National Carp Control Plan Issues Paper 5: Managing water quality impacts by carcass management/clean up.

Introductory section common to all papers

The National Carp Control Plan (NCCP) is being developed to examine and make recommendations about the feasibility of using a virus to assist in controlling common carp in Australia. The plan is to be developed by December 2019. Although focussed primarily on viral biocontrol, the NCCP will also make recommendations about the investigation and potential future use of other carp control methods.

This issues paper is one of seven prepared to summarise topics central to the NCCP's development, provide updates on emerging research results, and, where relevant, situate NCCP research within the broader context of scientific literature. Some papers within the series are intended primarily to provide background information or updates, whereas others seek stakeholder input to help shape development of the National Carp Control Plan document. An NCCP engagement report will be completed and published summarising stakeholder input.

The papers draw on results from the NCCP research program, the broader scientific literature, and stakeholder knowledge. Paper topics are:

i. Why and how did the National Carp Control Plan originate?
ii. What is science telling us about the potential use of the carp virus as a biological control agent for carp?
iii. Non-target species susceptibility testing and host-switching risk in carp biocontrol
iv. Water quality and carp biocontrol using Cyprinid herpesvirus 3 (CyHV-3)
v. Managing water quality impacts by carcass management/clean up.
vi. Understanding potential social and economic impacts of carp control
vii. Genetic biocontrol and common carp (provided as final report)

Each of the engagement papers can be read in sequence or singly. However, most of the important questions and challenges associated with carp biocontrol using CyHV-3 are inherently multidisciplinary and multifaceted, so cross-referencing between papers directs readers towards more detailed discussions of a particular topic where relevant. Additionally, readers are directed to Frequently Asked Questions (FAQs) on the NCCP website where relevant (http://www.carp.gov.au/FAQ).

Carp are an introduced pest fish common throughout a large area of Australia. When carp are abundant, they can damage aquatic ecosystems in several ways, with associated economic and social costs. Carp control initiatives in Australia are therefore based on the general premise that reducing carp numbers below the densities at which they cause environmental damage could result in improved environmental, social, and economic outcomes. While there is evidence for environmental improvements following carp control, these may not eventuate in all ecosystems, follow uniform trajectories, or be realised without activities to address other, non-carp impacts.

Consideration of CyHV-3 as a biocontrol agent for carp in Australia began when CSIRO research, funded by the Invasive Animals Cooperative Research Centre (IACRC), reported no evidence of CyHV-3 infection among 22 non-target species, and high mortalities in carp exposed to the virus under conditions appropriate for infection. The twin traits of species specificity and high mortality in the target organism are the fundamental criteria for a biological control agent, so this research indicated that the carp virus warranted further investigation as a carp control option.

Biological control of a pest fish species has never been attempted globally, so numerous knowledge gaps precluded an immediate assessment of whether the virus's apparent potential was translatable to its safe and effective deployment in the Australian environment. The Australian Government therefore invested $15 million in the development and potential implementation of the NCCP, including a program of research, planning, and community consultation.

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Issues Paper 4. Managing carp carcasses

About this paper

This paper outlines potential approaches to managing carp killed by viral disease following release of Cyprinid herpesvirus 3 (CyHV-3, hereafter 'the carp virus') as a biological control agent in Australia. The paper includes sections on:

i. Risks to be managed
ii. Carcass management strategies
iii. Clean up methods
iv. Selection of carcass management strategies and methods
v. Regional carcass management
vi. Coordination of carcass management

1.0. Risks to be managed

If the carp virus is deployed as a biological control agent in Australia, carp carcass management will be necessary to protect water quality, areas of natural environmental value, social amenity, and infrastructure. Protecting these assets and values will help to minimise negative impacts of carp biocontrol, such as potential risks to tourism and recreational activities.

Risks to water quality are outlined in Issues paper 3. These risks include:

1. Reduced dissolved oxygen
2. Nutrient enrichment and associated cyanobacterial risk
3. Treatability of water containing decomposing carp
4. Botulism risk
5. Other secondary infections arising from poor water quality

There are a range of environmental and social risks associated with a surge in dead carp numbers. These risks are researched and assessed in other NCCP research projects and regional case studies.

The principle way to manage water quality and other environmental and social risks is through carcass management/clean-up operations following virus deployment.

2.0 Carcass management strategies

The NCCP has identified a wide range of different strategies to manage risks from carp. These strategies are summarised and discussed below.

Manipulating movement and distribution of live carp before CyHV-3 release

- manipulating river flow and water level, including the use of permanent infrastructure (e.g. weirs, wetland regulators) to promote aggregation and concentration of carp in targeted subpopulations into low risk locations,

- manually removing carp (e.g. by netting or electrofishing) from targeted subpopulations in areas where the CyHV-3 will not be effective (e.g. downstream of large dams where water temperature will be below the permissive range due to cold water releases), and
- manually removing carp from targeted subpopulations in areas where carp density and habitat traits pose risks to water quality, or in other areas where strategically effective.

Movement and distribution of infected live carp

- using permanent and temporary infrastructure (e.g. floating booms and nets) to restrict movement of infected live carp into areas or habitat types where water quality impacts are more likely to occur and/or have serious consequences, and
- using permanent and temporary infrastructure to contain infected live carp in areas or habitat types where water quality impacts are less likely to occur and/or have serious consequences.

Movement and distribution of carp carcasses and nutrients

- using regulated water flows and permanent infrastructure to assist the flushing of carp carcasses and nutrients,
- using regulated flow conditions and permanent and temporary infrastructure to intercept and remove carp carcasses at strategic locations,
- using regulated water flows and permanent and temporary infrastructure to divert carp carcasses away from locations where water quality impacts are more likely to occur and/or have serious consequences, and
- using permanent and temporary infrastructure to contain carp carcasses in situ at locations where water quality impacts are less likely to occur and/or have serious consequences.

Clean up and disposal of carp carcasses

- physically remove (clean up) carp carcasses from locations where their accumulation cannot be avoided and water quality impacts are more likely to occur, and
- physically remove (clean up) carp carcasses at upstream strategic locations to mitigate downstream impacts.

3.0 Clean up methods

Physically removing (‘cleaning up’) carp carcasses from some waterways to mitigate risks will be an important carcass management strategy if biocontrol proceeds. Clean up will need to occur as soon as possible to ensure removal of carcasses before they decompose or sink. Several clean-up methods could be deployed depending on the conditions and circumstances. Potentially useful clean-up methods are identified and described below.

Collection of carp carcasses from boats and/or land adjacent to waterways

This method requires each carp carcass to be picked up by hand or scoop net. The majority of carp carcasses collected by this method will be from on-water, although some could be collected from land and or shallow water adjacent to waterways. This method is labour intensive with a low return on effort. Multiple boats will be required for high carp carcass biomass sites.

Where vehicle access is possible, carcasses along shorelines could be collected by land-based teams. Land based teams could be supported by small plant such as loaders where carcasses need to be removed from the shoreline.

Teams of kayaks and canoes can be used in inaccessible and challenging locations where there are multiple snags, tree stumps, or shallow waters, or in environmentally-sensitive locations that may be disturbed by larger craft. The canoes and kayaks could be supported by rotary aircraft. The aircraft can be used to deliver the crews and their equipment to the otherwise inaccessible sites. The aircraft could also be used to extract loaded bulk bags or biohazard bags if carcasses need to be removed from the site. Use of such bags means that each carcass need only be handled once.

Trawl netting by boat

This method involves the collection of a large number of carp carcasses by trawl netting and boat operations. Waterways need to be navigable for this method. Carcasses will usually need to be removed from the net(s) by hand.

At some locations net trawling could be undertaken from land using vehicles and plant to recover the net(s). This is similar to the method used by commercial fisherman working from beaches.

Nets – Drop and Seine

Other types of nets can also be deployed depending on environmental conditions to collect large numbers of carp carcasses. Woody debris and man-made structures across waterways may provide useful attachment points for some net types.

Vacuum collectors

Large mobile vacuum units have been increasingly used for a wide range of aquatic applications (e.g. garbage removal). They could be used for the collection of carp carcasses at sites where carp have aggregated or become confined by man-made or natural features.

Mechanical harvesters

Current water-based harvesting technology that is used for weeds and rubbish could be adapted to collect carp carcasses. Adapting this technology for carp carcass collection would require design and engineering to customise existing technologies specifically for carcass collection.

Use of heavy plant

Heavy plant such as excavators are able to collect and load large quantities of carp carcasses in a short time. The plant could be very effective in areas where carp have been confined by man-made or natural features and where water levels have been manipulated to concentrate carp in a designated area.

This method would be applicable where the carp have been attracted to a confined area using artificial feeding or in an area where there is a freshwater inflow that will attract carp. The heavy plant can be used once the carp are confined to a defined area.

The use of heavy plant may not be restricted to use from land. An excavator using a suitable bucket attachment and operating from a floating platform should be able to scrim and gather carp carcasses. An excavator on water has been used by various aquatic-based industries in Australia.

4.0 Selection of carcass management strategies and methods

The selection of carcass management strategies and methods should be customised to the particular waterway, taking into account site-specific risks and values and operational operational constraints and regulations. Other considerations for carcass management approaches are discussed below.

Predicted biomass of carp carcasses

The predicted carp biomass will give an indication of the scale of the carcass management challenge. A stated trigger point (e.g. weight of carcasses per volume or area of water) can be used to inform the decision to collect carcasses and / or targeted collection of carcasses.

The presence of dead carp alone may not necessarily trigger a need for a mass collection method(s). The aim of the carcass collection is to reduce the biomass below 150kg/ha. In some instances, such as social amenity risks, most carcasses will need collection regardless of the carcass biomass.

The decomposition stage of the carp carcasses also needs to be considered. The condition of carp carcasses will vary and reflect the time since the carp died and exposure of the carcass to the prevailing conditions including water flow,temperature and weather.

Social amenity

The presence of carp carcasses in some areas of waterways may affect the social amenity. Threats to social amenity are more likely in populated areas near waterways and areas frequented by recreational users such as tourists. Targeted collection methods supported by community engagement activities may reduce the need for more widespread carcass collection.

Cost to deploy a method and return on investment

The costs for each method are not equal. Manual methods will be expensive but in some locations may be necessary. Mechanisation will be more effective and efficient.

Capability

Successful execution of each carcass management method will depend upon availability of human, technical and financial resources. The ability to have the right resource in the right place at the right time and with sufficient capacity will underpin the successful use of each method.

Features of the waterway

There is a wide variety of different waterbody types across the range of carp distribution in Australia. Waterbody variables that will influence carcass management include, navigability, water depth, water temperature, flow rates, aggregation sites, ability to manipulate water flows and levels, infrastructure, shore based access, and values and sensitivities.

Potential impact on non-target species

The ability of a collection method to target carp carcasses and minimise potential collateral damage on non- target native species may be a consideration for an area(s) of a waterway.

Forecast weather

The effectiveness of field operations may be dependent upon weather conditions. For example, very hot weather may point toward mechanisation in preference to manual collection. Wet weather that includes significant rainfall may affect carcass distribution by water flows and the ability to deploy one or more methods.

Unloading and transport access

On-water collection methods will need efficient unloading of collected carp carcasses for transport to a disposal sites. Bulk handling of carcasses at the point of collection is more efficient.

Transport of carp carcasses should not provide any significant challenges provided there is good access for carcass loading. Risks associated with transporting organic matter such as carp carcasses are understood by the waste management industry and biosecurity emergency response sectors. Existing practices can be utilised.

Health and Safety risks

Selection of a particular carcass management method for a given context should aim to minimise health and safety risks for the personnel executing the method and any personnel associated with further processing (e.g. disposal site and surrounding communities).

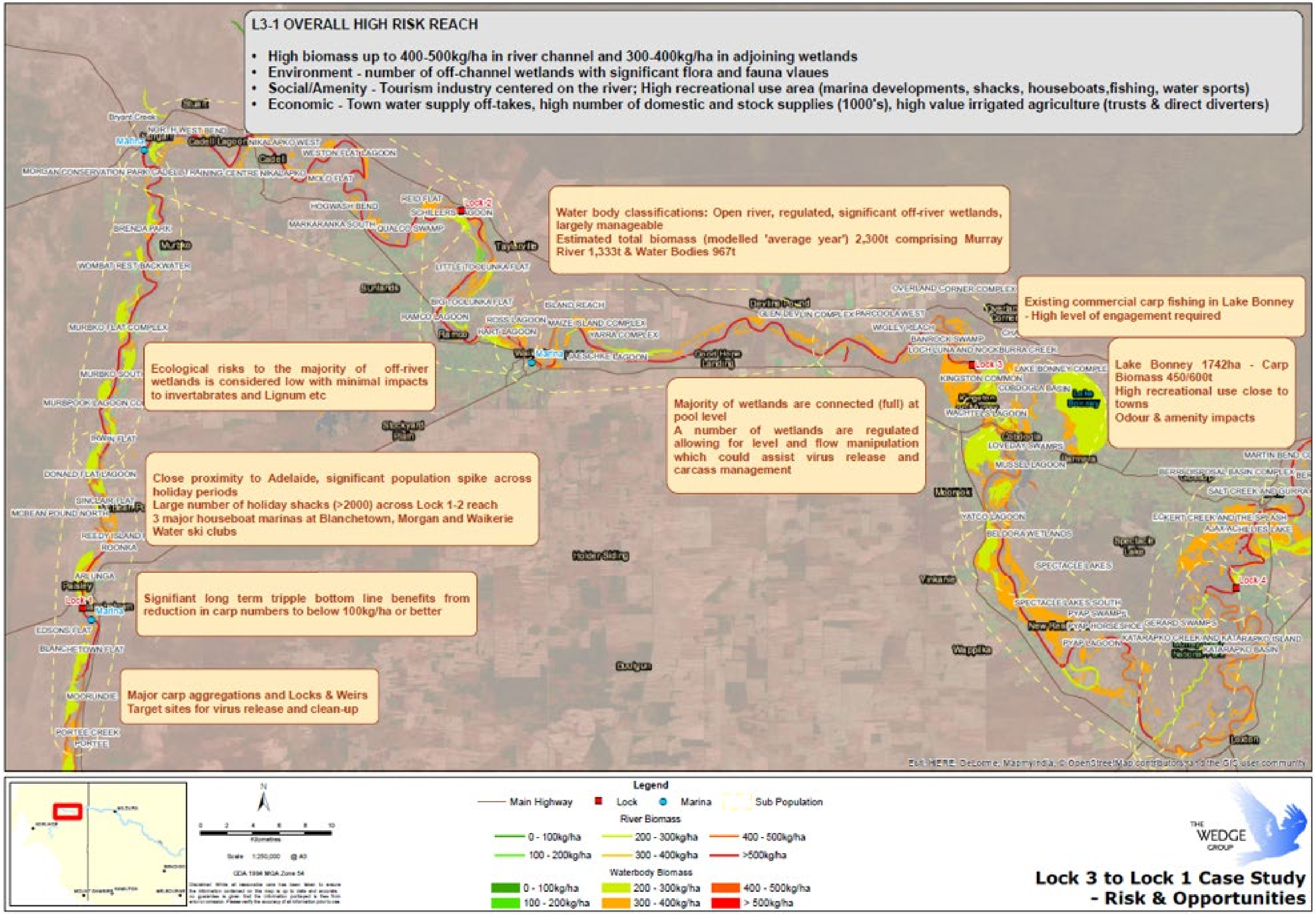
5.0 Regional Carcass management

The NCCP is proposing a regional approach to carcass management which involves regional local knowledge and expertise and considers specific regional conditions. A regional approach is suited to achieve rapid response with management resources located as close to the risk as possible.

The NCCP has completed a number of regional case studies to assess specific regional risks and scope carcass management approaches.

Riverland case study

Map 1 below outlines the risk assessment for the Riverland case study in SA. The map illustrates the region's key features relevant to carp biocontrol, and identifies major risks and operational considerations.



Map 1: Map showing the Riverland (South Australia) regional case study for carp biocontrol.

Risks
There are a range of social, environmental and infrastructure risks in the case study area. Specific risks for the case study area are annotated at Map 1.1.

Operational constraints
There are numerous operational challenges to manage carp carcasses in this case study area. Carp biomass is relatively high, and the area's numerous large shallow wetlands, lakes, and oxbow systems are difficult to access with boats. Lake Bonney is large and shallow with high carp biomass and intensive recreational use. The lake experiences strong winds that will affect carcass management operations by blowing dead carp to downwind locations.

Major river regulation infrastructure is located at each of the locks. Carp carcasses will likely concentrate at these locations. Carp control operations must be conducted without affecting river operations.

Carcass management
Risks in the region can predominantly be managed with strategic boom placement to facilitate carcass collection. Screens on irrigation intakes provide a simple solution to mitigate risks such as pump blockage. Lake Bonney will require more sophisticated carcass management using corralling and booming in navigable parts of the lake to direct carcasses to convenient collection points.

Priority carcass management locations include areas above water treatment plants, water offtakes, areas around townships and holiday shacks, locks, spot locations in which carcass accumulation is likely (e.g. Pelican Point), and wetlands holding environmental values.

6.0. Co-ordination of carcass management

NCCP operations (including virus deployment and carcass management) will require co-ordination and organisation across regions, agencies and jurisdictions to ensure efficient use of resources and to manage risks effectively. The NCCP proposes the adoption of existing and well-tested organisational management arrangements associated with incident responses in Australia. Although a possible virus release will be a planned activity (rather than an incident), these systems are well suited for carp biocontrol.

The Australasian Inter-Service Incident Management System (AIIMS)[1] Incident Control System (ICS) provides guidance on contemporary practices for the management of incidents in Australia. ICS has been developed nationally to ensure that incident management uses a systems-based approach that is clearly understood and agreed upon by all participating agencies before an incident. ICS applies to the management of any incident for any type of hazard or disaster impact. ICS is well understood and long practiced by each jurisdiction at the national, state and territory, and regional levels.

ICS ensures where and when there is an incident regardless of the hazard or disaster, the necessary arrangements to manage that incident are structured, systematic and uniform. The approach

[1]The Australasian Inter-Service Incident Management System (AIIMS) is the nationally recognised system of incident management for the nation's fire and emergency service agencies. Organisational principles and structure are used to manage bushfires and other large emergencies (e.g. floods, storms, cyclones etc.) utilising the all agencies approach.

supports expansion and contraction of management that reflects the scale and complexity of the incident.

The attributes of ICS that make it suited to use for implementation of the NCCP are

- ICS is familiar to all governments based on their experience with hazard management across a variety of incident types.
- ICS has proven effective in managing a range of incident scales and complexities.
- ICS articulates roles and responsibilities for coordination and control levels.
- ICS provides for efficient and timely implementation of measures to manage CyHV-3 deployment and associated risks.
- ICS supports efficient allocation of funds and risk management through evidence-based decision making.