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National Carp Control Plan socio-economic impact assessment: Native fish breeders and growers industry

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

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SUMMARY

In 2016 the Australian Government announced a \$15 million investment to develop the National Carp Control Plan (Plan). The Plan is being developed through research and consultation with stakeholders and community members. It focuses on evaluating the feasibility of releasing the carp virus Cyprinid herpesvirus-3 (referred to as the 'carp virus' from here) for reducing carp numbers. The Plan will be submitted to the Australian Government in December 2019, and the Government will draw on the Plan recommendations to make decisions about and to inform development of future carp control strategies.

Critical to the success of the Plan and use of its recommendations in subsequent carp control actions is support from the diverse range of stakeholders who depend on or have an interest in carp, freshwater health and fisheries, as well as from people living and spending time in the regions where carp control measures will be implemented. Researchers at the University of Canberra were commissioned to develop understanding of community and stakeholder attitudes across these areas and to evaluate anticipatory and potential socio-economic impacts of the Plan, focusing on potential use of the carp virus. This is one of several reports produced from this project. This report examines the potential socio-economic impacts of proposed carp control for the *native fish breeders and grower (native fish aquaculture) sector*.

This is the second edition of this report. At the time of this report, Plan research into feasibility of the carp virus was ongoing, and the actions that would be recommended for future carp control were not yet known. Given this, the focus of this report is on identifying *potential* impacts on the native fish aquaculture sector, the circumstances under which they could occur, and the types of actions that could increase potential for positive impacts and reduce risk of negative impacts. This follows best practice approaches to socio-economic impact assessment (SEIA), which recommends beginning SEIA as early as possible in order to ensure the design of a project or program incorporates consideration of social and economic impacts at all stages. This report does not attempt to quantitatively estimate potential impacts in terms of changes in numbers of jobs or economic activity. Instead the overall size of the sector is described as far as is possible together with its likely trajectory in the near future based on recent trends. This provides baseline information relevant to enabling assessment of impacts of future actions once they have been determined.

Thus, the impacts identified in this report should not be assumed to be 'likely' to happen as whether they occur, and to what extent, will depend on the nature and type of actions ultimately implemented as part of future carp control actions.

Methods

This report is based on i) research examining the size and nature of the industry, ii) phone interviews with native fish breeders and growers conducted between August and September 2018; iii) a stakeholder workshop held in November 2018, in Wagga Wagga, NSW; iv) a survey of community attitudes in 2019 that included questions assessing potential change in consumption of aquaculture products amongst Australian consumers related to carp control actions; and v) a multi-stakeholder workshop held in June 2019. A total of 12 members of this relatively small industry participated directly in the research (in interviews and workshops), while 4,428 members of the public participated in the survey of community attitudes.

Native fish aquaculture industry – existing conditions

Understanding the current size and nature of an industry's activities enables identification of the extent to which impacts on an industry have potential to flow-on to have broader impacts for the communities in which that industry operates, and the ability of the industry to adapt successfully to change.

Australia's aquaculture sector was valued at around \$1.35 billion dollars in 2016-17, for saltwater and freshwater aquaculture (Mosby 2018). Marine species account for most the production value with freshwater species accounting for approximately 6.7 per cent of Australia's aquaculture value for 2016-17 (ABARES 2017). As of 2016, approximately 1,100 people in total were employed on onshore aquaculture. Of those recorded as working in onshore aquaculture in the 2016 Census, 37% (approximately 407 people) worked in locations where carp have been recorded as present.

The inland native fish aquaculture sector is growing, although at differing rates depending on the part of the sector examined. Interviewees reported growing levels of foreign investment and collaboration, and rapid growth in export markets in recent years. However, despite this growth, they also reported limited public investment in research and development. Improvements in breeding and production technologies have largely been driven by private investment and experimentation at the operator level. The emerging status of the industry means there is high risk exposure associated with high levels of capital investment involved in business expansion, and with the exploratory nature of market relationships that have been established relatively recently as part of industry export growth.

At a national level, as part of the 2017 National Aquaculture Strategy eight priorities have been identified as central for supporting the growth and increased competitiveness of Australia's aquaculture industry. These priorities include promoting an efficient regulatory framework, conducting targeted research, developing and improving market access, understanding and managing biosecurity risk, improving public understanding of

aquaculture products, improving environmental performance of aquaculture, and promoting investment, training and education.

Several constraints to expansion of the industry were highlighted by participants in this research, including complex regulatory conditions, which can take a long time to navigate, challenges in the design of some restocking programs, limited public investment in research and development, and lack of industry coordination.

Impacts of developing the Plan

The period in which a proposed action is being developed, but when its exact nature is not yet known, is often associated with social and economic impacts for those who have potential to be impacted by the proposed action. In interviews, members of the native fish aquaculture sector were asked whether they experienced any impacts during the period in which the Plan was being developed. All participants indicated they had not experienced direct production or market-related impacts from the announcement of the Plan. However, in most cases, feedback from participants indicated people in the industry have experienced feelings of frustration and varying degrees of stress during the development of the Plan to date. This was primarily associated with: i) uncertainty about the future, ii) frustration with industry engagement, and iii) low trust in the Plan development process.

Potential impacts of the Plan

Participants were asked to discuss their concerns about potential impacts they would experience if the carp herpes virus is released. The most common impacts identified related to i) market impacts, ii) business costs and production, iii) native fish restocking and, iv) broader concerns associated with the carp virus.

Key topics discussed related to potential market impacts were concerned with: potential damage to Australia's 'clean-green' market brand and the associated price advantage in export markets; potential damage to consumer perceptions of food safety and quality of aquaculture products in domestic markets; potential for trade barriers for native fish aquaculture products; and potential for expanded business opportunities related to restocking.

The first concern, raised by most interviewees and discussed in both workshops, was that release of the virus had potential to reduce the 'clean, green' reputation that many export and domestic markets rely upon. This concern focuses on market perceptions of the impacts of the carp virus, rather than necessarily the actual impacts or risks presented by release of the virus. Participants reported they have been asked questions by their customers about issues such as whether the virus would be transmissible to humans, whether it would be transmissible to animals, and whether their products would still be 'healthy' if grown in areas where the virus was released in future. This indicated a high potential for negative

consumer reactions based on perceptions of health risks to consumers associated with the virus, or the 'cleanness' of the products being sold.

The subsequent survey of community attitudes conducted as part of this project investigated potential consumer reactions in more detail. It found that even when potential consumers are given clear statements confirming the safety of the virus in terms of transmissibility, 49% were concerned 'the virus could be transmissible to humans, despite research finding it is not', 57% were concerned about potential transmissibility to fish or animals other than carp, and 63% were concerned that releasing the virus would cause water quality problems. This suggests high potential for rapid formation of negative community perceptions about virus release, which have potential to flow on to choices made about consuming products from areas in which the virus is released. In particular, it suggests that reducing potential for negative impacts would require allocation of sufficient resources to the design and implementation of appropriate communication strategies to reduce misperceptions about risk of fish produced from areas in which the virus was released.

Currently, around 35% of Australians feel comfortable consuming fish caught or produced in inland waterways, while 38% do not, and 28% are neutral or unsure. This highlights that there is already reasonably high reluctance amongst a large group of consumers to consume local fish products grown in inland freshwater areas. Despite this, the native fish aquaculture industry has been successfully expanding markets, suggesting that it is effectively meeting the demand with those comfortable consuming fish. The community survey results suggest that, an active communication campaign is not implemented to reassure consumers, the virus release would likely be associated with some decline in willingness to consume aquaculture products. This would likely be no more than a one-third decline and is very likely to be a smaller decline than one-third, particularly if there is positive coverage that assists in reinforcing safety. Declines in demand are likely to be most acute in the short-term, with consumption returning over the longer term as the presence of the virus became 'normalised', unless large negative media coverage resulted in longer-term negative perceptions. These findings are indicative of the likely direction of consumer behaviour only, and likely to be different in reality depending on the extent of the 'intention-behaviour gap' as well as on the extent and effectiveness of communications about virus release and the effect of this on demand for aquaculture products.

In addition to changes in market demand resulting from shifts in consumer perception, there is potential for changes in market demand associated with transport or export restrictions or other regulatory change associated with biosecurity concerns. Associated with this, there is potential for increases in business costs in response to meeting requirements for introduction of new biosecurity measures. Many of these concerns were underpinned by concern that native fish, and the water they are transported in, may be carriers of the virus. The extent to which these would be issues that impacted the industry

depends on the length of time the virus remains viable in water, the length of time virus particles can remain active when transported on other species, and the costs of any biosecurity measures that need to be implemented in order to address these risks. These are areas being investigated in separate Plan projects to this one.

Several participants were concerned that release of the virus could result in other countries placing restrictions on the importation of inland aquaculture products from Australia. This concern does not emerge solely from concerns about actual biosecurity needs, but more from concern that negative perceptions may drive responses that go beyond what is needed to maintain safety from the virus.

Many of the countries native fish aquaculture businesses export to, such as China and Japan, already have the carp herpes virus. However, this does not mean these countries are likely to have lower concern. Japan and China both have extensive carp aquaculture industries and they have been reported to have strong emphasis with international customers on reducing risk of spreading the carp virus to reduce new outbreaks and to assist in efforts to contain the carp herpes virus. Additionally, some stakeholders have reported that their international customers hold a misperception that Australia is considering introducing a more virulent strain of the carp herpes virus. The concern is that perceptions such as this have the potential to dramatically affect trade even if they are unsubstantiated.

Imposition of trade or sale restrictions is the most severe type of potential impact identified by participants, followed by reductions in consumer demand. When asked how the risk of these impacts could be reduced, most identified similar actions. The first was implementing cost-effective biosecurity measures that clearly and demonstrably ensure safety of produce. The second was proactive and clear communications with markets, including investment in maintaining and strengthening relationships with international customers with support from the Australian government in the form of clear advice on biosecurity protections in place to ensure safety of product. The third was careful design of communications around virus release to reduce risk of long-term negative impacts on consumption: this requires ongoing investment to ensure that negative media images of events such as fish kills are followed by clear information on recovery of water quality and waterways, and safety of aquaculture produce.

Several participants were concerned that they may experience increased business costs, and complexity of production if the carp virus was released. This could result from growth in costs relating to water treatment, biosecurity measures, and assessment to meet 'virus-free' export requirements and domestic food safety regulations, as well as increases in production complexity and cost due to impacts on water quality and on native fish, particularly availability and health of brood stock.

Currently minimal water treatment technology is required in the aquaculture industry. Several industry representatives felt that investing in water treatment infrastructure is unlikely to be financially or logistically feasible for many of those reliant on pumping from natural water systems. This concern was in part driven by lack of information on what requirements the infrastructure would need to meet in terms of filtration, with stakeholders reporting a varying range of perceptions about what technologies and processes would be needed.

Poor water quality events can have a negative impact on native fish numbers in the wild, and this can impact brood stock the aquaculture industry relies on. If the population of wild brood stock are impacted this could have significant impacts on aquaculture production, particularly if (as has happened in some locations as a result of past poor water quality events) it takes several years for mature native fish stocks to recover.

As noted earlier, a large investment is being made in the Plan in investigating whether and what types of risks release of the virus would have for water quality, and this large body of work will inform its recommendations. The concerns raised by stakeholders and documented in this report support the importance of that assessment and highlight its importance to understanding whether and what types of socio-economic impacts may occur.

When asked about what positive impacts could result for the industry from release of the virus or carp control more generally, several identified the potential for the sector to contribute to restocking efforts after a reduction in carp. All wanted involvement in this, not simply as a business opportunity, but as an opportunity to contribute to improving environmental health in ecosystems they are strongly connected to and care about. For this opportunity to be realised, forward planning is needed to identify the types of species and volumes likely to be required, and to enable aquaculture businesses to invest in expanding or changing their production as needed, including obtaining relevant permits. Additionally, any restocking program would need to be designed effectively to ensure it was feasible for businesses to participate. This requires ensuring transaction costs such as number of individual contracts required, legal liability of aquaculture businesses, and responsibility for transporting fish for release, are designed appropriately to ensure it would be financially feasible for businesses to participate.

Recommendations

Based on the assessment in this report, the following actions should be considered as part of future carp control strategy development and implementation to reduce potential for negative impacts on the aquaculture sector and increase potential positive impacts:

- Provide clear advice on the likely timelines for future decision making about carp control and timing of implementation of carp control actions. This enables aquaculture businesses to better plan for the future, including assessing whether they should make

business investments they are currently planning. Associated with this, providing regular updates on progress of decision-making processes is important to improve levels of certainty and support ability to make business decisions.

- Invest in ensuring key questions creating uncertainty for the industry, such as questions on how long the virus remains viable in water or when present on native fish species, and risk of adverse water quality events affecting availability of brood stock, can be answered at a level of detail that enables improved certainty for the industry.
- Invest in identifying regulatory implications of carp control actions to be implemented, whether release of the virus or others. Aquaculture businesses require clear advice on the specific biosecurity requirements they will need to meet, batch testing, water treatment and any other measures. Once regulatory implications are known, conduct an assessment of their cost impacts on businesses and identify level of investment needed in assisting businesses cope with any cost impacts, specifically whether there is a need for support such as low interest loans or grants to invest in infrastructure, or a need to invest in research developing lower cost tests for virus-free status.
- Ensure sufficient resources are invested in communications to consumers of aquaculture products as part of carp control strategies. Develop appropriate campaigns to maintain consumer confidence in consumption of produce: this has high potential to offset any decline in consumption related to negative perceptions of produce grown in areas in which the carp virus would be released.
- Invest in early marketing and diplomatic strategies into export markets to reduce risk of impacts from future carp control actions, specifically release of the virus if a decision is made to release.
- Make decisions about restocking early. Following a decision to include restocking, invest in assessing capacity of the industry to supply the required species and volumes, and identifying lead times required to achieve the necessary levels of restocking. Ensure need to also supply the recreational fishing sector is factored into this assessment. Use appropriate programs and processes to contract businesses for restocking, ensuring regulatory conditions are clear and businesses are given an appropriate operating environment.
- Ensure future carp control strategies include appropriate contingency measures for worst case scenarios, which ensure protection of wild native fish in particular
- Provide assistance to those whose business activities are reduced, and, where needed, to support transition to new business activities or employment.

1. INTRODUCTION

THE NATIONAL CARP CONTROL PLAN

In 2016 the Australian Government announced a \$15 million investment to develop the National Carp Control Plan (Plan). The Plan is being developed through research and consultation with stakeholders and community members. It focuses on evaluating the feasibility of releasing the carp virus Cyprinid herpesvirus-3 (referred to as the 'carp virus' from here) for reducing carp numbers. The Plan will be submitted to the Australian Government in December 2019, and the Government will draw on the Plan recommendations to make decisions about and inform development of future carp control strategies.

STAKEHOLDER AND COMMUNITY SUPPORT

If the carp virus is found to be a feasible strategy for reducing carp numbers, it would potentially be delivered over a large geographic area, in waterways and waterbodies that are essential to Australia's traditional owners, primary industries, household water consumption, and millions of recreational users each year.

Critical to the success of the Plan and any subsequent use of its recommendations in carp control actions is widespread support from the diverse range of stakeholders who depend on or have an interest in carp, freshwater health and fisheries, as well as from people living and spending time in the regions where carp control measures will be implemented.

Support for the recommendations made in the Plan, and for action to control carp more broadly, will depend on a range of factors, including:

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

Researchers at the University of Canberra have been commissioned to develop understanding of community and stakeholder attitudes across these areas and to evaluate anticipatory and potential socio-economic impacts of the Plan, focusing on potential use of the carp virus, while also examining views and preferences about carp control more broadly. This work aims to inform development of recommendations that will have support from communities and stakeholder groups, through guidance on how these actions could be

designed in ways that appropriately address the needs, concerns and priorities of community and stakeholders.

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

The University of Canberra project focuses on:

- Identifying and understanding stakeholder and community needs, concerns and expectations regarding carp control, so these are considered throughout the development of the Plan and integrated in the recommendations under 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 measures to reduce negative and maximise positive socio-economic impacts, and
- Understanding the types of information, consultation and engagement needed by different stakeholders in the process of developing the Plan.

This work is being used to inform both the process used to develop the Plan (including communication, consultation and engagement with stakeholders and communities) and the content of the Plan. The work will inform evaluation of the feasibility of carp virus and strategies for minimising negative and maximising positive impacts of any carp control actions recommended in the Plan.

This project will also identify a framework for ongoing monitoring and evaluation of socio-economic impacts and community attitudes into the future beyond the life of this project. This will facilitate capacity for rapid identification of actions needed to address community and stakeholder concerns during any future implementation of the Plan recommendations.

The project has included a focus on identifying stakeholder concerns, views and needs, and identifying the potential impacts of releasing the virus on different groups. An initial round of phone interviews was conducted in 2017 with 23 representatives of stakeholder groups with differing interests in carp control. This included representatives of 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. A second round of stakeholder interviews was conducted in 2018 and a multi-stakeholder workshop in June 2019.

The initial round of interviews provided a baseline understanding of the views of stakeholders at the early stage of the Plan development. In the interviews most stakeholders expressed *conditional support* for the Plan, meaning they would 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.

In these initial interviews, it was identified that stakeholder support for any future carp control strategy was contingent upon the strategy including the following elements:

- 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 and appropriate mitigation of potential social and economic impacts of carp control on specific groups
- 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.

When discussing the recommendations being developed in the Plan, stakeholders also clearly identified a need to be able to engage with scientists undertaking research for the Plan, and in particular to be able to discuss and provide their views on the emerging findings of Plan research. To enable this, in June 2019 a workshop was organised in which stakeholders were both provided with presentations on emerging findings and discussed these findings as well as their views on implications of the emerging findings for future carp control action.

PROJECT REPORTS

This project includes several areas of investigations. These are being produced as separate reports and as chapters of reports for the overall project, in the following form:

- Getting the National Carp Control Plan right: Ensuring the Plan addresses community and stakeholder needs, interests and concerns (stand-alone report, also included as appendix to the Final Report for FRDC Project 'Carp Control: Understanding community and stakeholder attitudes and assessing social effects')
- Ensuring carp control is socially acceptable: Understanding key factors likely to influence social acceptability of carp control measures (journal paper prepared, with key findings also summarised in Final Report for FRDC Project 'Carp Control: Understanding community and stakeholder attitudes and assessing social effects')

- Stakeholder engagement recommendations for the National Carp Control Plan. Rather than being published as a separate report, this work was integrated directly into the Plan's stakeholder engagement and communications strategies over time (A summary of the work conducted is included in the Final Report for FRDC Project 'Carp Control: Understanding community and stakeholder attitudes and assessing social effects')
- Socio-economic impact assessment: potential impacts and negative impact mitigation strategies for (a) commercial/contract carp fishers, (b) tourism-dependent businesses, (c) native fish breeders and hatcheries, (d) the koi industry and, (e) recreational fishing sector (these have been produced as stand-alone reports, with earlier versions of the first four also included as Appendixes to the Final Report for FRDC Project 'Carp Control: Understanding community and stakeholder attitudes and assessing social effects', and the final versions of all five included as Appendixes to the Final Report for FRDC Project 'NCCP: Socio-economic impact assessment and stakeholder engagement').
- Engaging with the National Carp Control Plan: summary of a stakeholder workshop (stand-alone report, also included as Appendix to the Final Report for FRDC Project 'NCCP: Socio-economic impact assessment and stakeholder engagement')
- Monitoring socio-economic impacts and community attitudes: A framework for ongoing monitoring of the National Carp Control Plan (included in the Final Report for FRDC Project 'Carp Control: Understanding community and stakeholder attitudes and assessing social effects').
- Issues Paper: Understanding potential social and economic impacts of carp control. This was produced as a stand-alone paper, and summarises key findings across all the work regarding potential socio-economic impacts of reducing carp using release of the carp virus.

THIS REPORT

This report examines potential socio-economic impacts of carp control for native fish breeders and growers in Australia. Throughout the report this stakeholder group will be referred to as the 'native fish aquaculture' sector, although the stakeholders are diverse and not only include commercial table fish aquaculture enterprises but also aquaponics farmers and native fish breeders and growers who focus on native fish restoration.

As discussed earlier, this report is one of five examining potential impacts of the Plan for different groups. Each of the five reports uses a similar approach, and some text about impact assessment is repeated in each report so each can be read as a 'stand-alone' document.

This report was prepared while the Plan was engaged in ongoing research evaluating feasibility of use of the carp virus, and before decisions had been made about optimal

approaches to future carp control. This means that the exact actions to be implemented in future to reduce carp numbers were not yet known. Given this, the focus of this report is on identifying *potential* impacts, the circumstances under which they could occur (and which they would not occur under), and the types of actions that could be implemented as part of future carp control strategies in order to increase potential for positive impacts and reduce risk of negative impacts. The intent is to identify potential impacts so they can be considered and addressed as part of the design of the Plan with the goal of preventing or mitigating negative impacts and providing opportunities for positive impacts where possible. Thus, the impacts identified in this report should not be assumed to be 'likely' to happen as whether or not they occur, and to what extent, will depend on the nature and type of actions ultimately implemented as part of future carp control actions.

This approach to early assessment of potential impacts follows best practice approaches to socio-economic impact assessment (SEIA), which recommends conducting SEIA as an ongoing process that starts before a decision is made so that initial SEIA can inform decisions made about the types of actions to proceed with (Esteves et al. 2012, Schirmer 2017). This is different to traditional impact assessment, which is often undertaken after a proposed set of actions have been finalised - a point at which it is more difficult to make meaningful changes that can prevent or mitigate impacts (Esteves et al. 2012). It addresses concerns such as those raised by Momtaz and Gladstone (2008), who found that negative impacts experienced by fishers from estuarine management introduced by the NSW government could have been reduced if improved impact assessment and consultation processes had occurred during the process of developing the management actions.

A first edition of this report was produced based on initial interviews and a workshop with those in the native fish aquaculture sector. This was followed by further work assessing the potential for changes in consumer behaviour, using public survey, and a multi-stakeholder workshop. This second edition reports the additional work, and provides more detailed recommendations regarding actions to reduce risk of negative impacts and increase potential for positive impacts.

This report should be read as an early impact assessment produced to inform Plan development. It includes key questions and identifies important areas of assessment that are needed as the Plan is developed. As it is intended to inform development of the Plan and is not an assessment of the impacts of the Plan: once the specific actions to be included in the Plan are finalised, a formal assessment of their potential impacts should be undertaken.

The assessment has not attempted to quantitatively estimate potential impacts in terms of changes in numbers of jobs or economic activity as the specific actions to be recommended in the Plan, and ultimate decisions made by government about carp control were not known at the time of preparation. Instead, the overall size of the sector is described as far as is possible together with its likely trajectory in the near future based on recent trends. This

provides baseline information relevant to enabling assessment of impacts of future actions once they have been determined.

The report first briefly explains the key areas examined. This is followed by a description of assessment methods applied. Findings are then presented, with a focus on understanding (i) current status, constraints and opportunities for the native fish aquaculture sector, (ii) impacts of the announcement of the Plan development, (iii) potential impacts of carp control, and (iv) priority areas for further assessment. Finally, next steps for the impact assessment and responding to findings presented in this report are described.

2. SOCIO-ECONOMIC IMPACT ASSESSMENT

Impact assessment can mean different things to different people. This section explains the approach taken in this report, and why this approach is being used at this point of the Plan development.

As noted earlier, best practice in impact assessment involves assessment prior to decisions have been made about a course of action. This increases the scope of proponents to design their proposed action in ways that prevent or mitigate negative impacts and provide opportunities for positive impacts (Vanclay and Esteves 2011; Arce-Gomez et al. 2015). In addition, commencing impact assessment prior to final decisions allows it to form a central part of the decision-making process. When being undertaken along-side the decision-making process, participatory approaches should be used where the people or groups who are potentially impacted have opportunities to contribute to assessment of feasibility of the proposed actions, their potential impacts and to identify prevention and mitigation measures (Vanclay and Esteves 2011; Arce-Gomez et al. 2015).

This report examines four key areas important to early impact assessment that can then inform development of proposed actions:

- Current status, conditions, constraints and opportunities for the native fish aquaculture industry, including baseline trends in size and growth of the industry
- Impacts of the development phase of the Plan on the industry
- Potential impacts of implementation of carp control
- Broader industry concerns about potential impact and Plan development, and
- Recommendations for actions to reduce negative and increase positive impacts as part of future carp control actions.

ASSESSING EXISTING CONDITIONS

Existing conditions, constraints and opportunities experienced are an important starting point for impact assessment as they influence how a policy, program or project can impact

people and businesses (Schirmer 2011, Loxton et al. 2013). This part of assessment is important for two key reasons.

First, understanding the current size and nature of an industry's activities enables identification of the extent to which impacts on an industry have potential to flow-on to have broader impacts for the communities in which that industry operates.

Second, the influence of existing conditions on the ability of people, businesses and communities to adapt successfully to change is well recognised in literature across a range of contexts including climate change adaptation (e.g. Loxton et al. 2013). For example, a farmer experiencing drought may be less able to cope with reforms to water access, compared to one who is experiencing normal rainfall conditions (e.g. Schirmer 2017). This principle is applicable to assessment of the potential effects of the National Carp Control Plan. For example, if businesses are experiencing a change in markets, or expanding or contracting prior to implementation of the Plan, there may be less capacity to adapt to any new conditions that may arise.

ASSESSING IMPACTS OF DEVELOPING THE PLAN – 'ANTICIPATORY IMPACTS'

Many policies, programs and projects can have relatively long development phases which can, themselves, have important 'anticipatory' social and economic impacts. During the development phase of a program, even though it is not known exactly how the proposed action will impact, it is known there is potential for impacts to occur (see for example Loxton et al. 2012, 2013, 2014; Schirmer 2017).

A person anticipating a change they feel is likely to affect them may experience a range of associated impacts which can include mental health impacts such as anxiety and stress-related health problems. These can result from experiencing uncertainty about the future, and associated challenges with decision-making. Major life decisions such as getting married, having a child, or purchasing a house or car may be delayed as a result of uncertainty. Those who manage businesses can find it harder to obtain finance or maintain loans if financial institutions are aware a proposed action may have potential negative impacts on the business in the future. They may also experience changes in their markets as customers switch to other providers in anticipation of the action being proposed (Loxton et al. 2012, 2013, 2014).

'Anticipatory' impacts can be significant and create long-lasting impacts for households and businesses. It is therefore critical to understand how the announcement of the Plan has affected people and businesses involved in the native fish aquaculture industry, and to identify any actions that can be implemented to reduce potential negative impacts during the development of the Plan.

POTENTIAL IMPACTS OF CARP CONTROL

As noted earlier, implementing actions to control carp has potential to cause social and economic impacts – positive and negative – for different native fish aquaculture businesses. This report identifies potential impacts with a focus on understanding the conditions under which they could occur and actions that could increase likelihood of positive impact and reduce likelihood of negative impact.

BROADER INDUSTRY CONCERNS ABOUT POTENTIAL IMPACT AND PLAN DEVELOPMENT

In the interviews and workshops with the native fish aquaculture sector participants raised questions and concern about the proposed carp control under the Plan beyond those that were directly related to impacts on their sector. These are questions and concerns this group would need answered to be able to decide on their support for specific future carp control actions. This is also important for understanding willingness to accept negative impacts: past studies have documented that many groups are willing to accept some level of negative impact (usually temporary and not threatening their overall household or business viability) if they believe the actions being taken are ‘worth it’ – in other words, that they will achieve longer-term positive outcomes than justify the shorter-term negative impacts (see for example Gross 2008, 2011). This report includes discussion of the broader questions and concerns that were raised by participants to examine these aspects of willingness to accept impact in more depth.

The report provides recommendations for reducing risk of negative impact and increasing potential for positive impacts, ensuring any negative impacts are ‘worth it’ in the form of long-term positive outcomes for either the native fish aquaculture or freshwater and estuary health more generally.

3. METHODS

This report is based on the following research: phone interviews with native fish breeders and growers conducted between August and September 2018; a stakeholder workshop held in November 2018, in Wagga Wagga, NSW; a survey of community attitudes in 2019 that included questions assessing potential change in consumption of aquaculture products amongst Australian consumers related to carp control actions, and; a multi-stakeholder workshop held in June 2019.

INDUSTRY PARTICIPANTS IN STUDY

It was important in this initial assessment that a diversity of representatives across the industry were consulted to ensure the full range of potential impacts could be identified.

The potential participants identified were those most likely to be directly impacted by the implementation of carp control measures, which included owners or managers of businesses involved in native fish breeding and conducting their business activities (either growing or sale of fish) in areas affected by carp.

Participants included the following:

- Native fish hatcheries and growers operating in carp affected areas supplying domestic and export markets for both table fish and aquarium markets.
- Freshwater native fish hatcheries and growers supplying native fish for river restocking for both restoration and recreational angling purposes.

Participants were identified in the following ways: i) search of state-government fisheries and aquaculture websites; ii) circulation of an email invite to all aquaculture licence holders via state-government fisheries agencies; iii) circulation of an email invite via industry associations for states where they are operating (i.e. NSW and QLD) and, iv) Referrals from interviewees.

The participant sample is outlined in Table 1 with type of operation and species identified. Eight people participated in a phone interview, four of which also attended the workshop. An additional four people who did not participate in a phone interview attended one or both workshops. Therefore, this report is based on input from 12 industry representatives. The representation across states is as follows: NSW (6), VIC (3), SA (2), QLD (1). Participants have not been identified by state or territory in Table 1 for anonymity reasons.

The participants were representative of the diversity of operators in the sector, including hatchery-only operators, grow-out only, integrated hatchery-grow-out operations and aquaponic systems. The native fish species produced by participants included those targeted for table fish (domestic and export markets) and recreational fishing as well as small-bodied native fish species for both restoration the aquarium market (domestic and export).

Most business owners interviewed had mixed revenue sources, for example, table fish and restocking, or aquarium trade and restocking. However, there were some businesses that relied on restocking only. In all cases breeding for restocking stocking was an important revenue stream for businesses, including the integrated hatchery/grow-out businesses.

Table 1 Interview sample

Type of operation	Species	Market	Number of participants
Hatchery-only			
Aquarium fish	Pygmy perch Australian rainbowfish	Domestic & export	2
Research-based breeding for restoration	Macquarie perch Trout cod	Domestic	1
Table fish restocking for restoration or angling	Murray Cod Sliver Perch Golden Perch Sooty Grunter Sleepy cod	Domestic	4
Table fish fingerlings for grow-out & aquaponics	Murray cod Sliver Perch Golden Perch Jade Perch Catfish Sooty Grunter Sleepy cod	Domestic & export	4
Grow-out only			
	Silver Perch Barramundi	Domestic	1
Integrated hatchery and grow-out			
Table fish	Murray cod only	Domestic & export	3
Table fish fingerlings for restoration or angling	Murray cod only	Domestic	3
Table fish	Yabbies	Domestic	2
Integrated hatchery, grow-out and aquaponics			
Table fish	Yabbies Marron	Domestic	2
Total number of participating businesses			11
Total number of participants			12
Industry association reps. interviewed	n/a	n/a	3

INTERVIEW AND WORKSHOP TOPICS AND ANALYSIS

In phone interviews questions were asked on the topics outlined in the list below (see Appendix 1 for a detailed list of interview questions):

- History of working in or representing the native fish aquaculture industry
- Effects of the announcement of development of a National Carp Control Plan on business and household
- Views about the control carp methods
- Views about proposal to release the virus and potential impacts of release on own business and industry more generally
- Views on potential strategies to avoid or mitigate potential impacts

The one-day workshop held in Wagga Wagga involved facilitated discussion to expand on the key areas of potential impact identified in the phone interviews. The workshop attendees were also invited to identify any other topics they wished to discuss. The workshop agenda is presented in Appendix 2.

The multi-stakeholder workshop held in June 2019 covered a range of topics, reported in detail in a separate report (see Schirmer et al. (2019) for a detailed description of that workshop, attendees, and topics). In this report, we draw on only those aspects of the June 2019 workshop which involved discussion of topics relevant to aquaculture, which principally involved discussion of restocking after a reduction in carp control, and of potential regulatory and market impacts if the virus was released.

All interviewees provided permission for interviews to be recorded. The recordings were then transcribed. The first workshop was not audio recorded and instead detailed notes were taken on the day electronically and on butcher's paper. In the multi-stakeholder workshop, some discussion sessions were audio recorded. The transcripts and workshop notes were reviewed and thematically coded with a focused on identifying socio-economic impacts and the circumstances under which they arise, and factors affecting the extent to which impacts would occur. Themes around mitigation of potential negative impacts were also explored.

COMMUNITY ATTITUDE SURVEY

In May 2019, an online survey was conducted to track community perceptions about carp control, with 4,428 respondents. As part of this survey, a small number of questions were asked which tested potential consumer reactions to carp control if carp numbers were reduced via release of the carp virus. Rather than ask questions directly about the carp virus, something which could trigger negative responses due to high 'anticipatory impacts', the survey asked about likely changes in behaviour in response to existing scenarios that have occurred in inland waterways involving loss of water quality or fish diseases. This ensured that the survey data could provide insight into consumer responses to the types of water quality events that have some potential to occur after release of the virus in the short-term, as well to diseases known to be present currently.

The survey sample was recruited via the Qualtrics online survey panel provider service. The sample was stratified by state and territory, and within each state (but not territories) was stratified again based on whether the resident lived in a capital city or elsewhere in the state. The survey questions are described when results are presented.

ETHICS

Data collection via interviews, workshops and survey was approved by the University of Canberra Human Research Ethics Committee, protocol number HREC 17-152.

4. NATIVE FISH AQUACULTURE INDUSTRY: EXISTING CONDITIONS

As noted earlier, part of the impact assessment included exploring existing conditions and current size and trends in the native fish aquaculture sector. This supported understanding of the extent and nature of potential impacts, and the capacity of the sector to cope with change.

CURRENT OPPORTUNITIES FOR AN EXPANDING SECTOR

Australia's aquaculture sector was valued at around \$1.35 billion dollars in 2016-17, for saltwater and freshwater aquaculture (Mosby 2018). Marine species account for most the production value with freshwater species accounting for approximately 6.7 per cent of Australia's aquaculture value for 2016-17 (data from Table 17¹, ABARES 2017).

Estimates of the employment generated by aquaculture in Australia vary. Using data from the Australian *Labour Force Survey*, Mobsby (2018) estimated that in 2016-17 a total of 8,352 people were employed in Australian aquaculture in total, while the 2016 Census of Population and Housing estimated only 3,972 (ABS 2016). Neither of these estimates includes employment in seafood processing, much of which would depend on aquaculture-grown inputs. The Census indicated a total of 1,536 people were employed in all types of seafood processing across Australia in 2016 (this category includes both freshwater and saltwater processing).

The small sample of people in aquaculture in the *Labour Force Survey* mean it is more prone to errors in estimates of employment by industry compared to the Census, but the Census has been identified as undercounting some employment. This suggests the actual employment figure is likely to be higher than indicated in the Census, but lower than indicated in ABARES data for 2016-17.

Census data also identifies where people were employed across different types of aquaculture. The 2016 Census identified the following:

- 913 people employed in on-shore aquaculture across Australia
- 1,406 employed in offshore longline and rack aquaculture
- 912 employed in offshore caged aquaculture, and
- 737 people employed in 'aquaculture not further defined', some of whom would be employed in onshore aquaculture.

¹ Data for freshwater aquaculture includes, silver perch, barramundi, yabby, marron, and other which includes eel, other native fish and aquarium fish.

If we assume the 737 people employed in 'aquaculture not further defined' were spread proportionally across different aquaculture sectors² this would mean an additional 208 people worked in onshore aquaculture. This suggests approximately 1,100 people in total were employed on onshore aquaculture as of 2016.

We overlaid the 2016 Census data with data on spatial distribution of carp in Australia. This indicated that of those recorded as working in onshore aquaculture in the 2016 Census, 37% (approximately 407 people) worked in locations where carp have been recorded as present (ABS 2016).

Inland native aquaculture is a relatively small component of the aquaculture industry in Australia, however, some parts of it are growing rapidly. For example, in NSW Murray cod aquaculture production grew by 212 per cent between 2013-14 and 2017-18, from 85.3 tonnes to 265.9 tonnes. The total market value has increased over this same period from \$1.44 million to \$4.89 million (represented in nominal terms) (NSW DPI n.d.). This is consistent with aquaculture in Australia more broadly; aquaculture has been identified as Australia's fastest growing primary industry (FAO 2018), with employment in aquaculture growing by 18% between 2011 and 2016 (ABS 2011, 2016), including growth of 15% in employment in inland aquaculture during this period. Some of the key factors driving the expansion in aquaculture include increasing demand for fish protein across domestic and export markets and increased profitability made possible by technological improvements (DAWR 2017).

In interviews, industry stakeholders also noted that an increase in the relative price of many sources of animal protein relative to aquaculture products is another factor driving increasing demand for aquaculture products across domestic and international markets.

The inland native fish aquaculture sector is growing, although at differing rates depending on the part of the sector examined. Interviewees reported growing levels of foreign investment and collaboration, and rapid growth in export markets in recent years. However, despite this growth, they also reported limited public investment in research and development. Improvements in breeding and production technologies have largely been driven by private investment and experimentation at the operator level. The emerging status of the industry means there is high risk exposure associated with high levels of capital investment involved in business expansion, and with the exploratory nature of market relationships that have been established relatively recently as part of industry export growth.

² That is proportions of: 44% employed in offshore longline and rack aquaculture, 28% in offshore caged aquaculture and 28% in onshore caged aquaculture

The current expansion in inland native fish aquaculture industry is important to consider in this impact assessment. The emerging status of the industry means there is both high risk exposure arising from high levels of capital investment involved in business expansion, and risk associated with the relatively new and exploratory nature of many market relationships that have been established relatively recently as part of industry growth.

At a national level, further expansion of Australia's aquaculture sector has been identified as a key opportunity in the 2017 National Aquaculture Strategy. The Strategy sets out priority actions to achieve an increase in the annual value of the aquaculture industry to two billion dollars by 2027 (DAWR 2017). The Strategy was developed in consultation with state and Northern Territory governments and involved extensive industry consultation. The eight priorities identified as central for supporting the growth and increased competitiveness of Australia's aquaculture industry in the Strategy, outlined in the 2017 National Aquaculture Strategy (DAWR 2017, p.4), are:

1. Promoting an efficient regulatory framework modelled on established best practice that is transparent and removes unnecessary burden on business
2. Maximising the benefits of innovation in aquaculture through targeted research, development and extension
3. Developing and improving market access for Australian aquaculture products domestically and internationally, capitalising on Australia's clean and green image
4. Understanding and managing the biosecurity risks through a coordinated approach to protect the aquaculture industry and the Australian environment
5. Improving public perception and understanding of Australian aquaculture as a sustainable industry producing safe and healthy products
6. Continuing to improve the environmental performance of aquaculture, including identifying opportunities for optimising environmental performance through adoption of cost-effective strategies
7. Encouraging and promoting investment in Australian aquaculture, and
8. Improving training and education for the aquaculture workforce and ensuring future employment needs of the industry are met.

This highlights that it is important to consider potential impacts of carp control on areas such as regulatory burden, market access, biosecurity risk, public perceptions and investment in the sector.

The Department of Agriculture and Water Resources (DAWR 2016) identified Australia's strong reputation around food safety as being the foundation for continued expansion of the aquaculture industry:

Australia has established a reputation as a supplier of safe, high quality seafood which is produced using environmentally sustainable practices. Australian

aquaculture producers target high value domestic and overseas markets. The increasing demand for Australian native species and the proximity to Asian markets, together with world recognised seafood quality and standards, means Australian aquaculture is competitively positioned to take on high value aquaculture products.

The opportunity to capitalise on Australia's 'clean-green' image along with the other priorities identified by DAWR (2017) are consistent with many of those identified by interview and workshop participants as being important for supporting continued growth and competitiveness of the inland native fish aquaculture sector.

A focus on sustainable production was described by many interviewees as a key motivation for their decision to become involved in native fish aquaculture. It has also become a significant focus in their product marketing into domestic and international markets.

I guess most of our products are being aimed at the high-end market. We've got a very sustainable model here as well, given it's all land-based aquaculture, and with the re-use of water and things like that, and we are farming a native species. So we are finding more and more customers are interested in our product because of the sustainability story. You've got a growing wealth and a growing middle class throughout Asia, and they're looking for, and want to buy those more high-end products. They're striving to have products that other people haven't got which I think puts the industry in extremely good place. But we've just got to make sure that we do it right. (Stakeholder #4)

Based on the high environmental sustainability credentials of the industry along with expanding consumer demand, stakeholders reported growing demand from export markets for a range of native fish products that they felt would, if current conditions were maintained, continue into the future; opportunities for expanding Murray cod exports in particular were identified as a high-growth area. Scope was also identified to increase demand for small-bodied native species for both domestic restocking programs and the domestic and export aquarium trade.

Two other key opportunities highlighted by participants were:

- **Secure access to water:** Participants consistently identified that having secure access to high quality freshwater is critical to the success of the industry and its future growth. This is important in relation both to markets and to costs: currently, many producers have relatively high water treatment costs due to not having good access to water of high quality, and their marketing is in part reliant on being able to market product as having grown in high quality water requiring little treatment.
- **Low disease risk:** Participants currently experienced limited issues with disease outbreaks and had relatively low biosecurity measure costs. Fish deaths that have been experienced have primarily been caused by oxygen depletion due to on-farm mechanical failure or extreme weather conditions.

CURRENT CONSTRAINTS

As previously discussed, many operators across the industry are in the process of expanding or planning to expand their business. Several constraints to expansion were highlighted by participants and are grouped below under four themes: i) regulatory conditions, ii) design of restocking programs, iii) research and development, and iv) industry coordination.

REGULATORY CONDITIONS

The first significant constraint identified was an increasingly complex set of regulatory conditions across the aquaculture industry. Most interviewees identifying this as a challenge for the industry. This is consistent with the recently released National Aquaculture Strategy, which identified that a priority for achieving future industry growth is overcoming regulatory constraints by: ‘promoting an efficient regulatory framework modelled on established best practice that is transparent and removes unnecessary burden on businesses’ (DAWR 2017 p4).

The permit process for establishing new aquaculture ponds or holding new species was highlighted by some as a constraint to their innovation and growth. In some cases, it can take up to two years to navigate the state and local government permit requirements for establishment of new ponds (Stakeholder #5). The permit system to introduce a new native species into an aquaculture system was also identified as a significant barrier to experimentation and innovation, and more restrictive compared to the permits for exotic species (Stakeholder #8).

DESIGN OF RESTOCKING PROGRAMS

The conditions placed on participation in some native fish restocking programs were also highlighted as constraining the industry. Specifically, the conditions required of businesses participating in the NSW native fish restocking program concerning legal liability and high transaction costs associated with having to deal directly with individual fishing clubs. The costs of supplying into the NSW restocking program have been prohibitive for many businesses participating and several private hatcheries have opted not to participate in the program.

In contrast, industry representatives highlighted the restocking program in Victoria as a best-practice model:

The Victorian model is a good model. And that government department is very good to deal with. They listen to our concerns and their model works so much better than the New South Wales model. Basically the New South Wales model just became non-profitable for industry. [Victoria] actually coordinate it all. They pick up on farm and it's a really good model. We still engage with the fishing clubs but it's not complex and tedious like the dollar-for-dollar model [in NSW] where we're dealing with individual fishing clubs for all of our deliveries and we

have to invoice the fishing club then we invoice the government for their half of it so you've got 30, 40 or 50 invoices. So it does get cumbersome...(Stakeholder #7)

The big difference [in Victoria]... is they come and pick up in bulk and it's an invoice every time and pay straight away. And there's a lot of communication with Victorian fisheries, too. Since I've been here, you'd be on the phone at least twice a week with Victorian fisheries... (Stakeholder #3)

This suggests a need to investigate optimal models for design of restocking programs if restocking forms part of any future actions implemented after carp control (it was beyond the scope of this project to specifically investigate this).

LIMITED PUBLIC INVESTMENT IN R&D

Limited public investment in research and development was the second most commonly identified constraint to continuing or increasing the industry's current growth.

Probably the biggest challenge that I see the industry faces is, it has always been deemed as a cottage industry or small industry, and it still is, and rightly so to an extent, but it's probably never really got the support. Especially so in New South Wales, Victoria I would say is a little bit different, but it's never really had the credit that it may have deserved. So we've stepped up and spent a lot of our own money on R&D to try to grow the business. (Stakeholder #4)

Consistent with this, investing in targeted research, development and extension was identified as a key priority in the National Aquaculture Strategy (DAWR 2017).

Key research and development priorities identified by interviewees primarily focused on investment in improving breeding technologies (inducement and fecundity) and fish growth rates:

Another big constraint that you have and this is in particular with Murray cod, we rely on natural spawning, so there's no inducing of the fish. Currently at this stage, the spawning season for here is roughly the start of September through the end of November. So you basically get a two and a half to three month window when you need to get all of your eggs, all your larvae. (Stakeholder #3)

Improving breeding capacity for golden and silver perch, which currently requires hormone inducement to establish breeding in cultured environments, was identified as another example of the need for targeted investment in breeding technologies. This investment is also needed to ensure producers can continue to meet regulatory requirements for genetic diversity:

I would say you're lucky to get any better than one in six pairs of [golden or silver perch] fish that successfully spawn. Lots of others either do infertile eggs or they die within a few days... [B]ut the challenge there of course is these people sitting at desks and reading about animal husbandry. They came up with one of the

things, if you supply an order of 50,000 fish it has to be from five separate sets of parents. Now, a successful spawning of Golden Perch fish about a kilogram are going to do a hundred thousand, at least. If they order 50,000 off you, you're supposed to breed 500,000. Just give them 10% and the rest, if you haven't got a sale, just perish (Stakeholder #6)

INDUSTRY COORDINATION

Some participants also identified that limited industry coordination, and in particular a lack of coordination advocacy, was a constraint to growth. It is difficult for a small expanding industry to resource coordinated industry representation, collaboration and advocacy. There is currently no national level industry body for freshwater native fish aquaculture industry to fulfil the need for industry representation and advocacy.

5. IMPACTS OF DEVELOPING THE PLAN

This section examines whether and how the development of the National Carp Control Plan has affected native fish aquaculture businesses. As noted earlier, the period in which a proposed action is being developed, but when its exact nature is not yet known, is often associated with social and economic impacts for those who have potential to be impacted by the proposed action.

The Australian Government announced in May 2016 that funding had been committed to development of the National Carp Control Plan. At the time of writing this report (September 2019), there had been a three-year period in which those involved in the native fish aquaculture sector were aware a carp control plan was being developed, but in which the exact nature of the actions to be included in that Plan, and the ways those actions would affect the sector, was not yet known. This represented an extended period of uncertainty about the future, particularly uncertainty about how businesses would be affected by the recommendations included in the Plan, and about the likely timeframe of decision making and action after the Plan was delivered to the government for consideration.

Uncertainty about the future and having a lack of control over decisions are well demonstrated to impact negatively on mental health in the workplace (see for example Pollard 2001). Past studies examining impacts of proposed changes to natural resource management have identified that proposed changes often create heightened levels of stress, anxiety and associated mental health impacts (Loxton et al, 2014). In particular, high levels of stress have been identified at the 'anticipatory impact' stage where a person knows decisions will be made that will affect them, but do not yet know the nature of the decision (Loxton et al. 2012).

In interviews, members of the native fish aquaculture sector were asked how this period of uncertainty had impacted them directly, and the industry more broadly.

All participants indicated they had not experienced direct production or market-related impacts from the announcement of the Plan. However, in most cases, feedback from participants indicated people in the industry have experienced feelings of frustration and varying degrees of stress during the development of the Plan to date. This was primarily associated with: i) uncertainty about the future, ii) frustration with industry engagement, and iii) low trust in the Plan development process, particularly related to low trust in two specific areas of the scientific assessment: virus transmissibility and susceptibility of native fish to the virus. These three areas of ‘anticipatory’ impacts are discussed below.

UNCERTAINTY ABOUT THE FUTURE

Uncertainty about the future was described as resulting from development of the Plan in most interviews and both workshops. Uncertainty took many forms, including uncertainty about: details of the Plan (what specific actions it will include); how households and businesses in the industry would adapt and cope with anticipated impacts of virus release; and uncertainty about the provision of support if financial impacts result from carp control actions. This uncertainty was reported by some as causing high frustration and personal stress, while for others it had not caused significant stress.

Some (but not all) industry members interviewed felt they needed to put business investment on hold until there they had confirmation either way about whether the carp virus was released, including limiting investment in business expansion and in recruiting new employees or investing in skills building for employees. Some felt that this was a particular issue for those in the industry who were closer to retirement age, who were particularly likely to be cautious about investing while there was uncertainty about when a decision would be made about virus release, and when the virus would be released if a decision to release was made. There was concern that this could lead to some of these older members retiring without passing on some of their skills and knowledge.

For many, the uncertainty arising about the future as a result of the announcement of the Plan development has led to feelings of being ‘in limbo’ and unable to make decisions related to the future for their household or business:

...I think it has had an impact. Probably not significantly as a business, financially, but it certainly created doubt within the business. Our employees say, "Oh, what's going to happen if ...?" They always ask the question. I get invited to go to fishing clubs and that and talk to them about it, so there's certainly a bit of a groundswell there of people wanting to know about it and wanting to know the potential risks. (Stakeholder #4)

Some interviewees had attended Plan consultation sessions. Those that discussed these felt that they did not resolve their uncertainty as the research of the Plan was ongoing, and as a result it was not yet possible to receive advice on their key questions or concerns. In particular, industry participants wanted more detailed information about potential direct

and indirect impacts of the carp virus on native fish, potential for negative market response, water quality outcomes and related clean-up requirements (discussed further in the Section 6). Some also felt that in the first stages of the Plan some of the information they received about the Plan was contradictory, and/or felt that the research being conducted as part of the Plan would not be sufficient to answer some of their key questions. For example, interviewees wanted advice on the short-term impacts of virus release in term of water quality, rate of carp kill and potential for impacts on other fish and aquatic species as a result of impacts on water quality. They also wanted information on likely long-term response of ecosystems example about what would happen immediately after the release of the virus as well as to reduction in carp populations and potential changes to fish population dynamics and whole-of-food chain ecosystem responses.

Participants indicated they had not experienced any direct negative financial impacts in the development phase of the Plan, however, anticipation of potential financial impacts was of high concern for all participants. This was particularly pronounced for those supplying or currently looking to expand into export markets:

“The thing is that I haven’t spoken to anyone in [my export market] because I’m too scared to. Because if I highlight it then it might create that trouble”
(Stakeholder #1)

For some participants the concern about potential impacts has also created a need to actively pre-empt impacts and identify and implement strategies to mitigate any potential impacts.

“I don’t know [if the water treatment technology exists]. But I need to work on that now because if the virus is released and I’m not ready, I could end up with it and that’s going to be the hardest thing in the world” (Stakeholder #1)

FRUSRATION WITH INDUSTRY ENGAGEMENT

Participants expressed varying degrees of frustration related to industry engagement undertaken as part of the Plan. This frustration resulted from concern about limited direct engagement with the native fish engagement sector i) when research underpinning the Plan was being conducted prior to announcement of the Plan, specifically trials examining whether the virus was transmissible to other species; ii) limited engagement and communication with the sector in initial stages of the Plan; iii) lack of clarity around timeframes for decision making about future carp control actions, and iv) many felt that virus release was being strongly advocated or was a ‘done deal’ and that alternative carp control methods or integrated approaches to carp control were not being adequately considered.

The Plan was described as something being imposed with limited consultation and against industry recommendations. In the period after the announcement of the Plan development,

many participants felt on the 'back foot' with limited knowledge about the Plan development process, and believed other groups were being consulted in more depth than native fish aquaculture representatives. Several also indicated that the lack of consultation is reflective of broader treatment of native fish aquaculture in Australia as a relatively small industry:

Very early on, I rang [the NCCP]... and said "where is the consultation, we can get the industry together fairly quickly. And consult with us". They hadn't at that stage ... (Stakeholder #7)

The frustration with limited consultation left many participants concerned about whether the potential impacts of the proposed virus release for the native fish aquaculture industry would be considered:

"There's a massive chance that our export will be finished if they release this virus. And so that's a direct impact to our business that they have encouraged us to do over the years and they don't even come and talk to me about it" (Stakeholder #1)

I think that rather than us just being advised of community meetings and community consultative meetings, the NCCP should make the effort to consult more directly and frequently with the aquaculture associations and keep them updated. And take their questions and listen to their concerns. (Stakeholder #7)

Some did not trust that their concerns would be heard and properly considered in the consultation process:

It's just going to be one of those things, when they do it, and they wipe out whatever they wipe out, and then people like me going, "Told you so." I still won't be heard, even after that. (Stakeholder #2)

These concerns were in part driven by a perception in earlier stages of the Plan that all consultation related to carp control would occur as part of the Plan. In the June 2019 stakeholder workshop, it was clarified that further consultation would be necessary after the government had considered recommendations of the Plan and identified its preferred way forward with carp control. This reduced some of these concerns, as it highlighted that the key objective of the Plan was informing research and knowledge rather than conducting all consultations needed before a plan for carp control is implemented.

For some, concerns reduced with some growth in consultation during the process of Plan development.

I would have thought industry consultation would have been maybe one of the first things that you did when you were looking at the National Carp Control Plan. But on the flip-side, I'm pretty pragmatic about it, and I think it's fantastic that

they are doing it because my big concern was, we were never going to see any consultation. It's good to see it's starting to happen. (Stakeholder #4)

LOW TRUST IN PLAN DEVELOPMENT AND SCIENCE

Several participants had low trust in the credibility of the Plan development process. These concerns were associated with several issues including: i) perceived initial advocacy for virus release; ii) narrow focus of carp control measures; iii) time pressures for Plan development and; iv) validity of specific aspects of scientific research.

Many participants felt the Plan began from a position of advocating for virus release, rather than a position of evaluating whether virus release was or wasn't feasible. They felt the Plan was focused on 'when' the virus would be released, not 'if' it would be released. This perceived advocacy for virus release and positive messaging about the virus undermined confidence in the rigor of the evaluation of feasibility being undertaken:

One thing I'd like to say is that our industry believes that this proposal has come about with a predetermined outcome. And that's very disappointing. But basically there's been a massive push, a massive sales pitch to sell this release as a "good thing". And that's still happening. Rather than it just being science-based and about having a look at this and see if it's a potential, it's still being sold to people and that's very, very disappointing and frustrating for the industry to see that happen. (Stakeholder #7)

This highlights the importance of ensuring clear communication about the objectives of the Plan, which are to assess the feasibility of releasing the virus, rather than to advocate for release of the virus.

Participants strongly supported the need for carp control but most reported frustration that the Plan focused on assessing the use of the virus release and was not assessing other carp control options or an integrated approach that used multiple methods for carp control:

...[Y]ou're talking about the Carp Control Plan, which is I think a great thing, I've nothing against it, but there needs to be a definition... the pollies tend to blur the lines between the koi herpes virus release and the National Carp Control Plan. In my mind they're two different things, but I think the lines are getting a little bit blurred... in the way that this message is coming across. (Stakeholder #4)

At the time of interviews and workshops, which were held prior to release of much of the Plan research, native fish aquaculture industry members who participated in this assessment opposed the release of the carp herpes virus, with none reporting support for release:

...I would say out here the general consensus is that from a koi herpes perspective, people don't want it. Everyone is more than happy for a National

Carp Control Plan, but from the people I speak to, I think the overwhelming majority aren't that keen on the koi herpes virus. (Stakeholder #4)

*"Tell them I'd vote for a nuclear dump site before I voted for a carp virus"
(Stakeholder #5)*

Right from the outset, I have to say that when this virus release was proposed, I was absolutely horrified at the idea and I still am. And I will say bluntly that it's probably the stupidest thing I've ever seen proposed in our industry. I won't hold back on that. And I'm very, very disappointed that there's no work being done, no further work being done on the daughterless carp program. I spoke with an expert on the carp herpes virus from Israel ...and he was also stunned that Australia had dropped off that daughterless carp program³ and that they were even considering the release of the carp herpes virus. To come from an expert in Israel, that's an interesting comment because that's where this virus was first found. So I'm disappointed. (Stakeholder #7)

Some participants also felt that the impression given was that development of the Plan was being done in a rush with pressure to produce rapid outcomes:

I think a lot of the negativity surrounding the virus is because people ... talking to a lot of people, they feel as though it's being rushed. They feel as though it's been a political promise, there's supposedly, some quite powerful lobbying being done by certain parties. There's certainly individuals that are in there really pushing it. So I think if they came out and they said, "Okay, guys. Guess what? We're actually not going to look at releasing it until 2025 at the earliest. We're going to do all of this research first. So I think that it's a bit of a fear thing, it's that fear of it's all been pushed so quickly, but once it's done, it's too late. There's things that haven't been thought through longer-term. (Stakeholder #8)

These concerns arose in large part due to public statements made early in the Plan by the then Minister for Agriculture and Water Resources, which many stakeholders interpreted as suggesting that release of the virus was a 'done deal'. In the June 2019 workshop and in discussions in 2019 with three industry participants, all responded positively to the extension of timeframe given to the Plan to complete its research, and to discussions in which it was clarified that after the Plan hands in recommendations to the Australian

³ Note that the NCCP did commission a review to examine which genetic technologies were the most promising to date in terms of current technical development and social acceptability, to enable the NCCP to provide advice on potential synergistic controls that could accompany the carp virus. This will inform the NCCPs recommendations.

government further processes of regulatory approval will be needed. This was viewed as evidence of appropriate investment in evaluating feasibility of the virus and its potential risks.

Several participants had low trust in results of research conducted prior to the Plan that examined the potential susceptibility of native fish to the carp virus:

When the testing [of native fish] was done, the numbers of fish were very low...And what came out of that research was higher mortalities for some of the natives. Certainly, the silver perch. ... [R]eally those mortalities have not been properly explained. I would hope that they're going back and doing all of that again... I think the thing with science is it has to be repeatable... And you have to be able to explain why something was wrong and don't just say "it may have been a cross contamination at the time"...[I]f that was the case and the experiment didn't run properly, you have to go back and do it again. If your heater malfunctions and the temperature gets too high or whatever then you have to then go back and redo the whole experiment, to get rid of that anomaly and it has to be repeatable as part of science. (Stakeholder #7)

For me, one of the concerns with the CSIRO research and the results that came out of it, was that there were considerable losses with the native fish that they injected the virus into. I know, as far as their pathology reports were concerned, they didn't find any evidence of the actual virus. But they had large fish losses. So I think things like that really, really are concerning. Whereas if they can repeat those trials, do some more research to say, well okay, was it the stress on the fish that then made them susceptible to something else. Because I think that's the thing, just saying that the virus, they could not find any evidence of the virus on the dead fish is not good enough. (Stakeholder #8)

Several also felt that existing information and research being undertaken in early stages of the Plan did not answer key questions directly relevant to potential impacts on the aquaculture industry, specifically:

- How long can the carp virus stay live in water without a host? This is critical as aquaculture businesses need to transport produce in water and if water is considered to present a biosecurity risk of spreading the virus, will need to invest in appropriate measures to ensure water safety
- Can species other than carp be carriers of the virus, for example through transporting virus particles on scales? If so, what is the period of risk and what biosecurity measures are needed to address this?

There was also frustration about perceived gaps in scientific assessment of potential for indirect impacts of virus release on wild native species, including assessment of impact on

small bodied native fish species due to water quality changes and whole-of-food-chain impacts.

In subsequent stages of the Plan, review work was commissioned to better identify the need for further testing of species susceptibility and related issues; the Plan also commissioned a review into longer-term potential environmental outcomes of carp control. These are being drawn on by the Plan to inform its recommendations, and explicitly seek to respond to the types of concerns raised by stakeholders above.

6. POTENTIAL IMPACTS OF THE PLAN

Participants were asked to discuss their concerns about potential impacts they would experience if the carp herpes virus is released. The most common impacts identified are discussed below under four areas: i) market impacts, which include potential for negative and positive impacts depending on circumstances ii) potential impacts on business cost and production, iii) restocking considerations including conditions required for the sector to be able to contribute effectively to any restocking efforts after a reduction in carp population, and, iv) broader concerns.

POTENTIAL MARKET IMPACTS

Key topics discussed related to potential market impacts were:

- Potential for damage to Australia's 'clean-green' market brand and price advantage in export markets
- Potential damage to consumer perceptions of food safety and quality of aquaculture products in domestic markets
- Potential for trade barriers for native fish aquaculture products

In addition to these concerns about negative impacts, some participants discussed potential positive impacts in the form of expanded markets for restocking after reduction in carp populations, discussed further under 'restocking considerations'.

The first concern, raised by most interviewees and discussed in both workshops, was that release of the virus had potential to reduce the 'clean, green' reputation that many markets relied on. In the workshop participants discussed the importance of marketing their products as a premium, clean and sustainably produced product. This is seen as essential for maintaining prices for their produce, and so they can continue to be viewed as a product that can compete with wild-caught fish and supplementary protein products such as chicken, lamb and beef. There is significant concern that a carp virus release will result in reputational damage in markets:

"Clean and green", it's absolutely key for Australian produce. And that's across the board, whether it's seafood or fruit and vegetables or terrestrial animals, beef

or whatever. It's key to our marketing edge, especially in a lot of the Asian countries. China, Japan, et cetera, they have a high emphasis on the quality and safety of Australian food. (Stakeholder #7)

[E]verything that's coming out of Australia, is seen as this 'clean, green, pristine' product. We're seen on the world stage as a very clean area, so the food that we produce out here is really good. That's one big selling point that we have. They can breed Murray cod in China, no worries, but it's just because it's got the Australian name behind it. The concern that I have is that if we release this virus, does that then dent that 'clean green' brand? (Stakeholder #3)

If the price premium is compromised participants are very concerned about this impacting their capacity to compete in both export and domestic markets. In the context of the domestic market for Murray Cod, participants raised concerns about the potential impact to their competitiveness with barramundi systems that are well-established and based on 'closed-off' systems. This impact would result from two factors: one is perceptions of the carp virus and its impacts (irrespective of whether the feared impacts, such as reduced water quality, actually occur), while the other would result from any events occurring post-virus release, such as large fish kills or water quality events, that led to negative market perceptions.

This concern is highly related to concern about consumer perceptions and preferences. Participant reported they were being asked questions by customers about issues such as whether the virus would be transmissible to humans, whether it would be transmissible to animals, and whether their products would still be 'healthy' if grown in areas where the virus was released in future. This indicated a high potential for negative consumer reactions based on perceptions of the virus as causing health risks to consumers, or as reducing the 'cleanness' of the products being sold. Some participants also raised the example of the outbreak of white spot disease in prawns on seven Queensland prawn farms in 2016: they reported that at the time, media reports were damaging to the sector, and drove a market perception that the problem was insurmountable and negative consumer reactions due concerns about safety of consuming prawns.

As this was a key perception that was identified as a driver of many of the impacts with potential to be most severe for businesses, subsequent surveys of community attitudes investigated potential consumer reactions in further detail.

Some caution is needed when attempting to assess consumer reactions to hypothetical future events: there is strong evidence that stated behavioural intentions (such as a statement that a person would stop consuming a product under particular circumstances) do not always eventuate into actual behavioural changes when those circumstances occur. However, while many studies have established that intentions to engage in a behaviour are not always a good predictor of actual choices, other studies have found intention remains a strong predictor of likelihood of changing behaviour (see for example Hassan et al. 2016). In

other words, there is variability in the relationship between intention to change behaviour and actual behaviour change. This suggests that findings showing consumers intend to change behaviour can be interpreted as indicating that (i) some will change behaviour in the way indicated, but (ii) it will likely be a smaller proportion than state an intention to do so. Secondly, in addition to the intention-behaviour gap, it is well established that the nature of communication about an issue will influence the strength of consumer reaction. This means that it is not possible to predict actual consumer responses unless the nature and type of likely communication about the carp virus release is known. For example, this would require knowing the risk of widespread negative media coverage that (intentionally or unintentionally) promotes reduction of consumption of aquaculture products through actions such as widely reporting on the most negative outcomes of virus release, versus the potential to design positive communication strategies that reassure consumers about safety and promote consumption of products as part of supporting a sustainable industry.

The initial findings need to be interpreted with an understanding of these limitations: the findings presented below do not indicate the precise nature of consumer reactions, but do indicate what the direction and possible magnitude of consumer reaction could be in the absence of either large negative or positive messages being communicated via traditional and social media about virus release.

The survey of community attitudes examined several aspects of consumer reactions. The first aspect assessed was the level of concern held amongst Australian residents about potential impacts of the virus that could contribute to reduced willingness to consume produce from areas where the virus was released. This was assessed by providing the following information to survey participants:

In recent decades, concern has grown about increasing numbers of carp (an invasive pest fish species) in many of Australia's rivers, lakes and wetlands. In 2016, it was announced that a National Carp Control Plan would be developed to recommend how best to control carp. In particular, the Plan will recommend whether or not a virus that has killed carp in other countries (the carp herpes virus) should be released in Australia. Any efforts to control carp will use taxpayer money – so it's important to know what Australians think about the idea of investing funds to control carp. **Please answer the next questions even if you don't know much about carp**, as actions to control carp have potential to affect large parts of Australia, including areas visited by large numbers of people. Current research suggests that release of the virus may result in large amounts of dead fish in some areas in the short-term. Even with clean-up efforts, this would likely cause smell, and in some cases inability to use some waterways for periods of time. Work by the CSIRO and experience in other countries has found the virus is not transmissible to humans or to species other than carp or koi. Given this information, how much do you agree or disagree with the following statements?

The 4,428 survey participants, drawn from across Australia, were then asked the extent to which they agreed or disagreed with several statements about potential impacts of the carp

virus. Those relevant to assessing potential impacts on consumption of aquaculture products grown in areas where virus release has occurred are shown in Figure 1.

The responses suggest that despite clear statements that the virus is not transmissible, concern remained high, with 49% concerned ‘the virus could be transmissible to humans, despite research finding it is not’, and 57% concerned about potential transmissibility to fish or animals other than carp. Concerns about potential water quality problems were high, at 63%. This suggests high potential for rapid formation of negative community perceptions about virus release, which have potential to flow on to choices made about consuming products from areas where the virus is released. In particular, it suggests that reducing potential for negative impacts would require sufficient resources to be invested in design and implementation of appropriate communication strategies to reduce misperceptions about risk of produce from areas where the virus was released.

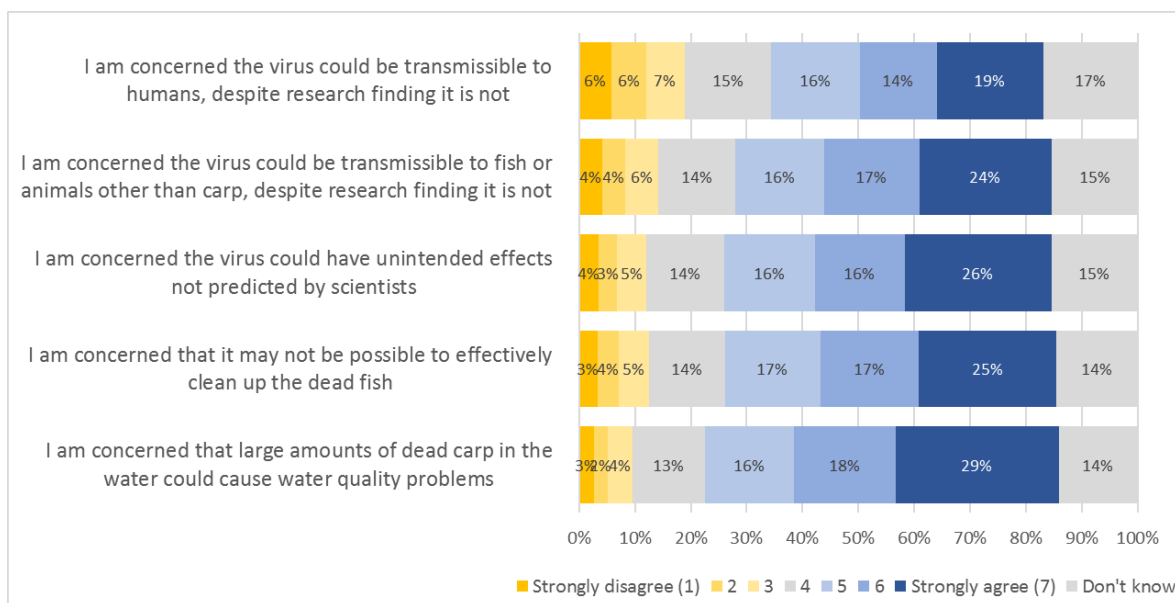


Figure 1 Initial reactions of 4,428 Australians to potential release of the carp virus, after being provided limited information

The 2019 survey also specifically assessed potential consumer responses to virus release. This was done by firstly stating:

Recent months have seen concern about water quality issues in some of Australia’s rivers, lakes and wetlands, and about water flow in those rivers. We are assessing the extent to which issues such as water quality issues affect your activities in and around these areas, and your likelihood of visiting them or of consuming products harvested from them. The next questions ask a bit more about this by asking your views about visiting rivers and lakes or using products harvested from them in three different circumstances.

Survey participants were then asked how likely they would be to consume fish from local rivers and lakes under three scenarios:

Scenario 1: You are planning a trip to an area with rivers and lakes. The water quality in the area you are planning to visit is good, with healthy vegetation, water that is often clear, and

good fishing. There is typically enough water flowing to enable activities like swimming or boating. There is a risk of outbreak of blue-green algae or other poor water quality events in warm weather: these occur once every 3-4 years, last anywhere from 2-4 weeks and during this time can stop swimming and cause some fish deaths and smell.

Scenario 2: You are planning a trip to an area with rivers and lakes. The water quality in the area you are planning to visit has been poor, with reports of fish kills and blue-green algae in a river about 50 kilometres from the place you plan to visit. Local authorities say it is still safe to boat but not to fish or swim, but expect to lift those restrictions in the next week so you'll be able to fish and swim by the time you visit.

Scenario 3: You are planning a trip to an area with rivers and lakes. The water quality in the area you are planning to visit is currently good. However, there has been a disease affecting fish in some nearby areas, and there is a possibility it might cause a large amount of fish deaths in the areas you will be visiting. The disease doesn't affect humans or any animals/birds other than fish. If a fish kill happens while you visit, there will be a lot of smell and poor water quality for a period of time, likely to be around two weeks (possibly longer). The risk of a fish kill happening when you visit is fairly low – around 10% - but no-one is able to tell you whether it will occur when you visit.

The first scenario reflected baseline conditions – meaning the current conditions experienced in many freshwater areas in which carp invasion has occurred. The second scenario reflects a potential outcome of virus release in the form of poor water quality, and tests responses to this by a person planning to visit or consume produce from a place some distance – 50km – from where the poor water quality is occurring. This was selected deliberately as it evaluates the likely behavioural responses to a scenario in which virus release results in some localised poor water quality events (rather than widespread poor water quality), and identifies if these localised events would be likely to produce more general consumer responses that affected other areas not experiencing poor water quality. The third scenario similarly reflects that virus release would involve a reasonable degree of unpredictability in timing of carp kills, and evaluates what responses to a risk of a fish kill would be.

Participants were then asked, amongst other questions, whether they would feel safe eating fish caught or produced from local rivers or lakes under each of the three scenarios. This question was deliberately generic: it did not specify fish produced in aquaculture facilities and those caught as wild catch. This was because initial testing of two separate questions distinguishing aquaculture and wild catch showed there was a lack of distinction made between the two and confusion about the differences amongst them for most consumers, suggesting that consumer responses would be similar for both.

As shown in Figure 2, under current conditions – in which there are sometimes water quality problems – around 35% of Australians feel comfortable consuming fish caught or produced in inland waterways, while 38% do not, and 28% are neutral or unsure. This highlights that in many areas experiencing carp invasion, there is already reasonably high reluctance

amongst a large group of consumers to consume local fish products. Despite this, the native fish aquaculture industry has been successfully expanding markets, suggesting that it is effectively working with those who do feel comfortable consuming fish.

Under both Scenarios 2 and 3, the proportion of people who felt safe consuming fish fell by just under one-third, from 35% to 22% and 21% for Scenarios 2 and 3 respectively. The proportion who felt unsafe increased from 38% to 58%, while 20% were neutral or unsure (compared to 28% for the baseline scenario). This suggests potential for a decline in willingness to consume products, that in the absence of significant negative media coverage would likely be no more than one-third, and much more likely to be less than this, particularly if there is positive coverage that assists in reinforcing safety. Declines in demand are likely to be most acute in the short-term, with consumption returning over the longer term as the presence of the virus became ‘normalised’, unless large negative media coverage resulted in longer-term negative perceptions. Importantly, these results suggest it would be difficult to expand domestic consumption after virus release, unless there is appropriate investment in campaigns to support consumption of aquaculture products. Investment in these types of campaigns would, if designed well, have potential to counteract the impacts of declining consumption through creating overall increase in awareness of sustainable aquaculture and the products available for consumption from inland freshwater aquaculture.

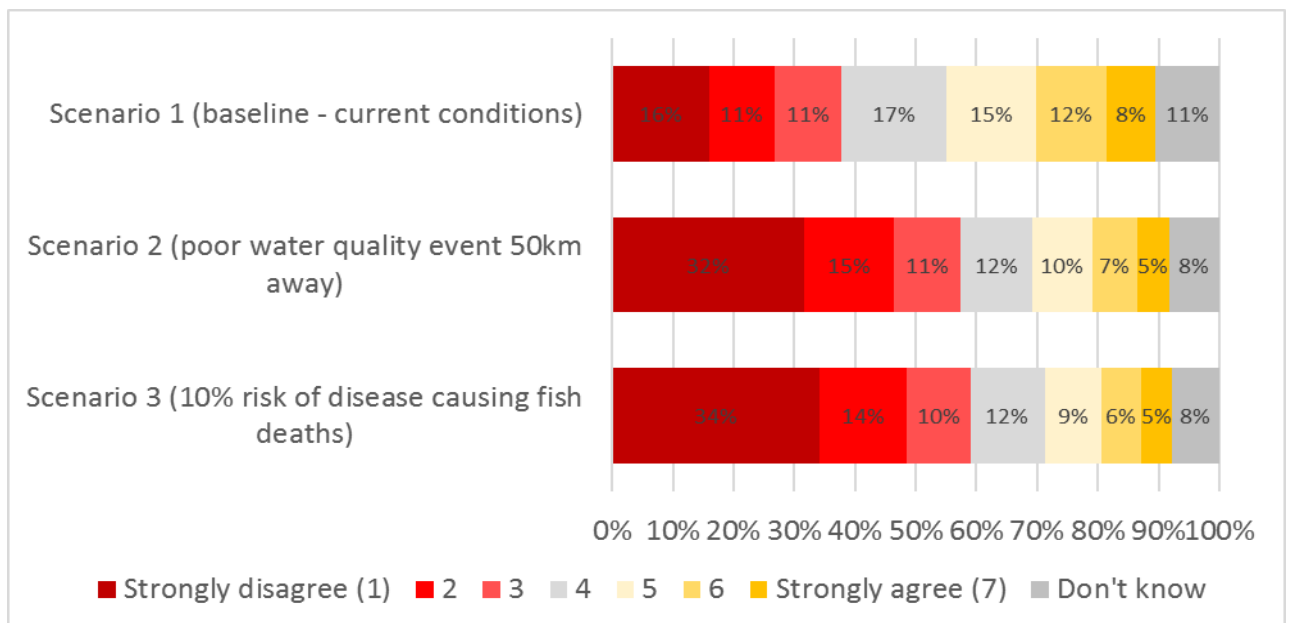


Figure 2 Level of agreement that ‘I would feel safe eating fish caught/produced in local rivers and lakes’ under three scenarios

These findings are, as noted earlier, indicative of the likely direction of consumer behaviour only, and likely to be different in reality depending on the extent of the ‘intention-behaviour gap’ as well as on the extent and effectiveness of communications about virus release and the effect of this on demand for aquaculture products. The findings apply to domestic

consumers, and do not provide insight into likely changes in consumer demand in the export markets that are of growing importance to the freshwater native fish aquaculture sector.

In addition to changes in market demand resulting from shifts in consumer perception, there is potential for changes in market demand associated with transport or export restrictions or other regulatory change associated with biosecurity concerns. Associated with this, there is potential for increases in business costs occurring as a result of needing to introduce new biosecurity measures. Many of these concerns were underpinned by concern that native fish, and the water they are transported in, may be carriers of the virus. The extent to which these would be issues that impacted the industry depends on the length of time the virus remains viable in water, the length of time virus particles can remain active when transported on other species, and the costs of any biosecurity measures that need to be implemented in order to address these risks.

Several participants identified that the carp virus is a notifiable disease listed by the World Organisation for Animal Health (OIE), of which Australia is a member country. They were concerned that this status as a notifiable disease may mean some countries refuse to import products produced in waters in which the virus is known to be present. They were also more broadly concerned about the potential for restrictions to be placed on trade or on transport of their products if the virus was released. These impacts would result either from formal restrictions placed by international government on actions such as importing native fish aquaculture products from Australia, or restrictions being placed on transport of produce across state or territory boundaries within Australia to reduce risk of virus spread. Most felt that it was possible to manage this from a biosecurity perspective, but were concerned that rather than invest in implementing appropriate biosecurity measures some jurisdictions may opt to simply impose a ban on sale. This meant that concerns about these potential impacts do not emerge simply from questions about the biosecurity measures needed to ensure safety of products, but also from questions of how perceptions may drive responses that go beyond what is needed to maintain safety from the virus.

The potential for trade barriers being imposed if the carp virus is released is one of the most significant concerns for participants.

I believe if they were going to [impose a ban], they would just stop it. There's no way we could influence them when they decide to do these things.... I know [foreign nations] have stopped the import of Murray Cod at times. Not sure [why]... I don't think they even tell you why...(Stakeholder #1)

...[T]o be honest, importing countries...if they have a certain view, and they look back through the process to uncover that Australia has intentionally released a notifiable disease into their waterways, then I really don't see how they're going to show us a great lot of respect as far as helping us to get imports into their

country. I honestly don't see diplomatically that there's anything that will be able to be done. (Stakeholder #7)

Many of the countries native fish aquaculture businesses export to, such as China and Japan, already have the carp herpes virus. However, this does not mean these countries are likely to have lower concern: both are reported to have strong emphasis with international customers on reducing risk of spreading the virus to reduce new outbreaks and to assist in efforts to contain the carp herpes virus (Stakeholder #7). Additionally, some reported that their international customers had reported to them a (incorrect) perception that Australia is considering introducing a more virulent strain of the carp herpes virus. The concern is that perceptions such as this have the potential to dramatically affect trade even if they are unsubstantiated. This concern was reinforced by feedback reported some study participants, who have experienced the imposition of trade barriers following a perceived disease risk. The experience typically has been a temporary barrier imposed for three to five years, after which they have been required to demonstrate their products are virus free.

Imposition of trade or sale restrictions is the most severe type of potential impacts identified by participants, followed by reductions in consumer demand. When asked how the risk of these impacts could be reduced, most identified similar actions. The first was implementing cost-effective biosecurity measures that clearly and demonstrably ensure safety of produce. This is discussed further in the next section. The second was proactive and clear communications with markets, including investment in maintaining and strengthening relationships with international customers with support from the Australian government in the form of clear advice on biosecurity protections in place to ensure safety of product. The third was careful design of communications around virus release to reduce risk of long-term negative impacts on consumption: this requires ongoing investment to ensure that negative media images of events such as fish kills are followed by clear information on recovery of water quality and waterways, and safety of aquaculture produce.

POTENTIAL IMPACTS ON BUSINESS COSTS AND PRODUCTION

Several participants were concerned that they may experience increased business costs, and complexity of production if the carp virus was released. This could result from growth in costs relating to water treatment, biosecurity measures, and assessment to meet 'virus-free' export requirements and domestic food safety regulations, as well as increases in production complexity and cost due to impacts on water quality and on native fish, particularly availability and health of brood stock.

Biosecurity and disease assessment Biosecurity measures and water treatment costs across the industry are currently reasonably low. Many felt that release of the virus would be likely to result in increased biosecurity requirements, that would in turn result in substantially

increased costs. Others were concerned that they may have limited options available for excluding the carp virus from open aquaculture pond systems:

The trouble is, parasites and that sort of thing we can deal with. We can kill. And we can treat and have the fish clean. But viruses are a completely different thing. ... you also have many pathways for viruses to move around. You have farms where, if you're closer to a waterway, you'll have things like turtles will walk in, you'll have birds that will fly in and out, and then you've got the water, and then you've got the fish from brood stock collection. So you've got lots of pathways for the virus to potentially get in. (Stakeholder #7)

Concerns were also raised about the potentially high costs that would be imposed if businesses were required to demonstrate absence of virus in fish products. They wanted clarity on whether, if this was a requirement, there would be investment in cost-effective tests to make it logistically and financially feasible to test for virus presence across diverse native fish aquaculture systems and businesses.

The batch testing currently required to assess 'disease free' status is already a significant cost producers face (e.g. \$300-500 per batch of 30 fish) and time consuming (results can take up to three weeks). Many were concerned that the introduction of a new virus would require their assessment for 'disease free' status to start again with a higher number of fish per batch (e.g. 150 has been cited in Queensland) and an associated increase in cost per batch. A substantial increase in batch testing has potential to cost some producers out of the market, and to reduce viability of others. If increased cost was combined with a reduction in demand and/or price receive, the cumulative effects of these combined impacts would threaten viability of a relatively large proportion of businesses.

WATER QUALITY IMPACTS

The other potential increase in business costs identified was increase in costs of water treatment and in pond water infrastructure. The native fish aquaculture industry is predominately based on open pond production systems which are exposed to natural water sources either directly through water extraction or from wild brood stock. In some cases, native fish aquaculture production systems use bore water or private reservoirs rather than natural waterways, however, these systems remain connected to the natural system through wild brood stock or supplementary water from adjacent waterways.

Industry representatives raised questions about how the potential risks to their systems are being considered in the Plan in relation to water quality outcomes under different virus release scenarios. There are also related questions about how the clean-up will be managed after the initial release and in subsequent virus outbreaks:

I think also it's not just related to oxygen in the water, that will be a problem with aquaculture, it's just putrid, rotting fish and bacteria and all sorts of things that

are going to be happening in this water. And so water quality for aquaculture is an issue. (Stakeholder #7)

As noted earlier, a large investment is being made in the Plan in investigating whether and what types of risks release of the virus would have for water quality, and this large body of work will inform its recommendations. The concerns raised by stakeholders and documented in this report support the importance of that assessment and highlight its importance to understanding whether and what types of socio-economic impacts may occur.

Currently minimal water treatment technology is required in the aquaculture industry. Several industry representatives felt that investing in water treatment infrastructure is unlikely to be financially or logistically feasible for many of those reliant on pumping from natural water systems. This concern was in part driven by lack of information on what requirements the infrastructure would need to meet in terms of filtration, with stakeholders reporting a varying range of perceptions about what technologies and processes would be needed.

There were also concerns about the potential for an increase in disease exposure more generally in aquaculture ponds, beyond the carp virus. This could occur as a result of the impacts of dying carp, both on water quality and on parasite loads more generally:

Another issue that really hasn't been considered very well at all, if at all, is the potential for parasites shedding off the carp when they die, and how that will actually impact native fish...That's a potential, real potential issue for native fish. If you all of a sudden kill massive numbers of carp that are carrying parasites, then they will shed the parasites and those parasites will then go looking for another host. If you combine that with an issue where you might have poor water quality that's bothering the natives but hasn't killed them, that's an absolute ideal scenario for parasite infestation. (Stakeholder #7)

POTENTIAL IMPACTS ON PRODUCTION VIA NATIVE FISH

Several industry participants had concerns that the virus might directly or indirectly affect production through having impacts on native fish. Potential impacts raised range from concerns that the carp virus could in future mutate to a form that native fish were susceptible to, through to concern that water quality impacts from release of the virus could adversely affect native fish populations in the wild or in aquaculture facilities, for example through oxygen depletion in blackwater events or create conditions conducive to spread of other diseases.

While most felt the risk of virus mutation was small, several felt that any risk of mutation – even minute - was too high to risk:

"I just feel with the carp virus, unless you can 100% guarantee that it's not going to affect our native fish it shouldn't be done...If it mutates to our fish and starts wiping out the native fish, who's going to put their hand up and take responsibility for that? ... Is that risk worth it? (Stakeholder #1)

...that's probably the number one really: what happens if this virus mutates? ... Just because this virus has a low risk of mutating doesn't mean that it has no risk of mutating, which is a huge concern. (Stakeholder #4)

As discussed previously, many industry members have questioned the findings of the trials testing native fish susceptibility to the carp virus and questioned how comprehensive those trials were. While recognising that the high number of deaths of some native fish species in the trials was not a direct result of the virus, trust remains low due to a lack of clear understanding of what did cause the deaths.

Native fish have potential to be impacted by any poor water quality events resulting from virus release, including blackwater events in which depletion of oxygen in water can cause mass fish kills events that reduce native fish numbers in the wild, and poor water quality increasing risk of other diseases that can affect native fish. This can significantly impact brood stock the aquaculture industry relies on. If the population of wild brood stock are impacted this could have significant impacts on aquaculture production, particularly if (as has happened in some locations as a result of past poor water quality events) it takes several years for mature native fish stocks to recover:

Under the hatchery quality assurance program we are required to turnover our brood stock every five years. So we're constantly sourcing new stock. Every single year we capture brood stock for this so that we can then turn them over. If we lose a lot of native fish out of the system [due to virus release], thus we are required to put more back in, how do we access the brood stock to breed the fingerlings? If we need to increase our brood stock numbers, and we can't capture them because there've been so many lost out of the river systems, then that's a massive barrier. For example, a Murray cod's really not useful for brood stock until it's at least five or six years old. So if you lose for some reason a lot of the big fish because of water quality issues, like dissolved oxygen depletion, then if you can't capture brooding-sized fish, then you can't breed fish. (Stakeholder #7)

When asked about measures to address these potential impacts, participants identified several actions. In particular, to be able to assess the likely extent and nature of business cost implications, they needed clarity on what changes to current biosecurity requirements would occur if the virus was released. Depending on what these changes were, potential actions that could assist in minimising impacts on business costs include:

- Investment in identifying cost-effective methods for things such as batch testing and demonstrating virus-free status, water treatment and implementing changes to pond infrastructure

- Providing access to grants or low-interest loans to enable businesses to make needed infrastructure investments was also identified as a potential action
- Developing and resourcing a plan to ensure maintenance of healthy levels of wild native fish brood stock, in collaboration with the industry

Several participants wanted to know whether businesses would have rights to access financial support if their business was impacted negatively by virus release, either through cost impacts or the production-related impacts described in the next section:

[T]he difference in my mind with this is I guess if an accident happens, and the industry is affected by it, then it's a hard call to get compensation. But where it's a researched and intentional release like this, then I would think that the industry would be well within its rights to expect compensation. Because it will be an intentional release against our advice. Right from day one. (Stakeholder #7)

RESTOCKING CONSIDERATIONS

When asked what positive impacts could result for the industry from release of the virus or carp control more generally, several identified the potential for the sector to contribute to restocking efforts after a reduction in carp. All wanted involvement in this, not simply as a business opportunity, but as an opportunity to contribute to improving environmental health in ecosystems they are strongly connected to and care about.

While this was viewed as a potential positive opportunity for the industry, it will only be realised under the right conditions. Businesses cannot typically rapidly switch to different species or rapidly increase production volumes. They would need sufficient lead time to invest in breeding the right stock to the right level of maturity and, where necessary, in expanding facilities. Depending on whether permits for new ponds or species are needed, and the maturity and number of stock to be supplied, this requires forward planning at least two years ahead of proposed actions, and ideally longer. Additionally, any restocking program would need to be designed effectively to ensure it was feasible for businesses to participate. This requires ensuring transaction costs such as number of individual contracts require, legal liability of aquaculture businesses, and responsibility for transporting fish for release, would need to be designed appropriately to ensure businesses could participate without losing money.

Several participants were concerned that the Plan was not directly examining potential for restocking to form part of actions after a reduction in carp populations. They identified a need for a formal assessment of current capacity of the industry in terms of ability to produce different species that may be used in restocking (particularly small-bodied native fish), current capacity, ability to expand capacity, and regulatory constraints to expansion. Some of the key topics raised in relation to restocking were:

- Restocking needs should be actively investigated. In particular, there were concerns from those in the sector that loss of carp populations would have potentially significant food-chain implications, with some large-bodied native fish species losing access to part of their current food supply (carp) and hence increasing predation of other native fish. Restocking efforts may be important to reducing impacts of this, but to do this would need to be timed appropriately.
- Restocking needs to be targeted and responsive to conditions such as a blackwater events that cause widespread fish deaths. Industry representatives have observed missed opportunities in the past for a restocking response following events causing large fish deaths which can leave a gap for carp to exploit and breed.
- The focus on commercial native fish species (e.g. Murray cod and silver perch) across the aquaculture industry means there is limited diversity of native fish species being bred at a commercial scale. There are currently a very limited number of hatcheries breeding small-bodied native fish species. This has been identified as a significant concern regarding current capacity to respond to potential changes in the whole food-chain if the virus is released in future. Future carp control strategies should actively identify investment needed in increasing capacity in the industry and timeframes required to achieve this to ensure ability to restock with the right timing.
- There is a need to understand potential implications for recreational fishing of virus release. If virus release had impacts on wild native fish populations, aquaculture businesses may receive both increased demand from environmental managers for restocking to improve environmental health, and increased demand from recreational fishers to restock angling species. This could readily create a production bottleneck.

Overall, this potential positive impact was one which would emerge only with sufficient investment in early assessment of industry capacity, identification of needs, and investment in restocking sufficiently early to enable availability of stocks. Industry representatives felt strongly that federal-level involvement in native fish restocking responses would be important to augment state-based responses. The Murray-Darling Basin Authority's Native Fish Strategy was given as a positive example of national involvement in a native fish restocking program.

BROADER VIEWS ABOUT POTENTIAL IMPACTS AND PLAN DEVELOPMENT

Participants also raised several broader concerns regarding potential impacts of carp virus release they felt need to be considered in the Plan. While in some cases the concerns raised have the potential to have native fish aquaculture production-related impacts, they were raised as broader concerns of general relevance, rather than as concerns specific to potential for impacts on the industry.

First, there was concern about the likely scale and nature of dead carp resulting from release of the virus, and whether clean-up would be feasible of dead carp to reduce risk of

dead carp leading to negative water quality events (which in turn could lead to deaths of other fish species, as well as other impacts). Many of the participants had personal experience of the challenges of cleaning up large sudden fish deaths. There was concern that inadequate ability to clean-up could have negative impacts for environmental health, town water supply, tourism and regional economies. Many participants also shared their insights on the complexity of the natural river system and what this means for virus epidemiology. The containment of the virus was seen as problematic, with many feeling the virus would not be readily contained. In the two workshops, presentations of early findings of the Plan regarding likely rate and extent of virus spread and potential for water quality impacts were presented and discussed with industry members, enabling further discussion of these concerns with industry participants.

Second, participants felt strongly that an integrated approach to carp control is critical as is consideration and acknowledgement of localised approaches to carp control. As part of this, the role of Murray cod predation was raised by many participants as an example of anecdotal evidence of localised reduction in carp populations that warrants further investigation. Other options participants wanted to see considered in an integrated approach to carp control included bounty incentives, traps, daughterless carp, and commercial carp harvesting. In the June 2019 workshop, the scope of the Plan and the desire for integrated methods of carp control was discussed in more detail. The report of that workshop provides more detail on this (Schirmer et al. 2019).

7. FURTHER ASSESSMENT

The first edition of this report identified key needs for further assessment, with a particular focus on addressing impacts being experienced during plan development. Some of the recommended actions were implemented during 2019 as part of the final stages of the Plan, namely:

- Representation of the industry on the Plan Operations Working Group to enable some direct input, and the representative to provide updates to the industry.
- Increased communication of emerging research findings from the Plan, through newsletters from FRDC.
- Opportunity for stakeholders to respond to emerging findings through commenting on discussion papers on the Bang the Table app, and attending the stakeholder workshop in June.
- Investment by the Plan in a review of previous virus susceptibility trials to identify gaps and areas requiring further assessment, in response to concerns raised about the outcomes of these past trials. This will enable the Plan to make specific recommendations about future needs for additional scientific trials.

- Assessment of consumer perceptions and potential responses to virus release. This was done through the survey of community attitudes described previously.

When impact assessment was first proposed, there was a proposal to include an industry survey to collect data on current production, business size, and business vulnerability. However, as it became apparent that ultimate decisions about and implemented of carp control actions would likely take some years after the Plan submits reports to government, this assessment was not conducted. This is because it is highly likely this type of assessment would be out of date by the time active planning begins for implementation, including planning for mitigation of impacts. Instead, the current size and trajectory of the industry was assessed using existing data sources, and a key recommendation is the inclusion of this type of assessment once planned timing of future carp control actions is known.

Some actions recommended in the Stage 1 report were not completed as part of the Plan, or could be only partially assessed. Where this is the case, recommendations that these actions occur as part of development of carp control strategies beyond the life of the Plan may be made, enabling issues raised that fell outside the scope of the Plan to be addressed in subsequent processes. For example, depending on findings of Plan research, this may include further scientific assessment of issues such as risk of virus mutation, potential for carp to develop resistance to the virus, persistence of the virus in water and on other species, and development of a native fish restocking strategy associated with future action in carp control. The next section provides a list of key recommendations that include a summary of types of information needed to inform action to reduce potential negative impacts and increase positive impacts for the aquaculture sector.

8. RECOMMENDATIONS

Based on the assessment in this report, the following actions should be considered as part of future carp control strategy development and implementation to reduce potential for negative impacts on the aquaculture sector and increase potential positive impacts:

- Provide clear advice on the likely timelines for future decision making about carp control and timing of implementation of carp control actions. This enables aquaculture businesses to better plan for the future, including assessing whether they should make business investments they are currently planning. Associated with this, providing regular updates on progress of decision-making processes is important to improve levels of certainty and support ability to make business decisions.
- Invest in ensuring key questions creating uncertainty for the industry, such as questions on how long the virus remains viable in water or when present on native fish species, and risk of adverse water quality events affecting availability of brood stock, can be answered at a level of detail that enables improved certainty for the industry.

- Invest in identifying regulatory implications of carp control actions to be implemented, whether release of the virus or others. This will require assessment by experts in regulatory and biosecurity issues. This is consistent with a key priority identified in the National Aquaculture Strategy which is *“developing and improving market access for Australian aquaculture products domestically and internationally capitalising on Australia’s clean and green image”* (DAWR 2017, p.4). Aquaculture businesses require clear advice on the specific biosecurity requirements they will need to meet, batch testing, water treatment and any other measures. Once regulatory implications are known, conduct an assessment of their cost impacts on businesses and identify level of investment needed in assisting businesses cope with any cost impacts, specifically whether there is a need for support such as low interest loans or grants to invest in infrastructure, or a need to invest in research developing lower cost tests for virus-free status.
- Ensure enough resources are invested in communications to consumers of aquaculture products as part of carp control strategies. Develop appropriate campaigns to maintain consumer confidence in consumption of produce: this has high potential to offset any decline in consumption related to negative perceptions of produce grown in areas in which the carp virus would be released.
- Invest in early marketing and diplomatic strategies into export markets to reduce risk of impacts from future carp control actions, specifically release of the virus if a decision is made to release.
- Make decisions about restocking early. Following a decision to include restocking, invest in assessing capacity of the industry to supply the required species and volumes, and identifying lead times required to achieve the necessary levels of restocking. Ensure need to also supply the recreational fishing sector is factored into this assessment. Use appropriate programs and processes to contract businesses for restocking, ensuring regulatory conditions are clear and businesses are given an appropriate operating environment.
- Ensure future carp control strategies include appropriate contingency measures for worst case scenarios, which ensure protection of wild native fish in particular
- Provide assistance to those whose business activities are reduced, and, where needed, to support transition to new business activities or employment.

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10. APPENDIX

INTERVIEW SCHEDULE

A semi-structured open-ended question format was used in interviews. The following set of questions was provided to attendees prior to the phone interview.

1. Could you tell me about your business or organisation – the types of fish you breed or grow, your markets, and your history of involvement in the sector?
2. Can you tell me a bit about the challenges and barriers that currently affect your business or the industry more generally? What things make it challenging to maintain or grow your business?
3. What do you see as the potential opportunities for the future of your business and the industry more generally?
4. Has the announcement that a National Carp Control Plan will be developed had any effects on you and your business?
5. What are your views about current effects that carp have on freshwater areas in Australia (good and bad)?
6. What are your views about the methods (if any) that should be used to control carp?
7. Are you supportive of the proposal to release the carp virus? Why/why not?
8. If the carp virus is released, what are the potential impacts on you and your business, and your industry more generally? You don't have to be certain they will happen – we'd like to hear about the impacts you worry might happen, and any positive impacts you think might be possible.
 - a. What are the potential negative outcomes from release of the carp virus for you/your business/your industry?
 - i. What will influence whether these arise?
 - ii. What could be put in place to help avoid/reduce these negative outcomes?
 - b. What are the potential positive outcomes from release of the carp virus for you/your business/your industry?
 - i. What will influence whether these arise?
 - ii. What could be put in place to help ensure these positive outcomes are achieved?
9. Next, we would like to ask if you have you have experienced any challenges or opportunities in the past few years related to changes related to water quality, biosecurity, and capacity/logistical changes, that we haven't already discussed? If so, what have these been?
10. Are there other people or organisations we should be talking in your industry who are likely to want to share their views about carp control and the potential impacts?
11. Is there anything else you'd like to discuss?

These questions were used as a general guide for the discussion. This provided the flexibility for participants to raise topics and questions important to their own circumstances and experience, while also ensuring key topics were included in the discussion. As participants had opportunity to review the topics prior to the interview, the topics for discussion were often pre-empted by the participants themselves rather than being prompted by the facilitator. The interviewer asked follow-up questions to gain further insight into different areas raised by participants.

WORKSHOP AGENDA

National Carp Control Plan Workshop

Considering the potential implications of carp biocontrol for the native fish breeders and growers

8.30am-3.00pm, Friday 23 November 2018

Mercure Hotel, 1 Morgan Street, Wagga Wagga

Agenda

8.30 Tea and coffee

8.45 Introductions & workshop planning

Introductions, what people are hoping to get from the day, outline structure of day and confirm/amend agenda

9.05 Socio-economic impact assessment – Industry feedback

Background to impact assessments, how it is done, and how it will be used to inform development of the Plan, and key challenges. Summary of key issues and questions raised in industry phone interviews with University of Canberra and ask if there are other additional issues/concerns/questions participants would add to this list, this will include discussion of:

- *Current challenges/opportunities for the industry*
- *Impacts of development of the Plan to date e.g. uncertainty*
- *Potential future impact under virus release scenario and key questions about these*
- *Broader issues and questions raised about the National Carp Control Plan*

Check in whether workshop agenda requires revision after this discussion

10.05 National Carp Control Plan – Discussion session with Matt Barwick

An opportunity to ask Matt Barwick your questions about the National Carp Control Plan, status of the Plan, research findings to date and forthcoming etc

10.30 Morning tea

11.00 Science discussion session: Virus epidemiology and transmissibility to other species

Presentation, discussion/question session

11.45 Science discussion session: Water quality implications and considerations under virus release scenario

Presentation and discussion/question session

12.30 Lunch

1.00 Discussion session: biosecurity & market impacts

1.30 Discussion session: ecosystem and native fish recovery, restocking logistics

2.00 Ideas and actions moving forward

A session to discuss what happens next including specific actions and how to best keep discussions with the industry happening. Reflections on the day.

2.45pm Workshop close