed as being able to cope with their presence:

> *I think there might need to be some information to the public about whether it [dead carp after virus release] may not be as bad as it might look... when we're talking about 100,000 fish in a small area, whether that's something that the ecosystem can handle. If it can, there might need to be some clear explanation about that because there's a general public view that we almost have to clean up straight away, and the system can't handle it and that's a really bad thing. We got to be careful we're not wasting a huge amount of money just for aesthetics … Because, there's going to be a lot of dead fish in a very short period of time and sometimes rivers can handle that sort of thing, sometimes they can't … there's going to need to be some quite strong public awareness raising so some of the things that [are done] really clearly explained – ENGO representative*

Some also identified that they felt there was a lack of basic understanding and awareness of the problem of carp, feeling that a key issue in communicating with the general public was a need to increase awareness of the extent of the problems of carp invasion and associated problems:

> *To me, one of the crucial things is … this whole issue of justification, that people need to understand why you're doing something … actually communicating what the problem is effectively is really important for people to be onside. ... Particularly something controversial, that they really understand that this is a problem and what's being done is going to help. – Other representative*

> *… what the government is trying to do is the introduction of a virus into the freshwater river system … and we live in an environment where people don't even want fluoride in their water. This is going to evoke a whole range of … emotive and uneducated responses. That is a given and how you deal with that becomes a much more difficult issue. The problem is that the majority of people … actually have no comprehension as to the magnitude of this problem. Have absolutely no idea. They've heard about it, they've seen the odd media grab of a wash up of carp under various beaches and bits and pieces and stuff like that. If you went to somebody in Sydney and said there's probably somewhere around 30*

tons of carp in Centennial Park, they just wouldn't believe you. If they then turned around and saw the numbers of it, they'll be just saying, "This is just not possible." – Commercial carp business representative

Several interviewees identified that one of the most important aspects of communication was not necessarily communication from those managing the Plan, but communication both to and amonst experts in freshwater science, and the level of debate amongst these scientists:

…the thing that will undermine community confidence is vigorous scientific debate about the veracity of the strategy [Plan] – Farmer representative

…the broader scientific community is not being very well communicated with to date, and that's annoyed some people. … I feel informed, but it's worthwhile reflecting on the fact that large numbers of other people don't – Freshwater scientist representative

However, this communication needed to be able to make information relevant to local areas:

I think it would need to see, they'd need to see it to believe it, sort of thing. … Examples of how it's worked in other places, maybe? How it's played out in other environments, countries, or whatever could help. The modelling side of things is always difficult for people to connect with, even if it seems to be good. I think people would want to understand how it's going to affect their area, their Country. – Traditional Owner representative

When discussing their own information needs, as opposed to those of the broader public, interviewees typically expected to have information available to that met their need for often highly detailed and specific evidence regarding key questions they had about carp control and its potential benefits, costs and risks:

I'm thinking about the information on the website now, I don't feel there's a lot of readily accessible information up there at the moment. I recognize that's probably a reflection [that] the information that I want to see, hasn't actually been developed yet, and we're going through that process. I think the greater visibility that you can provide to the public on the progress of the project, would be a very good thing. I think it's going well, and there's been great public engagement and lots of interest in it, but the more documentation that you can make available, I think the better. – Recreational fishing representative

Some expressed concern about initial discussion and information provision, in particular what they felt was overly simplistic or one-sided information associated with the announcement of the Plan. Others felt there was a lack of consistent communication about the activities being undertaken as part of the Plan, and about how different issues of interest to them were being addressed in the research program. Some of these identified that these concerns had been reduced by subsequent discussions with staff from the National Carp Control Plan. In particular, if they felt these discussions had been genuine,

recognized multiple points of view, as well as risks, uncertainties and knowledge gaps, and had given then information about the research being conducted for the Plan, they were more likely to feel they were being communicated with effectively.

Connected to this, there was a strong desire for good consultation, but for consultation to be highly targeted to meaningfully involving different stakeholder groups in developing aspects of the Plan relevant to them. For example, this might involve developing proposed biocontrol measures in collaboration with those engaged in breeding and keeping koi, or designing measures to protect water quality in active collaboration with on-ground water managers. This means that consultation should be targeted to meaningful discussions about on-ground actions, available evidence, and proposed content of the Plan, and should actively seek contributions of stakeholders who have high levels of knowledge and expertise in relevant areas. While consultation in the form of general community meetings was also considered useful, most stakeholders expressed a desire for direct involvement in developing relevant areas of the Plan, rather than more generic consultation options.

GOVERNANCE AND COMMITMENT TO FUNDING

When asked about governance, a common issue identified by interviewees was the length of time in which the Plan is being developed. Fourteen interviewees expressed concerns about the short time-frame for development of the Plan, and 10 specifically stated a desire to have a longer time period for research and planning of virus release and other actions before proceeding to implementing a national carp control plan. A longer time frame would assist in achieving support for the NCCP for most of the 14 who expressed concern about timeframes. Only three specifically expressed a desire to ensure the current timeframe for the NCCP was adhered to, with those three having the view that virus release should be progressed as rapidly as possible.

> *Instead of saying that we need to solve the carp problem and put a definitive start dated by the end of December 2018 to be releasing a virus, I'd turn around and say we need to have by 2020 or a much longer, much more detailed and much better information as to what the outcomes are going to be and how the effects … will roll out before we actually take such a drastic measure. – Commercial carp representative*

When asked how carp control actions should be governed and managed, interviewees emphasised a need for governance that:

- Is transparent – based on clear evidence that is made public, with differences in view and reasoning for decisions clearly stated
- Is inclusive – including a wide range of both government agencies and other stakeholder groups
- Has clear lines of responsibility – with different agencies making clear commitments to undertaking actions, and clarity around who is responsible for funding and for managing different activities

- Is accountable – with criteria for monitoring and evaluating outcomes
- Involves demonstrable commitment – with those involved signing on to providing the funding and resourcing needed for both the short and long-term.

Some concern was expressed by two interviewees about processes by which research funding had initially been distributed as part of development of the Plan, suggesting a need for greater transparency of these processes:

> *There's a set of concerns. One is the loud volume around the political interventions, saying, "We will do this," so a fait accompli, you know that doesn't matter what. That's one concern that drives it. The second one, who was in the research team? That's never been clearly articulated. Essentially, it has ended up being driven by state agencies and fisheries groups but that was never something that was explained. I think it's being managed better now but it wasn't initially. Third, how do you access resources and funding? Money is being seen as being handed out [for] research without a process that people felt like they could bid for. – Freshwater scientist representative*

There was particular concern about ensuring there are clear lines of responsibility and commitment to action from the multiple government organisations, and concern that aspects of managing the consequences of carp control might be left to organisations that are not adequately funded or equipped for the task, or that coordination of the different regulatory approvals and changed practices needed would be challenging:

> *… there's an argy-bargy over who's responsibility it is. The lowest common denominator is always local government, so they have a chip on their shoulder that 'we'll be left with the responsibility' - Tourism/community development representative*

> *…in an ideal world you'd say let's hold back environmental water, then when the virus comes, if we get in trouble and we're starting to get blackwater events, we'll dilute them out by releasing environmental water. There's a bunch of concerns around that. One is that environmental water is not for that purpose. … There are watering plans across the entire basin that would have to be suspended. Watering plans are delivered through the act and they can only be suspended by a parliamentary act, so that that's a problem. There's a problem, but you could do it. … So there's some big issues around environmental water and poorly appreciated, I think, issues around the problem. – Freshwater scientist representative*

Several stakeholders felt that maintaining collaborative governance was essential, and that governance processes needed to clearly involve both (i) all political parties, and (ii) groups other than government, to ensure widespread support for carp control:

> *I think one of great things about this carp program today, as being the really strong support from some of those strong stakeholders, whether it's the fisheries, the regulators, and conservationists, and I think that's a real strength that it'd be good to maintain through the programs, so that all of the groups feel like it's their program, rather than a government program and that we're willing to defend it and support it.* – ENGO representative

> *There is no point in introducing any standard of commercial or corporate governance bits and pieces and things like that if there is under willingness on both sides of politics to start a process, work it through and not change it halfway through. … This absolutely has to be a bi-partisan process. There*

could not be any hint of political interference in this process because it will get absolutely stymied. – Commercial carp representative

Ensuring that the Plan was developed with meaningful involvement of key groups – particularly Traditional Owners, water managers, freshwater scientists, fish breeders and fishers, amongst others – was important to most stakeholders. Meaningful involvement meant different things to different people, but many wanted a process in which different groups were involved in both developing actions included in the Plan, and in which they could explicitly endorse or reject actions proposed in the Plan, thus making their level of support for the Plan transparent and based on a high level of understanding of the Plan's content.

I guess as a given, we would want to see Aboriginal people given a meaningful, a substantive role or Aboriginal organisations having a substantive role in contributing to decision making about [the Plan]. At the same level as any interest group. – Traditional Owner representative

Key amongst the issues raised by interviewees was a need for clear commitment of different government agencies to funding all costs associated with the Plan, with concern that long-term funding was needed to achieve success in terms of restoration of freshwater ecosystems and long-term reduction in carp numbers.

EVALUATION OF THE PLAN

Several interviewees wanted the Plan to include specific metrics for monitoring and evaluating outcomes. This would enable the Plan to answer the question of 'what is success', by clearly identifying from the outset the objectives of carp control and what would indicate success in the short, medium and long-term. For example: to what extent would the Plan be considered successful if it achieved:

- Substantial reduction in carp numbers (how much reduction and over what time frame)?
- Increases in native fish populations (how much, which species and over what time frame)?
- Reduced turbidity of water over time.

Including metrics for monitoring and evaluation will ensure there is a clear and shared vision of what the Plan aims to achieve and how its outcomes can be evaluated.

DISCUSSION AND CONCLUSIONS

The stakeholders interviewed all had a strong existing interest in either carp, improving freshwater or estuarine health, or in commercial activities reliant on carp or on waterways and waterbodies carp have invaded. They are also typically highly influential stakeholders, being highly engaged in public discussions and in discussions with decision makers in a range of government agencies, and often acting as knowledge brokers who translate and interpret available evidence to communicate to the groups they represent (for example,

many recreational fishing organisations have provided communication about carp control to members of their groups). The views of these stakeholders about the acceptability or otherwise of actions proposed in the Plan will be critical to achieving both socio-political acceptance of proposed actions and community acceptance.

All demonstrated high levels of engagement with existing information about carp, and most had a strong desire and expectation to be provided with further detailed information and evidence from the research to be conducted as part of developing the Plan. Almost all demonstrated high levels of integrative complexity, discussing both pros and cons of potential carp control actions. They expected that communication from the National Carp Control Plan would do the same, and are much more likely to trust and engage with the process of developing the Plan if communications and information clearly identify all sides of the different issues being examined. The NCCP was viewed as an entity that would be trusted only if it was truly an independent broker that provided information on benefits, costs and risks, and if ut engaged stakeholders in discussions about how best to interpret that information and produce recommendations based on it. For these highly engaged stakeholders, providing overly simplistic information will reduce trust and hence likelihood of engaging in the process of developing the Plan. This means communication with these stakeholders should be matched to their already complex and detailed level of knowledge and thinking about carp control.

Similarly, these stakeholders expect meaningful opportunities to engage in aspects of developing the Plan, predominantly those aspects in which their knowledge can contribute to development of strategies. These aspects differ depending on the stakeholder. For example, tourism businesses expect to see both assessment of potential impacts on tourism businesses, and engagement of tourism industry representatives in developing strategies to minimise potential for negative impacts and promote potential positive impacts. Water managers expect to be engaged in discussions around proposed approaches to actions such as virus release, particularly managing things such as water flow, water quality and other aspects.

The stakeholders interviewed do not represent all interests in carp control, and new and differing interests will emerge during the process of developing the Plan. For this reason interviews will be repeated at future stages to identify how expectations, needs and concerns are changing, and will include new interviewees over time.

5. GENERAL COMMUNITY VIEWS ON CARP CONTROL

INTRODUCTION

This section provides insights into initial views of the broader community about carp control, and awareness of pest fish invasion. It analyses data collected in the 2016 Regional Wellbeing Survey. The survey was conducted approximately six months after the Australian Government first announced (in May 2016) that funding had been committed to development of the National Carp Control Plan. Between the announcement in May 2016 and the time of the survey, public discussion had included statements in the media that virus release would likely occur in 2018 (for examples, Science Minister Christopher Pyne was quoted by the ABC as stating this[6]). There had been major rainfall events in early to mid Spring 2016 which resulted in significant flooding in much of the Murray-Darling Basin, and in large blackwater events associated with this flooding, with floods and blackwater still affecting some areas at the time the survey was conducted. This context is important to interpreting responses to survey questions: answers to a survey inevitably reflect views at a particular point in time, which may change in a different context.

The 2016 Regional Wellbeing Survey included a very small number of questions about carp and carp control. These were included by the researchers who manage the survey with the intent of capturing an initial snapshot of views about carp control. The questions were not specifically designed for this project, which was commissioned several months after the survey was conducted. The survey responses provide an initial snapshot of key views that are relevant to further work in this study, but do not provide a comprehensive understanding of all factors that are likely to influence social acceptability of carp control. Instead, they provide a snapshot of four key areas:

- The extent to which pest fish are perceived to be an environmental problem
- Initial views on acceptability of carp virus release
- Views of recreational fishers about native fish and carp
- Preferred sources of information about natural resource management.

These four areas are useful starting points: the extent to which a person perceives the presence of a problem (e.g. pest fish) is a known factor influencing the acceptability of implementing actions to control that problem (together with other aspects such as value

[6] http://www.abc.net.au/news/2016-05-01/herpes-to-eradicate-carp-in-murray-river-pyne-says/7373736

orientations) (see for example Sharp et al. 2011). It is also a useful indicator of levels of awareness and engagement with information relevant to carp control.

Initial views about acceptability of virus release provide an understanding of the initial reactions to the announcement of the National Carp Control Plan. Views of recreational fishers provide a more detailed picture of how one group with very strong interests in freshwater management view both the problem of carp invasion and proposals to control carp. Understanding how people prefer to receive information enables identification of optimal communication methods as the Plan is further developed.

Subsequent surveys conducted for this project will examine views about a wider range of factors that influence the views people have about carp control, and provide a more comprehensive understanding of the influence of this broader range of factors.

The results presented in this section separately present views of (i) rural and regional Australians (defined as those living outside Australia's six largest cities) and (ii) large city residents. The two are separately presented as data on rural and regional resident's views has a much higher level of confidence, while data from the relatively small sample of 'big city' residents is drawn from a much smaller sample, with correspondingly lower levels of confidence in the results.

Data are presented descriptively, without presentation of data on statistical significance of differences between groups. This is for several reasons. First, no specific single hypothesis or question is being examined in this research; the examination of the data is exploratory and based on understanding overall patterns in the research. Given this, application of statistical analysis is less appropriate. Second, the sample of rural and regional Australians is very large, and as a result even small differences between groups are likely to be statistically significant, even with application of corrections for multiple comparisons. Using tests of statistical significance in this case risks falsely claiming meaningful differences between groups (see Blume et al. 2018 for a useful discussion of this issue). Visual presentation of results provides a useful indicator of meaningfulness, in that results that are visually different typically represent relatively meaningful differences. For 'big city' Australians, there is a different problem: the sample is small and not necessarily highly representative, and as such results should be considered exploratory only and likely to be accurate only to a fairly wide range of variance that is not adequately represented by either confidence intervals or tests of significance. To reflect this, figure captions for this group all state 'small sample with low reliability' to reflect that the sample may be unrepresentative. Future work in this study will present appropriate statistical analysis, when analyzing data from surveys designed specifically to test different hypotheses.

PERCEPTION OF PEST FISH AS AN ENVIRONMENTAL PROBLEM

The first key area examined using survey data was the extent to which pest fish invasion is viewed as a problem by Australians. One of the key factors likely to influence whether a person supports the investment of time and resources in carp control is whether they believe there are environmental health problems related to carp. For example, Sharp et al. (2011) found that having knowledge about specific invasive species issues in an area was predictive of support for particular approaches to management. While many other factors are also influential, a person's level of awareness of the existence of a problem is particularly relevant as it is something that can be modified through communication about the issue, whereas some other factors – such as a person's core values – are less readily modifiable[7] (Dietz et al. 2005), despite being shown to influence perceived social acceptability of invasive species management measures (Schüttler et al. 2011).

Survey participants were asked to rate the extent to which they believed a range of environmental problems were issues in their local area (shown in Figure 2), including three relevant to carp:

- *Pest fish species e.g. carp*: This item asks about all pest fish species, however answers in many regions will largely reflect carp invasion, particularly as the example given was carp
- *Declining numbers of native fish:* This item asks about an environmental problem often described as being in part due to invasion of carp in those systems where carp invasion has occurred
- *Water quality problems other than salinity:* Carp invasion is commonly argued to contribute to some water quality problems, particularly water turbidity, due to the feeding habits of carp.

These questions provide an indication of the extent to which people are (i) aware of the problem of pest fish invasion, and (ii) aware of the occurrence of two key issues often described as being an outcome of carp invasion – native fish decline, and water quality problems. However, it is important to note that native fish decline and water quality problems may results from a range of factors, only one of which is carp invasion. This means that people who identified these as issues do not necessarily believe they result from spread

[7] The term 'values' is defined differently in different disciplines. Here its use is drawn from social psychology, where a value is understood to be a deeply held construct that guides a person's behaviour and attitudes. The extent to which values are modifiable and change over time is debated, but they are generally agreed to be less readily modifiable in the short term than beliefs about issues about the extent to which issues like carp invasion are occurring.

of carp, although the overall level of awareness provides insight into the extent to which the problems overall are recognised. In addition to the three items relevant to carp, participants were asked to rate the extent to which they felt other environmental problems were issues, such as invasion of weeds, feral animals more generally, loss of vegetation, salinity and poor soil health.

OVERALL PERCEPTIONS

In total, 37% of rural and regional Australians felt invasion of pest fish species such as carp was a moderate to large problem in their local area (Figures 2 and 3), while 35% felt pest fish species were not a problem or a small problem and a significant minority – 28% – were unsure whether pest fish invasion was a problem locally. Overall, these results suggest low awareness of pest fish invasion problems for many Australians, and a need to invest in increasing awareness of the environmental problems presented by carp invasion amongst the broader community. Amongst the small sample of urban Australians, fewer (22%) felt invasion was a moderate to large problem and more felt it was not a problem locally (52%).

There was a similar pattern of findings when respondents were asked whether declining numbers of native fish were a problem: in rural and regional areas, 39% felt this was a problem, 35% felt it was a small or negligible problem, while 36% were unsure. This suggests low awareness of the one of the key consequences of pest fish invasion amongst the general population. Concern about water quality problems other than salinity was also relatively low, with 32% of rural/regional residents perceiving this as a problem, one in five being unsure (21%), and 46% feeling this was not a problem or only a small issue.

Other environmental issues – particularly invasive weeds, feral animals, loss of vegetation and declining numbers of native animals and birds – are more commonly perceived as significant local problems than invasion of pest fish, decline of native fish or water quality problems.

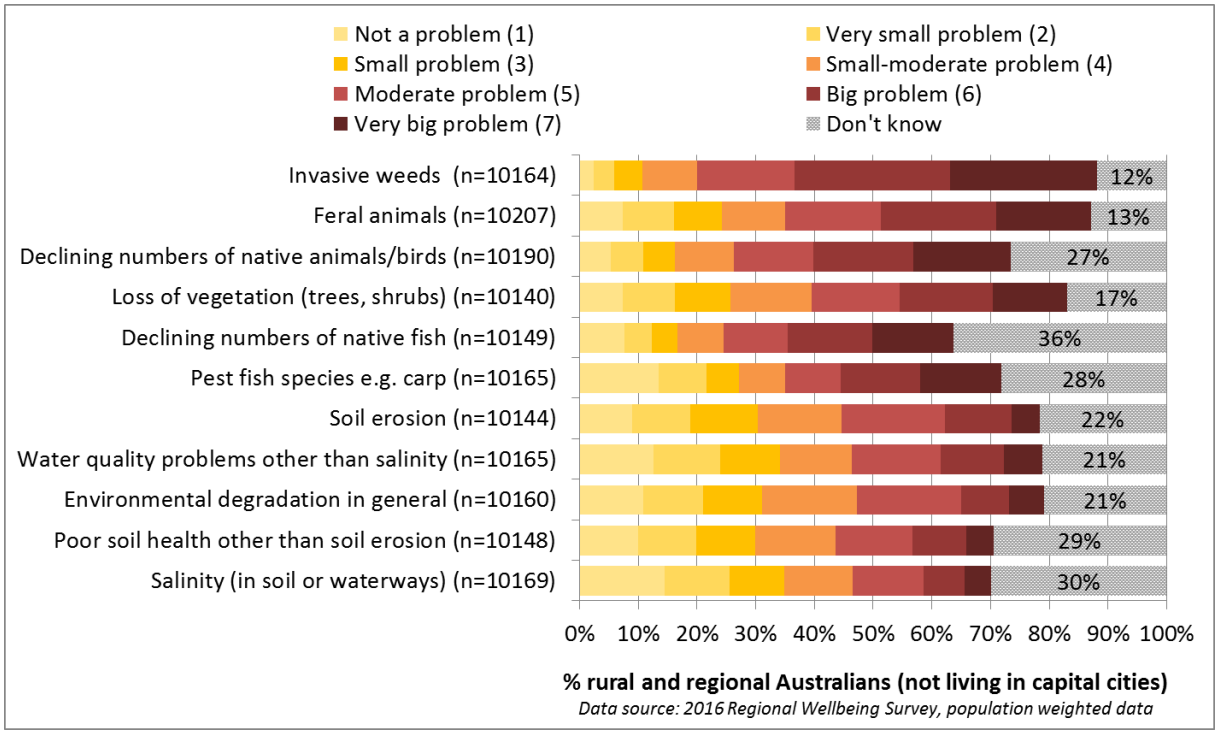

Figure 2 Perceived local environmental problems – rural and regional Australians

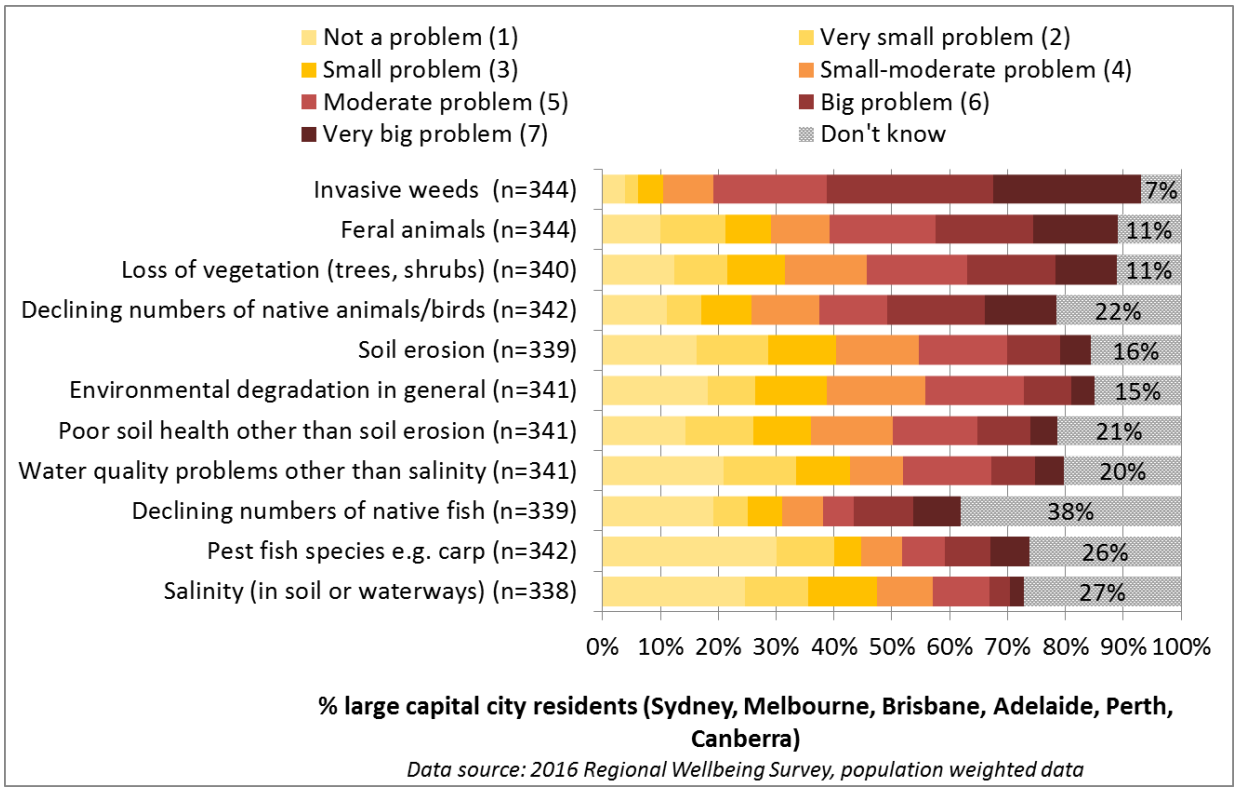

Figure 3 Perceived local environmental problems – 'big city' Australians (small sample with low reliability)

DIFFERENCES IN VIEWS - GEOGRAPHIC LOCATION

Views about whether pest fish invasion is a significant problem are likely to vary by region. Figure 4 shows the proportion of people who considered pest fish invasion to be a moderate

or large problem in their local region, by Natural Resource Management (NRM) region. For the most part, perceptions mirror where carp invasion occurs: for example, the highest levels of concern were reported by people living in catchments of the Murray-Darling Basin (the Basin), where carp invasion is most prevalent. More than 60% of residents in almost every part of the Basin rated pest invasion a moderate to large problem. The exception was North Central Victoria, where only 46% rated pest fish invasion a large problem. Across the Basin as a whole, 62% of the adult population considered pest fish invasion a moderate or large problem (n=4,680) compared to 22% of those living in regions outside the Basin (n=6,183). Some regions outside the Basin are experiencing some carp invasion; in these regions between 30% and 55% of residents considered pest fish a moderate or large problem. Concern about pest fish invasion was much lower in regions where carp invasion has either not occurred, or has not occurred to a large extent.

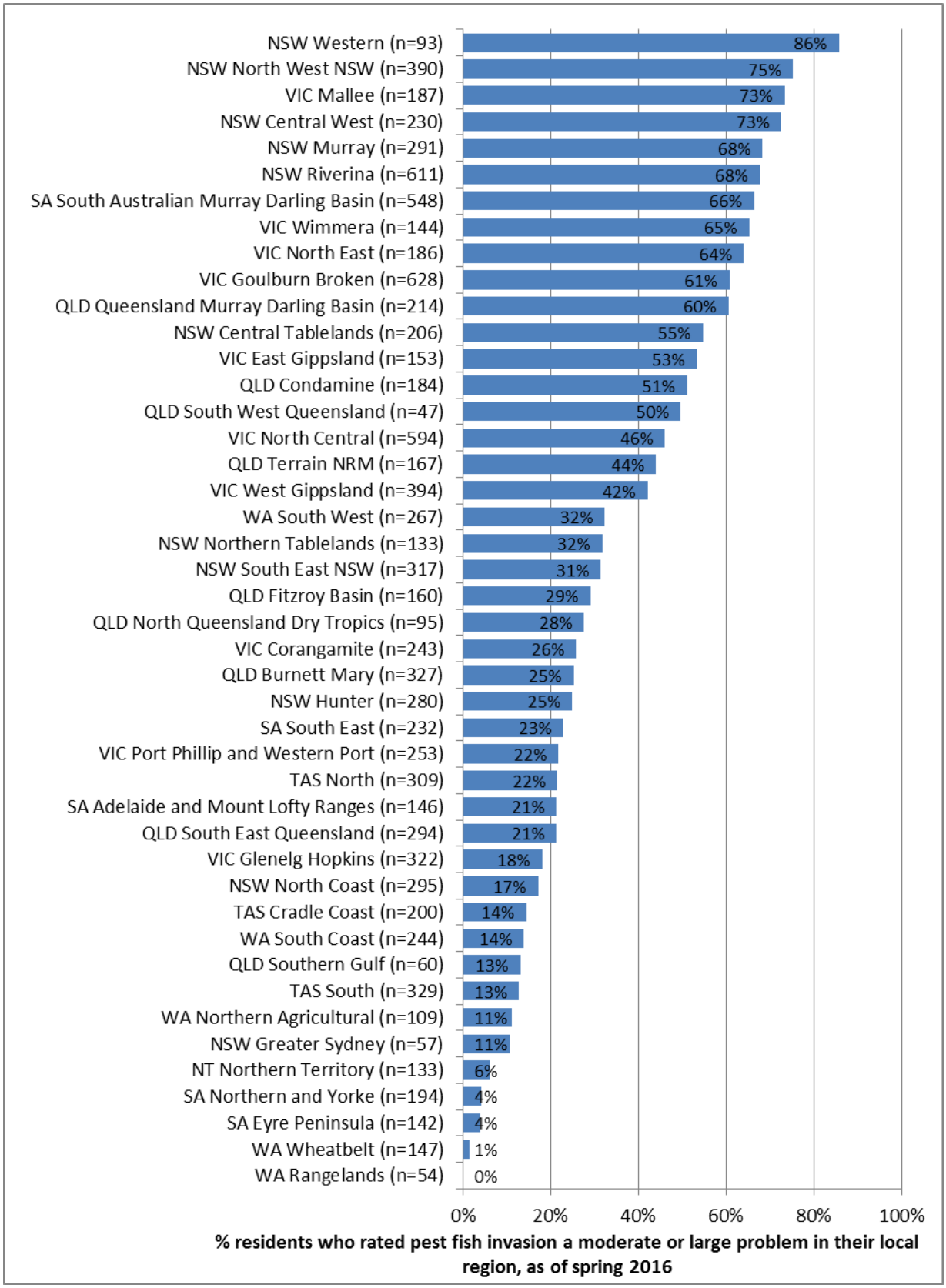

Figure 4 Rating of pest fish as a local environmental problem – views by region

DIFFERENCES IN VIEWS – AGE, GENDER, CULTURAL BACKGROUND, HEALTH

Differences in views were examined based on age, gender, cultural background and a person's health status. Given the often large differences in views of people living in different geographic regions, when examining these socio-demographic characteristics, the views of both (i) all Australians and (ii) those living in the Murray-Darling Basin were examined. This was done because carp invasion has affected almost all parts of the Murray-Darling Basin, and substantially fewer areas outside the Basin. This means that examining views of those living in the Basin provides a useful representation of views of those living in areas that are significantly impacted by carp. It was not possible to geo-code the dataset to all watersheds affected by carp outside the Basin given the variability of carp invasion in freshwater areas outside the Basin, and hence examining views of Basin residents is a useful proxy for views of those living in carp-affected areas more broadly.

While men and women had very similar views about the extent to which pest fish were a problem in their local area (Figure 5), views did vary by age (Figure 6). Younger people were less likely to view pest fish as a moderate or large problem (both in Australia as a whole and in the Basin), and those aged 35 and older more likely to.

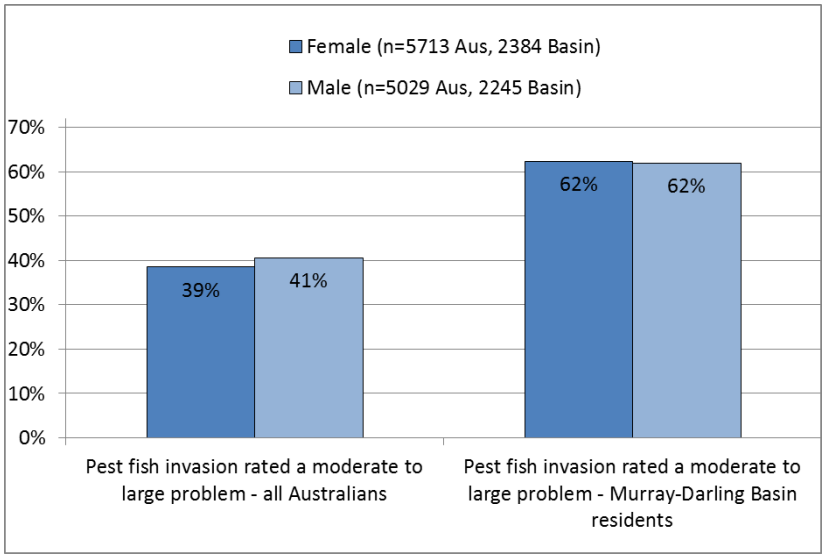

Figure 5 Rating of pest fish as a local environmental problem – by gender

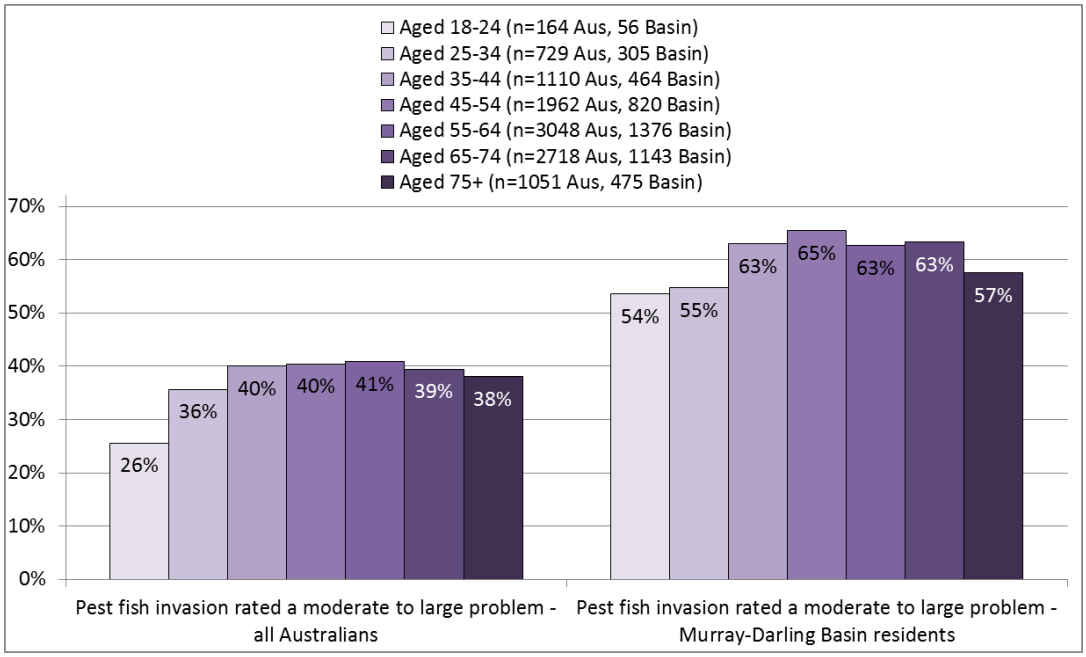

Figure 6 Rating of pest fish as a local environmental problem – by age group

Views also varied significantly amongst those with different cultural background. Those who identified as Aboriginal or Torres Strait Islander people were more likely than others to identify pest fish invasion as a problem (46% in Australia and 71% in the Murray-Darling Basin). Those born in Australia were more likely than those born outside Australia to identify pest fish invasion as a problem: 63% of Australian-born residents of the Basin identified pest fish invasion as a moderate to large problem, compared to 57% of residents born in English speaking countries other than Australia, and 53% of residents born in a non-English speaking country (Figure 7). While this is a very broad indicator, it does indicate cultural factors influence awareness of pest fish invasion as a problem, and in ways consistent with known cultural consumption patterns of carp. Carp are commonly eaten in a large number of countries, and particularly in non-English speaking countries through Asia, much of Europe, parts of South and Central America, and a smaller number of African countries (Peteri 2004); they are more commonly viewed as a pest in English speaking countries in which they are an invasive species, and there is little to no tradition of eating carp in English-speaking cultures (Peteri 2004).

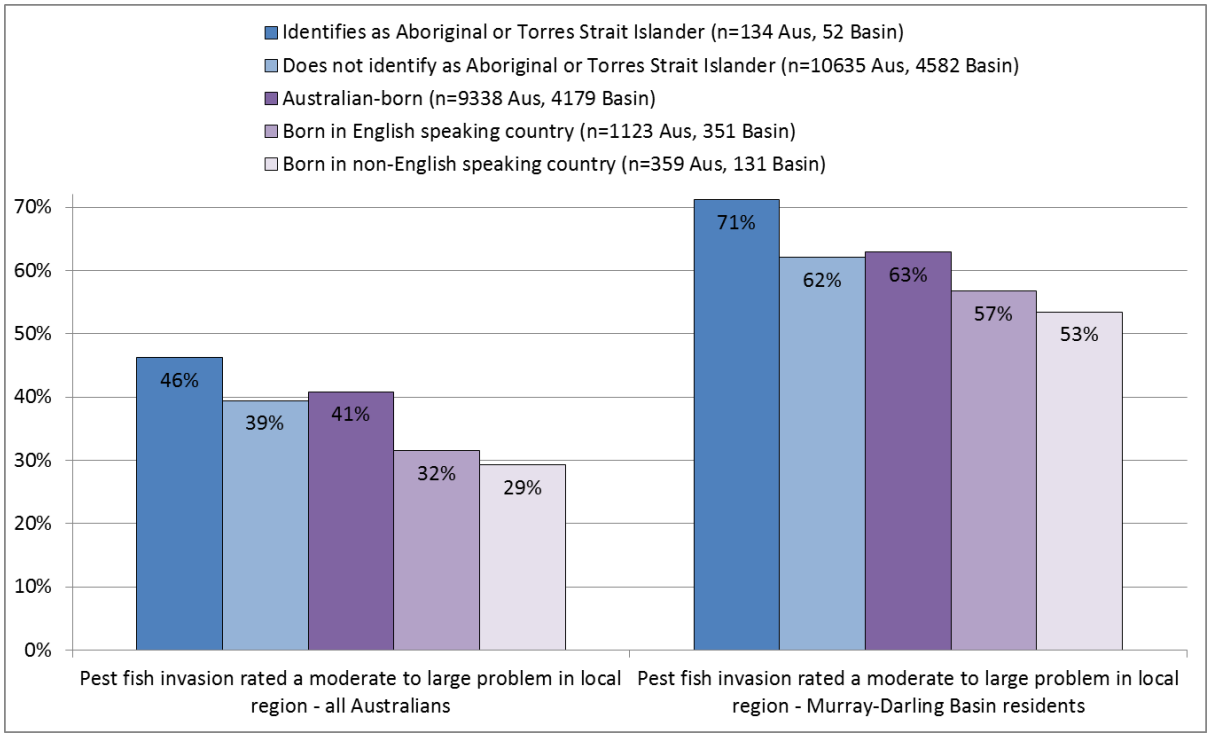

Figure 7 Rating of pest fish as a local environmental problem – by cultural background

These findings show that pest fish invasion is more commonly perceived as a problem by older people, those born in Australia and particularly Aboriginal people and Torres Strait Islanders, and less commonly by those aged under 35 and those born outside Australia.

DIFFERENCES IN VIEWS – EDUCATION, INCOME, OCCUPATION, ACTIVITIES

Views about pest fish invasion did not differ substantially between people with differing levels of formal education (Figure 8), household income (Figure 9), or occupation status (Figure 10). They did, however, vary between people who had different levels of engagement in agricultural activities, and in recreational fishing. Irrigators were much more likely than dryland farmers or those not engaged in agriculture to consider pest fish a moderate to large problem: 68% of Basin irrigators considered pest fish a moderate/large problem, compared to 62% of those not involved in agriculture, and 52% of dryland farmers (Figure 11). The differences between irrigators and dryland farmers suggest that the extent to which a person interacts with freshwater may be a predictor of awareness of pest fish invasion, with irrigators tending to both live closer to freshwater areas such as rivers and to directly interact through use of water from irrigation channels or rivers.

People who spend more time fishing are more likely to consider pest fish invasion a moderate to large problem, with this finding holding both for those who fish in general (Figure 12), and for those who fish in freshwater areas within two hours drive of their residence (Figure 13). In the Basin, only 46% of those who had never fished in their life considered pest fish invasion a moderate or large problem, compared to 78% of those who went fishing most weeks in the last year.

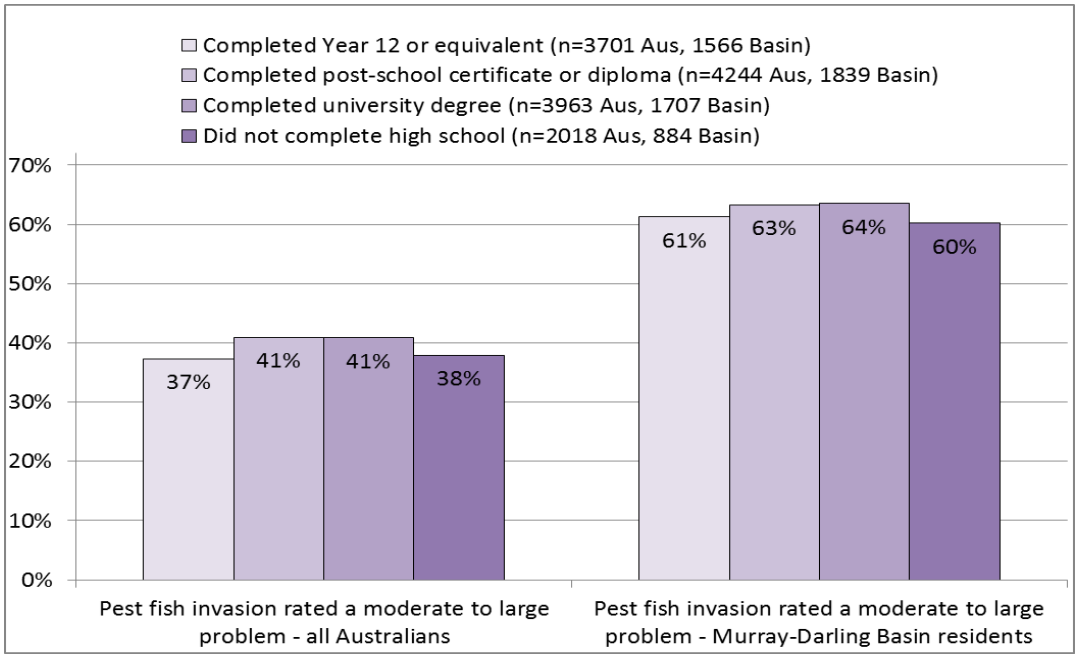

Figure 8 Rating of pest fish as a local environmental problem – by highest level of formal education achieved

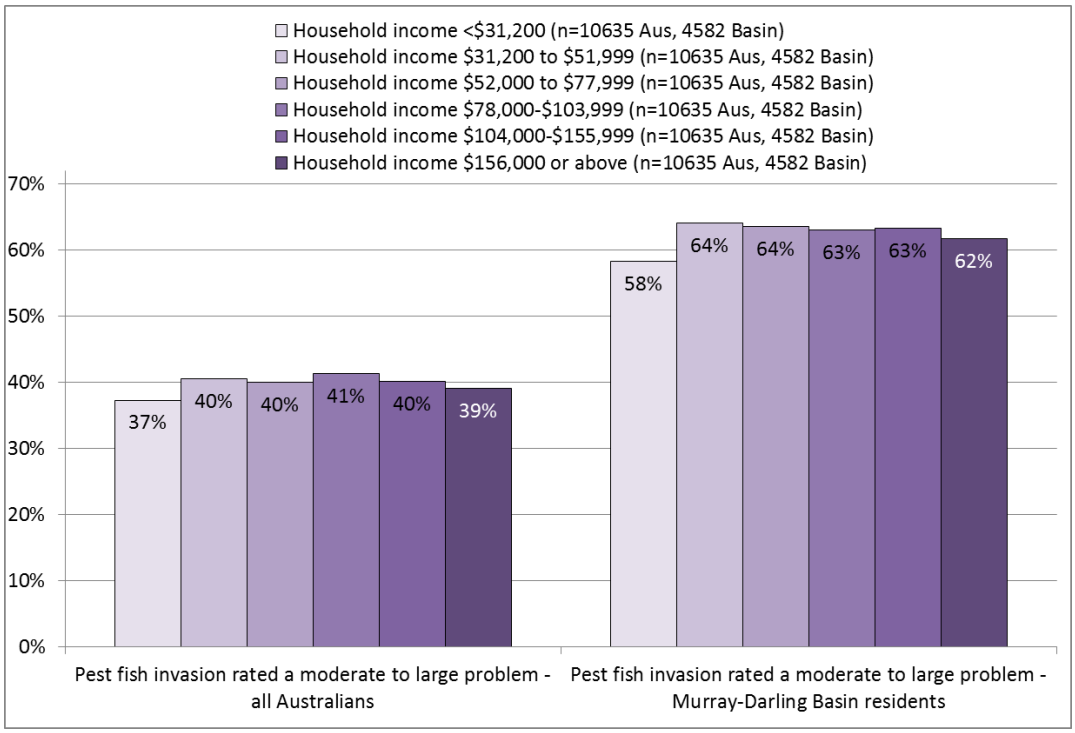

Figure 9 Rating of pest fish as a local environmental problem – by household income in 2015-16

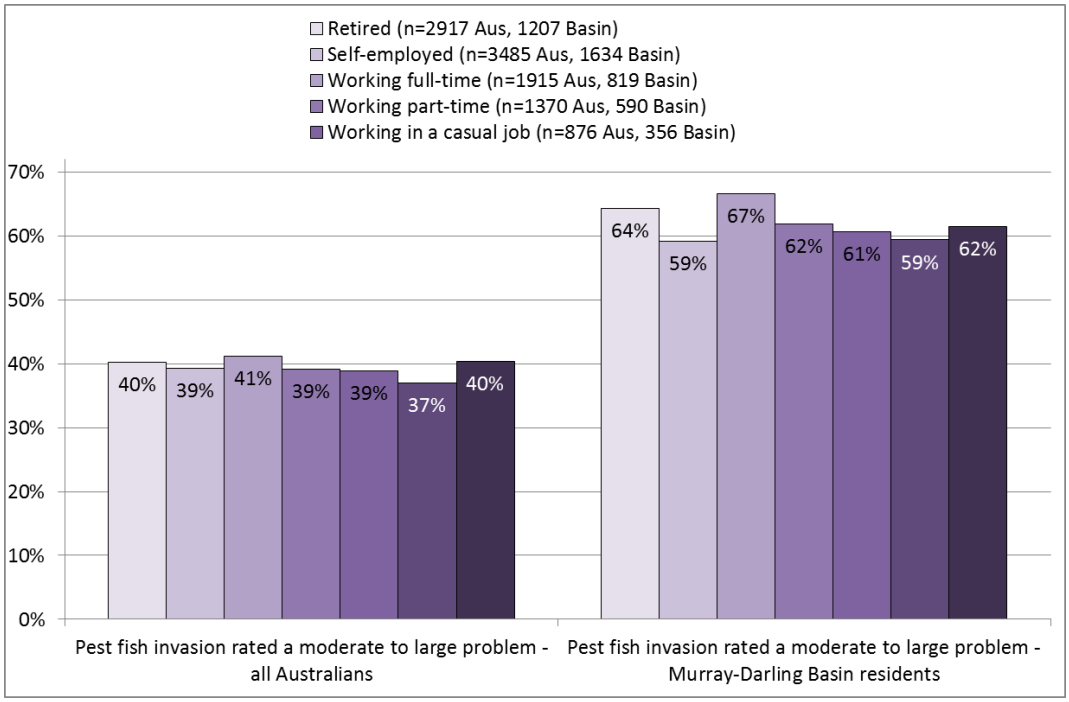

Figure 10 Rating of pest fish as a local environmental problem – by occupation status

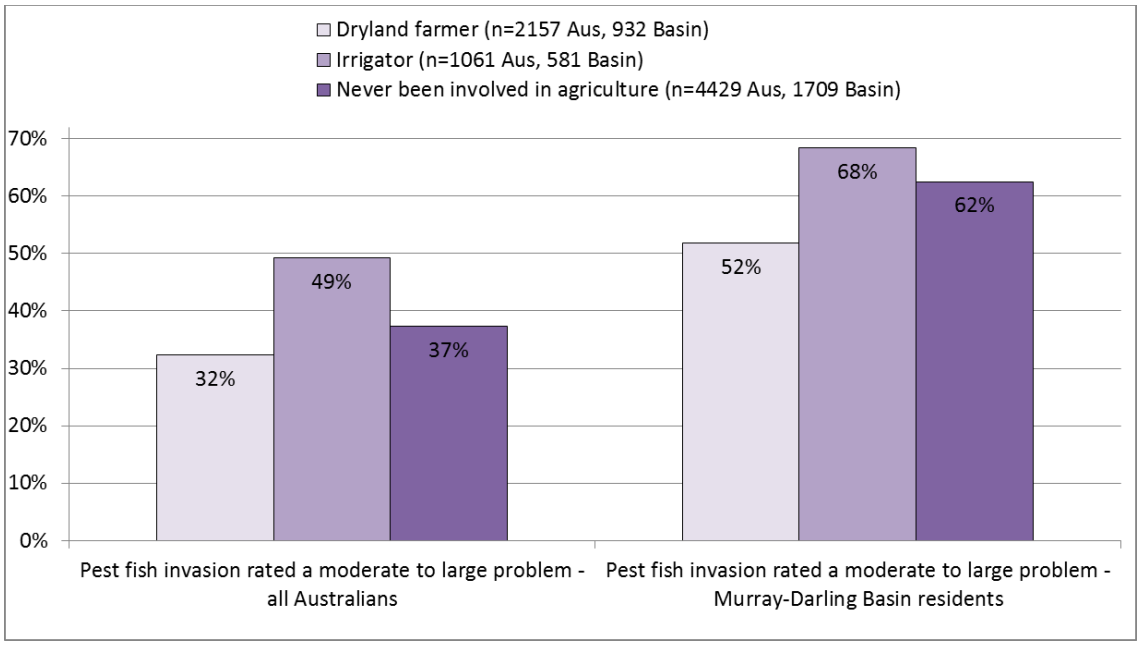

Figure 11 Rating of pest fish as a local environmental problem – by engagement in agriculture

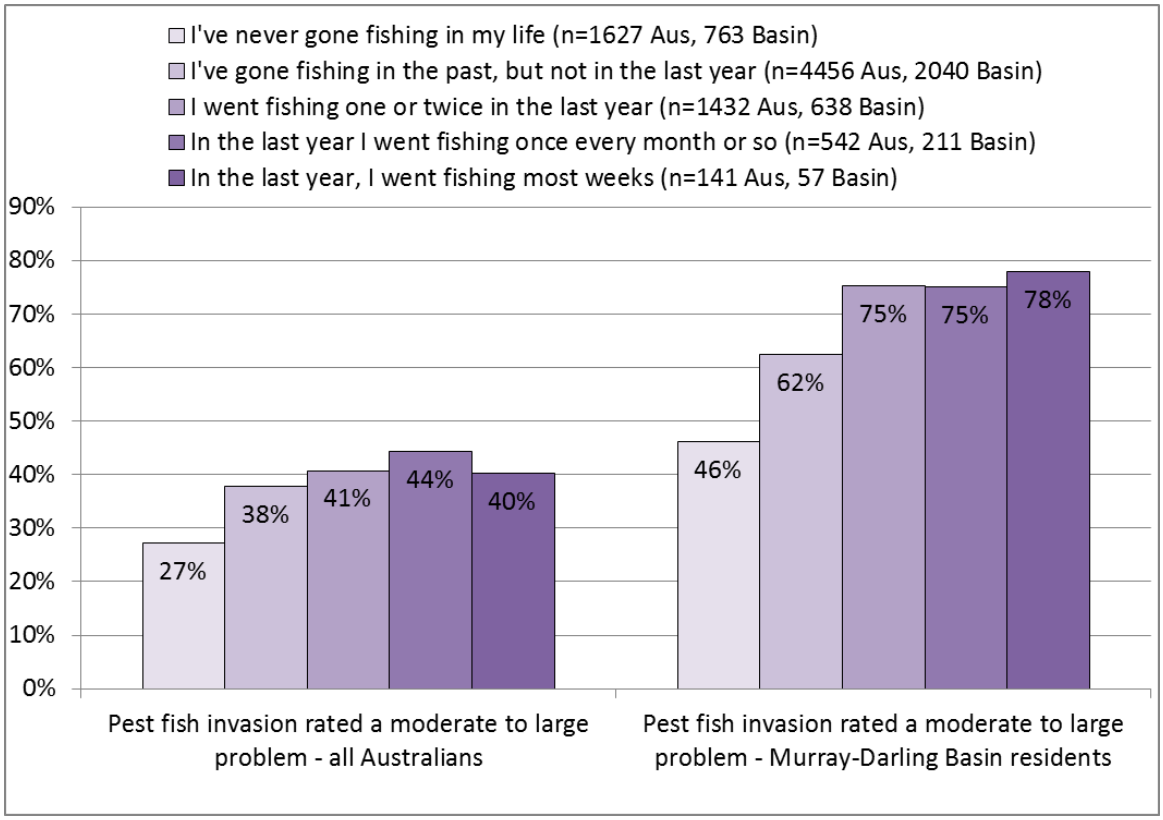

Figure 12 Rating of pest fish as a local environmental problem – by engagement in recreational fishing

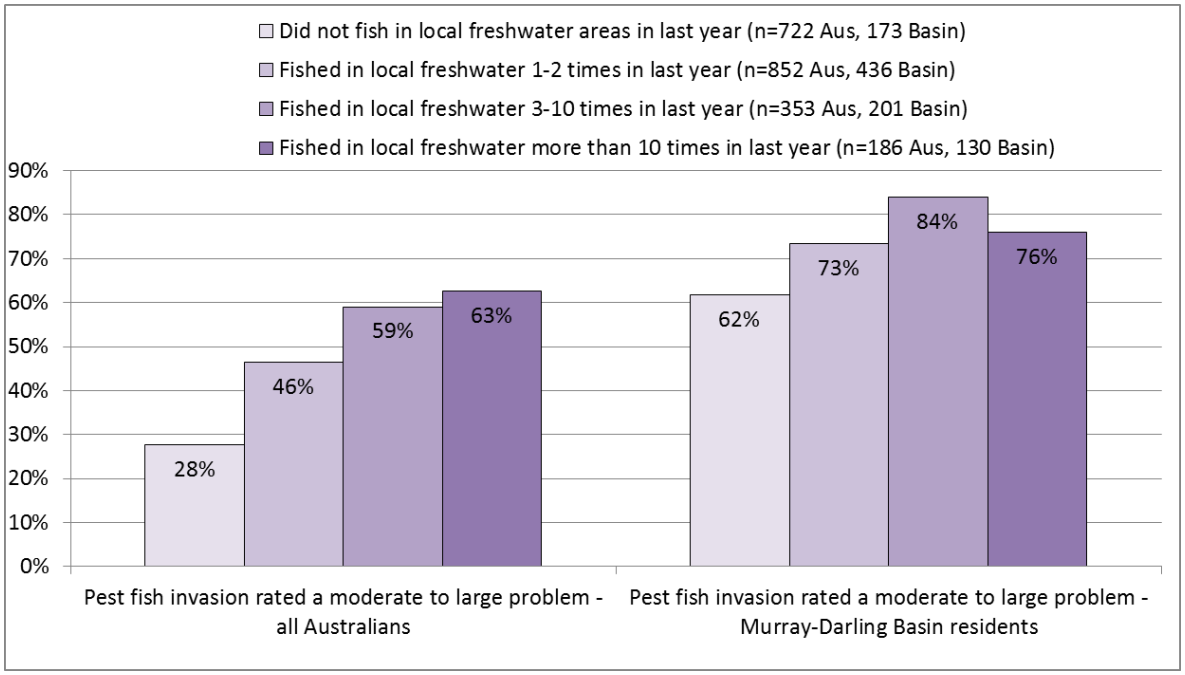

Figure 13 Rating of pest fish as a local environmental problem – by engagement in freshwater fishing in local area

CONCLUSIONS

A key factor influencing whether people feel it is appropriate to invest in measures to control carp is whether they perceive the presence of a problem in the first place. The findings presented in this section suggest that pest fish invasion is viewed as a significant problem by less than half of all Australians, and many viewed other environmental problems as being bigger problems in their local area. Future surveys should ask not only about the local area, but about perceptions of pest fish invasion as a significant environmental issue more generally. This will provide a better understanding of the relative importance Australians place on carp invasion as an issue of importance in general, rather than focusing only on their local area. There was also low awareness of the presence of environmental problems to which carp invasion is argued to contribute, with many Australians unsure whether declining number of native fish or water quality problems are problems in their area. Addressing this low level of awareness may increase support for implementing measures to control carp. Linking carp invasion to environmental issues which have higher levels of awareness – invasion of feral animals in particular – may assist in increasing the relevance of this issue for many Australians.

There is, however, much larger awareness of pest fish invasion in regions where carp populations are very high, with more than 60% of residents in almost every part of the Murray-Darling Basin (most of which is affected by carp invasion) rating pest fish invasion a moderate to large problem. Some regions outside the Basin are experiencing some carp invasion; in these regions between 30% and 55% of residents considered pest fish a moderate or large problem. However, even in these areas, one-quarter to one-third of residents did not consider pest fish to be a moderate or large problem. Increasing knowledge of carp invasion and its consequences is important to enabling local communities to make informed decisions about whether they support investment in measures to control carp. Young people and those born outside Australia are particularly unlikely to consider pest fish invasion to be a significant problem, while those who have close contact with freshwater – irrigators and recreational fishers – are much more likely to. In the Basin, only 46% of those who had never fished in their life considered pest fish invasion a moderate or large problem, compared to 78% of those who went fishing most weeks in the last year. Even amongst those who view pest fish invasion as a moderate to large problems, many rate other environmental problems as being more significant than pest fish invasion. This lower prioritisation of pest fish in terms of significance of the problem they present may reduce willingness to accept actions to control pest fish unless clear connections are made that identify how controlling pest fish may assist in addressing the environmental issues residents feel are more important. While the survey measure examined here was not specific to carp, it used carp as the example of a pest fish, and provides a useful overall indicator of awareness. However, future surveys should examine perceptions of carp invasion more specifically.

INITIAL VIEWS ON ACCEPTABILITY OF CARP VIRUS RELEASE

Initial views on acceptability of carp virus release were assessed by asking survey respondents to rated how acceptable or unacceptable they found the idea of carp virus release if it occurred in their local area, on a seven point scale from 'very unacceptable' to 'very acceptable'. They could also answer 'don't know'.

This question was asked without providing any contextual information about how and when the virus would be released and how the release would be managed. The views captured reflect initial reactions to the idea of virus release, but are likely to be highly subject to change as public discussion of virus release evolves over time. As people access more information and discussions on virus release, their views can readily change.

This section examines these initial views on acceptability to better understand the 'starting position' of community views on the proposed release of the carp virus. As the National Carp Control Plan will include integrated actions to control carp, future surveys should ask about the full range of methods that may form part of actions to control carp, rather than only about virus release.

OVERALL PERCEPTIONS

In both rural and regional areas of Australia, and in the 'big six' largest cities, initial responses suggest support for virus release is higher than opposition: 53% of rural and regional Australians and 56% of big city residents considered release of the carp virus acceptable. More than half of these rated virus release as being 'very acceptable' (Figures 14 and 15). Only 16% of rural and regional Australians, and 14% of large city residents, considered virus release unacceptable. The balance – 30% of residents in both rural/regional areas and large cities – were unsure or considered virus release neither acceptable or unacceptable.

These initial results suggest relatively high initial support for virus release. However, the high proportion of people indicating they are unsure also suggests high potential for views to change as further information becomes available on proposed virus release. The high proportion who indicated 'extreme' support (that releasing the virus was 'very acceptable') may also indicate that there is relatively low complexity of thinking about carp virus release when answering this question. This is consistent with perceptions of stakeholders interviewed, many of whom felt there were low levels of awareness and knowledge about carp control in the broader community, suggesting initial views are likely to be formed based on only hearing one or two arguments for or against carp control. The extremity of attitude demonstrated, if it is the result of limited knowledge and ability to identify arguments both for and against carp control, is likely to be highly subject to change.

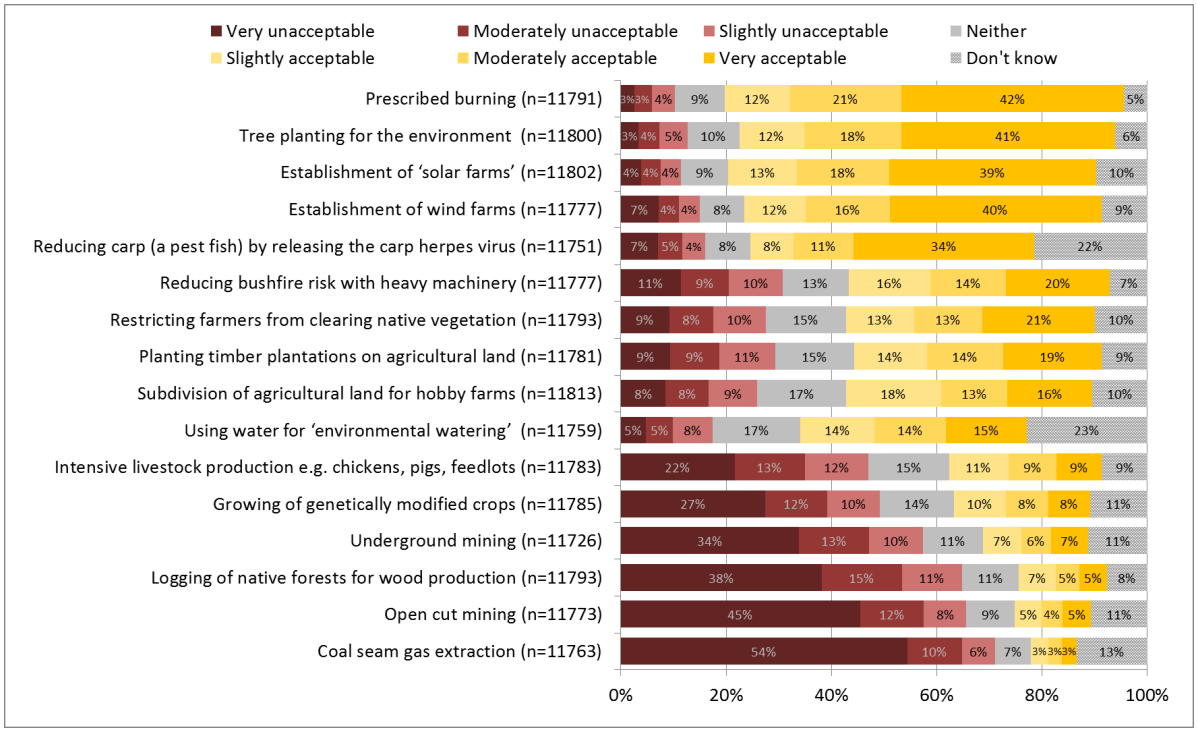

Figure 14 Acceptability of carp virus release compared to other actions – regional and rural Australians

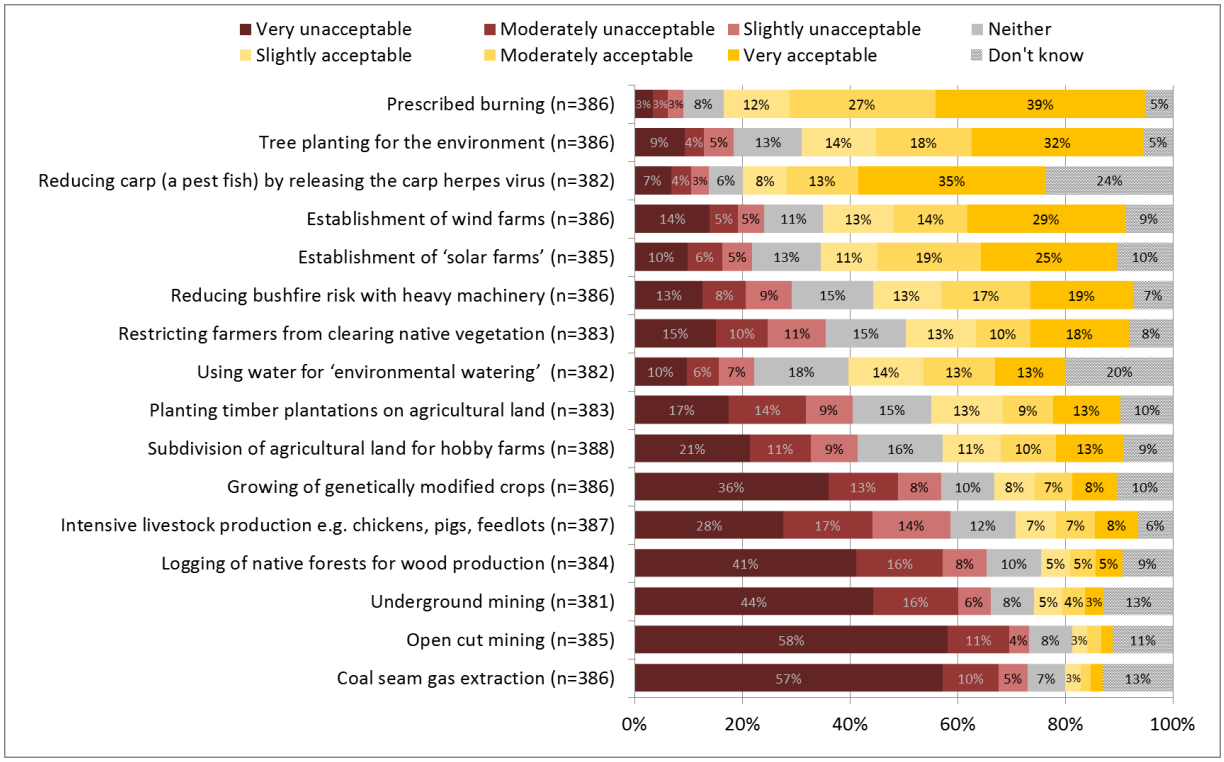

Figure 15 Acceptability of carp virus release compared to other actions – 'big city' Australians (small sample with low reliability)

DIFFERENCES IN VIEWS – PERCEPTIONS OF PEST FISH INVASION

Acceptability of virus release was strongly related to a person's views about pest fish invasion, as expected. Of people who considered pest fish invasion to be a large problem, 78% felt virus release was acceptable, compared to 66% of those who considered pest fish a moderate problem, 56% of those who considered pest fish to be no problem or a small problem, and 39% of those who were unsure if pest fish were a problem (Figure 16). However, opposition to virus release did not increase significantly for those who did not consider pest fish a significant problem: instead, these people were more likely to state 'don't know' when asked if virus release was acceptable. This suggests that higher awareness of pest fish as an environmental problem is in general associated with higher support for investing in measures to control carp.

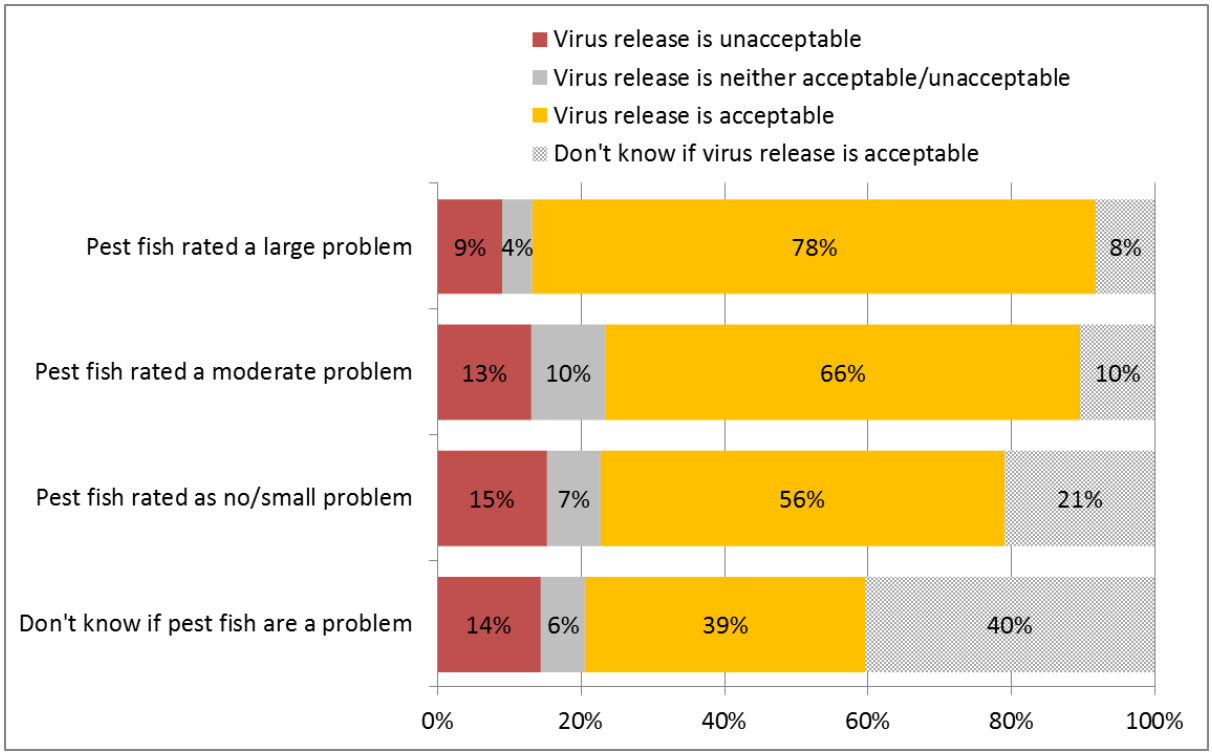

Figure 16 Acceptability of carp virus release – differences based on perceptions of pest fish invasion

DIFFERENCES IN VIEWS - GEOGRAPHIC LOCATION

When examined by geographic location, support for carp virus release was generally higher in regions where pest fish invasion was considered a significant problem by many local residents, and vice versa (Figure 17). While there was some variation, in almost all regions a higher proportion of people rated virus release acceptable than considered pest fish to be a moderate or large problem, indicating that while awareness of pest fish invasion influences views about acceptability, so do other factors. Support for virus release was generally highest in the Murray-Darling Basin (of the 20 regions in Figure 17 with the highest support

for virus release, 15 are located in the Basin and the remaining five have carp invasion in their region), and lower in most regions outside the Basin.

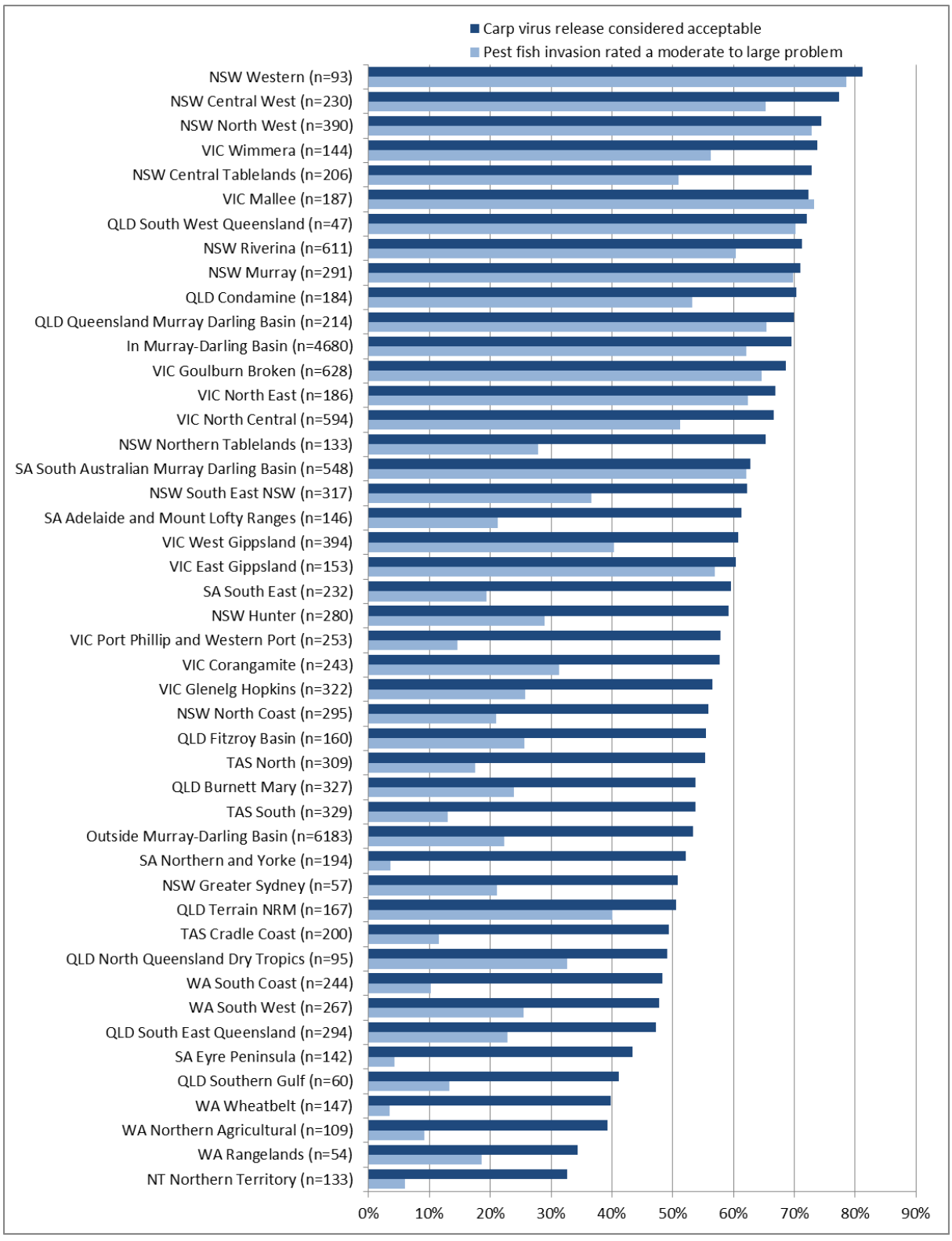

Figure 17 Acceptability of carp virus release – by geographic location

Women were significantly less likely than men to support virus release (63% of female Basin residents compared to 77% of male Basin residents), despite having similar perceptions about the extent to which pest fish invasion is a problem (Figures 18 and 19). This is not necessarily surprising, given that a large number of studies have identified that women often judge risks of proposed actions as being larger and more problematic than men, something that may then predict lower levels of support for proposed actions (Slovic 1999). The reasons for the common differences in risk perceptions of women versus men is a topic of contention, however (Slovic 1999).

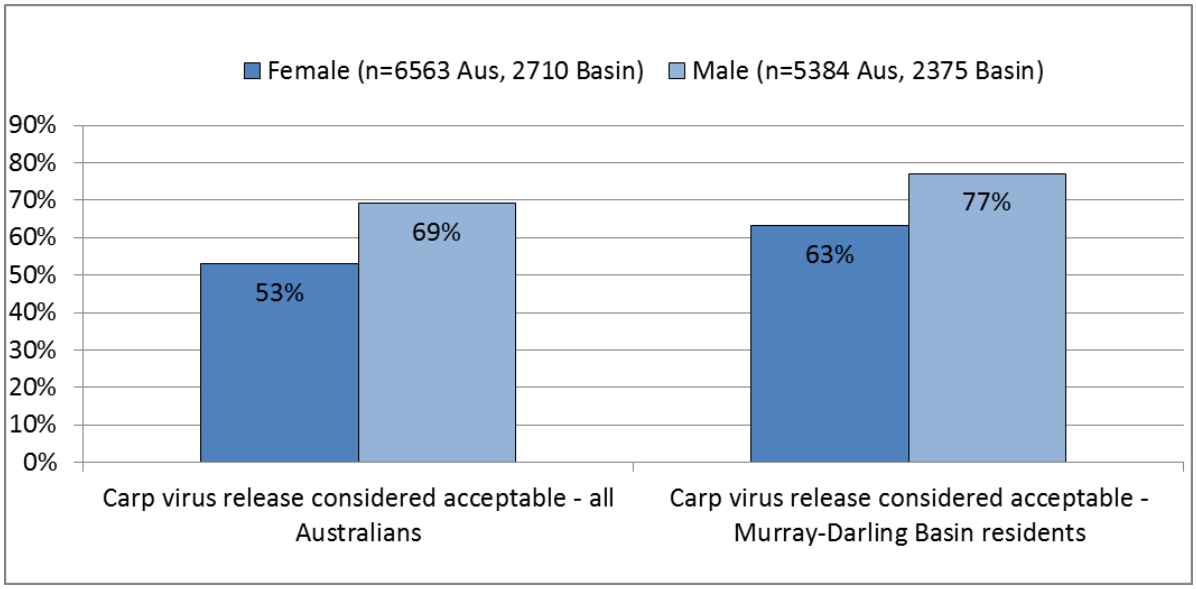

Figure 18 Acceptability of carp virus release – by gender

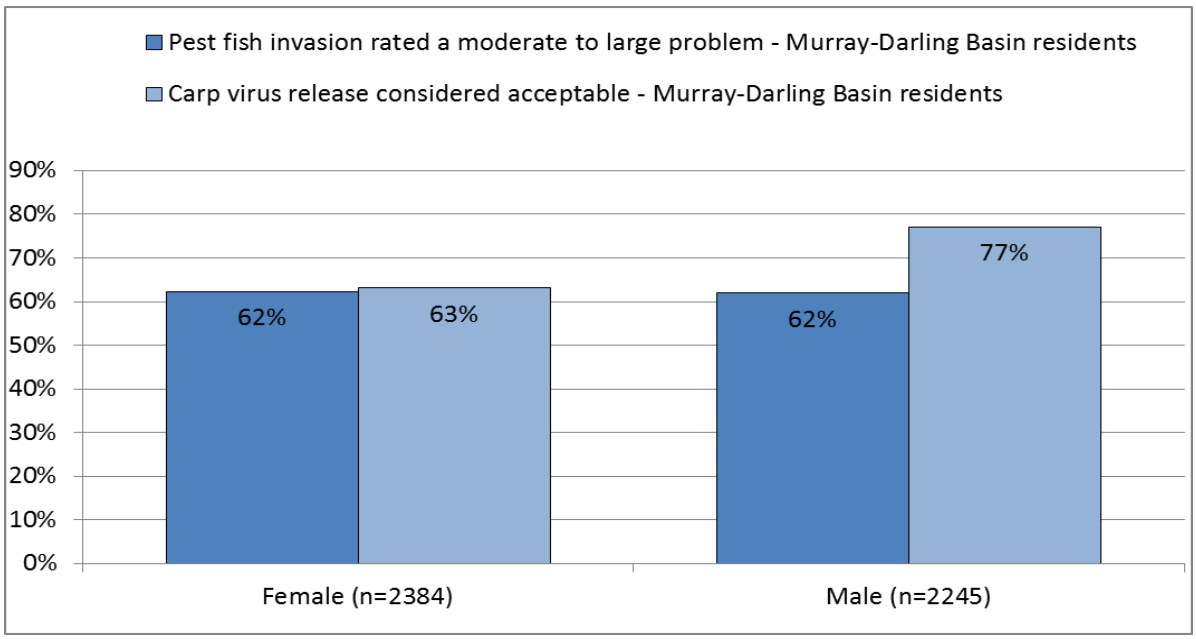

Figure 19 Acceptability of carp virus release – by gender and perceptions of pest fish invasion

Younger people are substantially and significantly less likely to support virus release compared to older Australians: within the Basin, only 42% of those aged under 25 found virus release acceptable, increasing to 54% of those aged 25-34, and reaching a high of 75% for those aged 65 to 74 (Figure 20). The differences are much larger than age-related differences in perceptions of pest fish invasion, suggesting there are specific effects related to age that are independent of perceptions about the problem of pest fish (Figure 21).

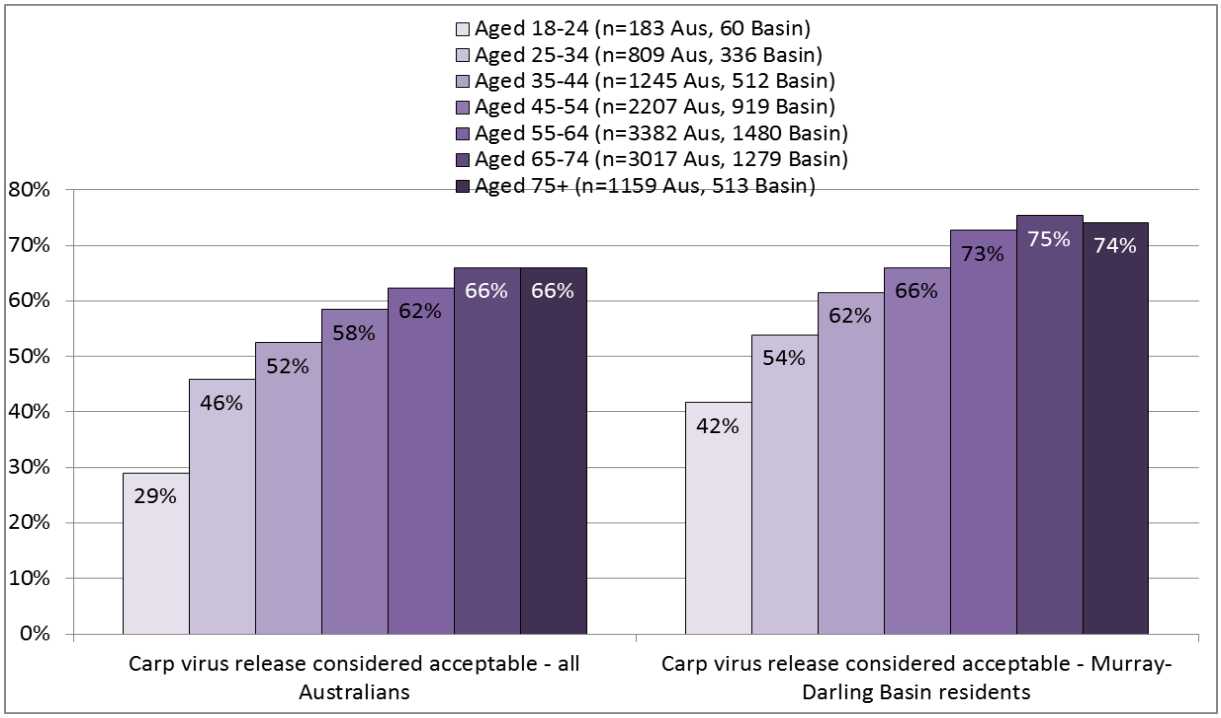

Figure 20 Acceptability of carp virus release – by age group

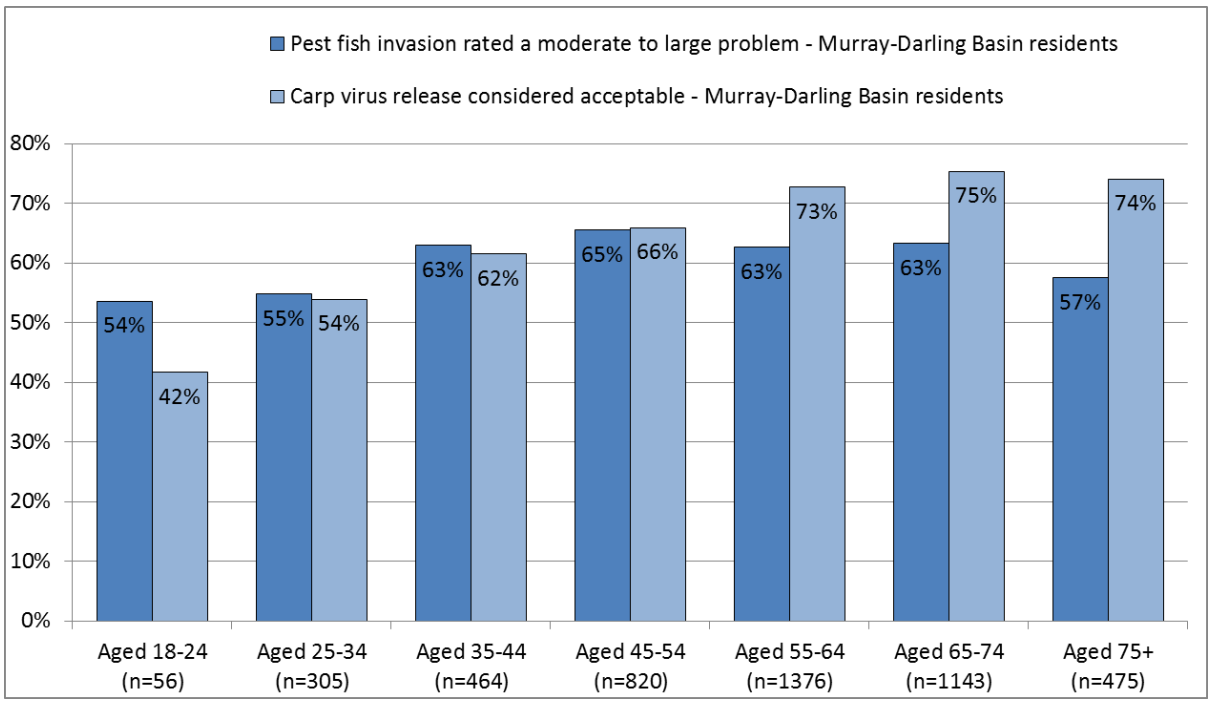

Figure 21 Acceptability of carp virus release – by age group and perceptions of pest fish invasion

Support for virus release was substantially lower amongst Aboriginal and Torres Strait Islander respondents (61% compared to 70% of all Basin residents, and 52% compared to 60% of all Australian residents), despite their higher reported concern about pest fish invasion. This suggests Aboriginal and Torres Strait Islanders may have specific concerns about virus release that need to be better understood and addressed. However, this result needs further investigation: the small number of people identifying as Aboriginal and Torres Strait Islander included in the survey means that confidence in the robustness of the results for this group is lower than for many other groups.

Support for virus release was lower amongst those born outside Australia (51% across Australia and 62% amongst those in the Basin) compared to those born in Australia (62% and 72% respectively) (Figures 22 and 23).

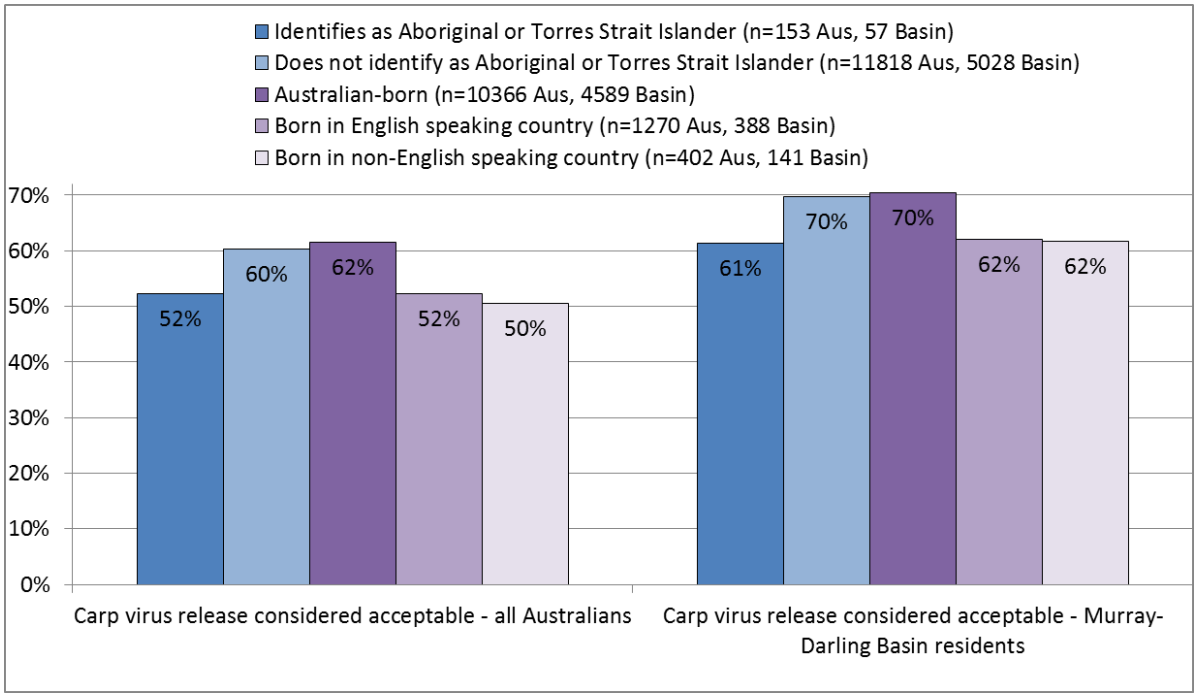

Figure 22 Acceptability of carp virus release – by cultural background

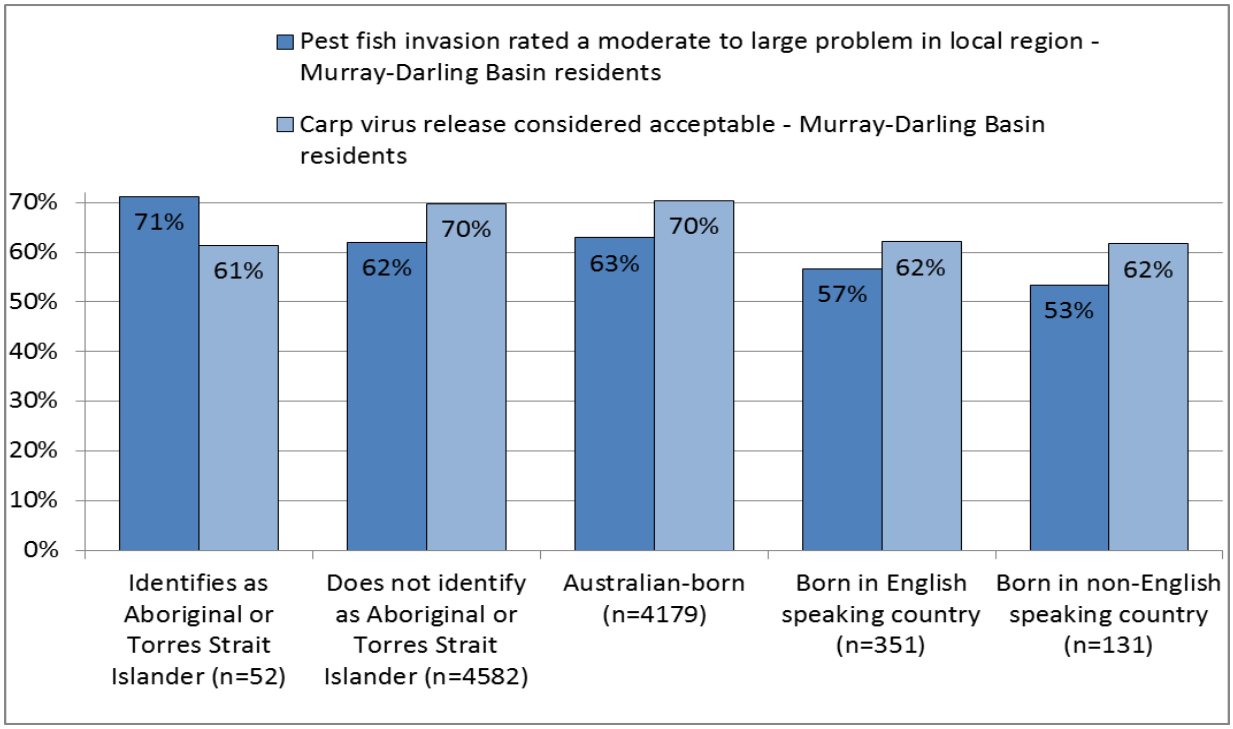

Figure 23 Acceptability of carp virus release – by cultural background and perceptions of pest fish invasion

Support for virus release was lower amongst people with poor health, despite perceptions of pest fish problems not varying between people with differing health status (Figure 24). This suggests that stresses occurring in a person's life unrelated to carp management are likely to influence their views about actions taken to control carp, consistent with the argument described in more detailed subsequently that people experiencing multiple psychosocial stressors in their life may be less likely to feel able to cope with potential effects of actions such as carp control.

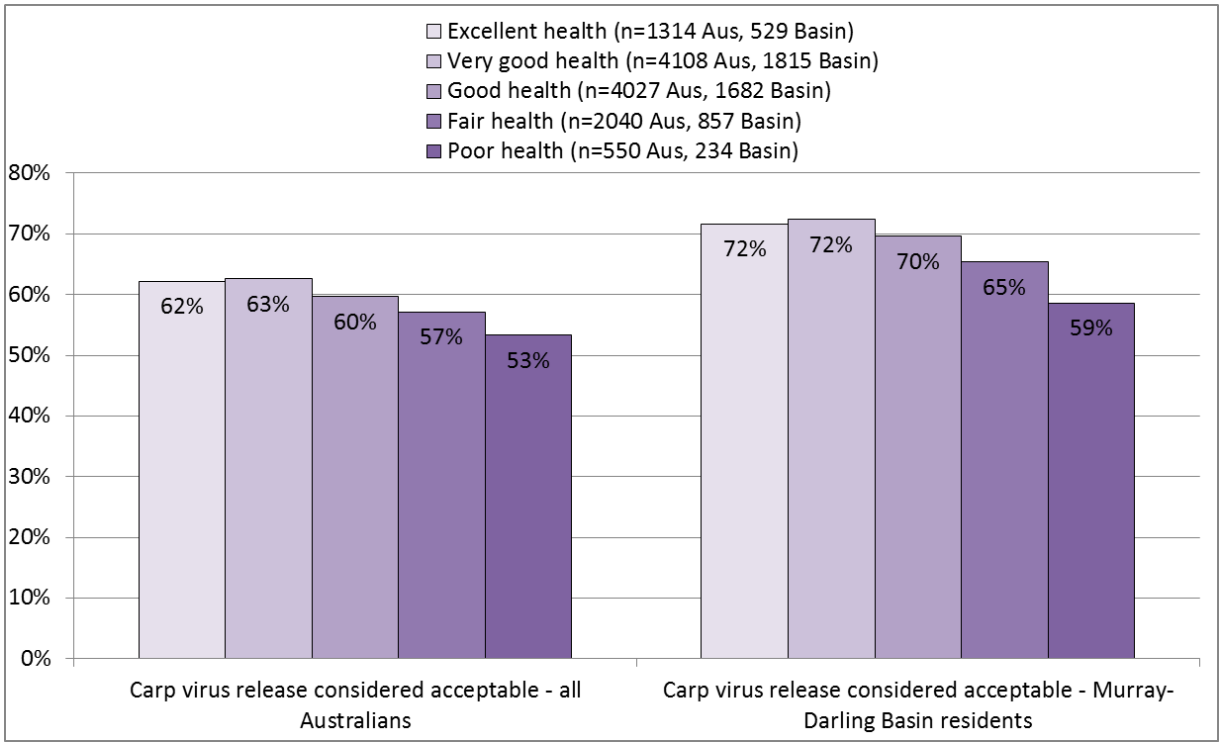

Figure 24 Acceptability of carp virus release – by health status

DIFFERENCES IN VIEWS – EDUCATION, INCOME, OCCUPATION, ACTIVITIES

Acceptability of virus release did not differ substantially between people with differing levels of formal education (Figure 25), but did increase slightly with household income (Figure 26). People who were retired or self-employed (often in older age groups) were more likely to support virus release, and those who were unemployed or studying (who are also often in younger age groups) less likely to (Figure 27). This result may simply reflect the different age groups of people with different status – those who are retired are typically older and those who are studying typically younger, for example – rather than reflecting differences in view driven by a person's occupational status. However, having an occupation or hobby related to land or water was associated with differences: farmers of all types were more likely to support virus release than non-farmers (Figure 28), with 76% of dryland farmers and 78% of irrigators in the Basin supporting release. This was despite dryland farmers being less likely than irrigators to consider pest fish invasion a moderate or large problem (Figure 29).

In general, those who engaged in fishing were more likely to support virus release compared to those who did not: for example, in the Basin 65% to 69% of fishers supported virus release compared to 54% of non-fishers (Figure 30). However, those who fished most frequently in freshwater areas of the Basin were less likely to support virus release, with 54% of those who fished more than 10 times a year supporting release compared to 71% of fishers who had fished less than 10 times in freshwater in the last year. This is despite high

levels of awareness of the problem of pest fish invasion by these avid freshwater fishers (Figure 32). This may indicate higher awareness of a large number of arguments for and against controlling carp using virus release amonst this group and overall higher integrative complexity, with highly experienced fishers more moderate in their views about virus release as a result of this higher level of engagement. This was supported by interview data, in which recreational fishers interviewed had high levels of knowledge of freshwater environments, and several identified that they knew multiple other experienced recreational fishers who were actively seeking detailed information about both virus release and options for controlling carp more generally.

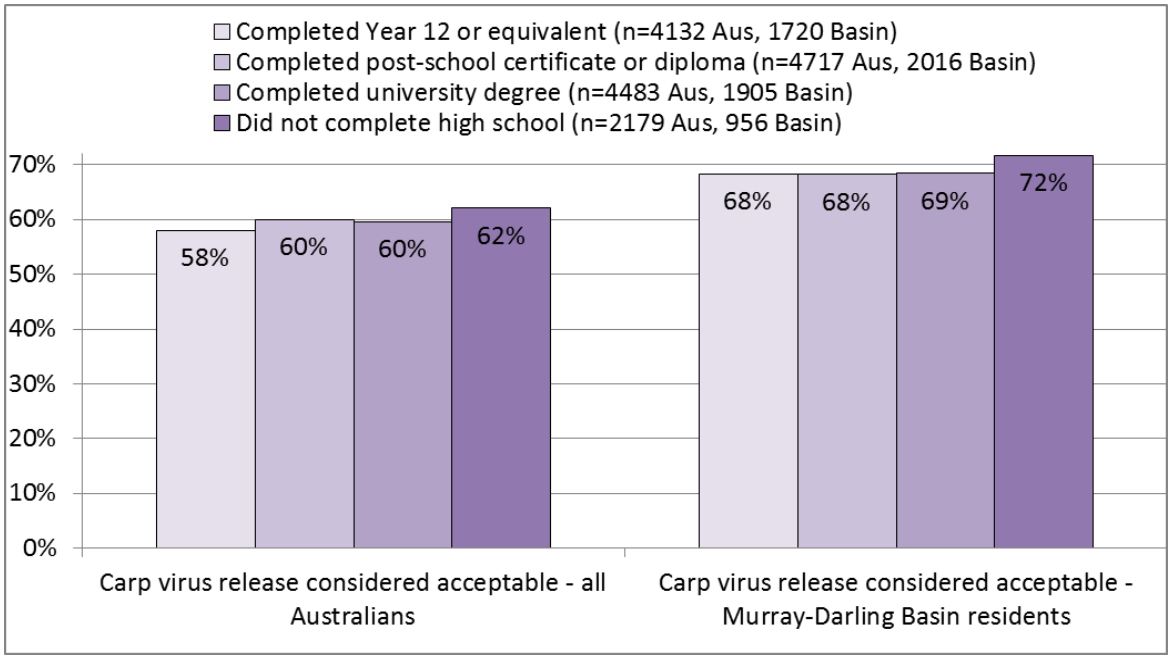

Figure 25 Acceptability of carp virus release – by highest level of formal education achieved

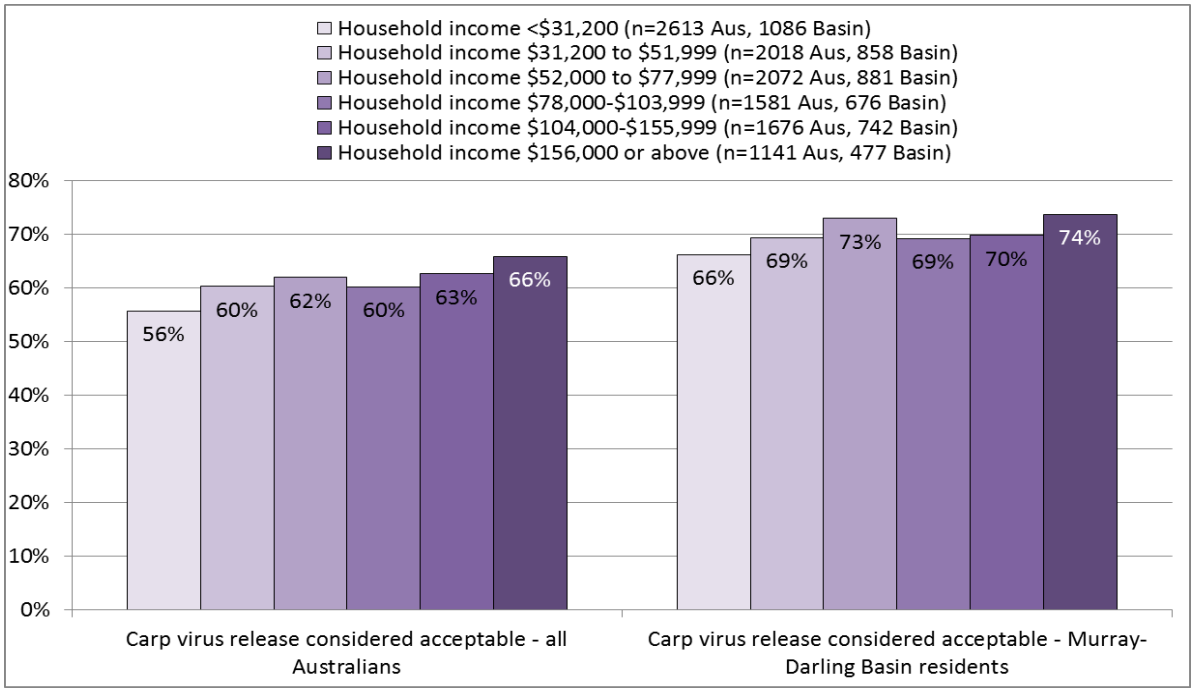

Figure 26 Acceptability of carp virus release – by household income in 2015-16

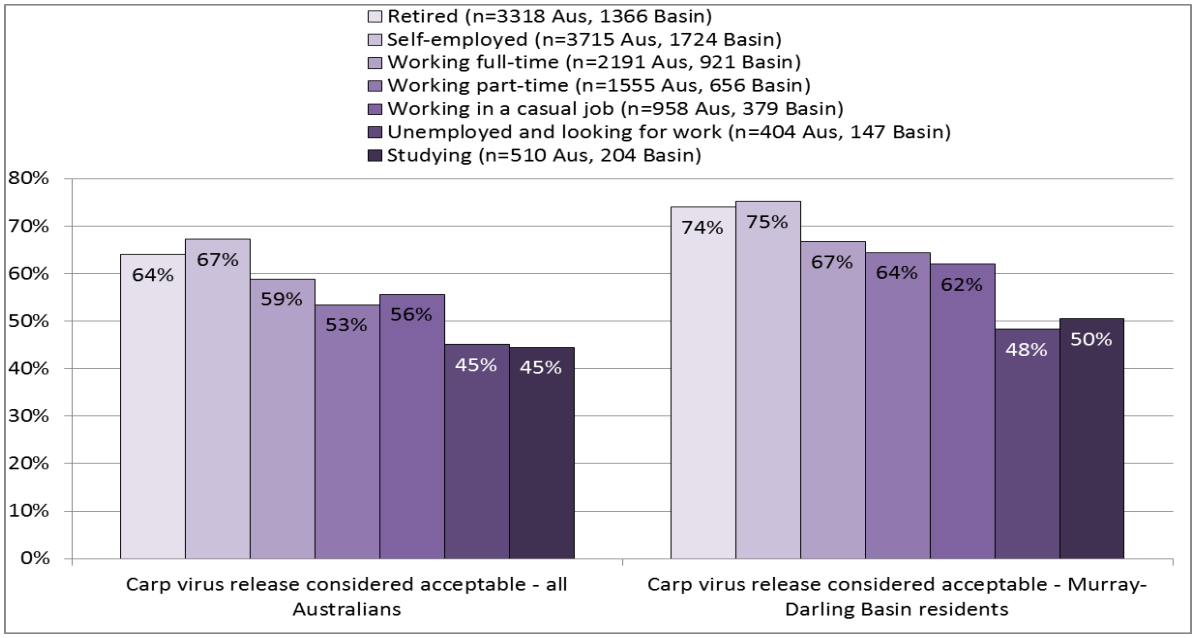

Figure 27 Acceptability of carp virus release – by occupation status

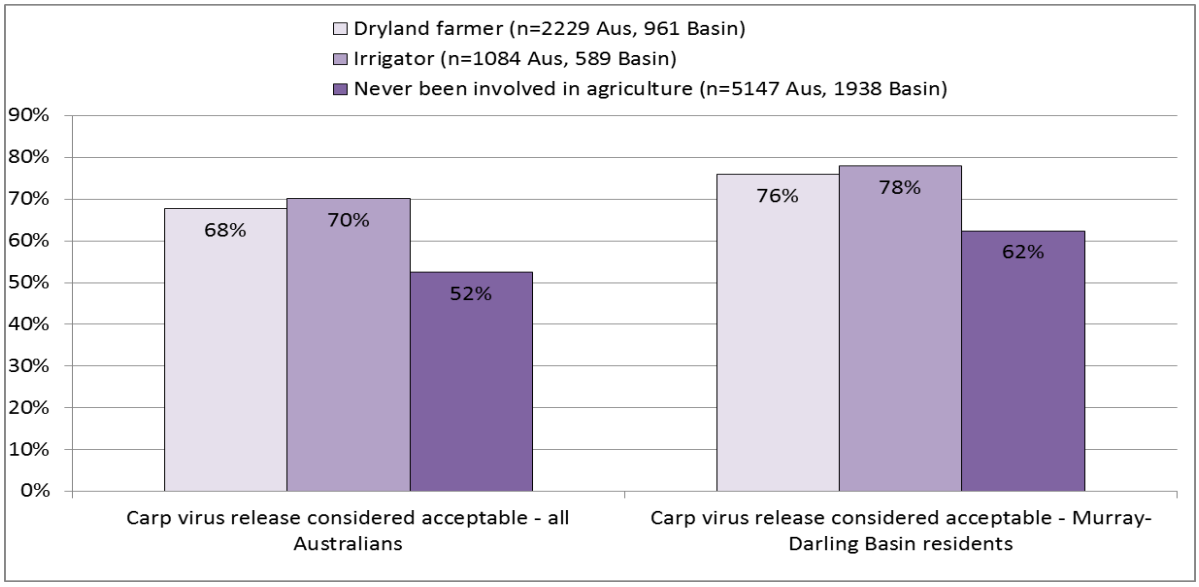

Figure 28 Acceptability of carp virus release – by engagement in agriculture

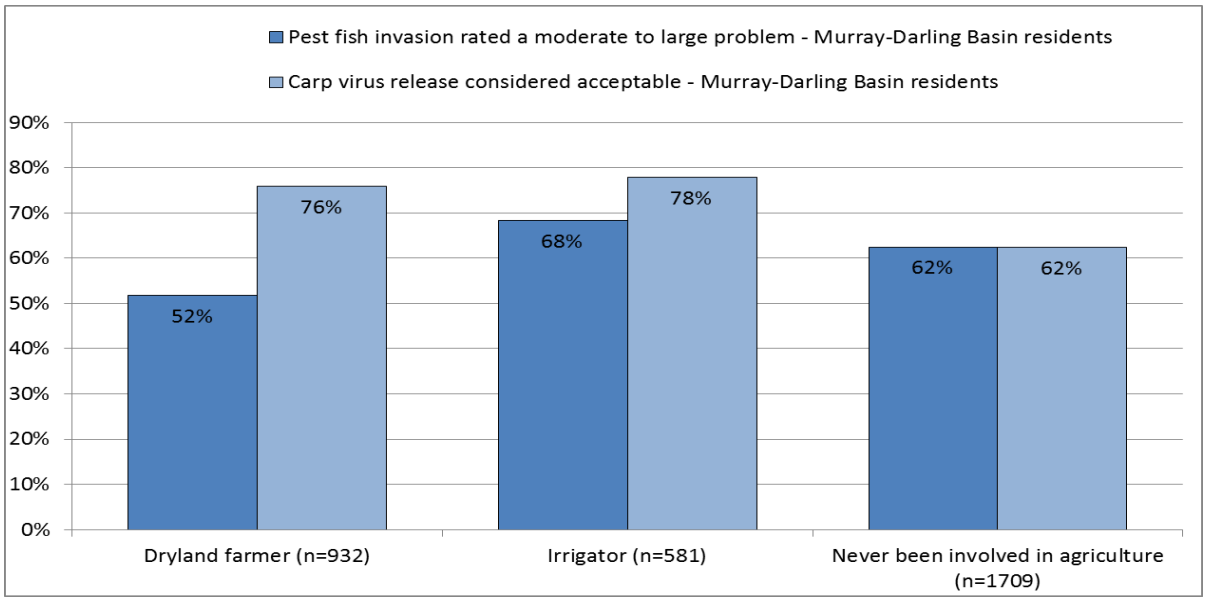

Figure 29 Acceptability of carp virus release – by engagement in agriculture and perceptions of pest fish invasion

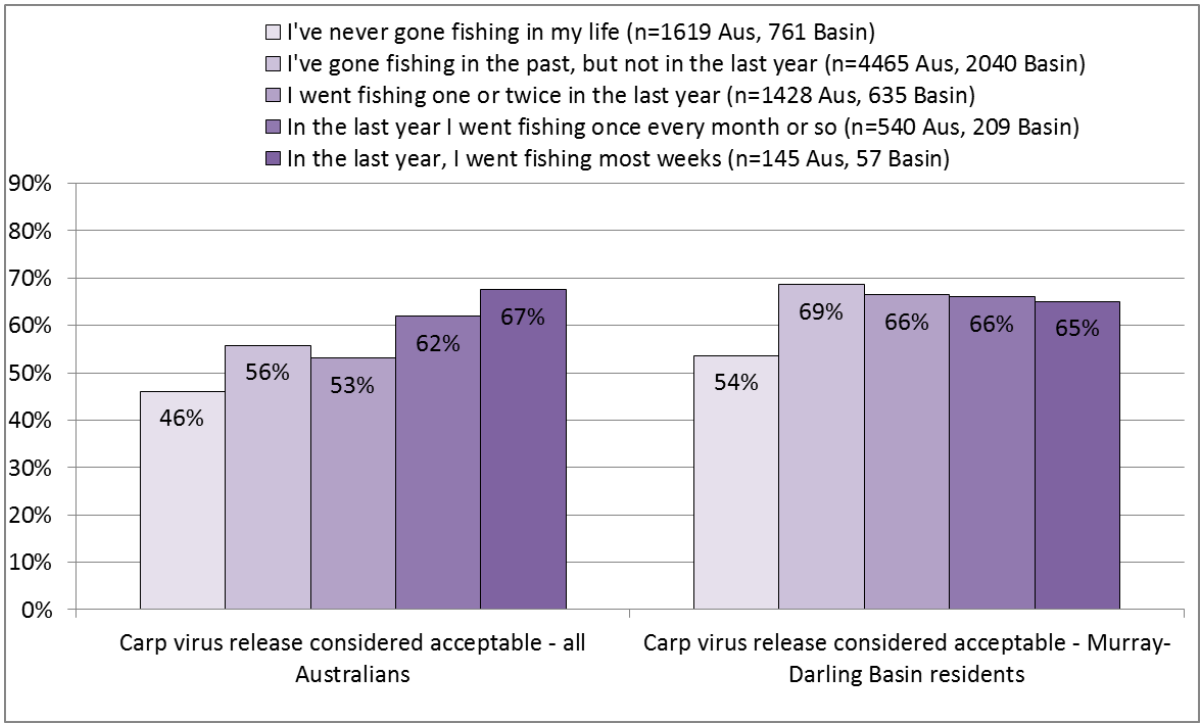

Figure 30 Acceptability of carp virus release – by engagement in recreational fishing in general

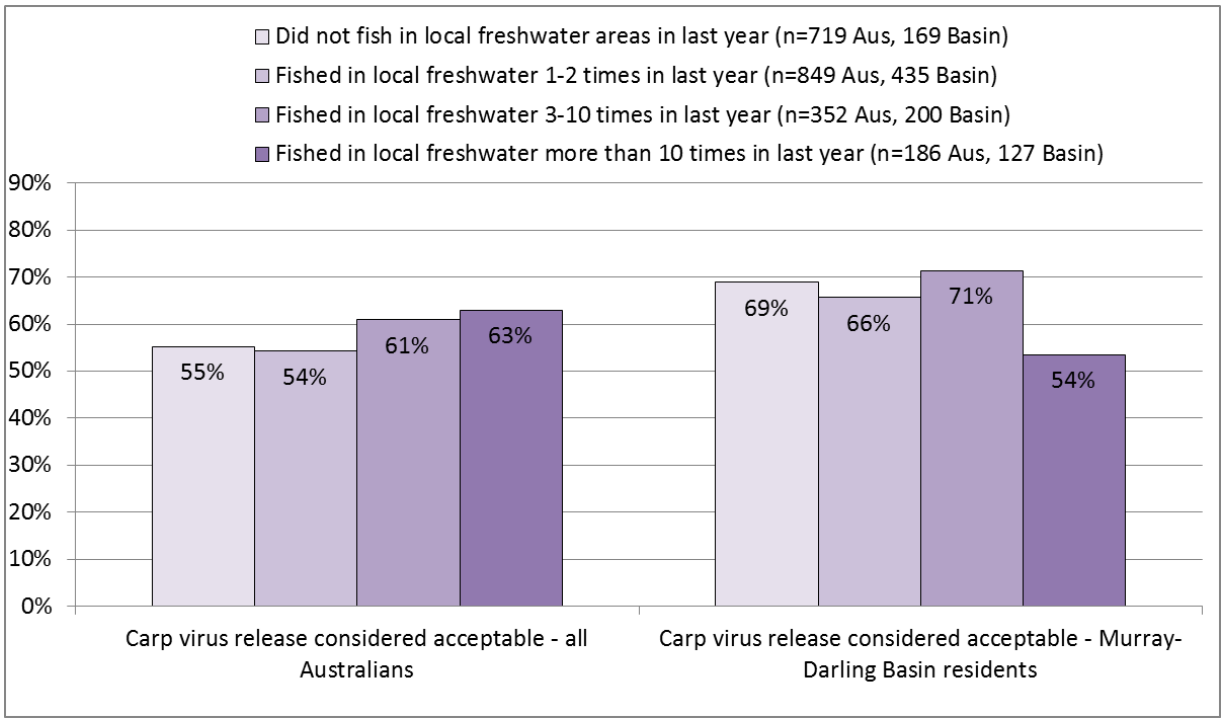

Figure 31 Acceptability of carp virus release – by engagement in freshwater recreational fishing in local area

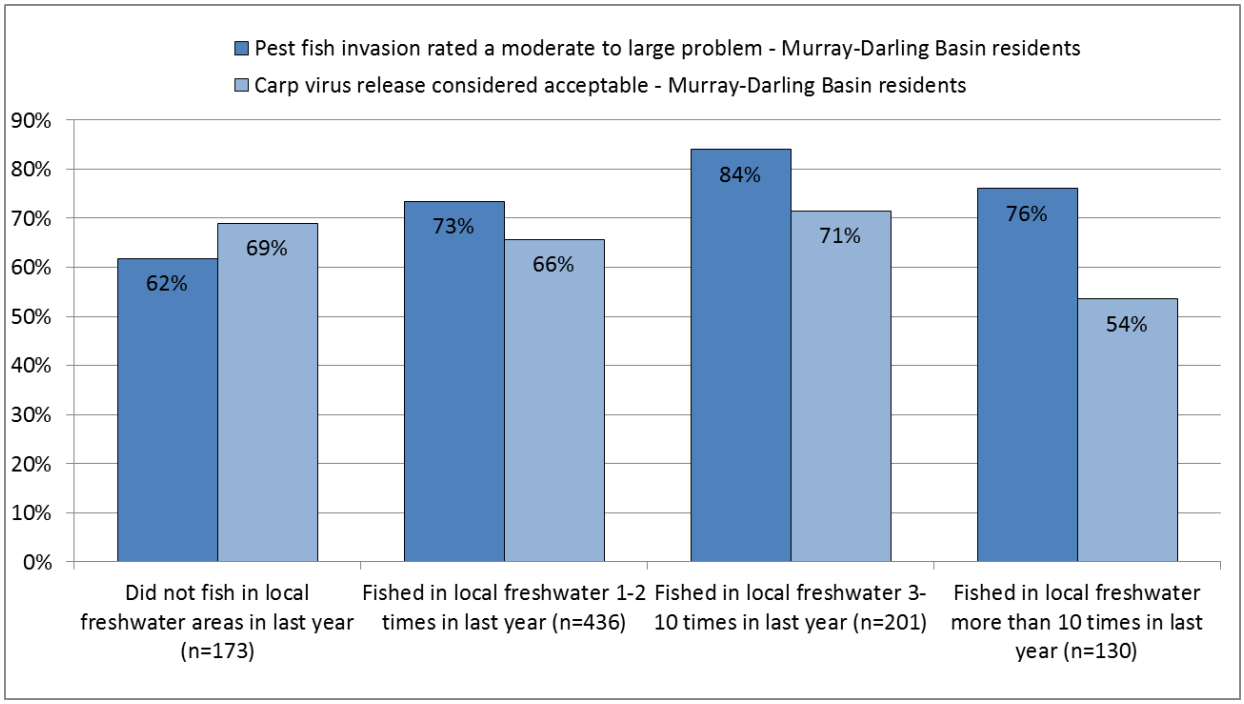

Figure 32 Acceptability of carp virus release – by engagement in freshwater recreational fishing and perceptions of pest fish invasion

DIFFERENCES IN VIEWS – COMMUNITY RESILIENCE

In some cases, factors other than those directly related to an issue may affect a person's perceptions of an issue. In rural areas in particular, a person's confidence in the quality of life, government and overall resilience of their community can influence the extent to which they view something as being a significant problem: to give an example, people who have high confidence that their local government is well placed to managed local water quality may express fewer concerns about the extent to which issues such as floods are problems for local water quality. This issue has often been described in studies examining the effects of cumulative impacts of psychological stress and ability to cope, which have typically identified that people already experiencing adversity are less able to cope with further adversity, although in the long-term some lifetime experiences of adversity are predictive of building resilience (see for example Seery et al. 2010). While the risks associated with cumulative exposures to environmental or other place-based stressors affecting communities are not well understood, it has been argued that environmental risk assessment should incorporate understanding of the effects of cumulative psychosocial stresses being experienced in social environmentals such as households and local communuities (deFur et al. 2007).

As the Regional Wellbeing Survey examines several psychosocial stressors occurring at the community levels, this could be examined. It was analysed firstly by examining whether people who feel more or less confident in different aspects of the resilience of their

community (which is an outcome of level of psychosocial stressors being experienced) were more or less likely to view pest fish invasion as a problem, specifically:

- Coping with challenges – whether the person felt confident their community could cope well with challenges
- Liveability – whether the person would recommend their community as a good place to live, a measure that reflects resilience and liveability in the community
- Local government – whether the person feels confidence their local government can manage challenges effectively
- Representation and engagement – whether the person feels they can get involved in local decision making, and that the people who make decisions represent all people in the community
- Economy – whether the person feels the local economy is health
- Local governance – whether the person feels local groups and organisations in general are able to work effectively and 'get things done' in the local area.

People who were less confident that their community was resilient were slightly but significantly less likely to support virus release. This applied to all measures of community resilience examined (Figure 33), and highlights that a person's level of confidence in the capacity of their community to cope with managing events such as release of a virus influence their support for these actions. The biggest differences in confidence occurred in relation to confidence in being able to participate in local decision making, and overall confidence in the community as a place to live: for example, 73% of those who felt able to get involved in local decision-making supported virus release, compared to 62% of those who did not feel able to be involved in decision-making processes.

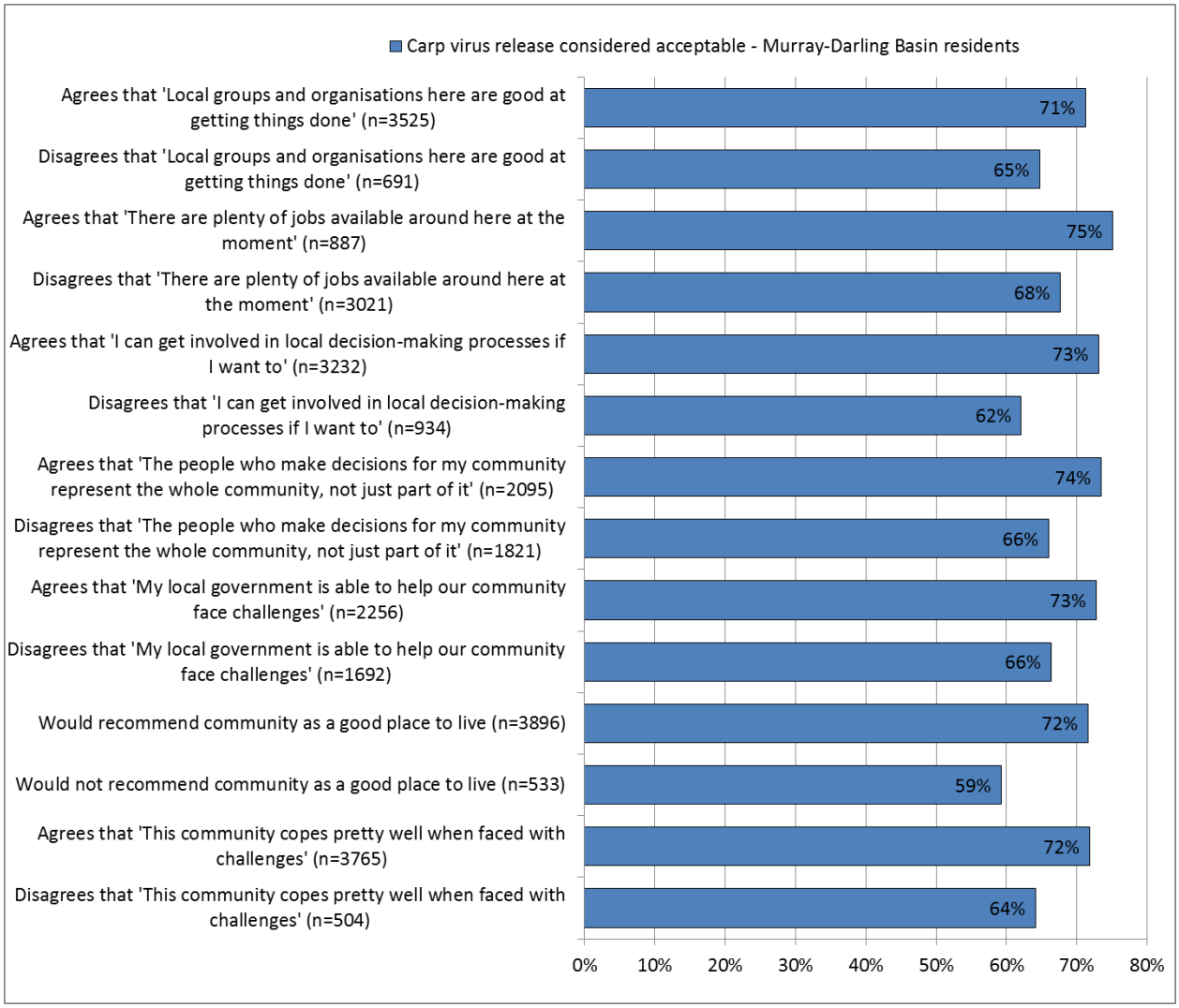

Figure 33 Acceptability of carp virus release – by community resilience

CONCLUSIONS

While initial views about carp virus release are relatively positive, with just over 50% of Australians supporting release, and less than 20% opposing it, many – 30% - are unsure or neutral. Views about acceptability of virus release or other carp control measures are highly likely to change over time as this large proportion of 'unsure' people gather more information and form opinions, and as some of those who initially strongly support virus release based on a limited awareness of arguments for and against virus release develop a more complex understanding of the discussion around potential benefits, costs and risks of virus release.

While awareness of pest fish invasion appears likely to be a driver of views about acceptability of virus release, with 78% of those who consider pest invasion a moderate or large problem supporting virus release compared to 56% of those who consider pest fish invasion no problem or a small problem, other factors also clearly influence acceptability. Amongst these are factors related to gender, age and cultural background that need to be

better understood. Factors such as a person's health, income and community resilience are also associated with differing levels of support, highlighting that people are more likely to consider a new action acceptable if they have high levels of personal resources that help them cope with change (such as health and wealth), and if they feel their community can cope well with change and with implementation of new actions. However, a person's level of formal education is not associated with differing levels of support.

Being a farmer or recreational fisher – activities associated with generally higher levels of knowledge about natural resource management and waterway management - was associated with higher support for virus release, however amongst some groups with particularly high knowledge, with more moderate levels of support.

VIEWS OF RECREATIONAL FISHERS ON NATIVE FISH AND CARP

Recreational fishers were asked specific questions about their views on health of native fish and spread of carp. First, survey participants were asked if they spent time fishing. In total, 9881 survey participants answered this question[8]. Of these, 19% had never gone fishing, 54% had gone fishing at some point in their life but not in the past year, 18% had gone fishing once or twice in the last year, and 9% had gone fishing three or more times in the last year (7% had fished 3-10 times and 2% more than 10 times).

Those who had spent time fishing in the last year were asked how often they fished in freshwater locations in the last year. In total, 38% had not fished in freshwater locations in the last year, 39% had fished in freshwater once or twice in the last year, and 23% had fished in freshwater locations three or more times in the last year.

Those who had fished in the last year were asked the extent to which they agreed or disagreed that:

- Carp numbers have been growing in recent years in some/all of the places I fish
- The average size of some of the native fish species I target has been declining over time
- The health of native fish in my local rivers and lakes is pretty good.

Answers to the first question, about carp numbers, are relevant to understanding perceptions of carp control: concern about carp invasion may be associated with greater support for proposed actions to control carp. Perceptions about native fish size and health may indicate broader concerns about environmental health, and measure one of the

[8] This question was not asked of all survey participants: it was asked of only around one in three farmers in order to reduce length of the survey of farmers, and therefore there are smaller numbers of respondents than for some other items asked in the Regional Wellbeing Survey.

environmental problems often argued to be associated with carp invasion. However, as fishers were not asked if they felt carp directly contributed to problems with health of native fish, these items provide contextual information only about the broader views of fishers about environmental health, rather than being an indicator of views about the extent of problems associated with carp invasion.

Answers to these questions were analysed for (i) all Australian fishers and (ii) fishers living in the Murray-Darling Basin. The Basin was selected as it represents the region in which most (but not all) carp invasion has occurred in Australia, and thus views of fishers in the Basin are a useful indicator of the views of fishers living in carp-affected regions in general.

Of the fishers surveyed, 69% across Australia felt that carp numbers were growing in some or all of the places they fished, including 73% of fishers based in the Murray-Darling Basin. Almost half (47% across Australia and 46% in the Murray-Darling Basin) felt the average size of native fish species they targeted had been declining over time. Despite this, almost half felt that the health of native fish in their local rivers and lakes was 'pretty good' (49% in Australia and 46% in the Murray-Darling Basin), while fewer disagreed (31% and 35% respectively) (Figures 34 and 35).

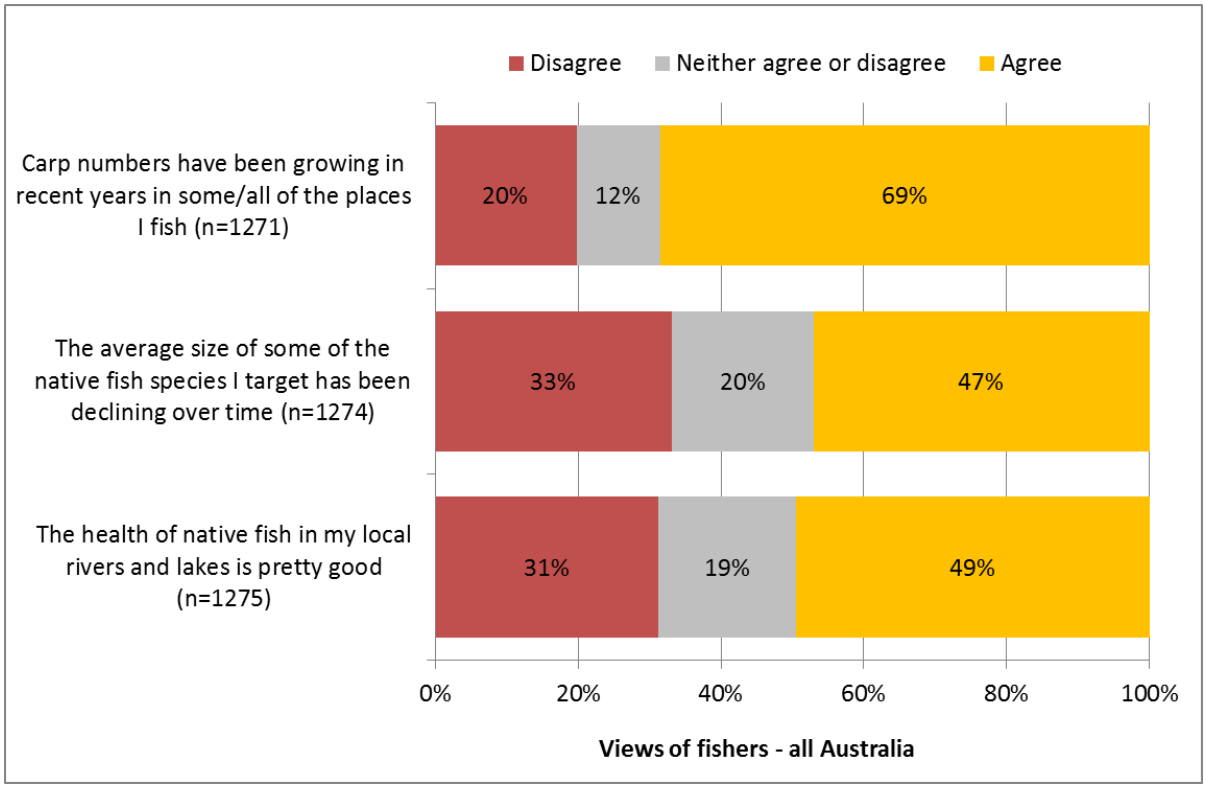

Figure 34 Views of recreational fishers about native fish species and carp – all Australian fishers

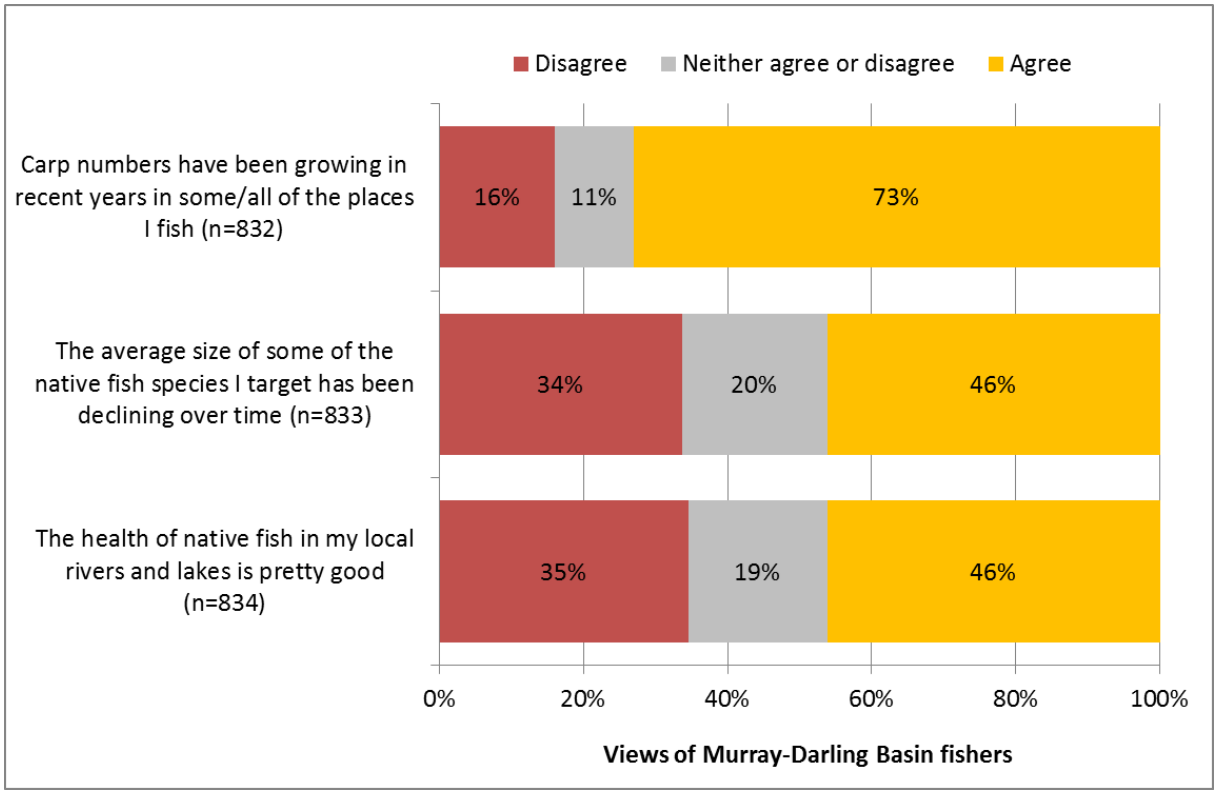

Figure 35 Views of recreational fishers about native fish species and carp – Murray-Darling Basin fishers

DIFFERENCES IN VIEWS – GEOGRAPHIC LOCATION

Recreational fishers living in the Murray Darling Basin were less likely to believe that the health of native fish in their local rivers and lakes was good, with 46% agreeing compared to 53% of fishers who lived outside the Basin. Within the Basin, fishers in the South Australian part of the Basin were least likely to consider native fish health as good, with only 23% agreeing it was good and 56% disagreeing (Figure 36). However, there were few differences in views about whether the average size of native fish caught by fishers was declining: across Australia, 47% reported average fish size had declined over time while 33% disagreed and 20% neither agreed or disagreed. The proportion of fishers reporting these views was almost identical in different parts of the Basin and outside the Basin (Figure 37).

When asked whether carp numbers were growing in some or all of the placed they fished, 73% of fishers living in the Basin agreed, compared to only 59% of fishers who lived outside the Basin (Figure 38). Within the Basin, those living in the southern parts of the NSW Basin and in the Victorian part of the Basin were somewhat less likely to report increasing numbers of carp, although more than two-thirds of fishers reported observing growth even in these regions (68% and 69% of fishers respectively in the NSW southern Basin and Victorian Basin). Fishers in the northern NSW and South Australian parts of the Basin were most likely to report observing growing numbers of carp (83% and 82% respectively).

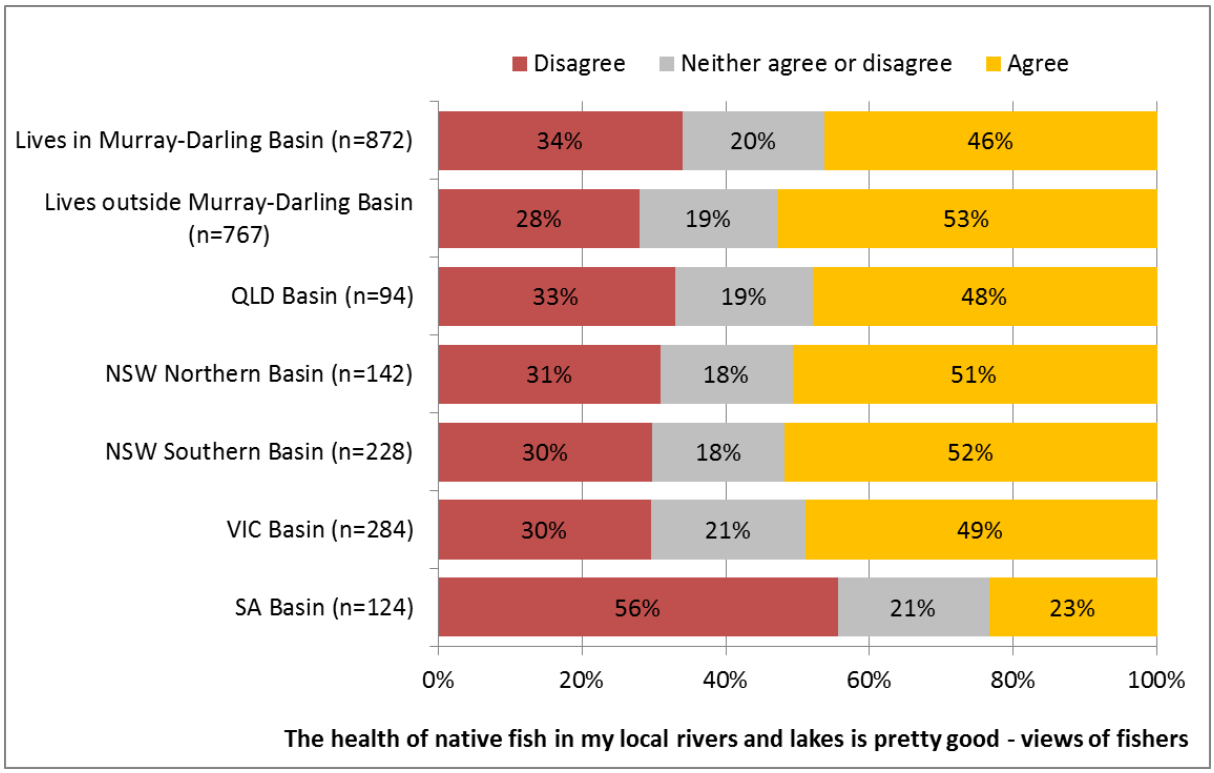

Figure 36 Views of recreational fishers about native fish health – by geographic location

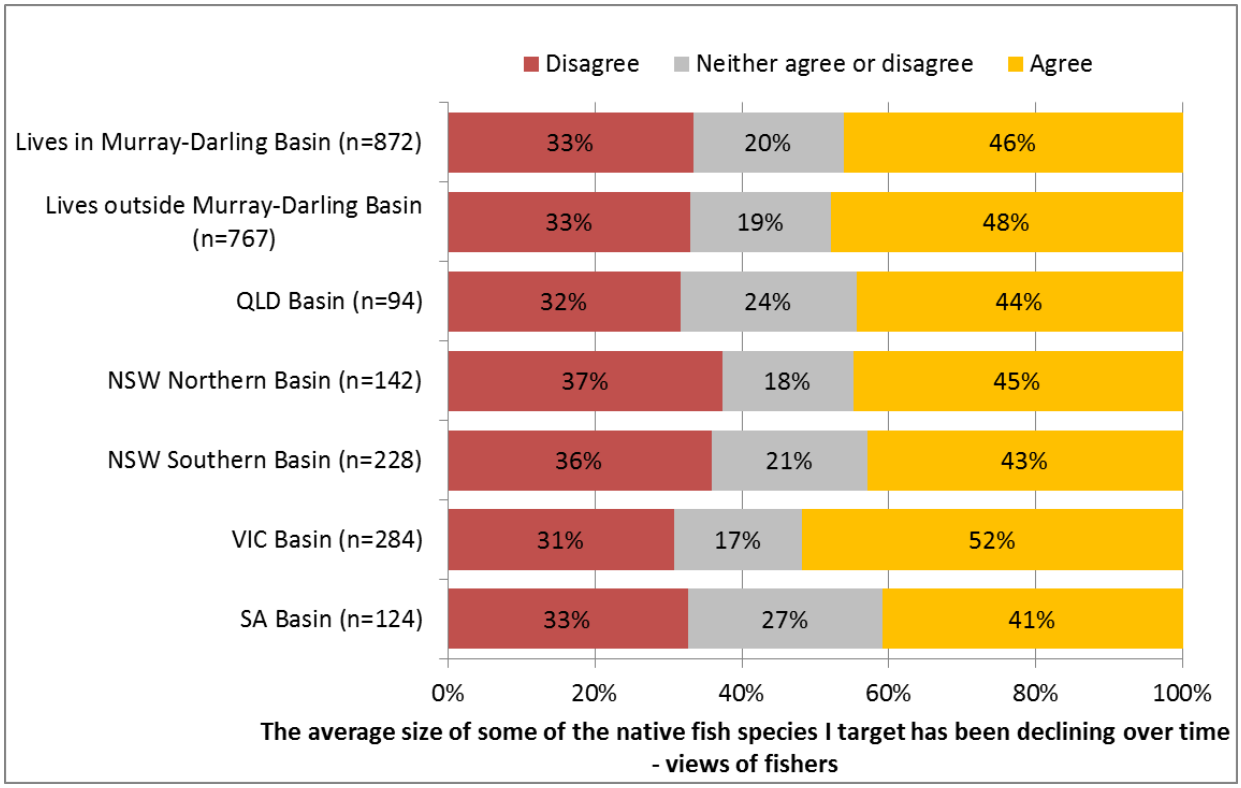

Figure 37 Views of recreational fishers about native fish size trends over time – by geographic location

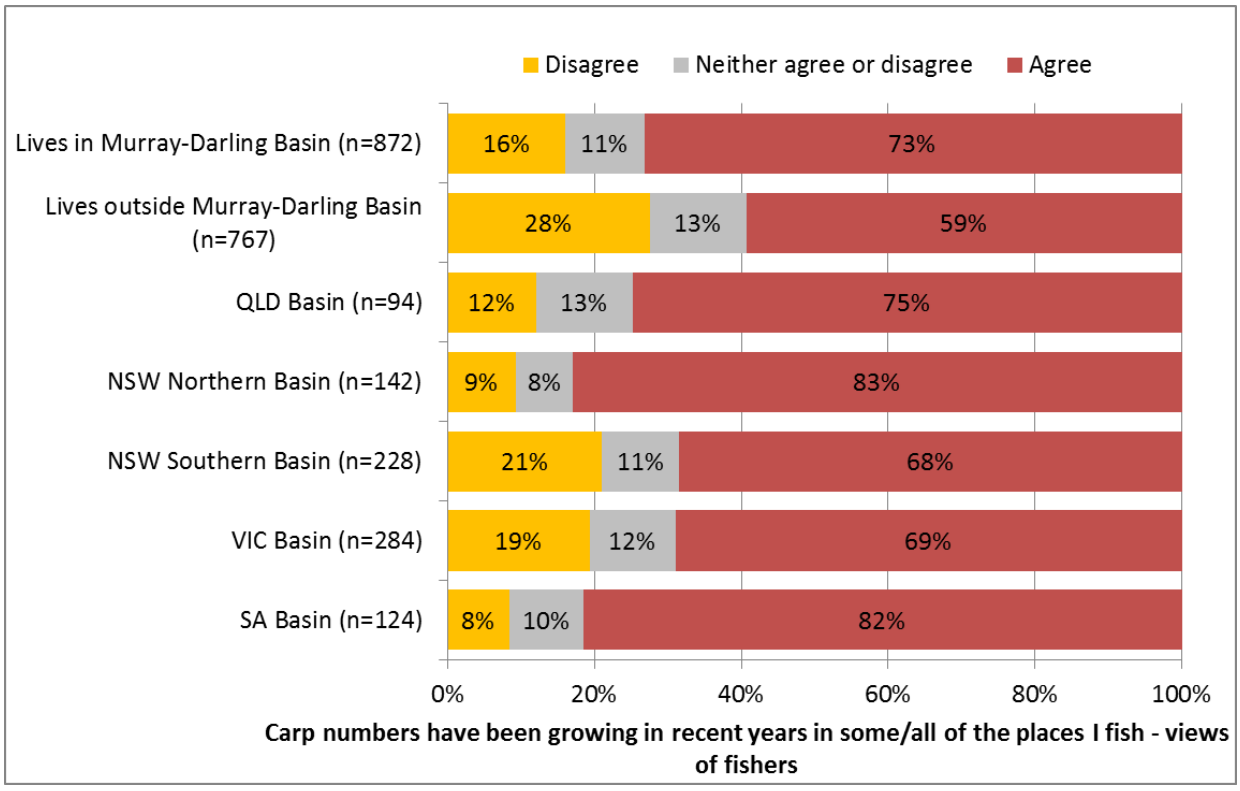

Figure 38 Views of recreational fishers about change in carp numbers in recent years – by geographic location

DIFFERENCES IN VIEWS – FISHING HISTORY

Differences in views were also examined based on how avid and experienced the fisher was: in other words, based on how often they reported fishing (avidity of fishing) and how many years they had been going fishing in local freshwater areas. Fishers who had spent more time fishing in local freshwater areas in the last year were significantly more likely to report that the health of native fish in their local area was pretty good (57% of those who fished 10 times or more, compared to 41% of those who fished only once or twice in the last year) (Figure 39). There was little difference in views of more and less avid fishers regarding whether average size of native fish species caught has been declining (Figure 40). Those who fish more often were less likely to report that carp numbers have been growing in the freshwater areas they fish, with 61% of those who fished more than 10 times in local freshwater areas in the last year agreeing that carp were increasing, compared to 75% of those who had fished only once or twice, and 80% of those who had not fished in a local freshwater area in the last year (Figure 41). This difference may result from multiple factors: for example, more avid fishers may target fishing in areas with less carp invasion, or fishers may opt to fish less if their local fishing areas are dominated by carp.

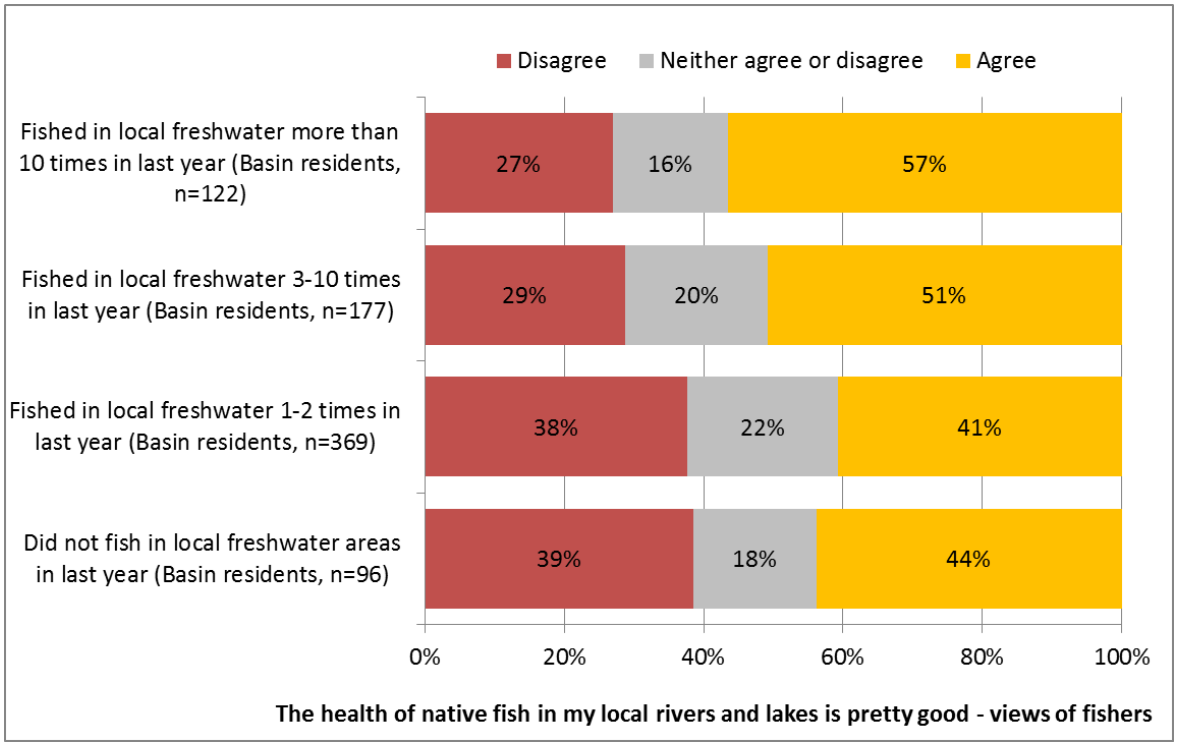

Figure 39 Views of recreational fishers about native fish health – by frequency of engaging in fishing

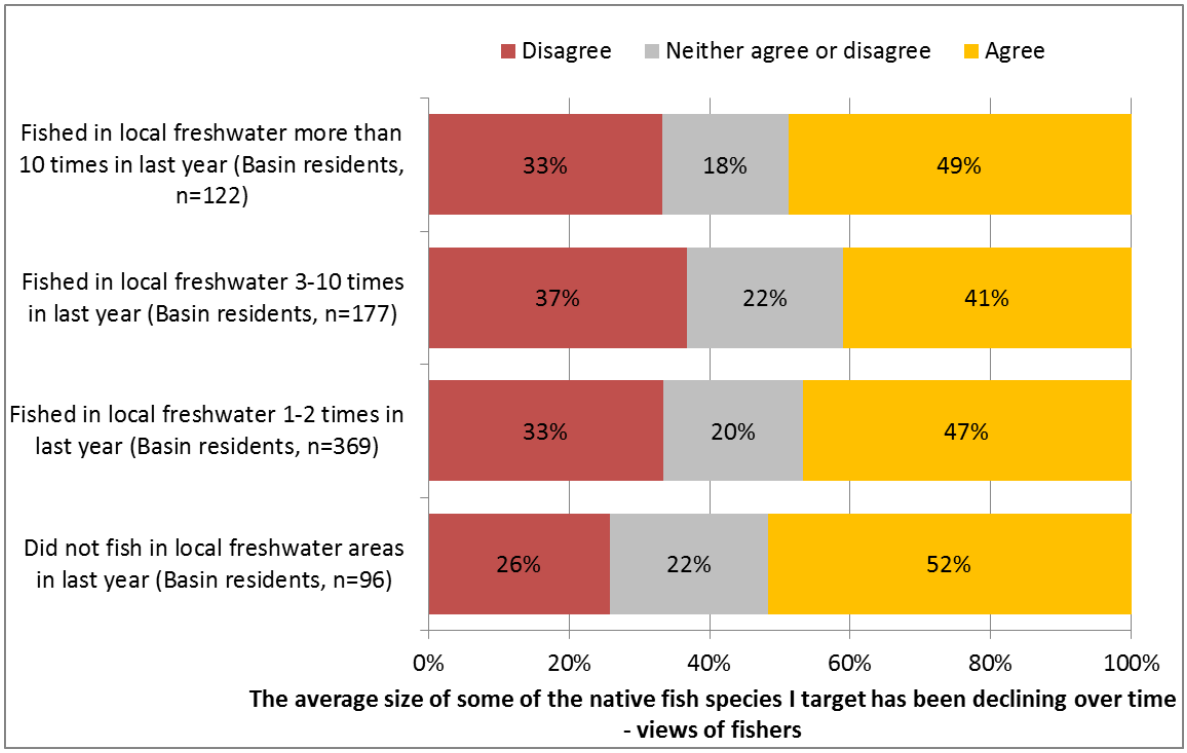

Figure 40 Views of recreational fishers about native fish size trends over time – by frequency of engaging in fishing

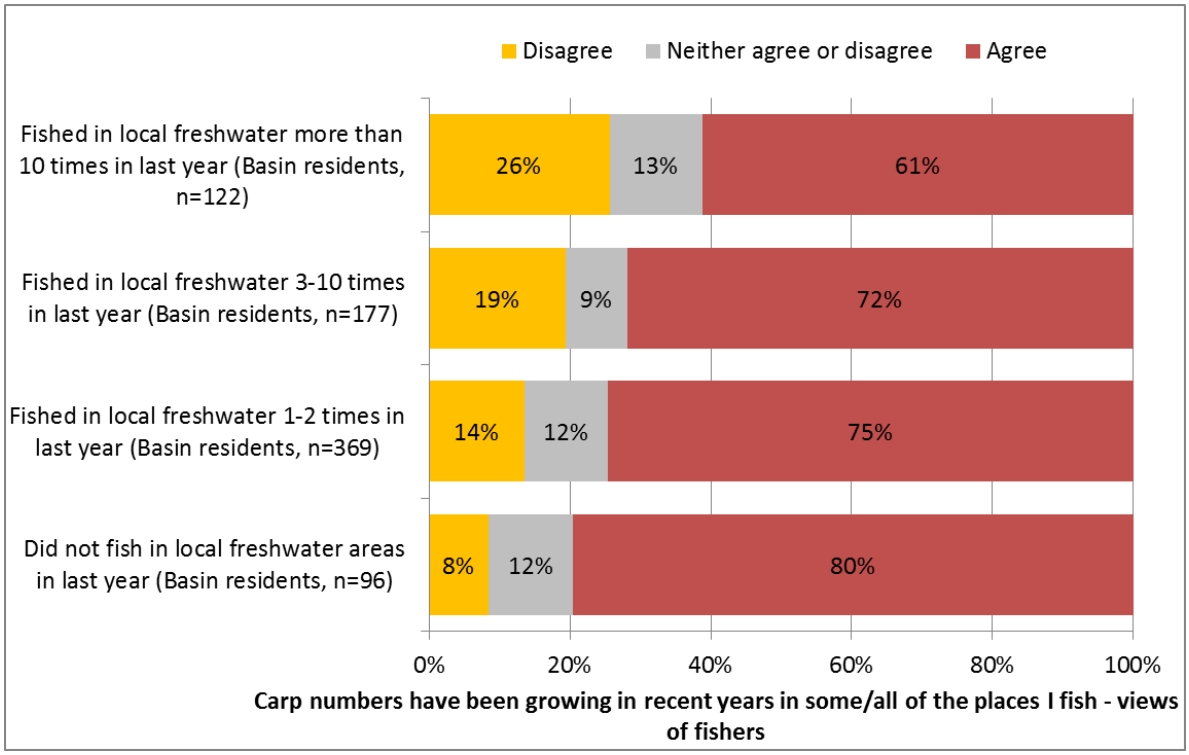

Figure 41 Views of recreational fishers about change in carp numbers in recent years – by frequency of engaging in fishing

The length of time a person had spent fishing locally was not associated with consistent differences in their views about the health of native fish in their local area, or about whether native fish size was declining (Figures 42 and 43). However, it was associated with different views about carp: those who had fished for fewer years locally were more likely to report that carp numbers had been growing in recent years (79% of those who had fished in their local area for less than five years), and those who had fished for more years less likely to (67% of those who had 20 years or more local fishing experience) (Figure 44). Despite these differences, a large majority of all fishers reported growth in carp numbers.

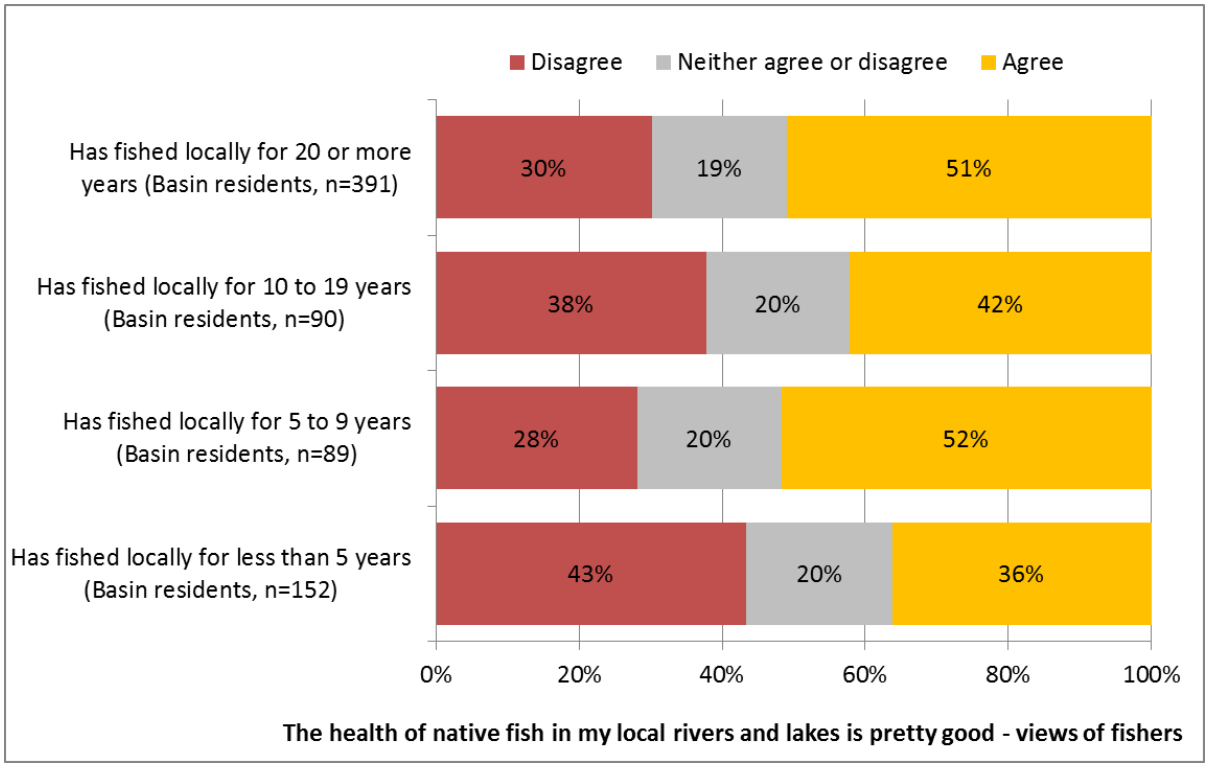

Figure 42 Views of recreational fishers about native fish health – by length of time engaged in fishing

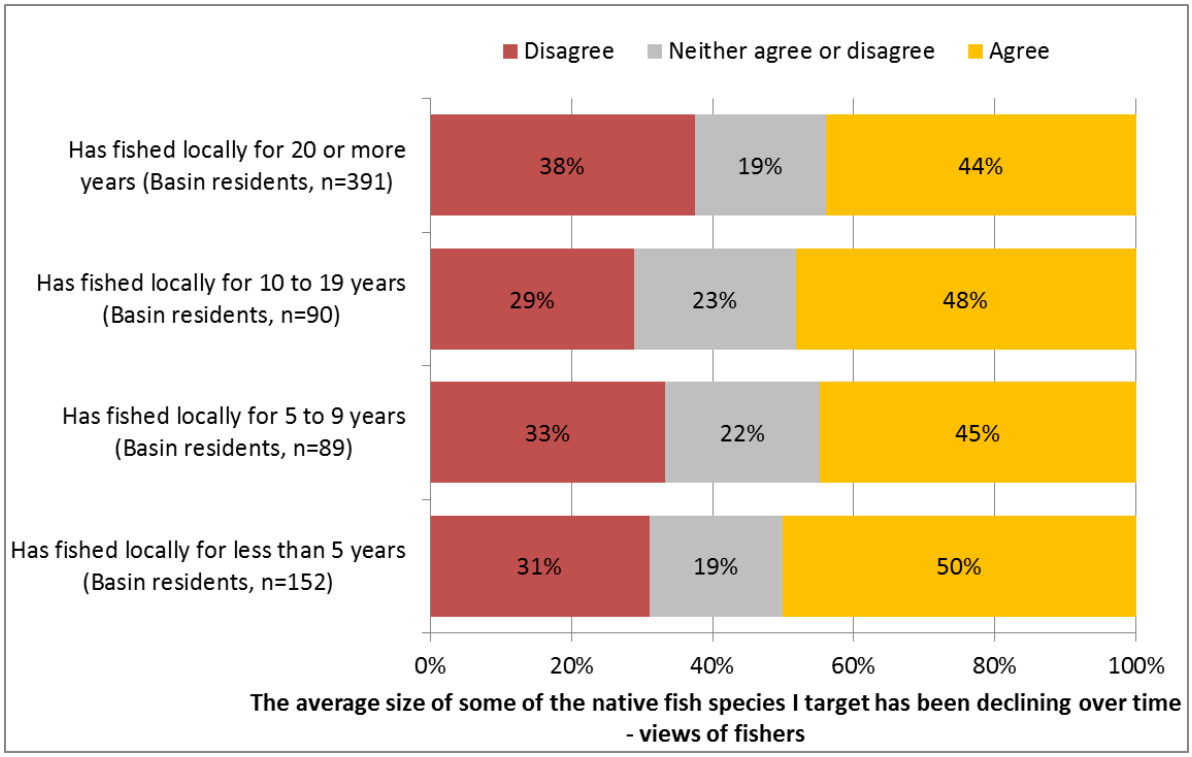

Figure 43 Views of recreational fishers about native fish size trends over time – by length of time engaged in fishing

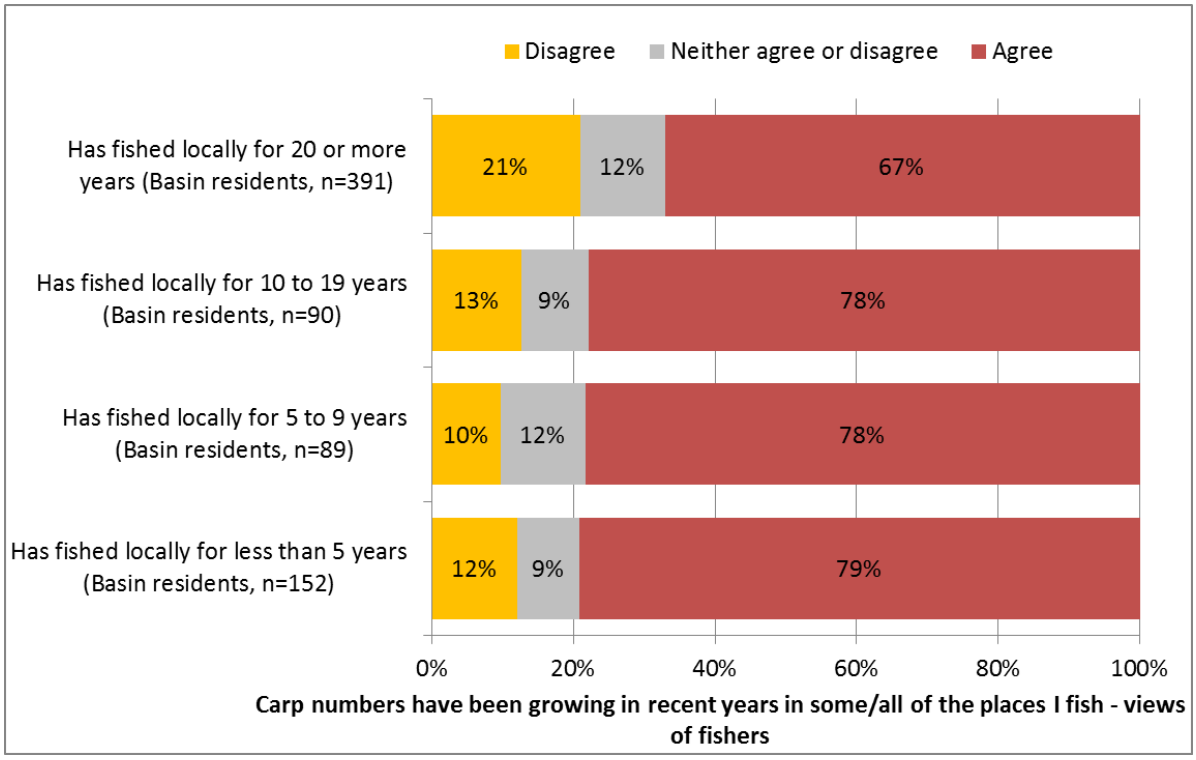

Figure 44 Views of recreational fishers about change in carp numbers in recent years – by length of time engaged in fishing

DIFFERENCES IN VIEWS – AGE OF FISHER

The age of fishers was not associated with substantially different views about (i) health of native fish in local rivers and lakes (Figure 45), (ii) whether size of native fish caught was declining over time (Figure 46), or (iii) whether carp numbers were growing (Figure 47). This indicates that direct experience of fishing may influence some of the factors that otherwise contribute to younger fishers being less likely to view pest fish as a problem or release of the carp virus as acceptable. To test this idea, the views of fishers and non-fishers of different ages about acceptability of carp virus release were compared (Figure 48). This shows that while an age-related trend exists, people who fish were more likely to find virus release acceptable compared to those who do not fish, in every age group.

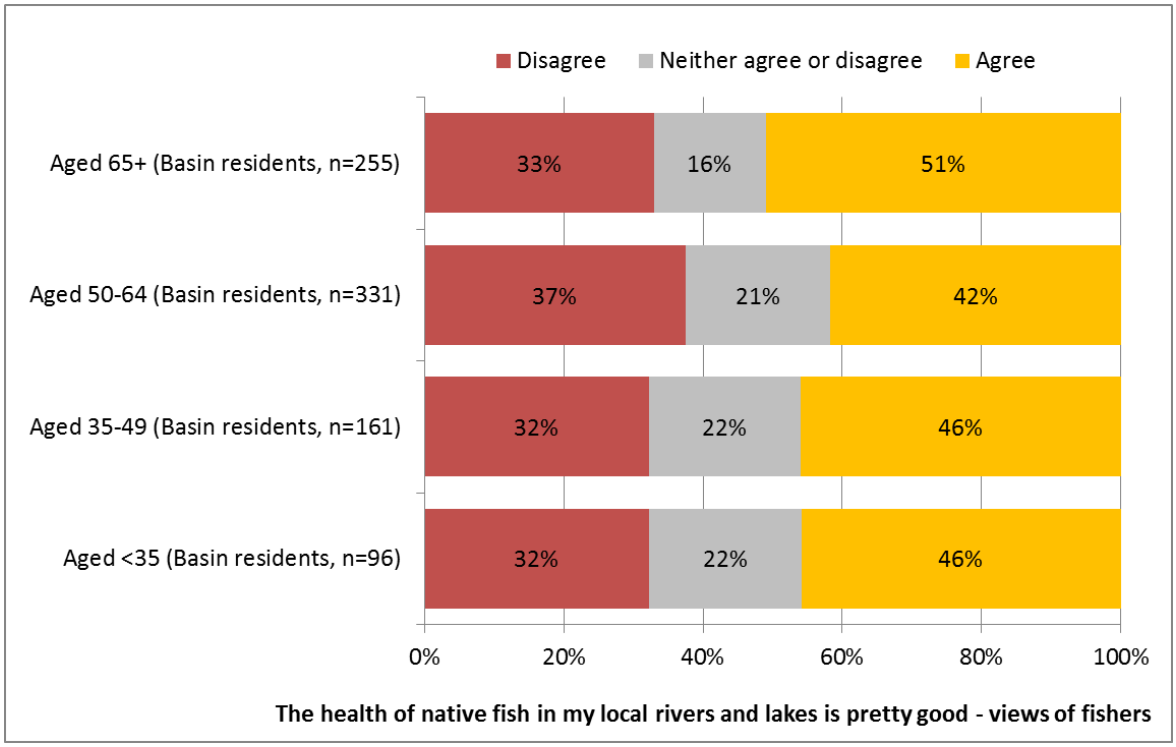

Figure 45 Views of recreational fishers about native fish health – by age of fisher

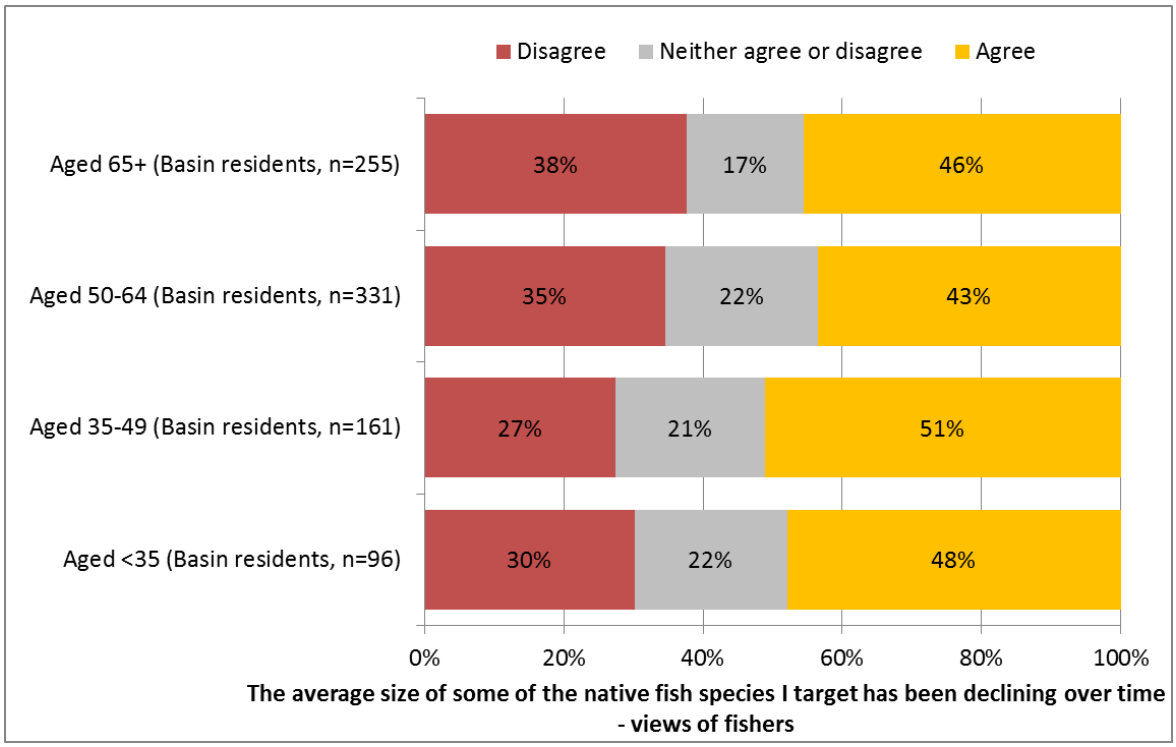

Figure 46 Views of recreational fishers about native fish size trends over time – by age of fisher

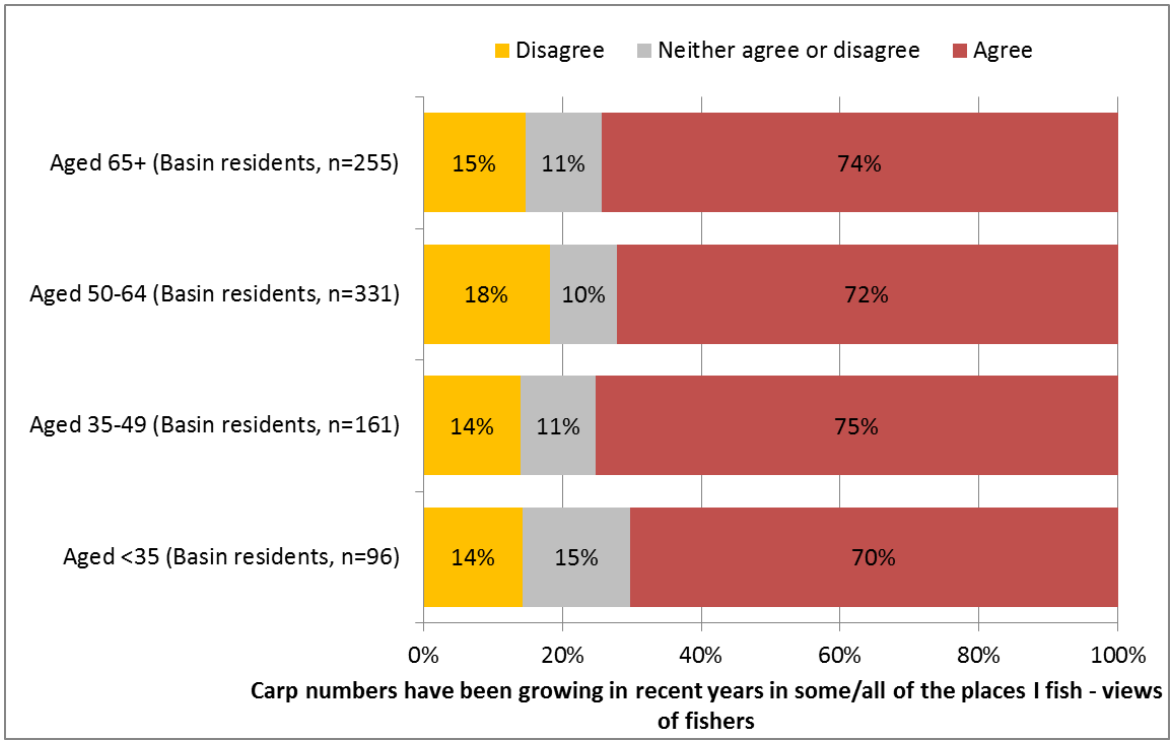

Figure 47 Views of recreational fishers about change in carp numbers in recent years – by age of fisher

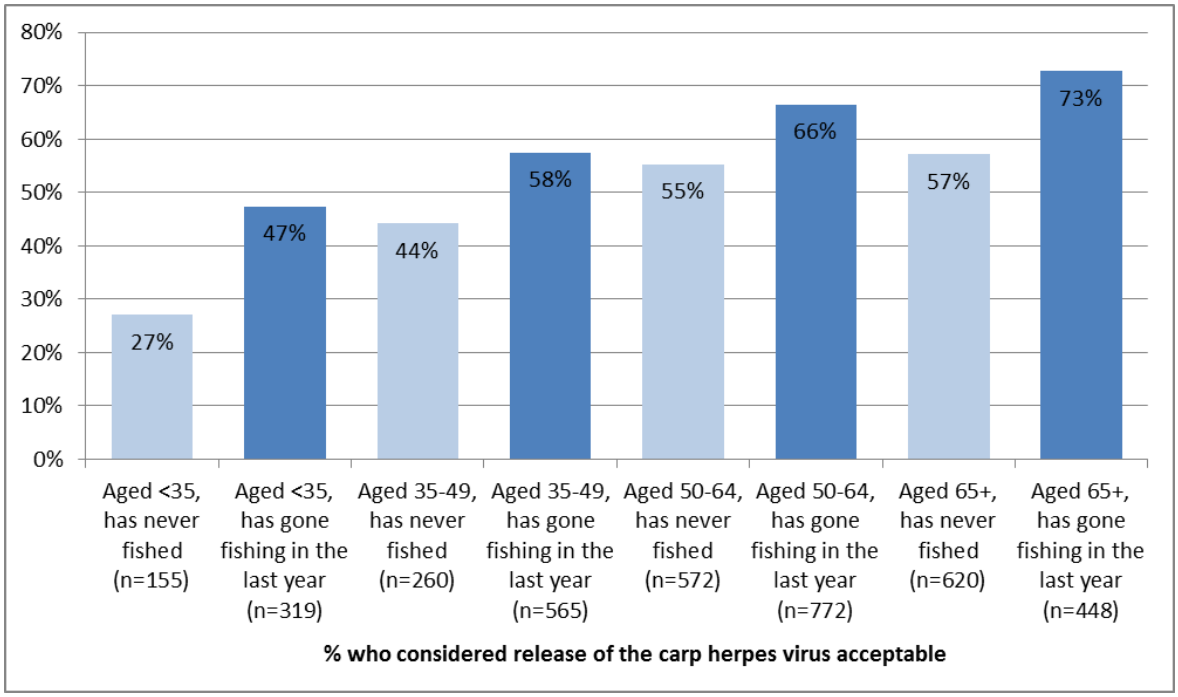

Figure 48 Acceptability of carp virus release – by engagement in recreational fishing and age group

CONCLUSIONS

A large majority of recreational fishers have observed growth in carp numbers in some or all of the places they fish in recent years (including 73% of those based in the Murray-Darling Basin). While just under half believe the average size of native fish they catch is declining over time, a similar proportion believe that overall the health of native fish in their local

rivers and lake is good. Those who fish more often are more likely to report health of native fish is good in their area, and less likely to report increasing numbers of carp: this may be driven by a range of factors, including that carp invasion may affect fishing frequency. Future surveys should examine how fishing behavior changes depending on observations of carp versus native fish locations in fishing areas. Fishers of different ages had similar views about carp and native fish, and those who fished were more likely than non-fishers to support carp virus release when compared by age group. This suggests that engaging in activities related to freshwater helps address some of the factors that contribute to lower support for virus release amongst younger age groups.

PREFERRED INFORMATION SOURCES

The 2016 Regional Wellbeing Survey asked survey participants how they preferred to receive information about land and water management issues. These data are briefly analysed here as they can provide some useful insight into preferred information sources of groups with differing views about pest fish invasion and the proposed release of the carp virus.

Respondents could identify whether each of a number of methods, such as accessing websites, receiving an email, media reports or social media reports, were way they (i) highly preferred, (ii) would use but did not prefer, or (ii) would not use to access information. They could select more than one 'highly preferred' response. Across almost all groups, the answers were similar (Table 3). Websites were preferred by 57% of people, email by 44%, TV by 43%, local newspapers by 42%, ABC radio by 41%, mailed letters/flyers by 37%, Facebook by 31%, local radio other than ABC by 28%, notices in local businesses/shops by 28%, local NRM or conservation groups by 20%, farming organisations by 11%, Twitter by 5% and other methods by 4%.

In most cases, preferences did not differ substantially between different groups. However, there were exceptions. As shown in Table 3, when preferred information delivery mechanisms were compared to views about pest fish invasion and carp virus release, while websites and emails remained the top two preferred methods of communication, TV, ABC radio and NRM/conservation groups were more strongly preferred by those who felt pest fish were a big problem and who found virus release acceptable than by others. When views were examined by geographic remoteness (Table 4), those living in big cities were least likely to want material mailed to them, and those living in more remote areas had a stronger preference for Facebook and notices in local businesses and shops.

Women more commonly preferred Facebook and directly mailed material than men, while men had a slightly stronger preference for information delivered on websites (Table 5). Younger people were less likely than older people to prefer TV, newspapers, ABC radio or NRM/conservation groups, and more likely than older people to have a preference for information delivered via Facebook and Twitter (Table 5). This suggests that while Facebook is not a highly preferred source, it is for many of the groups who are less likely to consider virus release acceptable.

There were few differences based on cultural background (Table 6) or amongst people with different levels of formal education (Table 7), although those who had not completed high school were less likely to prefer websites and emails, and more likely to prefer information delivered via TV, local newspaper and radio, and direct mailing of letters or flyers. Those with lower household income (Table 8) were more likely to express a preference for accessing information via TV, local newspaper, mailed letters/flyers, and notices in local businesses and shops. Farmers had a stronger preference for information delivered via ABC

radio, letters/flyers, NRM/conservation groups and farming organisations, and were less likely than non-farmers to prefer websites, TV and Facebook (Table 9).

Table 3 Preferred methods for accessing information on land and water management – by views about pest fish and carp virus release

	Australia (n=9636)	Don't know if pest fish are a problem - Basin residents (n=542)	Pest fish no/ small problem - Basin residents (n=701)	Pest fish moderate/ big problem - Basin residents (n=2036)	Don't know if carp virus acceptable - all Australians (n=2046)	Carp virus un-acceptable - all Australians (n=1557)	Carp virus acceptable - all Australians (n=5194)
Website I can check every now and then	57%	57%	57%	60%	54%	56%	59%
Email sent to me	44%	42%	45%	41%	41%	40%	46%
TV	43%	36%	40%	45%	41%	39%	46%
Local newspaper	42%	43%	40%	43%	42%	37%	43%
ABC radio	41%	34%	37%	45%	34%	33%	47%
Letter or flyer sent to my letterbox	37%	38%	39%	34%	40%	36%	37%
Facebook	31%	34%	24%	32%	32%	34%	30%
Local radio other than ABC	28%	21%	24%	29%	25%	26%	29%
Notices in local businesses/shops	22%	21%	17%	23%	22%	20%	23%
Local NRM or conservation group (e.g. Landcare, catchment group)	20%	13%	19%	21%	15%	16%	23%
Farming organisations	11%	9%	12%	14%	7%	8%	14%
Twitter	5%	5%	6%	6%	3%	4%	6%
Other	4%	6%	6%	3%	4%	4%	4%

Shaded areas indicate there is a significant difference in preference of people for this variable

Table 4 Preferred methods for accessing information on land and water management – by geographic location

	Australia (n=9636)	Major cities of Australia (n=372)	Inner regional Australia (n=3000)	Outer regional Australia (n=3245)	Remote Australia (n=516)	Very remote Australia (n=263)
Website I can check every now and then	57%	57%	58%	56%	55%	53%
Email sent to me	44%	45%	43%	44%	43%	41%
TV	43%	40%	43%	45%	41%	48%
Local newspaper	42%	39%	43%	43%	42%	36%
ABC radio	41%	39%	42%	42%	39%	44%
Letter or flyer sent to my letterbox	37%	27%	39%	40%	33%	40%
Facebook	31%	27%	31%	31%	40%	43%
Local radio other than ABC	28%	23%	27%	31%	27%	33%
Notices in local businesses/shops	22%	14%	21%	27%	26%	28%
Local NRM or conservation group (e.g. Landcare, catchment group)	20%	18%	19%	22%	22%	20%
Farming organisations	11%	5%	11%	15%	14%	13%
Twitter	5%	3%	6%	5%	3%	5%
Other	4%	2%	4%	4%	3%	2%

Table 5 Preferred methods for accessing information on land and water management – by gender and age

	Female (n= 5707)	Male (n= 3891)	Aged <25 (n= 378)	Aged 25-34 (n= 1475)	Aged 35-44 (n= 1807)	Aged 45-54 (n= 1949)	Aged 55-64 (n= 1737)	Aged 65+ (n= 2292)
Website I can check every now and then	55%	59%	54%	53%	62%	60%	58%	52%
Email sent to me	43%	44%	38%	47%	41%	41%	44%	46%
TV	45%	42%	48%	34%	37%	41%	47%	52%
Local newspaper	44%	40%	31%	32%	34%	42%	46%	53%
ABC radio	41%	43%	26%	24%	32%	41%	50%	56%
Letter or flyer sent to my letterbox	41%	34%	45%	38%	35%	35%	38%	40%
Facebook	38%	22%	54%	48%	43%	34%	23%	12%
Local radio other than ABC	29%	26%	38%	25%	27%	27%	29%	28%
Notices in local businesses/shops	24%	19%	21%	24%	19%	23%	23%	22%
Local NRM or conservation group (e.g. Landcare, catchment group)	20%	20%	11%	14%	18%	20%	22%	26%
Farming organisations	10%	13%	11%	11%	10%	10%	13%	13%
Twitter	5%	6%	9%	8%	6%	6%	5%	2%
Other	3%	4%	2%	2%	3%	6%	3%	6%

Table 6 Preferred methods for accessing information on land and water management – by cultural background

	Identifies as Aboriginal or Torres Strait Islander (n=124)	Does not identify as Aboriginal or Torres Strait Islander (n=9421)	Born in Australia (n=8083)	Born in English-speaking country other than Australia (n=1198)	Born in non-English speaking country (n=372)
Website I can check every now and then	57%	57%	56%	60%	54%
Email sent to me	37%	43%	43%	46%	46%
TV	43%	43%	43%	44%	48%
Local newspaper	36%	42%	42%	43%	48%
ABC radio	36%	42%	41%	43%	43%
Letter or flyer sent to my letterbox	33%	38%	38%	36%	39%
Facebook	59%	31%	32%	25%	30%
Local radio other than ABC	32%	28%	28%	26%	28%
Notices in local businesses/shops	28%	22%	22%	22%	27%
Local NRM or conservation group (e.g. Landcare, catchment group)	20%	20%	20%	22%	21%
Farming organisations	10%	11%	12%	10%	10%
Twitter	15%	5%	5%	4%	10%
Other	0%	4%	4%	3%	8%

Table 7 Preferred methods for accessing information on land and water management – by highest level of education attainment

	Highest level of education Year 12 or equivalent (n=9572)	Highest level of education post-school certificate or diploma (n=4048)	Highest level of education university degree (n=4427)	Did not complete high school (n=1073)
Website I can check every now and then	57%	59%	57%	50%
Email sent to me	44%	43%	47%	36%
TV	40%	45%	36%	57%
Local newspaper	38%	42%	38%	53%
ABC radio	37%	38%	45%	43%
Letter or flyer sent to my letterbox	38%	38%	32%	49%
Facebook	33%	34%	28%	32%
Local radio other than ABC	26%	30%	21%	40%
Notices in local businesses/shops	20%	25%	17%	29%
Local NRM or conservation group (e.g. Landcare, catchment group)	19%	19%	20%	20%
Farming organisations	11%	12%	9%	14%
Twitter	5%	5%	5%	4%
Other	3%	4%	4%	6%

Table 8 Preferred methods for accessing information on land and water management – by household income in 2015-16

	Household income <$31,200 (n=2031)	Household income $31,200 to $51,999 (n=1466)	Household income $52,000 to $77,999 (n=1694)	Household income $78,000-$103,999 (n=1433)	Household income $104,000-$155,999 (n=1682)	Household income $156,000 or above (n=953)
Website I can check every now and then	51%	59%	58%	62%	59%	57%
Email sent to me	39%	41%	47%	46%	47%	44%
TV	51%	49%	43%	41%	35%	34%
Local newspaper	47%	46%	42%	39%	38%	33%
ABC radio	44%	43%	41%	40%	38%	39%
Letter or flyer sent to my letterbox	45%	38%	36%	34%	34%	31%
Facebook	30%	27%	30%	33%	36%	34%
Local radio other than ABC	32%	29%	27%	25%	26%	24%
Notices in local businesses/shops	30%	22%	22%	20%	18%	15%
Local NRM or conservation group (e.g. Landcare, catchment group)	21%	22%	21%	19%	19%	17%
Farming organisations	12%	11%	12%	9%	11%	10%
Twitter	6%	4%	4%	5%	7%	6%
Other	5%	3%	5%	5%	2%	4%

Table 9 Preferred methods for accessing information on land and water management – by engagement in agriculture and recreational fishing

	Dryland farmer (n=700)	Irrigator (n=340)	Never involved in agriculture (n=6904)	Never fished (n=1678)	Fish often (n=863)
Website I can check every now and then	41%	46%	58%	42%	45%
Email sent to me	41%	45%	43%	53%	57%
TV	35%	33%	44%	38%	42%
Local newspaper	47%	40%	41%	43%	43%
ABC radio	51%	46%	39%	20%	21%
Letter or flyer sent to my letterbox	51%	48%	37%	40%	39%
Facebook	14%	14%	33%	24%	35%
Local radio other than ABC	29%	33%	27%	42%	48%
Notices in local businesses/shops	20%	21%	21%	10%	14%
Local NRM or conservation group (e.g. Landcare, catchment group)	37%	28%	18%	23%	28%
Farming organisations	45%	52%	8%	30%	37%
Twitter	3%	3%	5%	5%	7%
Other	3%	1%	4%	4%	1%

FURTHER WORK

The results of the 2016 Regional Wellbeing Survey provide useful insight, but are limited as the survey was not specifically designed to evaluate factors influencing views about the acceptability of implementing different carp control methods. Future surveys will examine a wider range of topics, including views about a wider range of carp control methods, views about the potential positive and negative impacts of these methods, and levels of trust in the agencies who may implement carp control action.

6. DISCUSSION AND CONCLUSIONS

Overall, this report identified that initial support for the *concept* of the Plan is high, with strong support for investing in carp control by a diversity of stakeholder groups with varying interests. Amongst the broader population, initial responses to the idea of virus release are mostly positive or undecided, and a minority are initially opposed to the idea based on the limited information they have heard about the proposal. However, support is not universal, with almost one in five people initially opposed to the proposed to release the carp herpes virus, as are some stakeholder groups. Additionally, initial views are likely to change amongst the broader community as public discussion about the Plan evolves.

For the most part, those interested stakeholders who support the Plan support it conditionally: in other words, their support is contingent on the design and content of the Plan addressing the issues that are documented in this report. Their eventual decision on whether to support the Plan will depend on whether its content addresses these key issues. In particular, achieving high levels of support for the Plan requires ensuring it includes an integrated set of carp control measures rather than focusing solely (or predominantly) on virus release, and a strong focus on identifying how to maximise ecological response to reduction in carp numbers – ensuring there is action to maximise potential for beneficial ecological response to reduced carp numbers. Ensuring the Plan is explicitly designed to maximise potential improvements in environmental health is essential given the key objective of reducing carp numbers is to support the ecological health of many of Australia's freshwater ecosystems.

Clear and transparent communication about potential positive and negative impacts of different carp control measures is essential to building support, as is clear communication about the extent of uncertainty and risk involved. The findings presented in this report suggest a high level of willingness amongst most – but not all - stakeholders to accept a level of uncertainty and short-term negative impacts from actions such as virus release, as long as they are confident that there is a high likelihood of positive longer-term effects on environmental health. Being transparent about levels of certainty and the limitations of available evidence is important to building trust in the actions eventually proposed in the Plan. It is also important to building constructive dialogue about the Plan that builds complexity of thinking about management of carp, and more broadly about management of freshwater ecosytstems (and estuarine ecosystems in some locations).

To achieve a high level of acceptance by both stakeholders with a strong interest in carp control and the broader community, there is a need to engage with both the stakeholders who already have high knowledge and strong interest in carp control, and with the broader community. The needs of each group are very different. Amongst stakeholder groups, there is a need to engage at the level of their already high level of knowledge about carp and carp

control: this means both providing opportunities for these groups to have meaningful input into development of the Plan, and ensuring they have access to detailed information that addresses the complexities of current knowledge about carp control and of developing actions to control carp. This can assist both in ensuring the Plan addresses key needs, concerns and topics raised by these groups, and that it further builds their detailed and complex knowledge through encouraging dialogue about the pros and cons of different types of action and strategies to control carp.

Amongst the broader community, knowledge needs are very different: there is often little to no awareness of carp invasion and associated problems, and as a result initial views are likely being formed on relatively limited information, and are more likely to be 'extreme' (in the case of initial views, most often in the form of high levels of support). Initial high levels of community support for the idea of virus release are therefore likely to be based on relatively limited information and exposure to limited discussion of the pros and cons of virus release. This, together with the relatively high proportion of people indicating they are unsure whether they support the idea, means views may shift rapidly depending on the types of information people access as they seek more detail about the Plan and what virus release may involve.

The information delivered to both interested stakeholders and the broader community should be aimed not at achieving uninformed support for the Plan, as this is likely to trigger polarisation of views and conflict, particularly amongst stakeholders who have existing strong interest in and knowledge about carp, carp control, and freshwater (and estuarine) management. This was evident from those interviews in which some interviewees described being concerned at overly simple or one-sided information circulating in the media, and described their conditional support as partially resulting from productive discussions with staff of the National Carp Control Plan in which there was recognition of multiple points of view, uncertainties and gaps in knowledge. This reinforces the importance in a process such as the Plan of supporting dialogue about the challenges of carp control, and of encouraging expression of differing views and ensuring they can contribute to development of the Plan. This can support public dialogue about carp control that better engages with the complex nature of the challenges presented by carp invasion, and reduce reliance on overly simplified arguments either for or against particular forms of carp control.

Information delivery should therefore focus not on achieving high support for particular actions, particularly during development of the Plan when evidence about the potential risks, benefits and costs of these actions is being produced. Instead, it should focus on developing an appropriate level of understanding that increases awareness of the extent of the problem of carp invasion, and enables engagement in discussions about the arguments for and against controlling carp. This does not require high levels of technical information, but does require that in the process of developing the Plan, information provided to the general public includes discussion of benefits, costs and the arguments for and against

taking different types of action. This can better enable people to develop informed opinions that integrate these different forms of information, and can reduce risk of subsequent conflict.

For stakeholders with a strong interest, there is a need for active engagement that goes well beyond information delivery. In particular, actively involving stakeholders in developing measures to manage and mitigate potential negative impacts, and in developing measures to maximise positive impacts, will help build trust in and support for these actions. There is no single appropriate way to engage stakeholders, but the engagement opportunity should match their expertise and interests – in other words, be designed to ensure their knowledge, experience and concerns can be actively incorporated into processes of designing the Plan. For example, this means that any plans for biocontrol actions to help protect koi must be developed in direct collaboration with representatives of koi organisations and businesses, as otherwise there is unlikely to be confidence from the koi sector in the likely efficacy of these measures. Similarly, water providers need to be actively partnering in developing strategies to protecting and managing water quality, and native fish hatchery managers in developing any plans for restocking. The involvement of freshwater scientists and NRM professionals in identifying likely ecological response to carp reduction and potential actions to promote positive ecological recovery is essential to building trust in and subsequent support for these strategies. This type of direct involvement will better enable stakeholders to ultimately identify whether they will support implementation of the Plan.

This type of engagement can help ensure that the content and issues stakeholders expect to addressed in the Plan are engaged with actively throughout its development. This includes consideration of how to integrate different measures to control carp and to promote longer-term ecological restoration of areas affected by carp, development of detailed guidance on the planned timing and management of carp control actions, particularly virus release, identification of risks and how they will be managed and mitigated, including planning for worst-case scenarios, identification of potential social and economic impacts of carp control on specific groups and development of appropriate mitigation and management measures, and development of transparent and workable plans for governance, monitoring and evaluation of the carp control activities proposed in the Plan.

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8. APPENDIX 1: REGIONAL WELLBEING SURVEY QUESTIONS

This Appendix lists the Regional Wellbeing Survey questions analysed for this report. Note that the questions are not presented in the order in which they appeared in the survey: instead, they are organized by topic, showing those most directly related to carp and carp control first, followed by contextual questions used to identify the communities and groups with differing views about carp control.

Acceptability of different industries, land and water uses

Sometimes we find some land or water use practices more acceptable than others, and some industries and land and water management practices are more controversial in rural areas than others. What are your views?

How acceptable do you find the following activities in your LOCAL area? *If they don't currently happen locally, indicate how acceptable you would find them if they did occur*	**NOT AT ALL acceptable** ①	②	③	④	⑤	⑥	**VERY acceptable** ⑦	**Don't know**
Subdivision of agricultural land for 'rural residential' development (sometimes called 'hobby farming')	○	○	○	○	○	○	○	○
Establishment of 'solar farms' (large areas of solar panels)	○	○	○	○	○	○	○	○
Planting trees on good agricultural land for environmental purposes	○	○	○	○	○	○	○	○
Planting trees on good agricultural land to produce wood and paper products	○	○	○	○	○	○	○	○
Logging of native forests for wood production	○	○	○	○	○	○	○	○
Controlled burning to reduce bushfire risk	○	○	○	○	○	○	○	○
Reducing bushfire risk by removing vegetation with heavy machinery	○	○	○	○	○	○	○	○
Reducing numbers of carp (a pest fish) by releasing the carp herpes virus	○	○	○	○	○	○	○	○
Establishment of wind farms	○	○	○	○	○	○	○	○
Coal-seam gas extraction	○	○	○	○	○	○	○	○
Open cut mining	○	○	○	○	○	○	○	○
Underground mining	○	○	○	○	○	○	○	○
Regulations restricting farmers from clearing native vegetation	○	○	○	○	○	○	○	○
Growing of genetically modified crops	○	○	○	○	○	○	○	○
Using water for 'environmental watering'	○	○	○	○	○	○	○	○
Intensive livestock production e.g. chickens, pigs, feedlots	○	○	○	○	○	○	○	○

Are any of the following problems for the health of the environment in your local region at the moment?	**NOT a problem** ①	②	③	④	⑤	⑥	**VERY BIG problem** ⑦	**Don't know**
Environmental degradation in general	○	○	○	○	○	○	○	○
Salinity (in soil or waterways)	○	○	○	○	○	○	○	○
Water quality problems other than salinity, in rivers, lakes or waterways	○	○	○	○	○	○	○	○
Soil erosion	○	○	○	○	○	○	○	○
Poor soil health other than soil erosion e.g. soil compaction, loss of soil structure	○	○	○	○	○	○	○	○
Feral animals e.g. pigs, goats, wild dogs, rabbits	○	○	○	○	○	○	○	○
Pest fish species e.g. carp	○	○	○	○	○	○	○	○
Invasive weeds	○	○	○	○	○	○	○	○
Loss of vegetation (trees, shrubs)	○	○	○	○	○	○	○	○
Declining numbers of native fish	○	○	○	○	○	○	○	○
Declining numbers of some native animals or birds (other than fish)	○	○	○	○	○	○	○	○

Fishing

This year, we're asking a few questions of fishers. We're asking these as there's a lot of discussion about how fishing can support a person's health and wellbeing – and there's also discussion about how native fish populations are changing.

Do you spend time fishing (whether in freshwater, salt water, or both)?	◯ I've never gone fishing in my life ◯ I've gone fishing in the past, but not in the last year ◯ I went fishing once or twice in the last year ◯ In the last year, I went fishing once every month or so ◯ In the last year, I went fishing most weeks

If you have fished once or more in the last 12 months, please answer the next questions.

In the last 12 months, how often have you fished in the following?	**Never**	**Once or twice**	**3-10 times**	**More than 10 times**
Freshwater rivers or lakes - in my local region (within 2 hours drive of your home)	◯	◯	◯	◯
Freshwater rivers or lakes – a bit further away (more than 2 hours drive)	◯	◯	◯	◯
Saltwater fishing (ocean or beach)	◯	◯	◯	◯

How many years have you fished in this type of spot?	**<5 years**	**5-9 years**	**10-19 years**	**20 years or more**
At freshwater rivers or lakes in my local region (within 2 hours drive of your current residence)	◯	◯	◯	◯
At freshwater rivers or lakes – a bit further away (more than 2 hours drive)	◯	◯	◯	◯
In saltwater (ocean or beach)	◯	◯	◯	◯

In the last year, which of the following species have you targeted when fishing in freshwater areas?				**Over the last few years, do you think the numbers of this species in the places you fish are…**			
	Never target this species	**Occasionally target this species**	**Regularly target this species**	**Declining**	**Staying the same**	**Increasing**	**Don't know**
Murray Cod	◯	◯	◯	◯	◯	◯	◯
Golden Perch	◯	◯	◯	◯	◯	◯	◯
Other native fish species e.g. Silver Perch, Macquarie Perch	◯	◯	◯	◯	◯	◯	◯
Exotic fish species e.g. Trout, Redfin	◯	◯	◯	◯	◯	◯	◯
Murray Crayfish & Yabby	◯	◯	◯	◯	◯	◯	◯
Hyrtl's Tandan (Hyrtl's Catfish)	◯	◯	◯	◯	◯	◯	◯

Do you agree or disagree with the following?	**Strongly DISAGREE** ①	②	③	④	⑤	⑥	**Strongly AGREE** ⑦	**Don't know**
The health of native fish in my local rivers and lakes is pretty good	◯	◯	◯	◯	◯	◯	◯	◯
The average size of some of the native fish species I target has been declining over time	◯	◯	◯	◯	◯	◯	◯	◯
Carp numbers have been growing in recent years in some/all of the places I fish	◯	◯	◯	◯	◯	◯	◯	◯

Accessing information about land and water management

A lot of land and water management activities happen in rural areas, but it's not always easy to find out about them.

How do you prefer to access information about land and water management in your region?	Not preferred	Would use, but not the best way	Highly preferred	Don't know
Email sent to me	◯	◯	◯	◯
Website I can check every now and then	◯	◯	◯	◯
Letter or flyer sent to my letterbox	◯	◯	◯	◯
Local newspaper	◯	◯	◯	◯
Local NRM or conservation group e.g. Landcare, catchment group	◯	◯	◯	◯
ABC radio	◯	◯	◯	◯
Local radio other than ABC	◯	◯	◯	◯
TV	◯	◯	◯	◯
Farming organisations	◯	◯	◯	◯
Notices in local businesses/shops	◯	◯	◯	◯
Facebook	◯	◯	◯	◯
Twitter	◯	◯	◯	◯
Other (please describe) _____	◯	◯	◯	◯

What are your views about the community you live in?	Strongly DISAGREE ①	②	③	④	⑤	⑥	Strongly AGREE ⑦	Don't know
My community is a great place to live	◯	◯	◯	◯	◯	◯	◯	◯
This community has a bright future	◯	◯	◯	◯	◯	◯	◯	◯
I feel proud to live in this community	◯	◯	◯	◯	◯	◯	◯	◯
There's good community spirit around here	◯	◯	◯	◯	◯	◯	◯	◯
I like the environment and surrounds I live in	◯	◯	◯	◯	◯	◯	◯	◯
This is a safe place to live	◯	◯	◯	◯	◯	◯	◯	◯
There are attractive buildings/homes in my community	◯	◯	◯	◯	◯	◯	◯	◯
There are attractive natural places in my community e.g. parks, bush	◯	◯	◯	◯	◯	◯	◯	◯

What are your views about how the community you live in is changing?	Getting WORSE ①	②	③	④	⑤	⑥	Getting BETTER ⑦	Don't know
The liveability of this community is…	◯	◯	◯	◯	◯	◯	◯	◯
The friendliness of this community is…	◯	◯	◯	◯	◯	◯	◯	◯
The local economy is…	◯	◯	◯	◯	◯	◯	◯	◯
The local landscape and surrounds in this community are…	◯	◯	◯	◯	◯	◯	◯	◯

How are your local economy, government and community groups going at the moment?	Strongly DISAGREE ①	②	③	④	⑤	⑥	Strongly AGREE ⑦	Don't know
Living costs are affordable here e.g. food, petrol, housing	◯	◯	◯	◯	◯	◯	◯	◯
Local businesses in this region are doing pretty well at the moment	◯	◯	◯	◯	◯	◯	◯	◯
There are plenty of jobs available around here at the moment	◯	◯	◯	◯	◯	◯	◯	◯
This community is financially well-off	◯	◯	◯	◯	◯	◯	◯	◯
People around here are good at getting help and ideas from other communities	◯	◯	◯	◯	◯	◯	◯	◯
Whatever the problem, someone in this community takes the lead in sorting it out	◯	◯	◯	◯	◯	◯	◯	◯
Local groups and organisations here are good at getting things done	◯	◯	◯	◯	◯	◯	◯	◯
This community copes pretty well when faced with challenges	◯	◯	◯	◯	◯	◯	◯	◯

Most people get a fair go around here	○	○	○	○	○	○	○	○
My local government is able to help our community face challenges	○	○	○	○	○	○	○	○
The people who make decisions for my community represent the whole community, not just part of it	○	○	○	○	○	○	○	○
I can get involved in local decision-making processes if I want to	○	○	○	○	○	○	○	○
I would recommend my community to others as a good place to live	○	○	○	○	○	○	○	○

What's your community like for you?	**Strongly DISAGREE** ①	②	③	④	⑤	⑥	**Strongly AGREE** ⑦	**Don't know**
I feel welcome here	○	○	○	○	○	○	○	○
I feel part of my community	○	○	○	○	○	○	○	○
I feel like an outsider here	○	○	○	○	○	○	○	○
Some groups in this community keep to themselves	○	○	○	○	○	○	○	○
Some groups in this community aren't made to feel welcome	○	○	○	○	○	○	○	○
There is a lot of disagreement between people in this community	○	○	○	○	○	○	○	○

HOW OFTEN do you do the following things (no matter where the activities occur)?	**NEVER or almost never** ①	②	③	④	⑤	⑥	**ALL the time** ⑦
I spend time doing things with family members who don't live with me	○	○	○	○	○	○	○
I make time to keep in touch with my friends	○	○	○	○	○	○	○
I chat with my neighbours	○	○	○	○	○	○	○
I take part in sports groups or teams	○	○	○	○	○	○	○
I attend meetings/social events of local clubs/groups e.g. Lions, CWA	○	○	○	○	○	○	○
I attend community events such as farmers markets, community festivals	○	○	○	○	○	○	○
I go to arts or cultural events e.g. galleries, performances, music shows	○	○	○	○	○	○	○
I volunteer in my local community e.g. for groups like fire brigades, sports clubs, school canteen, meals on wheels, festivals	○	○	○	○	○	○	○

How good is your access to the following in your community?	**Very POOR** ①	②	③	④	⑤	⑥	**Very GOOD** ⑦	**Don't know**
General health services - GPs, general health consultation services	○	○	○	○	○	○	○	○
Mental health services e.g. psychologist, psychiatrist	○	○	○	○	○	○	○	○
Specialist health services (other than mental health)	○	○	○	○	○	○	○	○
Mobile phone coverage	○	○	○	○	○	○	○	○
Education e.g. schools, distance education, vocational training	○	○	○	○	○	○	○	○
Child care	○	○	○	○	○	○	○	○
Roads	○	○	○	○	○	○	○	○
Public transport (including taxis, buses, trains)	○	○	○	○	○	○	○	○
Professional services e.g. accountants, lawyers	○	○	○	○	○	○	○	○
Retail shops	○	○	○	○	○	○	○	○
Fresh fruit and vegetables	○	○	○	○	○	○	○	○
Affordable food	○	○	○	○	○	○	○	○
Aged care services e.g. retirement villages, in-home support	○	○	○	○	○	○	○	○
Banking and financial services	○	○	○	○	○	○	○	○

YOU AND YOUR LOCAL COMMUNITY

This section asks about where you live, and the type of place you live in. This helps us later produce results for individual communities, and for people who live in different places (for example, on a rural property versus in a town).

Where do you live? We ask this because we analyse and produce results for every community where enough people participate in the survey. To do this, we need to ask you where you live. We make sure to protect the privacy of our survey participants when we report results. *If you live in more than one place, please put in your primary residence*	**State / territory you live in:** *e.g. VIC, SA* _____ **Rural locality, town or suburb you live in:** _____ **Postcode you live in:** _____
Do you have more than one residence?	○ Yes ○ No
Is the place where you live most or all of the time *Select one*	○ In a town, suburb or village ○ On a rural property
How many years have you lived in your current community? *Include the total time, even if you've shifted houses within the same community*	Years: _____
How likely are you to shift to a new community in the next 12 months? *Select one*	○ Very unlikely ○ Unlikely ○ Neither likely nor unlikely ○ Likely ○ Very likely ○ Don't know

Part 2: Your health and wellbeing

The questions so far have mostly been about your community. This section asks about your health and wellbeing.

Thinking about your own life and personal circumstances, how satisfied are you with the following?	**Completely DISSATISFIED** ⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨	**Completely SATISFIED** ⑩
Your life as a whole	○	○	○	○	○	○	○	○	○	○	○
Your standard of living	○	○	○	○	○	○	○	○	○	○	○
Your health	○	○	○	○	○	○	○	○	○	○	○
What you are currently achieving in life	○	○	○	○	○	○	○	○	○	○	○
Your personal relationships	○	○	○	○	○	○	○	○	○	○	○
How safe you feel	○	○	○	○	○	○	○	○	○	○	○
Feeling part of your community	○	○	○	○	○	○	○	○	○	○	○
Your future security	○	○	○	○	○	○	○	○	○	○	○

	NOT AT ALL worthwhile ⓪	①	②	③	④	⑤	⑥	⑦	⑧	⑨	**COMPLETELY worthwhile** ⑩

Overall, to what extent do you feel the things you do in your life are worthwhile?	○	○	○	○	○	○	○	○	○	○	○

How would you rate your general health? *Select one*

○ Excellent ○ Very good ○ Good ○ Fair ○ Poor

How much do you agree or disagree with the following statements?	Strongly DISAGREE ①	②	③	④	⑤	⑥	Strongly AGREE ⑦	N/A
I am confident I can achieve the things I want in life	○	○	○	○	○	○	○	○
I am confident I can achieve the things I want in my work	○	○	○	○	○	○	○	○

In the last four weeks, how often have you felt…	None of the time	A little of the time	Some of the time	Most of the time	All of the time
Nervous?	○	○	○	○	○
Hopeless?	○	○	○	○	○
Restless or fidgety?	○	○	○	○	○
Depressed?	○	○	○	○	○
That everything was an effort?	○	○	○	○	○
Worthless?	○	○	○	○	○

If you are feeling distressed or need assistance, you can contact the following services for assistance, 24 hours a day:

Beyond Blue - 1300 22 4636 **Lifeline - 13 11 14**

Part 3: You and your household

We'd like to know a bit about you and your household. This information helps us understand if particular groups usually have higher or lower wellbeing, or are particularly vulnerable.

Do you identify as… *Select one*	○ Female ○ Male ○ Other e.g. gender fluid, inter-gender or don't identify with a gender ○ Prefer not to answer
How old are you?	Years: _____
How would you describe yourself? *Select one*	○ Australian-born ○ Born overseas in an English speaking country e.g. UK, New Zealand ○ Born overseas in a non-English speaking country e.g. China, France
Are you of Aboriginal or Torres Strait Islander origin? *Select all that apply*	○ No ☐ Yes, Aboriginal ☐ Yes, Torres Strait Islander
Which best describes you at the moment? *Select one*	○ Single ○ Married or de facto ○ Divorced or separated ○ Widowed
Have you completed any of the following formal qualifications? *Select **ALL** that apply*	☐ Year 12 of high school or equivalent ☐ Certificate or diploma from TAFE ☐ University degree (undergraduate or postgraduate) ○ None of these

In 2015-16, about how much was your <u>household</u> income <u>before</u> tax? *Select one* *This includes income earned by everyone in your household. Include income from government pensions, investments/dividends, and paid work. The categories below may look odd – they let us compare our survey results to those from the national census, so we can't change them.*	◯ Negative or nil income ◯ $1-10,399 ◯ $10,400-20,799 ◯ $20,800-31,199 ◯ $31,200-41,599 ◯ $41,600-51,999 ◯ $52,000-62,399	◯ $62,400-77,999 ◯ $78,000-103,999 ◯ $104,000-124,999 ◯ $125,000-155,999 ◯ $156,000-207,999 ◯ $208,000-259,999 ◯ $260,000 or more
Given your current needs and financial responsibilities, would you say that you and your family are... *Select one*	◯ Very poor ◯ Poor ◯ Just getting along	◯ Reasonably comfortable ◯ Very comfortable ◯ Prosperous
Are you currently receiving any Australian government allowance or pension? *Select all that apply*	◯ No, not currently ◯ Yes – Age pension ◯ Yes – Disability pension	◯ Yes – NDIS (for yourself or a person you care for) ◯ Yes – Study allowance ◯ Yes – Other
In the last year, did any of the following happen to you because you didn't have enough money? *Select all that apply*	☐ Had to delay or cancel non-essential purchases e.g. holiday, going to a restaurant or movie, buying clothes ☐ Could not pay bills on time e.g. electricity, rent, gas ☐ Went without meals, or was unable to heat or cool home ☐ Asked for financial help from friends or family ◯ None of these	

Work, study, caring, retirement – what do you do?

This section asks about whether you are retired, working, studying, a carer or unemployed. If you're working, we ask some questions about the type of work you do.

Which of the following describes your situation right now? *Select **ALL** that apply*	☐ Retired ☐ Unpaid carer (part or full time) ☐ Self-employed ☐ I have full-time paid work ☐ I have part-time paid work	☐ I have casual paid work ☐ Unemployed & looking for paid work ☐ Studying part-time or full-time ☐ Other (please describe below) _____
Are you involved in farming or work related to agriculture? *Select all that apply*	☐ No - I have never worked in farming or agriculture ☐ No - I used to manage/help manage a farm, but don't any more ☐ No - I used to work in an agricultural job other than managing a farm, but don't any more ☐ Yes - I own or co-own a farm business ☐ Yes - I manage a farm business (this can be in partnership with others) ☐ Yes - I assist in the management of a farm business (whether paid or unpaid) ☐ Yes - I am a farmhand ☐ Yes - I work in agricultural contracting ☐ Yes - I am in other agriculture-related work	

Do you earn salary or wages from any of the following industries other than agriculture (which we asked about above)? *Select all that apply*	☐ Mining ☐ Forestry ☐ Fishing ☐ Food/agricultural manufacturing ☐ Wood/paper manufacturing ☐ Other manufacturing ☐ Transport ☐ Building / construction	☐ Tourism ☐ Retail or hospitality ☐ Government ☐ Education ☐ Health, healthcare, social services ☐ Professional services e.g. banking, legal, accounting ☐ Other
Are you a business manager or owner? *Select all that apply*	) Not a business manager or owner ☐ Business manager or co-manager ☐ Business owner or co-owner	
What sort of work do you do? Please list your job/s *e.g. farmer, truck driver, sales, teacher*	Job type/s : _____	
If you have a spouse/partner who is in paid employment, what sort of work do they do?	Job type/s : _____	

9. APPENDIX 2: INTERVIEW TOPICS

This Appendix provides the full list of topics used to guide interviews with stakeholders. All people interviewed were provided with this list of topics prior to the interview, and asked to discuss each topic in as much or little detail as they wished.

Carp control: Interview topics

This document explains the topics that will be discussed about carp control, in interviews with a range of representatives of different groups and organisations. Before the topics are discussed, you will be asked if you have any questions about the information sheet or consent form. You do not have to discuss all the topics listed below – just the ones relevant for you/your organisation.

For those people who represent an organisation: Throughout the interview, you are invited to speak about your organisation's viewpoint, and your personal viewpoints as a person with experience, expertise or interest in issues related to carp control. However, we do ask that you clearly identify when you are speaking on behalf of your organisation versus about your personal views, to ensure we do not misunderstand the views of your organisation. In the following questions, the term 'you' can refer to your organisation or yourself personally, and we will ask you to specify which point of view you are expressing.

8) Could you tell me about yourself, and what aspects of freshwater management, freshwater ecosystems, and/or carp control are of interest for you/your organisation?

9) What do you feel are the current effects of carp in Australia's waterways (both good and bad)?

10) What measures do you think should be implemented to help control carp in Australia?

11) I'd like to ask for your views about the potential release of the carp herpes virus (other carp control measures will be discussed later)

   a) Would you say that overall you/your organisation support, oppose, or haven't yet made your mind up about the proposed release of the virus in Australia? What are the main reasons for support/opposition/being unsure?

   b) What are the potential positive outcomes from release of the carp virus for you/your organisation/people represented by your organisation? What could be put in place to help ensure these positive outcomes are achieved?

   c) What are the potential negative outcomes from release of the carp virus for you/your organisation/people represented by your organisation? What could be put in place to help avoid/reduce these negative outcomes?

   d) What are the potential positive outcomes from release of the carp virus for other people and groups? What could be put in place to help achieve these positive outcomes?

e) What are the potential negative outcomes from release of the carp virus for other people and groups? What could be put in place to help avoid/reduce these negative outcomes?

f) How much knowledge do you feel you have about the carp herpes virus (for example, do you have a little knowledge of it or a lot)?

g) What information have you accessed about the carp herpes virus? From what sources?

h) What kinds of additional information and evidence would you like to have about the virus and about any potential release of it in Australia?

i) Do you have other comments, observations, or concerns you would like to discuss?

12) What other types of carp control measures would you like to discuss? *(e.g. trapping, genetic biocontrol measures that alter genes of carp so they produce offspring of a single sex, commercial collection of carp, and installing carp exclusion screens or separation cages).* For each measure you nominate, we will ask you to comment on the same topics asked about in Q4.

13) What systems, processes, and governance do you think should be put in place for carp control activities?

14) Are there any other aspects of carp control you would like to discuss?

NATIONAL CARP CONTROL PLAN

The National Carp Control Plan is managed by the
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