Review of the Silver Perch Recovery Plan

April 2017

Introduction

This document reviews the NSW Silver Perch (*Bidyanus bidyanus*) 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 Silver Perch Recovery Plan was finalised in 2006. The overall objective of the recovery plan is to prevent the extinction and ensure the recovery of Silver Perch populations in NSW. Specific objectives of the recovery plan are to:

- Increase awareness of the current status of Silver Perch throughout its range
- Increase scientific knowledge of the current distribution, ecological requirements, habitat preferences and population genetics of Silver Perch
- Protect and enhance remaining natural populations of Silver Perch
- Ameliorate the impacts of major threats to Silver Perch
- Minimise fishing impacts on natural Silver Perch populations through enhanced regulation and engagement of recreational fishers
- Improve management of aquaculture and stocking programs
- Encourage and support the involvement of indigenous communities with recovery actions
- Establish a program to monitor the status of Silver Perch and evaluate the effectiveness of recovery actions

The plan will be judged a long-term success in NSW if Silver Perch are delisted from Schedule 5 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

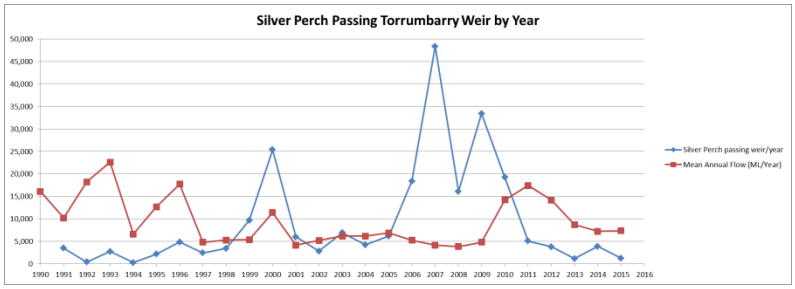
This statutory review of Silver Perch recovery actions has been undertaken in consultation with a range of managers and scientists and drew on several sources of information (e.g. Fisheries Scientific Committee's Annual Reviews of the threatened species lists, scientific papers, consultant reports, internal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

The recovery plan includes six program areas:

- Habitat protection and restoration
- Reducing impacts from illegal fishing and incidental capture
- Minimising risks from inter-specific competition and introduced species
- Minimising negative impacts to wild Silver Perch from stocking programs
- Research and monitoring
- Community awareness, involvement and support

Implementation details for each recovery action are outlined in Tables 1 - 6.

Table 1: Review of recovery actions – 1.1 Research and information needs

Recovery Action	Implementation Details
1.1.1 Collate existing information and conduct targeted sampling to identify the current distribution and abundance of Silver Perch, including the location of significant natural populations	
• Compile existing records of Silver Perch (both scientific and anecdotal) and map the species' current known distribution in NSW	Ongoing: Silver Perch are widely distributed throughout the Murray-Darling Basin (MDB) with detections in most major tributaries recorded since 2006. However, strong numbers of Silver Perch are concentrated in the lower Murray roughly overlapping with the Trout Cod Protection Area (TCPA) below the Yarrawonga Weir (Lintermans 2007). In 2016 an indicative distribution map of Silver Perch was produced based on scientific and public sightings data. These maps are available online as part of the publication "Fish communities and threatened species distributions of NSW".
• Continue to collect and collate data on Silver Perch using fishways such as that at Torrumbarry Weir	Ongoing: Weir monitoring is conducted in South Australia, Victoria and NSW in order to evaluate the "Sea to Hume Fishway Project". Annual Silver Perch passage at the Torrumbarry Weir (Lock 26) is variable from year to year. While annual weir passage numbers range widely, the information does suggest that the Silver Perch population in this portion of the basin is relatively stable and responds with a strong migratory pulse when biotic and abiotic conditions are suitable (2000, and 2006-2010). 
• Continue to collate data on the presence / absence of Silver Perch collected during incidental and formal surveys including the Sustainable Rivers Audit (SRA)	Ongoing: Silver Perch data is collected and maintained in accordance with standardised Sustainable Rivers Audit (SRA) protocols. Additionally, annual data summaries of Silver Perch captures from DPI programs are combined with other agency sampling efforts and are provided to the NSW Fisheries Scientific Committee each year.
• Develop a sampling protocol and conduct targeted sampling to identify the location of remaining natural populations of Silver Perch ensuring that genetic samples (fin clips) are collected from any captured Silver Perch to support Action 1.1.3	Ongoing: Basin wide sampling conducted in accordance with SRA protocols has been used to locate and describe remnant wild populations of Silver Perch in the Murray Darling Basin. Significant natural self-recruiting populations in NSW are believed to occur in parts of the upper Darling River Basin but the most significant self-sustaining Silver Perch population is located in the lower Murray between Torrumbarry and Euston weirs (Morris et al 2001, Koehn and Lintermans 2012).
• Conduct research to determine the status of identified remnant populations	Ongoing: SRA sampling and weir monitoring conducted under the Sea to Hume monitoring project indicate that Silver Perch populations in the Mid-Murray have increased in numbers since 2006. Expansion of this population into the Murrumbidgee and Darling catchments may be restricted by migration barriers at weirs in the lower reaches of both systems.
1.1.2 Encourage community reporting of Silver Perch through the Threatened, Protected and Pest Species Sighting Program	
• Ensure that the Threatened,	

Protected and Pest Species Sighting Program is widely promoted throughout the NSW section of the MDB, and encourage reporting of any sightings or accidental captures of Silver Perch in rivers	Ongoing: NSW DPI produces multiple threatened species advisory materials for distribution at Fisheries offices, on the internet and through event attendance such as the Sydney Boat Show and other outdoor recreation conferences. Information on reporting sightings is included in these documents and is also available on the NSW DPI webpages. Additionally, Fishcare Volunteers actively engage the community across NSW and emphasise aquatic conservation priorities based on relevant location. Silver Perch awareness and conservation training is included in these activities and is an ongoing community engagement focus within the Murray Darling Basin.
• Incorporate any information obtained from the public into the species database, available via the web, and use it to assist in mapping the current distribution of Silver Perch (Action 1.1.1)	Ongoing: Community reporting of Silver Perch sightings assisted with the development of an indicative distribution map for this species. Silver Perch sighting information is received via the Fisheries watch hotline (1800 043 536) and the online threatened species reporting form.
1.1.3 Conduct genetic research to establish the genetic variability within wild and stocked populations of Silver Perch in NSW and the origin of extant river populations	
• In collaboration with a university or other research institution, initiate a project to determine population genetic variation of Silver Perch in NSW	Ongoing: Genetic analysis of wild and hatchery populations of Silver Perch have shown that there is significantly higher genetic diversity in wild populations across the MDB than is present in cultured populations (Moore et al 2010). Further, there is evidence of weak genetic separation among specific Silver Perch populations in the MDB that should be considered in fish movement or stocking programs. Specifically, separation between the MDB and Paroo drainage Silver Perch populations should be observed. Evidence of genetic divergence is also present for wild Silver Perch in the Condamine and Maranoa Rivers of QLD as well as the Macintyre, Severn and Dumaresq Rivers in Northern NSW (Moore et al. 2010). However, there is little to no genetic separation for Silver Perch across the rest of the interconnected MDB.
• If possible, establish the origin (wild vs stocked) of identified remnant populations in rivers	Incomplete: Given the limited number of Silver Perch stocking events in NSW rivers it is likely that remnant populations in lowland regions are of wild origin. In contrast, remnant upland populations are almost certainly the result of dispersal of hatchery-bred fish from stocked impoundments, ie. in and adjacent to Wyangala Dam, Keepit Dam and Pindari Dam.
1.1.4 Support research into the habitat requirements and ecology of Silver Perch and key threats to wild populations	
• In collaboration with a university or other research institution, initiate a project (or projects) to investigate key areas of the biology and ecology of Silver Perch to provide information critical to the recovery program (e.g. migration, habitat requirements, factors critical to successful spawning and recruitment, interactions with introduced species, and environmental tolerances). This may include encouraging university students (honours or postgraduate) to undertake relevant projects	Ongoing: Several studies have helped to identify key Silver Perch life history requirements including river flow patterns (Hammer et al. 2013, King et al. 2009, 2010), thermal conditions (Koehn and Lintermans et al. 2012), habitat connectivity, fish passage and predation (Baumgartner 2007, Baumgartner and Boys 2012, Lintermans et al. 2013) and floodplain interaction (Jones et al. 2008). Additional studies have illuminated the genetic profile of Silver Perch in wild and hatchery populations (Moore et al. 2010) as well as the species susceptibility to disease (Becker et al. 2013). While additional work to understand early life history and recruitment for Silver Perch is needed, the general life history requirements for recovery of this species are known. However, considerable uncertainty exits about what flow regimes are best for Silver Perch recruitment. NSW DPI and the Arthur Rylah Institute (ARI) have partnered on a project in 2016 to explore age, growth and recruitment of Silver Perch in the mid Murray River to better inform management of environmental flows for this species. Implementation of findings detailing larval and egg drift through riverine water regulatory structures also shows promise for minimising negative impacts of water management infrastructure on native fish populations (Boys et al. 2016).
• Ensure priority is given to research in areas where relatively large, natural	Ongoing: King et al. 2007, 2009, 2010 undertook extensive pre and post monitoring of native fish (including Silver Perch in their largest known

populations currently exist, to enable identification of key features of these environments (e.g. key components of flow regimes) and the species' habitat requirements, including use of floodplain habitats	remnant population) responses to a large environmental flow (e.g. mid Murray 2005). The lessons from this study are being used to inform current environmental flow efforts as well as habitat restoration priorities across the MDB. Silver Perch are known to undertake large upstream migrations that are associated with spawning activity and thus require passage at instream structures like weirs and road crossings as well as environmental flow management across large (>100km) reaches to complete their life history (Mallen-Cooper and Zampatti 2015). Silver Perch also prefer faster flowing main-stem habitats and rely less upon large woody debris habitats when compared with other native species like Trout Cod and Murray Cod (Ellis et al. 2016).

Table 2: Review of recovery actions – 1.2 Habitat protection and restoration

Recovery Action	Implementation Details
1.2.1 Actively promote actions to ameliorate the impacts of altered river flows on Silver Perch, giving priority to areas in the vicinity of remnant natural populations	
• In consultation with aquatic ecologists, develop guidelines and principles to help determine the ecological needs of Silver Perch and flow levels required to complete their lifecycle, and distribute this information to water management committees and other relevant agencies	Ongoing: Various studies have investigated the response of Silver Perch to environmental flows. Work undertaken by King et al. (2007, 2009 and 2010) provide extensive pre and post monitoring of native fish responses to a managed environmental flow. The lessons from these studies are being used to inform current environmental flow efforts and habitat restoration priorities for native fish in the MDB. Silver Perch are a flow pulse specialist that is generally thought to require flow pulses to trigger migratory and spawning activity. Targeted environmental flow regimes have been proposed and are now being incorporated into MDB watering plans to benefit native species including Silver Perch (MDBA 2014, Ellis et al. 2016). Considerable uncertainty still exits about what flow regimes are best for Silver Perch recruitment. Starting in 2016 NSW DPI and the Arthur Rylah Institute (ARI) have partnered on a project to explore age, growth and recruitment of Silver Perch in the mid Murray to better inform management of environmental flows for this species. Environmental Water Requirements (EWRs) have been developed for native fish, including Silver Perch as part of the Fish and Flows projects (NSW DPI, 2015; Ellis et al., 2016). These EWRs are based on best available scientific literature, agency data and expert opinion to guide the development of water management plans which protect and enhance outcomes for Silver Perch. These reports and associated information have been shared with NSW DPI Water, NSW Office of Environment and Heritage (OEH), Murray Darling Basin Authority (MDBA), and the Commonwealth Environmental Water Office (CEWO).
• Continue to advocate (e.g. through environmental flows reference groups) increased allocation and improved management of environmental flows, particularly in areas known to support remnant natural populations and at critical phases of the life cycle, and reduced diversion volumes during the spawning and larval period	Ongoing: Early life stages of Silver Perch may access off-channel habitat during elevated flows, resulting in high growth rates and low mortality (Sharpe 2011, Ellis et al. 2015). As such, incorporating overbank flows into environmental flow regimes has been an ongoing objective for the Basin Watering Plan. See section 1.2.5 for details on specific environmental flows that have been undertaken to benefit Silver Perch populations across the MDB. 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, with specific Silver Perch outcomes focussing on expanding the range of current core populations and improving the range in additional locations (MDBA, 2014). Various planning processes

	are occurring as part of Basin Plan Implementation across the MDB, including the development of Long Term Environmental Watering Plans (LTEWPs) and Water Resource Plans (WRPs). These plans aim to improve water management across the MDB to enhance environmental, social and economic outcomes. Native fish objectives and targets, including those for Silver Perch, are being incorporated into these planning processes in partnership with lead agencies in NSW (DPI Water and OEH).
1.2.2 Continue to work on improving fish passage in the MDB, encouraging priority to be given to areas that support remnant Silver Perch populations	
• Continue to work on restoring fish passage in the MDB, for example through the Weir Review Program, Aquatic Habitat Rehabilitation Program and MDBC 'Lake Hume to the Sea' project	Ongoing: Completion of the Hume to Sea fish passage project in 2010 marked a major milestone for fish passage in the Murray River. Additionally, the Brewarrina fishway was completed in 2012 restoring fish passage to over 1,000 km of the Barwon and its tributaries. Fishways on the lower Lachlan at Booligal Weir and on the Edwards River at Stevens Weir opened 91 and114 km respectively addressing two of the highest priority barriers in the Murray-Riverina area in 2012. An additional 7 barriers, including 2 floodgates were remediated in the Murray River at this time. Together, these fish passage improvements opened a total of 1,356 km of river for migratory Silver Perch and other native species.
• Identify the most significant barriers to migration of Silver Perch on a Statewide basis and seek funding for capital works to provide fish passage at these sites	Ongoing: As noted above, a significant number of fish passage barriers for Silver Perch have been remediated since 2006. However, the need for construction of a fishway on the Menindee Main Weir (Darling River) to allow fish passage from the Murray catchment into the mid to upper Darling remains a priority. While there is evidence of increasing abundance of Silver Perch populations in the southern portion of their distribution in the mid to lower Murray River (Koehn and Lintermans 2012), the species remains rare upstream of the Menindee Main Weir in the Barwon-Darling catchment. Barriers in the lower Murrumbidgee River are also a restoration priority as they may be limiting migrations of Silver Perch into this major tributary as well.
• Work with councils and relevant government agencies to mitigate the effects of other barriers to fish passage (e.g. roads and culverts)	Ongoing: Local councils are required to comply 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 development that occurs in or around waterways in NSW.
1.2.3 Promote further investigation and action to address the impacts of cold water pollution	
• Encourage the development of a strategy for the MDB to address the need for variable level off-takes or alternative options for large dams where thermal pollution is a problem, including a priority list	Complete: The NSW Cold Water Pollution Strategy: Guidelines for managing cold water releases from high priority dams was produced in 2011. Nine dams in NSW were identified for targeted actions including: Blowering Dam, Hume Dam, Copeton Dam, Burrinjuck Dam, Burrendong Dam, Wyangala Dam, Keepit Dam, Khancoban Dam, and Pindari Dam. All of these reservoirs are within the historic range of Silver Perch.
• Encourage the development of a dedicated NSW Cold Water Pollution Reduction Program, including a program of works and funding options, for whole-of-government endorsement and action	Ongoing: Progress on cold water pollution mitigation in NSW is available in the NSW Cold Water Pollution Strategy: Report on the implementation of stage one. Major undertakings detailed in this report include the completion of a thermal offtake control curtain on Burrendong Dam and louvre control gates for Lake Keepit, both completed in 2015. These works have the potential to improve water release temperatures below the associated dams. However, lightning damage has decommissioned the trial thermal control curtain at Burrendong Dam highlighting the need for ongoing commitment to cold water mitigation in the MDB.
• Investigate the contribution of smaller impoundments (e.g. weir pools) to reductions in river temperatures, and low-cost options for their management	Complete: An Environmental Trust study (Preece 2003) assessed 3,000 dams and weirs in NSW, finding eight that caused severe cold water pollution, 14 that caused moderate impacts, and four that caused less severe impacts. Of these, nine were identified for targeted actions (Blowering Dam, Hume Dam,

	Copeton Dam, Burrinjuck Dam, Burrendong Dam, Wyangala Dam, Keepit Dam, Khancoban Dam, and Pindari Dam). All of these reservoirs are within the historic range of Silver Perch.
1.2.4 Ensure that management authorities carry out appropriate planning and impact assessment and make management decisions which minimise impacts on Silver Perch habitats	
• Ensure that councils, government agencies and other relevant organisations are aware of the location of important areas for Silver Perch, for example by providing maps of known and potential habitat and the location of significant populations	Ongoing: Information on threatened aquatic species distribution in NSW has been widely distributed through the available species' Primefacts and web based advisory materials. A new publication titled: Fish Communities and threatened species distributions in NSW was completed and made available for public distribution and disseminated in August 2016 and has been sent to council bodies state-wide (September 2016). Additionally, maps of NSW key fish habitat are available online at: http://www.dpi.nsw.gov.au/fishing/habitat/publications/pubs/key-fish-habitat-maps
• Provide other relevant information to support appropriate planning and impact assessment, e.g. Environmental Impact Assessment Guidelines	Ongoing: Detailed information on environmental planning procedures has been provided to stakeholders through the Policy and guidelines for fish habitat conservation and management, and the Policy and guidelines for fish friendly waterway crossings. Public stakeholders have also been provided with a guide for Living and Working on a Riverbank. Additionally, Primefacts about aquatic habitat protection have been circulated to councils and the public in hard copy and are available on the NSW DPI webpages.
• Negotiate with local councils and industry groups regarding the type and scale of development near key areas known to support significant remnant populations of Silver Perch	Ongoing: Local councils and developers 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.
• Negotiate with relevant authorities to encourage the identification, assessment and modification of natural resource management plans and policies to minimise impacts on stream flows, connectivity of habitats, riparian vegetation and water quality	Ongoing; NSW DPI Local Land Service (LLS) delivers best practice riparian management guidance using PROfarm training courses to inform agricultural producers how 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.
1.2.5 Encourage protection and rehabilitation of river reaches known to support important Silver Perch populations	
• Encourage community groups, relevant natural resource management agencies, local councils and landholders to protect and rehabilitate riparian vegetation and instream habitats along key river stretches where remnant Silver Perch populations are known to occur	The following project descriptions offer a cross section of activities completed for Silver Perch recovery but do not represent an exhaustive list of all actions taken during the lifetime of the recovery plan (Many works to improve general river health are not specified): 2006-2010 NSW DPI and partners secured external funding to reinstate more than 5,000 snags into the Murray, Darling, Barwon, Castlereagh, Lachlan and Namoi rivers. The NSW DPI Aquatic Habitat Rehabilitation Unit reconnected 869 km of waterways within Silver Perch habitat throught the consruction of fishways and achieved wetland management improvements on 48 farms totalling 1 million hectares of agricultural land. 2011: Work to achieve riparian restoration on the Namoi River engaged 13 individual landholders and numerous local contractors and community groups. As a result 455 hectares of riparian and aquatic revegetation was completed and 189 hectares of riparian habitat was protected. An additional, 1,104 hectares of riparian woody weed management was undertaken with these stakeholders. 2012: Fish Passage was restored on the lower Lachlan at Booligal Weir and on the Edwards River at Stevens Weir opened 91 and114 km respectively addressing two of the highest priority barriers in the Murray-Riverina area occupied by Silver Perch.

2013: Gwydir Valley 20,000 ML delivered in Mallowa Creek; 8,000 ML delivered in the Mehi River; 3,915 ML delivered in Carole Creek, and; 1,000 ML delivered in the Lower Gwydir/Gingham watercourses. These environmental flows assisted with the maintenance of instream habitat, and riparian vegetation restoration.

2014 season - Gwydir Valley 42,000 ML delivered to the Wetland systems; 13,000 ML delivered in the Mehi River, and; 5,000 ML delivered in Carole Creek. These environmental flows assisted with the maintenance of instream habitat and water quality.

2014: Installation of a Thermal Control Curtain for the mitigation of thermal pollution below Burrendong Dam (200 km of Macquarie River). Education and awareness of monitoring results presented to >100 stakeholders/anglers/water managers working within Silver Perch habitat.

2014: Removal of a barrier to fish passage on the Obley Weir reinstating fish access to 46 kilometres of the Little River. Fish passage signage was installed at two locations to aide public outreach and understanding of the works.

2014: Thirty five kilometres of riparian fencing installed to improve livestock and grazing management for the benefit of riparian habitat in the Barwon Darling catchment.

2014: Lachlan River - Environmental Flow Management
A total of 5,821ML of environmental water was deducted from Lachlan e-water accounts – the e-water event was formulated to provide opportunities for native fish. An unregulated flow event from the Boorowa River was embargoed and allowed to flow a full run-of-the-river past Booligal and into the lower wetlands allowing replenishment of core Cumbung Swamp areas. Interim larval sampling results indicate that breeding response post event were detected in a suite of native fish.

2014: Environmental Flow Management of 34+ GL in the regulated Macquarie Cudgegong plan area. Pre and post water delivery sampling was undertaken by DPI Fisheries. Otolith back-dating indicates an in-channel breeding response from Eel-tailed catfish (and other native fish species) occurred during the environmental flow release. At East, South & North Marsh a total of 28,498ML of additional environment water was delivered to maintain wetland and riparian vegetation.

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

2016: Macquarie River - 127 snags installed as 39 log complexes at 12 locations. In addition, 5 km of riparian zone was fenced. Explorative partnership meetings showcasing fish entrainment mitigation approaches were also held with extractive water users.

2016: Environmental flows conducted in the Lachlan, Macquarie, Murrumbidgee, Mid-Murray, Edward-Wakool, Gunbower Creek, Lower Murray, and Lower Darling Rivers for the maintenance of instream habitat, riparian habitat and to provide spawning ques for native fish.

Table 3: Review of recovery actions – 1.3 Introduced species and diseases

Recovery Action	Implementation Details
• **1.3.1 Feed information on the location of Silver Perch populations into State and national pest management programs**	
• Ensure the location of Silver Perch populations are considered during the development and implementation of pest eradication and control programs.	Ongoing: Information on threatened aquatic species distribution in NSW has been widely distributed using Primefacts and web based advisory materials. In August 2016 a new publication titled "Fish communities and threatened species distribution in NSW" was made publically available. This information is being provided to council bodies state-wide. Further, local councils are bound to 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 or actions that may have environmental impacts in or around NSW waterways.
1.3.2 Investigate the potential impacts of diseases on wild Silver Perch populations	
• In collaboration with a university or other research institution, initiate a project to investigate the occurrence of EHNV and other disease agents in wild populations of Silver Perch, and assess their potential impacts	Ongoing; Silver Perch display both mortality and potential carrier response to EHNV with up to 30% of juvenile Silver Perch succumbing to the disease in challenge trials (Becker et al. 2013). No studies have been conducted to assess the ecological impacts this disease may have on wild populations of Silver Perch.
1.3.3 Improve disease management protocols for aquaculture facilities to prevent transfer of disease agents to wild populations	
• Implement the Hatchery Quality Assurance Scheme to ensure that Silver Perch hatcheries and aquaculture facilities employ best practice health management programs to minimise the risk of diseased fish being sold, transferred or stocked into the wild	Complete: The Hatchery Quality Assurance Program was implemented in 2007 and is currently in its 6th revision, finalised in 2010. Additionally, in 2007 NSW DPI produced a manual titled Diagnosis, Treatment and Prevention for Diseases of the Australian Freshwater Fish Silver Perch to further reduce the risk of disease impacts in the NSW Silver Perch aquaculture industry.

Table 4: Review of recovery actions – 1.4 Fishing

Recovery Action	Implementation Details
1.4.1 Develop an education program for recreational fishers to improve awareness of the status of Silver Perch and increase compliance with fishing regulations	
• Produce information and materials for use by Fishcare volunteers	Complete, ongoing: Community awarness activities are carried out by Fisheries Education officers at outdoor industry events that assist the public with Silver Perch identification, angling regulations, and how to report sightings.
• Produce and distribute information brochures (Fishnotes) and other advisory materials to angling groups and other stakeholders, and make them available in NSW DPI offices and at appropriate functions (e.g. expos, public meetings)	Ongoing: NSW DPI produces threatened species advisory material for distribution at fisheries centres, on the internet and through event attendance such as the Sydney Boat Show and other outdoor recreation oriented conferences. Information targeting recreational anglers is widely distributed and available on the web including a Primefact on Silver Perch.
• Improve recreational fishers' compliance with fishing regulations in priority Silver Perch areas	Ongoing: Fishcare volunteers have actively engaged the community across NSW and emphasise aquatic conservation priorities that are relevant to the location where they are being delivered. Silver Perch awareness and conservation actions have been included in these efforts and are an ongoing focus for Fishcare Volunteer engangement within the MDB. This is particularly true in the remnant population of Silver Perch below Yarrowanga where compliance activities assist with protection for both Trout Cod and Silver Perch.
1.4.2 Improve understanding about the traditional and cultural importance of Silver Perch to indigenous communities	
• Continue to implement the NSW Indigenous Fisheries Strategy	Ongoing: NSW Fisheries continues to coordinate and implement the Indigenous Fisheries Strategy across NSW.

• Encourage and support the involvement of indigenous communities in implementing Silver Perch recovery actions	Ongoing: The latin name for Silver Perch (*Bidyanus bidyanus*) is derived from the aboriginal name for the species, Bidyan. Aboriginal comunities were consulted and provided input for the implementation of Silver Perch stocking efforts in the Namoi River.
1.4.3 Review and if necessary, amend the fishing regulations to reduce fishing impacts on Silver Perch	
• Review the impacts of fishing and current fishing regulations on Silver Perch to determine the need for any changes, e.g. a seasonal closure to protect spawning populations or restrictions on certain gear types	Ongoing: Targeted fishing for Silver Perch is prohibited in rivers and streams in the MDB. Any Silver Perch accidentally caught must be returned to the water with minimal harm. However, it is legal for anglers who comply with the recreational fishing rules to catch and keep Silver Perch from stocked impoundments and private dams. Harvesting Silver Perch grown in approved aquaculture facilities is also permitted. No changes to the current NSW Silver Perch management arrangements are proposed.

Table 5: Review of recovery actions – 1.5 Aquaculture and stocking

Recovery Action	Implementation Details
1.5.1 Improve the management of Silver Perch hatcheries and grow-out facilities to minimise the risk of genetic impacts on wild populations	
• Improve management of genetic stocks through the Hatchery Quality Assurance Scheme to ensure use of appropriate broodstock and tracking of sale of different genetic stocks	Ongoing: Genetic analysis of wild and hatchery populations of Silver Perch has shown significantly higher genetic diversity in wild populations across the MDB than is present in cultured populations (Moore et al. 2010). Further, there is evidence of genetic separation among specific Silver Perch populations in the MDB that should be considered in fish movement or stocking programs. Specifically, separation between Silver Perch populations in the MDB and Paroo drainage should be observed. Evidence of genetic divergence is also present for wild Silver Perch in the Condamine and Maranoa Rivers of QLD as well as the Macintyre, Severn and Dumaresq Rivers in Northern NSW (Moore et al. 2010). However, there is little to no genetic separation for Silver Perch across the rest of the interconnected Murray Darling Basin. This information should be considered and incorporated under the HQAS for Silver Perch aquaculture.
• Implement appropriate controls on Silver Perch farms at the development application stage to minimise the risk of fish escaping into the wild	Ongoing: Aquaculture guidelines under NSW Land Based Sustainable Aquaculture Strategy (2009) apply to Silver Perch to reduce risk or mitigate fish escape.
• Develop and implement approval processes for Silver Perch hatcheries that recognise different requirements and standards for production for aquaculture as opposed to stocking into the environment	Complete: All proposed freshwater fish stocking events must be assessed and approved under the NSW Freshwater Fish Stocking Management Strategy by NSW DPI Fisheries staff. HQAS accreditation for Silver Perch stocking in open waterways of NSW has only been granted to the NSW DPI Narrandera Fisheries Centre (NFC). No private hatcheries have been permitted to produce Silver Perch for use in stocking open waterways within NSW In order to safegaurd genetic stocks for this species.
1.5.2 Develop an education program targeting Silver Perch hatcheries to increase awareness of the threatened status of Silver Perch in the wild and encourage compliance with regulations and guidelines	
• Develop appropriate advisory	Ongoing: NSW DPI produces threatened species advisory materials for

materials (e.g. Primefacts)	distribution at fisheries centres, on the internet and through event attendance including Primefacts on Silver Perch, Fish in Farm Dams and a manual of best practices for aquaculture of Silver Perch. Information on threatened species reporting is included in these documents and is also available as an online form on the NSW DPI website. NSW DPI Aquaculture Management ensures these messages are distributed to the NSW aquaculture industry.
• Incorporate information on the threatened status of Silver Perch, and the steps that should be taken to reduce impacts on wild populations, in aquaculture advisory programs	Ongoing: HQAS accreditation for Silver Perch restocking waterways has only been granted to the NSW DPI Narrandera Fisheries Centre (NFC). No private hatcheries have been permitted to produce Silver Perch for use in stocking open waterways within NSW.
1.5.3 Implement the NSW Freshwater Fish Stocking Fishery Management Strategy to prevent significant impacts from stocking on wild (riverine) Silver Perch populations	
• Conduct research to determine the cumulative impacts of stocking on wild populations	Ongoing: Conservation stocking of Silver Perch into NSW rivers began in 2016. As such, no studies have been conducted as yet to determine the impacts these efforts have had on wild populations for this species.
• Review and assess stocking proposals to ensure no significant impacts on wild Silver Perch populations	Complete: All proposed freshwater fish stocking events must be assesed and approved unter the NSW Freshwater Fish Stocking Fishery Management Strategy by relevant NSW DPI Fisheries Managers.
1.5.4 Develop a conservation-stocking program using genetically appropriate broodstock and in compliance with the HQAP, broodstock collection policy, and NSW Freshwater Fish Stocking Fishery Management Strategy	
• Review genetics information from Action 1.1.3 to ensure genetically appropriate broodstock are collected for conservation-stocking	Ongoing: In 2015 Silver Perch broodstock were sourced from the mid-Murray population between the Yarrawonga and Torrumbarry weirs. Ten parental pairs were used to produce fingerlings for conservation stocking that began in 2016.
• Identify and assess appropriate conservation-stocking sites in accordance with stocking review guidelines in the NSW Freshwater Fish Stocking Fishery Management Strategy and having regard to the habitat requirements of the species and the requirements of this recovery plan	Ongoing: In 2016 Silver Perch fingerlings were approved for release at three prioritised locations in the Namoi River based on habitat conditions, the recently updated indicative distribution map for Silver Perch, and Aboriginal consultation. Approximately 15,000 fingerlings were released at Gunnedah, 15,000 at Boggabri and 20,000 at Narrabri. Silver Perch conservation stocking into the upper Namoi River will continue for at least four more years to meet a target of five years of conservation stocking at these sites.

Table 6: Review of recovery actions – 1.6 Evaluation

Recovery Action	Implementation Details
1.6.1 Establish ongoing monitoring of the status of Silver Perch and the effectiveness of recovery actions	
• Use the Sustainable Rivers Audit as a long term monitoring program to assess the ongoing status of Silver Perch in the MDB	Complete, ongoing: Sustainable Rivers Audit (SRA) monitoring is the protocol utilised for all freshwater monitoring efforts undertaken by NSW DPI researchers within the MDB. While the SRA has been suspended, the subsequent MDB Fish Survey monitoring project and associated state-based

	Basin Plan Environmental Outcomes Monitoring (BPEOM) project will continue to monitor the condition of native fish populations going forward.
• Complement Sustainable Rivers Audit monitoring with targeted monitoring and survey of the status of remnant wild populations and re-established populations resulting from conservation-stocking programs	Ongoing: Basin wide sampling conducted in accordance with SRA protocols has been effectively used to locate and describe remnant wild populations of Silver Perch in the Murray Darling Basin. Significant natural self-recruiting populations are only believed to occur in parts of the Barwon River and the lower Murray between Torrumbarry and Euston Weirs (Morris et al. 2001). Monitoring of conservation stocking of Silver Perch in the Namoi River is planned but has not commenced at the time of this review.

Assessment of Action Implementation

A majority of Silver Perch recovery actions identified in the plan have been initiated and are complete or ongoing. The nature of species recovery requires long term commitment to conservation works. This is reflected in the large number of actions labelled as “ongoing” and reinforces the need for continued efforts to reach long term population viability for Silver Perch in NSW.

Research and information needs: Ten out of eleven actions have been completed or are ongoing under this section of the recovery plan. Knowledge of Silver Perch ecology has made significant progress in the past decade as a number of research projects have contributed information to recovery efforts, including population modelling and distribution mapping, habitat preferences, environmental watering needs and the effectiveness of habitat restoration.

Habitat protection and restoration: All thirteen actions have been completed or are ongoing under this section of the recovery plan. The extent of implementation varies for these actions and critical work remains on most, if not all, habitat protection and restoration actions in order to recover Silver Perch populations across their historic range within NSW.

Introduced species and diseases: All three actions have been completed or are ongoing under this section of the recovery plan. Non-native fish interactions continue to have a negative impact on Silver Perch recovery. Research initiatives including the exploration of the Cyprinid Herpesvirus CyHV-3 show promise for future pest fish management in the MDB.

Fishing: Five out of six actions have been completed or are ongoing under this section of the recovery plan. Most significantly, Silver Perch catch is prohibited in NSW from rivers or streams in the MDB to conserve these wild populations.

Aquaculture and stocking: All nine actions have been completed or are ongoing under this section of the recovery plan. In 2016 the first Silver Perch conservation stocking in NSW was undertaken. A total of 50,000 fingerlings were released at three prioritised locations in the Namoi River (Gunnedah, Boggabri and Narrabri). Conservation stocking of Silver Perch in the Namoi River will continue for at least four more years to maximise the chances for population establishment and recovery in this catchment.

Achievement of Recovery Plan Objectives

The overall objective of the recovery plan is to prevent the extinction and ensure the recovery of Silver Perch populations in NSW. Significant improvements in Silver Perch population size and distribution have occurred since 2006. However, Silver Perch numbers are still extremely low in much of its historic range signifying that work is still required to fully accomplish the objectives of the NSW Silver Perch Recovery Plan.

Positive gains for Silver Perch include SRA and weir monitoring data that show increasing numbers of Silver Perch in the wild population, particularly in the Murray River (below Yarrawonga Weir). Recognition of this positive trend has helped prioritise fish passage

restoration in the lower Murrumbidgee and Darling rivers to allow upstream dispersal of these increasing wild stocks in NSW. Specifically, the need for the construction of a fishway on the Menindee Main Weir (Darling River) has been prioritised, which will allow unrestricted fish passage from the Murray River catchment into the mid to upper Darling River. Conservation stocking of Silver Perch into the Namoi River has also commenced and will continue to assist with recovery of this species in northern NSW.

Finally, recovery efforts will continue to benefit from ongoing education and engagement of recreational anglers and the wider community about the threats and issues still facing Silver Perch in NSW. Updated information and further outreach is needed to explain the value of this species to the inland aquatic ecosystems of NSW which may increase public support for Silver Perch conservation and overall riverine ecosystem health.

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