

Australian Capital Territory

Nature Conservation (Murray Cod) Native Species Conservation Plan 2017

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made under the

Nature Conservation Act 2014, s 122 (Draft native species conservation plan—final version and notification)

1 Name of instrument

This instrument is the *Nature Conservation (Murray Cod) Native Species Conservation Plan 2017*.

2 Commencement

This instrument commences on the day after its notification day.

3 Preparation of a Native Species Conservation Plan

Schedule 1 sets out the Native Species Conservation Plan prepared by me.

Annie Lane
Conservator of Flora and Fauna
06 October 2017



ACT
Government

NATIVE SPECIES CONSERVATION PLAN

MURRAY COD (*MACCULLOCHELLA PEELII*)



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1. INTRODUCTION

Murray Cod are endemic to the Murray–Darling Basin. In the ACT, Murray Cod are found in the Murrumbidgee River and parts of the Molonglo River, the Cotter River, the Gudgenby River and Ginninderra Creek. They are also stocked into five urban lakes and ponds.

The Murray Cod is the largest fresh water fish in Australia and is the apex predator¹ across its range. It is an iconic species in the Murray–Darling system and is culturally and environmentally important through its role in Aboriginal creation stories about the Murray River and in providing food and recreation through fishing.

Murray Cod is nationally listed as a threatened species under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act); however, it is fished for recreation in every jurisdiction in which it occurs, including the ACT.

This plan aims to provide for the protection and appropriate management of the Murray Cod under the *Nature Conservation Act 2014* (NC Act), while allowing for the continuation of sustainable recreational fishing of Murray Cod in the ACT.

1.1 CONSERVATION STATUS

1.1.1 National

Murray Cod was listed as a threatened (vulnerable) species under Part 13 of the EPBC Act in June 2003 and, as such, is a Matter of National Environmental Significance (MNES). Under section 18(4) of the EPBC Act, a person must not take an action that has, will have, or is likely to have, a ‘significant impact’² on a listed threatened species. If a person does take such an action they may be liable to prosecution for an offence under section 18A of the EPBC Act.

For vulnerable species under the EPBC Act, significant impact criteria³ relate to important populations or the species as a whole. The Murrumbidgee River Murray Cod population has been identified as an important population in the National Recovery Plan for the Murray Cod (the National Recovery Plan) (National Murray Cod Recovery Team 2010).

1.1.2 Regional (south-eastern Australia)

Murray Cod is listed as a threatened species in Victoria under section 10 of the *Flora and Fauna Guarantee Act 1988*. It is also listed under this Act as part of the listed threatened ecological community Lowland Riverine Fish Community of the Southern Murray Darling Basin. Recreational fishing of the Murray Cod is permitted in Victoria and is regulated under the *Fisheries Act 1995*.

Murray Cod is not listed as a threatened species under NSW legislation; however, it is included within the listing for the Lower Murray River aquatic ecological community, which is listed as an Endangered Ecological Community (EEC) under the NSW *Fisheries Management Act 1994*. The listing includes all native fish and aquatic invertebrates within all creeks, rivers and associated waterways of the regulated parts of the Murray River, including the Murrumbidgee downstream of Burrinjuck Dam. Recreational fishing of some species included in this listing (including Murray Cod) is permitted through regulations under the *Fisheries Management Act 1994*.

1.1.3 Local

Murray Cod are not listed as threatened under ACT legislation but they do receive special protection status under the NC Act as an EPBC Act listed species. Fishing of Murray Cod in the ACT is regulated under the *Fisheries Act 2000* (Fisheries Act).

1.2 POLICY CONTEXT

Murray Cod has special protection status in the ACT under part 5.1 of the NC Act. It is afforded this status because it is a listed threatened species under the EPBC Act. The Conservator for Flora and Fauna may make a native species conservation plan for a species that has special protection status. As described under Part 5.3 of the NC Act, a native species conservation plan details the appropriate management of the native species on stated land and may include provisions about carrying out an activity that would usually require a nature conservation licence. In this plan, stated land refers to all public waters in the ACT as defined under the Fisheries Act. A range of offences under Division 6.1.2 of the NC Act apply to native animals unless otherwise excepted.

This native species conservation plan will describe the conditions for the management of Murray Cod in stated waters in the ACT and for exception from committing an offence under certain provisions of chapter 6 of the NC Act.

Recreational fishing of Murray Cod in accordance with this plan will not constitute an offence in relation to killing (s 130), injuring or endangering (s 131) or taking (s 132) native animals and means a nature conservation licence is not required to undertake those activities. This plan does not provide exception to liability for offences relating to interfering with the nest of a native animal (s 128-129) or to offences relating to keeping, selling, importing or exporting a native animal (s 133-138).

The Fisheries Act is the primary legislation in the ACT for the management of recreational fishing and the commercial trade of fish. Part 3 of the Fisheries Act enables the Minister to set restrictions on recreational fishing in public waters through a disallowable instrument (Fisheries Prohibition and Declaration).

Part 8 of the Fisheries Act details the offences against provisions under that Act. Activities not specified in this plan may require a licence or constitute an offence under the Fisheries Act, including taking a fish for sale without a licence. Any fishing activity undertaken not in a way specified in this plan and/or an instrument under the Fisheries Act may constitute an offence under both the NC Act and the Fisheries Act.

The provisions for recreational fishing of Murray Cod in this plan are consistent with those in the Fisheries Prohibition and Declaration 2016 (No 1).

1.3 CURRENT AND EMERGING THREATS

Murray Cod was listed as threatened (vulnerable) under the EPBC Act on the basis of:

- » a significant decline in the Murray Cod population over the past 50 years
- » threats from continuing habitat degradation including loss of natural water flows, physical barriers to natural spawning migration and cold water pollution from dam releases
- » desnagging of rivers and streams removing woody in-stream structures that provide habitat
- » unsustainably low recruitment to the adult breeding population through past changes to core habitat
- » fragmentation of populations (TSSC 2003).

The National Recovery Plan lists several important populations of Murray Cod, including the Murrumbidgee River population (National Murray Cod Recovery Team 2010). This population is important because of its scale, size and integrity, its regional importance (near the upland limit of its distribution in the upper Murrumbidgee) and the quality of the fish community.

Threats to Murray Cod in the ACT include:

- » habitat loss and modification
- » barriers to fish movement
- » alteration and reduction of river flows
- » reduced water quality
- » alien fish species such as carp
- » illegal fishing.

Habitat degradation due to sedimentation is rated as the most severe threat to Murray Cod in the ACT (TAMS 2007).

Emerging threats to the species include a potential increase in recreational fishing pressure associated with residential development close to river corridors, and changes to habitat and the broader aquatic ecosystem due to climate change.

1.3.1 Sustainable fishing of a threatened species

The National Recovery Plan recognises that the species has “significant economic, cultural, recreational and environmental values” and states that the objective of the plan is to have self-sustaining populations of Murray Cod that are managed for both conservation and recreation.

The management objectives of this conservation plan are consistent with the National Recovery Plan.

The national Murray Cod Fishery Management Group has produced a draft Action Plan that aims to enhance Murray Cod recreational fisheries through collaboration in management and research between stakeholders (Murray Cod Fishery Management Group 2011).

The Fisheries Act, and similar legislation in other states, places restrictions on the recreational fishing of Murray Cod in order to maintain the sustainability and recovery of the species. In December 2016, ACT legislation that regulates the size limits for Murray Cod was amended to reflect current knowledge on sustainable fishing practices for the species, and to align with NSW and Victorian size regulations by introducing a “slot limit” indicating that you can catch Murray Cod that are within a specified minimum and maximum size range.

Angling mortality can be a localised risk to certain populations where heavy fishing activity occurs (National Murray Cod Recovery Team 2010) and overfishing (e.g. through organised events with multiple anglers) is recognised as a potential threat in the Commonwealth’s draft referral guidelines (Commonwealth of Australia 2016). These draft guidelines also recognise that “Individual recreational fishing activities following relevant state or territory regulations on fishing equipment, size and bag limits and closed seasons” have a low risk of significant impact to Murray Cod.

The ACT works with other jurisdictions to identify and fill knowledge gaps to improve the ecological and recreational fishing sustainability of Murray Cod populations.

1.4 OBJECTIVES AND ACTIONS

1.4.1 This management plan has six objectives, with six actions to implement the objectives.

Objective	Action
1: Maintain or improve passage for Murray Cod along rivers and streams throughout their range in the ACT.	1: Monitor the effectiveness of existing fishway modifications and investigate the feasibility of making changes to artificial barriers, including Point Hut Crossing, in order to improve fish passage.
2: Continue to improve in-stream habitat for Murray Cod within the ACT river system, including through improving riparian habitat and land condition in river corridors..	2a: Construct further habitat improvement structures in the Murrumbidgee River. 2b: Monitor the progress of action plans and strategies across Environment, Planning and Sustainable Development Directorate (EPSDD) involving riparian and river corridor restoration to inform the ongoing management of Murray Cod.
3: Increase knowledge of important habitat, movement, recruitment drivers, ecology, population structure and impact of water quality.	3: Support targeted research in the Murrumbidgee River to address key gaps in the knowledge of upland Murray Cod, including habitat association and identification of important habitat, breeding and larval ecology, genetics and population structure.
4: Increase public support for measures to enhance the conservation of Murray Cod and the maintenance of a viable recreational fishery.	4: Provide the community with access to adequate information to enable them to support the conservation of Murray Cod and the maintenance of a viable recreational fishery: <ul style="list-style-type: none"> » Review available information for currency and update to reflect any changes in legislation or knowledge. » Provide a link from EPSDD Fish webpage to information on the NSW DPI website on catch and release methods. http://www.dpi.nsw.gov.au/fishing/recreational/fishing-skills/catch-and-release » Update the Murray Cod information sheet.
5: Maintain a viable recreational Murray Cod fishery in rivers, urban lakes and ponds.	5a: Continue to enforce and educate the public on the fishing regulations relating to Murray Cod, including fishing in appropriate locations and within Murray Cod season and the set size and bag limits. 5b: Continue to stock urban lakes to maintain a recreational fishery and monitor stocked waterways to provide knowledge on the effectiveness of the stocking program.
6: Work with other jurisdictions to increase knowledge of the impact of the recreational fishery on Murray Cod in the ACT to enable more effective management.	6a: Address key knowledge gaps in angler behaviour towards Murray Cod including catch and release rates and the amount of illegal take (i.e. take that is not in line with Fisheries Act regulations). 6b: Support targeted research in the wild populations of Murray Cod on the fate of fish post release, recapture rates of fish and the impact of closed season and other regulations specific to Murray Cod.



2. MANAGEMENT

The major management objectives for Murray Cod in the ACT are to:

- » manage the species for conservation and provide adequate protection under the EPBC and NC Acts
- » manage the recreational fishing of Murray Cod so it is sustainable and viable in the long term and so conservation efforts are not compromised.

2.1 MANAGEMENT FOR CONSERVATION

The Aquatic Species and Riparian Zone Conservation Strategy (Aquatic Strategy) is the primary strategy related to the management and improvement of habitat for native fish in the ACT. The goals of the current strategy include the conservation of wild populations of aquatic and riparian native fauna and flora and the maintenance and rehabilitation of aquatic and riparian communities and habitats (TAMS 2007). This strategy is undergoing review in 2016–17; it is expected any revised actions and strategies related to native fish habitat conservation would continue to benefit the Murray Cod population.

The ACT Nature Conservation Strategy 2013–2023 recognises the importance of the river corridor landscape and improved catchment management. Outcomes of strategies and actions included in the Nature Conservation Strategy will assist in the conservation of native fish and their habitat in the ACT.

Conservation efforts for Murray Cod are aimed at reducing or mitigating threats and improving habitat through the objectives and actions detailed below.

2.1.1 Managing threats

OBJECTIVE 1: Maintain or improve passage for Murray Cod along rivers and streams throughout their range in the ACT.

Barriers to fish passage, such as weirs and river crossings for vehicles, pose a threat to native fish including Murray Cod as they limit the ability of the fish to move throughout their range. For example, a vertical slot fishway constructed on the Casuarina Sands weir on the Murrumbidgee River was found to be non-functional for passing fish, especially at lower flows when passage through the fishway would be more critical. A fishway designer assessed the fishway and determined design modifications to improve its function (EPD 2015).

These modifications were implemented in 2015. The road crossing at Point Hut has also been assessed as being a barrier to fish passage, including Murray Cod (Mallen Cooper 2012), and recommendations have been made about how to amend the crossing and improve fish passage. A project to model the likelihood of Murray Cod passage past natural barriers in the Murrumbidgee River (e.g. Red Rocks Gorge) has recently been completed (Dyer et al. 2014), but field verification is required.

ACTION 1: Monitor the effectiveness of existing fishway modifications and investigate the feasibility of making changes to artificial barriers including Point Hut Crossing in order to improve fish passage.

2.1.2 Managing habitat

One of the greatest threats to Murray Cod in the ACT is habitat degradation and loss. High levels of sediment in rivers can lead to the filling of larger holes that would otherwise provide important refuge habitat for large fish species such as Murray Cod (TAMS 2007). Investing in improving in-stream habitat for the species will help sustain populations and enhance management measures already in place.

OBJECTIVE 2: Continue to improve in-stream habitat for Murray Cod within the ACT river system, including through improving riparian habitat and land condition in river corridors.

Projects designed to improve native fish habitat, such as the construction of rock groynes (Lintermans 2004) and Engineered Log Jams (ELJs) in the Murrumbidgee River, benefit Murray Cod. The ELJs are designed to provide feeding habitat, shelter and improved access to breeding sites for native fish and cause the deepening of the channel to improve fish movement (EPD 2013). ELJs were constructed in the Murrumbidgee River, near Tharwa, through a section severely degraded by sediment accumulation (Lintermans 2004; EPD 2013). Monitoring has shown a significant increase in water depth around the ELJs and fish sampling has shown that Murray Cod are the dominant species, outnumbering carp in these areas (EPD 2015). It is important to follow on from the success of the Tharwa ELJs by constructing them in other areas as appropriate. Further funding has been obtained to build more ELJs downstream of the existing structures.

ACTION 2A: Construct further habitat improvement structures in the Murrumbidgee River.

The loss of, or damage to, riparian vegetation from current and historic land use activities within the catchment such as land clearing, erosion and urban development poses a threat (TAMS 2007) to Murray Cod through increasing the impacts of sedimentation and the loss of in-stream habitat. For example, much of the sedimentation in the Murrumbidgee River can be attributed to historical poor land management in the upper catchment (Starr 1995, TAMS 2007). Objectives and actions associated with the Aquatic Strategy and with the Nature Conservation Strategy aim to improve the quality of riparian vegetation and land condition in river corridors.

The Aquatic Strategy identifies the need to protect river corridor values in planning, to focus on weed and pest control in river corridors, and erect fencing to prevent uncontrolled stock access to aquatic and riparian zones.

Objectives of the Nature Conservation Strategy include the implementation of improved catchment management to support aquatic ecosystems and to monitor the Murrumbidgee–Cotter River system as one of the most sensitive ecosystems in the ACT. Monitoring will focus on fish within the ecosystem, including the Murray Cod. Where unexpected negative changes are observed, appropriate management responses will be implemented.

Progress on actions under the Nature Conservation Strategy will be reported through implementation plans under that strategy.

The 2014–15 Catchment Health Indicator Program (CHIP) report for the Upper Murrumbidgee Catchment included an assessment of riparian condition. The assessment looked at the functional characteristics of riverbank vegetation. The results of the assessment highlighted the poor condition of riparian vegetation in the catchment. The information gained from this, and future, riparian assessments can help identify issues and areas for improvement within river corridors and help focus remediation efforts (Upper Murrumbidgee Waterwatch 2015).

ACTION 2B: Monitor the progress of actions plans and strategies across EPSDD involving riparian and river corridor restoration to inform the ongoing management of Murray Cod.

2.1.3 Improving knowledge

In addition to current Murrumbidgee River fish monitoring activities, research is required where there are key gaps in the knowledge of upland Murray Cod. These gaps include habitat association and identification of important habitat, breeding movement and recruitment drivers, larval ecology, genetics and population structure.

OBJECTIVE 3: Increase knowledge of Murray Cod within the ACT, including of important habitat, movement, recruitment drivers, ecology, population structure and the impact of water quality.

In order to better protect and enhance important habitat for Murray Cod within the ACT, areas of key or important habitat need to be defined. Increasing knowledge in this area would also support an objective of the National Recovery Plan to broaden knowledge of the species across its range.

ACTION 3: Support targeted research in the Murrumbidgee River to address key gaps in the knowledge of upland Murray Cod, including habitat association and identification of important habitat, breeding and larval ecology, genetics and population structure.

The knowledge gained from this research will inform policy decisions on appropriate management of recreational fishing of Murray Cod in important habitat areas and allow targeted protection and/or enhancement of these areas if required.

2.2 MANAGING RECREATIONAL FISHING

A major objective of this conservation plan is to manage the recreational fishing of Murray Cod so it remains viable in the long term and is consistent with conservation efforts.

2.2.1 Community engagement

It is important to engage the community in sustaining the Murray Cod fishery. Informing the local community about the regulations that apply to recreational fishing is an important part of the management of the fishery.

OBJECTIVE 4: To increase public support for measures to enhance the conservation of Murray Cod and the maintenance of a viable recreational fishery.

Information about recreational fishing in the ACT is provided on the Environment, Planning and Sustainable Development Directorate's (EPSD Directorate) website. This includes a fact sheet, available in several languages, informing the community on its obligations under the Fisheries Act. The fact sheet outlines the waters in which fishing is allowed, provides information on protected, recreational and pest aquatic species, and information about bag limits, fishing seasons and gear restrictions for fish in the ACT. The fact sheets are also available at most fishing supply stores. Signage is erected at rivers to help anglers identify the type of fish they have caught and the appropriate action to take; for example, if a fish may be kept or must be returned to the water.

The recent ACT and Region Social Expectations of Waterways survey (Schirmer and Mylek 2016) reported that only 2% of anglers surveyed who caught Murray Cod kept and killed the fish, indicating a very high rate of catch and release. While the recreational fishing fact sheet includes some information on ethical fishing practices, including catch and release, further information on best practice catch and release applicable to the ACT recreational fishery is available on the NSW Department of Primary Industries (DPI) website. While best practice catch and release fishing should be encouraged and promoted, it should be noted that management actions need to take into account the fact that mortality can, and does, occur during catch and release fishing.

Providing up to date information about Murray Cod and its habitat, ecology and threats will increase the community's understanding of the importance of the protection measures, including fishing regulations, in place for the species.

ACTION 4: Provide the community with access to adequate information to enable them to support the conservation of Murray Cod and the maintenance of a viable recreational fishery:

- » Review available information for currency and update to reflect any changes in legislation or knowledge.
- » Provide a link from EPSDD Fish webpage to information on the NSW DPI website on catch and release methods. www.dpi.nsw.gov.au/fishing/recreational/fishing-skills/catch-and-release
- » Provide education to anglers on catch and release methods through workshops or other educational activities
- » Update the Murray Cod information sheet
- » Promote the use of citizen science applications among the angling community to encourage the contribution of catch information.

2.2.2 Regulation

Regulation of recreational fishing activity is key to the sustainable management of the fishery. Recreational fishing of Murray Cod is regulated through the Fisheries Act to ensure the species is not significantly impacted by fishing activities.

OBJECTIVE 5: Maintain a viable recreational Murray Cod fishery in rivers and urban lakes and ponds.

Part 3 of the Fisheries Act (sections 13–17) enables the Minister to set restrictions on recreational fishing in public waters by way of a disallowable instrument. This instrument may be used to prohibit the taking of fish at certain times or from certain waters and may also be used to declare the size of fish that may be taken (i.e. caught and kept) and the fishing gear used.

The Fisheries Prohibition and Declaration 2016 (No 1) (the current instrument at 1 December 2016) sets out the conditions by which Murray Cod may be caught in the ACT. These regulations are detailed below.

The taking of Murray Cod for personal (non-commercial) use in accordance with the Fisheries Prohibition and Declaration 2016 (No1) does not constitute an offence under ss. 130, 131 and 132 of the Nature Conservation Act. Fishing for commercial purposes, and other activities including the retail sale of Murray Cod, may still require a licence under the Fisheries and Nature Conservation Acts.



The regulations prohibit the taking of Murray Cod from public waters between midnight 31 August and midnight 30 November in any year in order to protect them from overfishing during the spawning season when mature breeding fish are often very aggressive, making them easier to catch (Lintermans 2002).

The taking of Murray Cod less than 55 cm or greater than 75 cm in length is prohibited. The introduction of a 75cm upper size limit aims to protect the larger breeding fish and reduce the number of years across their lifespan that they can be caught.

No more than two Murray Cod may be taken in any one day, except in the Murrumbidgee River. No more than one Murray Cod may be taken per day from parts of the Murrumbidgee River classified as open waters. Note that all fishing is prohibited in the Murrumbidgee River downstream of the concrete crossing at Angle Crossing to the junction with the Gudgenby River. Limiting the take of Murray Cod in the Murrumbidgee River provides additional protection to this important population.

In order to limit excessive take during recreational fishing activities and protect native fish, the declaration prescribes the type of fishing gear that may be used. In open waters including the Murrumbidgee and Molonglo rivers, no more than two rods or handlines with no more than two hooks per rod or handline may be used. In trout waters such as the Cotter River below Cotter Dam, only one rod may be used with no more than two artificial lures or flies. A landing net may also be used to catch a fish that is already hooked (ACT Government 2016). In addition, section 84 of the Fisheries Act prohibits the use of live finfish as bait to prevent the introduction of pest species.

Education in, compliance with, and enforcement of fishing regulations is vital in order to ensure the sustainability and viability of the Murray Cod fishery.

ACTION 5A: Continue to enforce and educate the public on the fishing regulations relating to Murray Cod, including fishing in appropriate locations and within the Murray Cod season and within the set size and bag limits.

2.2.3 Stocking urban lakes and ponds

Murray Cod are stocked into urban lakes and ponds in the ACT. The ACT Government, in conjunction with the National Capital Authority (NCA) and local fishing clubs, conducts an annual fish stocking program in accordance with the Fish Stocking Plan for the Australian Capital Territory 2015–2020 (EPD 2015a).

The Fish Stocking Plan provides a schedule of species to be stocked in each of the relevant water bodies as a planning tool for fisheries managers, recreational anglers and suppliers (EPD 2015a). Between 2011 and 2015, over 120,000 Murray Cod were stocked into Lake Ginninderra, Lake Tuggeranong, Lake Burley Griffin and Gungahlin and Yerrabi Ponds under the stocking program (EPD 2013, 2015, and 2015a). Fisheries management activities such as stocking are necessary to ensure viable recreational fishing opportunities for Canberra residents into the future.

The stocking of recreational fish species in Canberra's urban lakes may aid in the conservation of native species by providing a recreational fishing resource in lakes, thereby reducing fishing pressure on the more fragile rivers and streams in the ACT.

Stocking lakes also helps establish a balanced ecosystem in waters where fish may not be present or cannot reproduce to support a fishery (EPD 2015a). Stocked fish may also control nuisance species such as mosquitoes and pest fish including Redfin and carp. Management actions that remove or significantly reduce the number of pest fish in urban lakes and ponds may lead to changes to the ecosystems of those water bodies.

Fish stocking activities will take into account carp management activities and any probable impacts.

MONITORING

Conservation Research, within the EPSD Directorate has undertaken annual fish surveys, including for Murray Cod, since 2011 (EPD 2013; EPD 2015). Surveyed lakes include Yerrabi Pond, Gungahlin Pond, Lake Tuggeranong and Lake Ginninderra, with the occasional survey of Lake Burley Griffin (ACT Gov 2011). Monitoring of the fish communities provides data on the proportion of pest species, identifies growth and success of stocking events, identifies natural breeding events and allows for the detection of disease outbreaks and new pest species.

2011–13 surveys of urban lakes and ponds found that Murray Cod were present in all lakes where they were stocked. Large specimens (over 60 cm) were found in all lakes except Lake Tuggeranong. Monitoring shows that stocking is largely successful in maintaining a population of Murray Cod in urban lakes and ponds.

Fish kills in lakes and ponds occur from time to time and can result in the depletion of fish stocks including the Murray Cod. Ongoing monitoring aims to determine the impacts of events such as fish kills on the population and inform the stocking schedule accordingly.

It is important to monitor the impacts of pest management activities on native fish species and ecosystems and adapt management systems, such as fish stocking, accordingly.

ACTION 5B: Continue to stock urban lakes and ponds to maintain a recreational fishery and monitor stocked waterways to provide knowledge on the effectiveness of the stocking program.

IMPROVING KNOWLEDGE

OBJECTIVE 6: To increase knowledge of the impact of the recreational fishery on Murray Cod in the ACT to enable more effective fishery management.

While management measures are in place to sustain a recreational fishery and limit its impacts on Murray Cod, there is still relatively little known about the actual impacts of recreational fishing on the Murray Cod population locally. The National Stock Status Report, produced by the Fisheries Research and Development Corporation, includes a section on Murray Cod (Ye et al. 2014) and provides an overview of the stock status for Murray Cod across its range and individual jurisdictions.

Although the report provides an overview of the effects of recreational fishing on the species across its range, no information is provided on impacts to local populations.

ACTION 6A: Address key knowledge gaps in angler behaviour towards Murray Cod including harvest, catch and release rates and the amount of illegal take (i.e. take that is not in accordance with Fisheries Act requirements).

Regular surveys of recreational anglers to determine the number of Murray Cod caught, whether they were kept or released and the method of catch and release, along with the recording of instances of illegal take, will help to address these key knowledge gaps. Surveys such as the Survey of Recreational Fishing in NSW and the ACT (West et al, 2015), undertaken by the NSW Department of Primary Industries, and the ACT and Region Social Expectations of Waterways survey (Schirmer and Mylek 2016) undertaken as part of ACT Healthy Waterways, contribute valuable knowledge on recreational fishing in the ACT. Information gained from these surveys can be used to address these knowledge gaps.

However, surveys alone are not likely to provide sufficient information on post catch and release survival rates, recapture rates and the impact on wild fish populations of the closed season, illegal fishing and increased fishing participation.

ACTION 6B: Support targeted research into the wild populations of Murray Cod on the harvest rates, fate of fish post release, recapture rates of fish and the impact of recreational fishing activity, the closed season and other regulations specific to Murray Cod.

The National Recovery Plan identifies the Murrumbidgee River Murray Cod population as an important population within the context of the species' overall distribution. Although the current instrument prescribes a lower take limit for Murray Cod in the Murrumbidgee River, research into the impact of fishing activity on this population, and other wild populations, would support management actions and allow fisheries managers to make decisions on allowable take limits based on recorded impacts of angling on the species and allow fisheries managers to make decisions on allowable take limits based on recorded impacts of angling on the species.



3. IMPLEMENTATION, MONITORING AND REVIEW

The NC Act does not provide a statutory timeframe for the review of native species conservation plans. However, it is important to continue to monitor the effectiveness of management measures under this plan to ensure the objectives are met.

This conservation plan should be reviewed five years from the date of publication, taking into account the results of monitoring under the Murrumbidgee Fish Monitoring Program and the biennial monitoring program undertaken in lakes and ponds which occurs within this five year timeframe.

If monitoring indicates numbers have declined or that stocking of lakes and ponds has been unsuccessful and/or is not meeting the demand on the Murray Cod fishery, management objectives and actions will be reviewed to address these issues.

The plan should also be reviewed if changes are made to legislation affecting the management of the Murray Cod or to management priorities.

The review will provide an opportunity to assess progress, take account of developments in nature conservation and fisheries management knowledge, policy and administration, and review directions and priorities for future conservation action, including in the light of emerging threats related to climate change and any increase in fishing pressure.

Table 2 below includes indicators against each objective and associated action that serve to assist monitoring of the plan and guide management actions. An Implementation Plan is attached as an appendix to this plan.



3.1 OBJECTIVES, ACTIONS AND INDICATORS

Objective	Action	Indicator
1: Maintain or improve passage for Murray Cod along rivers and streams throughout their range in the ACT.	1: Monitor the effectiveness of existing fishway modifications and investigate the feasibility of making changes to artificial barriers, including Point Hut Crossing, in order to improve fish passage.	Fishway modifications are monitored and investigated and further modifications undertaken if feasible.
2: Continue to improve in-stream habitat for Murray Cod within the ACT river system, including through improving riparian habitat and land condition in river corridors.	<p>2a: Construct further habitat improvement structures in the Murrumbidgee River.</p> <p>2b: Monitor the progress of action plans and strategies across EPSDD involving riparian and river corridor restoration to inform the ongoing management of Murray Cod.</p>	<p>Further structures constructed</p> <p>Monitor progress on work reported in the Nature Conservation Strategy Implementation Reports relating to any benefits for Murray Cod.</p>
3: Increase knowledge of important habitat, movement, recruitment drivers, ecology, population structure and impact of water quality.	3: Support targeted research in the Murrumbidgee River to address key gaps in the knowledge of upland Murray Cod, including habitat association and identification of important habitat, breeding and larval ecology, genetics and population structure.	Support provided for research institutions for relevant research.
4: Increase public support for measures to enhance the conservation of Murray Cod and the maintenance of a viable recreational fishery.	<p>4: Provide the community with access to adequate information to enable them to support the conservation of Murray Cod and the maintenance of a viable recreational fishery:</p> <ul style="list-style-type: none"> » Review available information for currency and update to reflect any changes in legislation or knowledge. » Provide a link from EPSDD Fish webpage to information on the NSW DPI website on catch and release methods. www.dpi.nsw.gov.au/fishing/recreational/fishing-skills/catch-and-release » Update the Murray Cod information sheet. 	<p>Information sheets, signage and website updated to reflect new information/legislation amendments etc.</p> <p>Murray Cod information sheet updated and made publicly available.</p>

Objective	Action	Indicator
<p>5. Maintain a viable recreational Murray Cod fishery in rivers, urban lakes and ponds.</p>	<p>5a: Continue to enforce and educate the public on the fishing regulations relating to Murray Cod, including fishing in appropriate locations and within Murray Cod season and the set size and bag limits.</p> <p>5b: Continue to stock urban lakes to maintain a recreational fishery and monitor stocked waterways to provide knowledge on the effectiveness of the stocking program.</p>	<p>PCS will regularly liaise with recreational anglers and undertake enforcement actions where required.</p> <p>Monitoring indicates survival of stocked fish maintaining a viable Murray Cod recreational fishery in lakes and ponds.</p>
<p>6: Increase knowledge of the impact of the recreational fishery on Murray Cod in the ACT to enable more effective management.</p>	<p>6a: Address key knowledge gaps in angler behaviour towards Murray Cod including catch and release rates and the amount of illegal take (i.e. take that is not in line with Fisheries Act regulations).</p> <p>6b: Support targeted research in the wild populations of Murray Cod on harvest rates, the fate of fish post recreational fishing activity, release, recapture rates of fish and the impact of closed season and other regulations specific to Murray Cod.</p>	<p>Surveys undertaken by EPSDD at five yearly intervals and responses analysed and information gained from other relevant surveys used to inform knowledge of Murray Cod recreational fishery.</p> <p>Support provided to research institutions to undertake required research</p>





4. ADDITIONAL BACKGROUND INFORMATION

4.1 DESCRIPTION AND ECOLOGY

4.1.1 Description

The Murray Cod is the largest fresh water fish in Australia, growing up to 180 cm long and over 100 kg in weight (however, fish around 75 cm and 20 kg are more common). It is a heavy-bodied fish, with a light to dark green back mottled with dark green or black and a white to cream belly. Murray Cod are the top predator across their range, feeding on other fish, crustaceans and terrestrial prey such as birds, mice and reptiles (Lintermans 2007; National Murray Cod Recovery Team 2010).

4.1.2 Habitat across their range

Murray Cod are endemic to the Murray–Darling Basin, which includes waterways across Queensland, New South Wales, ACT, Victoria and South Australia.

Across this range Murray Cod occurs in a range of waters from smaller rocky rivers on the upland slopes (such as the ACT) to large slow moving rivers, lakes and billabongs in the inland plains. Within these areas they are usually associated with structural habitat such as large rocks, snags, woody habitat and undercut banks (National Murray Cod Recovery Team 2010).

4.2 DISTRIBUTION AND ABUNDANCE IN THE ACT AND REGION

Murray Cod were formerly widespread and abundant in the Murrumbidgee, Molonglo and lower Queanbeyan rivers (Lintermans 2002).

They are thought to have been an important animal to Aboriginal people of the area, both as a source of food and spiritually. Different Aboriginal groups are thought to have related to the cod in different ways but one creation story, attributed to the lower Murray region, tells of the Murray Cod as the creator of the river (Kearney and Kildea 2001). The cod were also an important food source for early European settlers, with their abundance recorded in several journals from the time (Rowland 1989).

Murray Cod were eliminated from the Molonglo River by heavy metal contamination from the Captains Flat mine and abundance has generally declined across rivers within the ACT and regionally. They have been recorded in the Murrumbidgee River as far upstream as Bredbo (these occurrences may be related to stocking upstream), in the Molonglo River below Kowen Forest, in the Queanbeyan River and in the Lower Paddys and Cotter rivers (Lintermans 2002).

Murray Cod have not been recorded in the smaller higher altitude rivers in the ACT including the Tidbinbilla (Rutzou et al. 1994), Orroral (Lintermans 2002), Naas or Gudgenby (Jones et al. 1990) rivers, or the Cotter River above the Cotter Dam wall (Lintermans and Rutzou 1990, Lintermans 2002).

The ACT Government and the NCA, in association with local fishing clubs, stocks Murray Cod in Lake Burley Griffin, Lake Ginninderra, Lake Tuggeranong, Gungahlin Pond and Yerrabi Pond in line with the Fish Stocking Plan for the ACT 2015–2020. Murray Cod recorded in the Molonglo River and Tuggeranong, Ginninderra and Jerrabomberra creeks are attributed to fish stocking programs but limited natural breeding is likely in the Molonglo (Lintermans 2002). Unsanctioned illegal stocking into smaller urban ponds is known to occur.

Murray Cod are also stocked in the Googong Reservoir and the Queanbeyan River by NSW DPI and Queanbeyan–Palerang Council.

4.3 THREATS

4.3.1 Habitat degradation

Habitat degradation and modification, such as the increased sedimentation of rivers and damage to and removal of riparian and in-stream vegetation, pose a threat to Murray Cod in the ACT.

SEDIMENTATION

Increased sediment load in rivers and streams can occur from current and historic land use practices, such as poor land management, extensive land clearing, industrial activity (sand mining), erosion and urban development, roads or construction sites and bushfires.



For example, the majority of sedimentation in the Murrumbidgee River is a result of historic floods and poor land management in the upper catchment. The 2003 Canberra bushfires resulted in a large amount of sediment being deposited into river systems. A reduction in the number of high-flow events in regulated rivers and streams contributes to sedimentation as high-flow events scour sediment from the river beds.

Sedimentation is ranked in the Aquatic Strategy as a highly significant threat to Murray Cod populations in the ACT because it damages aquatic habitat. High levels of sediment can decrease usable habitat areas by filling deep pools and holes and smothering breeding sites or juvenile habitat.

REMOVAL OF VEGETATION

Riparian vegetation acts as a buffer to activities taking place in catchment areas. For example, stream-side vegetation acts as a filter to sediment and pollutants and riverbank vegetation helps to prevent bank erosion. Riparian vegetation also provides in-stream habitat from fallen logs and woody debris while organic matter from vegetation provides nutrients into the river system and terrestrial invertebrates and vertebrates that form part of the food chain.

The loss of, or damage to, riparian vegetation from activities such as land clearing and development poses a moderate threat (TAMS 2007) to Murray Cod through increasing the impacts of sedimentation and the loss of habitat.

The removal of in-stream habitat such as snags, logs and branches results in a loss of resting habitat for larger fish and refuge for juvenile fish. Removal of large woody debris from streams and rivers is listed as a key threatening process under the NSW *Fisheries Management Act 1994*. Under section 146 of the NC Act it is an offence to take fallen native timber of greater than 10cm in diameter from unleased land.

4.3.2 Barriers to fish movement

Both natural and artificial barriers to fish movement occur in ACT rivers and streams. Barriers are a threat to native fish as they restrict movement required for activities such as breeding, maintenance of population diversity, and access to refuge areas for climate change drought and other extreme events.

Artificial barriers to Murray Cod movement on the Murrumbidgee River include the Casuarina Sands weir, Point Hut Crossing. The Tharwa sand slug is a natural barrier caused by sedimentation associated with historical land use in the catchment.

The Red Rocks Gorge and Gigerline Gorge pose partial natural barriers to seasonal upstream movement of Murray Cod under some flow conditions, however Murray cod are found upstream of both these barriers (TAMS 2007). These natural barriers are increased by reductions in flow caused by upstream water extraction such as Tantangara Dam.

A vertical slot fishway was incorporated into the Casuarina Sands weir when it was replaced in 2000. A survey of fish passage through the fishway indicated that modifications were required to effectively allow for the upstream passage of fish, particularly at low river levels (CPR 2015). These modifications were undertaken in 2015.

The Tharwa sand slug, a depositional area produced by sedimentation from upstream areas of clearing and erosion and in-stream bed movement, has resulted in a significantly reduced channel depth, posing a barrier to fish passage and smothering structural fish habitat in the area (CPR 2015). Engineered log jams (ELJs), which can provide fish habitat and increase channel depth, have been trialled near Tharwa and have proven to be quite successful. Further ELJs are being constructed in this area in 2017–18.

4.3.3 Alteration of river flows

Flow regulation has greatly altered the natural flow regime of rivers and played a significant role in the decline of Murray Cod nationally (National Murray Cod Recovery Team 2010). The construction of dams and weirs affects the quality of fish habitat through the alteration of natural flows and can also impact on water quality.

River regulation can also result in longer periods of low flow which can lessen water quality and habitat availability and quality (TAMS 2007). For example, a 30–43% flow reduction in the ACT portion of the Murrumbidgee River is a result of diversions by Tantangara Dam in the upper catchment (Lintermans 2002).

In the ACT, Scrivener Dam poses a potential threat to Murray Cod as it has three sluice gates that release water from the bottom of the dam. Murray Cod juveniles caught in water releases from undershot weirs experience rapid pressure change that can be lethal (Commonwealth of Australia 2016).

4.3.4 Reduced water quality

Raised or lowered water temperatures, reduced levels of dissolved oxygen, higher concentrations of nutrients and environmental contaminants can all impact water quality and affect fish. For example, cold water released from dams can affect spawning behaviour of native fish, including Murray Cod, and high levels of contaminants can lead to fish kills, such as the incidence of heavy metal poisoning in the Molonglo River near Captains Flat, which led to the local extinction of the species in that river (Lintermans 2002). Fish kills have also occurred recently in Yerrabi Pond, Lake Tuggeranong and Lake Ginninderra; however Murray Cod populations still exist in these water bodies.

Murray Cod populations may also be under threat from other factors such as endocrine disrupting chemicals known generally to impact fish (TAMS 2007). The Molonglo Water Quality Control Centre may be a source of such chemicals into the lower Molonglo River, although there is little data at present to indicate levels of these chemicals and whether fish in the area are impacted.

4.3.5 Alien fish species

In 2015 surveys were taken of the Murrumbidgee River fish population as part of the biennial Murrumbidgee Fish Monitoring Program (undertaken by EPSDD Conservation and Research). The survey found that carp were present at all nine survey sites and that Redfin were also present at some sites. Fish populations in Canberra's urban lakes and ponds are also monitored with results showing the presence of carp, Redfin and goldfish in these water bodies.

The possible impacts to native fish, including Murray Cod, from alien fish species include predation, reduced water quality, habitat degradation through loss of aquatic macrophytes and the spread of disease and parasites. It can be difficult to separate these impacts from other threatening processes, so it is difficult to determine the specific impact of alien species. There is, however, a general correlation between high numbers of alien fish species and low numbers of native fish (National Murray Cod Recovery Team 2010).

Carp comprise the majority of fish biomass throughout the Murray Darling Basin and within some water bodies in the ACT and may compete with Murray Cod for habitat space and food at some age classes. Murray Cod are known to prey on juvenile carp (Koehn 2005).

The main known threats posed to Murray Cod by alien fish species in ACT river systems are predation of juveniles, particularly by Redfin, increased competition for food and habitat, and the introduction of diseases or parasites into the population (TAMS 2007).

4.3.6 Recreational fishing

Recreational angling is stated to be a low threat to Murray Cod populations in the upper Murrumbidgee catchment (TAMS 2007), that is, it is unlikely by itself to result in significantly reduced populations or extinction. Similarly, “the legal catch of a recreational angler is unlikely to constitute a significant impact on the Murray Cod” in relation to the listing of Murray Cod under the EPBC Act (McKelleher (2005)). It can however, result in fewer large, mature brood fish in the population, as larger fish are often targeted by anglers and fishing events involving large numbers of anglers or areas that are heavily fished can impact certain populations. Recent changes to ACT fishing regulations include a slot limit prescribing a minimum and maximum size limit for Murray Cod. The new maximum size limit should lead to an increase in numbers of larger breeding adults. The reduction of the bag limit to one fish per day in the Murrumbidgee River will also help to increase cod numbers.

The National Recreational and Indigenous Fishing Survey conducted from March 2000 to April 2001 provided the first comprehensive estimate of the recreational catch of Murray Cod within the Murray–Darling Basin (MDB; Park et al. 2005). In the ACT it was estimated that 607 Murray Cod were caught during the survey period (0.13% of the total MDB catch of Murray Cod) and that all fish were released. More recently, NSW DPI completed the Survey of Recreational Fishing in New South Wales and the ACT, 2013/14. This survey showed that the ACT recreational fishery accounted for around 1% of cod caught across ACT and NSW and that, across NSW and the ACT, a large percentage (87%) of Murray Cod caught were released (DPI 2015). The recent ACT and Region Social Expectations of Waterways survey (undertaken as part of ACT Healthy Waterways) reported that 53% of anglers target Murray Cod, almost 30% of anglers caught a Murray Cod and, of those who caught them, only 2% of anglers killed a Murray Cod.

Studies undertaken by NSW and Victorian Government agencies on catch and release fishing have shown varying mortality rates of between 15% (NSW) and 2% (Vic). The studies were undertaken under different circumstances and different conditions, but both found that post release mortality was influenced by handling of fish and the conditions they are kept in prior to release.

4.3.7 Emerging threats

The growing population of the ACT and surrounding area may result in increased numbers of recreational anglers, leading to pressure on the Murray Cod population. In particular, the encroachment of new housing developments on river corridors and increasing fishing pressure from its population may pose a threat. For example, the proposed Riverview residential development at West Belconnen may facilitate increased public access to the Murrumbidgee River corridor, including for recreational fishing, and urban development upstream has the potential to impact the river through changes to hydrology and erosion and sedimentation risks.

Options to reduce impacts near rivers are being considered as part of the development proposal for this area (TRC 2015). In order to address the likely increased pressure on the Murray Cod population arising from improved access to the river corridor, the implementation of a Sustainable Fisheries Plan for the development including measures such as angler

education and a catch and release Murray Cod fishery have been proposed.

Climate change is likely to impact aquatic ecosystems across the country. In cooler climate areas such as the ACT, climate change may result in higher water temperatures and a higher chance of summer storms. Murray Cod are sensitive to temperature, which is thought to play a role in determining when they spawn. The ideal spawning temperature appears to be around 20 degrees Celsius, so changing temperatures could lead to changes in spawning activity and timing (MDBA 2011). Murray Cod are also susceptible to temperature stress; longer periods of high temperatures in summer could lead to fish kills.

Warmer waters may also be more conducive to breeding for pest species, leading to greater competition. There is also the possibility of less water in the river system and alterations to flow regimes, which could lead to fewer areas of ideal habitat and impacts to larvae dispersal (MDBA 2011).

The extraction of water for domestic consumption from rivers is a growing threat in the ACT. While Angle Crossing and Casuarina Sands have been designed not to impinge on larvae or juvenile fish, several other extractions exist which may have an impact.

4.4 LINKS TO OTHER PLANS AND STRATEGIES

ACT Aquatic Species and Riparian Zone Conservation Strategy (Action Plan 29)

This plan is in line with the following management goal expressed in this strategy “Recreational fishing in the ACT is managed so as to provide a satisfying and sustainable recreational experience, and to protect threatened, uncommon and declining species.”

ACT Nature Conservation Strategy 2013-2023

The following strategies in the Nature Conservation Strategy (NCS) relate to the conservation of native fish and their habitat in the ACT.

Strategy 2:

Manage threats to biodiversity. Action 5 of this strategy is to implement improved catchment management to support aquatic ecosystems – this action includes that the ACT will continue to manage catchments, with the aim of maintaining or improving the condition of aquatic ecosystems under a changing climate.

This includes the development of projects that increase habitat for in-stream biodiversity. Actions under this strategy may serve to improve and increase habitat for the Murray Cod.

Strategy 3:

Protect species and ecological communities. Action 5 of this strategy is to monitor five priority ecosystems across the ACT. The Murrumbidgee-Cotter River system will be monitored as one of the most sensitive ecosystems in the ACT. Monitoring will focus on fish within the ecosystem, including the Murray Cod.

The strategy also has a focus on restoring the ACT's focal landscapes. The river corridor is identified as a focal landscape in the strategy and the strategy aims to maintain water quality and flows, and protect and restore riparian vegetation.

National Recovery Plan for the Murray Cod

The long term objective of the National Recovery Plan is to have self-sustaining Murray Cod populations, managed for conservation, fishing and culture. Specific objectives under this plan include:

- » determine the distribution, structure and dynamics of the Murray Cod populations across the Murray-Darling Basin
- » manage flows to enhance recruitment
- » determine habitat requirements of Murray Cod for certain life stages and populations
- » manage recreational fishery for Murray Cod in a sustainable manner while recognising the social economic and recreational value of the fishery.

The objectives of this conservation plan mirror those of the National Recovery Plan but at a local (ACT) scale. Knowledge gained under objectives of this plan may assist to meet some of the objectives of the National Recovery Plan.





5. APPENDIX A

5.1 IMPLEMENTATION TABLE

In this table:

- » EPSDD refers to the Environment, Planning and Sustainable Development Directorate
- » CRU refers to the Conservation Research Unit in EPSDD
- » PCS refers to the Parks and Conservation Service in EPSDD
- » NCP refers to the Nature Conservation Policy unit in EPSDD

Action/strategy	Indicator	Implementation responsibility	Timing
OBJECTIVE 1: MAINTAIN OR IMPROVE PASSAGE FOR MURRAY COD ALONG RIVERS AND STREAMS THROUGHOUT THEIR RANGE IN THE ACT.			
1: Monitor the effectiveness of existing fishway modifications and investigate the feasibility of making changes to artificial barriers including Point Hut Crossing in order to improve fish passage.	Fishway modifications are monitored and investigated and further modifications undertaken if feasible.	CRU	2017–21
OBJECTIVE 2: CONTINUE TO IMPROVE IN-STREAM HABITAT FOR MURRAY COD WITHIN THE ACT RIVER SYSTEM.			
2b. Consider how the progress of actions plans and strategies across EPSDD involving riparian and river corridor restoration have benefited the Murray Cod.	Further structures constructed	2a. CRU, PCS	2017–18
2a: Construct further habitat improvement structures in the Tharwa section of the Murrumbidgee River.	Monitor progress on work reported in the Nature Conservation Strategy Implementation Reports relating to any benefits for Murray Cod.	2b. NCP to monitor and review progress	Ongoing
OBJECTIVE 3: INCREASE KNOWLEDGE OF IMPORTANT HABITAT, MOVEMENT, RECRUITMENT DRIVERS, ECOLOGY, POPULATION STRUCTURE AND IMPACT OF WATER QUALITY FOR MURRAY COD WITHIN THE ACT.			
3: Support targeted research in the Murrumbidgee River to address key gaps in the knowledge of upland Murray Cod, including habitat association and identification of important habitat, breeding and larval ecology, genetics and population structure.	Support provided for research institutions for relevant research.	CRU, NCP	Ongoing

Action/strategy	Indicator	Implementation responsibility	Timing
OBJECTIVE 4. TO INCREASE PUBLIC SUPPORT FOR MEASURES TO ENHANCE THE CONSERVATION OF MURRAY COD AND THE MAINTENANCE OF A VIABLE RECREATIONAL FISHERY.			
4: Provide the community with access to adequate information to enable them to support the conservation of Murray Cod and the maintenance of a viable recreational fishery by:	4. Information sheets, signage and web site updated to reflect new information/legislation amendments etc.	NCP with input from CRU as appropriate.	2017-18
i. Reviewing available information for currency and update to reflect any changes in legislation or knowledge, and	Murray Cod information sheet developed and made publically available.	PCS raise awareness amongst anglers of the relevant information and regulations through their interactions and through the erection of signage.	Ongoing
ii. Providing a link from EPSDD Fish web page to information on the NSW Department of Primary Industry web site on catch and release methods. http://www.dpi.nsw.gov.au/fishing/recreational/fishing-skills/catch-and-release			
iii. Development of a Murray Cod information sheet.			
OBJECTIVE 5. TO MAINTAIN A VIABLE RECREATIONAL MURRAY COD FISHERY IN RIVERS, URBAN LAKES AND PONDS.			
5a. Continue to enforce and educate the public on the fishing regulations relating to Murray Cod, including fishing in appropriate locations and within Murray Cod season and the set size and bag limits.	5a. Fishers are educated on fishing rules and regulation of illegal fishing is undertaken.	5a: Conservation Officers (PCS, EPA)	Ongoing
5b. Continue to stock urban lakes to maintain a recreational fishery and monitor stocked waterways to provide knowledge on the effectiveness of the stocking program.	5b. Monitoring indicates that stocking activities are assisting to maintain a viable Murray Cod recreational fishery in lakes and ponds.	5b: CRU	Ongoing
OBJECTIVE 6. TO WORK WITH OTHER JURISDICTIONS TO INCREASE KNOWLEDGE OF THE IMPACT OF THE RECREATIONAL FISHERY ON MURRAY COD IN THE ACT TO ENABLE MORE EFFECTIVE MANAGEMENT.			
6a. Address key knowledge gaps in angler behaviour towards Murray Cod including catch and release rates and the amount of illegal take (i.e. take not in line with Fisheries Act regulations).	6a. Surveys undertaken by EPSDD at 5 yearly intervals and responses analysed and information gained from other relevant surveys used to inform knowledge of Murray Cod recreational fishery.	6a. NCP undertakes surveys and analysis of survey results to inform policy. Supported by PCS field observations.	Initial survey 2018 Murray Cod season (Dec 17 –Aug 18) Ongoing every 5 years
6b. Support targeted research in the wild populations of Murray Cod on the fate of fish post release, recapture rates of fish and the impact of closed season and other regulations specific to Murray Cod.	6b. Support provided to research institutions to undertake required research	6b. CRU and NCP provide funding and other support.	Ongoing

6. REFERENCES AND FOOTNOTES

6.1 REFERENCES

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6.2 FOOTNOTES

- 1 An apex predator is the predator at the top of the food chain.
- 2 The definition of 'significant impact' and criteria for assessing whether an action will have a significant impact on a listed vulnerable species are provided in Australian Government Department of Environment guidelines (Commonwealth 2013; www.environment.gov.au/resource/significant-impact-guidelines-11-matters-national-environmental-significance)
- 3 See footnote 2.

