



## Native fish and wetlands in the Murray-Darling Basin

*Action plan, knowledge gaps and supporting papers*

*Workshop held in Canberra, 7-8 June 2005*

## **Integrated catchment management in the Murray–Darling Basin**

A process through which people can develop a vision, agree on shared values and behaviours, make informed decisions and act together to manage the natural resources of their catchment: their decisions on the use of land, water and other environmental resources are made by considering the effect of that use on all those resources and on all people within the catchment.

### **Our values**

We agree to work together, and ensure that our behaviour reflects the following values.

#### ***Courage***

- We will take a visionary approach, provide leadership and be prepared to make difficult decisions.

#### ***Inclusiveness***

- We will build relationships based on trust and sharing, considering the needs of future generations, and working together in a true partnership.
- We will engage all partners, including Indigenous communities, and ensure that partners have the capacity to be fully engaged.

#### ***Commitment***

- We will act with passion and decisiveness, taking the long-term view and aiming for stability in decision-making.
- We will take a Basin perspective and a non-partisan approach to Basin management.

#### ***Respect and honesty***

- We will respect different views, respect each other and acknowledge the reality of each other's situation.
- We will act with integrity, openness and honesty, be fair and credible, and share knowledge and information.
- We will use resources equitably and respect the environment.

#### ***Flexibility***

- We will accept reform where it is needed, be willing to change, and continuously improve our actions through a learning approach.

#### ***Practicability***

- We will choose practicable, long-term outcomes and select viable solutions to achieve these outcomes.

#### ***Mutual obligation***

- We will share responsibility and accountability, and act responsibly, with-fairness and justice.
- We will support each other through necessary change.

### **Our principles**

We agree, in a spirit of partnership, to use the following principles to guide our actions.

#### ***Integration***

- We will manage catchments holistically; that is, decisions on the use of land, water and other environmental resources are made by considering the effect of that use on all those resources and on all people within the catchment.

#### ***Accountability***

- We will assign responsibilities and accountabilities.
- We will manage resources wisely, being accountable and reporting to our partners.

#### ***Transparency***

- We will clarify the outcomes sought.
- We will be open about how to achieve outcomes and what is expected from each partner.

#### ***Effectiveness***

- We will act to achieve agreed outcomes.
- We will learn from our successes and failures and continuously improve our-actions.

#### ***Efficiency***

- We will maximise the benefits and minimise the costs of actions.

#### ***Full accounting***

- We will take account of the full range of costs and benefits, including economic, environmental, social and off-site costs and benefits.

#### ***Informed decision-making***

- We will make decisions at the most appropriate scale.
- We will make decisions on the best available information, and continuously improve knowledge.
- We will support the involvement of Indigenous people in decision-making, understanding the value of this involvement, and respecting the living knowledge of Indigenous people.

#### ***Learning approach***

- We will learn from our failures and successes.
- We will learn from each other.

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7–8 June 2005*

*Bill Phillips (Editor)*

*MainStream Environmental Consulting*



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# Executive summary

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This workshop represented the seventh in the series held over the past five years directed at a particular priority issue or theme of the Murray-Darling Basin's Native Fish Strategy 2003–2013 (NFS). The theme of this workshop, namely, native fish and wetlands, was in direct response to Objective Two of the NFS as follows; *“To rehabilitate and protect the natural functioning of wetlands and floodplain habitats for native fish; and revive the links between terrestrial ecosystems, wetlands and rivers”*.

For the purposes of this workshop the following definition of ‘wetland’ was applied: *“off main-channel or floodplain habitats (ephemeral or permanent) such as billabongs, swamps, backwaters, flood-runners, small/shallow natural lakes etc, with the importance to fish being the unifying theme”*. Excluded from consideration were large lakes, weirpools etc, and also main river channel habitats.

The workshop, held in Canberra on 7–8 June 2005, was attended by 31 people representing a broad cross-section of government agencies and departments, non-government organisations and other key stakeholders (see List of Participants).

Prior to the workshop, a draft action plan was formulated, based on the relevant parts of the NFS and its companion document. This was reviewed and contributed to by members of the Fish Management and Science Committee before being circulated to all workshop participants several days in advance of the gathering. The workshop proceeded with four keynote presentations on priority issues and the participants then worked to fine tune and improve the draft action plan, and identify the knowledge gaps that their deliberations highlighted. Following the workshop, participants received a near-final version of the action plan to review and were asked to indicate their views on the priorities (high, medium and low) of the actions and knowledge gaps. Twenty of the 31 participants provided their views, thus giving a strong representation of the collective and relative priorities in terms of the actions and knowledge gaps.

The full action plan and list of identified knowledge gaps can be viewed elsewhere in this report. Below are those actions and knowledge gaps that were rated the most highly by the participants based on a simple tally system. They are presented here to give an indication of the range of issues canvassed in the

workshop, and those follow-up measures considered the highest priority for attention by decision-makers within the Commonwealth and State/ACT governments, within catchment management bodies and for all wetland managers across the Basin.

## Highest priority actions from the Action Plan

(The order presented does not necessarily indicate relative priorities)

- Promote policy and programmatic linkages and coherence at the Commonwealth and State/ACT levels, so that fisheries management, wetlands management, biodiversity conservation, water resources management etc agencies are working in a united way for pursuing the Native Fish Strategy targets.
- Identify all high conservation value wetlands (aquatic ecosystems) at the Basin and catchment scale and ensure their protection and rehabilitation (where needed) through Habitat Management Area (HMA) declarations and other mechanisms (Ramsar listings, fish habitat reserves etc).
- Review, and where warranted and feasible, act to remove obstructions to native fish passage between river channels and floodplain wetlands.
- Develop and apply operating rules that deliver appropriate water regimes to facilitate timely native fish passage to, from and between floodplain wetlands.
- Develop, and where necessary modify, operating rules for regulators to optimise native fish movements to and from floodplain wetlands during inundations, and to minimise fish strandings when regulators are closed.
- Formalise the rapid response plan for a potential *Tilapia* outbreak in the Basin.
- Seek to gain stronger political-level support for native fish management issues with the Murray-Darling Basin and Natural Resource Management Ministerial Councils.
- Hold an annual Basin-wide workshop on NFS-related research and management experiences to promote knowledge sharing among stakeholders.



## *Highest priority knowledge gaps for attention*

(The order presented does not necessarily indicate relative priorities)

- Identify priority wetland sites for native fish species across the Basin.
- Identify near-threatened species that rely on wetlands at a Basin and catchment level.
- Develop an inventory of critical wetland habitat areas for threatened and near-threatened native fish species and communities across the Basin.
- Identify and map artificial barriers to wetland inundation across the Basin.
- Establish the timing of native fish responses to flooding and recessions (movement cues); including for smaller native species. Establish if these cues can be managed in “regulated” wetlands.
- Identify key point sources of alien species recruitment.
- Investigate the effectiveness of methods for excluding alien fish from off-channel habitats, including carp screens, and the impacts of these methods on native fish passage, population dynamics etc.



Wetlands and fish have not had a close association in the public eye. In most States and Territories those agencies working to see inland wetlands protected or managed for long-term sustainability have done so in isolation of fisheries agencies. Native fish should be seen as intrinsic natural assets of wetlands so that both fish and wetlands can be better off. Indeed, a little known (and used!) trigger for declaring Wetlands as International Importance under the Ramsar Convention on Wetlands is the presence of ecologically important fish populations.

This workshop is a valuable contribution to the discussion of native fish and wetlands, particularly as it has developed an action plan using the objectives of the Murray-Darling Basin's Native Fish Strategy 2003–2013 (NFS) as a framework.

The NFS aims to ensure that the Basin sustains viable fish populations and communities throughout its rivers. The 50-year goal of the NFS is to rehabilitate all native fish species in the Basin back to 60 per cent or more of their estimated pre-European settlement levels. In particular, the Strategy provides for the rehabilitation and protection of the natural functioning of wetlands and floodplain habitats for native fish and aims to revive the links between terrestrial ecosystems, wetlands and rivers.

This workshop is another in a series that have been conducted over the last five years to address specific issues under the banner of the NFS. Previous workshops have

addressed issues such as fishways, thermal pollution, translocation and stockings, downstream migration, habitat rehabilitation and management, and the conservation and management of Murray cod.

The workshop explored in detail some of the more pertinent issues relating to fish and wetlands, including the significance of floodplain wetlands for Murray-Darling Basin native fish species, the impact of invasive fishes on wetland ecosystems in the Basin, and the need to take more integrated approaches, involving regional and catchment groups, private landowners, anglers, non-government organisations, the business sector and government. There is also a case study approach to managing ephemeral wetlands for native fish, linking fish ecology to regulatory structure design and operation.

The collection of papers contained in this document summarises the current body of knowledge on the relationship between freshwater fish and wetlands. The challenges now are to strive for pragmatic, workable solutions that will lead to tangible improvements, to enhance knowledge of the complex relationships between fish and wetlands to facilitate better management, and to achieve an uptake of the priority actions by decision-makers.

**Jim Barrett**  
Manager  
Native Fish Strategy  
Murray-Darling Basin Commission



## *Development of this Action Plan*

Prior to the workshop, a draft action plan was formulated, based on the relevant parts of the Murray-Darling Basin Commission's Native Fish Strategy and its companion document. This draft was reviewed and contributed to by members of the Fish Management and Science Committee before being circulated to all participants several days in advance of the workshop. The workshop proceeded with four keynote presentations on priority issues and the participants then worked (in break-out groups followed by open plenary reports and discussion) to fine tune and improve the draft action plan, and identify the knowledge gaps that their deliberations highlighted. Following the workshop, all participants received a near-final version of the action plan to review and were asked to indicate their views on the priorities (high, medium and low) of the actions and knowledge gaps. Twenty of the 31 participants provided their views, thus giving a strong representation of the collective and relative priorities in terms of the actions and knowledge gaps. The knowledge gaps identified can be found in the section following. Below, the action plan is presented, organised under the following themes.

- 
- A. Planning and coordination: Basin or State/ACT levels
  - B. Planning and coordination: All levels
  - C. Priorities for catchment management and regional natural resource management bodies
  - D. Site management
  - E. Financing and incentives
  - F. Information management and training
  - G. Flow management and improving connectivity
  - H. Raising awareness

A. Planning and coordination: Basin or State/ACT levels.

Recommended actions	Level of implementation		Priority (see below)
1. Promote policy and programmatic linkages and coherence at the Commonwealth and State/ACT levels, so that fisheries management, wetlands management, biodiversity conservation, water resources management etc agencies are working in a united way for pursuing the Native Fish Strategy targets.	Basin	•	<b>H+</b>
	Catchment		
	Local		
2. Formalise the rapid response plan for a potential Tilapia outbreak in the Basin.	Basin	•	<b>H+</b>
	Catchment		
	Local		
3. Develop and implement recovery plans for all threatened fish species, including consideration of using "managed" wetlands (those where hydrology can be controlled or manipulated) as part of recovery actions.	Basin	•	<b>H</b>
	Catchment	•	
	Local	•	
4. Undertake critical risk analysis of other potential pest species; develop and adequately resource rapid response plans for each. (Note: this priority has been addressed, at least in part, by the report cited below; ARI 2002).	Basin	•	<b>H</b>
	Catchment		
	Local		
5. Assess and review existing listings of species, populations and ecological communities and provide protection at the national level.	Basin	•	<b>M</b>
	Catchment		
	Local		
6. Support the initiative to broaden the scope of the Sustainable Rivers Audit (SRA) process to include consideration of floodplain habitats.	Basin	•	<b>M</b>
	Catchment		
	Local		
7. Expand the concept of strategic environmental assets (that is, wetland icon sites) from the Living Murray Initiative to apply Basin-wide and develop objective processes for identifying these sites.	Basin	•	<b>M</b>
	Catchment		
	Local		
8. Provide additional resources for pursuing site-based actions directed at the control or containment of alien species in wetlands.	Basin	•	<b>M</b>
	Catchment	•	
	Local		
9. Regulate Koi carp production and distribution in NSW and South Australia to minimise the risk of escape into the wild.	Basin (NSW and SA)	•	<b>L</b>
	Catchment		
	Local		
10. Where appropriate, seek to re-establish threatened and near-threatened wetland specialist native fish species across their former ranges through captive breeding programs for re-stocking or translocation.	Basin	•	<b>L</b>
	Catchment	•	
	Local		



B. Planning and coordination: All levels.

Recommended actions	Level of implementation		Priority (see below)
11. In conjunction with 6 above, identify all high conservation value wetlands (aquatic ecosystems) at the Basin and catchment scale and ensure their protection and rehabilitation (where needed) through Habitat Management Area (HMA) declarations and other mechanisms (Ramsar listings, fish habitat reserves etc). See also action 26 below.	Basin	•	<b>H+</b>
	Catchment	•	
	Local	•	
12. Incorporate wetland rehabilitation into Native Fish Strategy (NFS) 'demonstration reaches' to ensure the inclusion of floodplain ecosystems. See actions 13 and 23 below also.	Basin	•	<b>H</b>
	Catchment	•	
	Local	•	
13. Include alien species control and containment measures in wetlands within the NFS 'demonstration reaches' across the Basin. See actions 12 above and 23 below also.	Basin	•	<b>H</b>
	Catchment	•	
	Local	•	
14. Develop cross-agency informal communication mechanisms for regionally-based on-ground operators to promote information exchange between natural resource management agencies.	Basin	•	<b>M</b>
	Catchment	•	
	Local	•	
15. Continue implementation of the Murray-Darling Basin Commission's Integrated Catchment Management Strategy, ensuring that priority attention is given to managing the potentially negative impacts on wetlands and native fish from nearby or upstream land use practices.	Basin	•	<b>M</b>
	Catchment	•	
	Local	•	
16. Continue implementation of the Murray-Darling Basin Commission's Salinity and Water Quality Management Strategies, ensuring that the objectives of both are not detrimental to native fish populations.	Basin	•	<b>M</b>
	Catchment	•	
	Local	•	

C. Priorities for catchment management and regional natural resource management bodies.

Recommended actions	Level of implementation		Priority (see below)
17. Seek to give native fish management in wetlands a higher priority with regional and catchment bodies through the Natural Resource Management program, and have it reflected as such within their integrated catchment/regional plans and associated investment strategies (see action 45 and 61 also).	Basin	•	<b>H</b>
	Catchment	•	
	Local		
18. Develop catchment-level alien species management plans and undertake coordinated control and containment measures (see knowledge gap 16 below also).	Basin		<b>H</b>
	Catchment	•	
	Local		
19. Ensure that the integrated regional and catchment-level natural resources management plans and their associated investment strategies give attention to matters of threatened and near-threatened native fish in wetlands. See action 17 above also.	Basin		<b>H</b>
	Catchment	•	
	Local		

D. Site management.

Recommended actions	Level of implementation		Priority (see below)
20. Ensure the management plans of existing wetland protected areas include native fish management objectives, such as: a) recognition of the importance of floodplain wetlands to native fish in their objectives and management actions; b) the inclusion of native fish-specific actions where appropriate; and c) minimisation of actions that could have negative consequences for native fish populations. Note: many of the management issues that need to be considered in site plans are addressed in the following sections in greater detail.	Basin		<b>H</b>
	Catchment		
	Local	•	
21. Promote use of the range of local threat management and mitigation approaches and tools (such as buffer zoning, stock exclusion etc) to help maintain suitable water quality regimes to maintain, and where possible, enhance, resident native fish populations at the individual wetland scale.	Basin		<b>H</b>
	Catchment		
	Local	•	
22. Manage for a diversity of wetland water qualities such that the diversity of native fish species is preserved and the abundance of alien species is not enhanced.	Basin		<b>H</b>
	Catchment	•	
	Local	•	
23. Develop management plans for key wetlands that include clear objectives for native fish species. Ideally these will be hypothesis-driven, apply adaptive management, be developed in consultation with stakeholders and have a minimum ten year horizon. See actions 12, 13 and 26 also.	Basin		<b>H</b>
	Catchment		
	Local	•	
24. Identify the key threats to wetlands across the Basin and the existing and emerging tools for mitigating these threats. Develop decision support systems that assess and prioritise the threats and a process for promoting the application of the appropriate tools.	Basin	•	<b>H</b>
	Catchment		
	Local		
25. Develop and implement plans for controlling alien species in wetlands, using pest management principles and risk management strategies (see 65 below also). Where necessary, revise existing site plans to give greater attention to alien species control.	Basin	•	<b>M</b>
	Catchment	•	
	Local	•	
26. Support the development of site plans for wetlands identified as priorities for the recovery of threatened species, and for assembling a HMA network for the catchment. See actions 11 and 23 also.	Basin	•	<b>M</b>
	Catchment	•	
	Local	•	
27. Manage temporal water quality variability to maintain, and where possible, enhance, resident native fish populations at the individual wetland scale. Habitat management measures can support such aspirations – see action 21 above also.	Basin		<b>M</b>
	Catchment		
	Local	•	
28. Where appropriate and feasible, incorporate wetting and drying regimes on wetlands and floodplains into site management plans, and use these to inform environmental flow determinations. See knowledge gap 26 also.	Basin		<b>M</b>
	Catchment	•	
	Local	•	
29. Involve the community and stakeholders in management planning and the setting of environmental flow allocations for key wetland areas.	Basin		<b>M</b>
	Catchment		
	Local	•	
30. Within wetland management site plans, and associated actions, ensure water quality issues are given appropriate priority.	Basin		<b>L</b>
	Catchment		
	Local	•	



E. Financing and incentives.

Recommended actions	Level of implementation		Priority (see below)
31. Offer financial and other incentives, and encourage corporate support, for enhanced wetland management to assist native fish rehabilitation.	Basin	•	M
	Catchment	•	
	Local	•	
32. Promote greater resource allocation to the pursuit of freshwater fish ecology research in universities.	Basin	•	M
	Catchment		
	Local		
33. Identify potential investment partners (including those outside government) and opportunities to link into and value-add on existing wetland and native fish-related funding arrangements.	Basin	•	M
	Catchment	•	
	Local	•	
34. Provide additional resources for pursuing site-based actions directed at the control or containment of alien species in wetlands.	Basin	•	M
	Catchment	•	
	Local	•	
35. Offer incentives to commercial anglers for the removal of alien fish from wetlands where it may not otherwise be financially viable.	Basin	•	L
	Catchment	•	
	Local	•	

F. Information management and training.

Recommended actions	Level of implementation		Priority (see below)
36. Hold an annual Basin-wide workshop on NFS-related research and management experiences to promote knowledge sharing among stakeholders.	Basin	•	H+
	Catchment		
	Local		
37. Develop and disseminate information on alien species including the potential impacts on native fish and wetland habitats, dispersal mechanisms; how they end up in the wild and the range of control and containment techniques available.	Basin	•	H
	Catchment	•	
	Local		
38. Identify appropriate methods for indigenous communities to gather and manage indigenous knowledge on native fish and wetlands, ensuring careful consideration of intellectual property issues with indigenous knowledge.	Basin	•	M
	Catchment	•	
	Local	•	
39. Provide information on environmental flow targets and release patterns for each catchment to help guide planning and local actions.	Basin	•	M
	Catchment	•	
	Local	•	
40. As information becomes available (See knowledge gaps 21 and 25), develop water quality management policies and guidelines to reflect the requirements, tolerances and adaptive capacities of native fish species in wetlands (incorporating a diversity of species and life history stages).	Basin	•	M
	Catchment	•	
	Local	•	

Recommended actions	Level of implementation		Priority (see below)
41. Provide concise, accessible information on current wetland management and how and where improvements can be gained in each catchment (such as through Plans for Implementation of Environmental Water Allocations).	Basin	•	<b>M</b>
	Catchment	•	
	Local		
42. Seek to establish or support existing training efforts to raise the management capacity of wetland-holders.	Basin	•	<b>M</b>
	Catchment	•	
	Local		
43. Develop and make available information on the location and status of all wetlands and floodplain channels in relation to protection or rehabilitation requirements and priorities.	Basin	•	<b>M</b>
	Catchment	•	
	Local		
44. At the catchment level, establish wetland water quality assessment and monitoring databases to facilitate exchange and comparison of data on native fish requirements and tolerances being compiled at the Basin scale.	Basin		<b>L</b>
	Catchment	•	
	Local		
45. Use the above as a vehicle for collecting and prioritising community values about the importance of wetlands for fish. Ensure this is used to harness and incorporate local knowledge, respectively, and, seek to have this information used to inform regional/catchment NRM planning (See actions 17 and 61 also).	Basin	•	<b>L</b>
	Catchment	•	
	Local	•	
46. Improve the documentation and publication of information related to threatened and near-threatened native fish species that have wetland associations.	Basin	•	<b>L</b>
	Catchment		
	Local		
47. Provide concise and accessible information on the historic wetland habitats of native fish populations and their subsequent decline in those sites (and associated decline of those sites if relevant). This should include a wide range of sources including scientific findings, oral histories and indigenous knowledge. Undertake oral history documentation in those catchments where it has not been done to date.	Basin	•	<b>L</b>
	Catchment		
	Local		



G. Flow management and improving connectivity.

Recommended actions	Level of implementation		Priority (see below)
48. Develop and apply operating rules that deliver appropriate water regimes to facilitate timely native fish passage to, from and between floodplain wetlands.	Basin		H+
	Catchment	•	
	Local		
49. Review, and where warranted and feasible, act to remove obstructions to native fish passage between river channels and floodplain wetlands.	Basin		H+
	Catchment	•	
	Local	•	
50. Develop, and as necessary modify, operating rules for regulators to optimise native fish movements to and from floodplain wetlands during inundations and to minimise fish strandings when regulators are closed.	Basin		H+
	Catchment		
	Local	•	
51. Where possible, manage flows to mimic more closely natural high and low flow events, in terms of their timing, duration and volumes.	Basin	•	H
	Catchment	•	
	Local	•	
52. Within each catchment, identify those wetlands that may be enhanced for native fish conservation by use of environmental flows (taking into consideration operational and legal constraints) and seek to achieve such allocations.	Basin	•	H
	Catchment	•	
	Local	•	
53. Encourage the establishment of water trusts and the allocation of further water for environmental purposes so that the flow management objectives can be pursued.	Basin	•	H
	Catchment	•	
	Local	•	
54. Identify wetlands subjected to periods of excessive inundation and promote the introduction of more natural watering regimes to provide multiple ecosystem benefits, including for native fish.	Basin	•	M
	Catchment	•	
	Local	•	
55. Preserve a portion of opportunistic unregulated flow events to allow for enhanced wetland flooding and improve native fish habitat availabilities, passage etc.	Basin	•	M
	Catchment	•	
	Local		
56. Where environmental flows are allocated for priority wetland sites, (such as The Living Murray Initiative's icon sites) seek to maximise the benefits of these flows for other wetland sites within the 'donor' catchments as part of the water transmission process.	Basin		M
	Catchment	•	
	Local	•	
57. Develop and implement revised flow manipulation strategies to prevent water quality impacts on native fish within wetlands (such as blackwater events).	Basin	•	M
	Catchment	•	
	Local	•	
58. Manage large woody debris in off-channel habitats to maximise habitat values but not impair connectivity with the main channel.	Basin		L
	Catchment		
	Local	•	
59. Promote the value of seasonally inundated ephemeral areas for native fish passage in wetland-related water management planning.	Basin	•	L
	Catchment	•	
	Local	•	



H. Raising awareness.

Recommended actions	Level of implementation		Priority (see below)
60. Seek to gain stronger political-level support for native fish management issues with the Murray-Darling Basin and Natural Resource Management Ministerial Councils.	Basin	•	<b>H+</b>
	Catchment		
	Local		
61. Raise agency and NRM body awareness of the wetlands-native fish linkages and the importance of managing these areas appropriately (see actions 17 and 45 also).	Basin	•	<b>H</b>
	Catchment	•	
	Local		
62. Promote the native fish-wetlands 'partnership' through the development of a range of marketing tools such as: a) The use of icon native fish species, including both the larger, better known species (like Murray cod) and the smaller, more cryptic species such as Purple-spotted gudgeon to become well recognised flagships for mobilising community interest and involvement in management. b) Using well recognised fishing (and other) celebrities to be 'champions' of native fish and wetlands management initiatives. c) Using a number of wetland-related icon species (e.g. waterbirds, frogs) to demonstrate food webs and species associations within these ecosystems and how native fish are a vital component.	Basin	•	<b>H</b>
	Catchment		
	Local		
63. Undertake a range of awareness raising activities to establish support for the concept of HMAs and their incorporation into planning processes and on-ground works at the Basin, catchment and local scales.	Basin	•	<b>H</b>
	Catchment	•	
	Local	•	
64. Raise community understanding of the importance of wetland habitats for native fish and promote the community's role in management through field days, seminars, videos, pamphlets, youth forums and schools for example. Include in these efforts education on threatening processes and impacts and management options in wetlands.	Basin	•	<b>H</b>
	Catchment	•	
	Local	•	
65. Raise community and agency understanding of using pest-management principles for managing pest fish species in wetlands. See action 25 above also.	Basin	•	<b>M</b>
	Catchment	•	
	Local	•	



Ratings for priority actions and knowledge gaps.

Highest priorities	<b>H+</b>
High	<b>H</b>
Medium	<b>M</b>
Lesser priorities	<b>L</b>

Note: see 4 above: ARI, 2002. "A Risk Assessment of the Impacts of Pest Species in the Riverine Environment in the Murray-Darling Basin – Report to the Murray-Darling Basin Commission" (2002); Arthur Rylah Institute, Keith Turnbull Research Institute and Dr Jane Roberts; Victoria.

## Knowledge gaps

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The introductory text under the Action Plan (preceding section) explains how the knowledge gaps presented below were arrived at, and the process by which they were ranked for priority.

Note that under each priority level, the order and numbering should not be taken to infer relative rankings.

### *Highest priorities*

1. Identify priority wetland sites for native fish species.
2. Identify near threatened species that rely on wetlands at a Basin and catchment level.
3. Develop an inventory of critical wetland habitat areas for threatened and near-threatened native fish species and communities across the Basin.
4. Identify and map artificial barriers to wetland inundation across the Basin.
5. Establish the timing of native fish responses to flooding and recessions (movement cues); including for smaller native species. And, establish if these cues can be managed in “regulated” wetlands.
6. Identify key point sources of alien species recruitment.
7. Investigate the effectiveness of methods for excluding alien fish from off-channel habitats, including carp screens, and the impacts of these methods on native fish passage, population dynamics etc.

### *High priorities*

8. Document basic life history information and habitat-use by all threatened and near-threatened native fish species, including the smaller, less iconic ones such as Glass perch and Purple-spotted gudgeon in northern catchments and Pygmy perch or Murray hardyheads in the southern Basin where pockets of abundance exist. (Note: this priority has been addressed, at least in part, by the report cited below; SKM 2004).
9. Investigate key threatening processes that potentially impact on threatened and near-threatened native fish species and ecological communities.

10. Assess the process for and ecological value of retaining floodwaters with regulators on floodplains at Chowilla, Barmah, Peel, Macquarie Marshes, Gwydir Wetlands, Great Cumbung Swamp, Lowbidgee and Narran Lakes at times to suit native fish recruitment and growth.
11. Investigate the benefits of modified regulator operating practices for native fish.
12. Investigate options to maximise the value (for native fish) of environmental flow delivery to wetlands within the existing regulated system.
13. Investigate the impact of watering trials and similar floodplain flow manipulations on native fish species.
14. Investigate whether or not wetlands offer drought refuges for native fish.
15. Determine the relative and combined effectiveness of traps, pheromones, flow manipulations etc for removing spawning aggregations of carp.
16. Establish the most effective array of alien species control and containment techniques for a range of circumstances and pilot the techniques across a range of sites (see Actions 8 and 18).
17. Investigate the timing and patterns of alien fish dispersal and movements so they don't benefit from improved native fish passage.
18. Document local and indigenous knowledge about native fish in wetlands at the Basin, catchment and local levels.

### *Medium priorities*

19. Identify commence-to-flow (and where it applies other less-defined flow) levels for wetland connecting channels to aid design of environmental flows for wetland watering.
20. Develop and apply methods to quantify and maximize the ecosystem outcomes of water delivery to floodplains and floodplain wetlands.
21. Establish the relationship between a diversity of water qualities in a wetland (spatial and temporal) and fish presence, absence and abundance.

22. Document the basic life history information for all native fish species (through to sexual maturity) including the smaller, less iconic ones. (Note: this priority has been addressed, at least in part, by the report cited below; SKM 2004).
23. Review the impacts of watering regimes on water quality and fish (native and alien) in wetlands.
24. Determine how flow changes impact on wetland-mainstream connectivity and the percentage loss of wetland habitat areas due to flow management.
25. Determine water quality tolerances (lethal and sub-lethal) for individual native fish species and their different life history stages.
26. Through large scale weir pool manipulations, regulator operations and other appropriate methods, continue to investigate and increase knowledge of the impacts of wetting and drying regimes on native fish populations and species (both seasonal and multi-year).
27. Examine the relationship between imposed wetland water management regimes (e.g. different durations/seasons of wetting and drying) and wetland water quality and native fish.
28. Establish the role and impacts of wetland/ floodplain return water on the food web of the river, including blackwater events.
29. Promote study of the ecology of wetland-dependent fish species, such as the Flat-headed galaxias.
30. Improve understanding of wetland processes that support threatened or near-threatened native fish species.

31. Document the extent, location and history of floodplain alienation.
32. Establish the specific impacts of smaller species such as Gambusia and Oriental weatherloach on native fish species in wetlands.
33. Review and test the impacts on native fish species of diseases introduced by alien species.
34. Improve understanding of wetland to main channel food webs and trophic linkages, including through examination of carbon transfer models.

### *Lesser priorities*

35. Determine the impacts of increased salinisation on native fish communities in wetlands including the affects on each life cycle stage.
36. Investigate the roles and habitat value of large woody debris in off-channel habitats.
37. Assess the community's knowledge and understanding of the role of wetlands in the riverine environment and their importance for native fish.
38. Develop predictive tools for managing blackwater events.
39. Examine the linkages between wetlands and groundwater to help develop more robust management and risk mitigation approaches.

Note: See 8 and 22: SKM, 2004 report. "Review of Habitat Associations of Native Fish in the Murray-Darling Basin – Murray-Darling Basin Commission Project R2105" (2004); Sinclair Knight Merz; Victoria

