

Review of the Trout Cod Recovery Plan

January 2017

Introduction

This document reviews the Trout Cod (*Maccullochella macquariensis*) Recovery Plan. The review assesses the implementation of recovery actions in NSW and details progress made towards meeting stated recovery objectives. The review also aims to clarify any required changes in management actions or priorities necessary for the recovery of the species.

The Trout Cod Recovery Plan was finalised in 2006. The overall objectives of the recovery plan are to ensure the recovery and natural viability of Trout Cod populations in their former range in the Murray-Darling Basin. Specific objectives of the recovery plan are to:

- Ensure the security of the remnant Trout Cod population in the Murray River by maintaining, protecting and improving the aquatic habitat values in that locality
- Establish and protect additional stocked populations of Trout Cod at selected locations throughout the species former range
- Reduce fishing related mortality of Trout Cod by setting appropriate regulatory controls and maximising angler compliance
- Improve our understanding of the population size, distribution, ecological requirements, and genetic status of Trout Cod
- Improve our understanding of the threats to the survival of Trout Cod, and contribute to management actions to ameliorate these threats
- Coordinate and initiate new community awareness and education programs relating to Trout Cod
- Coordinate and support appropriate actions by the community and government to provide a strategic, regional approach to Trout Cod survival and threat abatement
- Increase community awareness of the status of and threats to Trout Cod to improve support for recovery actions
- Assess the outcomes of past and current recovery actions and the species' conservation status

The plan will be judged a long-term success in NSW if the status of Trout Cod is revised from 'endangered' to 'vulnerable' and eventually removed from the schedules of the NSW *Fisheries Management Act 1994* within 15 years.

The recovery plan requires a major review within ten years of its publication. This document comprises the review and complies with section 220ZR (review of recovery and threat abatement plans) of the NSW *Fisheries Management Act 1994*.

Review of Recovery Actions

This statutory review of Trout Cod recovery actions has been undertaken in consultation with a range of managers and scientists and has drawn on several sources of information (e.g. Fisheries Scientific Committee's Annual Reviews of the threatened species lists, scientific papers, consultant reports, internal DPI reports, and personal communication with a range of professionals with involvement in Trout Cod recovery operations).

The recovery plan includes six program areas:

- Habitat protection and restoration
- Reduction of negative fishing impacts
- Minimising risks from inter-specific competition and introduced species
- Establishing new populations through stocking
- Research and monitoring
- Community awareness, involvement and support

The implementation details for each program area listed above are outlined in Tables 1 to 7.

Table 1: Review of recovery actions – 6.1 National Recovery Plan

| Recovery Action | Implementation Details |
|--|---|
| 6.1.1 Maintain contributions to national recovery plan | |
| <ul style="list-style-type: none"> Continue membership of National recovery team | Funding and coordination for the National Trout Cod Recovery Plan was not renewed with the development of the 3 rd National plan in 2008. As such, the National Trout Cod Recovery Team disbanded with the expiration of the 2 nd National Trout Cod Recovery Plan. |
| <ul style="list-style-type: none"> Continue cooperative involvement and liaison, including information exchange, with other State/Territory agencies involved in Trout Cod recovery | Ongoing cooperation with other State/Territory agencies is maintained where possible without assistance from a National Trout Cod Recovery Team. |
| <ul style="list-style-type: none"> Continue to assist with the implementation of the National Trout Cod recovery plan | Ongoing but without coordination from a National Trout Cod Recovery Team. |

Table 2: Review of recovery actions – 6.2 Habitat protection and restoration

| Recovery Action | Implementation Details |
|---|---|
| 6.2.1: Minimise Trout Cod habitat degradation | |
| <ul style="list-style-type: none"> Ensure that councils, government agencies and other relevant organisations are aware of the location of important areas for Trout Cod by providing maps of known and potential habitat and the location of significant wild populations | Ongoing: Information on threatened aquatic species distribution in NSW has been widely distributed since 2006 using Primefacts and web based advisory materials. In August 2016 a new publication titled: Fish communities and threatened species distribution in NSW and a new online map for Trout Cod indicative distribution was made available for public distribution and was distributed to council bodies state-wide. |
| <ul style="list-style-type: none"> Provide information to relevant stakeholders including local councils and government agencies to support appropriate environmental planning and impact assessment procedures | Ongoing: Information detailing required environmental planning procedures are provided to stake holders through the Policy and guidelines for fish habitat conservation and management , and policy and guidelines for fish friendly waterway crossings . Public stakeholders have also been provided with a guide for living and working on inland riverbanks. |
| <ul style="list-style-type: none"> Negotiate with relevant local councils in regard to local environmental plans, development control plans and other planning documents, regarding the type and scale of development permitted near key areas known to support Trout Cod | Ongoing: Local councils are required to comply with the NSW DPI Policy and guidelines for fish habitat conservation and management as well as the policy and guidelines for fish friendly waterway crossings in regard to any development that occurs in or around waterways in NSW. |
| <ul style="list-style-type: none"> Encourage the adoption of land use 'best practice' (e.g. agriculture, industry) to assist in minimising adverse impacts on stream flows, habitat connectivity, riparian vegetation and water quality | Ongoing: New South Wales Local Land Service (LLS) delivers PROfarm training courses to agricultural producers to increase water use efficiency, improve on farm riparian habitat, and reduce negative impacts of cropping practices on adjacent waterways. Public stakeholders have also been provided with a guide for living and working on inland riverbanks. |

6.2.2: Investigate and implement measures to protect and rehabilitate Trout Cod habitat

- Prepare and implement a strategic plan for the protection and rehabilitation of key Trout Cod habitats

Ongoing: The NSW Trout Cod Recovery Plan and Priority Action Statement, in conjunction with the National Trout Cod Recovery Plan detail specific actions that need to be undertaken to ensure the species persistence and rehabilitation of key habitats throughout the known and former range of the species range.
- Identify and implement the most appropriate mechanisms to enhance the protection and rehabilitation potential of key Trout Cod habitat

Ongoing: Trout Cod habitat protection and restoration has been guided by adaptive management (KoeHN et al 2013). Post project monitoring has helped identify and evaluate the most effective approaches for improving habitat for this species. These include: Installation of large wood instream structures, fish passage restoration, delivery of ecological flows, and restoration of riparian habitats (Lintermans 2013).
- Investigate the use of critical habitat protection as a means of protecting key Trout Cod habitats

Complete: No critical habitat has been declared for Trout Cod but alternative special protections have been placed on activities occurring in the Trout Cod Protection Area (Yarrowonga weir downstream to the Tocumwal road bridge). These currently include an annual closed fishing season from 1 September to 30 November and a prohibition on the use of set lines in all areas known to contain Trout Cod.

6.2.3: Actively promote Trout Cod habitat protection and rehabilitation within natural resource management programs in NSW

- Work with community groups, relevant natural resource management agencies, local councils, landholders etc to identify, restore and protect known and potential Trout Cod habitats with the aim of protecting existing Trout Cod habitats and populations, and re-establishing additional viable populations

Ongoing: Primary habitat protection and improvement initiatives in NSW have been undertaken by NSW DPI and the Murray-Darling Basin Authority. Activities have also been taken up by the angler based [Inland Waterways Rejuvenation Association](#) (IWRA) and [OzFish Unlimited](#). IWRA has raised over \$75,000 for habitat improvement works in the Macquarie River that may benefit Trout Cod population recruitment in that waterway.
- Seek funds to undertake priority rehabilitation and restoration work (e.g. restoring fish passage, re-snagging activities, riparian revegetation, implementing mitigation measures for cold water pollution etc.) at key sites through grant schemes or other sources

Ongoing: Trout Cod restoration efforts have received a high degree of attention and funding during the last decade. The following project descriptions offer a cross section of activities completed for Trout Cod recovery but does not represent an exhaustive list of all actions taken during the lifetime of the recovery plan (works to improve general river health are not specified).
- Develop guidelines and principles to assist in determining the flow requirements of Trout Cod, and distribute this information to relevant natural resource management committees and agencies

Ongoing: King et al. 2009 found that juvenile Trout Cod survival increased with the application of spring environmental flows. Further, specific flow hydrographs have been developed targeting Trout Cod spawning in the Murrumbidgee River and Yanco Creek (Baumgartner et al. 2014). These findings exploring native fish response to flows in the MDB are being used to guide environmental flow planning with the Murray Darling Basin Authority (MDBA) and its stakeholders.
- Continue to support habitat rehabilitation / restoration activities throughout the range of Trout Cod through existing programs including the Weir Review Program and related programs

2008-2010: NSW DPI and partners secured external funding to reinstate more than 5,000 Large Woody Habitat (LWD) into the NSW part of the MDB. NSW DPI also reconnected 869 km of waterways within Trout Cod habitat and achieved wetland management improvements on 48 farms totalling more than 1 million hectares of agricultural land during this time.

2012: Fish Passage restored on the Stevens Weir of the Edwards River adding 114km of habitat in the lower Murray reach, this addressed the highest priority fish migration barrier in the lower Central Murray and is an area occupied by Trout Cod.

2014: Management of 34+ Giga Litres (GLs) of environmental water to date in 2014/15 water year in the regulated Macquarie Cudgegong plan area.

2014: Macquarie River downstream to Burrendong Dam: Installation of a Thermal Control Curtain Mitigation of Thermal Pollution ~200 km Macquarie River. Education and awareness -monitoring results presented to >100 stakeholders/anglers/water managers in Trout Cod habitat areas.

2014: Macquarie River - Dubbo area weed removal, riparian vegetation regeneration, community education & awareness, reinstating LWD, riparian protection. Macquarie River - Wellington to Dubbo Reach, Reinstating LWD at 11 sites – a total of 124 LWH installed in 26 complexes.

2014-15: The Basin-wide Environmental Watering Strategy (BWS) was produced by the MDBA to describe expected environmental outcomes associated with Basin Plan Implementation. This includes expected outcomes for native fish that focus on improved distribution, population structure, movement opportunities and breeding success. Specific Trout Cod outcomes focus on expanding the range of current populations and establishing at least 2 additional populations in the southern Basin and 1 to 3 additional populations in the northern Basin (MDBA, 2014). These planning processes are occurring as part of Basin Plan Implementation across the MDB, including the development of Long Term Watering Plans (LTWPs) and Water Resource Plans (WRPs). These plans aim to improve water management across NSW to enhance environmental, social and economic outcomes. Native fish objectives and targets, including those for Trout Cod, are being incorporated into these planning processes in partnership with lead agencies (NSW DPI Water and OEH) and based largely on the outcomes described in the BWS.

2015: Macquarie River: 72 individual trees installed in 14 LWD complexes at two reserve locations.

2015: Upper Murrumbidgee River, invasive weed control in key Trout Cod reaches.

2015: Environmental Water Requirements (EWRs) developed for native fish, including Trout Cod as part of the Fish and Flows projects (NSW DPI, 2015). These EWRs were developed based on best available scientific and grey literature, empirical data and expert opinion, and provide principles to guide the development of water management plans to protect and enhance outcomes for Trout Cod. The reports and associated information have been shared with NSW DPI Water, NSW Office of Environment and Heritage (OEH), MDBA, Commonwealth Environmental Water Holder (CEWH), and other MDB agencies.

2016: Macquarie River 127 LWD installed in 39 complexes at 12 locations, Willows controlled at public reserves, 5 km riparian zone fenced, 24 ha riparian zone weeded, 385 native trees and shrubs planted, 42.5 ha riparian zone protected, Macquarie Habitat Mapping – Bathurst, 21 km river length mapped. Macquarie River and Lachlan River - 3 fish entrainment workshops held with extractive users and other stakeholders. Presentations included the development of a Fish Entrainment infographic advisory material.

2016: Queanbeyan River, 20 LWD installed, 0.4 km riparian zone weeded, 0.7 km riparian zone revegetated with native species.

2016: Environmental flows conducted in the Lachlan, Macquarie, Murrumbidgee, Mid-Murray, Edward-Wakool, Gunbower Creek, Lower Murray, and Lower Darling Rivers.

- Encourage the identification, assessment and modification of natural resource management plans and policies (including catchment action plans, water management plans, vegetation management plans,

Ongoing: Dissemination of up to date best practice recommendations for Trout Cod habitat management is undertaken through presentation of findings at annual fisheries conferences, public meetings, the NSW DPI webpages and press releases. Habitat management advice is also incorporated into advisory guidelines used by DPI to inform stakeholder agencies of their responsibilities in regard to Trout Cod recovery efforts.

and other natural resource management plans) which may influence the recovery of Trout Cod or their habitat (e.g. appropriate environmental flow recommendations)

Table 3: Review of recovery actions – 6.3 Reduce the impact of illegal fishing and incidental capture

| Recovery Action | Implementation Details |
|--|--|
| <ul style="list-style-type: none"> • 6.3.1 Reduce or prevent fishing induced mortality | |
| <ul style="list-style-type: none"> • Maintain regulations in the Trout Cod protection area between Yarrowonga and Tocumwal | Ongoing. |
| <ul style="list-style-type: none"> • Investigate the impact of incidental capture on Trout Cod | Ongoing: Survival of freshwater fish after catch-and-release angling indicates greater than 85% survival of Murray Cod post capture (Hall et al. 2012). This study also evaluated and made recommendations on best practices for increasing survival rates for catch and release practices including: minimising handling time, cutting the line for deeply hooked fish, and not lifting large fish out of the water during hook removal and release. The data from this study can be used to infer survival of catch and release angling for Trout Cod and has been used to develop best practice guidance for incidental catches of Trout Cod. |
| <ul style="list-style-type: none"> • Assess the need for modifying existing regulations/activities to restrict methods likely to induce high levels of mortality or severe injury | Ongoing: Since 2007 – Prohibition on the use of set lines in freshwater areas of NSW. Continuation of annual fishing closure from 1 September to 30 November in the Trout Cod Protection Area. |
| <ul style="list-style-type: none"> • Maximise angler compliance through enhanced community advisory and education activities (see action 6.7) and through effective law enforcement | Ongoing: 55 Trout Cod identification signs have been erected throughout the Trout Cod Protection Area as well as conservation stocking sites. A guide for protecting Trout Cod for recreational fishers was produced in 2007. An updated guide was produced in September 2016 aimed at both fishers and land managers. |
| <ul style="list-style-type: none"> • Implement targeted enforcement activities by regional DPI Fisheries Officers | Ongoing: NSW Fisheries Compliance undertakes an average of 15 patrol days during the closed fishing season in the Trout Cod Protection Area. The number of angler citations for non-compliance has remained stable since 2006. |
| <ul style="list-style-type: none"> • Investigate options to improve reporting illegal activities and providing feedback on actions taken | Ongoing: community awareness activities are carried out by Fisheries Education officers at outdoor industry events that assist the public with Trout Cod identification, conservation regulations, and how to report sightings. |

Table 4: Review of recovery actions – 6.4 Minimise risks from inter-specific competition and introduced species

| Recovery Action | Implementation Details |
|--|--|
| <ul style="list-style-type: none"> • 6.4.1 Minimise Trout Cod impacts associated with stocked, translocated and introduced species | |
| <ul style="list-style-type: none"> • Implement the Freshwater Fish Stocking Fishery Management Strategy (FMS) to prevent significant impacts from stocking on Trout Cod populations and increase law enforcement activities to maximise | Ongoing: The Freshwater Fish Stocking: FMS is in use and law enforcement activities are ongoing. |

compliance

- Encourage community identification and reporting of introduced species throughout the range of Trout Cod through the Protected, Threatened and Pest Species Sighting Program
Ongoing: Community reporting of introduced species is achieved using hotline and email accounts including the Aquatic Biosecurity hotline and email (+61 02 4916 3877, aquatic.pests@dpi.nsw.gov.au).
- Monitor populations of non-endemic fish species at key sites and undertake eradication and/or control programs where appropriate
Ongoing: The [Murray-Darling Basin Authority Sustainable Rivers Audit \(SRA\)](#) was used to systematically monitor native and non-endemic fish populations throughout the MDB. The SRA has been suspended, but the subsequent MDB Fish Survey monitoring project and associated state-based Basin Plan Environmental Outcomes Monitoring (BPEOM) projects continue to monitor native fish populations in the MDB. Various projects have been undertaken to reduce numbers of European Carp in the MDB including: Optimised Carp exclusion screens which can prohibit up to 92% of sexually mature carp from reaching breeding areas in off channel wetlands of the Murray River (Hillyard et al. 2010), installation of traps at fishways, investigations into biological control of carp using [Koi Herpes Virus \(CyHV-3\)](#) and utilisation of commercial fishers.
- Study interactions between introduced species (such as Trout, Carp, Redfin and Goldfish) and Trout Cod to better establish the degree of threat posed by such species
Ongoing: Introduced fish have been shown to reduce Trout Cod restoration effectiveness through a combination of competitive actions and habitat alteration impacts (Koehn et al. 2013). LWD installation has shown to favour native fish such as Trout Cod without benefiting introduced species, particularly Carp (Nicol et al. 2004). Improved fish passage has also been shown to reduce competition for food resources between native and introduced species in the MDB (Baumgartner 2007).

Table 5: Review of recovery actions – 6.5 Establish new self-sustaining populations through stocking

| Recovery Action | Implementation Details |
|---|--|
| 6.5.1 Enhance the strategic conservation stocking program | |
| • Select and prioritise potential new stocking sites | Ongoing: There is some evidence that self-sustaining populations have been established through conservation stocking at three prioritized locations in the: Mid-Murrumbidgee River in NSW, Lower Ovens River*, and Mid-Goulburn River* in Victoria (*populations that will likely provide wild offspring into NSW waters). Trout Cod appear to be reproducing in three additional stocking areas but are not yet considered self-sustaining (Koehn et al. 2013). |
| • Identify funding opportunities to support and / or expand the conservation stocking program | Ongoing: Funding for the production of Trout Cod fingerlings is achieved through cooperation with NSW DPI Fisheries (Recreational and Indigenous Fisheries). |
| • Develop a strategy to ensure maximum viability of Trout Cod stocking events. This may include for example, determining the optimum stocking density and best times for stock release to maximise survival | Ongoing: Population modelling has shown that to obtain maximum results it is best to stock a small number of sites with large numbers of fingerling Trout Cod over many successive seasons (Todd et al. 2004, Ebner et al. 2007, Lyon et al. 2012). |
| • Implement a comprehensive monitoring program (including genetic monitoring) to assess stocking survival and subsequent reproduction of stocked populations | Ongoing: Funding restrictions have fragmented monitoring programs leading to a reduced capacity to evaluate Trout Cod stocking effectiveness in several locations. Trout Cod monitoring outside of specific conservation stocking areas is generally included in the Murray Darling Basin Sustainable Rivers Audit and the subsequent MDB Fish Survey and state-based BPEOM Fish Plan . |
| 6.5.2 Maintain genetic management protocols for the Trout Cod conservation stocking program | |

| | |
|---|---|
| <ul style="list-style-type: none"> • Maintain strict genetic management protocols for the breeding of Trout Cod | Ongoing: Comprehensive genetic testing and management is being used in the implementation of the Trout Cod conservation stocking program (Moore et al. 2010, Lyon et al. 2012). |
| <ul style="list-style-type: none"> • Introduce a tagging program for the broodstock released from the breeding program to prevent repeated use | Completed, all broodstock sourced from the Trout Cod Protection Area have been tagged with Passive Integrated Transponder (PIT) tags since 2000. |
| <ul style="list-style-type: none"> • Continue marking of all stocked fish | Ongoing: Various tagging methods have been in use since 1993 including fin clips and PIT tagging. |
| <ul style="list-style-type: none"> • Periodically review and assess the genetic management protocols for the breeding of Trout Cod to ensure the use of 'best practice' and maintenance of genetic diversity | Ongoing: (see Moore et al. 2010, Lyon et al. 2012). |

Table 6: Review of recovery actions – 6.6 Research and monitoring

| Recovery Action | Implementation Details |
|--|---|
| 6.6.1 Monitor Trout Cod populations and contribute to research requirements in conjunction with other agencies | |
| <ul style="list-style-type: none"> • Actively seek funds to initiate research and monitoring programs through grant schemes or other sources | Ongoing: Research and monitoring funding for Trout Cod is sourced from a wide range of local, state, national and private funding sources. Since 2006 more than 10 peer reviewed articles on Trout Cod ecology and population monitoring have been published (see references). Trout Cod expenditure and activities peaked in 2010. Funding for Trout Cod research and conservation actions has been more restricted since 2011. |
| <ul style="list-style-type: none"> • Contribute to research to improve understanding of the size, distribution and ecological requirements of Trout Cod, as well as the species' historical and existing genetic status | Ongoing: Considerable knowledge of Trout Cod ecology has been gained since 2006 and is being used to direct recovery efforts. Studies have illustrated that; Trout Cod show high site fidelity and limited long range movements suggesting proximity to source populations is important for habitat recolonisation efforts (Koehn et al. 2008, Thiem et al. 2008, Ebner et al. 2009); Trout Cod habitat preferences are strongly linked to LWD in deep sections of low flow river channels (Nicol et al. 2007); delayed stocking of Trout Cod (one and two year old fish) showed high mortality rates and poor effectiveness for re-establishing populations via conservation stocking (Ebner et al. 2007); and environmental watering can be used to increase survival of juvenile Trout Cod (King et al. 2009). |
| <ul style="list-style-type: none"> • Undertake research to assist in clearly identifying the precise impacts of known and potential threats to Trout Cod | Ongoing: Fish entrainment at irrigation offtakes may significantly reduce recruitment for native fish in the MDB indicating fish screening projects may benefit native fish recovery efforts (Baumgartner and Boys 2012). Further, increased competition for food resources occurs between native fish when congregating below impassable instream structures such as weirs indicating the importance of maintaining and improving fish passage (Baumgartner 2007). Though not directly involving Trout Cod the negative impacts of reduced stream flows was illustrated with flow monitoring conducted during the millennium drought (Hammer et al. 2013), these conclusions can be extended to Trout Cod populations. Finally, negative impacts from salinity must be monitored and considered in context with native fish recovery efforts in the lower MDB (James et al. 2003). |
| <ul style="list-style-type: none"> • Establish and undertake regular monitoring surveys for Trout Cod to assess the species conservation status and the effectiveness of recovery actions | Ongoing: Thorough and effective Trout Cod population monitoring has been conducted in particular localities across the MDB (E.g. Ovens River Victoria, Lyon et al. 2012). However, determining the success of many individual projects has been problematic as a result of dispersed and fragmented information, a lack of critical details about monitoring works, a lack of trend monitoring and reporting for individual species, and time lags for species recovery to become apparent. Although considerable monitoring associated with on-ground activities has been reported in NSW, |

little detail is available on monitoring designs or approaches used. As such, the adequacy of monitoring efforts remains largely unknown (Lintermans 2013). Challenges in consolidating, synthesising and evaluating past attempts to recover freshwater fish in NSW and beyond hampers progress for aquatic recovery science and management. To overcome this limitation a national database that includes reporting and evaluation protocols has been identified as a priority for freshwater species recovery in NSW and Australia more broadly (Price et al. 2009).

Table 7: Review of recovery actions – 6.7 Enhance community understanding, involvement and support

| Recovery Action | Implementation Details |
|--|---|
| <p>6.7.1 Increase community awareness and support of Trout Cod issues and recovery actions</p> | |
| <ul style="list-style-type: none"> Produce information brochures and other advisory materials and distribute to relevant stakeholders including local councils | <p>Ongoing: NSW DPI produces multiple advisory materials for distribution through district fisheries offices, the DPI website and through event attendance such as the Melbourne Fishing Show, the Sydney Boat Show and other outdoor recreation workshops. Specifically, a guide for protecting Trout Cod aimed for recreational fishers was produced in 2007. An updated guide “Protecting Trout Cod: A guide for fishers and land managers” was produced in September 2016 aimed at both fishers and land managers. Hard copies were produced and distributed to relevant district fisheries offices and local stakeholders and a web-accessible version is available for download here.</p> |
| <ul style="list-style-type: none"> Develop and distribute an education kit for use in schools | <p>Following a request from the IFISH fishing TV program, NSW DPI organised a sampling permit allowing a film crew to catch and handle Trout Cod on the Murrumbidgee River. The purpose of the show was to illustrate physical differences between Trout Cod and Murray Cod to help recreational fishers properly identify the two species. The program also focused on best practice catch and release techniques which will benefit Trout Cod that are accidentally caught. An interview with NSW DPI Researcher Martin Asmus provided information on DPIs recovery work for Trout Cod including the conservation stocking program. The TV segment was first broadcast Sunday 11 September 2016 on Channel ONE.</p> |
| <ul style="list-style-type: none"> Develop and distribute an education kit for use in schools | <p>Partly completed: Copies of the 2016 “Protecting Trout Cod: A guide for fishers and land managers” has been provided to DPI School Education Officers for distribution at school fishing workshops. Additionally, A story book was developed by Holbrook Public School “Tommy the Trout Cod” through the Creative Catchment Kids program. A copy of the book can be found here.</p> |
| <ul style="list-style-type: none"> Maintain the Fishcare Volunteers program, with emphasis on Trout Cod issues in the Murray, Murrumbidgee and Macquarie River catchments | <p>Ongoing: Fishcare volunteers have actively engaged the community across NSW emphasising aquatic conservation priorities relevant to the location where they are based. Trout Cod awareness and conservation training has been included in this work and is an ongoing focus in the south eastern portion of the Murray-Darling Basin for Fishcare Volunteers.</p> |
| <ul style="list-style-type: none"> Where appropriate actively encourage community involvement in aspects of Trout Cod recovery including for example, research and monitoring programs | <p>Ongoing: Fisheries Officers prioritise Trout Cod awareness in educational activities by taking live Trout Cod to fishing shows which increases public awareness and fish identification skills. In addition, three fish entrainment extension workshops were held with extractive water users in the Macquarie and Lachlan Rivers. Development of a fish entrainment infographic (advisory material) was also produced to assist with these efforts.</p> |
| <ul style="list-style-type: none"> Install signs and / or interpretative displays at appropriate locations to assist in raising awareness of the identification and protected status of Trout Cod | <p>Ongoing: 55 Trout Cod identification signs have been erected throughout the Trout Cod Protection Area. Additional Trout Cod information signage has been placed in Trout Cod recovery stocking areas.</p> |

6.7.2 Enhance angler knowledge of Trout Cod identification, and the protected status of the species

- Install advisory signs which differentiate between Murray cod and Trout Cod at appropriate locations (such as re-introduction sites) Ongoing: 55 Trout Cod identification signs have been erected throughout the Trout Cod Protection Area. Additional Trout Cod information signage has been placed in Trout Cod recovery stocking areas.
- Develop and distribute (e.g. via Fishcare volunteers) advisory material specifically targeting anglers Ongoing. An information brochure detailing the ecology of Trout Cod, protected status and differentiation from Murray Cod has been produced for anglers since 2007 and was [updated in 2016](#).

6.7.3 Improve understanding about the traditional and cultural importance of Trout Cod to indigenous communities

- Continue to implement the NSW Indigenous Fisheries Strategy Initiated.
- Encourage and support the involvement of indigenous communities in implementing Trout Cod recovery actions Not started.

Assessment of Action Implementation

The vast majority of Trout Cod recovery actions have been initiated and are complete or ongoing. The incremental nature of threatened species recovery requires long term commitment and maintenance of conservation works. This is reflected in the large number of actions labelled as “ongoing” from the NSW Trout Cod Recovery Plan and reinforces the need for continued efforts to reach long term population viability for this iconic species.

National Recovery Plan: Two of the three actions outlined in the NSW Trout Cod Recovery Plan have been commenced and are ongoing under this section. The National Trout Cod Recovery plan expired in 2015. Development of an updated National Trout Cod Recovery Plan has not been initiated by the Commonwealth Government as of September 2016. Coordination of recovery efforts across jurisdictions has been hampered with the discontinuation of the National Trout Cod Recovery Team in 2008.

Habitat protection and restoration: All 12 actions outlined in the NSW Trout Cod Recovery Plan have been commenced and are ongoing under this section. The extent of implementation varies for these actions and critical work remains on most if not all habitat restoration and protection actions in order to recover Trout Cod to a significant portion of their historic range.

Enhance community understanding, involvement and support: 8 out of 9 actions outlined in the NSW Trout Cod Recovery Plan have been commenced and are ongoing under this section. Community awareness and support of Trout Cod recovery has increased significantly over the past ten years but work to improve angler identification and recognition of Trout Cod threats remain priorities for the future.

Research and monitoring: All 4 actions outlined in the NSW Trout Cod Recovery Plan have been commenced and are ongoing under this section. Understanding of Trout Cod ecology has made great strides in the past decade with a large number of research projects contributing useful information for recovery efforts including population modelling, habitat preferences, stocking approaches and habitat restoration effectiveness. However, conducting effective ongoing monitoring programs that allow quantitative comparison of restoration actions continues to be a challenge.

Establish new self-sustaining populations through stocking: All 8 actions outlined in the NSW Trout Cod Recovery Plan have been commenced and are ongoing under this section. Conservation stocking has played an integral role in Trout Cod recovery efforts and has shown

considerable success, particularly in the past 7 years as stocking has been concentrated at fewer locations with greater numbers of fingerlings.

Minimise risks from inter-specific competition and introduced species: All 4 actions outlined in the NSW Trout Cod Recovery Plan have been commenced and are ongoing under this section. Non-native fish interactions continue to have a negative impact on Trout Cod recovery. Research initiatives including the exploration of the Carp Virus CyHV-3 show promise for future pest fish management in the Murray-Darling Basin.

Reduce the impact of illegal fishing and incidental capture: All 6 actions outlined in the NSW Trout Cod Recovery Plan have been commenced and are ongoing under this section. Angler knowledge and adherence to Trout Cod fishing regulations continues to improve. However, recent angler reporting on tagged Murray Cod and Trout Cod from the Trout Cod Protection Area indicates that Trout Cod are mistaken as Murray Cod up to 30% of the time (Jarod Lyon personal communication). This has strong negative impacts for Trout Cod survivorship in this area as Trout Cod are likely being mistakenly harvested as Murray Cod in the size slot limit of 400-800 millimetres. Increased education and enforcement in NSW and Victoria is needed to improve this situation.

Achievement of Recovery Plan Objectives

The overall objective of the recovery plan is to restore natural viability of Trout Cod across its former range. Significant improvements in Trout Cod population size and distribution have occurred since 2006 and there is room for optimism for the recovery of the species. However, self-sustaining populations have only been established in a small percentage of the species' historic range indicating much work is still required before the overall objective of the NSW Trout Cod recovery plan can be achieved.

Focused efforts have led to the completion of many specific recovery plan objectives. For example, monitoring has documented downstream expansion of the remnant Trout Cod population in the mid Murray. Additionally, three new self-sustaining populations have been established through conservation stocking at selected locations across the species' historic range. Moreover, research has identified the largest threats to Trout Cod as well as improving our understanding of the species' ecological needs in order to mitigate these threats.

Additional work is needed in order to reduce fishing related mortality of Trout Cod by improving angler identification skills, particularly in the Trout Cod Protection Area where recent angler tag reporting indicates a relatively high percentage of misidentification. Recovery efforts may also benefit from ongoing education and engagement to inform recreational anglers and the wider community of the issues still facing Trout Cod. More outreach work is needed to explain their value in aquatic ecosystems which may help improve public desire to protect and enhance Trout Cod populations. Increased community awareness and education programs aimed at recognising primary threats for Trout Cod and strategies to overcome them will likely aid this work. Outreach efforts should include stakeholders in southern NSW and the Melbourne region of Victoria where the vast majority of anglers that fish in the Murray River Trout Cod Protection Area reside.

A relatively large percentage of recovery actions for Trout Cod have been driven by the National Recovery Plan. A comprehensive review of Trout Cod recovery efforts (Koehn et al. 2013), emphasised the need to review and redraft the expired National Recovery Plan and reinstate the National Trout Cod Recovery Team (disbanded in 2008). This action would help better focus national recovery efforts and expand funding opportunities for recovery actions. A national Trout Cod recovery team would also improve ongoing jurisdictional coordination that is required to ensure recovery of this endangered freshwater fish is achieved.

References

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