PESTSMART

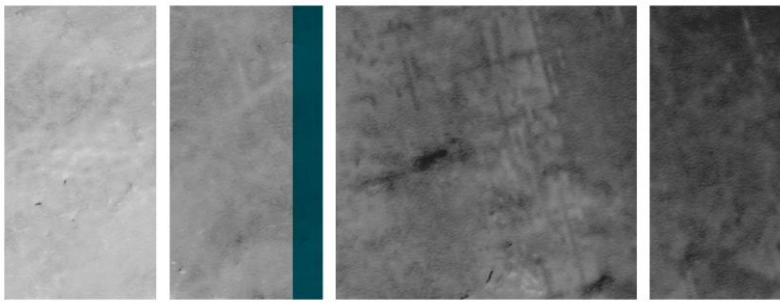
Towards a national emergency response system for freshwater fish incursions

R. Ayres and P. Clunie

Invasive Animals CRC

State Government Victoria

Department of Sustainability and Environment



Towards a national emergency response system for freshwater fish incursions

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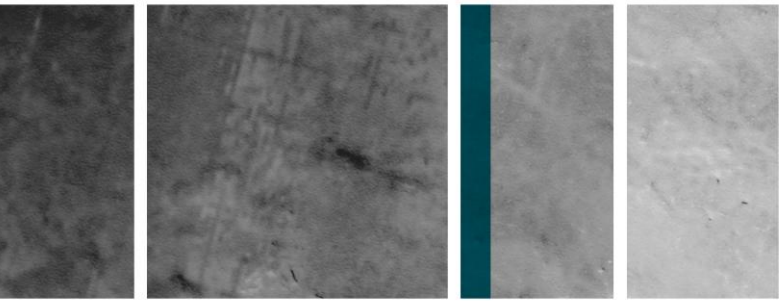
2010

An IA CRC Project



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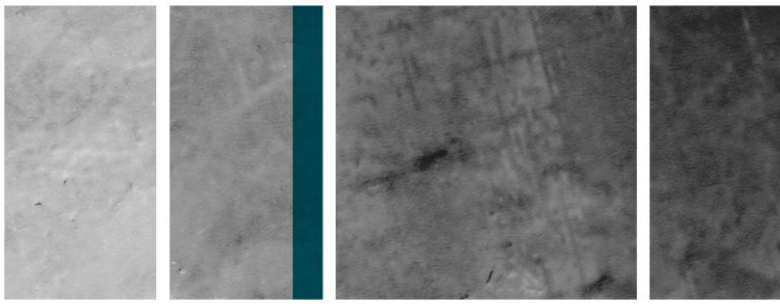

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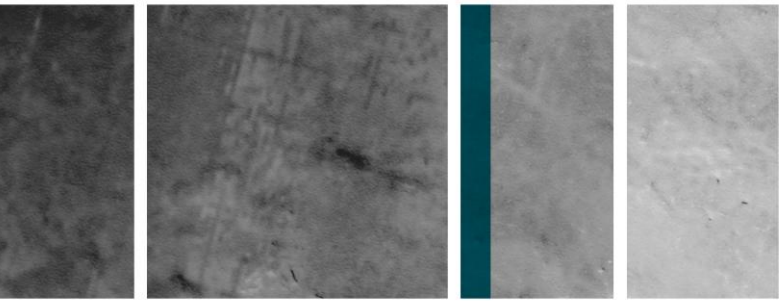

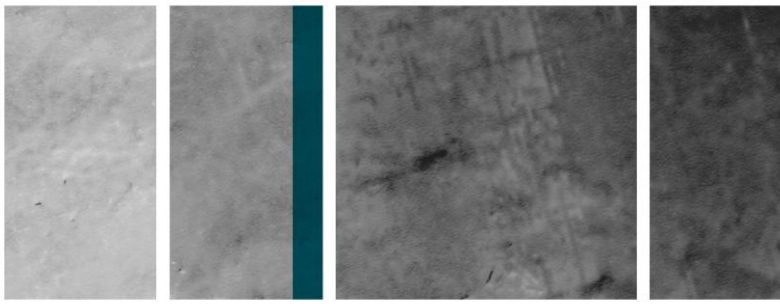

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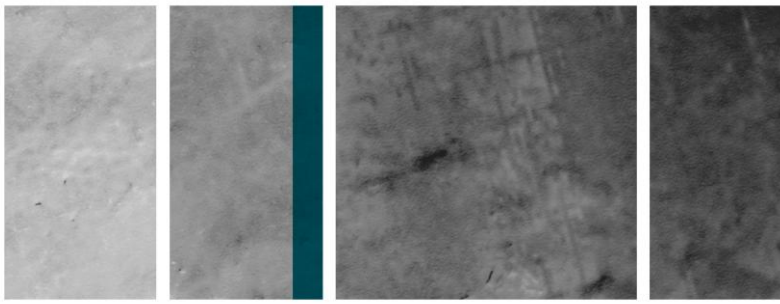

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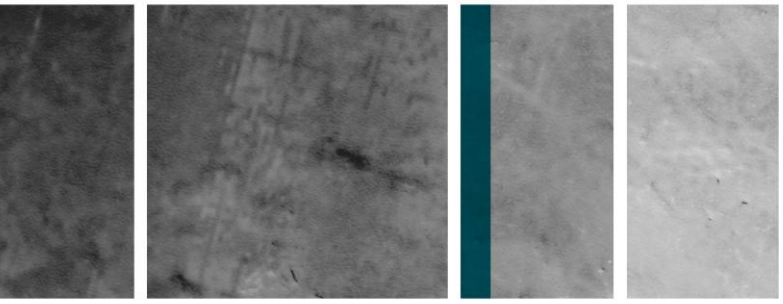


Summary

Freshwater fish incursions are a significant issue in Australia and a major biosecurity risk to freshwater ecosystems. The introduction of freshwater fish to areas outside of their natural range can exert various environmental, social and economic impacts. Currently 44 alien (meaning foreign in origin) freshwater fish species have been recorded in Australian freshwaters, with a further 76 native freshwater fish species found outside their natural range.

Preventing alien freshwater fish incursions into the natural environment, through quarantine, legislation and education, is the most cost-effective management approach. Once an incursion has occurred, appropriate national emergency response arrangements are required to facilitate coordinated, cooperative and timely response actions to provide the best opportunity for containment and eradication. Effective response to freshwater fish incursions in Australia has been inhibited by a lack of national emergency response arrangements for freshwater species. In recognition of this, the Invasive Animals Cooperative Research Centre initiated a project 'Developing a national rapid response plan for invasive freshwater fish in Australia'. Key tasks of this project included preparation of a review document and development of a *National Rapid Response Plan for Invasive Freshwater Fish in Australia*.

The review document (Ayres and Clunie 2010) considered:

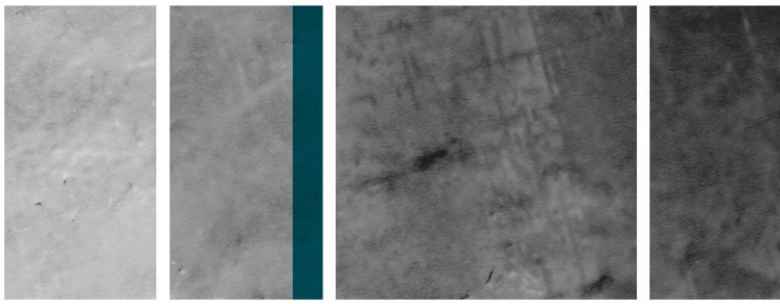
- national and international approaches to new alien freshwater fish incursions
- surveillance, eradication and control programs in Australia
- short-term barriers and containment methods.

In Australian states and territories, current response activities to freshwater fish incursions are generally ad hoc, inconsistent and uncoordinated. Jurisdictions rely on passive surveillance to detect new incursions — a process hindered by poor community education and awareness of alien fish issues, as well as limited understanding of the vectors and pathways of introduction. The varying roles and responsibilities of agencies and staff are sometimes not clearly defined or embraced. In some jurisdictions, fisheries staff lack basic emergency response training and there are few skilled staff and resources available.

The review highlighted inconsistencies and gaps in current alien freshwater fish management approaches in Australia and suggested that Australia would benefit from learning from the approaches and experiences of other countries.

As the project progressed, it became apparent that development of a *National Rapid Response Plan for Invasive Freshwater Fish in Australia* would be complicated, partly due to changing national biosecurity arrangements. The work requirements and likely duration needed to develop national emergency response arrangements for freshwater fish incursions were deemed to be beyond the capacity of the project. However, immediate value could be achieved by identifying relevant actions required to progress development of such arrangements.

This report therefore provides direction on how to advance development of national emergency response arrangements for freshwater fish incursions in Australia. Recommendations are summarised in Figure 1 and Section 7, with their context and value further detailed throughout the document. While most recommendations are preparedness



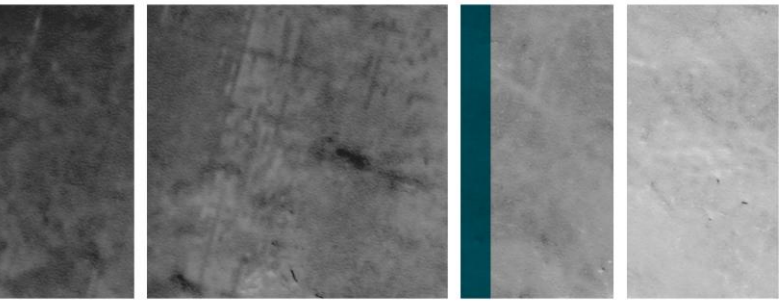
and emergency response measures, others relate to prevention, ongoing management and control, and supporting arrangements. Some recommendations are entirely new, while others link into existing processes that may require revision or expansion. There are several recommendations that are essential to progress this issue, while other recommendations highlight strategic approaches to enable effective and efficient management.

A major impediment to the development of national emergency response arrangements for freshwater fish incursions is the current lack of recognition of the problems alien freshwater species pose at the national level. National biosecurity is governed by a complex structure of ministerial councils and committees. It is important that ministerial councils acknowledge issues with the current management of alien freshwater species, particularly fish, to facilitate policy reform and resolve issues between the federal, state and territory governments on specific policy. National arrangements for freshwater fish incursions are needed to provide nationally consistent guidelines, standards and protocols. Linking with the national biosecurity structure will be essential and may provide access to existing tools and experience in biosecurity emergency management and response. The National Biosecurity Committee is encouraged to appoint an appropriate sectoral committee responsible for developing an emergency response arrangement for freshwater fish incursions, with recognition that many existing sectoral committees have overlapping interest in freshwater biosecurity issues.

Current changes to national biosecurity arrangements are encouraging cohesiveness of biosecurity approaches between sectors. The national project 'Harmonising Australia's biosecurity emergency response arrangements' aims to reduce existing duplication in national emergency response arrangements across biosecurity sectors and create closer alignment of these arrangements with the broader emergency management community and with existing nationally recognised standards. Additionally, a new intergovernmental agreement, the *National Environmental Biosecurity Response Agreement*, is being finalised to provide national arrangements for response to nationally significant biosecurity incidents where there are predominately public benefits. Hence, this intergovernmental agreement will cover freshwater fish incursions. It is important that any arrangements developed for emergency response to freshwater fish incursions align with outcomes of the national project 'Harmonising Australia's biosecurity emergency response arrangements' and fulfil conditions or requirements of the *National Environmental Biosecurity Response Agreement* to facilitate their acceptance at the national level.

The management of biosecurity threats in the freshwater sector, particularly freshwater fish incursions, significantly lags behind other sectors. Well-advanced national biosecurity response arrangements, covering prevention, preparedness, response and recovery, exist for other sectors, including animal diseases, plant pests and marine pests. These arrangements include, for example, intergovernmental agreements, strategies and programs, emergency response plans and industry biosecurity plans. Various documents, programs and resources will need to be developed specifically for freshwater fish incursions, including a clear policy and objectives statement, priority species lists, species-specific control plans and technical and operational manuals. Similar existing components from other sectors may be used as a guide.

Other supporting arrangements to assist managing freshwater fish incursions are also recommended. These are anticipated to improve efficiency and effectiveness of emergency response through improved awareness, training, planning, communication and information transfer and research to fill knowledge gaps. Examples of these recommendations include:



- management support products — such as decision-support tools and a national incursion register
- communication resources and training — such as a centralised website, communication and education programs and tools, staff skills and training programs
- research — for example, pathways analysis, social analysis and chemical treatments.

The development and implementation of national emergency response arrangements for freshwater fish incursions may reduce risk of the entry and spread of alien freshwater fish and will enable a consistent and coordinated national management approach. Alien freshwater fish incursions potentially cause loss of native species diversity and abundance, as well as additional adverse impacts on the environment, industry and society. Provision of emergency response arrangements will reduce management expenses because investment will focus on prevention and emergency response activities rather than ongoing management.

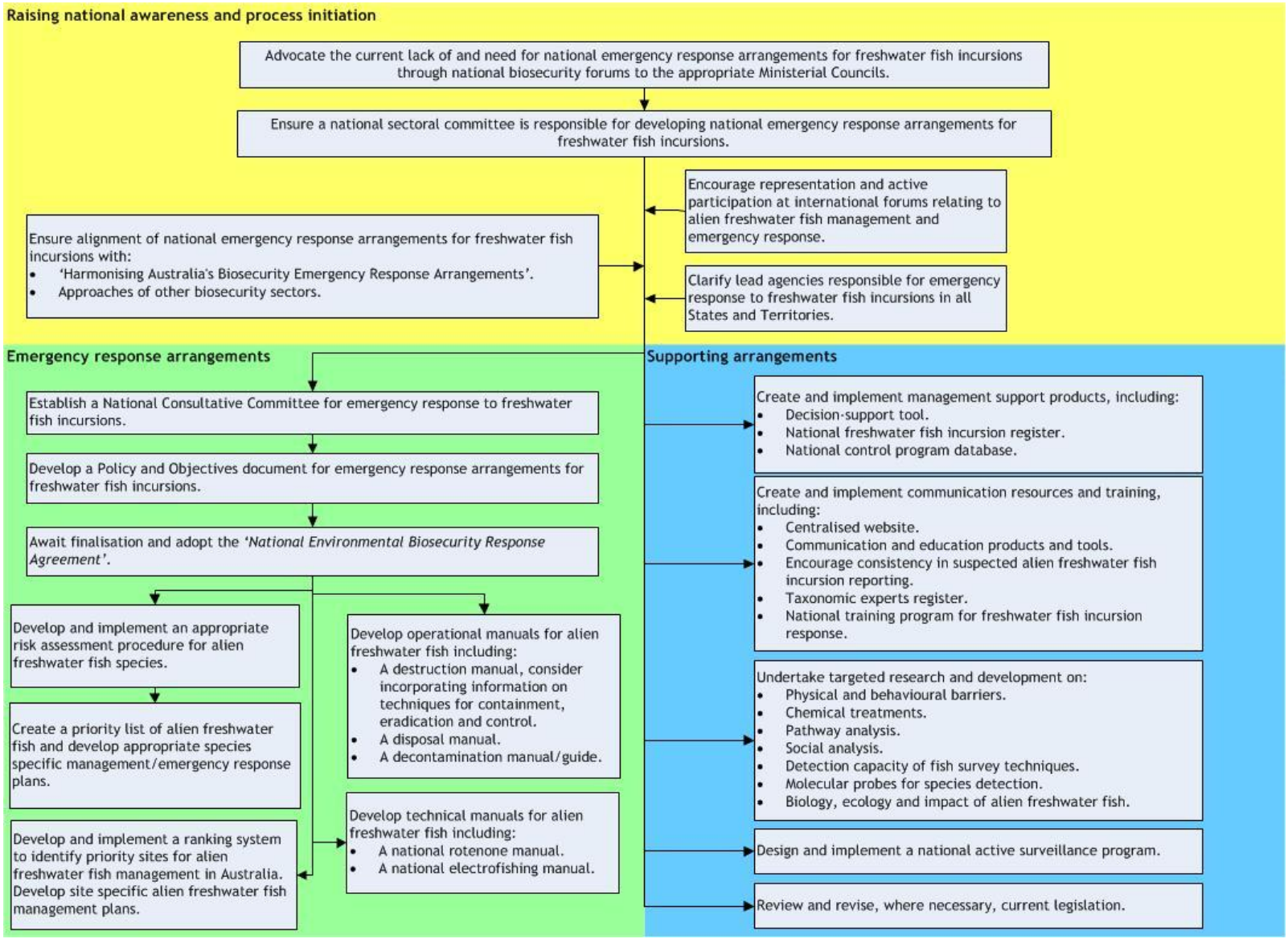
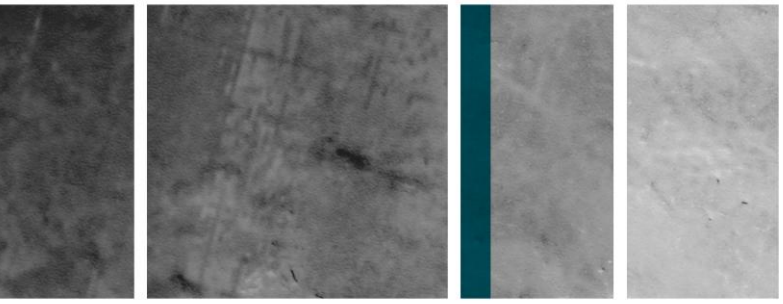


Figure 1. Actions required to develop national emergency response arrangements for freshwater fish incursions



Scope

Aim

The overall aim of this document is to present an overview of the project 'Developing a national rapid response plan for invasive freshwater fish in Australia' and advise how to progress establishing national emergency response arrangements for freshwater fish incursions.

The specific objectives of this document are to:

- provide a brief history of freshwater fish introductions into Australia and their impacts
- briefly overview the Invasive Animals Cooperative Research Centre (IA CRC) project, 'Developing a national rapid response plan for invasive freshwater fish in Australia' and its progress
- summarise ministerial councils and subcommittees involved in biosecurity and discuss potential roles and responsibilities for sectoral committees in developing national emergency response arrangements for freshwater fish incursions
- outline existing national emergency response arrangements for other biosecurity sectors
- provide recommendations on how to develop national emergency response arrangements for freshwater fish incursions.

Approach

This document summarises information gathered during the evolution of the project 'Developing a national rapid response plan for invasive freshwater fish in Australia'. Extensive engagement with agency professionals was undertaken to explore emergency response arrangements for other sectors and gain advice on progressing the development of national emergency response arrangements for freshwater fish incursions. Relevant information is summarised and presented.

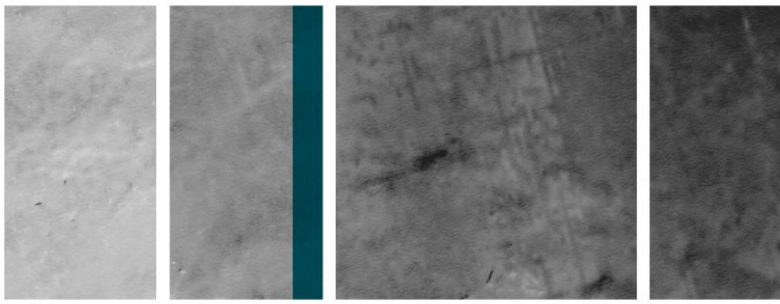
This document was written based on information gathered prior to July 2009. Since this time, national biosecurity arrangements and associated committees have evolved. Attempts have been made to incorporate updated information into this document where possible.

Outline

Section 1 provides background information on alien fish introductions in Australian freshwater ecosystems, the reasons for their introduction and their environmental, social and economic effects.

Section 2 describes the project 'Developing a national rapid response plan for invasive freshwater fish in Australia', including the project's objectives, milestones and outcomes.

Section 3 briefly explains the ministerial councils and committees associated with biosecurity sectors in Australia. It considers avenues for raising awareness of the need for establishing national emergency response arrangements for freshwater fish incursions to ministerial councils and suggests which sectoral committee might be appropriate to accept responsibility for establishing national emergency response arrangements for freshwater fish incursions.

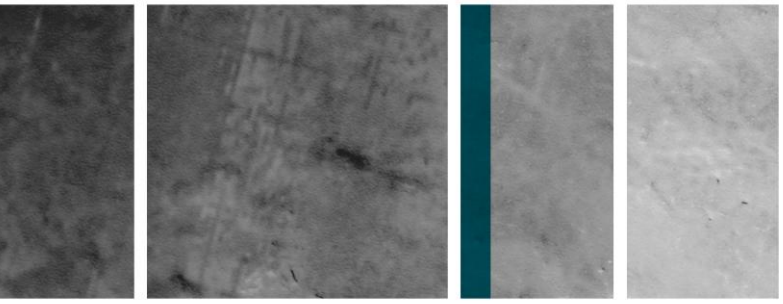


Section 4 discusses existing national emergency response plans for other sectors, the current national project 'Harmonising Australia's biosecurity emergency response arrangements' and the proposed *National Environmental Biosecurity Response Agreement*.

Section 5 outlines valuable components to develop for the management of freshwater fish incursions.

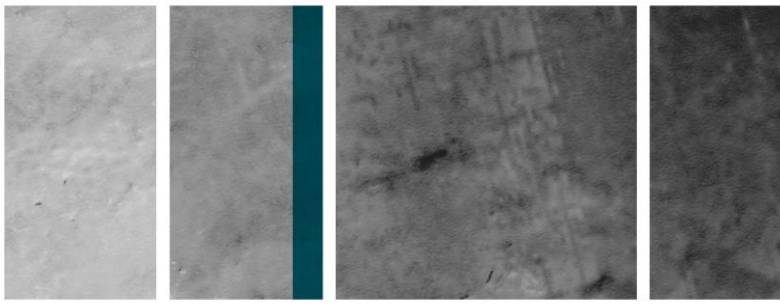
Section 6 outlines a range of supporting arrangements that would be valuable to develop to improve the ability to rapidly and effectively respond to incursions.

Section 7 provides a summary of recommendations.

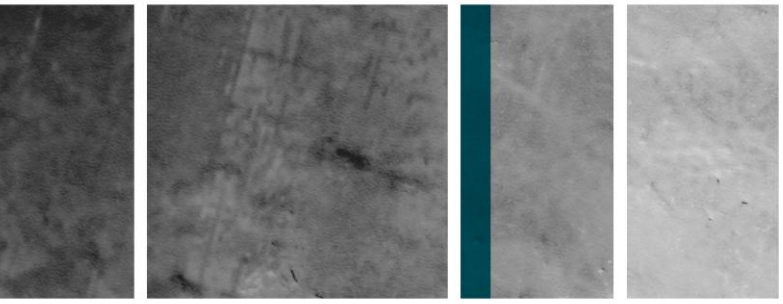


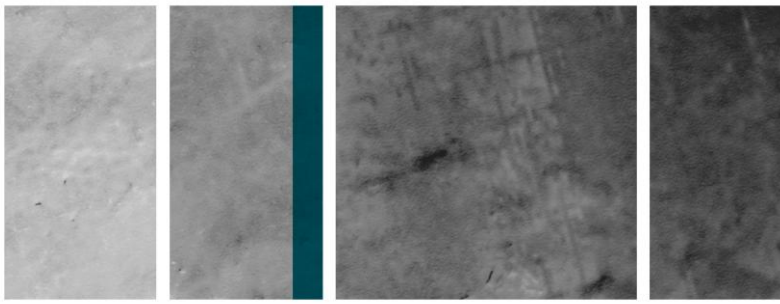
Acronyms

AAHC	Aquatic Animal Health Committee
AC	Aquaculture Committee
AFMF	Australian Fisheries Management Forum
AHC	Animal Health Committee
AIIMS	Australasian Inter-service Incident Management System
AMG	Australian Maritime Group
ANZECC	Australia New Zealand Environment and Conservation Council
APVMA	Australian Pesticides and Veterinary Medicines Authority
AQIS	Australian Quarantine and Inspection Service
Aquatic CCEAD	Aquatic Consultative Committee on Emergency Animal Diseases
ARI	Department of Sustainability and Environment, Arthur Rylah Institute for Environmental Research
ARMCANZ	Agricultural and Resource Management Council of Australia and New Zealand
ATC	Australian Transport Council
AusBIOSEC	Australian Biosecurity System for Primary Production and the Environment
AWC	Australian Weeds Committee
AWPIT	Animal Welfare and Product Integrity Taskforce
AWWG	Animal Welfare Working Group
BEPWG	Biosecurity Emergency Preparedness Working Group
CCEPI	Consultative Committee on Exotic Plant Incursions
CCEPP	Consultative Committee on Emergency Plant Pests
CCIMPE	Consultative Committee on Introduced Marine Pest Emergencies
CCEAD	Consultative Committee on Emergency Animal Diseases
CSWG	Certification Services Working Group
DEWHA	Department of Environment, Water, Heritage and the Arts
DQMAWG	Domestic Quarantine and Market Access Working Group
EBC	Environmental Biosecurity Committee
EMWG	Emergency Management Working Group
FFPC	Forestry and Forest Products Committee
IA CRC	Invasive Animals Cooperative Research Centre
IDC	Industries Development Committee
MACC	Marine and Coastal Committee
MBDA	Murray-Darling Basin Authority
MCFFA	Ministerial Council on Forestry, Fisheries and Aquaculture
MDBC	Murray-Darling Basin Commission
NAAH-TWG	National Aquatic Animal Health Technical Working Group
NBC	National Biosecurity Committee



NFFWG	National Fruit Fly Working Group
NIMPCG	National Introduced Marine Pests Coordination Group
NRMMC	Natural Resource Management Ministerial Council
NRMSC	Natural Resource Management Standing Committee
NRPPC	Natural Resource Policies and Programs Committee
NWIC	National Water Initiative Committee
OFMIG	Ornamental Fish Management Implementation Group
OFPWG	Ornamental Fish Policy Working Group
PHC	Plant Health Committee
PIMC	Primary Industries Ministerial Council
PISC	Primary Industries Standing Committee
PSIC	Product Safety and Integrity Committee
QDWG	Quarantine Domestic Working Group
SCAAH	Sub-committee on Aquatic Animal Health
SCAHLS	Sub-committee on Animal Health Laboratory Standards
SCEAD	Sub-committee on Emergency Animal Diseases
SCOT	Standing Committee on Transport
SPHDS	Subcommittee on Plant Health Diagnostic Standards
SRG	Surveillance Reference Group
VPC	Vertebrate Pests Committee
VPC PFWG	Vertebrate Pests Committee Pest Fish Working Group





1. Fish introductions in Australian freshwater ecosystems

1.1 Status of freshwater fish introductions in Australia

The risk of introduction and establishment of species outside their natural range is increasing with trade, transport, travel and tourism activity as a consequence of globalisation (Olden et al 2008, Westphal et al 2008). Australia has been identified as one of six global invasion hotspots for freshwater fish invasions where non-native species represent more than a quarter of the total number of species per basin (Leprieur et al 2008).

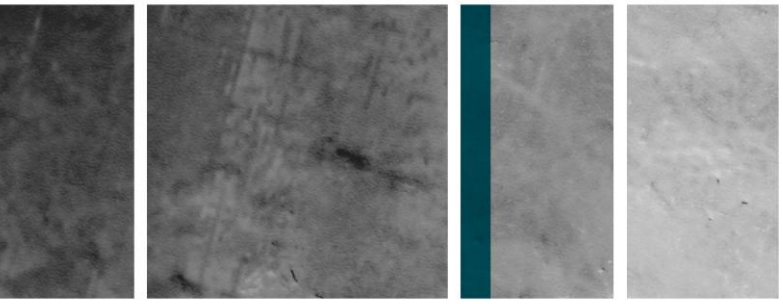
In Australian freshwater ecosystems, the number of alien freshwater fish species forming established populations has steadily increased, particularly since the 1970s (Lintermans 2004, Koehn and MacKenzie 2004). Forty-four alien freshwater fish species have been recorded in natural environments in Australia (Koehn and MacKenzie 2004). Of these, brown trout (*Salmo trutta*), common carp (*Cyprinus carpio*), rainbow trout (*Oncorhynchus mykiss*), eastern gambusia (*Gambusia holbrooki*) and Mozambique tilapia (*Oreochromis mossambicus*) are among eight freshwater fish species listed in the top *100 of the world's worst alien invasive species* (Lowe et al 2000).

A large number of alien freshwater fish have been imported into Australia through trade and the potential release of any of these species into the wild is a great threat. In the past 40 years, 1181 alien ornamental fish species have been recorded in Australia (predominantly from the freshwater aquarium trade) despite only 481 of these being legally approved for importation (McNee 2002). Ornamental fish are considered a major risk to freshwater ecosystems in Australia because of their potential to become established in natural environments or to transfer diseases and pathogens.

Likewise, the number of translocations of Australian native freshwater fish outside of their natural range and dispersal potential has increased particularly post 1980 (SKM 2008). Seventy-six native freshwater fish species have been introduced outside of their natural range within Australia (SKM 2008). The majority of these translocations have resulted from approved stocking (SKM 2008). Illegal translocations and unanticipated impacts of approved stocking may warrant management action.

1.2 Reasons for the introduction of freshwater fish in Australia

A range of motives exist for introducing fish into freshwater environments. Most frequent objectives are for ornamental trade, aquaculture, recreational angling, or biological control. McKay (1984) identified three distinct phases of alien freshwater fish introductions into Australia. The first phase related to the acclimatisation period associated with early European settlement. During this time colonial governments and acclimatisation societies introduced many alien freshwater fish species to make the wildlife more familiar to colonisers, for recreational angling, food supply or ornamental reasons. This era brought about the establishment of several sport fishes and an ornamental species (Lintermans 2004). The second phase involved the release of eastern gambusia for mosquito control. From the 1920s, health authorities and army corps dispersed this species throughout all mainland states and territories. The introduction of eastern gambusia is no longer considered effective for



mosquito control. This species has substantial environmental impacts (Macdonald and Tonkin 2008) and is now classified as noxious in all jurisdictions. The final phase deals with more recent introductions of alien freshwater fish species (post-1970s) predominately via the aquarium and ornamental fish trade. Ornamental fish now represent the largest proportion of alien freshwater fish species in Australian freshwater ecosystems (Lintermans 2004, Koehn and MacKenzie 2004).

The translocation of native fish species outside their native range and dispersal potential is largely attributed to stocking for recreational angling opportunities and for aquaculture production (SKM 2008). Acknowledgement of the effect of native fish translocations on the integrity of native fish populations has led to the adoption of federal, state and territory policies and regulations.

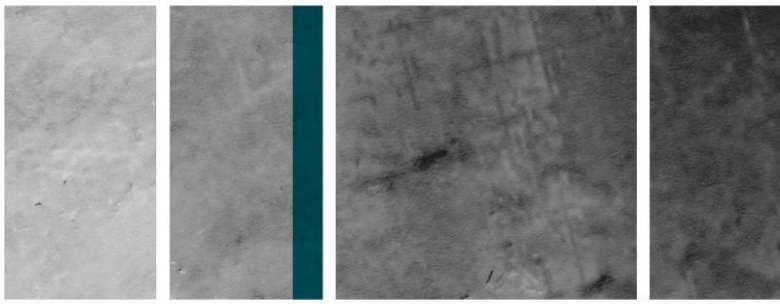
1.3 Impacts of freshwater fish introductions

Freshwater fish introductions can exert various effects on recipient environments, social assets and values and economies. Alien freshwater fish have been implicated in the decline of native fish abundance and diversity through:

- competition for food and habitat (Arthington et al 1986, Crowl et al 1992, Fausch 2007, Bohn et al 2008)
- direct predation and aggressive behaviour (Crowl et al 1992, Ivanstoff and Aarn 1999, Belk and Lydeard 1994, Canonico et al 2005, Fausch 2007)
- spatial exclusion (Canonico et al 2005, Fausch 2007)
- transmission of diseases and parasites (Langdon 1989, Geiger et al 2005, Whittington and Chong 2007)
- altering and degrading aquatic habitat (Roberts and Tilzey 1996, Koehn et al 2000, Starling et al 2002, Geiger et al 2005)
- reducing genetic integrity (Hickley and Chare 2004, Gunnell 2008).

These impacts may influence multiple ecological levels simultaneously, including genetics (introgression, hybridisation), individuals (life history, morphology, behaviour), population dynamics (abundance, population growth), communities (species richness, diversity, trophic status) and ecosystem processes (nutrient availability, primary production, and so on) (Hurlbert et al 1972, Parker et al 1999, Simon and Townsend 2003, Mack et al 2000). Recent reviews by Corfield et al (2007), Rowe et al (2008) and SKM (2008) discuss the impacts of several alien freshwater fish species in Australia. Very few examples exist where alien freshwater fish cause positive environmental impacts. Exceptional circumstances are international examples where alien freshwater fish are used for biological control of aquatic vegetation (Petr 2000, McIntosh et al 2003, Wells et al 2003).

There has been little research on how alien freshwater fish species impact on social health, values and assets. Communities vary in their awareness of alien freshwater fish and therefore there is great diversity in their perceived 'value' (Ansell and Jackson 2007). Some people value alien fish species as desirable recreational angling species. Such recreational fisheries can contribute significantly to jurisdictional economies and can benefit local communities through, for example, enhanced employment opportunities and tourism. Examples include the recreational trout fishery in the Snowy Mountains region of southern New South Wales, which generates significant economic expenditure in the region estimated at $A70 million per annum (Dominion Consulting 2001). Stocking of salmonids in New South Wales is conducted in accordance to the comprehensive *Freshwater Fish Stocking Fishery Management Strategy*



(NSW DPI 2005) based on an environmental impact statement, which examined biophysical, socio-economic, aboriginal culture and heritage issues (NSW Fisheries 2003). Likewise, the estimated value of recreational fishing for barramundi in Queensland is $A8 to $A15 million per annum, with the barramundi stocking program in Lake Tinaroo generating a potential $A31 per $A1 spent to the Queensland economy (Rutledge et al 1990). Other alien fish species provide social benefits because of their commercial or religious value.

Alternatively, alien fish species may detrimentally impact social health. Their cultural impact on indigenous communities is complex; alien freshwater fish species may effect highly valued iconic native fish and reduce angling opportunities for native fish. Rowe et al (2008) recognised four key areas of possible social impacts of alien fish:

- way of life (encompassing access to recreational opportunities, impact on local economies, tourism and amenity values)
- personal health and well-being
- culture and environment (including cultural heritage and beliefs, and community values)
- fears and aspirations (impacts on native species).

Likewise, very few Australian studies have estimated the economic costs of alien freshwater fish largely because of difficulty quantifying their effects on assets and values. Recreational angling of alien freshwater fish species creates revenue through industries related to fishing, tourism and aquaculture. Harvesting of alien freshwater fish has resulted in the creation of commercial industry, for example, K&C Fisheries Pty Ltd and Charlie Carp Ltd. However, economic loss through management and impact mitigation of alien freshwater fish species is substantial. McLeod (2004) estimated that the impact of carp cost a total of $A15.8 million per annum; carp management ($A2 million), impact mitigation ($A11.8 million) and research ($A2 million). During 2006–2007, total expenses for tilapia monitoring, management and prevention in northern Queensland were approximately $A900 000 (Greiner and Gregg 2008). Nearly a third of these expenses were associated with activities by water corporations to minimise the risk of tilapia using irrigation channels and impacting water supplies (Greiner and Gregg 2008). Prior investment by water corporations to install and maintain screen barriers to prevent tilapia movement incurred a total cost of $A1.5 million during 2004 and 2005 (Greiner and Gregg 2008). In the United States of America (USA), economic loss due to alien fish is conservatively valued at $US5.4 billion per annum (Pimentel et al 2005). Sea lamprey control in the Great Lakes region alone totals $US21 million per annum (Government of Canada 2004).

Predicting the environmental, social and economic impacts of alien species is difficult because impacts vary in type, scale, duration and time; they can occur at multiple organisational levels; they may be subtle, cumulative, direct/indirect, synergistic; and they may cause cascading effects (McIntosh and Townsend 1996, Rilov et al 2004, Boggs et al 2006, Reaser et al 2007). The most cost-effective and environmentally friendly methods to avert alien species establishment and impacts are by applying preventative and precautionary management approaches, including preventing an alien species leaving native habitat and/or entering new environments and implementing actions to mitigate potential impacts despite lack of scientific certainty. Well-established national emergency response arrangements for freshwater fish incursions are required to facilitate coordinated, cooperative and efficient management actions to provide the best opportunity for their containment, eradication and/or control.

1.4 Emergency management of alien species incursions

Emergency management includes a range of measures to manage risks to the environment, economy and society (Emergency Management Australia 1998). These measures are underpinned by various approaches (Emergency Management Australia 2004) including the:

- 'comprehensive' approach — eg emergency arrangements consider aspects of risk assessment, prevention, preparedness, response and recovery
- 'all hazards' approach — eg all types of emergencies are dealt with using similar, consistent management arrangements
- 'all agencies (or integrated)' approach — eg active partnership between all federal, state, territory and local governments, business, industry and communities when dealing with emergencies
- 'prepared community' approach — eg application of the comprehensive, all hazards and all agencies approaches at the local level.

A general framework commonly applied when managing alien species incursions in Australia incorporates governance and infrastructure, measures for prevention, emergency preparedness and response, ongoing management and control and supporting arrangements. This is represented in Figure 2 and described further below.

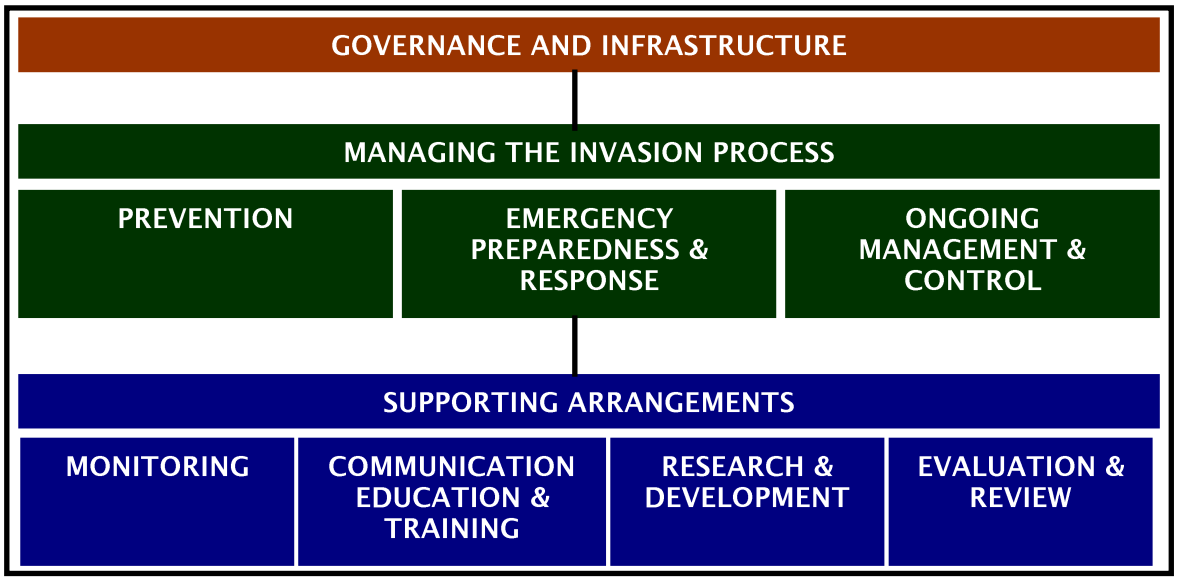
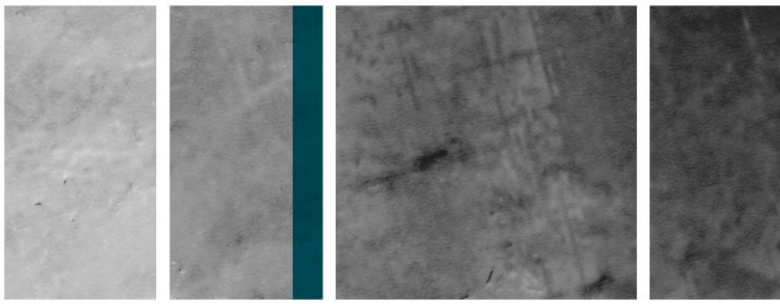


Figure 2. The general framework commonly applied when managing pest and disease incursions in Australia

National arrangements need to be overseen and coordinated by a governing national committee and should be supported by adequate legislation, policy, strategies and processes. Facilities and resources need to be available to develop and implement arrangements.

Prevention activities aim to reduce the risk of introduction and spread of alien species or mitigate their effects. Prevention includes pre-border, border and post-border activities, such



as regulatory measures, quarantine and codes of practice. Preventing species from leaving native habitat and/or entering new environments is recognised as the most cost-effective and environmentally friendly management approach.

Preparedness includes arrangements to ensure that, should an incursion occur, all those resources and services needed to address the incursion can be efficiently mobilised and deployed. Preparedness activities are aimed at identifying, developing and sustaining levels of capability required to perform response actions. Preparedness includes conducting risk assessments, creating and distributing manuals, procedures and work instructions, establishing organisational arrangements, known communication procedures and reporting lines, appropriate and adequate resourcing (eg human, financial, facilities and equipment), personnel training and skill development, simulation exercising and evaluation and revision.

Emergency response includes all actions taken in anticipation of, during and immediately after an incursion to ensure its impacts are minimised. The response process is divided into four key phases of investigation, alert, operational and stand-down. Broad actions associated with each phase are displayed in Figure 3.

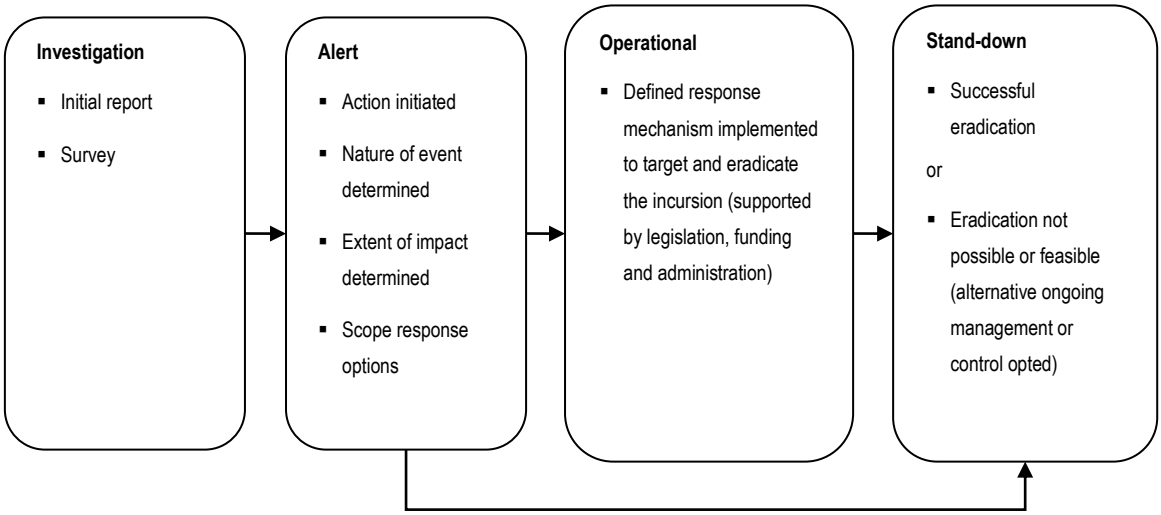
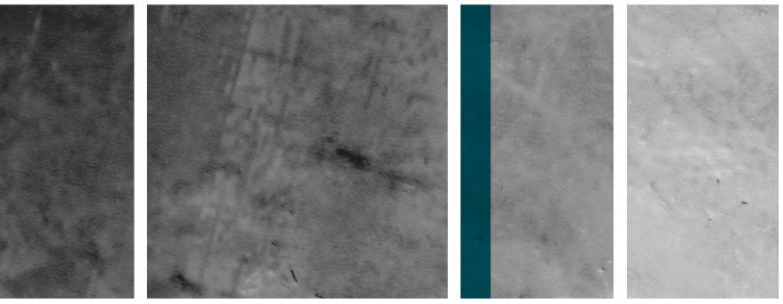


Figure 3. Broad actions associated with the phases of emergency response

Ongoing management and control activities occur after an initial emergency response to an incursion has been unsuccessful, is not feasible or cost-effective, or has ceased. Ongoing management and control activities are also applied to established populations of alien species incursions.

Supporting arrangements include activities associated with monitoring, communication education and training, research and development, and evaluation and review. Monitoring can include active surveillance programs to provide for early detection of new incursions, or targeted surveys (site or species specific), for example, to assess whether eradication has been successful. Monitoring is an essential component of emergency management.

Communication, education and training encompass industry and community awareness and education. Various tools and resources, potentially targeted at different audiences, are



required to facilitate engagement with industry and the community, convey key messages, educate and teach relevant skills.

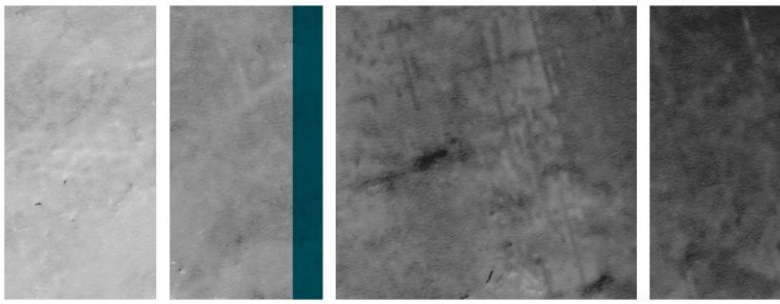
Research and development comprises targeted research and technology development to assist with the establishment and implementation of policy and emergency management measures.

Evaluation measures the effectiveness of preparedness and emergency response activities. Such evaluation enables review and revision to enhance the approach to preparedness and emergency response.

Developing national management arrangements for alien freshwater fish incursions in accordance with this framework will facilitate a coordinated, cooperative and efficient management approach to provide best opportunity for alien freshwater fish containment, eradication and/or control. Recommendations of actions required to advance development of national emergency response arrangements for alien freshwater fish incursions are discussed in Sections 5 and 6, with a summary provided in Section 7. While most recommendations are preparedness and emergency response measures, others relate to prevention, ongoing management and control and supporting arrangements.

1.5 Summary

- Forty-four exotic freshwater fish species have established populations in Australian ecosystems.
- Seventy-six native freshwater fish species have been translocated outside of their native range and dispersal potential within Australia.
- Over 1000 exotic ornamental fish species are present in Australian aquariums. Some of these pose a significant risk if released into natural environments.
- Alien freshwater fish are implicated in the decline in native fish diversity and abundance and can have wider effects on aquatic communities and people that depend on them. There is limited understanding and quantification of the social and economic impacts of alien freshwater fish. Some alien freshwater fish provide significant social and economic benefit, for example trout is a highly valued recreational angling species.
- Emergency management includes a range of measures to manage risks to the environment, economy and society. A general framework commonly applied when managing pest and disease incursions in Australia incorporates governance and infrastructure, measures for prevention, emergency preparedness and response, ongoing management and control and supporting arrangements. Developing national arrangements for alien freshwater fish incursions in accordance with this framework will facilitate coordinated, cooperative and efficient management of alien freshwater fish.



2. Project overview

The Invasive Animals Cooperative Research Centre (IA CRC) proposed the project 'Developing a national rapid response plan for invasive freshwater fish in Australia' following recognition among fisheries managers that national emergency response arrangements for freshwater fish incursions were required.

The milestones of the project were:

- establishment of a suitable steering committee
- preparation of three reviews:
  - national and international approaches to new pest fish incursions
  - surveillance, eradication and control programs in Australia
  - short-term containment methods
- a national rapid response plan and hazard analysis workshop on reducing risks of spread of pest fish
- development of a national rapid response plan for invasive freshwater fish in Australia to the satisfaction of the steering committee.

2.1 Progress against key project milestones

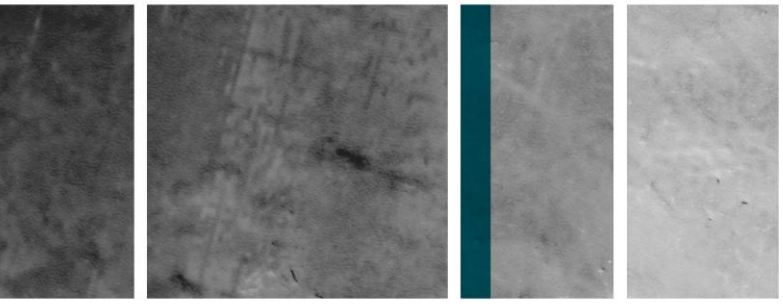
2.1.1 Reviews

The three reviews were integrated into a single resource because the issues were interrelated and together presented a more comprehensive review (Ayres and Clunie 2010). An introductory chapter provided context of the issue and each review topic was addressed in successive chapters.

Extensive engagement with international and national stakeholders was required to gather relevant information and publications to incorporate into the review. Preparation of the review provided valuable insight into the existing processes implemented in Australia and overseas to manage alien freshwater fish incursions. The review highlighted inconsistencies and gaps in current Australian management approaches that require attention. Various recommendations to improve alien freshwater fish management approaches in Australia were embedded within the document.

Key conclusions of the review include:

- New Zealand, and to lesser extent the USA, has well-advanced emergency response arrangements for aquatic species incursions. These countries apply incident management frameworks to enable consistent and coordinated organisation and implementation of response activities and resources. National legislation provides capacity to rapidly respond to new incursions. Emergency response operations are managed by a lead agency in collaboration with multiple stakeholders, including other government agencies, primary production organisations, industry, local councils and community members. Australian agencies and organisations should seek opportunities to cooperate and collaborate with international counterparts including, as a minimum, participating in relevant international conferences and forums, such as the International Conference on Aquatic Invasive Species.
- There are no national emergency response arrangements for freshwater fish incursions in Australia. Response activities to new freshwater fish incursions in states



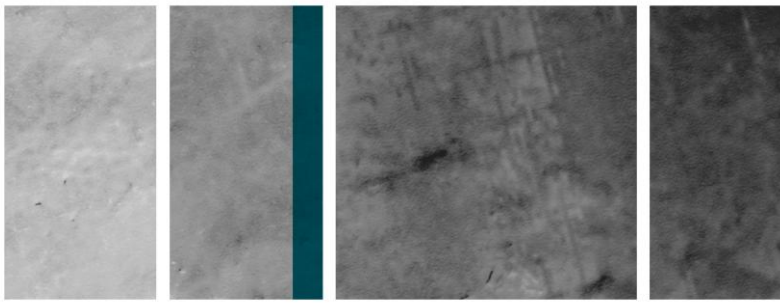
and territories are generally ad hoc, inconsistent and uncoordinated. In some jurisdictions it is unclear which agency is primarily responsible for managing freshwater fish incursions. States and territories rely on passive surveillance to detect new incursions. However, surveillance and reporting of suspected incursions is hindered by poor community education and awareness of alien fish issues, complemented by limited understanding of social aspects of freshwater fish management, and the vectors and pathways of introduction. The roles and responsibilities of staff in some cases are not clearly defined, and most fisheries staff lack basic emergency management training. There are limited skilled staff and resources available to allow rapid response. Procedures detailing the lines of communication within and between agencies within states and territories, or between states and territories are required.

- Learning from previous attempts to control or eradicate alien freshwater fish in Australia is hampered because many cases are undocumented or lack detailed documentation and knowledge has been lost with staff turnover. Of known attempts, carp has received greatest management attention. More recent management has focused on eastern gambusia (Tasmania), the one-spot livebearer (New South Wales and South Australia), tilapia (Queensland) and goldfish (Western Australia). Rotenone treatment is the most frequently applied eradication technique.
- There are various fish containment options, commonly classified as 'behavioural' or 'physical' barriers. Barriers differ in design, cost, effectiveness and maintenance and operational requirements. Hence their application must be considered on a case-by-case basis with prior knowledge of the target species and location characteristics. The ease of construction and deployment of barriers and their durability, will influence whether they are suitable for short-term or long-term use. Research, development and application of barriers has largely occurred in the USA, United Kingdom, Europe and New Zealand, primarily to protect fish at water abstraction intakes and more recently to exclude or contain alien freshwater fish. Very few barrier methods have been trialled or applied in Australia. Research is required to determine the effectiveness of various barriers to contain alien fish existing in Australia and their effect on non-target and native fish species.

2.1.2 Developing a national rapid response plan for invasive freshwater fish in Australia

During progression of the project, it become apparent that developing a national rapid response plan for invasive freshwater fish in Australia is more complicated than was originally anticipated. Some other sectors have well-advanced national emergency response arrangements (eg for animal diseases, plant pests and marine pests). These arrangements involved developing multiple manuals, programs and tools. They were created over many years and required significant stakeholder engagement and resourcing. These arrangements could be used to guide establishment of national arrangements for freshwater fish incursions, particularly to maintain consistency in approach. Advice on how to develop national arrangements for freshwater fish incursions was provided by representatives from each biosecurity sector based on their past experiences.

Concurrently, changes to national biosecurity arrangements are underway to improve and closer align arrangements between biosecurity sectors and the broader emergency management community through the project 'Harmonising Australia's biosecurity emergency

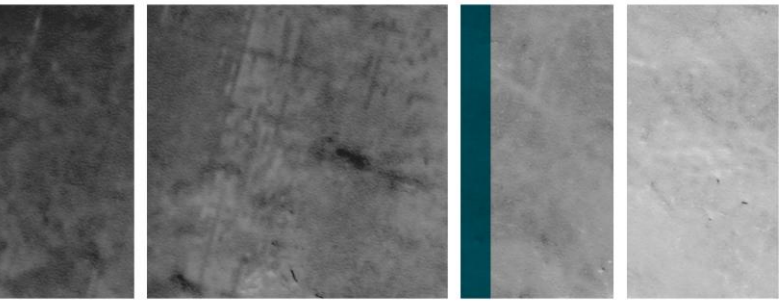


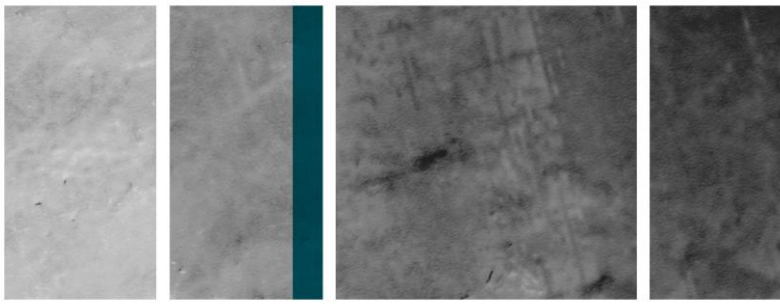
response arrangements'. Liaison with representatives of this national project enhanced awareness that national emergency response arrangements for the freshwater sector, particularly for freshwater fish incursions, are currently lacking and are required. They encouraged that development of national emergency response arrangements for freshwater fish incursions should align with outcomes of this national project to avoid premature creation of arrangements that may require future amendment. Foremost, they recommended that formal national recognition of the issue was of utmost importance for a national sectoral committee to assume responsibility and facilitate development of national emergency response arrangements for freshwater fish incursions.

The preparation of a document highlighting the actions required to advance development of national emergency response arrangements for freshwater fish incursions was considered the most appropriate outcome. This could flag the issue on the national agenda. The level of work and likely duration required to establish national emergency response arrangements for freshwater fish incursions was therefore deemed beyond the scope and capacity of this project. Continued liaison between federal, state and territory agencies involved in biosecurity and alien fish management will encourage alignment of arrangements, cooperative, best-practice management and appropriate resourcing.

2.2 Summary

- The IA CRC proposed the project 'Developing a national rapid response plan for invasive freshwater fish in Australia'.
- Key milestones of the project included three reviews and developing a national rapid response plan for invasive freshwater fish in Australia.
- Extensive engagement with national and international stakeholders underpinned progression of the project. Continued liaison between federal, state and territory agencies involved in biosecurity and alien fish management will encourage alignment of arrangements, cooperative, best-practice management and appropriate resourcing.
- The three reviews were amalgamated. The resulting review is a valuable resource that highlights current issues with emergency response approaches to new incursions of freshwater fish in Australia. Key findings of the review inform future management requirements.
- Enhancing national recognition of alien freshwater fish issues and acknowledging the lack of emergency response arrangements for freshwater fish incursions is important to facilitate their development. In respect of the project's timeframe, as well as the current changes to national biosecurity, a document highlighting the actions required to advance development of national arrangements for freshwater fish incursions was considered an appropriate and valuable project outcome. This document could be used to flag the issue on the national agenda.





3. Ministerial councils and committees associated with biosecurity

In Australia, over 40 ministerial councils facilitate policy reform and resolve issues between the federal, state and territory governments on specific policy areas (Council of Australian Governments 2009). To gain national support for developing national emergency response arrangements for freshwater fish incursions, the issue must be raised through committees and forums to the appropriate ministerial councils associated with biosecurity. Australia has a complex structure of ministerial councils and committees associated with biosecurity, of which the Natural Resource Management Ministerial Council (NRMMC) and the Primary Industries Ministerial Council (PIMC) are the overarching councils. Several expert advisory committees report to the NRMMC and the PIMC via their standing committees. The National Biosecurity Committee (NBC) is the lead expert advisory committee convened to address and provide advice on all environmental, animal and plant biosecurity concerns. Several sectoral committees report to the NBC. These sectoral committees and their subordinate working groups are responsible for individual sectoral biosecurity issues. Figure 4 displays the relationships of these committees to the ministerial councils. The role and membership of the ministerial councils, their standing Committees, the NBC and selected sectoral committees and working groups are explained in more detail in this section to understand their potential to assume responsibility for creating policy and procedures for managing freshwater fish incursions. This information is summarised in Table 1.

3.1 Natural Resource Management Ministerial Council and Primary Industries Ministerial Council

The role of the NRMMC is to 'promote the conservation and sustainable use of Australia's natural resources', while the PIMC is required to 'develop and promote sustainable, innovative and profitable agriculture, fisheries/aquaculture, and food and forestry industries'. The NRMMC and the PIMC were developed in 2001 following restructure of the previous ministerial councils, the Agricultural and Resource Management Council of Australia and New Zealand (ARMCANZ), the Australia New Zealand Environment and Conservation Council (ANZECC) and the Ministerial Council on Forestry, Fisheries and Aquaculture (MCFFA).

The NRMMC is co-chaired by the Australian federal Minister for Environment, Water, Heritage and the Arts and the Australian federal Minister for Agriculture, Fisheries and Forestry. The NRMMC contains government ministers accountable for natural resource management issues from all federal, state and territory and New Zealand governments. Papua New Guinea and the Australian Local Government Association participate in meetings as observers. The NRMMC meets biannually and is supported by a permanent standing committee, Natural Resource Management Standing Committee (NRMSC).

The PIMC is chaired by the Australian federal Minister for Agriculture, Fisheries and Forestry and contains government ministers accountable for agriculture, food, fibre, forestry, fisheries and aquaculture industries/production and rural adjustment policy from all federal, state and territory, and New Zealand governments. Papua New Guinea participates in meetings as an observer. The PIMC meets biannually and is supported by a permanent standing committee, the Primary Industries Standing Committee (PISC).

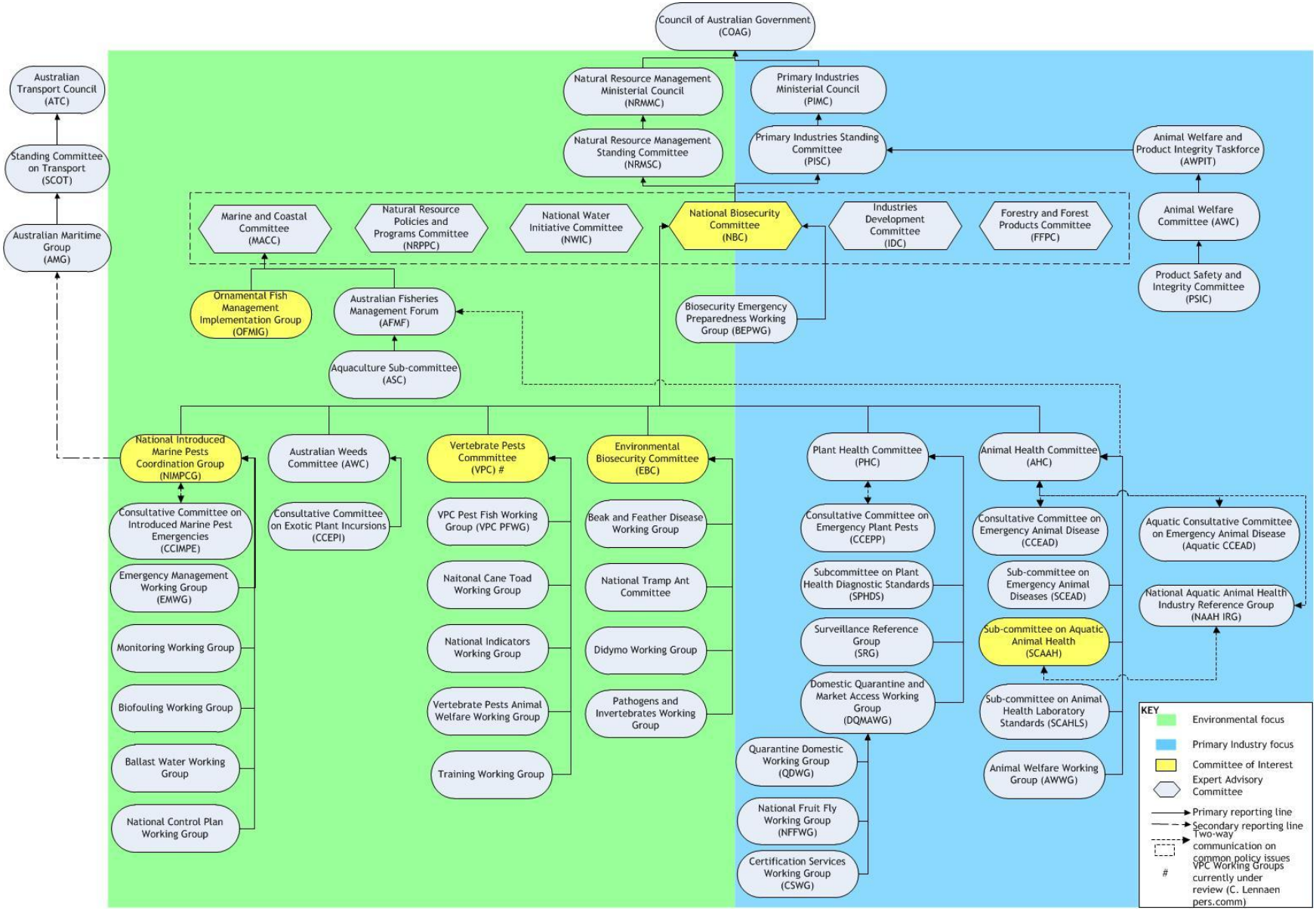


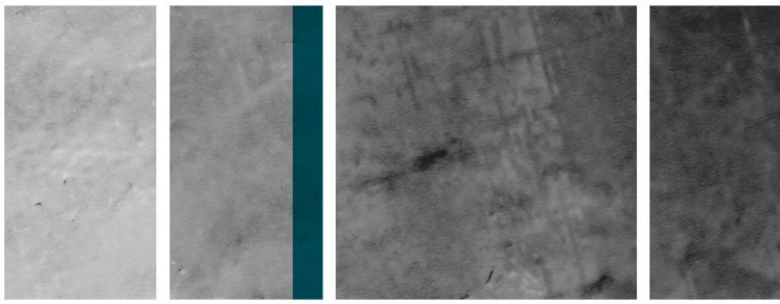
Figure 4. National biosecurity policy institutional arrangements (modified from EBC Terms of Reference; current at June 2009) Note: EBC has since dissolved

Table 1. Summary of various national biosecurity committees and their potential role in national emergency response arrangements for freshwater fish incursions. * denotes Expert Advisory Committee to Ministerial Councils; # EBC has since dissolved

Committee	Reports to	Responsibility	Potential role/interest in national emergency response arrangements for freshwater fish incursions
Natural Resource Management Ministerial Council	Council of Australian Governments	Policy and strategy development for national conservation, sustainable use and management of land, water, vegetation and biological resources	• Need to gain support for establishing national emergency response arrangements for freshwater fish incursions • Final approval
Primary Industries Ministerial Council	Council of Australian Governments	Policy and strategy development for national approaches to sustainable primary and related food industries	• Need to gain support for establishing national emergency response arrangements for freshwater fish incursions
National Biosecurity Committee*	Natural Resource Management Ministerial Council (via standing committee) Primary Industries Ministerial Council (via standing committee)	Overarching responsibility for all environmental, animal and plant biosecurity concerns	• Allocate and oversee responsibility of national emergency response arrangements for freshwater fish incursions to appropriate sectoral committee • Ensure consistency in emergency response approach with those applied in other sectors
Environmental Biosecurity Committee#	National Biosecurity Committee	Biosecurity issues impacting the natural environment and social amenity, including invertebrates and pathogens	• Potential responsible sectoral committee for national emergency response arrangements for freshwater fish incursions (as they are responsible for pests posing substantial impact to environment and social amenity) • Potential similarities in management approaches for invertebrates and pathogens in aquatic environments • Similarly the EBC has since dissolved following its initial two year review. • Consistency in emergency response approach
Vertebrate Pests Committee	National Biosecurity Committee	All aspects of vertebrate pest emergency response and management	• Potential responsible sectoral committee for national emergency response arrangements for freshwater fish incursions • Shared interest in emergency response to freshwater vertebrate incursions • Consistency in emergency response approach
Vertebrates Pests Committee Pest Fish Working Group	Vertebrate Pests Committee	To be clarified	• Potential subcommittee/working group tasked with developing national emergency response arrangements for freshwater fish incursions • Shared interest in emergency response to freshwater fish incursions • Consistency in emergency response approach

Table 1 (continued)

Committee	Reports to	Responsibility	Potential role/interest in national emergency response arrangements for freshwater fish incursions
Animal Health Committee	National Biosecurity Committee	Animal health emergency response and management	• Shared interest in emergency response to freshwater incursions (disease potential) • Potential similarities in the management approach in aquatic environments • Similar resources required for emergency response • Consistency in emergency response approach • Note: Animal Health Committee assumed responsibility of aquatic animal health diseases after 30 June 2009
Sub-Committee on Aquatic Animal Health	Animal Health Committee	Aquatic animal health emergency response and management	• Shared interest in emergency response to freshwater incursions (disease potential) • Potential similarities in the management approach in aquatic environments • Similar resources required for emergency response • Consistency in emergency response approach
National Introduced Marine Pests Coordination Group	National Biosecurity Committee	Introduced marine pests emergency response and management	• Shared interest in emergency response to freshwater incursions • Collaboration and cooperation in the management of estuarine pests • Collaboration and cooperation in the management of fish species incursions that migrate between marine, estuarine and freshwater environments during their lifecycle • Potential similarities in the management approach in aquatic environments • Consistency in emergency response approach
Australian Weeds Committee	National Biosecurity Committee	Introduced weeds emergency response and management, including freshwater weeds	• Possible shared interest in emergency response approach to freshwater fish incursions because they manage introduced aquatic weeds • Consistency in emergency response approach
Plant Health Committee	National Biosecurity Committee	Plant health (plant pests) emergency response and management	• Consistency in emergency response approach
The Ornamental Fish Management Implementation Group	Marine and Coastal Committee	Development and implementation of the national strategy A Strategic Approach to the Management of Ornamental fish in Australia	• Shared interest in the management of freshwater fish incursions • Overlapping resources • Similar objectives, strategies, programs



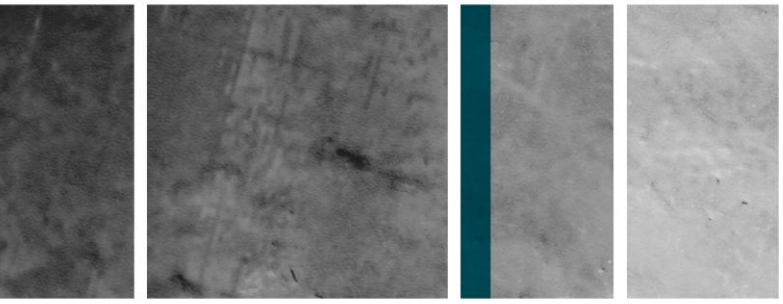
The main objectives of the NRMSC and the PISC are to assist their ministerial councils to achieve their objectives and to develop cooperative and coordinated approaches to matters of concern to their ministerial councils. The NRMSC and the PISC direct the work of their subordinate committees, secure cooperation between members, and advise their ministerial council on the initiation, review and development of standing committee activities, in accordance with their relevant ministerial council's Terms of Reference (Appendix 2a and 2b). The NRMSC is co-chaired by the Secretaries of the Australian Government Department of Environment, Water, Heritage and the Arts and the Australian Government Department of Agriculture, Fisheries and Forestry, while the PISC is chaired solely by the Secretary of the Australian Government Department of Agriculture, Fisheries and Forestry. Membership of the NRMSC and the PISC includes all Department Chief Executive Officers of federal, state and territory and New Zealand government agencies responsible for natural resource policy issues or responsible for agriculture, food, fibre, forestry, fisheries and aquaculture industries/production and rural adjustment policy issues respectively, plus invited observers. The NRMSC and the PISC each meet biannually, generally in March and September, roughly a month before their ministerial council meetings. Advice to the NRMSC or the PISC is provided by several expert advisory committees including the Marine and Coastal Committee (MACC), the Natural Resource Policies and Programs Committee (NRPPC), the National Water Initiative Committee (NWIC), the National Biosecurity Committee (NBC), the Industries Development Committee (IDC) and the Forestry and Forest Products Committee (FFPC). Various committees, working groups and taskforces operate under each advisory committee.

3.2 National Biosecurity Committee

The NBC was established in July 2008 to address all environmental, animal and plant biosecurity concerns. The NBC is the appropriate expert advisory group to advocate the development of national emergency response arrangements for freshwater fish incursions. The NBC's Terms of Reference (Appendix 2c) clearly state that one role of the NBC is to allocate responsibility for biosecurity matters to an appropriate sectoral committee when it is unclear which sectoral committee should be responsible. Several sectoral committees report to the NBC including the National Introduced Marine Pest Coordination Group (NIMPCG), Australian Weeds Committee (AWC), Vertebrate Pests Committee (VPC), Environmental Biosecurity Committee (EBC), Plant Health Committee (PHC) and the Animal Health Committee (AHC). The Aquatic Animal Health Committee (AAHC) previously reported to the NBC, but this committee has recently disbanded. Aquatic animal health issues are now managed by the Sub-committee on Aquatic Animal Health (SCAAH), which is overseen by the AHC. Similarly the EBC has since dissolved following its initial two year review. The NBC advises and reports to the NRMSC and PISC as necessary. Membership of the NBC includes the chairs of the sectoral committees, representatives from the NRPPC, MACC and IDC, and jurisdictional representatives from primary industry and environment and natural resource management agencies, plus ongoing-observers from the Health sector, Plant Health Australia, Animal Health Australia, CSIRO and New Zealand. The NBC generally convenes at six monthly intervals before standing committee meetings.

3.3 Environmental Biosecurity Committee

The EBC reports to the NBC and was established in September 2007 by the NRMSC and the PISC following recognition that there were gaps in the existing sectoral arrangements. The EBC's goal is to minimise biosecurity threats to the natural environment and social amenity.



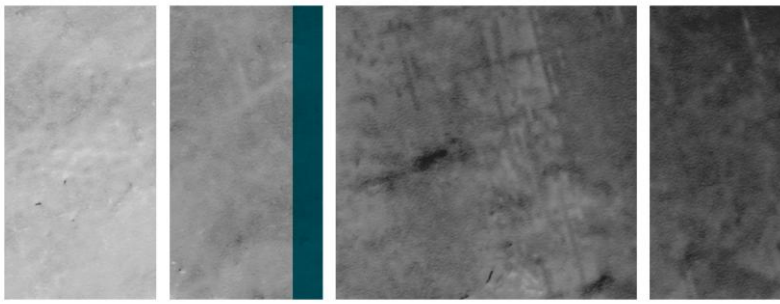
Its Terms of Reference (Appendix 2d) are divided into two categories: 1) roles that concern biosecurity issues that impact the natural environment and/or social amenity, and 2) roles relating to the development of national biosecurity policy for invertebrates and pathogens that impact the natural environment and/or social amenity. Membership of the EBC includes one representative from federal, state and territory governments, plus official observers from the AHC, AAHC, AWC, PHC, VPC and the CSIRO. The EBC reports directly to the NBC, who then communicate as appropriate to the NRMMC via the NRMSC. The EBC convenes every three months. The EBC was reviewed after its initial two year period and has since been dissolved.

There is a need to establish emergency response arrangements for freshwater fish incursions to prevent or mitigate their environmental, social and/or economic impacts, which aligns with the objectives of the EBC. As such the EBC may have been an appropriate committee to be allocated responsibility for management of freshwater fish incursions. Incursions of freshwater invertebrates, such as crayfish and mussels, also pose similar risks and their management options will often be similar to those applied for freshwater fish incursions. The EBC took on responsibility for creating national biosecurity policy for invertebrates and pathogens that impact the natural environment and/or social amenity (including freshwater threats). Therefore, it is important that the committee assigned responsibility for freshwater fish incursions considers outcomes of the EBC to ensure consistency in approach and progression of environmental biosecurity threats.

3.4 Vertebrate Pests Committee

The VPC reports to the NBC and was established in the 1960s to provide coordinated national policy and planning solutions to vertebrate pest issues. The VPC operates according to Terms of Reference defined by the NRMSC and report via the NBC. Points 6 and 7 of their Terms of Reference (Appendix 2e) clearly indicate that the VPC is accountable for developing emergency response arrangements for vertebrate pests, which presumably would include freshwater fish incursions. Membership of the VPC includes the federal government and each state and territory government. Official observers include representatives from the Invasive Animals Cooperative Research Centre (IA CRC), the Bureau of Rural Sciences, the CSIRO, Primary Industries and Resources South Australia and the Office of the Chief Veterinary Officer. The VPC convenes a number of technical working groups that are currently under review (C Lennaen, personal communication, 2009). Understanding the function of one such technical working group, the Vertebrate Pests Committee Pest Fish Working Group (VPC PFWG), is important to progress future development of policy and procedures for freshwater fish incursion management.

The VPC potentially could be allocated responsibility for management of freshwater fish incursions because it aligns with their policy to manage all aspects of vertebrate pests. Considering the VPC's current Terms of Reference, it is unlikely that the VPC would be interested in representing the freshwater sector as a whole, or even assuming responsibility of freshwater invertebrate emergency response and management, although the required skills, resources and approaches would be similar. The VPC has had limited experience to date dealing with emergency response. Their actions have largely focused on ongoing management and control of terrestrial vertebrate species. The VPC has technical expertise within the VPC PFWG to take responsibility for emergency response and management of freshwater fish incursions, but the VPC PFWG currently lacks direction, capacity and resources to achieve this.



3.5 Vertebrate Pests Committee Pest Fish Working Group

The VPC PFWG was formed in 2007 and reports to the VPC. Its key role is to provide advice to the VPC on freshwater fish pests, in particular, prioritising species and assets for research and management action, international best practise for pest fish management, eradication, control and surveillance, and identifying new animals with pest potential (Appendix 2f). Membership of the VPC PFWG includes the federal government, each state and territory government and the Murray–Darling Basin Authority. The VPC PFWG requires clear and adequate administrative and operational arrangements to progress alien freshwater fish policy and management.

The VPC PFWG may be the appropriate working group to be allocated responsibility for management of freshwater fish incursions. However, the role and focus of the VPC PFWG needs to be clarified and should incorporate management of established and 'next threats' alien freshwater fish.

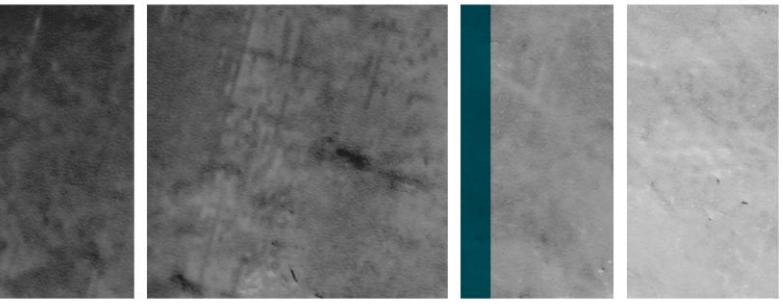
3.6 Sub-committee on Aquatic Animal Health

The AAHC was established in September 2002 by the PISC and was disbanded on 30 June 2009. The AHC has since assumed responsibility for aquatic animal health issues in addition to animal health issues. Subsequently, the sub-committee on Aquatic Animal Health (SCAAH) was formed to provide high-level scientific and technical advice to the AHC to support policy and program development on national aquatic animal health affecting the recreational fishing, aquaculture and ornamental fish industries. Membership includes a diverse range of people from the Australian, state and territory and New Zealand governments, the CSIRO Australian Animal Health Laboratory and Australian universities. Additional aquatic animal health experts may also be invited to participate as needed.

With consideration of the role of the disbanded AAHC (Appendix 2g) and recognition of the recent change in responsibility to the AHC, it is apparent the SCAAH and the AHC are unsuitable to accept responsibility for freshwater fish incursion management. However, close linkages should be formed with the AHC and SCAAH because incursions of freshwater fish may harbour disease and therefore subsequent management will require collaboration. Additionally, the strategies and practices applied in management of aquatic animal health diseases may be similar to those required to respond to and manage freshwater fish incursions. Hence a great deal can be learnt from the experiences of the SCAAH (and previous AAHC) through the AHC.

3.7 National Introduced Marine Pests Coordination Group

The NIMPCG reports to the NBC and was established in 2000 to address development and implementation of governance arrangements for introduced marine pests. Its role includes development of emergency response arrangements for new marine pest incursions and translocations, and ongoing control of established marine pests in Australia (Appendix 2h). The NIMPCG includes representatives from state and territory governments, several federal government agencies and multiple industry and environmental representatives. Several working groups report to the NIMPCG and assist in the development and implementation of governance arrangements for introduced marine pests. The NIMPCG meets biannually and operates according to a strategic work plan that is reviewed at least yearly.



The NIMPCG is not an appropriate group to accept responsibility for freshwater fish incursion management because it is marine focused. However, close linkages should be formed with this committee because of shared interest and potential common approach in management strategies and practices. A great deal can be learnt from their experiences. Some alien fish inhabit or migrate between marine, estuarine and freshwater environments. A cooperative and collaborative approach will be required to manage species incursions of this nature. Emergency response and management of estuarine species may also require a joint approach from the NIMPCG and a freshwater committee.

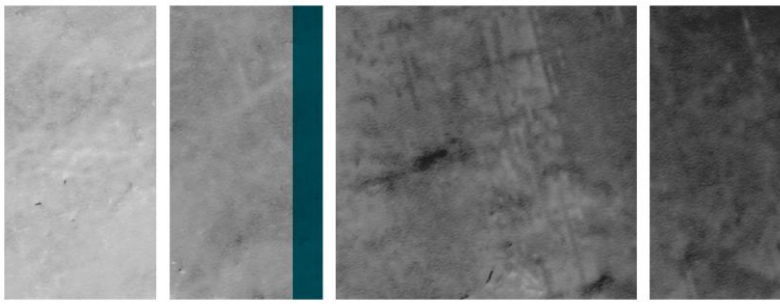
3.8 Ornamental Fish Management Implementation Group

The Ornamental Fish Management Implementation Group (OFMIG) was established to progress implementation of the national strategy *A Strategic Approach to the Management of Ornamental Fish in Australia* (DAFF 2007). This strategy was created by the Ornamental Fish Policy Working Group (OFPWG) in close consultation with industry and other stakeholders. The OFPWG was established following a recommendation by the Australian Fisheries Management Forum to the Marine and Coastal Committee (MACC). Upon completion of the national strategy it was recognised that an implementation group was needed, leading to the formation of the OFMIG and the OFPWG becoming obsolete. The OFMIG reports to the MACC for final endorsement by the NRMSC. Members of the OFMIG include the Commonwealth Department of Water, Environment, Heritage and the Arts (DEWHA), state/territory government representatives, Industry representatives, the Pet Industry Association of Australia (PIAA), Biosecurity Australia and Australian Quarantine and Inspection Service (AQIS). A key strength of the OFMIG is that it involves industry in all decisions and directions to improve management of ornamental fish. The OFMIG is resourced solely by states and territories and DEWHA. The OFMIG convenes two times a year, with out of session discussions and actions as required.

It is important to clarify that the OFMIG does not partake in emergency response activities and instead focuses on preventative actions, including noxious listings and other legislative mechanisms, education, and registration and licensing systems. It has recently begun Phase 2 of the implementation plan for the national strategy *A Strategic Approach to the Management of Ornamental Fish in Australia* (DAFF 2007), which involves:

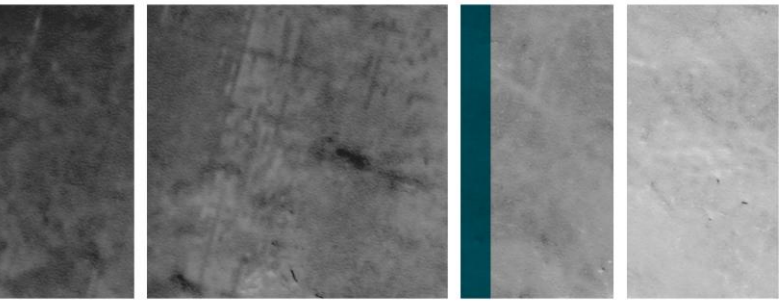
- ensuring that the nationally agreed noxious fish species list is implemented in all states and territories
- reviewing the 'grey list' of species identified in the national strategy through a scientific/technical panel of industry and scientific experts
- providing communication and education materials to support this noxious list
- providing communication and education materials to support best practice in the industry, among higher level industry and hobbyists, as well as novices.

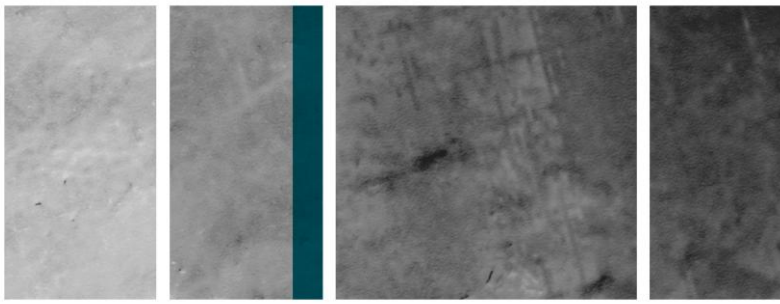
The OFMIG is not an appropriate group to accept responsibility for freshwater fish incursion management; however, close linkages should be formed with this committee because of shared interest and overlap in management activities. It will be important that the committee responsible for freshwater fish incursion emergency response and management does not duplicate processes that the OFMIG are undertaking, but supports initiatives and benefits from their work.



3.9 Summary

- Australia has a complex structure of ministerial councils and committees associated with biosecurity, of which the NRMMC and the PIMC are the overarching councils. The NBC is the lead expert advisory committee convened to address and provide advice on all environmental, animal and plant biosecurity concerns. Several sectoral committees report to the NBC.
- To gain national support for the development of national emergency response arrangements for freshwater fish incursions, the issue must be raised through appropriate committee forums to the attention of the NBC.
- The NBC could then consider and allocate responsibility for freshwater fish incursion management to the appropriate sectoral committee. Possible options include the VPC, possibly previously linking to the EBC and invertebrate management.
- Several other sectoral committees may have shared interest in freshwater fish incursion management and should be engaged to ensure consistency in approach.
- The committee allocated responsibility for developing freshwater fish incursion policy and procedures needs to be appropriately directed and resourced to ensure that actions are progressed efficiently and effectively.





4. Existing national emergency response arrangements across biosecurity sectors

4.1 Emergency response arrangements for various biosecurity sectors

The NBC oversees all environmental, animal and plant biosecurity concerns. Several sectoral committees report to the NBC on sector-specific biosecurity issues and are responsible for establishing sector-specific policy, objectives and overall arrangements for managing response to and initial recovery from a biosecurity emergency in that sector.

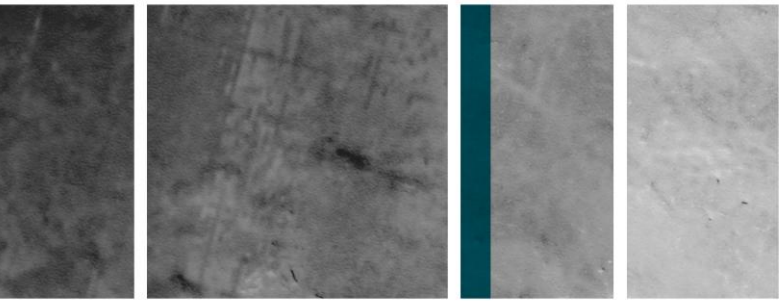
Figure 5 highlights the biosecurity concerns addressed by each sectoral committee that report to NBC and the strategies and programs created to provide biosecurity emergency management arrangements for that sector. Such strategies and programs in each sector include:

- intergovernmental agreements that outline, for example, cost-sharing arrangements for a national biosecurity emergency response
- strategies to address the management of diseases or pests
- emergency response plans that describe the proposed national approach to respond to an emergency incident
- industry biosecurity plans that outline pests or diseases of highest priority to the associated industry, the risk they pose and procedures to reduce the chance of pests or diseases establishing and to minimise their impact if an incursion occurs.

The development of each of these strategies and programs has involved partnerships between several agencies, organisations and/or individuals from all jurisdictions. Often specific documents require multiple writing groups, consultation and workshops, and thus, take years and sufficient resourcing to complete.

These strategies and programs may simply consist of one document, or alternatively may consist of several documents or manuals, as in the case of emergency response plans. The emergency response plans AUSVETPLAN and AQUAVETPLAN are a series of technical response manuals that describe the proposed national generic approach to emergency terrestrial animal or aquatic animal disease occurrences (Figure 6), while PLANTPLAN (Plant Health Australia 2008) and EMPPlan (DAFF 2005) are individual technical response manuals that describe the proposed national generic approach to emergency plant or marine pest incursions. Examples of manuals that form emergency response plans include:

- summary or enterprise manuals, which overviews the national approach and policy
- control centre management manual, which describes the chain of command, roles of personnel, phases of activation of an emergency response and the organisation and management of control centres
- destruction manual, which provides guidance on animal destruction procedures
- disposal manual, which provides guidance on best practice for safe transport and disposal of destroyed animals and waste



- decontamination manuals, which describes procedures for cleaning, destruction of infective agents and disposal of contaminated materials.

Each manual is reviewed regularly and revised as a result of outcomes from simulation exercises and workshops or activation of the plan.

Common to all biosecurity arrangements across the various sectors is the consistency of approach. There is consistency in policy and guidelines for the management of pests and diseases in each sector; consistency in emergency response arrangements; compatibility of operation and procedures between federal and state/territory governments and industry; and consistency in training of personnel in operational response procedures.

There are some sectors that are well advanced in developing appropriate biosecurity arrangements and much can be learnt from their experiences. Resources should be devoted to developing biosecurity arrangements in other sectors, including vertebrate pests and the newly established environmental biosecurity sector. These arrangements should be developed to maintain consistency in approach with other biosecurity sectors and align with the conditions of the proposed National Environmental Biosecurity Response Agreement and the national process 'Harmonising Australia's Biosecurity Emergency Response Arrangements'.

4.2 National Environmental Biosecurity Response Agreement

A *National Environmental Biosecurity Response Agreement* is currently being finalised and will provide national arrangements for response to nationally significant biosecurity incidents where there are predominately public benefits. This agreement will not replace or displace the operation of any related biosecurity arrangements, including those for cost-sharing under pre-existing arrangements. It is intended to build on and be consistent with related biosecurity arrangements for Australia.

The *National Environmental Biosecurity Response Agreement* is anticipated to deliver key outcomes to strengthen national biosecurity arrangements, such as:

- improved management of pests and diseases and a reduction in their impact on the environment, people and business activity
- more efficient and timely emergency response to pest and disease outbreaks
- compliance with Australia's rights and responsibilities under international agreements
- cost-effective management of biosecurity incidents underpinned by science and a risk-based management approach.

The agreement considers:

- Commonwealth, state and territory roles and responsibilities in preparedness and response to outbreaks
- national approaches to pest and disease outbreaks
- cost-sharing arrangements
- institutional structures
- legislative and administrative arrangements.

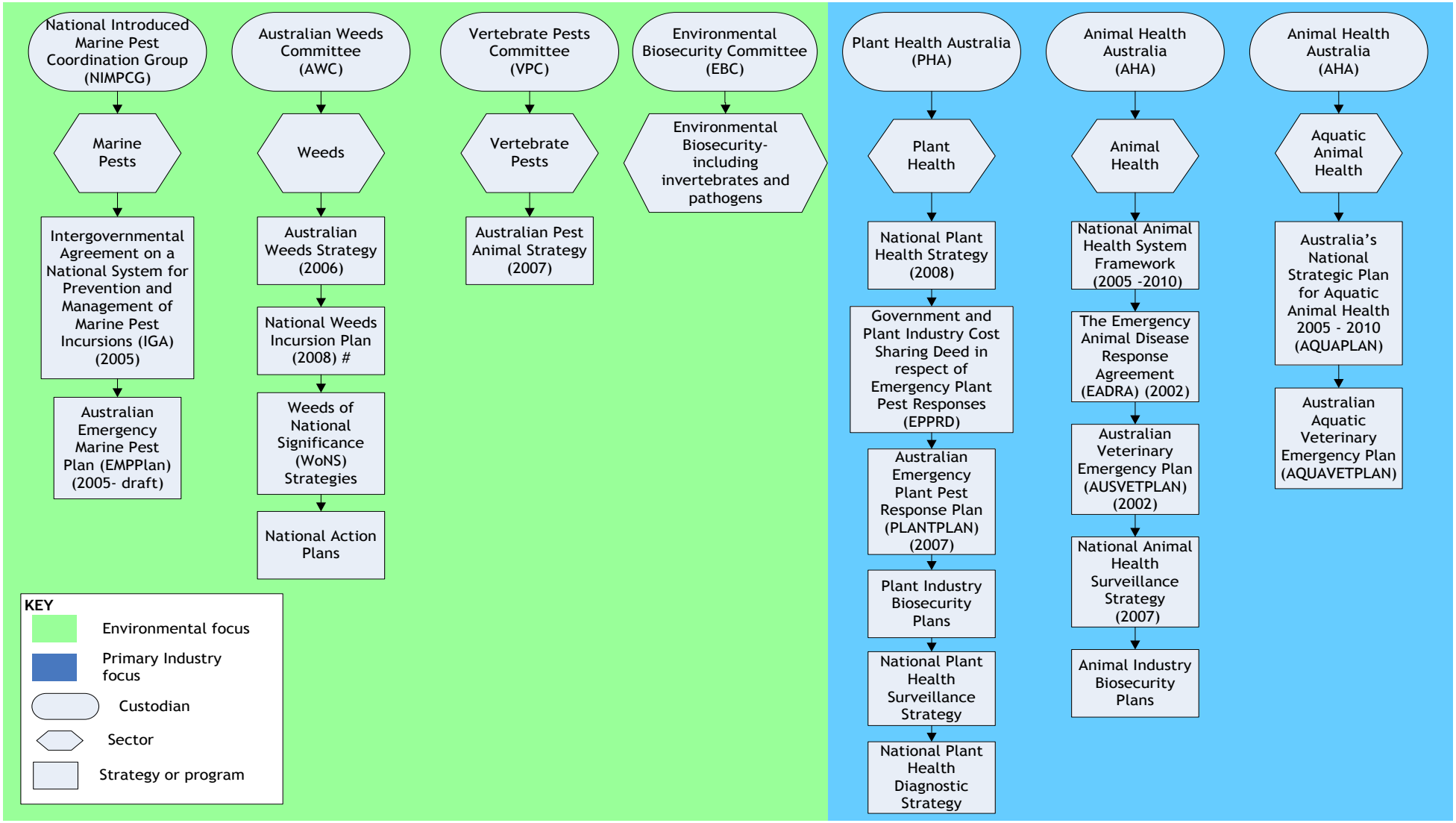
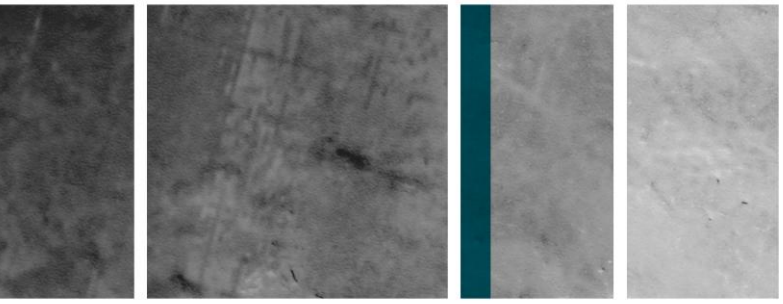


Figure 5. Current sectoral programs and strategies (modified from Plant Health Australia 2009; current at June 2009)



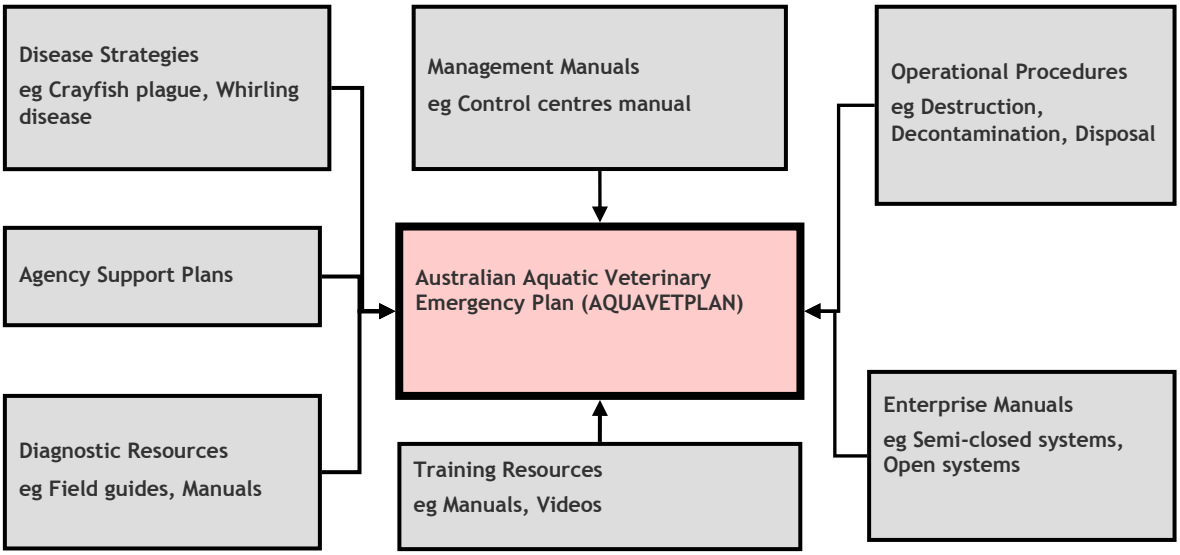


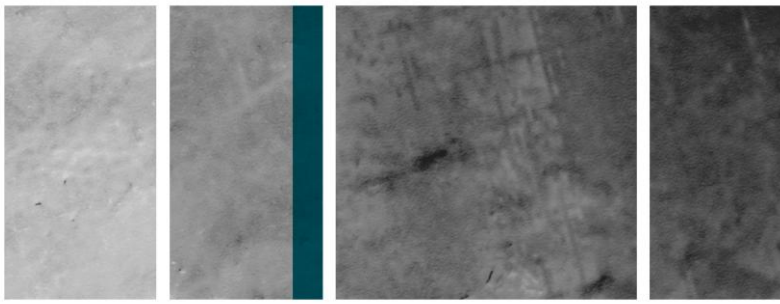
Figure 6. Components of AQUAVETPLAN and related resources (Source: http://www.daff.gov.au/animal-plant-health/aquatic/aquavetplan, accessed 5 May 2009)

Development of the *National Environmental Biosecurity Response Agreement* has involved collaboration between the federal, state and territory governments, industry, environmental groups and other stakeholders. This proposed intergovernmental agreement will apply for biosecurity incidents in freshwater environments, including freshwater fish incursions, because it addresses current gaps in policy where pre-existing arrangements are absent. The development of emergency response resources for freshwater fish incursions will need to be consistent with conditions stipulated in this intergovernmental agreement.

4.3 Harmonising Australia's Biosecurity Emergency Response Arrangements

It has been recognised that there are similarities in biosecurity arrangements for different sectors that could be improved by the adoption of a single generic response planning framework. The Harmonisation Working Group formed by the AusBIOSEC Steering Committee suggested 22 recommendations to improve arrangements for biosecurity emergencies, which are detailed in a paper titled 'Recommendations for harmonising Australia's biosecurity emergency management arrangements' (Harmonisation Working Group 2007–2008).

The NBC formed the Biosecurity Emergency Preparedness Working Group (BEPWG) to assess these recommendations, develop an action plan for the appropriate implementation of these recommendations and manage subsequent activities. In October 2008, BEPWG reviewed the recommendations from the Harmonisation Working Group and drafted an action plan titled 'Action plan for harmonising Australia's biosecurity emergency response arrangements'



(Biosecurity Emergency Preparedness Working Group 2008). This action plan was endorsed by the NBC in December 2008.

Key outcomes from implementing these recommendations, in accordance with the action plan, include:

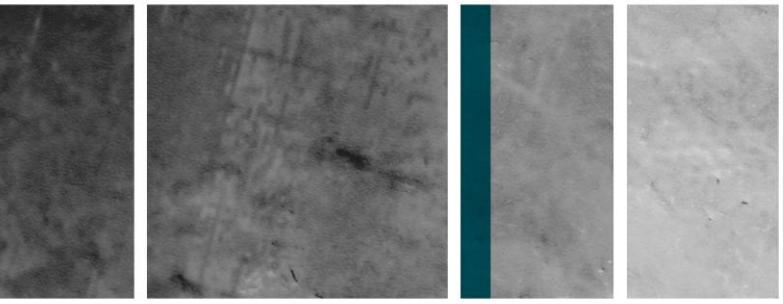
- efficiencies in reducing duplication that currently exists in emergency response arrangements across biosecurity sectors
- closer alignment of biosecurity emergency response arrangements with the broader emergency management community
- alignment of biosecurity emergency response arrangements with existing nationally recognised standards.

The timeframes to implement the recommendations vary, with many activities considered ongoing and others expected to be finalised prior to June 2011. It is possible that existing biosecurity arrangements for sectors may require revision to align with outcomes of harmonising Australia's biosecurity emergency response arrangements. For example, the national biosecurity harmonisation process proposes a documentation framework in accordance with Australian standards. This documentation system includes policy and objectives, manuals, procedures, work instructions and forms. Templates will be developed detailing the scope of each of these documents. Existing biosecurity documents in each sector may need to be restructured to align with the new documentation format.

It has been recognised that developing emergency response arrangements for freshwater fish incursions must align with this national biosecurity harmonisation process to avoid the creation of documents that may be superseded in the near future. Relationships established with BEPWG project officers should be maintained to ensure consistency of approach.

4.4 Summary

- Specific committees are responsible for establishing sector-specific policy, objectives and overall arrangements for managing response to and initial recovery from a biosecurity emergency in that sector.
- Each sector has developed strategies and programs to provide biosecurity emergency management arrangements for that sector. Common to all biosecurity arrangements across the various sectors is the consistency of approach.
- Some sectors are well-advanced in developing appropriate biosecurity arrangements and much can be learnt from their experiences. Resources should be devoted to developing biosecurity arrangements in other sectors, which are less advanced.
- A National Environmental Biosecurity Response Agreement is currently being finalised. This intergovernmental agreement will provide national arrangements for response to nationally significant biosecurity incidents where there are predominately public benefits, and will apply to freshwater fish incursions. The development of emergency response resources for freshwater fish incursions will need to be consistent with conditions stipulated in this intergovernmental agreement.



- A current project is underway to 'Harmonise Australia's biosecurity emergency response arrangements'. Development of national emergency response arrangements for freshwater fish incursions should align with outcomes of this project.

Recommendation 1: Advocate the need for national emergency response arrangements for freshwater fish incursions through national biosecurity forums to the appropriate ministerial councils. The issue should be raised directly to the National Biosecurity Committee or indirectly to the committee through relevant sectoral committees, to be presented to the appropriate ministerial council. These arrangements should be applicable to new introductions of alien freshwater fish into Australia and introductions of alien freshwater fish already present in Australia that have not yet been released into the natural environment. Ongoing management arrangements are required for range expansions of established alien freshwater fish in Australia. Arrangements for native fish translocated outside their natural range and dispersal potential could also be considered. These emergency response arrangements will primarily be applicable for freshwater fish incursions, but could be applied to other freshwater vertebrate and invertebrate incursions (noting that some modification may be required to suit individual circumstances).

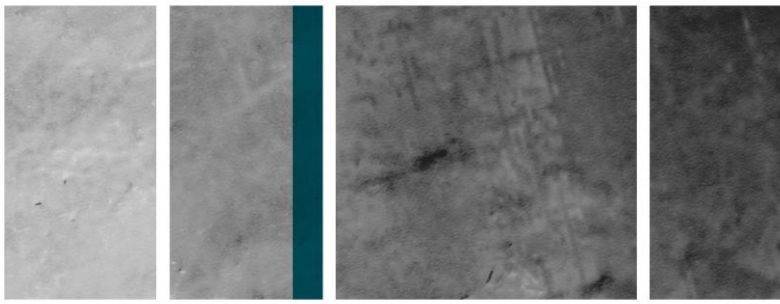
Recommendation 2: Ensure a national sectoral committee becomes responsible for developing national emergency response arrangements for freshwater fish incursions. The National Biosecurity Committee should be approached to advocate this issue and clarify the responsible committee.

Recommendation 3: Ensure that development of national emergency response arrangements for freshwater fish incursions aligns with actions of the 'Harmonising Australia's biosecurity emergency response arrangements'. This will require ongoing engagement with the Biosecurity Emergency Preparedness Working Group.

Recommendation 4: Ensure that development of national emergency response arrangements for freshwater fish incursions is consistent with other sectoral approaches. Actively engage with other sectors to learn from their experiences and ensure potential gaps in arrangements are addressed (eg freshwater invertebrates).

Recommendation 5: Encourage representation and active participation at international forums relating to management of alien freshwater fish and emergency response. It is essential that innovative, cost-effective management methods used overseas are incorporated in emergency response to alien freshwater fish incursions in Australia. Such forums will also provide the opportunity to promote Australian innovations.

Recommendation 6: Clarify which lead agencies are responsible for emergency response to freshwater fish incursions in all states and territories.



5. Emergency response arrangements

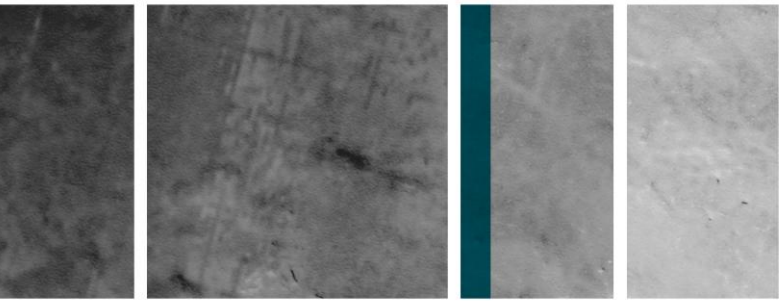
5.1 National consultative committees for emergency response

A national consultative committee reviews whether an incursion is of national significance, analyses the species and the incursion and provides recommendations to the sectoral committee regarding the technical feasibility and cost-effectiveness of eradication. The affected state or territory conducts on-ground response actions as advised. Most biosecurity sectors have established specific consultative committees. For example, the marine sector has the Consultative Committee on Introduced Marine Pest Emergencies (CCIMPE), plant health has the Consultative Committee on Emergency Plant Pests (CCEPP) and animal health has the Consultative Committee on Emergency Animal Diseases (CCEAD). Membership of consultative committees normally comprises representatives from all lead agencies (Commonwealth, state and territory governments) with legislative responsibility to manage and respond to the incursion. Technical input is provided through representation from other relevant organisations, for example, CSIRO, Cooperative Research Centres and industry. Technical expertise may also be sought as needed from within Australia and overseas.

Generally, the process involves the appropriate officer from the affected state or territory notifying the appropriate Commonwealth officer of the confirmed or suspected incursion within 24 hours of an initial report being received and investigated. A consultative committee meeting is then scheduled within 72–96 hours of receiving the notification. Meetings are most often teleconferences because they facilitate participation by all representatives and are considerably cost and time efficient. During this time, the affected state or territory conducts a preliminary site investigation and a situation report is provided to the consultative committee for consideration. The consultative committee evaluates relevant information, assesses various response options (eg technical feasibility, cost-benefits) and advises the affected jurisdiction what actions should be undertaken. The consultative committee may advise that no further action is required (at a national level) if, for example, the incursion is not considered of national significance or response actions are not feasible. Consultative committees continue to provide advice until the biosecurity threat no longer exists or national response is no longer required.

Formation of a consultative committee is required to coordinate and advise on national response to emergency freshwater fish incursions. Establishment of such a consultative committee could occur immediately to enable nationally coordinated responses to freshwater fish incursions pending the development of formal national emergency response arrangements for freshwater fish incursions. The consultative committee would need to establish clear terms of reference that should reflect conditions stipulated in the relevant intergovernmental agreement and/or policy and objectives. For example, CCIMPE's role relates to emergency management of introduced marine pest incursions and not emergency management of translocated native marine pests.

Recommendation 7: Establish a national consultative committee for emergency response to freshwater fish incursions.



5.2 Policy and objectives

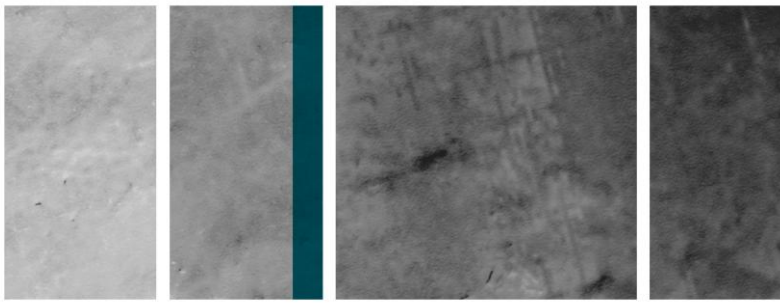
BEPWG is developing a biosecurity response documentation framework, based on recognised Australian standards, to ensure consistency in the documentation of response and recovery arrangements (Biosecurity Emergency Preparedness Working Group 2008). The component parts of the framework include: policy and objectives, manuals, procedures, work instructions and forms and templates. Future steps in developing this documentation framework include determining the structure of each document type and devising templates, identifying where existing documents fit within the framework and revising as necessary, and identifying duplication in documentation and developing cross sectoral documents (Biosecurity Emergency Preparedness Working Group 2008).

Outlining clear policy and objectives is an important initial step in developing emergency response arrangements for freshwater fish incursions. Such a policy and objectives document should follow the template to be developed by BEPWG. Some sectors have documents containing relevant policy and objective statements, for example the AUSVETPLAN Summary Document (Animal Health Australia 2008), which may be helpful as guides. It is logical and ideal that other document types are created thereafter, however they may be developed simultaneously with the policy and objectives document.

Recommendation 8: Develop a policy and objectives document for emergency response arrangements for freshwater fish incursions. The document structure should follow the template soon to be developed by BEPWG. It is logical and ideal that other document types are created thereafter (or possibly simultaneously) in accordance with the biosecurity response documentation framework established by BEPWG.

5.3 Intergovernmental agreements/deeds

An important component of developing national emergency response arrangements is the development, party signatory and implementation of intergovernmental agreements or deeds. Some other biosecurity sectors have relevant deeds in practice. For example, the Government and Livestock Industry Cost Sharing Deed in Respect of Emergency Animal Disease Responses is agreed to by federal, state and territory governments and livestock industry groups and covers arrangements for combating animal diseases including participation and cooperation, risk management, detection and response, cost sharing and training. Similarly, the emergency plant pest deed, the Government and Plant Industry Cost Sharing Deed in Respect of Emergency Plant Pest Responses, includes response arrangements to pest plants under the same themes of participation and cooperation, risk management, detection and response, cost sharing and training. Cost sharing is part of the rights and obligations of contracting parties to these agreements, which involves relevant parties committing to contributing to the costs of responding to a pest incident, with equitable contributions from parties commensurate with their respective resource bases. It is important to note that these agreements or deeds do not take priority over relevant state or territory legislation.



The development of agreements or deeds is a comprehensive and lengthy process. The Government and Plant Industry Cost Sharing Deed in Respect of Emergency Plant Pest Responses involved workshops and preparation of detailed discussion and issues papers to consider compensation and funding options. Agreements are drafted, reviewed by each party and revised, as needed, until arrangements are satisfactory and approved by each signature party.

A *National Environmental Biosecurity Response Agreement* is being drafted to provide national arrangements for response to nationally significant biosecurity incidents where there are predominately public benefits. This proposed intergovernmental agreement will apply for biosecurity incidents in freshwater environments, including freshwater fish incursions. The agreement will not replace or displace any existing biosecurity arrangements and it is intended to build on and be consistent with related biosecurity arrangements for Australia.

If the *National Environmental Biosecurity Response Agreement* is not finalised and approved by appropriate parties, the development of a similar agreement specifically addressing national freshwater biosecurity incidents will be required.

Recommendation 9: Ensure that the development of national emergency response arrangements for freshwater fish incursions aligns with conditions of the National Environmental Biosecurity Response Agreement.

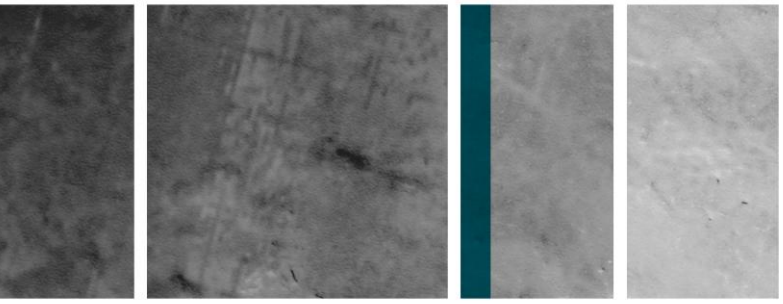
5.4 Species-specific actions

5.4.1 Priority species list

Within other sectors, there are processes in place for determining high-risk or high-priority species for management purposes. For example, the National System for the Prevention and Management of Marine Pest Incursions includes a process for identifying high-priority species by ranking them according to their invasion potential and impact potential (Hayes et al 2005). These rankings were then used by the National Introduced Marine Pest Coordinating Group in Australia to assist in the development of national control plans, which could include options for control, eradication and/or long-term management.

Within the plant sector, there are a series of approaches to prioritising species for a range of purposes. These include:

- an Exotic Weeds Watch List of threats to primary industries
- Weeds of National Significance (WONS) identified by Australian governments because of their invasiveness, impacts on primary production and the environment, potential for spread and socio-economic impacts
- the National Environmental Alert List (the Alert List) for environmental weeds — plant species in the early stages of establishment with the potential to become a significant threat to biodiversity if not managed



- Sleeper Weeds — plants from overseas that have currently established only small wild populations but have the potential to spread widely and affect agricultural or natural environments.

Within the freshwater sector, there is currently no consistent and comprehensive process of prioritising all species of potential concern. There has been some progress in developing priority lists for particular species and for particular issues.

A Nationally Agreed List of High-risk Noxious Fish Species was developed as a component of *A Strategic Approach to the Management of Ornamental Fish in Australia* (DAFF 2007). This list was developed according to a risk assessment model developed by Bomford and Glover (2004) and considered key factors for determining establishment risk: number of release events (propagule pressure), climate match, history of establishing exotic populations elsewhere, overseas geographic range size and taxonomic group. It is intended that this list will be incorporated into fisheries regulations within states and territories in the near future.

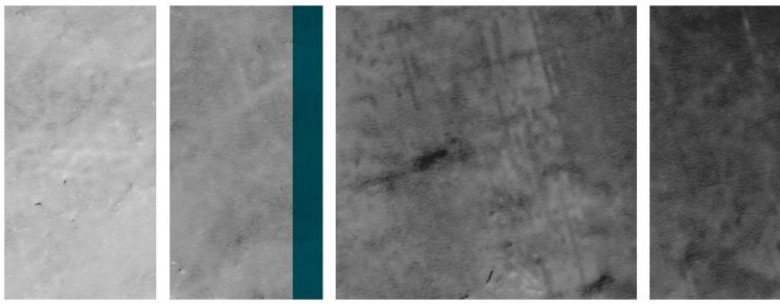
The list of high-risk noxious species (68 genera from 37 families) was then approved by the federal, state and territory governments through the NRMMC. These governments have agreed to control these species through legislation. A second list of species, known as the 'grey list', included 780 species (from 31 families) considered to be 'potentially noxious'. This list includes species that require further technical consideration, risk assessment and consultation with industry. A revised methodology has been developed to include consideration of 'hardiness'. Further work is being undertaken to review species according to the revised methodology.

The VPC PFWG is currently developing a list of priority alien freshwater fish for management. This work is primarily focused on established alien freshwater fish in Australia.

The existing processes for developing priority species vary in their approach and all potentially relevant species have not been assessed in a consistent manner. A comprehensive risk assessment procedure is required to assess all potentially relevant species, including species that are:

- already present and established in Australia
- present in Australia but have not yet been released into the wild
- not yet present in Australia but are of potential significant concern.

There may be other alien fish species that represent a risk to Australia, which may enter via pathways other than through the ornamental trade. Consideration should be given to whether ranking of any other species should be undertaken to incorporate within a national list. Risk assessments may consider environmental, social and economic impacts, levels of significance of threat, ranking of invasiveness and stage of establishment. Following risk assessment, a priority list of alien freshwater fish for national emergency responses could be considered. Other priority lists could also be created for planning purposes. For example, lists could be developed with varying categories to reflect levels of significance of threat, invasiveness and/or stage of establishment or invasion.



Recommendation 10: Develop and implement an appropriate risk assessment procedure for the prioritisation of alien freshwater fish species. Existing risk assessment procedures should be considered, for example, Bomford and Glover (2004), Bomford (2008). A priority list of alien freshwater fish for national emergency responses should then be developed.

5.4.2 Species-specific contingency, response and/or control plans

Other sectors have recognised that in addition to developing general emergency response procedures for incursions, there is a need for specific plans to focus on:

- particular high-priority threats, for example, species, diseases — these may include species already present, or at high risk of entry
- particular needs of certain industries.

AUSVETPLAN includes individual disease strategies and specific enterprise manuals (eg poultry industry, zoos). Similarly, AQUAVETPLAN has many individual disease strategies. Under PLANTPLAN there are a number of pest and pathogen specific plans and industry specific plans. Contingency plans for particular weed species address pest significance, where they may be found in Australia, likely means of introduction, diagnosis and delimiting surveys and immediate actions required following detection.

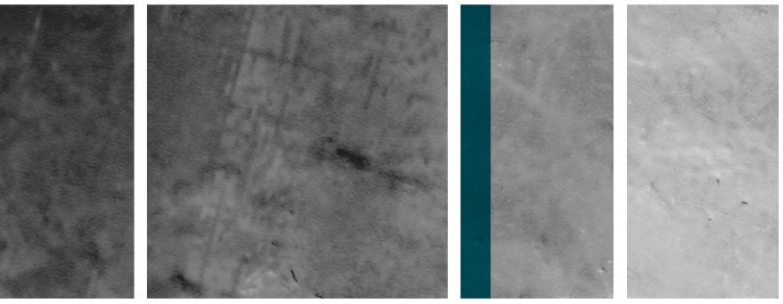
The National System for the Prevention and Management of Marine Pest Incursions includes a process for identifying species for which national control plans are required that can outline options for control, eradication and/or long-term management. This national system distinguishes between an 'ongoing management and control' component for management of pests already present in Australia, and 'emergency response' for new incursions and translocations. The national control plans fall within the 'ongoing management and control' component, and to date six have been developed to reduce impacts and minimise spread of agreed pests of concern. These plans include practical management actions and cost-effective approaches to control or reduce the impact of the pest, research and development recommendations, linkages to the national system monitoring strategy, public awareness and education strategies and an implementation strategy.

There is clear value in developing plans for priority alien freshwater fish that have been identified as high risk in their invasion and/or impact potential. Such plans could potentially include species that are:

- already present and established in Australia
- present in Australia but have not yet been released into the wild
- not yet present in Australia but are of potential significant concern.

There are a variety of plans that could be developed including those that address:

- emergency response and contingency planning
- ongoing management and control of established pests.



Managers would benefit from specific scientific and technical information, checklists of issues and considerations, and guidance for decision making on options for eradication and control. Existing lists of priority species should provide some guidance as to the most appropriate species for the development of specific plans. Tilapia may be among the list of species considered, given the recognition that they are a significant threat to Australia and currently the focus of management attention to eradicate/control new incursions. Much can be learnt from existing contingency, response or control plans prepared within other sectors. Some of these plans have been implemented and therefore much can also be learnt from existing assessments of their strengths, weaknesses and approaches.

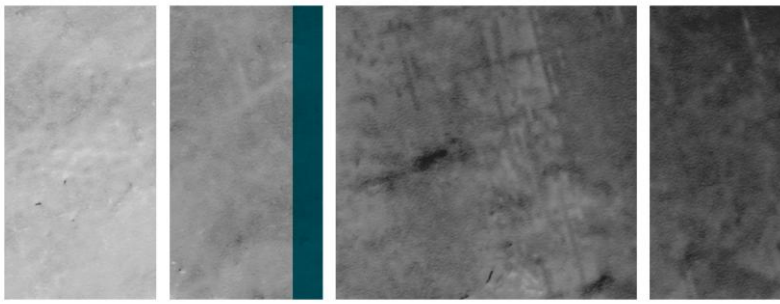
Recommendation 11: Develop species-specific plans (contingency, response and/or control plans) for high-priority alien freshwater fish in Australia. High-priority species should be identified using appropriate risk assessment procedures (Recommendation 10). The need for plans for particular high-priority species is already apparent and should be initiated, for example, tilapia.

5.5 Priority alien freshwater fish management areas and plans

Focusing management attention on high-priority sites is a logical approach to alien freshwater fish management where resources are limited. High-priority sites could be areas with high environmental, social or economic values or assets, or areas with high risk of alien incursion (eg hubs of activity, high population densities). Management could concentrate on protection, prevention and impact mitigation from alien species at high-priority locations. Alternatively, priority sites could be areas where intensive management intervention would provide greatest cost-effective management results, for example:

- areas where alien fish congregate at particular times of year ('hot spots')
- locations where there is high community and/or agency interest and support
- sites containing highly valued assets
- sites of high social, cultural, environmental and/or economic value.

Examples of priority sites in Australia include the management of salmonids in Victoria to protect native barred galaxias (*Galaxias fuscus*) and carp management plans for particular locations, such as known reproductive 'hot spots'. In some Victorian upland streams, physical barriers have been constructed to prevent upstream dispersal of salmonids into headwaters where threatened native barred galaxias occur (Lintermans and Raadik 2003). The negative interaction between barred galaxias and rainbow trout and brown trout are a key threat to barred galaxias. By preventing niche overlap of these species, the impact of trout on barred galaxias would be mitigated. Carp management plans aim to develop a ready-to-implement, community-based carp management program to test and demonstrate the effectiveness of intensive and integrated application of various carp management techniques to address the carp problem at an on-ground, pragmatic level (Stuart 2008, Braysher et al 2008). Carp management plans have been developed for particular sites, such as Tahbilk Lagoon and the



Lower Avoca Wetlands (Stuart 2008, Braysher et al 2008). The Invasive Animals CRC project 'Identification of hot spots of carp reproduction in the Murray–Darling Basin' involves determining key locations important for carp breeding that may be suitable for focused control as part of an integrated carp management strategy (Gilligan et al 2008). Carp do not breed throughout river systems in the Murray–Darling Basin. Instead, several main hotspots have been identified that produce very high abundances of juvenile carp, including the Namoi Wetlands, Gwydir Wetlands and Barmah–Millewa Forest (Gilligan et al 2008).

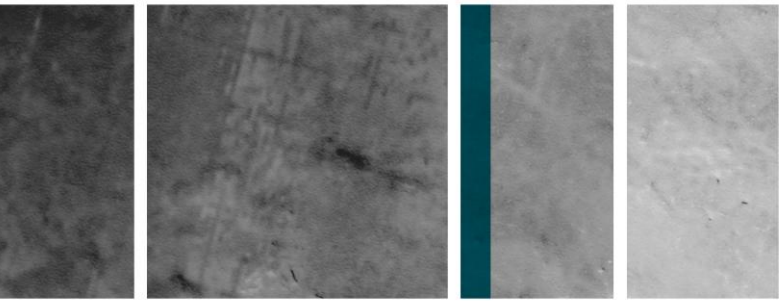
There is value in expanding existing approaches to develop procedures for identification of priority sites in Australia for alien fish management. A process for identification of priority areas for alien freshwater fish management should review existing approaches in Australia and internationally. Such a review could consider their strengths, weaknesses and gaps, and should identify issues to include within a priority ranking system.

Recommendation 12: Develop and implement a ranking system to identify high-priority sites for alien freshwater fish management in Australia. This system should involve an initial review of existing approaches in Australia and internationally. Site-specific alien freshwater fish management plans could subsequently be prepared.

5.6 Operational and technical manuals

During the implementation of a response to an incursion, various practical on-ground actions must be undertaken. For the management of incursion responses within other biosecurity sectors, such as animal diseases, a range of technical and operational manuals are available that outline the roles, responsibilities and actions that must be undertaken when a new incursion is detected. These include destruction, disposal and decontamination manuals, which have been developed by writing groups of relevant committees, with contribution from all jurisdictions. The existing manuals used in other biosecurity sectors have been nationally agreed and must be followed where cost-sharing is sought. These manuals enable managers to access adequate information on procedures to make informed management decisions at short notice and provide a valuable training resource for inexperienced staff.

Similar manuals are required for alien freshwater fish incursions since existing actions across Australia are sometimes ad hoc, inconsistent and variable. They should be developed following approaches taken by other biosecurity sectors. Existing destruction, disposal and decontamination manuals for other biosecurity sectors will be useful initial guides. Other technical manuals specifically for managing freshwater fish incursions would be valuable, including electrofishing and use of registered piscicides. As is the case within other biosecurity sectors, the manuals would be regularly revised, particularly following the evaluation of field tests and workshops.



5.6.1 Operational manuals

Destruction manual

Destruction manuals provide information on the available techniques to euthanase relevant species. The methods must be as humane as possible, effective and readily available. The AQUAVETPLAN destruction manual outlines choice of methods for euthanasia, available chemicals and recommended methods for particular systems (eg closed, semi closed, semi open and open) (Agriculture Fisheries and Forestry, Australia 2002a). The AUSVETPLAN destruction manual describes management considerations and best-practice procedures for achieving euthanasia of various animal species (Animal Health Australia 2004). Details are provided for several methods, including those specific to particular species. As noted within the AQUAVETPLAN destruction manual, euthanasia of fish must be conducted in accordance with animal ethics guidelines and legislation (Agriculture Fisheries and Forestry, Australia 2002a). Destruction options will vary according to each incident.

The development of a destruction manual for freshwater fish incursions would most likely use the AQUAVETPLAN destruction manual as an initial guide. The AQUAVETPLAN destruction manual outlines a few destruction options, focusing on chemical treatment. Creating a similar manual for the destruction of freshwater fish collected during incursion response would be beneficial. Many managers recognise the value of having detailed and adequate information on these techniques to make informed decisions on appropriate management options for particular situations at short notice. Euthanasia of some fish species might be difficult, for example, for species that can survive long periods out of water or have broad tolerances to various conditions, such as temperature and pH.

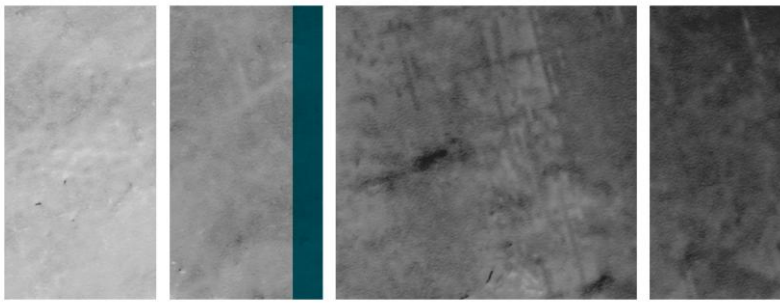
There is interest in adapting the destruction manual to be broader in context by including information on techniques for containment, eradication and control. The limitations and application considerations of different methods could be described. There are few options currently available for containment, eradication and control of alien freshwater fish. Existing options include electrofishing, netting, traps, cages, registered piscicides and water manipulation. Historically, containment, eradication and control programs often used a combination of these techniques.

While a destruction manual would provide some information on rotenone usage and possibly electrofishing, it is recognised that detailed and specific technical manuals for these two methodologies is warranted.

Recommendation 13: Develop a destruction manual for alien freshwater fish. Consider incorporating information on techniques for containment, eradication and control.

Disposal manual

An essential component of a freshwater fish incursion response program is the disposal of all fish collected as soon as possible after destruction. Key issues for disposal include disposal location, volume and mass of animals, legislation, operator safety, community concerns, health concerns, transport options, environmental considerations, cost-effectiveness and timing. Disposal options may be available through local governments or local companies. Most



past eradication and control programs for alien freshwater fish in Australia have limited documentation, including lack of detailed information on fish disposal methods used. It is likely that agencies within each state and territory align with jurisdictional fish disposal requirements, which are also likely to vary significantly.

The AQUAVETPLAN disposal manual outlines disposal options for carcasses, animal products, materials and wastes to prevent the spread of infection (Agriculture, Forestry and Fisheries, Australia 2002b). This manual considers the selection of disposal sites, methods of disposal (eg burial, cremation, ensiling, rendering, composting, onsite processing and freezing) and particular items that require special consideration (eg blood water and liquid waste, effluent) (Agriculture, Forestry and Fisheries, Australia 2002b). The structure of the AQUAVETPLAN disposal manual is based on the AUSVETPLAN disposal manual (Agriculture, Forestry and Fisheries, Australia 2002b). The AUSVETPLAN disposal manual includes additional information on decision-making frameworks, media and community concerns and several checklists (Animal Health Australia 2007a).

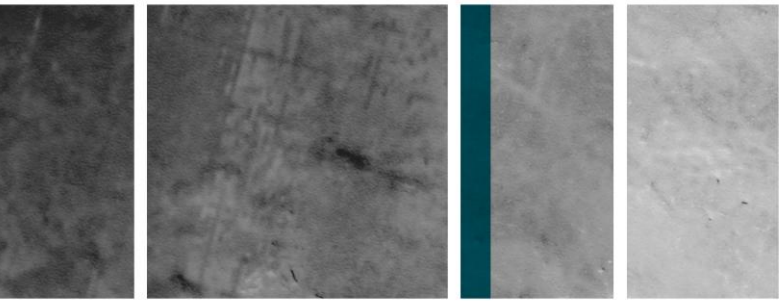
The development of a disposal manual for alien freshwater fish would most likely use the AQUAVETPLAN disposal manual as an initial guide. A disposal manual for alien freshwater fish should provide a decision-making framework to facilitate informed selection of a disposal option. Such a manual would primarily be a general guide given that there are many specific jurisdictional restrictions associated with the disposal of fish (eg legislation currently differs between states and territories concerning movement of noxious fish). A project is currently being completed investigating carp harvest and disposal in the Murray River associated with the operation of the Williams' carp separation cages (P Jackson, personal communication, 2009). The final report for this project will include information on carp harvesting and disposal options, legislation, ethics, and workplace health and safety, which may inform the development of a disposal manual for alien freshwater fish.

Recommendation 14: Develop a disposal manual for alien freshwater fish.

Decontamination manual

Decontamination includes all physical and chemical processes required to clean and disinfect premises, vehicles and objects that may have been directly or indirectly contaminated by pathogens and biological material during the emergency response. A decontamination manual for alien freshwater fish incursions is required to outline the decontamination procedures to be implemented during emergency response. It is important that incursion responses do not inadvertently spread biological material including eggs, larvae and juvenile alien fish.

The AUSVETPLAN decontamination manual provides guidelines on disinfectants and chemicals for the inactivation of emergency animal disease agents and decontamination procedures for premises where animals infected with the emergency animal disease have been held (Animal Health Australia 2007b). AQUAVETPLAN also has a decontamination manual, which is divided into two parts: Part A provides information on the basic principles and planning of a decontamination program, and Part B gives specific recommendations for a range of common tasks (Department of Agriculture Fisheries and Forestry 2008). The AUSVETPLAN and AQUAVETPLAN decontamination manuals both consider registered chemical use, environmental issues and safety precautions during a decontamination process.



The *Australian Code of Electrofishing Practice* includes guidance about the transfer of biological material between waterways, including weeds, fish and diseases (NSW Fisheries 1997). The code recommends thorough cleaning and sun drying of all gear (eg nets, traps, boats, trailers) to ensure removal of plant material (NSW Fisheries 1997). Both the deck and live-well of boats should be flushed with chlorine solution or sodium metabisulphite when on land (NSW Fisheries 1997). The need for effective cleaning is emphasised when entering pristine or protected waterways, such as municipal water supplies (NSW Fisheries 1997).

Standard decontamination requirements for alien freshwater fish should vary little from the AQUAVETPLAN decontamination manual and this could be used as an initial guide. It contains relevant information for a decontamination manual for alien freshwater fish, such as equipment decontamination, including boats and vehicles, and recommendations for open systems (Department of Agriculture Fisheries and Forestry 2008). Most jurisdictions are likely to have existing general decontamination procedures for freshwater equipment, although they may vary in their detail, implementation and formality. A review of existing jurisdictional procedures is required to identify various relevant decontamination methods, level of implementation and their effectiveness to inform development of a decontamination manual for alien freshwater fish.

Providing advice to researchers and the general public on equipment decontamination procedures is important to prevent the introduction and spread of alien freshwater fish. Relevant decontamination procedures for such stakeholders could be clearly and simply outlined in a separate guide.

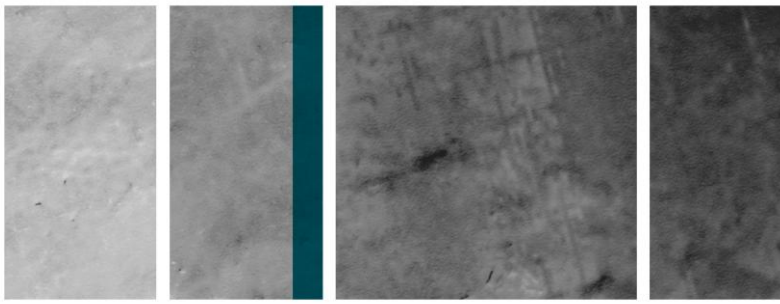
Recommendation 15: Develop a decontamination manual to be used during response to alien freshwater fish incursions and a decontamination guide for everyday use by people participating in freshwater activities.

5.6.2 Technical manuals

Rotenone manual

Rotenone is a naturally occurring chemical derived from the roots of plants within the genus *Lonchocarpus* or *Derris* (Finlayson et al 2000). It is used as a pesticide, insecticide and a piscicide and functions via inhibiting cellular respiration (Finlayson et al 2000). Rotenone has also historically been used as a fish survey technique in structurally complex habitats and where other sampling methods are of limited use (Finlayson et al 2000; J McKenzie, personal communication, 2009). A review of previous fish eradication programs in Australia (Ayres and Clunie 2010) indicated that the majority applied a chemical treatment of rotenone. However, there is no comprehensive rotenone manual available in Australia to provide detailed guidance on rotenone application in different freshwater habitats, the lethal concentration ranges for particular fish species, usage considerations, likely effects, legal considerations, permits and examples of application.

In North America, rotenone has been used since the 1930s in fisheries management for fish sampling and control (Finlayson et al 2000). In 1993, fisheries managers recognised the negative publicity and growing concern among the general public of the environmental and



human health impacts of rotenone. A Rotenone Stewardship Program was initiated to balance environmental safeguards with careful use of rotenone. This program produced the *Rotenone Use in Fisheries Management: Administrative and Technical Guidelines Manual* (Finlayson et al 2000) for safe and effective rotenone use. A symposium was held, surveys were conducted on rotenone usage and public information material was produced. A website was developed that includes a list of experts for fisheries managers to contact for information (www.fisheries.org). The *Rotenone Use in Fisheries Management: Administrative and Technical Guidelines Manual* (Finlayson et al 2000) is very detailed and provides extensive guidance and background concerning administrative and technical procedures, project assessments, issues and responses. This manual is a valuable reference document for Australia.

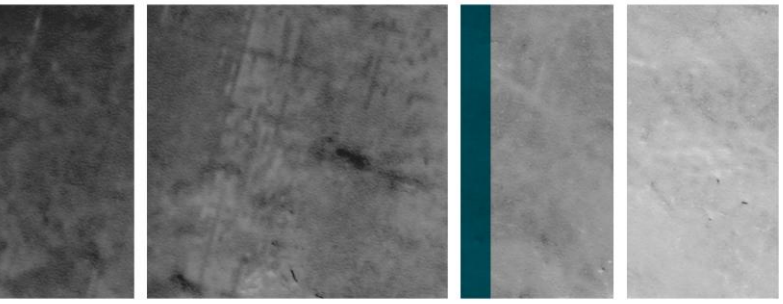
In Australia, the AQUAVETPLAN destruction manual (Agriculture Fisheries and Forestry, Australia 2002) provides some basic guidance on how rotenone should be used, including recommended dosages, the inclusion of a dye, use of a neutraliser, and the influence of environment on its breakdown process. The Queensland Department of Employment, Economic Development and Innovation, previously the Department of Primary Industries and Fisheries Queensland, has also developed a manual for rotenone use (Department of Primary Industries and Fisheries 2005). These manuals and other state and territory guidelines would also be valuable reference material for the development of an Australian rotenone manual.

Varying legislation and protocols currently exist across Australia for the use of rotenone to eradicate alien fish. Rotenone must be currently registered through the Australian Pesticides and Veterinary Medicines Authority (APVMA) to allow its application in Australia. Jurisdictions must obtain a permit for its use, which includes conditions outlining specific requirements of its usage. In 2004, New South Wales lead the development of the current APVMA permit for rotenone, which was supported nationally and endorsed by all states except Victoria. Victoria is the only jurisdiction where rotenone use is not permitted. Rotenone registration is periodically reviewed to evaluate the conditions of its use. It is critical that continued access to rotenone is ensured for all types of applications. It is important that permits are renewed in a timely manner to avoid lapses between current permits and to ensure rotenone application can occur when required.

A national rotenone manual for Australia is required to guide managers and operators on various aspects of rotenone use, including occupational health and safety considerations. All staff involved in rotenone application should be properly trained in chemical usage and take precautions against safety risks. Jurisdictions should ensure their rotenone permits are current and enable rotenone application as required.

Recommendation 16: Develop a national rotenone manual for use during response to alien freshwater fish incursions.

Recommendation 17: Ensure continued access (registration, permits and practical application) to rotenone in all Australian states and territories.



Electrofishing manual

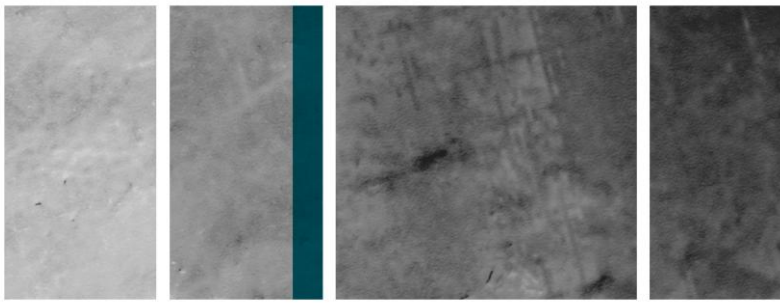
Electrofishing is a method of applying electricity to freshwater to stun fish to allow their easy collection. Electrofishing is commonly used in Australia and internationally to conduct fish surveys to determine species composition, abundance and density. It can also be applied to manage alien freshwater fish because stunned alien fish can be collected and subsequently removed from the waterway. In emergency management or response activities for alien freshwater fish, electrofishing may be applied, for example, as an active surveillance method, during delimiting surveys, to remove alien freshwater fish or during post-response monitoring.

There are various electrofishing machines presently used in Australia, including back-pack, shore-based or boat-mounted units (NSW Fisheries 1997). Electrofishing machines differ in their design, specifications, capacity and applicability. Electrofishing efficiency can be affected by water conductivity, temperature, velocity, depth and clarity, as well as fish size and species, technique and operator experience and site logistics.

An electrofishing manual could provide guidance and detailed information to operators on the various electrofishing machine designs, their applicability (including advantages and limitations) in various conditions, habitats and for different fish species and fish sizes and associated operational, safety and maintenance information. The manual should be revised as needed with advances in the field, particularly relating to increasing efficiency and consistency of methodology, standardisation, catchability, operator safety, fish trauma and specialised equipment.

An electrofishing manual may complement the existing *Australian Code of Electrofishing Practice* (NSW Fisheries 1997). This code was developed under the auspices of the Fishery Management sub-committee of the Standing Committee for Fisheries and Aquaculture (SCFFA) following an International Workshop on Developments in Electrofishing conducted in Canberra in 1995 (NSW Fisheries 1997). The code was subsequently approved by the SCFFA in 1997 (NSW Fisheries 1997). This national code aims for a consistent and coordinated approach to training and safety and outlines objectives, hazards, staff training and certification, equipment and operational practice (NSW Fisheries 1997). Several states have their own guidelines and amendments to the code. This code is currently being reviewed and an additional training document is under development (J McKenzie, personal communication, 2009).

Recommendation 18: Develop a national electrofishing manual for freshwater fish.



6. Supporting arrangements

6.1 Management support products

6.1.1 Decision-support tool for management of freshwater fish incursions

A review of previous eradication and control programs for alien fish undertaken by agencies across Australia indicated that many programs were ad hoc, poorly documented, unclear in their purpose and planning approach and lack comprehensive monitoring and follow up (Ayres and Clunie 2010). Agency employees participating in such programs vary in their:

- knowledge of fish species, including existing and potential invaders, their biology/behaviour, level of threat to the environment, and most effective methods of detection
- knowledge and experience using available techniques for containment, eradication and/or control, including pros, cons, key considerations and specific methodologies
- roles, responsibilities, training and expertise.

Many agency staff seek clear and easily accessible information to guide decision making regarding the most appropriate course of action when dealing with a new incursion or ongoing management of an alien freshwater fish. Development of a decision-support tool would allow relevant information to be easily accessible to guide decision making, thereby:

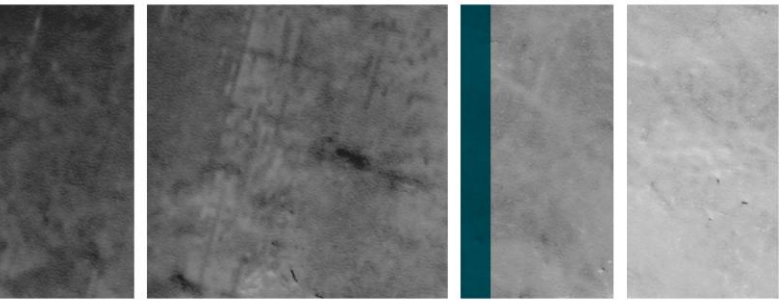
- maximising the speed of response
- enabling a logical consideration of all potential options, including their pros and cons, and various practical considerations that should be taken into account
- facilitating communication between agencies
- ensuring valuable lessons learnt from past experiences are shared
- allowing consistency of approaches
- allowing suitable documentation of planning and implementation.

This tool should be utilised once an incursion has been confirmed.

Several containment, eradication and control options are currently available in Australia and overseas, including physical removal, chemical methods, habitat manipulations, genetic methods and biological control. Each option has advantages, disadvantages and limitations. The suitability of options will depend on many factors, including species and invasion characteristics, site conditions and specific purposes of programs and timeframes for action. For most initial emergency response procedures, the greatest focus would be on options that provide eradication, such as chemical treatment, physical removal and habitat manipulations, including water draw-down. Decisions on managing an incursion will also be influenced by the species involved.

A suite of alien freshwater fish species could be the subject of an incursion, including those:

- already present and established in Australia
- present in Australia but not yet released into the wild
- not yet present in Australia.



The amount of ecological information available for these species varies. There is great value in identifying relevant ecological information, including breeding biology, habitat preferences and requirements, movement patterns, seasonal patterns, longevity and detection factors, because it is likely to influence management approaches. Collation of existing information and resources would be an initial step in development of such a tool. This process could also provide research direction by assisting in the identification of knowledge gaps. A web-based tool could involve the users answering a series of questions and following logical steps to reach a decision as to how to best manage a fish incursion. The user could then print a document summarising the decision-making process.

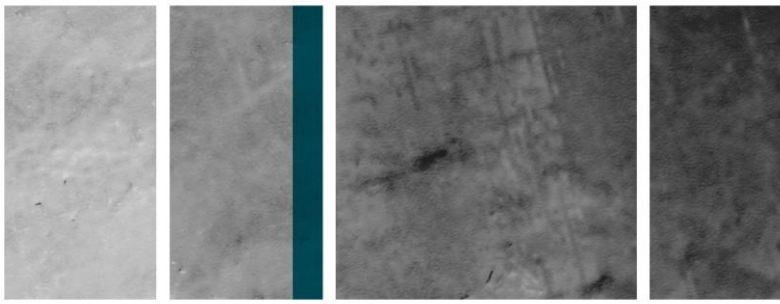
The development of a decision-support tool would not replace existing jurisdictional procedures and would represent a complementary guide. For example, there would be state and territory specific permits and processes that must be adhered to. However, the tool could indicate various general questions a manager should consider in determining relevant jurisdictional issues and processes. Its development would require the planning skills of ecologists, managers and computer program designers. Once a draft tool was developed, it would require trialling.

There may also be potential to incorporate additional features into the tool. For example, inclusion of a GIS component to describe the composition of the fish community expected in an affected area. This would be particularly valuable in making an assessment of the potential impact of proposed actions on non-target species.

Recommendation 19: Develop and trial a decision-support tool for the management of freshwater fish incursions. Such a decision-support tool would guide managers and facilitate rapid response, consistent approaches and effective dissemination of relevant information.

6.1.2 National incursion register

It is important that appropriate agencies within states and territories are informed and aware of new alien freshwater fish incursions in Australia. However, there is currently no national formal communication process to notify jurisdictions of new alien freshwater fish incursions. A centralised national incursion register would essentially be a national database of all new confirmed alien freshwater fish incursions, accessible by relevant managers and agency staff throughout the country. It would facilitate the collection and dissemination of information on new incursions of alien freshwater fish. Obligation to register a new alien freshwater fish incursion could be incorporated into a relevant intergovernmental agreement, similar to the reporting of emergency animal disease incidents in accordance with the Government and Livestock Industry Cost-Sharing Deed in Respect of Emergency Animal Disease Responses whereby government parties are obligated to give formal notification to the Consultative Committee on Emergency Animal Diseases within 24 hours of becoming aware of an emergency animal disease incident. Specific information to be included in the national incursion register should be consistent with information gathered on a standardised national alien freshwater fish incursion reporting form (Recommendation 24). Such a register would ensure that all new incursions of alien freshwater fish are nationally documented and that all jurisdictions are aware of the occurrence and location of new alien freshwater fish incursions and the contact details of the appropriate person regarding the incident.



The national incursions register would link closely with:

- Recommendation 21: Development of a national control program database. For example, after an incursion is included on the national incursion register, documents detailing subsequent eradication/control actions should be added to the national control program database.
- Recommendation 24: Standardised suspected alien freshwater fish incursion reporting form. For example, a standardised suspected alien freshwater fish incursion reporting form should be developed to ensure consistent, minimum amount of information is gathered on suspected new alien freshwater fish incursions across jurisdictions. This information could then be made available to other jurisdictions once the suspected incursion is confirmed through the national incursion register.

The development of such a register would require consideration of:

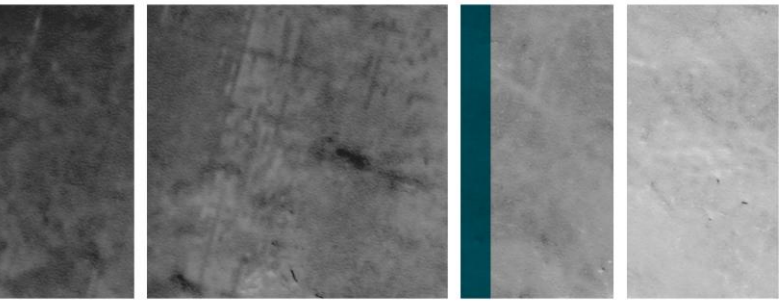
- where the register is located
- how information on new additions to the register is disseminated (eg email alerts)
- how the registered is accessed (eg login)
- allocation of responsibility and funding for ongoing maintenance of the register.

Evaluation of information stored on a national incursion register could inform additional required management actions. For example, confirmed frequent incursions of a particular species may warrant a national community education program targeting this species.

Recommendation 20: Develop a national freshwater fish incursion register.

6.1.3 National control program database

Documentation of past containment, eradication, or control programs for alien freshwater fish in Australia has been limited. Exploring past experiences in managing alien freshwater fish issues has emphasised the need to adequately document actions in such programs and make these reports readily and easily accessible. A centralised national control program database is required to collate, store and make available reports on the containment, eradication or control of alien freshwater fish to inform practitioners in the future. Guidelines should be provided on basic information to be included in reports, such as specific detail on aims, description of invasion, habitat, methods, outcomes (level of success/failure), issues, costs, lessons learnt and key contacts. The database would be comparable to an electronic library, where users could search for reports by author, date or keywords (eg specific methods, species, habitats). Ideally, reports would be electronic and stored on the database to enable their download. Otherwise, information should be included on how to obtain copies of non-electronic reports from relevant authors/agencies. Additionally, these reports may be useful for staff training and educational purposes.



The development of such a database would require consideration of:

- where the database is located
- how information can be accessed, for example, login
- allocation of responsibility and funding for ongoing maintenance of the database.

Recommendation 21: Develop a national control program database.

6.2 Communication resources and training

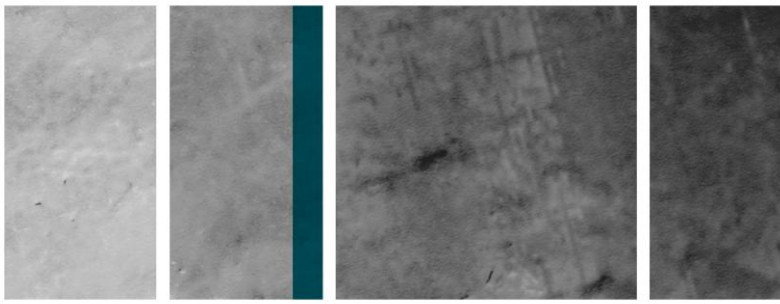
6.2.1 Communication resources

Central website for national alien freshwater fish incursions

A central website is needed to display and make available up-to-date information on the management of alien freshwater fish incursions in Australia. Procedures, documents, tools and communication and education products relevant for management of alien freshwater fish could be promoted and made accessible to various stakeholders, including government agencies, interest groups and the broader community, via this website. The website may be used as a link for agency managers and staff to login to databases, including the decision-support tool (Recommendation 19), national incursion register (Recommendation 20) and national control program database (Recommendation 21). The website could include access to communication and education products and tools (Recommendation 23). The website may contain links to other relevant websites, including the national pests and disease outbreaks website (www.outbreak.gov.au) and the national marine pest website (www.marinepests.gov.au). Such relevant websites should be reviewed when developing the national alien freshwater fish incursion website to gain ideas on website structure and content. Web-links to other appropriate websites, such as those formerly mentioned and other federal, state and territory government websites, would be provided on the national alien freshwater fish incursion website.

National communication and education products and tools

There is currently no national community education program targeting alien freshwater fish species. The level of public awareness on alien freshwater fish species and their risk and potential impacts of introduction is not high. States and territories have some community education programs that address alien fish to varying extents. For example, many jurisdictions have online information and downloadable publications on specific alien freshwater fish species. This information could be advanced further by developing a coordinated, national communication and education program for alien freshwater fish. Resources could be developed to promote key, consistent messages and they could be targeted to particular stakeholders. The national communication and education program could include engagement with stakeholder groups to facilitate dissemination of key messages and resources, and increase their awareness of alien freshwater fish issues.



Development of an online community awareness tool represents a valuable component of a national communication and education program. This tool could achieve several goals including:

- increasing the community's awareness of the threats posed by alien freshwater fish species
- enhancing the ability of the community to identify alien freshwater fish species, through provision of easily accessible identification tools
- increasing the potential for the community to contribute to early detection of new incursions.

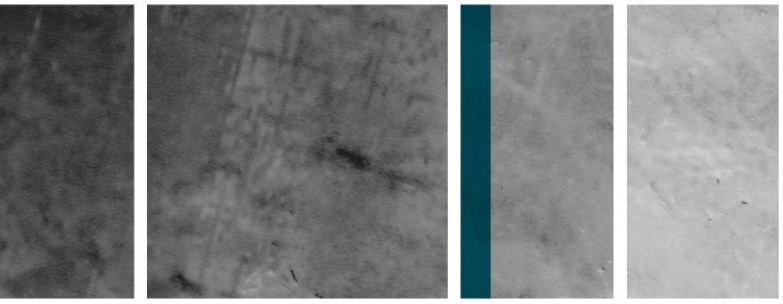
Such a tool would involve development of a website providing information on fish identification characteristics, ecological information and links to other sources of information, including other relevant websites. The online community awareness tool could be hosted on the national alien freshwater fish incursion website, as described in the previous section. Development of an online community awareness tool could potentially link in with the Fishes of Australia website currently under development by OzFishNet, a consortium of Australian ichthyologists mostly based at Australian museums. OzFishNet is currently developing an interactive key and species information sheets, including images and distributional maps (M Gomon, personal communication, 2009).

Community awareness tools have been developed for other sectors including the marine and plant sectors; much could be learnt from these tools. For example, the national marine pests website (www.marinepests.gov.au) includes access to the National Introduced Marine Pest Information System (NIMPIS). The NIMPIS contains detailed information on the biology, ecology and distribution of marine pest species detected in Australian waters as well as potential control options for selected pests. The national marine pests' website also includes a Marine Pest Interactive Map. Locations within Australia can be selected on the interactive map and the various marine pests recorded at that site are displayed. Individual marine pests can be selected to learn about how to identify the species (including information on species that they may be confused with), their habitat, impacts and current distribution. Additional educational resources available on the marine pests website include pest identification cards for priority species, including those already present and absent in Australia.

Likewise, Weeds Australia (www.weeds.org.au) is the national website created by the Australian Weeds Committee to promote access to information on key weed policies, regulations, current issues, national initiatives, research, extension, training and personnel. The website includes an online Weed Identification Tool to enable users to search for weeds in particular regions of Australia using an interactive map. Searches can be refined further by searching for weeds according to weed type (herb, grass, shrub, tree, vine, water plant). Individual weed species can be selected to display species information including origin, description, distinguishing features, dispersal characteristics, species commonly confused with, photographs and references. The Weeds Australia website also includes access to training and materials, including the 'Weedbusters — Activities, Information and Curriculum Links' education kit for schools.

Encouraging consistency in suspected alien freshwater fish incursion reporting

Reporting of suspected alien freshwater fish incursions or unusual fish in freshwater environments is vital to trigger emergency response actions. Early detection is important to begin appropriate and effective responses to provide the best opportunity of eradication and limit adverse social, economic and environmental impacts.



Jurisdictions currently have separate reporting procedures for suspected alien freshwater fish incursions. All jurisdictions have phone lines or online forms that can be completed and submitted to report a suspected alien freshwater fish incursion. Some states have comprehensive, well-publicised reporting procedures in place (eg New South Wales) while reporting options in other jurisdictions are poorly or ambiguously advertised to the public.

All stakeholders, particularly the general public, need to be informed about what they should do if they suspect an alien freshwater fish incursion (eg collect samples, take photographs, note the location and nearby landmarks and contact the relevant state or territory authority). They should be aware of and understand how to report suspected alien freshwater fish incursions in each jurisdiction. Thus, reporting systems for each state and territory need to be well advertised, easily accessible and user friendly.

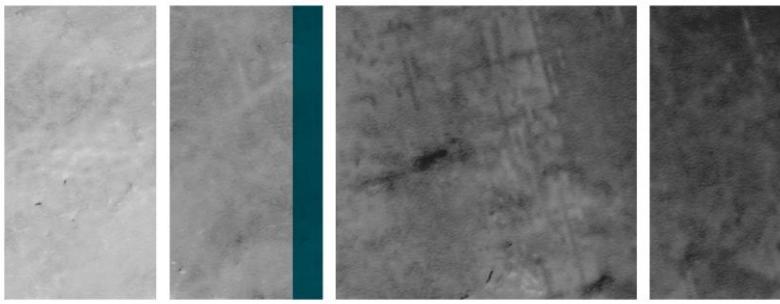
A standardised suspected alien freshwater fish incursion reporting form would be valuable to detail basic information for state or territory authorities during the investigation process (eg contact details, location and description of fish). A standardised form would support consistency in approach and provision of adequate information to inform subsequent actions. A review of current information collected during existing jurisdictional reporting processes would facilitate development of such a template. The template would be simple to create, but should link with existing jurisdictional reporting processes. Overall, consideration of a national reporting system for suspected alien freshwater fish incursions (eg national hotline and a generic reporting form) is suggested to provide simple methods to encourage early reporting.

Existing approaches applied in other sectors may be useful to learn from. For example, the free national Exotic Plant Pest Hotline connects to relevant state and territory agencies. This hotline is supported by the state and territory departments of agriculture, primary industries and natural resource management, the Australian Government Department of Agriculture, Fisheries and Forestry, and Plant Health Australia. The Weeds Australia webpage provides access to an online weed reporting form, which aims to provide a rapid and convenient method of reporting suspected incursions of weeds. In the marine sector, each jurisdiction has individual reporting procedures. At the national level, guidance is provided about what to do if you suspect a marine pest incursion, as well as the relevant state and territory hotline phone numbers to contact.

Recommendation 22: Develop a centralised website to provide access to national procedures, documents, tools and communication and education resources relating to the management of alien freshwater fish incursions.

Recommendation 23: Develop national communication and education products and tools for alien freshwater fish.

Recommendation 24: Encourage consistency in suspected alien freshwater fish incursion reporting by considering the adoption of a national reporting system.



6.2.2 Taxonomic experts register

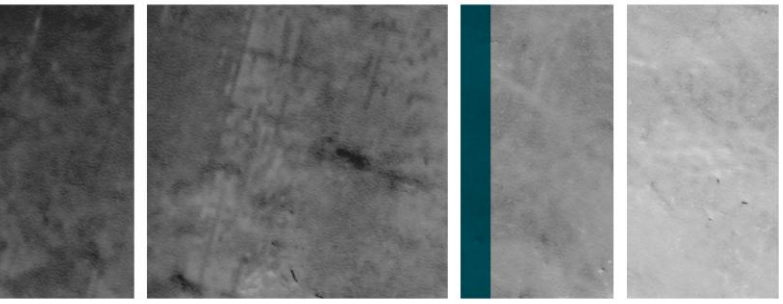
An important step in emergency response to an alien freshwater fish incursion is the correct identification of species. A species identification and verification procedure is required to clearly outline the steps from collection of samples to the confirmation of the species identity and reporting back. Staff need to obtain taxonomic skills and training to enable species identification capability. There are few taxonomic experts presently in each jurisdiction and there is continuing loss of experienced curators. Authorities need to be aware of appropriate taxonomic experts in their jurisdiction that can assist in confirming species identity. At least two independent taxonomic confirmations should be obtained for accuracy.

There is currently no national procedure in place for confirming the identity of an alien freshwater fish incursion. Development of such a procedure will include creating several work instructions and forms addressing each step in the process. Most states and territories have varying procedures in place, which may range in their detail, the level of implementation and whether they are formalised. Taxonomic experts at museums, universities and other relevant organisations, such as CSIRO, Cooperative Research Centres and external consultants, may also play a role in the identification and verification of specimens received by state and territory authorities or national authorities, such as AQIS. Occasionally, local museums seek advice from international taxonomic experts for particular fish taxa.

It would be extremely valuable to develop a national register of taxonomic experts and an associated national procedure for the collection, preservation, taxonomic identification and verification and storage of alien freshwater fish specimens, including associated forms and reporting back procedures. Important components are the lodging of voucher specimens with appropriate museums and documenting where specimens are stored and how they can be accessed. Appropriate collection and preservation of adequate numbers of samples would enable their circulation to other museums across Australia, as valuable reference material.

A taxonomic experts' register could easily be developed to inform authorities of the contact details of freshwater fish taxonomic experts within Australia and overseas. It would enhance existing international, national, and state and territory linkages and collaboration. Information on the qualifications, experiences and skill sets of experts would be included on the register and could inform training requirements (Recommendation 26). Once the procedure and the register have been developed, their existence needs promotion and they should be easily accessible, for example, via the centralised website (Recommendation 22).

Existing species confirmation procedures within other sectors may be a useful guide. PLANTPLAN (Plant Health Australia 2008) includes procedures and protocols for collecting, storing, labelling, transportation, diagnosis and identity confirmation of specimens, including laboratory standards, chain of evidence and specific proformas. AUSVETPLAN has a specific laboratory manual (Animal Health Australia 1996) that addresses handling of specimens, communication, training, security, cleaning and documentation. The control centres manuals for AUSVETPLAN (Animal Health Australia 2008) and AQUAVETPLAN (Agriculture, Fisheries and Forestry – Australia 2001) include checklists and guidance for diagnostic teams and collection of material for laboratory confirmation.



Recommendation 25: Develop a national taxonomic expert register and a national standard procedure for specimen collection, preservation, taxonomic confirmation and verification and storage. This should include a review of current procedures in each state and territory.

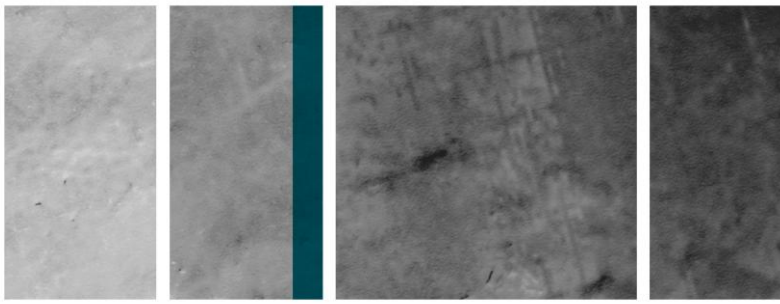
6.2.3 Early detection and emergency response skills and training

There are two key groups of people that require training to develop capability in early detection and emergency response:

1. Government agency or other organisation employees responsible or likely to be involved in detection and emergency response to freshwater fish incursions
2. Others who may notice suspected incursions during their course of activities, for example, recreational anglers, commercial operators, community groups (Landcare, Waterwatch), ecologists, landowners, general public.

There are many ways to develop awareness and capability of stakeholders. Creating a national education program and communication tools and resources would facilitate understanding, awareness and capability of community stakeholders, as discussed in previous recommendations. Training of government agency and other organisation employees responsible or likely to be involved in detection and emergency response to freshwater fish incursions is important to enable rapid response capability, coordination and effectiveness.

Many state and territory fisheries and natural resource management staff currently lack understanding and basic training in emergency response management. There is a need to clarify what emergency response skills and accreditations state and territory fisheries and natural resource management staff currently hold, and what skills and accreditations are required in an emergency response to a freshwater fish incursion. Comparison of these skills and accreditations will identify gaps in capability and training needs. In addition to gaining generic emergency management skills and accreditations (eg Australasian Inter-service Incident Management System (AIIMS) training), there are several freshwater specific skills staff may require to respond to a freshwater fish incursion, such as electrofishing, boat licenses and handling, application of chemical treatments to aquatic environments and specimen collection, preservation and identification. There is a need to develop and deliver learning and activities based on incident management functions and skills specifically required in response to alien freshwater fish incursions. Activities should align with and complement the national biosecurity training framework to be established under 'Harmonising Australia's biosecurity emergency response arrangements'. Training should include preparatory training, such as courses and simulation exercises, as well as 'just in time' training. Skills, competencies and assessment could be based on a national standard to facilitate consistency in approach across jurisdictions and to enable staff and resource sharing when required. Emergency response managers for freshwater fish incursions should promote participation in emergency management learning activities and train more staff than what is immediately necessary to maximise the number of skilled staff available for response activities. Managers should also consider trained staff retention and turnover to ensure response capability.



Recommendation 26: Incorporate freshwater fish incursion response into a national training program for emergency response.

6.3 Active surveillance program

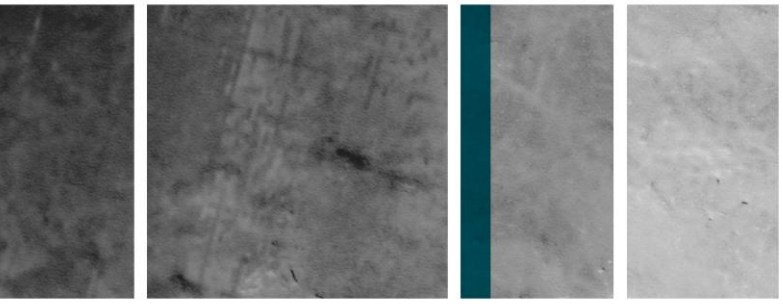
Surveillance programs represent a valuable management tool to enable detection of a species' presence and to determine the success of management actions. Tasmania is the only jurisdiction in Australia that currently conducts regular routine active surveillance for alien freshwater fish; however, this is site-specific surveillance targeting carp occurrence (Inland Fisheries Service 2004, 2009). Queensland previously implemented routine active surveillance for tilapia as part of the Queensland Vulnerable Catchments Program, but this program was discontinued.

There are currently no federal, state or territory surveillance programs targeting alien freshwater fish. There are several programs across and within states and territories that provide valuable information on fish species occurrence. These include broad scale programs (eg the Sustainable Rivers Audit) and smaller scale programs focusing on particular species (eg threatened species), sites (eg those of high ecological value), or environmental issues (eg habitat degradation impacts). Information on alien freshwater fish occurrence is often collected as a by-product of research programs.

The value of any survey program in rapidly detecting an alien freshwater fish incursion is clearly influenced by their frequency, intensity and survey techniques. All jurisdictions are generally heavily reliant on passive surveillance approaches (eg via general public reporting) to detect new alien freshwater fish incursions.

Development of a comprehensive national active surveillance program targeting alien freshwater fish could assist in rapid detection of alien fish incursions. Given the likely significant financial costs of such a proposal, particular focus could be given to priority catchments and alien fish species considered to be of greatest potential concern (Recommendations 10 to 13). Aspects to consider for such a program would include appropriate frequency, intensity and survey techniques to maximise detection of particular species. Once molecular probes are developed for selected alien freshwater fish species (Recommendation 36) genetic techniques could be implemented as part of an active surveillance regime to accurately detect alien freshwater fish occurrence.

Recommendation 27: Develop a comprehensive national active surveillance program targeting high-priority areas and/or high-priority alien freshwater fish species.



6.4 Legislation

Legislation represents a tool for the management of alien freshwater fish in Australia. The literature review (Ayres and Clunie 2010) identified that a common challenge to alien species management is fragmented, outdated and inadequate legislation and variation in definitions of alien species. A suite of legislation influences the management of alien fish species, both in relation to preventing their entry and spread, and protection of the environment and its fauna once they are present. In Australia, key federal legislation includes the *Quarantine Act 1908* and the *Environment Protection and Biodiversity Conservation Act 1999*. Each state and territory has relevant legislation relating to fisheries management, pest management, threatened species management and aquaculture and disease management.

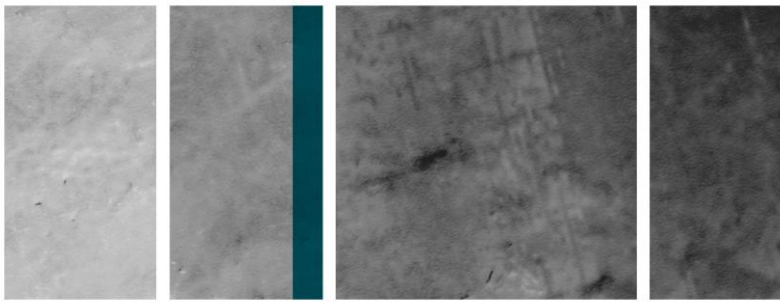
Comprehensive reviews undertaken by Higham (2007) and Rowe et al (2008) outline the specific sections of acts and regulations relevant to alien species management in Australia. The fisheries legislation for most states and territories represent key legislation concerning alien fish management, including making it illegal to keep, trade, move or release live fish into a waterway if the species is declared 'noxious'.

A key issue relates to the existing variation in terminology within acts and policies across Australia. Legislation uses a range of terms including 'noxious', 'pest', 'exotic' and 'non-indigenous', and there is potential overlap between some legislation. There is clear potential for confusion and inconsistencies regarding management of such species across borders. The definition of a 'noxious' fish varies across states and territories. Species listed as 'noxious' also vary across jurisdictions, but this is currently being addressed through the adoption of a nationally agreed noxious fish list developed as part of the national *Strategic Approach to the Management of Ornamental Fish in Australia* (DAFF 2007). Tasmania operates slightly differently, declaring pest fish as 'controlled' rather than noxious (Rowe et al 2008). Western Australia has a 'prohibited organisms' list under its new *Biosecurity and Agriculture Management Act 2007*, which moves alien fish management into biosecurity legislation rather than fisheries legislation.

In addition to fisheries legislation, there is a suite of other state and territory legislation relevant when planning responses to alien freshwater fish incursions (Ayres and Clunie 2010). These relate to:

- animal welfare
- animal health
- biological control methods
- chemical control methods
- protection of flora and fauna, and management of threatening processes
- development of management plans
- management of alien species
- access to, control, management and protection of land, parks, reserves
- emergency management procedures
- water pollution prevention.

Clarification is required to identify any inconsistencies and/or gaps in existing legislation that may potentially hamper the preparedness of responsible agencies or their ability to rapidly respond to alien freshwater fish incursions. There is also a need for legislation to have the



capacity to rapidly deem a species as noxious to facilitate emergency response actions to new incursions of species not currently declared noxious. While it may be initially unknown whether a species will become noxious, a precautionary approach is most appropriate. There is also a need to ensure legislation has the ability to restrict public access into areas, including rapidly declaring quarantine areas.

Managers dealing with response to freshwater fish incursions should be familiar with relevant components of legislation. If a potential incursion is reported and options for management are being considered, managers need quick access to information, including relevant legislation.

Recommendation 28: Support the incorporation of the nationally agreed noxious fish list into fisheries legislation and regulations within states and territories.

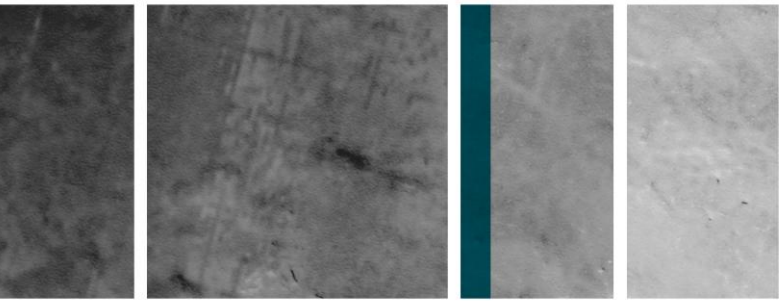
Recommendation 29: Clarify relevant legislation within each jurisdiction related to the management of alien freshwater fish incursions. Managers responsible for emergency response to freshwater fish incursions should be familiar with relevant legislation and permit requirements to enable response options to be considered and implemented rapidly. This information will require regular updating, particularly after amendments to legislation.

Recommendation 30: Review existing legislation and revise any inconsistencies and/or gaps that may potentially hamper the preparedness of responsible agencies or their ability to rapidly respond to alien freshwater fish incursions.

6.5 Research and development

Much can be achieved to improve emergency response procedures for freshwater fish incursions in Australia, through initiation of procedures and development of specific tools outlined within this document. The literature review for this project (Ayres and Clunie 2010) identified clear gaps in our knowledge and approaches that limit our ability to effectively detect and manage alien freshwater fish incursions in Australia. Much can be learnt from the experiences of agencies in other countries and relevant techniques should be investigated for their applicability to Australia. Relevant research areas can be broadly grouped into:

- understanding key pathways of entry of alien freshwater fish — this would enable those pathways to be targeted to minimise entry
- understanding social attitudes and understanding of alien freshwater fish issues
- understanding the ecology of high-priority species to maximise effective targeting of management approaches
- enhancing detection and surveillance capabilities through enhanced and targeted technologies
- expanding the suite of tools available for eradication, control and containment through trialling and implementation of new techniques.



6.5.1 Pathways analysis

Species are increasingly being introduced and becoming established in areas outside their natural range (Vitousek et al 1997, Mack et al 2000). Various motives exist for introducing alien fish into freshwater environments. Most are associated with social or economic interests, including for recreational angling, aquaculture, biological control and the aquarium and ornamental fish trade. Within Australia, eight alien freshwater fish species with established wild populations have been introduced for recreational angling, one for aquaculture, one for biological control, 32 for ornamental purposes and two via ballast water (Koehn and MacKenzie 2004, Lintermans 2004). Many native species have also been translocated outside their natural range (SKM 2008).

The importation of aquarium fish is a major potential source of alien fish species. In the past 40 years, 1181 alien ornamental fish species have been recorded in Australia (predominantly from the freshwater aquarium trade) despite only 481 of these being legally approved for importation (McNee 2002). The potential for the release of any of these species into the wild is a very real threat. In Australia, the ornamental aquarium fish trade incorporates breeding facilities, wholesale traders, retail outlets and the hobby industry. The release of many ornamental fish species into natural environments has been attributed to the general public. The pathways and vectors associated with these introductions and the frequency of release has received little attention (Copp et al 2005).

Table 2 summarises known human-mediated vectors of alien freshwater fish dispersal. Further investigation is required on pathways of introduction of alien freshwater fish species in Australia.

Such research would:

- enable a greater understanding of the significance of each pathway
- provide insight into options and approaches to address and restrict pathways
- identify areas and pathways to target community education and awareness and other approaches to reduce such pathways
- identify stakeholder groups who should be targeted to assist in reducing particular pathways
- identify areas to target surveillance, which could subsequently focus management attention on key areas and maximise the ability to rapidly detect and respond to new incursions.

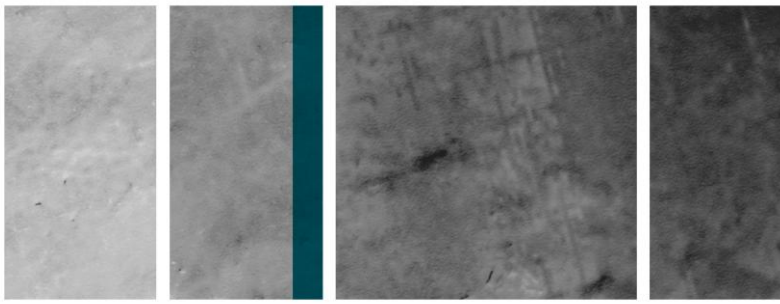


Table 2. Human-mediated vectors of the dispersal of alien freshwater fish (Source: Griffiths 1997, Economidis et al 2000, Government of Canada 2004, Lintermans 2004, Kerr et al 2005)

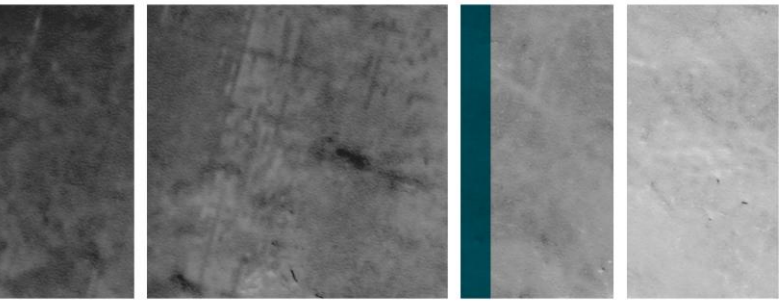
Human mediated vectors of the dispersal of alien freshwater fish	
Intentional	Unintentional
Deliberate legal stocking	Contaminants of fish stocking
Deliberate illegal stocking	Escape from outside ponds and dams
Deliberate introductions for biological control	Transfers via water diversion
Bait bucket introductions	Transfer on commercial fishing equipment
Discarding of aquarium fish	Escape from aquaculture facilities
Deliberate release for cultural purposes	Contaminants of ballast water

Recommendation 31: Undertake an analysis of the pathways of introduction of alien freshwater fish.

6.5.2 Social analysis

Humans are a key factor in both the introduction and movement of alien freshwater fish in Australia. There is a need to better comprehend community perceptions, attitudes and understanding of alien freshwater fish issues, as well as the reasons and mechanisms for their deliberate or accidental introduction. Understanding the values, behavioural drivers and knowledge levels of stakeholders will assist in identifying approaches to reduce human-related introductions. Communication resources and community engagement can then be improved and better targeted to address knowledge gaps and misconceptions regarding the management and impacts of alien freshwater fish. Outcomes of social analysis would greatly inform analysis of the pathways of introduction of alien freshwater fish (Recommendation 31).

Recommendation 32: Undertake social research to understand the values, behavioural drivers and knowledge levels of stakeholders regarding alien freshwater fish, their impacts and management. Research results may inform how communication resources and community engagement approaches could be improved and targeted to reduce human-related introductions.



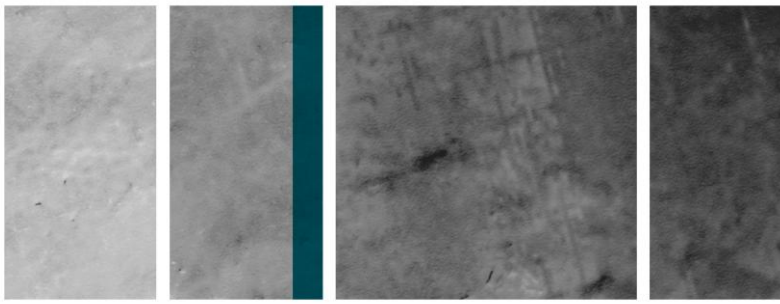
6.5.3 Understanding the biology and ecology of alien freshwater fish

Understanding the biology and ecology of alien freshwater fish is important to inform management decisions for their effective containment, eradication and/or control (Simberloff 2003). Basic research and knowledge on species life history, dispersal characteristics, environmental tolerances and habitat requirements can greatly aid management by highlighting biological aspects, which can be exploited. For example, significant time and funding has been allocated to carp research in Australia. Ecological assessment identified that carp undergo reproductive migrations and unlike native fish, exhibit a jumping ability. Subsequently the carp separation cage, an innovative control technique targeting carp, was developed to exploit these characteristics (Stuart et al 2006). Research on the biology and ecology of other alien freshwater fish species in Australia has received little attention. Targeted research is required to fill knowledge gaps on the biology, ecology and impact of other alien freshwater fish species, particularly established species with limited distributions, such as tilapia, redfin, oriental weatherloach, to identify potential 'Achilles' heels' and inform development of potential management strategies.

Recommendation 33: Undertake targeted research on the biology, ecology and impact of priority alien freshwater fish in Australia, to identify potential 'Achilles' heels' and inform development of potential management strategies.

6.5.4 Detection capacity

The reliability of survey methods is fundamental to determine the occurrence of species incursions and the effectiveness of eradication attempts (Tyre et al 2003, Field et al 2005, Heard et al 2006, Rout et al 2009). When a species is collected at a particular location, its occurrence is undeniable. However, when a species is not detected there are two possible explanations: either the species is truly absent or the species has a false absence (failure to record the species when it is present). It is important to understand the effectiveness, limitations, precision and relative efficiency of various freshwater fish sampling methods to predict the likelihood of false negative errors. The probability of such an error is likely to be influenced by the number of individuals present, species characteristics (eg life-history stage, body size, behaviour), physical characteristics (eg temperature, stream flow, conductivity, turbidity) and technical characteristics (eg survey methods, sampler experience, effort, resourcing/funding) (Peterson et al 2004, Poos et al 2007, Ebner et al 2008). Electrofishing is currently the most frequently applied and highly regarded method for freshwater fish surveillance and is commonly used by government agencies in fish biomonitoring programs (Barbour et al 1999, MDBC 2004). However, the limitations and effectiveness of various fish surveillance methods in Australia is largely unstudied. Research is required to assess the detection capability and capture efficiency of various fish survey techniques, and to determine effective, best-practice taxon-specific monitoring methods, particularly for priority species, such as tilapia. Accurate detection of species incursions is critical because this information provides the basis for subsequent management decisions. Appropriate information learnt from research on the detection capability of freshwater fish sampling



methods can be added to relevant manuals (eg destruction and electrofishing manuals) as required.

Recommendation 34: Assess the detection capability of various fish survey techniques.

Recommendation 35: Determine the most effective taxon-specific monitoring methods (eg for priority species, such as tilapia).

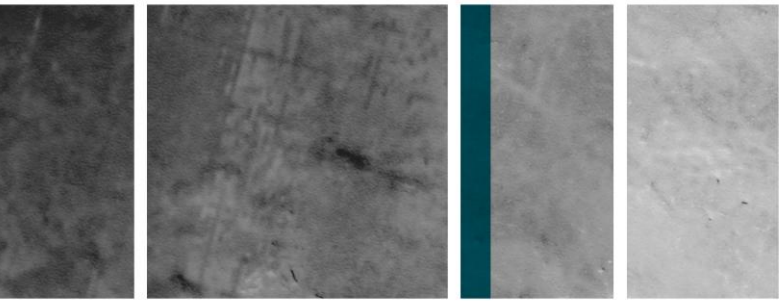
6.5.5 Molecular probes

Accurate detection and identification of alien freshwater fish is a fundamental component of an emergency response program. Molecular markers are more commonly being applied to accurately identify specimens that may be difficult to discriminate using morphology-based identification systems (Hebert et al 2003, McGlashan et al 2008). Molecular probes are also being developed and tested to quickly and inexpensively detect aquatic pests in environmental samples. Extensive research to develop molecular techniques to detect marine pest has occurred (Goffredi et al 2005, Mountfort and Hayden 2007). Deagle et al (2003), Gunasekera et al (2005) and Patil et al (2005) describe research whereby single samples (eg planktonic or ballast-water samples) are collected and analysed using molecular methods to detect targeted marine pests species.

Research focusing on developing methods to accurately detect alien freshwater fish species from environmental samples is required. Traditional methods of detecting or collecting alien freshwater fish, primarily electrofishing, are labour intensive and operationally expensive. Traditional sampling methods may produce false negative results (failure to record the species when it is present), particularly if the species occurs in low abundances. Low abundances are likely to occur during the initial stages of invasion or following an eradication attempt.

Molecular probes represent a rapid, accurate and cheap alternative method for assessing the occurrence of alien freshwater fish species. Initial stages of research could focus on collating existing information on molecular markers developed for freshwater fish species in Australia and learning about the approach taken by marine researchers to develop molecular probes for marine pests. Subsequently, developing and trailing molecular probes for high-risk/priority alien freshwater fish species, such as Tilapia, may occur. Ideally, research would generate standard protocols for collecting environmental samples and using molecular techniques for detecting multiple targeted freshwater fish species from single samples.

Recommendation 36: Develop molecular probes to accurately detect alien freshwater fish species from environmental samples.



6.5.6 Investigation of chemical treatments to eradicate fish

In Australia, rotenone is commonly applied with the intention of achieving complete eradication of alien freshwater fish populations. Lime treatment is another chemical method of fish eradication, but lime is not applied as often as rotenone. The development and/or investigation of other chemical treatments for the elimination of alien freshwater fish is warranted, particularly to:

- minimise off-target and environmental impacts
- increase the efficacy of chemical agents against different species and life-history stages
- increase the range of situations where chemical treatments can be administered (eg water parameters, such as temperature and sediment loads can inhibit the use of some chemicals).

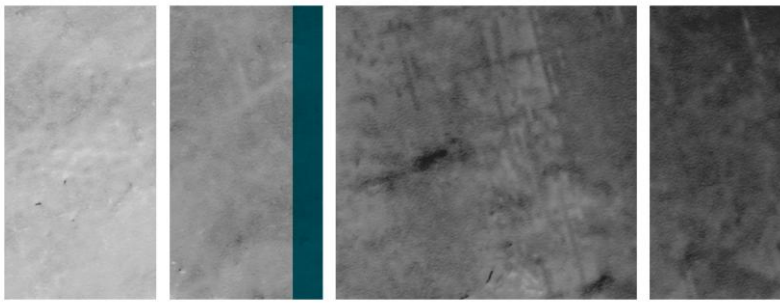
All chemicals studied would require registration and permit approval through the Australian Pesticides and Veterinary Medicines Authority.

Antimycin represents one potential chemical. Antimycin (Fintrol®) is a naturally occurring substance produced by the bacteria *Streptomyces*. It was discovered in the 1940s, and is used in the USA as a tool for fish control prior to restoration of threatened fish species. Antimycin has a high toxicity to fish and low toxicity to mammals (Greselin and Herr 1974). The substance breaks down rapidly and the by-products are considered safe (Herr et al 1967). Antimycin is similar to rotenone in that it affects oxygen transfer during cellular respiration and can be neutralised using potassium permanganate. The American Fisheries Society website (www.fisheries.org) has monographs for the use of antimycin for removal of fish in streams, rivers and lakes. These monographs outline application techniques and considerations, safety and equipment, evaluation and subsequent treatments.

Recommendation 37: Develop and/or investigate chemical treatments for the eradication of alien freshwater fish.

6.5.7 Barrier technology

Important aspects of alien freshwater fish management are preventing their entry into an area (exclusion) or limiting their spread into a defined geographical area (containment). Effective containment and exclusion are critical actions during an emergency response program and ongoing management of established alien fish populations. Both natural and artificial barriers can function as methods of containing and excluding fish. Artificial barriers are often categorised into physical and behavioural barriers. Physical barriers are structures through which fish physically cannot pass, including rotating drum screens, travelling screens, vertical drops and barrier nets. Behavioural barriers involve the application of an external stimulus to elicit fish movement in a desired direction. Examples include light barriers, sound deterrents, electrical barriers, air bubble curtains, hydrodynamic louvre screens, pheromones and combinations of these systems. An important complicating factor to establishing barriers is the potential impacts these may have on natural migration and movements of native species.

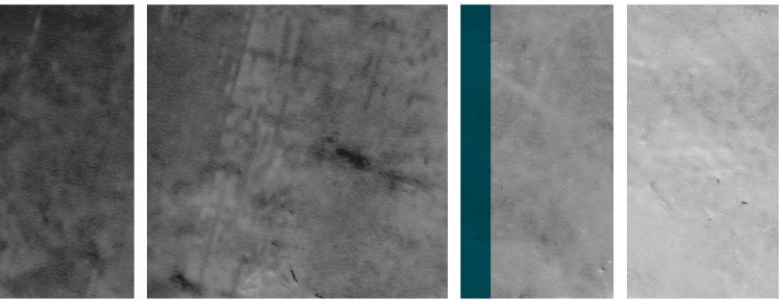


Various physical and behavioural barriers have been extensively reviewed by several authors (Turnpenny et al 1998, Coutant 2001, DWA 2006, Jamieson et al 2007). Research, development and application of fish barriers have largely occurred in the USA, UK, Europe and New Zealand. The literature review (Ayres and Clunie 2010.) summarised the characteristics and considerations of various physical and behavioural barriers trialled overseas and in Australia.

In Australia, experience of installing barriers has been limited to screens and cages, primarily for carp in South Australia, New South Wales, Victoria and Tasmania (Kelly 2003, Stuart et al 2006, Thwaites et al 2007) and tilapia in Queensland (Greiner and Gregg 2008). Barrier nets have also been applied to restrict carp movement in Tasmanian lakes (Inland Fisheries Service 2004, 2009). There are many physical and artificial barriers worthy of investigation in Australia and much can be learnt from the experiences of other countries with advanced approaches to limiting alien freshwater fish movement. Both laboratory and field trials will be required to assess various physical and artificial barriers. Investigations may involve fish ecologists and managers as well as hydrologists, engineers and other specialists. Investigations should consider a suite of issues including:

- their applicability and cost effectiveness in different environments, conditions and time frames (eg temporary, long term)
- their impacts on native and alien species
- the pros and cons of particular barriers including practicalities, cost, construction and installation difficulty, operational and maintenance requirements, flow applicability and requirements, power supply needs and safety considerations.

Recommendation 38: Identify physical and behavioural barriers worthy of laboratory and field trials for high-priority alien freshwater fish species and high-priority locations. Conduct relevant laboratory and field trails to assess their effectiveness, including their impact on non-target species.



7. Summary of recommendations

Table 3. Summary of actions required to develop national emergency response arrangements for freshwater fish incursions. Action number does not reflect order of implementation. *Association to existing procedures: New = processes/actions that do not currently exist and require development. Expansion = processes/actions currently exist and may require modification, Currently occurring = processes/actions in place or being established, Clarification = processes/actions may already be in place but require clarification, Adoption = processes/actions are being finalised and will require uptake

Number	Action Title	Priority	Time Scale	Association to existing procedures *	Comments
Raising national awareness and process initiation					
1	Advocate the current lack of and need for emergency response arrangements for freshwater fish incursions through national biosecurity forums to the appropriate ministerial councils.	Essential	1-2 years	New	The issue should be raised to the NBC for presentation to the appropriate ministerial council. These arrangements should be applicable for new introductions of alien freshwater fish into Australia and introductions of alien freshwater fish already present in Australia that have not yet been released into the natural environment. Ongoing management arrangements are required for range expansions of established alien freshwater fish in Australia. Arrangements for native fish translocated outside their natural range and dispersal potential could also be considered. These emergency response arrangements will primarily be applicable for freshwater fish incursions; however, their application could be suitable to other freshwater vertebrate and invertebrate incursions (noting that some modification may be required to suit individual circumstances).
2	Ensure a national sectoral committee becomes responsible for developing national emergency response arrangements for freshwater fish incursions.	Essential	1-2 years	New	The NBC should be approached to advocate this issue and clarify the responsible committee.
3	Ensure that development of national emergency response arrangements for freshwater fish incursions aligns with actions of 'Harmonising Australia's biosecurity emergency response arrangements'.	Essential	1-2 years	New	This will require ongoing, active engagement with the BEPWG.
4	Ensure development of national emergency response arrangements for freshwater fish incursions is consistent with other sectoral approaches.	Essential	1-2 years	New	This requires active engagement with other sectoral committees to learn from their experiences and to ensure potential gaps in arrangements are addressed (eg freshwater invertebrates).
5	Encourage representation and active participation at international forums relating to management of alien freshwater fish and emergency response.	High	Ongoing	Expansion	It is essential that we incorporate cost-effective, innovative international approaches to emergency response to alien freshwater fish incursions, and promote Australian innovations internationally.

Table 3 (continued)

Number	Action Title	Priority	Time Scale	Association to existing procedures *	Comments
6	Clarify the lead agencies responsible for emergency response arrangements for freshwater fish incursions in all states and territories	Essential	1–2 years	Clarification	States and territories have various emergency response arrangements in place. Summarise to identify where clarification is required.
Emergency response arrangements					
7	Establish a national consultative committee for emergency response to freshwater fish incursions.	Essential	1–2 years	New	A national consultative committee is required to coordinate and make technical decisions on emergency response to a freshwater fish incursion of national significance.
8	Develop a policy and objectives document for emergency response arrangements for freshwater fish incursions.	Essential	1–2 years	New	The document structure should follow the template soon to be developed by the BEPWG. It is logical and ideal that other document types are created thereafter (or possibly simultaneously) in accordance with the biosecurity response documentation framework established by the BEPWG.
9	Ensure that the development of national emergency response arrangements for freshwater fish incursions aligns with conditions of the *National Environmental Biosecurity Response Agreement*.	High	1–2 years	Adoption	
10	Develop and implement an appropriate risk assessment procedure for the prioritisation of alien freshwater fish species.	High	1–2 years	Expansion	Existing risk assessment procedures should be considered, eg Bomford and Glover (2004), Bomford (2008). A priority list of alien freshwater fish for national emergency responses should then be developed.
11	Develop species-specific plans (contingency, response and/or control plans) for high-priority alien freshwater fish in Australia.	High	1–2 years	New	High-priority species should be identified using appropriate risk assessment procedures (Recommendation 10). The need for plans for particular high-priority species is already apparent and should be initiated (eg tilapia).
12	Develop and implement a ranking system to identify high-priority sites for alien freshwater fish management in Australia. Site-specific alien freshwater fish management plans could subsequently be prepared.	Medium	2–3 years	Expansion	This system should involve an initial review of existing approaches in Australia and internationally. Management actions at priority sites may vary from simply monitoring to implementation of intensive control and eradication programs.

Table 3 (continued)

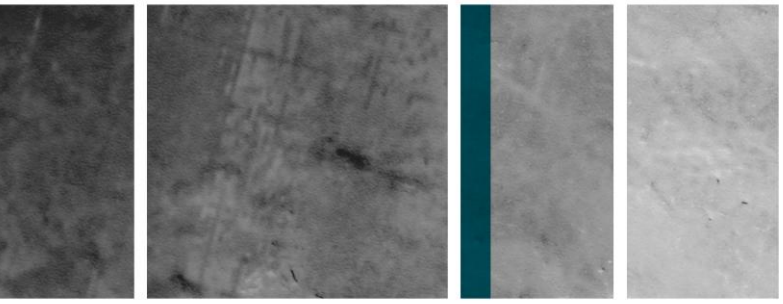
Number	Action Title	Priority	Time Scale	Association to existing procedures *	Comments
Operational and Technical manuals					
13	Develop a destruction manual for alien freshwater fish. Consider incorporating information on techniques for containment, eradication and control.	Medium	2-3 years	Expansion	Destruction manuals exist for other sectors and may be relevant as an initial guide. International and jurisdictional procedures and experiences could be adopted and incorporated where appropriate.
14	Develop a disposal manual for alien freshwater fish.	Medium	2-3 years	Expansion	Disposal manuals exist for other sectors and may be relevant as an initial guide. International and jurisdictional procedures and experiences could be considered and incorporated where appropriate.
15	Develop a decontamination manual to be used during response to alien freshwater fish incursions and a decontamination guide for everyday use by people participating in freshwater activities.	Medium	2-3 years	Expansion	Decontamination manuals exist for other sectors and may be relevant. International and jurisdictional procedures and experiences could be considered and incorporated where appropriate.
16	Develop a national rotenone manual for use during response to alien freshwater fish incursions.	High	1-2 years	Expansion	Consider and adopt, as appropriate, any existing jurisdictional procedures. Refer to relevant jurisdictional and international guides.
17	Ensure continued access (registration, permits and practical application) to rotenone in all Australian states and territories.	High	1-2 years	Expansion	Rotenone is registered through the Australian Pesticides and Veterinary Medicines Authority. A permit is needed for its use, which includes conditions outlining specific requirements of its application.
18	Develop a national electrofishing manual for freshwater fish.	Medium	2-3 years	Expansion	Complementary to the *Australian Code of Electrofishing Practice*.
Supporting arrangements					
Management support products					
19	Develop and trial a decision-support tool for the management of freshwater fish incursions.	High	1-2 years	New	Such a decision-support tool would guide managers and facilitate rapid response, consistent approaches and effective dissemination of relevant information.
20	Develop a national freshwater fish incursion register.	High	2-3 years	New	A centralised register of all new confirmed alien freshwater fish incursions in Australia. Accessible by relevant managers and agency staff. Linked to recommendations 21 and 24.
21	Develop a national control program database.	High	2-3 years	New	A centralised national control program database to collate, store and make available reports on the containment, eradication or control of alien freshwater fish to inform practitioners in the future. Linked to recommendations 20 and 24.

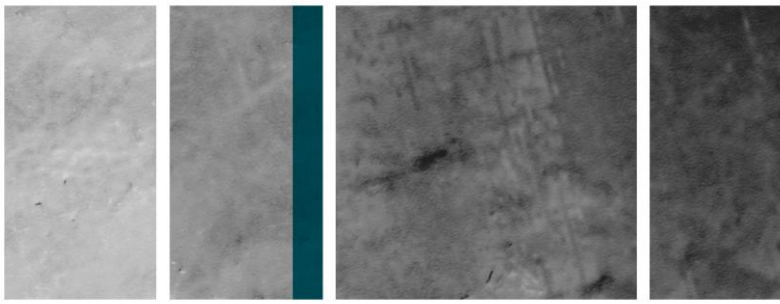
Table 3 (continued)

Number	Action Title	Priority	Time Scale	Association to existing procedures *	Comments
Communication resources and training					
22	Develop a centralised website to provide access to national procedures, documents, tools and communication and education resources, and so on, relating to the management of alien freshwater fish incursions.	High	2-3 years	New	Allows various stakeholders to access information on alien freshwater fish management. The website may be used as a link for agency managers and staff to login to databases, including the decision-support tool (recommendation 19), national incursion register (recommendation 20) and national control program database (recommendation 21). Web-links to other federal, state and territory government websites would be provided.
23	Develop national communication and education products and tools for alien freshwater fish.	High	1-2 years	Expansion	Some resources exist, however a nationally coordinated approach is needed.
24	Encourage consistency in suspected alien freshwater fish incursion reporting by considering the adoption of a national reporting system.	High	2-3 years	Expansion/ New	Includes providing consistent messages to the public about what they should do if they suspect an alien freshwater fish incursion, developing a standardised suspected alien freshwater fish incursion reporting form, promotion of state/territory reporting hotlines, and so on. This action would link closely with, and be complementary to, existing state and territory processes.
25	Develop a national taxonomic experts' register and a national standard procedure for specimen collection, preservation, taxonomic confirmation and verification and storage.	High	1-2 years	New	This would include a review of current procedures in each state and territory.
26	Incorporate freshwater fish incursion response into a national training program for emergency response.	High	2-3 years	Expansion	Need to clarify current emergency response skills and accreditations, and those required.
National active surveillance program					
27	Develop a comprehensive national active surveillance program, potentially targeting high-priority areas and/or high-priority alien freshwater fish species.	Medium	Ongoing	Expansion	Review existing state and territory approaches to develop consistent approach, to maximise strategic surveillance. Links to recommendations 10-13, and 34.
Legislation					
28	Support the incorporation of the nationally agreed noxious fish list into fisheries legislation and regulations within states and territories.	High	1-2 years	Currently occurring	This will be an ongoing process until all species on the grey list have been assessed.
29	Clarify relevant legislation within each jurisdiction related to the management of alien freshwater fish incursions.	High	1-2 years	Expansion	Managers responsible for emergency response to freshwater fish incursions should be familiar with relevant legislation and permit requirements to enable response options to be considered and implemented rapidly. This information will need regular updating, particularly after amendments to legislation.

Table 3 (continued)

Number	Action Title	Priority	Time Scale	Association to existing procedures *	Comments
30	Review existing legislation and revise any inconsistencies and/or gaps that may potentially hamper the preparedness of responsible agencies or their ability to rapidly respond to alien freshwater fish incursions.	High	1-2 years	Expansion	Builds on existing reviews, but focuses on gaps that hamper emergency response. Potentially includes the ability of legislation to have the capacity to rapidly deem a species as noxious as well as the ability to restrict public access into areas, including rapidly declaring quarantine areas. Determine options to address any inconsistencies.
Targeted research and development					
31	Undertake analysis of pathways of introduction of alien freshwater fish.	High	2-3 years	Expansion	Broad pathways have been identified but a greater understanding would assist in preventing introductions.
32	Undertake social research to understand the values, behavioural drivers and knowledge levels of stakeholders regarding alien freshwater fish, their impacts and management.	High	2-3 years	Expansion	Research results may inform how communication resources and community engagement approaches could be improved and targeted to reduce human-related introductions.
33	Undertake targeted research on the biology, ecology and impact of priority alien freshwater fish in Australia, to identify potential 'Achilles' heels' and to inform development of potential management strategies.	High	2-3 years	Expansion	Key knowledge gaps for high-priority alien freshwater fish species exist that may potentially hamper effective management.
34	Assess the detection capability of various fish survey techniques.	Medium	2-3 years	Expansion	The limitations and effectiveness of various fish surveillance methods in Australia require further investigation, particularly in the response to different fish species and environmental conditions.
35	Determine the most effective taxon-specific monitoring methods.	Medium	2-3 years	New	Involves developing effective, best-practise monitoring protocols for specific taxa, for example, high-priority species including tilapia.
36	Develop molecular probes to accurately detect alien freshwater fish species from environmental samples.	High	2-3 years	Expansion	Molecular probes represent a rapid, accurate and cheap alternative method for assessing the occurrence of alien freshwater fish species. Much can be learnt from the marine sector.
38	Identify physical and behavioural barriers worthy of laboratory and field trials for high-priority alien freshwater fish species and high-priority locations. Conduct relevant laboratory and field trails to assess their effectiveness, including their impact on non-target species.	High	2-3 years	Expansion/ New	There is a suite of barriers worthy of investigation in Australia.
37	Develop and/or investigate chemical treatments for the eradication of alien freshwater fish.	Medium	2-3 years	Expansion	All chemicals studied would require registration and permit approval through the Australian Pesticides and Veterinary Medicines Authority





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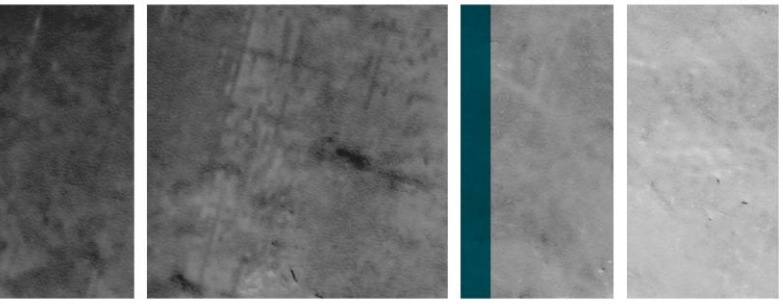

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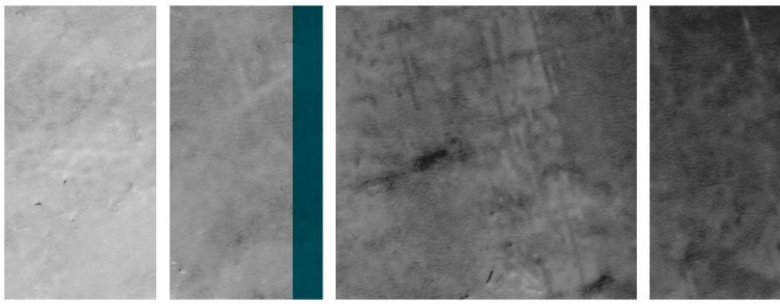

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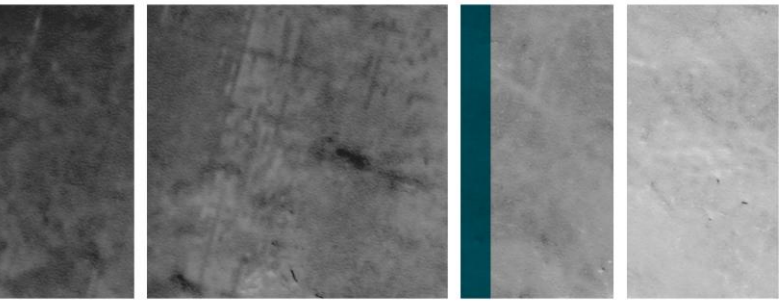

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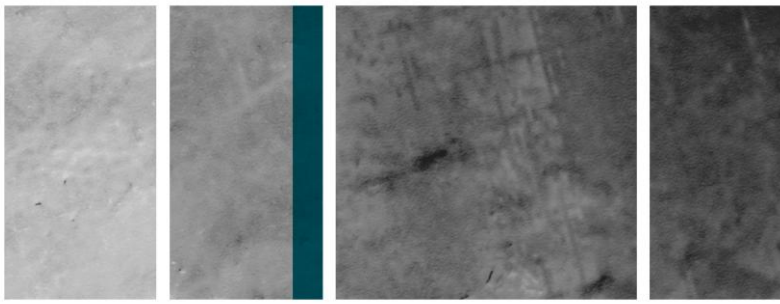

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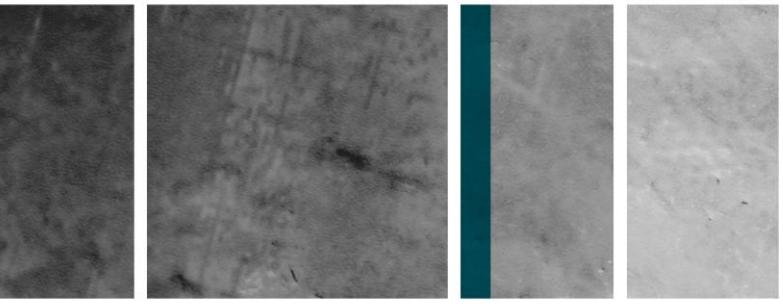

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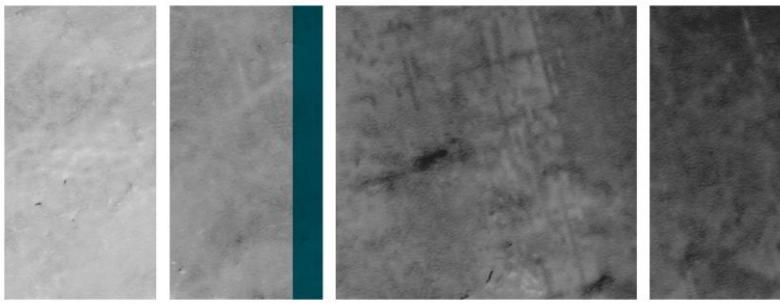

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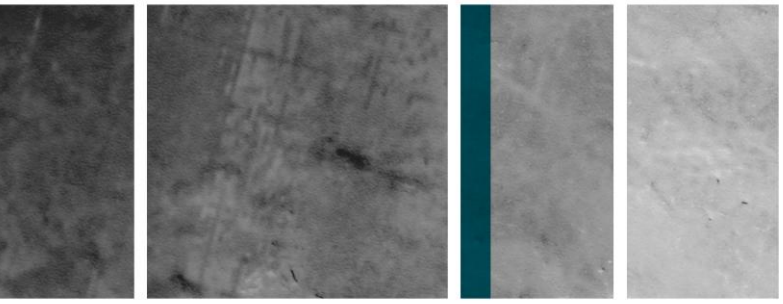

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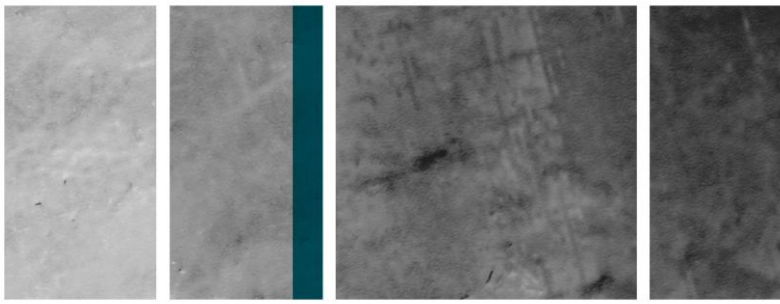
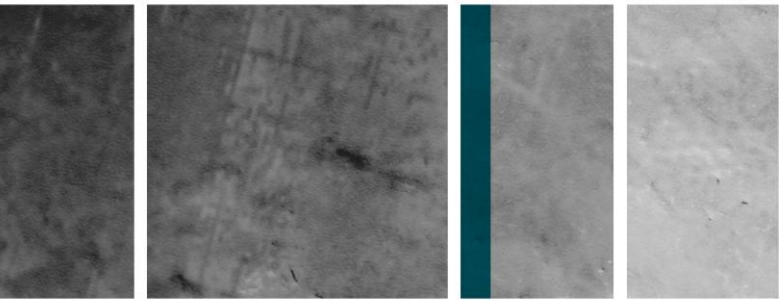


Appendices

Appendix 1. Steering Committee Membership (as of October 2008)

Person	Agency
Wayne Fulton	IA CRC Freshwater Program Leader
Tarmo Raadik	Department of Sustainability and Environment, Arthur Rylah Institute for Environmental Research, Victoria
John Koehn	Department of Sustainability and Environment, Arthur Rylah Institute for Environmental Research, Victoria
Pam Clunie	Department of Sustainability and Environment, Arthur Rylah Institute for Environmental Research, Victoria
Renae Ayres	Department of Sustainability and Environment, Arthur Rylah Institute for Environmental Research, Victoria
Jon Presser	Department of Primary Industries, Fisheries Victoria, Victoria
Karen Weaver	Department of Sustainability and Environment, Victoria
Bill O'Connor	Department of Sustainability and Environment, Victoria
John Diggle	Inland Fisheries Service, Tasmania
Jamie Knight	New South Wales, Department of Trade and Investment, Regional Infrastructure and Services
Jane Frances	New South Wales, Department of Trade and Investment, Regional Infrastructure and Services
Heleena Bamford	Murray-Darling Basin Authority
Mark Lintermans	Institute for Applied Ecology, University of Canberra, representing Department of Territory and Municipal Services, Australian Capital Territory
John Gilliland	Department of Primary Industries and Resources, South Australia
Mike Braysher	Institute for Applied Ecology, University of Canberra
Zafer Sarac	Department of Employment, Economic Development and Innovation, Queensland
Helen Cribb	Department of Regional Development, Primary industry, Fisheries and Resources, Northern Territory
Andrew Hill	Department of Fisheries, Western Australia
Paul Hardiman	Department of Environment, Water, Heritage and the Arts



Appendix 2a. Natural Resource Management Ministerial Council (NRMMC) Terms of Reference

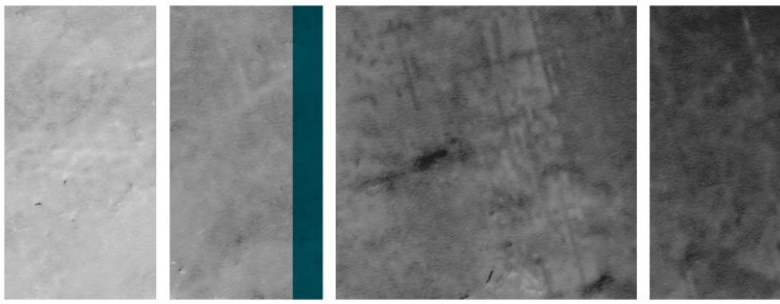
The terms of reference of the NRMMC are:

- To develop policies and strategies for national approaches to the conservation, sustainable use and management of Australia's land, water, vegetation and biological resources.
- To oversee the development and implementation of national natural resource management programs including the National Action Plan for Salinity and Water Quality (NAP), the Natural Heritage Trust (NHT) and other agreed programs.
- To monitor and evaluate outcomes of these policies, strategies and programs and the health of the nation's natural resources.
- To promote community understanding of and engagement with the key challenges associated with the sustainable use and management of Australia's land and water, vegetation and biological resources.
- To liaise with other ministerial councils and other bodies on matters relevant to the activities of the Council.

Appendix 2b. Primary Industries Ministerial Council (PIMC) Terms of Reference

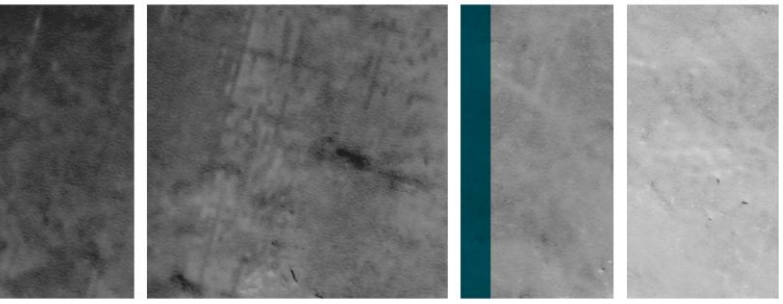
The terms of reference of the PIMC are to:

- develop, implement and review policies and strategies for achieving agreed national approaches to the development of sustainable primary and related food industries
- actively liaise with other ministerial councils and other bodies on matters relevant to the activities of the Council
- direct the work of and consider matters submitted by its Standing Committee.



Appendix 2c. National Biosecurity Committee (NBC) Terms of Reference

1. Provide strategic leadership and direction in the development and implementation of national biosecurity policy.
2. Provide strategic policy advice to Natural Resource Management Standing Committee (NRMSC) and Primary Industries Standing Committee (PISC) on key biosecurity issues or as directed by Standing Committees, including identifying potential and emerging national biosecurity issues and recommending appropriate national policy approaches.
3. Task and oversee, as appropriate, sectoral committees and other subordinate working groups to develop national biosecurity policies or procedures.
4. Refer responsibility to the appropriate sectoral committees or other subordinate working groups for developing national biosecurity policies or procedures relating to biosecurity threats impacting on economic, environmental, social amenity and human health values.
    i) For biosecurity matters where it is not clear which committee should be responsible, in particular for biosecurity threats with predominantly environmental, social amenity or human health impacts, the National Biosecurity Committee (NBC) will allocate responsibility to the appropriate committee on a case-by-case basis.
5. Receive reports from sectoral committees on addressing national biosecurity issues as identified by the NBC.
6. Build appropriate linkages with other ministerial council committees, relevant industry and non-government associations with an interest in national biosecurity policy, in particular NRMSC, PISC, relevant health committees, Marine and Coastal Committee (MACC), Natural Resource Policies and Programs Committee (NRPPC) and Industries Development Committee (IDC).
7. Coordinate and monitor the implementation of the enhancement of the Australian Biosecurity System for Primary Production and the Environment (AusBIOSEC), and specifically oversee the implementation of the Intergovernmental Agreement.
8. Continue to identify opportunities for the enhancement of AusBIOSEC.



Appendix 2d. Environmental Biosecurity Committee (EBC) Terms of Reference

The Terms of Reference provided to the EBC state:

Role 1

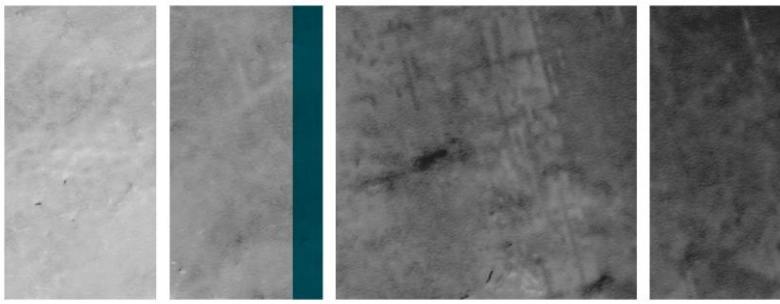
The Committee will coordinate, as appropriate, work under the National Biosecurity Committee on biosecurity matters as they impact on the natural environment and social amenity.

1. Maintain an overview of national biosecurity work impacting on the natural environment and social amenity, identify priority natural environment and social amenity policy and operational biosecurity issues, and facilitate them being addressed by one or more sectoral committees.
2. Coordinate progress in developing comprehensive national biosecurity arrangements to protect the natural environment and social amenity.

Role 2

The Committee will coordinate development of national biosecurity policy in relation to invertebrates and pathogens that impact on the natural environment and/or social amenity.

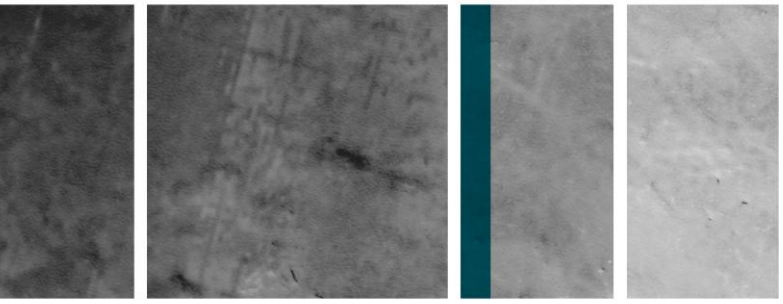
1. Develop a draft national strategy for addressing invasive invertebrates and pathogens that impact on the natural environment or social amenity.
2. Provide policy advice on all biosecurity matters relevant to invasive invertebrates and pathogens impacting on the natural environment or social amenity, including preparedness and operational activities, both for species present and not yet present in Australia.
3. Provide advice on responding to new incursions of invertebrates and pathogens impacting on the natural environment or social amenity.
4. Work closely with Animal Health Committee, Australian Weeds Committee, Aquatic Animal Health Committee, National Introduced Marine Pests Co-ordination Group, Plant Health Committee, Vertebrate Pests Committee and other relevant agencies to ensure consistency in approaches across sectors and on species of shared interest.



Appendix 2e. Vertebrate Pests Committee (VPC) Terms of Reference

Ensure an integrated approach to all aspects of vertebrate pest management by:

1. Providing national policy and planning solutions to vertebrate pest issues.
2. Developing a National Vertebrate Pest Strategy and planning, coordinating and monitoring its implementation.
3. Providing policy and planning advice to Natural Resource Management Standing Committee (NRMSC) and Primary Industries Standing Committee (PISC) on national vertebrate pest issues or as directed by NRMSC. Identify and facilitate implementation of action on significant vertebrate pest issues.
4. Building linkages with NRMSC, PISC, Plant Health Australia, Animal Health Australia, and fisheries and research agencies in Australia and New Zealand on vertebrate pest issues.
5. Identifying potential and emerging vertebrate pest problems and recommend appropriate actions to NRMSC.
6. Identifying and facilitating development, planning, coordination, implementation and monitoring of consistent national approaches to vertebrate pest management including:
    a. National strategies
    b. Codes of Practice
    c. Vertebrate Pest Threat Abatement Plans
    d. Biological control programs
    e. Harmonisation of relevant legislation
    f. Vertebrate risk assessment processes
    g. Research, education, extension and training
    h. Harmonisation of vertebrate pest data collection and management systems
    i. Response to emergency vertebrate pest incursions.
7. To promote consistent approaches to vertebrate pest issues across all relevant jurisdictions, including:
    a. prevention
    b. preparedness for new incursions
    c. reduction of the impact of established populations
    d. consistent, coordinated and strategic approaches to management of the economic, environmental and social impacts
    e. eradication of infestations where feasible and appropriate
    f. standards for management responses.
8. Developing a communications strategy for increasing the profile of vertebrate pests throughout the community, government and key stakeholders.



Appendix 2f. Vertebrate Pests Committee Pest Fish Working Group (VPC PFWG) Terms of Reference*

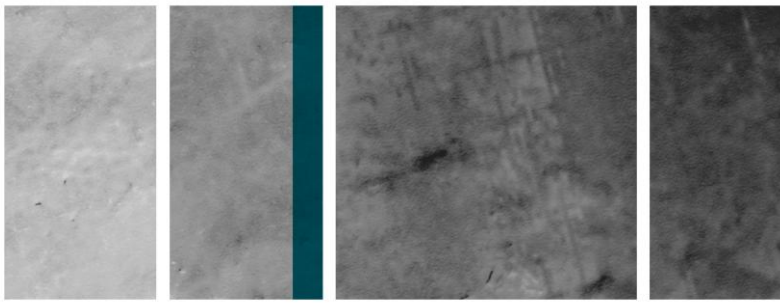
1. To provide advice to Vertebrate Pests Committee on freshwater fish pests:
    a. prioritise species and assets for research and management action
    b. international best practice for pest fish management, eradication, control and surveillance
    c. identify new animals with pest potential (next pests)
2. Develop a communication strategy aimed at raising awareness about freshwater aquatic pests with key stakeholders (including governments, communities, Catchment Management Authorities, Natural Resource Management boards, special interest groups)
3. Coordinate and promote planning and collaboration between jurisdictions and relevant stakeholders on research and management programs
4. Report regularly to Vertebrate Pests Committee on actions and progress
5. Maintain close linkages with relevant groups (OFMIG, AAHC, NIMPCG)

*under revision

Appendix 2g. Aquatic Animal Health Committee (AAHC)

The role of AAHC is to:

- review and refine national aquatic animal health policies and programs
- provide national coordination on identified emerging aquatic animal health issues and make recommendations for policy development and management, and facilitate the coordination role across the states and territories through existing processes
- actively respond to identified resource requirements of national aquatic animal health policies and programs
- provide advice on international quarantine and import risk assessments as required
- provide advice and submit recommendations to the PISC and other stakeholders on those issues
- report on strategic issues and submit recommendations relating to AQUAPLAN and its implementation to PISC and other stakeholders
- provide strategic guidance on the development of aquatic animal disease diagnostics, disease emergency management planning, and disease emergency management training and incident simulation
- review communication and extension strategies on aquatic animal health issues and facilitate implementation of those strategies.

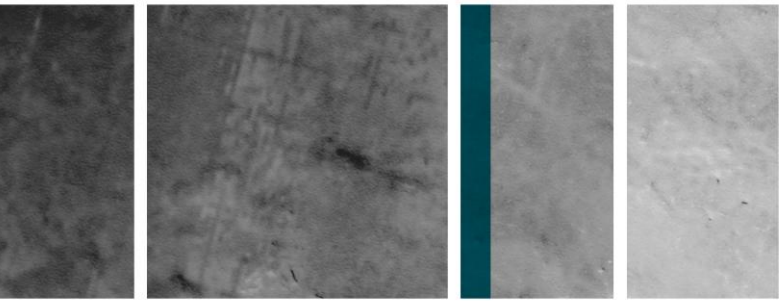


Appendix 2h. National Introduced Marine Pests Coordination Group (NIMPCG) Terms of Reference

The National Introduced Marine Pests Coordination Group will:

1. Facilitate long-term governance arrangements for introduced marine pests. This will be achieved by:
    - monitoring to assist in risk assessment, detection of new incursions or spread of existing introduced marine pests, and control programs
    - targeted research to underpin policy and management initiatives
    - a community preparedness program to ensure public participation in and support for the National System
    - education and training to support operation of the National System
    - a clear division of responsibilities between governments, agencies and stakeholders involved in introduced marine pests management
    - explicit agreement on the statutory framework that will be used to enable action under the System's components and to regulate all relevant sectors
    - secure funding arrangements for each element of the National System, including contributions from relevant private sector beneficiaries and potential polluters.
3. Oversee implementation of the arrangements to improve the national capacity to respond to outbreaks of introduced marine pests, including:
    - agreed emergency administrative procedures in the event of an outbreak of an introduced marine pest, including clearly defined agency roles, responsibilities and legal powers
    - early warning and prevention systems for a short list of introduced marine species that pose a major threat
    - cost-sharing arrangements.
4. Coordinate the development of the longer-term National System for the Prevention and Management of Marine Pest Incursions, including the following components:
    - prevention systems operating at the pre-border, border and post-border levels to reduce the risk of importation and translocation of introduced marine pests covering all vectors and sources
    - coordinated emergency response to new incursions and translocations
    - ongoing control of introduced marine pests already in Australia.
5. Facilitate inter-governmental and stakeholder negotiations.
6. Agree a Strategic Work Plan, to be reviewed at least every 12 months.

The National Introduced Marine Pests Coordination Group is to report to the Natural Resource Management Ministerial Council (NRMMC) and the Australian Transport Council (ATC) through



their Standing Committees. The NIMPCG is also to receive reports from and provide reports to the Consultative Committee on Introduced Marine Pest Emergencies (CCIMPE).

The NIMPCG is to be established for a period as may be determined by the Natural Resource Management Ministerial Council.

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