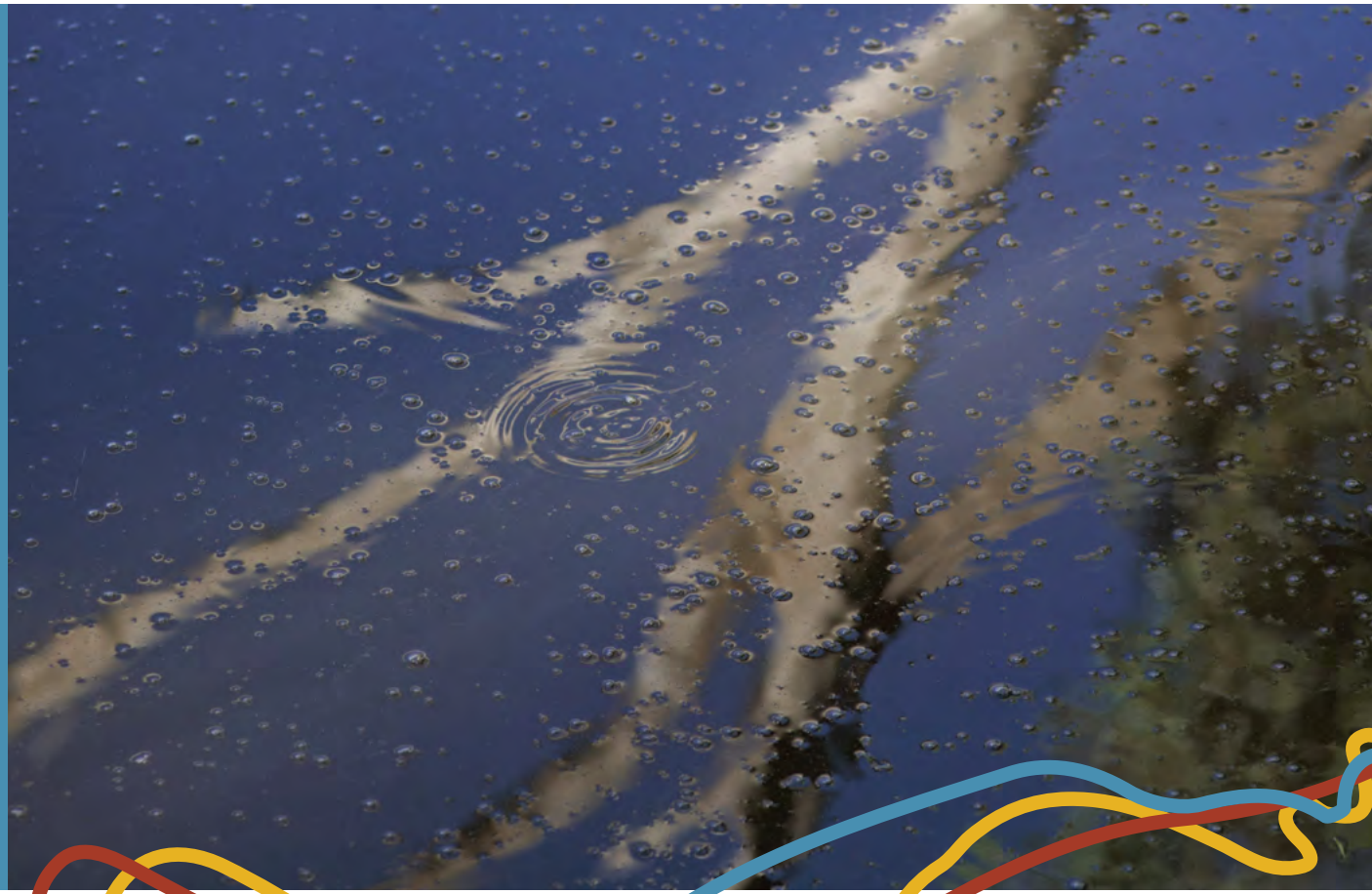
**WHAT ARE THE CARP VIRUS BIOCONTROL RISKS AND HOW CAN THEY BE MANAGED?**

NATIONAL CARP CONTROL PLAN

# The socio-economic impact assessment and stakeholder engagement

**APPENDIX 8**: Socio-economic impact assessment — koi hobbyists and businesses



This suite of documents contains those listed below.

**NCCP TECHNICAL PAPERS**

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

**NCCP RESEARCH (peer reviewed)**

*Will carp virus biocontrol be effective?*

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

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

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

**NCCP PLANNING INVESTIGATIONS**

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

UNIVERSITY OF CANBERRA | HEALTH RESEARCH INSTITUTE

# *National Carp Control Plan socio-economic impact assessment: Koi hobbyists and businesses*

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

**November 2019**

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# ACKNOWLEDGEMENTS

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# CONTENTS

# 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 *koi sector*, which includes people who keep koi as pets (koi hobbyists), commercial koi breeders, and the large range of businesses that supply goods and services to koi hobbyists and breeders, including aquatic vets and aquatic supply businesses.

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 koi 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 hobbyists, 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 the following research: phone interviews with koi hobbyists, representatives of koi associations, aquatic vets, and koi breeders conducted in 2018 and 2019; notes on discussions held during the 2019 Sydney koi show, which was attended by the authors of this report, and surveys of community attitudes in 2018 and 2019 that included questions assessing current and past engagement in koi keeping and likely future engagement in koi keeping if the carp virus is released.

Potential interview and workshop participants were identified through initial discussions with representatives of koi associations, website searches, a stall held at the 2019 Sydney Koi Show, and contact with koi keepers who were identified via their participation in surveys of the general public that included a question asking if the respondent currently or had ever kept koi. A total of 36 people involved in the koi industry, including koi breeders, koi keepers, aquatic vets and those involved with koi associations were interviewed or participated in workshops.

A further 154 current koi keepers and 308 people who had in the past kept koi or lived in a household where a person kept koi, were surveyed as part of collecting broader data on community attitudes, enabling an understanding of views of koi hobbyists about carp control and the carp virus.

**Existing conditions**

Koi keeping is a relatively small hobby in Australia, with koi able to be kept legally as pets in the states of New South Wales and Western Australia and in the Australian Capital Territory, and not in other parts of Australia. Based on two surveys of the general public in which participants were asked if they currently or had ever kept koi, we estimated that the prevalence of koi keeping is more likely to be between 0.4% and 0.6% of the population, mostly concentrated in the states in which koi keeping is legal, albeit with many living in Victoria also reporting keeping koi. If this is correct, between 40,000 and 78,000 people across Australia live in households where koi are currently kept as pets.

The value of koi keeping in Australia is similarly difficult to estimate. Based on very conservative estimates of spending by hobbyists, the koi sector conservatively generated annual expenditure of at least $20 to $52 million Australia-wide in the form of koi keeping costs (power, fish food, maintenance of water quality etc), purchase of new fish, and spending on equipment such as koi ponds, water pumps etc. This would in turn be associated with further generation of value through supply chains, meaning this is an estimate of part of the value of the koi industry only.

For many koi keepers, koi are relatively substitutable for other fish species. However, for enthusiastic koi hobbyists this is not the case, with keepers being very attached to their pets and specifically to koi keeping as a hobby. Similar to other countries in which koi are a

cultural tradition, many people engaged in koi keeping in Australia spend years and decades breeding specific lines of koi for particular characteristics.

**Current constraints**

The small size of the koi sector presents some challenges for the sector. As importing koi into Australia is banned, there is 100% reliance on a relatively small number of breeders and hobbyists for stock, and limited stock of some varieties of koi. The small market means there are limited opportunities for commercial breeders to achieve economies of scale via investing in large-scale facilities. Several interviewees identified that rising costs of electricity and of some koi supplies in recent years have reduced affordability of the hobby for some.

**Impacts of developing the Plan**

The NCCP process created uncertainty for many involved in the koi sector. Uncertainty about the future resulting in psychological distress, stress, mental health impacts was principally occurring for koi breeding businesses and koi associations, due to uncertainty about ability to continue successful koi breeding and koi shows in future if the virus was released. While koi shows have continued as usual during the anticipatory period, some decline in auction sales of koi was observed after the initial announcement of the NCCP, followed by a rebound, and some breeding businesses reported delaying new investment until the future was more certain. To a lesser extent, this has caused some impacts for koi hobbyists, principally in the form of uncertainty about the future.

Participants expressed varying degrees of frustration related to engagement with the koi sector undertaken as part of the Plan. Some felt that research being undertaken in early stages of the Plan did not answer key questions directly relevant to potential impacts on freshwater health in general, or the koi sector more specifically. In subsequent stages of the Plan, review work was commissioned to better identify the biosecurity risks the virus presented for koi and potential mechanisms for addressing these risks.

**Views about the carp virus**

At the time of interviews and workshops, the majority of those interviewed in the koi sector were opposed to release of the carp virus. To assess whether this was also the case amongst the broader koi keeping community, views of those who self-identified as currently keeping koi or having done so in the past about the acceptability of releasing the carp virus were compared to views of the broader community. Those who reported currently keeping koi were more likely to report that they felt releasing the carp virus was unacceptable, with 28.4% reporting this compared to 17% to 18% of those who did not currently keep koi. However, 44.0% reported they felt releasing the carp virus would be acceptable to some extent. This suggests that while those who are highly enthusiastic and committed koi keepers are likely to oppose use of the virus, amongst many smaller koi keepers views are less strong, and less likely to be opposed.

**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 impacts discussed typically may or may not occur depending on how readily the virus transmitted to koi stocks and how exposed koi were, and the effectiveness and cost of biosecurity options to reduce risk. If cost-effective biosecurity options were able to be readily implemented by both breeders and hobbyists, it is likely that there would be relatively little negative impact for the koi sector. If, however, biosecurity options are either not highly effective and/or so costly they cannot be readily adopted, negative impacts are likely to occur. These potential impacts include:

- Psychological distress for both hobbyists and koi breeders if their koi are destroyed due to the virus, with substantial mental health impacts likely for some
- Financial costs of implementing biosecurity measures, and their affordability
- Financial costs of replacing koi that die due to the virus
- A likely reduction in overall numbers of people engaged in koi keeping
- Loss of social connection between koi hobbyists due to less frequent visits to others' koi ponds.

**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 impacts for those in the koi sector, particularly those related to length of time the virus stays viable in water and ability of other species to transport virus particles. However, most were raised as broader concerns of general relevance, rather than as concerns specific to potential for impacts on the industry. These included concern about the likely scale and nature of dead carp resulting from release of the virus, and impacts on environmental health, town water supply, tourism and regional economies. Many koi sector participants felt alternative carp control measures other than the virus should be assessed in more detail.

**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 koi sector:

- Provide a clear timeline for decision making to help enable planning for the future and reduce uncertainty.
- Provide clear and accurate advice on conditions under which the virus could be transmitted to koi and measures to reduce risk for breeders, sellers and hobbyists.
- Invest in identification of appropriate biosecurity measures and their level of likely effectiveness.

- Identify costs of effective biosecurity options, and invest in reducing costs where feasible for breeders, sellers and koi keepers.
- Clear communication of biosecurity options and their likely effectiveness to all involved in the koi sector.
- Assist koi industry to implement phone support for hobbyists and breeders to increase use of appropriate biosecurity measures, and to refer those experiencing distress to appropriate services.
- Establish clarity around regulations regarding transportation and sale of koi if the virus is released.
- Identify how to ensure safe social interactions between koi hobbyists can continue, and clearly communicate this, to reduce impact.
- Potentially provide support for koi breeders to diversify businesses beyond koi, to reduce total impact.

# 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 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, 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 is 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')
- 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')
- Discussion 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 koi hobbyists, koi breeders and associated businesses involved with the koi sector in Australia. Throughout the report this stakeholder group will be referred to as the 'koi' sector.

As identified 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.

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 koi sector is described as far as is possible. 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 koi 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 alongside 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 koi sector, including identifying key gaps in knowledge
- Impacts of the development phase of the Plan on the industry
- Potential impacts of implementation of carp control
- Broader koi sector 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 the activities of a group or industry enables identification of the extent to which impacts on that group/industry have potential to flow-on to have broader impacts for the communities in which that industry operates. In this report, the focus is on understanding the current nature of koi keeping in Australia, both in terms of the number of hobbyists, their attachment to the hobby, and in terms of the businesses that depend on the koi sector.

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 koi sector, 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 for those involved in the koi sector. This report identifies potential impacts with a focus on understanding the conditions under which they could occur and actions that could reduce likelihood of negative impact and, where feasible, increase likelihood of positive impact.

## BROADER INDUSTRY CONCERNS ABOUT POTENTIAL IMPACT AND PLAN DEVELOPMENT

In the interviews and workshops with members of the koi 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 either change their current views about virus release (usually strong opposition) or, more broadly, 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.

# 3. METHODS

This report is based on the following research: phone interviews with koi hobbyists, representatives of koi associations, aquatic vets, and koi breeders conducted in 2018 and 2019; notes on discussions held during the 2019 Sydney koi show, which was attended by the authors of this report, and surveys of community attitudes in 2018 and 2019 that included questions assessing current and past engagement in koi keeping and likely future engagement in koi keeping if the carp virus is released.

### KOI SECTOR PARTICIPANTS

It was important in this initial assessment that a diversity of representatives across the koi sector were consulted to ensure the full range of potential impacts could be identified. The koi sector is diverse. Based on initial discussions with representatives of koi associations, the following types of participants in the koi sector were identified as important to interview if possible:

- Koi hobbyists who keep koi as pets, some of whom also breed specific lines of koi and enter them in shows, with a long tradition of producing specific colourations, scalations and body types that form well over 100 recognised varieties of koi.
- Commercial koi breeders who sell koi to the public, often investing in developing specific lines of koi for decades, with specific breeding stocks built for the purpose of producing specific varieties of koi.
- Aquatic vets who provide care and treatment for koi, and have in-depth knowledge of both koi and their keepers.
- Businesses supplying goods needed for koi keeping, such as ponds, water pumps, water filtration systems, decorative elements used in and around koi ponds, and koi food.

- Australian Koi associations. In Australia, there are three koi associations: the Australian Koi Association, the Koi Society of Australia, and the Koi Society of Western Australia. Each of these associations has multiple local branches, located in New South Wales or Western Australia; while estimates vary, there are at least 2,000 koi keepers who are members of these societies, as well as many more who attend shows and auctions organised by the associations while not being members.
- International koi associations. Internationally, many countries have koi associations, including in countries in which there have been outbreaks of the carp virus. Representatives of these associations have experience in observing the impacts of virus outbreaks on koi keeping and associated businesses over both the short term and the long term.
- Prospective koi keepers: those who do not currently keep koi but are interested in doing so at some point in the future.

Potential interview and workshop participants were identified through:

- Initial discussions with representatives of koi associations, who provided recommendations of people to interview
- Website search identifying koi breeders, supply businesses and aquatic vets, followed by direct invitations sent to those businesses to participate in interviews
- A stall held at the 2019 Sydney Koi Show on 26 May 2019, at which the two authors of this report held discussions with several attendees through the day, as well as recruiting further interviewees who were interviewed after the show.
- A random sample of 25 participants in the 2018 and 2019 community attitudes surveys who indicated they currently kept koi, and who had given permission to be contacted for further research in their survey responses, were contacted and asked if they would be willing to participate in an interview; of these, eight participated in interviews by phone or email.
- Snowball sampling, with each interviewees asked if there were others they recommended be interviewed.

A total of 36 people involved in the koi industry, including koi breeders, koi keepers, aquatic vets and those involved with koi associations were interviewed or participated in workshops. These included:

- Three commercial koi breeders (meaning people who breed and sell to the public; many hobbyists also breed but sell only through informal or limited means and were not considered ‘commercial’).
- 26 koi keepers (many of whom also had other roles such as being involved with koi associations, although those recruited via the community attitudes survey typically had little to no contact with koi associations).

- 3 businesses supplying koi hobbyists other than koi breeders. These businesses supplied equipment such as koi ponds, water pumps and filtrations systems, and koi food.
- 3 people considering starting to keep koi, recruited to participate in the study at the 2019 Sydney koi show, were asked whether and how the potential for future release of the virus would affect their decisions about entering the hobby.
- 5 aquatic vets who have knowledge of the koi sector.
- 8 people directly involved in elected positions with koi associations
- 2 representatives of international koi associations were contacted and discussed impacts of virus outbreaks on koi hobbyists in (i) Japan and (ii) Malaysia via phone, to provide an understanding of typical responses to virus outbreak in those countries.

A further 154 current koi keepers and 308 people who had in the past kept koi or lived in a household where a person kept koi, were surveyed as part of collecting broader data on community attitudes, enabling an understanding of views of koi hobbyists about carp control and the carp virus. These were identified as part of broader samples of the overall community, and hence many of those who had a knowledge of koi were people who had kept koi in the past and fewer kept them currently.

Some representatives of the koi sector also attended two workshops in 2019, one a koi-specific workshop discussing biosecurity measures which was held for a separate project but also provided input to this project; and one a multi-stakeholder workshop held in June 2019 with a wide range of stakeholders.

In addition to data collected in interviews and workshops, at the Sydney koi show, and via community surveys, materials produced by koi associations and koi enthusiasts and published publicly on the internet were searched for and are drawn on in parts of the results section.

## INTERVIEW AND WORKSHOP TOPICS AND ANALYSIS

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

- Their involvement with koi
- Whether the announcement of the National Carp Control Plan had any effects for them/their business (if relevant) or the koi sector more broadly, since it was made
- Their views about current effects that carp have on freshwater areas in Australia (good and bad), and the methods (if any) they felt should be used to control carp
- Their views about the proposal to release the carp virus, including whether they supported this, and what concerns they had

- Potential impacts of virus release for the interviewees and the parts of the koi sector they were engaged with, over the short or long term, including both positive and negative impacts, the conditions under which impacts they identified might occur, and actions that could reduce potential for negative impacts and increase potential for positive impacts

- What actions they felt should be included in any biosecurity strategies that seek to reduce effects on the koi industry if the carp virus is released
- Whether they or others they knew of or represented experienced any challenges or opportunities in the past few years related to disease koi are susceptible to, and/or biosecurity; the impacts of these events; what worked well to help cope with this and what didn't; and the types of support that were useful or would have been helpful.

- Recommendations for other people or organisations in the koi sector the researchers should talk to.

- Any other topics the interviewees wished to discuss.

The one-day workshop held in Sydney in 2019 examined biosecurity strategies, as well as having broader discussions about concerns held about virus release.

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 the koi sector which principally involved discussion of broader concerns about use of the virus, and some limited discussion of biosecurity challenges.

Of the 36 interviewees, 21 agreed to have interviews audio recorded, a further nine participated in discussions by email, and six were interviewed by phone or in person but did not wish the interview to be recorded, with detailed notes taken instead. Those interviews that were audio recorded were transcribed. The koi biosecurity workshop was not audio recorded and instead detailed notes were taken on the day electronically. 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 December 2017, an online survey was conducted which includes some questions about koi keeping. Specifically, 4,627 people were asked whether they had ever engaged in keeping koi or knew anyone who did (a total of just over 6,300 people were surveyed; of these, 5,000 were asked the question about keeping koi, and some of the 5,000 did not answer the question). Participants were also asked a number of other questions about their views on carp control and the carp virus. Participants were recruited via two separate processes, in which questions about carp, including those about koi keeping, were included in:

- The 2017 Regional Wellbeing Survey, a much longer omnibus survey of which carp questions formed only part, and which recruited participants through sending email requests to a long-standing panel of participants and flyers inviting participation to a random sample of new recruits into the survey
- A stand-alone online panel survey, which asked only questions related to carp, and recruited participants from an existing online panel of participants, using quota sampling to achieve a stratified random sample that deliberately over-sampled some specific groups.

The findings of this survey were drawn on as part of estimating numbers of people keeping koi in Australia, but did not ask about potential change in koi keeping if the virus was released.

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 related to the koi sector, specifically whether respondents either currently kept koi, had kept koi in the past, or whether they knew others who kept koi; all participants were also asked the extent to which they agreed or disagreed that they were less likely to keep koi in future if the carp virus was released. 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 asked in the 2017 and 2019 surveys are described in detail 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. KOI SECTOR: EXISTING CONDITIONS

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

## BRIEF OVERVIEW OF THE KOI SECTOR

Koi keeping is a relatively small hobby in Australia, with koi able to be kept legally as pets in the states of New South Wales and Western Australia and in the Australian Capital Territory, and not in other parts of Australia.

It is difficult to estimate the total size of koi keeping as a hobby in Australia, or its total economic value. In surveys of the general community conducted for this project, questions about koi keeping provided some insight into the proportion of people who report either currently keeping koi, having done so in the past, or knowing others who have kept koi. As shown in Table 1, surveys at two points in time, which recruited participants using different approaches, identified reasonably similar rates of koi keeping. In 2017, 1.9% of participants recruited in the stand-alone carp survey, and 1.1% of those recruited via the larger omnibus Regional Wellbeing Survey that does not have a specific focus on carp, reported currently keeping koi (2017). In 2019, when participants were recruited into a specific survey whose main topic was examining carp and a slightly different wording was used, 1.9% reported having kept koi regularly/for a long time (2019).

It was considered likely that estimates of koi keeping collected as part of surveys in which the main topic was carp would be overestimates. This is because koi keepers have a stronger interest in carp management than the general population, something that will make them more likely to opt to complete a survey about this topic. In both interviews and survey findings, keepers had substantially higher awareness of carp and the carp virus proposal compared to the broader public. The large difference in prevalence of koi keeping reported in the omnibus survey sample is consistent with this hypothesis, with only 1.1% of respondents who participated in a survey not focused primarily on asking questions about carp control keeping koi, compared to 1.9% recruited to complete a survey whose topic was advertised to potential participants as asking about carp management.

The 1.1% may still be an overestimate. Aquatic vets and some koi keepers interviewed for the project identified that many people confuse koi and other smaller ornamental specie. While this would not occur for any serious koi keeper, it can occur for people living in households who are not primary pet owners. This is likely to lead to an overestimate of koi keeping in the survey data.

While this could not be directly assessed, as participants in self-report surveys are not able to self-assess the accuracy of their species knowledge, it was indirectly assessed by comparing rates of koi keeping reported by different groups in the population likely to have

greater versus lesser knowledge of koi keeping. In interviews, many identified that koi keeping is more common amongst many (although not all) people of Asian descent, with awareness of koi also higher amongst these groups due to the higher rates of koi keeping. As part of the 2017 stand-alone survey, a large comparison sample was collected of people who were of Asian descent, primarily Chinese, Japanese, Malaysian, Indonesian and Vietnamese. Amongst this group, as reported in Table 1, only 1.4% reported keeping koi currently, much less than the 1.9% who reported keeping koi in the representative sample of adults. This suggests there may be high rates if misidentification amongst respondents not of Asian descent with limited knowledge of ornamental fish species, as those of Asian descent were much *more* likely than others to report having kept koi in the past (9.4% compared to 5.5%), and knowing others who kept koi (21.5% compared to 14.9%).

**Table 1 Prevalence of koi keeping in the Australian adult population, 2017 and 2019**

| | December 2017 survey | | | May 2019 (n= 4428, representative sample achieved through quota sampling of online panels) |
|---|---|---|---|---|
| **Weighted** | **Participants recruited in omnibus survey** | **Participants recruited in stand-alone carp survey** | **Participants of Asian descent recruited in stand-alone survey** | |
| I have never done this and I don't know anyone who does | 80.8% | 77.7% | 67.6% | 82.2% |
| I have never done this but I know other people who have | 15.4% | 14.9% | 21.5% | 10.7% |
| Yes, I've done this but not for a while | 2.7% | 5.5% | 9.4% | 5.1% |
| Yes, I do this and have done it recently (2017 wording), Yes, I've done this regularly/for a long time (2019 wording) | 1.1% | 1.9% | 1.4% | 1.9% |

This suggests that even the 1.1% estimate reported by omnibus survey respondents may be a significant overestimate: as the 1.4% of Asian-descent respondents who reported keeping koi came from the stand alone survey, it is likely to be a significant overestimate due to the salience bias issue identified above.

For the general population, the comparison of the two 2017 samples suggests that actual rates of koi keeping are 54% of that reported in surveys focused on carp in which there is a salience bias when recruiting people (the ratio of 1.1% to 1.9%). If it is assumed that those of Asian descent are highly likely to accurately identify koi species (close to 100% accuracy), and keep koi at the same rate as others in the population, then findings of the 2017 stand-alone survey suggests at least 28% of those in the general population mis-identify koi species for others. This means that and that the actual prevalence of koi keeping is the actual prevalence of koi keeping should be estimated at no more than 72% of that reported, suggesting actual koi keeping is currently undertaken by no more than 0.78% of the population. Finally, however, with those of Asian descent reported to have a higher likelihood of engaging in koi keeping, this 0.78% is still likely to be an overestimate. Given

this, it is considered likely that actual prevalence of koi keeping is more likely to be between 0.4% and 0.6% of the population.

This estimate reflects largely legal koi keeping, with those who reported keeping koi largely living in areas in which it is permitted. This is shown in Table 2, where despite prevalence being over-reported (as identified above), there are clear differences in prevalence between different states (Table 2). In both NSW and WA, koi keeping rates were double the rates in other states in 2019. In Victoria, despite a ban, 2.4% of respondents reported currently keeping koi, similar to rates reported in Western Australia and New South Wales. In other States where koi keeping is not permitted, around 1% of people reported currently keeping koi. As these are all over-estimates, this would in reality be a much smaller proportion in the states in which koi keeping is not legal.

**Table 2 Rates of koi keeping by state/territory, 2019**

| | ACT (n=208) | NSW (n=714) | NT (n=83) | Qld (n=840) | SA (n=842) | Tas (n=230) | Vic (n=578) | WA (n=1003) |
|---|---|---|---|---|---|---|---|---|
| I have never done this and I don't know anyone who does | 84.1% | 80.2% | 88.9% | 87.6% | 82.0% | 88.6% | 82.4% | 77.3% |
| I have never done this but I know other people who have | 9.1% | 12.0% | 7.5% | 8.4% | 11.7% | 8.3% | 9.6% | 13.3% |
| Yes, I've done this but not for a while | 5.8% | 5.5% | 2.4% | 2.9% | 5.2% | 3.1% | 5.6% | 6.8% |
| Yes, I've done this regularly/for a long time | 1.0% | 2.3% | 1.2% | 1.0% | 1.2% | 0.0% | 2.4% | 2.6% |

Given that koi keeping often occurs as a household activity, the data presented above suggest that somewhere between one in every 200 people and one in every 300 households has a current association with keeping koi. If this is correct, between 40,000 and 78,000 people across Australia live in households where koi are currently kept as pets.

The commercial side of the koi sector is complex, and ranges from koi breeders who have established often large koi farms with large numbers of ponds. Some of these predominantly sell wholesale to retail shops that then on-sell, while many also open and sell direct to hobbyists and the public. In addition to these commercial breeders, many enthusiasts breed koi and sell within clubs at regularly held auctions. This means the koi business environment ranges from full hobbyists through to commercial operations selling to aquariums as well as to koi clubs and individual enthusiasts.

For all those who breed, the focus is on breeding to achieve koi that meet pattern, scalation and colour quality specifications for the many different varieties of koi.

> *It's pattern and colour quality. … the Japanese are probably the main ones that instigated, bred the breeds that we have today. And so, it's colour, and pattern, and body shape and things like that. There's certain criteria for them. When they judge them, they really*

*scrutinise where the colour is and things like that. For example, a Kohaku is a red and white fish and it can't have a red nose, it's got to have a white nose and the colour has to hue down between the eyes. They look at the lines between the colours, the crispness of the colour, and they've got terminology for all that. I guess from a novice point of view, the easiest way to look and decide whether it's a good koi is if it's pretty. It's honestly like looking at a... Someone said to me once … "It's like looking at a work of art, a picture, a painting. You might love it, I might not." And so, everyone's got individual tastes. You look at them, and if you like it, well that's all that matters. That's what I always tell people. Koi breeder #1*

For some koi keepers, particularly smaller keepers, koi are relatively substitutable for other fish species. However, for enthusiastic koi hobbyists this is not the case, with at least 2,000 highly enthusiastic koi hobbyists being members of koi societies in Australia (Koi Society of Australia 2015), and the number of 'keen' hobbyists who would find it difficult to switch to keeping other species likely to be substantially higher than these 2,000 members. Koi differ to other pet fish in many respects, and many keepers keep koi, grow them on and auction them, or breed them, often moving on to koi after keeping other types of fish:

*…the fact they get so big, and they are a big fish, and they're very long living as well. I mean, I don't know if this is true, but I've been told there are fish in Japan that are over 300 years old. And I would tend to believe that because, look, I've got fish that I bought, and I knew they were about 25 years old when I bought them, and that was 20 years ago. And, they haven't grown a lot, they haven't changed much, so that's a 45-year-old fish that I know of. I wouldn't be surprised if they could live that long. I personally haven't done any breeding yet. I prefer to get them small and grow them on and then sell them at the auctions. Koi hobbyist #1*

*So, this is just a hobby since … I always liked fish. So, 1991 I started keeping Koi a bit more keenly. I found, through the Yellow Pages back then [a local Koi farm] … I went there and basically got hooked onto the actual Koi thing. Before it was just normal tropical fish. Or a goldfish kind of level. Just garden pond. Koi hobbyist #2*

The value of koi keeping in Australia is similarly difficult to estimate. In interviews, hobbyists were asked to estimate their overall expenditure on their hobby annually. Those recruited to interviews via the community surveys, who were generally small hobbyists with somewhat less strong attachment to koi, typically reported spending $400 to $800, with an average of $600 a year. Those who were 'committed' koi keepers, particularly those who were members of one of the koi societies, typically spent much more, reporting between $1,500 and $5,000 annually, with more reporting towards the bottom of this range.

Based on an estimate of annual spending of $600 by smaller hobbyists and $3,000 by enthusiastic hobbyists (many of whom in reality spend significantly more than this on the hobby, for many extending into tens of thousands of dollars), the industry conservatively generated annual expenditure of at least $20 to $52 million Australia-wide in the form of koi keeping costs (power, fish food, maintenance of water quality etc), purchase of new fish, and spending on equipment such as koi ponds, water pumps etc. This is highly likely to be an

underestimate, as it does not include the larger amounts of spending by very keen koi hobbyists, and it is also likely that many koi keepers underestimate expenditure on koi keeping when attempting to do so in an interview.

This estimate is also only of expenditure by koi hobbyists. This would in turn be associated with further generation of value through supply chains, meaning this is an estimate of part of the value of the koi industry only. The total value of koi keeping in Australia would be significantly higher than this.

Similar to other countries in which koi are a cultural tradition, many people engaged in koi keeping in Australia spend years and decades breeding specific lines of koi for particular characteristics. They report that their koi are important to their wellbeing, with enthusiastic hobbyists having a very strong attachment to their pets, and describing their koi ponds as places they could de-stress, relax, and recharge:

> *I can get home at the end of a hard day, and just sitting near the pond, watching them, it's … like my form of mindfulness – Koi hobbyist #10*

Social interaction is a core part of the culture of koi keeping, with koi enthusiasts often visiting each other's ponds and reporting strong positive social outcomes from their engagement in koi keeping. The close knit nature of much of the koi hobbyist community was identified as a strength of the community, and were reported to be key sources of social connections and friendship for many involved in the hobby.

## CURRENT CONSTRAINTS

The koi industry is a relatively small hobby in Australia (Koi Society of Australia 2015). The hobby is only permitted legally in two states and one territory, and import of koi from other countries is banned. The domestic hobby is therefore reliant on Australian breeders.

### *SECTOR SIZE AND LINKAGES TO OTHER COUNTRIES*

The small size of the koi sector presents some challenges for the sector. As importing koi into Australia is banned, there is 100% reliance on a relatively small number of breeders and hobbyists for stock, and limited stock of some varieties of koi.

The small market means there are limited opportunities for commercial breeders to achieve economies of scale via investing in large-scale facilities. The import ban combined with relatively small numbers of commercial breeders also means that there is a high risk of loss of unique breeding lines with any disease outbreak, and that it can be more difficult to enter the hobby:

> *We can only breed with what we've got in, was brought in say 30 odd years ago or whatever, before the ban got put on. So, a lot of old stock, but considering that I don't think we do too bad really. Koi hobbyist #4/breeder #2*

*We're hampered somewhat in Australia because for 20 years or more we've not been allowed to import koi from overseas, from Japan or Israel or America, so that means everything here is home produced. That means that there's some costs and logistics involved in maintaining blood stocks and that, I think, wears on people's minds. That's one of the reasons we don't get quite as many coming into the hobby that are brand new. In Europe and the USA where koi are imported freely from Japan and Israel, they're readily available from dealers and breeders, it's easier for people to start up the hobby and go into it, whereas here, it's a little bit more laborious and a bit more effort involved. Koi representative #3*

### *RISING COSTS*

Several interviewees identified that rising costs of electricity and of some koi supplies in recent years have reduced affordability of the hobby for some. The costs of establishing a koi pond were also described by some as presenting a barrier to some entering the hobby.

### *LIMITED CONNECTIVITY*

The small size of the hobby and large distance between the two key areas in which it is permitted reduces ability for hobbyists to interact at places like shows, although a large number of auctions and several shows are held each year in both NSW and WA.

# 5. IMPACTS OF DEVELOPING THE PLAN

This section examines whether and how the development of the National Carp Control Plan has affected the koi sector. 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 koi 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 susceptible koi would be to the virus, the types of investment in biosecurity needed to protect koi, and the cost of that investment for commercial breeders and hobbyists.

Uncertainty about the future and feeling a lack of control over decisions that affect your life are 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). While most of these studies have examined anticipatory impacts experienced by those who are employed in an industry in which a change has been proposed, it is likely that those engaged in a hobby they have a strong connection also have potential to experience these types of impacts.

In interviews, members of the koi sector, including both businesses engaged in breeding and providing supplies, and hobbyists, were asked how this period of uncertainty had impacted them directly, and the industry more broadly.

The NCCP process created uncertainty for many involved in the koi sector. Uncertainty about the future resulting in psychological distress, stress, mental health impacts was principally occurring for koi breeding businesses and koi associations, due to uncertainty about ability to continue successful koi breeding and koi shows in future if the virus was released.

While koi shows have continued as usual during the anticipatory period, some decline in auction sales of koi was observed after the initial announcement of the NCCP, followed by a rebound, and some breeding businesses reported delaying new investment until the future was more certain. Breeders did not report an ongoing decline in demand, but did have many customers expressing uncertainty about their likelihood of staying in koi keeping if the virus was released, and some felt demand had declined:

> *I've got some contact with the koi farms … and they've commented to me before that since the announcement [of the NCCP] they've seen significant drop in their orders, and I can't tell you whether that's directly because of the announcement or not, but they feel that it is. Koi representative #2*

> *People still had the auctions, but people at the auctions were less than what they were in previous years when the thing was just going on normally. As soon as the mention of the virus was introduced to wipe out carp in the wild, then everyone started talking about, "What about my pond? If some fish come into my pond it'll kill all my koi" … The main diehards within the koi association kept their sales going. They did drop off in sales, as I did in the shop. I had a drop off in sales of the koi that have been sold in the shop. Koi retailer #1*

> *I think initially there was a little bit of a pullback from koi. People thinking, "Oh no, I need to find something else to put in my pond. When they bring this out all my fish are going to die." And, a couple of people I supply actually said, "The customers have said they don't want koi anymore because they're going to be no longer." That was initially, and now that the plan's been postponed … not so much now. … a lot of my Asian clientele come from countries where the disease is endemic anyway … they're like, "Well, we had it over in Indonesia," or, "We had it in China. What's the matter? We know what it is. It's not a new thing to us and we know what precautions to take to stop it spreading." Koi breeder #1*

To a lesser extent, this has caused some impacts for koi hobbyists, principally in the form of uncertainty about the future. Key concerns were about whether in future their koi would be exposed to the virus and what if any actions could reduce risk of this:

> *If your concern is mitigating against unintended consequences or unintended spread, for example, you need to know whether it's going to be able to be transmitted by dirty mud. You need to know whether water based transmission is going to occur, whether birds can transmit this virus, whether boat bilges can transmit it, because if you don't have that information, your assumption is that it won't happen, and then your model says, "Oh no, because we're only going to release it here, where there's heavy fish to fish contact, therefore the spread will be limited to that area and we can control it," but if one infection happens by another vector, then you've got fish to fish contact occurring there and suddenly you've got a far greater outbreak and a much less manageable outbreak than you originally had. Koi representative #2*

> *I have asked the question, but no one seems to answer it. I thought, "Well if it's in a river and it's in my waterway and I turn the tap on", which you know, you've got to top ponds up from just evaporation and things like that, "Would I end up having to have water tanks and that because it could come through the pipework?" Koi hobbyist #4/Breeder #2*

> *Individuals who actually have smaller operations would want to know how they're going to protect their operations from when this virus is released, because they have no way of protecting their environment if this virus gets put into their establishment by birds or by individuals or by other people walking in there and causing problems. They haven't got a clue about what's going on. They are a bit apprehensive at present, because they think their establishment may get wiped out or may get killed off for the sake of having bred koi. …There will be a lot of anxiety amongst all the koi breeders amongst all that situation happening. Koi retailer #1*

> *We need to understand how it's transferred and then we can tackle it. Yeah. At the moment you can't find a solution without knowing what the problem is, I suppose. … And I guess that's a thing, because it is quite sad. I mean, would that mean, I suppose... this is again in the short term, or just being ugly but, would it mean that now, if I see a water dragon, I have to kill it? … Just because I'm paranoid? Or see a bird? I have to have a complete net over my pond? So, yeah, it would completely change the hobby. And I suppose the unknown is what probably what makes it worse. We react worse when we don't know what the solution is. So, yeah. I don't think I can answer how you can trust biosecurity, when you don't know how it spreads, and how it's actually meant to control it. Koi hobbyist #2*

A small number reported delaying investment in new koi or equipment for koi keeping:

> *To be honest, I've cut down my investment … I have slowed for the last, probably, two three years. … Maybe a bit paranoid of one day I might lose the whole thing …with the internet now, you get to know people across the pond, really. … You do come across a lot of hobbyists in South Africa and America [where the carp virus has occurred], that well, basically, you're*

*sharing photo of the whole dead collection. … it's kind of put perspective on what could happen to us if one of us do get this KHV virus into our pond. Koi hobbyist #2*

*Well, personally it hasn't had much really impact on me at this stage. Initially I thought, "Ah, it's been announced," you know, the prices of the koi and the fish, in the club, would go up … but I don't think it really has. But there's more of a bit of a nervousness about people swapping orders, swapping nets, contaminating and things like that. Koi hobbyist #1*

Participants expressed varying degrees of frustration related to engagement with the koi sector undertaken as part of the Plan. In particular, representatives of koi societies and aquatic vets felt that the experience of other countries in terms of biosecurity challenges for koi owners, and in terms of the efficacy of the virus for long-term reduction of carp populations, was not drawn on sufficiently. Some felt that early statements made about potential impacts on the koi sector were dismissive of the concerns of the koi sector, particularly about the potential impacts of virus outbreaks on supply of quality koi in Australia given the ban on imports.

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.

*There's been a lot of information that was promised over time and none of it has eventuated. There have been a lot of assurances, like there will be biosecurity measures available, that there are simple things that can be done, but none of that has ever been provided. The complication relating to that is the sources of those biosecurity studies are known to the people here and they don't support the use of those methodologies as a way to safely go up against the viral infection. Koi representative #2*

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.

Similar to stakeholders in some other sectors (particularly those involved in native fish aquaculture), many in the koi sector, particularly enthusiastic hobbyists, had relatively 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. However, not all held these concerns: smaller hobbyists, and one aquatic vet interviewed, had fewer concerns. The vet felt the process of evaluating feasibility of virus was robust and well communicated.

Those who held concerns typically felt that research being undertaken in early stages of the Plan did not answer key questions directly relevant to potential impacts on freshwater health in general, or the koi sector more specifically.

In particular, their uncertainty about the future of koi keeping as a hobby was exacerbated by lack of clarity about the following:

- How long can the carp virus stay live in water without a host? Several felt that there was conflicting and unclear evidence about this, with evidence from other countries suggesting the virus could stay live for longer than some studies cited in early NCCP studies suggested. This is critical as koi are kept and transported 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. A critical question related to whether the virus could stay viable for sufficient time to be present in domestic water supplies used to supply ponds.
- 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? Most hobbyists reported that their bonds were regularly visited by birds, small mammals and reptiles, and amphibians such as frogs. They wanted to know how long virus particles could stay viable if carried on these. Lack of clear evidence about this increased uncertainty about the future.

In subsequent stages of the Plan, review work was commissioned to better identify the biosecurity risks the virus presented for koi and potential mechanisms for addressing these risks. However, concern remained from several interviewees who felt that the concerns being raised by those in the koi sector had not been taken seriously in early stages of the NCCP, despite many emphasising they also had respect for the effort and work put in by key NCCP staff.

At the time of interviews and workshops, the majority of those interviewed in the koi sector (with the exception of those who were recruited from community surveys) were opposed to release of the carp virus.

To assess whether this was also the case amongst the broader koi keeping community, views of those who self-identified as currently keeping koi or having done so in the past about the acceptability of releasing the carp virus were compared to views of the broader community. Those who reported currently keeping koi were more likely to report that they felt releasing the carp virus was unacceptable, with 28.4% reporting this compared to 17% to 18% of those who did not currently keep koi. However, 44.0% reported they felt releasing the carp virus would be acceptable to some extent. This suggests that while those who are highly enthusiastic and committed koi keepers are likely to oppose use of the virus, amongst many smaller koi keepers views are less strong, and less likely to be opposed. This may be because many smaller koi keepers have a less strong attachment to koi and greater ability to substitute koi for other species, something suggested by three koi keepers in interviews:

*For me, koi are everything and I couldn't keep anything else – but some people just keep koi for a year or two, or don't even know exactly what species they have in their pond, and could just as easily keep something else – Koi hobbyist # 7*

*Yeah, I keep koi, but it's only a couple, and I just like having a pond with fish in it – Koi hobbyists # 12*

**Table 3 Views about acceptability of releasing the carp virus in Australia**

| | Have you ever kept koi? | | | |
|---|---|---|---|---|
| **How acceptable would you find … reducing numbers of carp (a pest fish) by releasing the carp herpes virus** | **I have never done this and I don't know anyone who does (n=2713)** | **I have never done this but I know other people who have (n=1545)** | **Yes, I've done this but not for a while (n=197)** | **Yes, I do this and have done it recently (n=66)** |
| Unacceptable | 17.2% | 17.8% | 17.6% | 28.4% |
| Neither acceptable or unacceptable | 8.5% | 10.2% | 14.6% | 9.8% |
| Acceptable | 48.1% | 54.2% | 53.1% | 44.0% |
| Don't know | 26.2% | 17.9% | 14.7% | 17.9% |

# 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) loss of koi by hobbyists, ii) loss of breeding stock for koi breeders, iii) change in social connection between koi hobbyists, and iv) change in overall engagement in koi keeping in Australia. As the impacts described in these four sections all depend on the extent to which koi could be exposed to the virus and the ability to implement effective biosecurity measures, before examining each area, key issues and gaps in knowledge about potential exposure risk and biosecurity measures at the time this assessment was undertaken are identified.

Many people interviewed from the koi sector preferred to discuss their concerns about the use of the virus more generally, particularly concerns about potential for virus mutation and water quality impacts that would have an impact on a range of species. It was typically only after discussing these concerns that they were willing to talk about potential impacts on koi keeping and associated businesses in Australia. The impacts listed below are specifically related to the impacts of a decision to release the carp virus: other carp control methods were not considered likely to cause any meaningful impact for the koi sector.

## POTENTIAL RISKS TO KOI AND BIOSECURITY

The impacts discussed in the next sections are predominantly negative. All are conditional on one or more of the following occurring:

- The virus readily transmitting to koi stocks, and the potential vectors of transmission; as highlighted in the previous section, many wanted more specific information on transmission risk in different situations
- Biosecurity options being relatively ineffective at reducing exposure of koi to the virus, either in breeding facilities or in hobbyists koi ponds
- Effective biosecurity options being too costly for most hobbyists or breeding businesses to implement.

Multiple questions were raised about transmission via water, air, animals and humans, and how to minimise risks of both unintended and intended transmission. Many koi businesses and those involved in koi associations had held multiple discussions with those involved in the koi sector in other countries in which virus outbreaks had occurred, and asked multiple questions based on what they had heard from those contacts:

> *I think my business is relatively well insulated because, probably the closest waterway that could be affected [by carp] might be [NAME] River …. as the crow flies, it's probably 50 kilometres away. Not to say that a bird could pick a fish up there and fly straight to my farm and be carrying that virus. So, I'm not saying it can't happen, but... I have heard from [koi farmer in another country], that he believes the virus could be airborne. Short distances on water molecules in certain climatic conditions. And that's how he feels his farm … got infected a few times. From basically a farm that's only a couple of kilometres away that has the virus. … he seems to think when the wind is blowing the wrong way, he gets the virus blown in. So, that's probably unlikely to happen to my farm because of the potential distance from a river or whatever that could be infected. But I'd have to be really, really careful which I already am as far as quarantine and bringing fish into the farm. I've basically been a closed farm for about the last 10 years probably. I haven't really brought any fish in at all, because there are other pretty nasty things out there that were getting around for a while. Koi breeder #1*

> *The virus can come in in a number of different ways. You can walk it into your property without washing your boots or your shoes or your feet. You have migrating birds can do that. You can have cormorants can do it, and other kingfishers can do it. They can go and kill a koi in the wild, pick it up, eat it, and get the virus on their feathers and on their feet, pass it through from their, go and land on another waterway and pass it on from there. That could happen anywhere. It can also happen by disgruntled people who don't like certain people … The koi people just wouldn't have the money to fence off their properties to such the extent that nothing like that could happen. It's near impossibility. It'd cost them thousands and thousands and thousands of dollars. They just wouldn't have those type of funds to do it. Koi breeder #3*

*Well birds fly across water and grab fish anyway, so if there was a carp near the top that had a bit of a virus, the bird can grab that fish, and all of a sudden the bird eats that fish, so the bird's now carrying the virus. You know how far birds can fly? Koi hobbyist #1*

*…being a virus, and from what we again heard, is either it could be easily transportable by just birds that happen to be dipping their feet on the affected waters, and fly back to our ponds and so on. … So, yeah, obviously the most direct concern is obviously to the actual collections and to the hobby overall. Koi hobbyist #2*

*…from the Koi hobbyist point of view, Koi is a garden pond fish. So, it's not like an aquarium, where we have it inside the house. … Pretty much all Koi hobbyists that I know of, it all started as just an addition to the garden. So, I almost can probably say 99% would be having the fish outside. And part of the beauty of it... almost all of us, especially in Sydney, have water dragons in our ponds … I think it becomes a very open system. And one of the challenges of keeping Koi is you do suddenly get parasites, which we get from skinks and water dragons. All their little... which we handle … But, just the fact that there are members that haven't been buying or selling, or moved their fish for years and suddenly get this parasite … it just proves that being an open system, in the open natural environment, you can't control every aspect of it. Koi hobbyist #2*

There were varying views about biosecurity, with a common concern being about the length of time koi would need to be isolated, particularly during cooler months when there was a possibility of koi having dormant virus presence that might become activity in warmer temperatures, and the feasibility of using technologies that heat water to destroy the virus:

*I'd definitely have [new koi I bought in] in an isolated tank where I could monitor them, and it would be well and truly separated from the rest of the farm, water supply, everything like that. And, I'd want to quarantine fish for at least 12 months because some of these diseases only show themselves in certain seasons. They come out in spring. The Aeromonas bacteria's a bit like that. It can lie dormant through winter and then in spring when the bacteria speed up, it comes out. … At least 12 months would be the quarantine period and that sort of thing. … the guy in [other country] told me, he said he only buys from farms where they regularly test all their fish and so, there must be some blood test or something that they can do there. Koi breeder #1*

*…if they're thinking that the introduction of rigorous biosecurity is going to solve the problem of the virus being released and its impact on the koi hobby, it's not. The bio securities that I've mentioned with thermo cycling and that sort of thing is completely and utterly beyond the capabilities of koi hobbyists. It can't be done. The logistics inside the tanks, the cost involved, the time, it's not something that a hobbyist could do. In the UK it's done by the dealers, but they're then adding that cost on to the selling price of the fish so they're recovering the cost. A koi hobbyist couldn't do that. We're not going to be able to implement anything like rigorous enough biosecurity. It's just not possible. One of the other things that's often flagged up is the opportunity to inoculate or immunize koi against CyHV-3 in the same*

*way that pet rabbits are often inoculated or reinoculated against the calicivirus strains as the government releases those to take care of wild rabbit numbers. That's not viable either. The cost involved would be extraordinary. I'm a relatively small hobbyist in terms of the number of koi that I keep, and I've got about 40. Some the guys have got thousands. If you sort of get an idea of how much a course of injections would be per fish, you could be talking tens of thousands of dollars just to immunize your fish against the virus, so that's not on. The efficacy of the inoculation itself is questionable. Koi representative #3*

*…to be more specific on the biosecurity side of things, several statements have been made previously by various scientists involved in the program suggesting what those biosecurity processes would be, and I think it's fair to categorize them as massively over-simplistic. "All you have to do is get a simple aquarium heater, and you'll make your fish immune," or, "All you have to do is screen off water or do your water changes from a vessel that you've allowed water to stand in for up to four days because it won't survive much longer than that." ... If you look at the full body of studies globally, it doesn't support those assertions …if you've got a pond with 50,000 litres, or 100,000 litres of water, which is more common than you would think, the chances of ramping up the heat on a facility of that size is just ... The physics of it are impossible. … there was a guy in the US who advocated thermo cycling for quite a while, and it worked. It seems to work from the limited research that he'd done. The problem was, it bleaches the fish. You do it in a rapid period of time, if the fish lose their color, they lose their value and their appeal to the hobbyist. They become worthless, so yes, you've saved your fish, but they no longer have value which is sad. … The other suggestion that's been offered up on a biosecurity point of view was UV sterilization. UV sterilization is almost universal in pond keeping because they use it to control algae and green water situations, but most of those commercially available UV sterilizers are not to a standard where they're effective on viruses. There may be some out there, but I haven't seen them used by koi keepers and I certainly haven't heard that they're effective from the countries that have KHV. I've not heard of that, so I think if it worked, they would have done it. It just seems too simple. Either there's a really, really high cost overhead in having that happen, or it doesn't work as advertised. Koi representative #2*

Some discussed biosecurity measures introduced at koi shows in the last decade, querying whether they would be sufficient to enable koi shows to continue successfully, or whether there was inability to introduce further biosecurity measures on top of those already introduced:

*When we used to show fish years ago when I first started, if we had a class fish or that's fish, we'd put all our fish in the one bin of that class. Right, so the judges could walk straight over and look in that pond and that fish all were in there. What happens now is, we all have our own ponds. And the judges have got to walk from one tank to the next, so they've got the numbers of which the size fish or what sort of variety it is. And they've got to walk from one to the other. So, that's where it changed in shows overseas mainly to start with, and then we started that about six or seven years ago. Koi hobbyist #4/breeder #2*

If cost-effective biosecurity options were able to be readily implemented by both breeders and hobbyists, it is likely that there would be relatively little negative impact for the koi sector, as those who have high attachment to or enthusiasm for koi would be able to protect their pets from the virus with high certainty that the actions they take will be effective in reducing risk to a very low level.

If, however, biosecurity options are either not highly effective and/or so costly they cannot be readily adopted, the types of negative impacts described in the following sections could occur, depending on whether koi are exposed to the virus. Many interviewed would not trust recommended biosecurity options unless they either had personally been able to review studies into their efficacy, or people from the koi sector they trusted had been able to.

A separate NCCP project investigated the different mechanisms by which koi could potentially be exposed to the virus, the risk of exposure via these different mechanisms (for example, exposure through water used to fill koi ponds, introduction of new koi into ponds, frogs or other amphibians transporting virus particles to nearby koi ponds), and potential biosecurity mechanisms.

## POTENTIAL IMPACTS: LOSS OF KOI BY HOBBYISTS

Koi hobbyists are often highly psychologically attached to their pets, similar to other animal owners. Loss of koi due to the virus, or having to destroy koi known to have been exposed to the virus, will have significant negative psychological impacts, causing high distress. Some interviewees referred to reports of koi hobbyists in both Australia and other countries experiencing significant mental health impacts from loss of koi due to the carp virus or other causes, including reports of suicide by some. For those who have this high attachment, the mental health impacts have potential to be significant if koi are affected by the virus:

> *Typically what happens in other countries … once an outbreak [of the carp virus] happens in a pond, all fish are destroyed. They might not have all died from the virus … but the remaining fish are carriers and, as a result, the protocol is to destroy the remainder of the collection because you can't introduce any new fish and you don't want to risk being the source of an outbreak to other hobbyists. Typically they destroy the fish and they disinfect the facilities which is a very involved and expensive process. There's further impacts. I've heard of people committing suicide as a result of that, and, when it's a lifetime of work, I guess it's understandable. I know that there have been suicides in Australia, not from KHV outbreaks, but from people losing their life's work in terms of a particular line that they'd bred up or something along those lines and then they make a mistake. They leave a filter turned off for a period of time, and then they come home and all their fish are dead. You can't assume or think that that would be an outcome that's common, but it does happen and the high end guys are beyond passionate about this hobby. Koi representative #2*

*The KHV is pretty horrible. It tends to erode the gills and the internal organs so it's a pretty lingering painful death for the carp. What you basically have to know as a koi keeper with something like KHV, you're going to have to kill your entire collection. You can't cure it. You can't risk if a fish survives it not being infectious to other fish in the future, so you're basically going to have to shut everything down, kill all the fish, sterilize everything and then start again. From a financial point of view, we're talking ten to hundreds [00:27:35] of thousands of dollars worth of stock loss, depending on your collection. Mostly, it's sounds daft when you talk about fish, but the bottom line is these are pets. Any pet keeper will tell you when you're seeing your pet suffer, it's very unpleasant. Koi representative #3*

The psychological impact of losing koi also has potential effects on overall engagement in the hobby. Several koi hobbyists interviewed described that they felt they could not remain in the hobby if their current koi – often bred over long periods – had to be destroyed due to the virus, due to both the psychological and financial impact of the loss. The unique nature of koi keeping in Australia may increase the risk of impact, as some feel it fosters a closer attachment to koi as pets due to lack of ability to readily replace stock:

*In [other countries] they're more finding the pain from the financial point of view, because ... the show fish outside Australia... are a lot more expensive, because they're imported from Japan, and there's a bigger market. … So, when they lose a collection, they're losing a lot of money... like hundreds of thousands of dollars. For us, probably, the value I guess is more of because we can't import this fish. In Australia, the fish are more like a pet. So, we actually raise them, we breed them ourselves. Or we breed them. Or we buy, or we swap from the members. So it's a very close environment, where we can't just buy fish from overseas and bring them in. So, we probably don't have the value... in terms of dollar value... it's obviously slightly different to the rest of the world. But we can see this fish from the very literally from the egg. So, it has a different attachment. So, there's more emotional, I guess, attachment to the fish than being able to buy large ones from the U.S. Or from Japan at, like, $20,000 kind of thing. So, it's a completely different feeling and that's why, I guess … I have cut down my investment. I don't breed anymore. I stopped breeding, and I don't expand my ponds. I'm really just keeping the pond as whatever I have now. Koi hobbyist #2*

In addition to the psychological impacts of losing koi, financial impacts can be high. Koi hobbyists described costs involved with destroying koi humanely, emptying ponds of water, re-establishing pond water and vegetation, and purchasing new stock, amongst others. Beyond these financial impacts, many would require years or decades to rebuild their koi to the same quality and number of varieties they had bred up to prior to a loss, with hobbyists often investing in breeding to produce specific colouration, scalation and patterning over long periods of time. With limited stock available for purchase in Australia, re-establishing these lines can be challenging.

The other impact identified by koi hobbyists was the impact of higher koi keeping costs if they need to introduce biosecurity measures to reduce risk of their koi being exposed to the carp virus, and if they have to invest in new stock if their existing koi contract the virus. An

increase in costs is likely to lead to some hobbyists ceasing koi keeping; the proportion who stop keeping koi will vary depending on the extent to which costs of keeping koi increases, as well as the complexity of implementing biosecurity measures.

> *I think if it … was getting into ponds I think you'd find in the end, [koi keeping at a hobby] would just die, because if you lost your whole collection or three quarters of it that...You wouldn't be bothered. Like a bloke my age, I turn 70 in about two weeks' time and it wouldn't be worth me… to get back into it you know, I'd just give it away. Go on cruises. Koi hobbyist #4/Koi breeder #2*

## POTENTIAL IMPACTS: LOSS OF BREEDING STOCK AND SALES BY KOI BUSINESSES

Koi breeders are typically highly psychologically attached to koi breeding and their koi, as well as financially dependent on koi, with many (but not all) breeders relying on koi breeding for a large part of their income. As many koi breeders have built breeding lines over several years and in many cases multiple decades, it is very difficult to replace stock, particularly with limited availability of many varieties of koi with specific coloration, patterning or scalation. A key challenge is that there are relatively few koi breeding businesses in Australia, meaning the industry is at risk if multiple breeders experience loss of stock simultaneously, and limited ability to re-establish breeding lines. Koi breeders discussed their potential vulnerability by identifying various ways virus could reach their facility:

> *Obviously if you had a backyard pond and down the road there was a big lagoon full of carp that were affected by the disease, then you're probably at high risk. A water bird or a lizard or something's going to wander up. But it would be site specific, I guess. If you were quite isolated from any natural water bodies, you're probably pretty safe. And I think, it's probably more... Quite often more the koi clubs and things that are moving fish around a lot. They're moving fish to auctions. They're moving fish to koi shows. Koi breeder #1*

Loss of koi due to virus outbreak would result in loss of business for many breeders, due not only to the loss of the existing stock, but also to the substantial financial costs and time required to rebuild suitable breeding stock of similar value to those lost, and long term impacts on reputation:

> *I've got fish that I've had for 20 years and they're key breeders. If I lost them, that would probably have a bigger impact on my business than losing 50,000 little ones. Do you know what I mean? Because they're my brood stock and they're genetics that I'd have a lot of trouble replacing. Koi breeder #1*

> *Because word spreads quickly when a fish breeder, or a shop has a virus go through it. The word from everyone is, "Don't touch that place ever again.", because it's got a virus through the pipes and so on. So that's what would end up happening… the damage is done and you get your stamp as in you're infected, or whatever and maybe change of ownership, change*

*your name, re-model, re-brand everything, have another crack at something. … it could damage them [koi breeders] a lot. Koi hobbyist #1*

Introduction of biosecurity measures to reduce spread of the virus amongst koi populations has a high likelihood of increasing costs for koi breeders and sellers. The extent of impact depends on the cost of effective biosecurity measures. Concerns were also raised about the potentially high costs that would be imposed if businesses were required to demonstrate absence of virus in koi they were selling, as well as health impacts for koi of testing.

*I can hopefully get some sort of accreditation to say that I'm disease free. And whether that requires me to do a regular testing program or whatever, to say that I'm herpes virus free and that allows me to sell to retailers, I guess the issue is the economic cost of proving your fish are virus free for koi club members, things like that. They might have to test every fish before they take it to a show, and that could really put most of them off. They'll most probably go, "That's all too much trouble and too expensive," and everything else. Unless they can develop like a little... Like, almost a litmus test where, a swipe in the koi's mouth or something and it turns blue and they're okay. … Even jabbing them with needles is risky. What? Are you going to take them to a vet to get that done? Most people aren't confident with syringes and things. I don't know. I don't know how that's all going to work. But for me as a koi breeder, I could see that I could send 10 fish away or whatever out of every batch and get them tested maybe or something, I don't know, just to get accreditation or something. … there could be impacts and it will hang on some of the precautions, the costs, and... Not only the costs, but the time and the rigmarole that could be involved in terms of actually making sure they're virus free and that sort of stuff. Koi breeder #2*

In addition to loss of breeding stock and potential increase in business costs, koi breeders were concerned they may experience a reduction in overall demand that created further stress for businesses. This was reinforced by several hobbyists stating in interviews that if they lost their koi due to the virus they would be reluctant to rebuild their koi stock, due to the psychological impact of the loss of existing stock and risk of loss happening again, and the cost and time involved in rebuilding their koi collection. This is examined further subsequently in the next sections.

## POTENTIAL IMPACTS: CHANGE IN SOCIAL CONNECTION

When asked to describe potential impacts of the virus on them, some hobbyists, particularly those who were members of koi societies, felt that the presence of the virus would reduce the social nature of koi keeping as a hobby. The social connections made via koi were commonly described as one of the most valued aspects of the hobby:

*I usually come to this [the Sydney Koi Show] once a year, I try to go to the auctions as much as I can, which is probably 3 or 4 times a year … and a few of the hobby meetings like barbecues and get-togethers. Koi hobbyist #1*

*… I ended up joining the club and found, obviously, like-minded people, as you do with a club, and the hobby itself becomes a lot more, I guess, enjoyable. But it becomes a lot more serious as well. So, yes... so, I've been doing this almost, what, 20, almost 30 years now. Yeah, and just loving the whole aspect of having something in the garden, to relax as well as there's the social part of it, which is the club. … we've become very good friends. You know, most of us end up becoming good friends... like going to weddings of their kids and activities... It did become quite a close-knit group, because it is quite a weird hobby. I get a lot of people who doesn't keep Koi, didn't think there's such thing... like such a club existed. So we're, kind of like, like-minded people obviously attract each other. So, yeah. Koi hobbyist #2*

Internationally, koi associations report that virus outbreaks have led to long-term reduction in the amount of social visits between koi hobbyists and breeders, due to the need for increased biosecurity. Large reductions in social interaction were reported to occur during outbreaks, followed by some recovery in social visits, but not to previous levels. Reduced numbers of koi at koi shows was also reported, although internationally koi shows have generally continued successfully in countries affected by the virus, albeit with substantial decline in numbers of koi shown during any period when virus outbreak is occurring or has recently occurred. Local koi representatives felt similar outcomes could happen in Australia:

*In places like Japan, the people I know tell me there's not as much going to visit people, see their ponds. Here, other koi hobbyists are often the main social contacts for people. If they lose that, they lose their social network. Koi representative #4*

*I just think if [the virus was release], it would really damage [koi keeping] in the fact that the senior guys, which are older than me, would be very, very nervous about trading or swapping fish or picking up a fish from somewhere else. So they're not going to put a contaminated fish in with their prized fish or show fish. So, it's hard to say, like, some people boycott these things and just completely pull away. … their own prize fish are like your own kids or something, they want to keep it safe and protected. … I mean, personally I've only got, maybe 30 fish at the most, but I wouldn't be that keen to share them or show them or whatever, if I knew there was viruses out. Koi hobbyist #1*

## POTENTIAL IMPACTS: CHANGE IN OVERALL ENGAGEMENT IN KOI KEEPING

Many interviewees felt that overall, koi keeping would reduce in size as a hobby in Australia if the carp virus is released. This would result from reduced interest in entering a hobby where the pet may catch a lethal virus, and existing hobbyists not remaining in the hobby if they lost their pets, described earlier:

*The koi industry won't go away. It will still be there, maybe in a reduced capacity, but it won't be obliterated all together, unless things like this happen. There will be a few pond people that their ponds will be damaged by the virus getting into their ponds, and it might affect a*

*few people. A few other people might decide not to get into koi. I still think there will be the diehards there that will be continue to do it, because the animals themselves are so beautiful they would not want to see them wiped out completely. Koi retailer #1*

*The hobby itself is already under a great deal of pressure because of costs of electricity, cost of food, et cetera. I think there will be significant pressure on those people who will think you know, "Right. Okay. If this virus is going to be released, it's probably going to do in my koi, so I either won't expand what I'm doing at the moment, or I might even give up all together." I think we've seen people dropping out of the hobby, and I would hazard a guess that the introduction of the virus has tipped the balance in that respect. … There definitely seems to be less breeding going on in terms of hobbyists. I think that might be that people just are a little bit worried to spread koi and also potentially spread the infection when it is released. I think there is a plateauing off, of a diminishing of the hobby already and that's just based on the threat of the release. Koi representative #3*

Internationally, there is a lack of clear evidence about total impacts on the number of people keeping koi. As the hobby does not have as significant a cultural history in Australia as in many other countries, it is likely Australian hobbyists would have a higher likelihood of exiting the hobby than those in other countries with strong cultural traditions of koi keeping.

In the May 2019 community attitudes survey, participants were asked the extent to which they agreed or disagreed that 'I am less likely to consider keeping koi in future if the virus is released'. Of those who currently kept koi or had done so in the past, 11% were unsure whether they would be less likely to keep koi. Of the 89% who had an opinion, 58% said they were less likely to keep koi in future, while 42% disagreed with this. Of those who had never kept koi, 32% were unsure, and of the remaining 68%, just over half (55%) felt they would be less likely to keep koi in future if the virus was released. While stated intentions do not necessarily translate into actual behaviour, this does suggest high potential for some reduction in koi keeping associated with virus release.

## 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 almost all stated they supported investment in reducing carp populations, many did not feel use of the virus was the best approach to achieving this. While in some cases the concerns raised have the potential to have impacts for those in the koi sector, particularly those related to length of time the virus stays viable in water and ability of other species to transport virus particles, most were raised as broader concerns of general relevance, rather than as concerns specific to potential for impacts on the industry.

*I know they have a big impact on the rivers, and I see what they do to my dam walls at the farm. They do, they chew the mud. You can watch them chew it and you can hear them*

*sometimes, and they just suck away. They do increase the turbidity and all sorts of things which stops the aquatic weed growing, so there's no aquatic weed, there's no shrimp and things like that that are in there. It does. If they didn't breed up to such numbers, they wouldn't have such an impact, but they seem to just... Like rabbits, they destroy their own environment. … I definitely would like to see something done about them. But, at the same time, I really understand that they're actually a really important part of the ecosystem out there now. So, things like birds, I mean, I don't know if you've been out that way, but the bird life … on the Darling River is unbelievable. Pelicans, cormorants, I've never seen so many shags in my life. And the Pelicans, and all the water birds, and they must be eating... Carp must be a fairly large part of their diet. If they get rid of them all in one hit, I don't know what's going to happen to all those animals that... In that food chain. I don't know. Koi breeder #1*

Some expressed 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). There was concern that inadequate ability to clean-up could have negative impacts for environmental health, town water supply, tourism and regional economies.

*…you won't have enough people there to remove all the dead and moribund carp that's from those areas you're going to be treating. You've got to get it out of there quickly. You can't leave them there for too long, because then you start getting oxygen depletion levels, which causes problems to the natives. All of this has to be done in a very, very short amount of time. I don't think they'll have the time to do it all. I really don't. Koi retailer #1*

*It's easy to tip the virus in the water, but who's going to clear up all the dead fish and all this? Koi hobbyist #1*

Many koi sector participants felt alternative carp control measures other than the virus had not been sufficiently assessed. Other options participants wanted to see considered included daughterless carp, and commercial carp harvesting.

*…we've never been against clearing the carp out, it's just the way they're going to do it. And we know the effects from all the things we've got from overseas. Koi hobbyist #4/Breeder #2*

*I mean, the virus is one option but, I'm saddened that we can't actually use that resource that is there. Those carp, I mean... They're good protein, and they're in those rivers, and they need jobs out in those areas. Why haven't we been able to establish a commercial fishing industry around that? That would twofold, keep the carp under control, give people jobs and utilise all that protein. Koi breeder #1*

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).

A further common topic raised in interviews was that of the potential for carp to develop a level of resistance to the virus. This was related to concern about whether the negative impacts most felt the carp virus would have for koi keepers would be 'worth it' in the form of successful suppression of carp populations over the long term:

> *20% will become immune to it, we know that from ponds in England. … And see with the 20% that become immune, they breed and even if you've only got 20% of them that's another lot. And, then the next year we get 20% of them, and it could even be bigger than that will become immune to it, and you're looking at ten to 15 years down the track, we're back to where we started from. Koi hobbyist #4/Breeder #2*

> *... I mean, I know the history of things like the rabbit viruses and things. That they do lose effectiveness because the fish that do survive do have resistance or whatever, so there's that thing. Is it just going to be a relatively short-term fix? … I think I've read it somewhere, cited in a paper that, most of the carp in the river systems have a bit of goldfish genetics.... The CSIRO are saying in the science that it doesn't affect a goldfish. It's very koi specific. But I'm wondering, if there is this mixed genetics, at what point and how much goldfish genetics in the koi stops the virus being effective? I've often wondered about that because I've never heard any talk about that hybridisation between goldfish and koi, and at what level the virus becomes effective or not. If it's koi specific, if it's going to affect goldfish as well? Koi breeder #1*

Similarly, others supported carp control but queried the effectiveness of the virus:

> *… [carp are a] significant invasive species in Australia, not something that we need to or should have in our waterways. It's a shame that they've been introduced. I would like to see them controlled. I do not, at this stage, feel that the scientific evidence supports the release of a virus to control on two fronts. One, I do not believe the virus will be effective. It will kill carp, no doubt. It will kill large numbers of them but the goal isn't just to kill a bunch of carp, it's to actually control them in our waterways, and there's very little evidence to suggest that it would be effective in that regard in the Australian situation. I also think that there are significant issues in terms of environmental impact on native species and on our waterways in general … I definitely support an integrated approach to controlling carp in our waterways. I support genetic measures and a plethora of other things. A lot of them relate to correction of environmental flow issues and river modification that's turned our rivers into essentially a series of ponds, which is ideal for carp and pretty terrible for our native fish. Koi representative #2*

> *I'm not a carp apologist. I would like to see the number of carp in our waterways reduced significantly in an environmentally sustainable way. Having said that, I think there are bodies, and this included the NCCP that are quick to point the finger at carp as being one of the overriding issues in terms of the water quality, different things like turbidity and the impacts on native species, Murray cod et cetera, caused by carp. I think that's way, way too simplistic and I would not point the finger at carp as being the major factor in the decline of our native fish stocks or the reduction in our water quality. I think there are other elements such as overfishing, pollution, agricultural run off, de vegetation along water lines that are probably more likely to*

*have caused the issues with water quality and predominantly the Murray-Darling Basin with way too much water being taken off of the top end that's restricted flows further downstream. … anyone that thinks we're going to get a 50 percent reduction in carp numbers in a couple of years is kidding themselves. It needs to be sustained. It needs to be widespread. I think commercial fishing, as well as electro fishing, flow control as well. Koi representative #3*

# 7. FURTHER ASSESSMENT

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 from koi breeders and businesses supplying goods and services to the koi sector. However, many interviewees indicated high reluctance to participate in such a survey, due to a lack of trust in the NCCP, and also as a separate survey (not published publicly at the time this report was produced) had been conducted in 2017. Additionally, 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, it is 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, this type of assessment should take place once planned timing of future carp control actions is known.

Many of the potential impacts on koi owners depend on whether cost effective biosecurity measures can be implemented that meaningfully mitigate risks of the carp virus affecting carp. The key need for further assessment is therefore to assess both the likely effectiveness of different biosecurity measures and the cost and complexity associated with implementing them. This should be paired with assessing the capacity of hobbyists and breeders to implement these measures in terms of being able to cope with the costs involved. This assessment, combined with improved understanding of the potential mechanisms by which the virus could be carried into koi ponds or otherwise transmitted to koi, is central to then more fully assessing the likely socio-economic impacts of virus release in Australia if it occurs.

# 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 koi sector. No recommendations for increasing potential positive impacts were identified as potential positive impacts for those in the koi sector were not identified in interviews or workshops:

- Provide a clear timeline for decision making to help enable planning for the future and reduce uncertainty. This enables koi breeders in particular better plan for the

future, including assessing whether they should make business investments they are currently planning.

- Provide clear and accurate advice on conditions under which the virus could be transmitted to koi and measures to reduce risk for breeders, sellers and hobbyists. This in turn requires investing in ensuring key questions creating uncertainty for koi hobbyists, associations and businesses, such as questions about how long the virus remains viable in water or when carried on other species, can be answered at a level of detail that enables improved certainty.
- Invest in identification of appropriate biosecurity measures and their level of likely effectiveness. Effectiveness is a key question as the relative benefit of implementing biosecurity measures depends on the extent to which they reduce risk of koi being exposed to the carp virus.
- Identify costs of effective biosecurity options, and invest in reducing costs where feasible for breeders, sellers and koi keepers.
- Clear communication of biosecurity options and their likely effectiveness to all involved in the koi sector. This is a separate recommendation to the two above as, if the virus is released, a specific communication strategy would need to be implemented well ahead of time to enable koi breeders to invest in appropriate biosecurity actions. This in turn requires ensuring that there is early, clear and comprehensive communication about biosecurity options, their costs and their likely effectiveness, to support early decision making and investment prior to release of the virus.
- Assist koi industry to implement phone support for hobbyists and breeders to increase use of appropriate biosecurity measures, and to refer those experiencing distress to appropriate services.
- Establish clarity around regulations regarding transportation and sale of koi if the virus is released. Koi breeders 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, an assessment of the likely cost impacts on of these regulatory conditions on koi businesses should be undertaken to identify the 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.
- Identify how to ensure safe social interactions between koi hobbyists can continue, and clearly communicate this, to reduce impact. This should be done collaboratively with koi hobbyists to develop guidance that can be readily understood and adopted by hobbyists.

- Potentially provide support for koi breeders to diversify businesses beyond koi, to reduce total impact. This support could take a range of forms, from low interest loans to direct grants or hosting seminars and workshops to build business ideas.

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# 10. APPENDIX

## National Carp Control Plan: Assessing socio-economic effects

### INTERVIEW QUESTIONS – Koi industry

This is a list of questions we would like to ask as part of talking to you about the project. We encourage to talk in as much detail as you wish to, and we will also ask you to raise any other topics you wish to discuss.

- Could you tell me a bit about your involvement with koi?
- What effects have the announcement of the National Carp Control Plan had on you/your business/ the koi industry since it was made?
- What are your views about current effects that carp have on freshwater areas in Australia (good and bad)?
- What are your views about the methods (if any) that should be used to control carp?
- Are you supportive of the proposal to release the carp virus? Why/why not? What concerns do you have that you feel need to be addressed in the development of the Plan?
- If the carp virus is released, what are the potential impacts for you/ your business/ the koi industry in the short-term and long-term? You don't have to be certain they will happen – we'd like to hear about the impacts you are concerned might happen, as well as any positive impacts you think might be possible.
    a. What are the potential negative outcomes from release of the carp virus?
        i. What will influence whether these arise?
        ii. What could be put in place to help avoid/reduce these negative outcomes?
    b. Are there any potential positive outcomes from release of the carp virus?
        i. What will influence whether these arise?
        ii. What could be put in place to help ensure these positive outcomes are achieved?
- What types of actions do you believe need to be included in any biosecurity strategies that seek to reduce effects on the koi industry if the carp virus is released?
- Have you (or others you know of or represent in the industry) experienced any challenges or opportunities in the past few years related to disease koi are susceptible to, and/or biosecurity? If so, what have these impacts been, and what

worked well to help cope with this and what didn't help? What kinds of support were useful or would have been helpful?

- As a final question, we would like to ask if there are other people or organisations we should be talking in your industry or involved in your hobby who are likely to want to share their views about carp control and the potential impacts?

- 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.

NATIONAL CARP CONTROL PLAN

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