

Recovering native fish in Gunbower Creek and the lower Loddon River

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Key Points

- Native fish populations and diversity have declined substantially since river regulation
- Native fish recovery through integrated action
- Combined environmental and consumptive flows produce ecological benefits in regulated systems without compromising consumptive uses
- Monitoring fish before during and after flows will, in the longer term, indicate the success of the NFRP and the approach to flows, with early signs being positive
- Strong stakeholder partnerships are critical in ensuring complex projects are successfully delivered

Abstract

Of the 22 native fish species that were historically present in the Gunbower Creek and lower Loddon River system, only 13 are still present and nine are considered locally extinct. Iconic species such as Murray cod are still present but have significantly declined in number. The key threats to fish are blocked migrations, changes to flow regime, entrainment in irrigation channels, loss and degradation of habitat and impacts from invasive species.

North Central Catchment Management Authority's (CMA) *Native Fish Recovery Plan - Gunbower and lower Loddon* (NFRP) aims to reinstate the three components critical to fish survival and recovery: flow, habitat and connectivity. Works include re-snagging in Pyramid Creek, provision of preferred flows using consumptive water *en-route*, barrier removal and installation of fish screens. The plan is delivered collaboratively with a range of community and institutional stakeholders.

The North Central CMA, Victorian Environmental Water Holder and Goulburn Murray Water collaborate to deliver the 'flow' component of the NFRP. Environmental and consumptive water is managed to optimise ecological outcomes without impacting on irrigators' needs. The major successes include provision of spawning and recruitment flows for Murray cod in Gunbower Creek and attractant flows encouraging fish movement through the Loddon River, Pyramid Creek and Kow Swamp. The partnership between the organisations is the foundation of the success of environmental flows in the project area.

Keywords

- Native fish; fish migration; habitat reinstatement; environmental flows; fish passage; regulated waterways

Introduction

Murray cod (*Maccullochella peelii*), trout cod (*Maccullochella macquariensis*), golden perch (*Macquaria ambigua*) and silver perch (*Bidyanus bidyanus*) were once very abundant in north-central Victorian waterways. Large numbers of Murray cod greater than one meter in length and weighing upwards of 50 kg were regularly caught in Gunbower, Pyramid and Barr creeks and the Loddon and Murray rivers (Trueman, 2012).

The 350 kms of waterways that snake through the region are currently managed wholly for irrigation water delivery through a system of weirs and channels. These waterways have little or no flows when there is no irrigation demand. This has contributed to declining native fish populations and the loss of some species through the Murray-Darling Basin. Nine of 22 species of native fish have disappeared from this part of the Murray-Darling system since regulation, including channel species such as Macquarie perch (*Macquaria australasica*) and river blackfish (*Gadopsis marmoratus*), and small-bodied wetland specialist species such as olive perchlet (*Ambassis agassizii*), southern pygmy perch (*Nannoperca australis*) and purple spotted gudgeon (*Mogurnda adspersa*). (Mallen-Cooper et al. 2014).

The North Central CMA's Native Fish Recovery Plan – Gunbower and Lower Loddon (NFRP) was developed in partnership with some of Australia's leading fish ecologists in response to this decline. It is an ambitious, long term (10+ years) and large-scale plan that aims to enhance native fish populations in almost 350 kms of waterways in northern Victoria. Specifically, the plan includes actions to improve connectivity, flows and habitat and manage threats. The plan encompasses Gunbower Creek, Taylors Creek, Box-Pyramid Creek, Barr Creek, the lower Loddon River and the Little Murray River, along with the wetlands and lagoons associated with these waterways such as Kow Swamp (Figure 1).

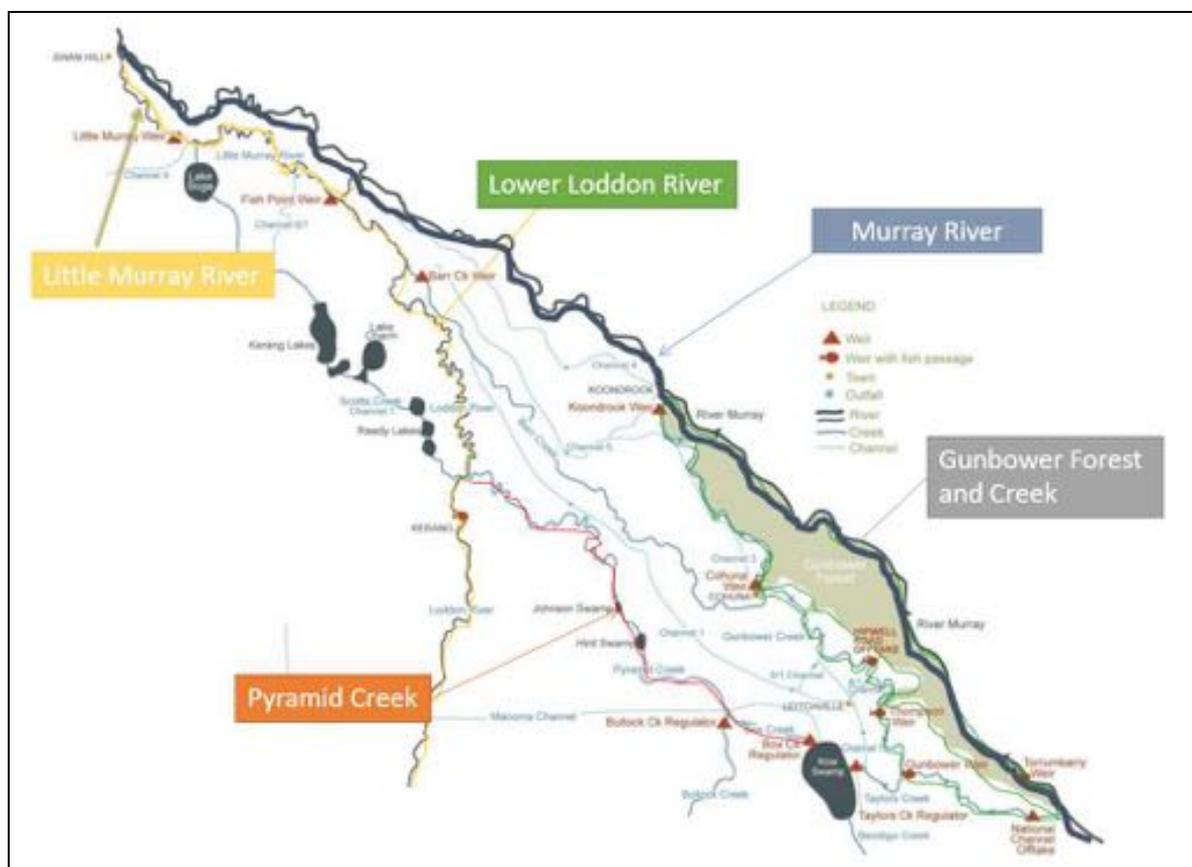


Figure 1. Map showing waterways in the Native Fish Recovery Plan area

Native fish recovery – Gunbower and Loddon

Unlike many other river health plans, the NFRP is focused entirely within an irrigation area, meaning we work with the irrigation sector to achieve positive outcomes for both agriculture and ecosystems. By using environmental water, flows can be delivered in conjunction with irrigation flows to make them more fish-friendly (less extreme daily/hourly fluctuations in water levels) and deliver flows in the irrigation off season (May – August) when naturally waterways would experience high flows. Waterways within the NFRP area are

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mostly anabranches of the Murray River, so environmental flows delivered for fish are then returned to the Murray River for downstream consumptive use, making every drop count twice.

What also makes this project different is its integrated nature. There is little value in delivering environmental flows for fish if there is no habitat for them, or they are obstructed from moving to breeding areas. So in conjunction with improved flow management, a real difference can be made to native fish populations by

- increasing the amount of habitat available instream for fish to rest, feed and breed
- excluding stock and replanting native trees to protect river banks and reduce erosion
- addressing barriers that prevent fish movement and migration and
- addressing threats such as exotic fish and entrainment of fish into unscreened irrigation channels and pumps.

Components of the plan

Habitat reinstatement

Channelisation and snag removal increased hydraulic efficiency but reduced the availability and variability of instream habitat. The reinstatement of snags provides habitat elements for fish to rest, feed and breed. Over the past three years upwards of 40 snag piles and fish 'hotels' have been installed in Pyramid Creek and the lower Loddon River. Fifty-seven additional structures are planned for installation in the lower Loddon and Little Murray rivers this financial year.

In addition to reinstating instream habitat, waterways in the plan area have been fenced and stock excluded. To the end of the 2017-18 financial year, outputs from this component of the plan are

- 13 km fencing
- 3 off stream watering systems
- 20 ha of woody weed removal
- 10 ha of revegetation

These activities combine to improve water quality, reduce erosional impacts and contamination from stock access to the waterways and enhance the quality of riparian ecosystems.

Deep pools and bathymetric variability have declined over many years, not only through the intervention of irrigation, but also through the erosion and sedimentation caused by land clearing and reduced river roughness. One approach to reinstating some of that bed variability is to deepen existing large pools that have, over time, silted up. In the lower Loddon River between Fernihurst (Loddon) Weir and the Little Murray River, trial deepening will take place over the next year. Pools have been selected for the trial and pre-monitoring (fish, macroinvertebrates, habitat assessment) completed. Groundwater observation bores will be sunk to monitor any interaction between surface and groundwater, and deepening works are expected to start in summer 2019/20.

Connectivity

Historically fish moved freely from the Murray River through the anabranches of Gunbower and Pyramid creeks back into the Murray. The construction of weirs, regulators, culverts and channels not only introduced barriers to fish movement, but also meant floodplains and wetlands associated with the waterways were disconnected, hampering fish breeding in all but the wettest years.

In the last 10 years fishways have been installed at Kerang Weir, the Kow Swamp outlet to Box-Pyramid Creek, the Chute in the lower Loddon River and Torumbarry Weir. In Gunbower Creek, there are fishways at Hipwell Rd, the inlet to Gunbower Forest and Thompsons Weir (Figure 2). When Gunbower Forest drains, fish can escape back into the creek via a number of regulators that are either opened or overtopped.

In the last twelve months fishways have been constructed and commissioned at Little Murray Weir and Fish Point Weir on the Little Murray River, opening up the connection from the Murray River through to Kow Swamp and Fernihurst Weir. Fishways for Koondrook and Cohuna Weirs on Gunbower Creek are in the planning phase, with construction at Cohuna Weir to commence soon.

Ultimately fishways will connect Torumbarry Weir with Taylors Creek, Gunbower Creek, Kow Swamp, Box-Pyramid Creek, the lower Loddon River, Little Murray River and back to the Murray River downstream. This opens up nearly 350 kilometers of waterways that have been mostly closed to fish movement since regulation in the 1920s.

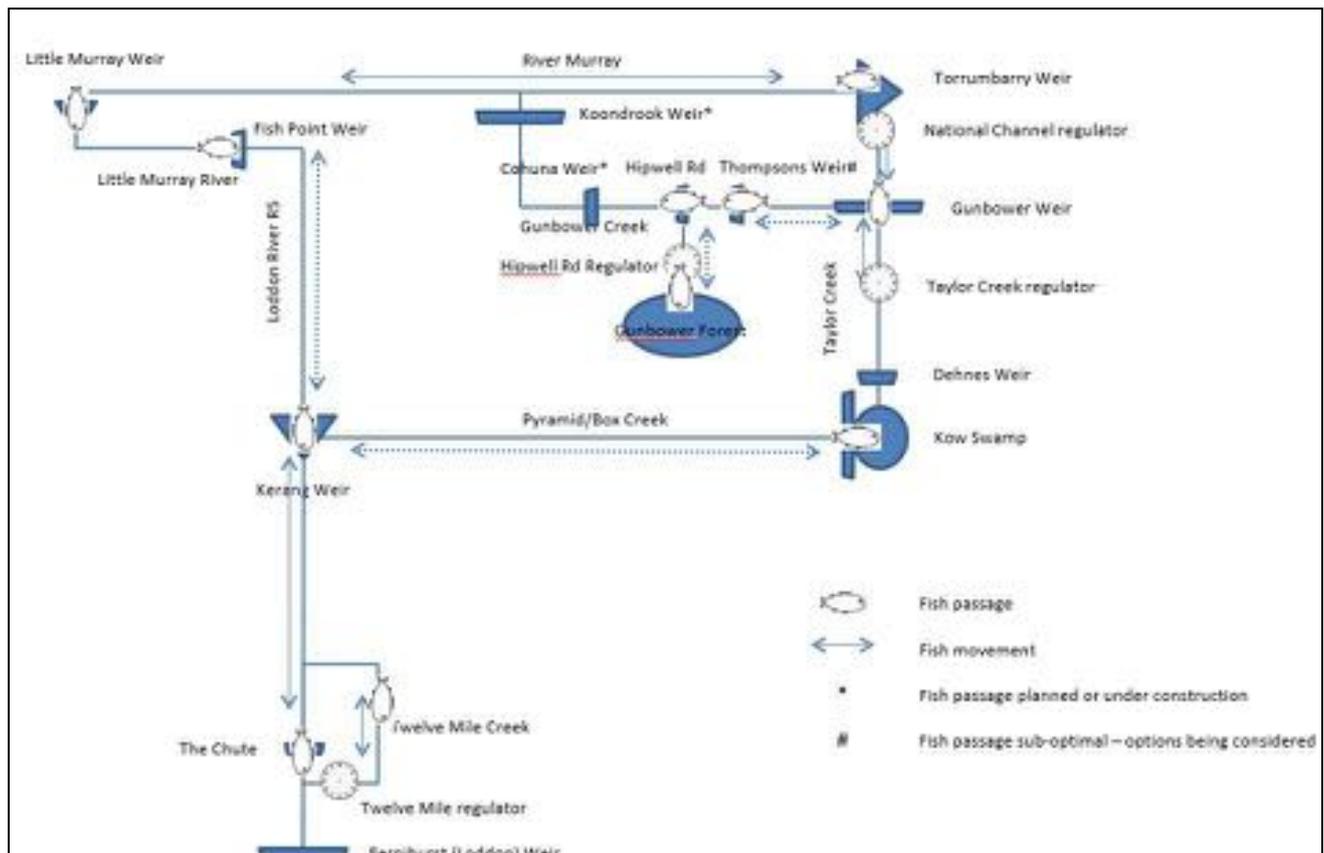


Figure 2: Schematic diagram of the NFRP area showing existing and planned fish passage

Risk Management

Major threats to native fish populations include exotic fish (particularly European carp (*Cyprinus carpio*)), entrainment of native species in irrigation channels and fish mortality associated with irrigation offtakes.

The damage that European carp do to instream vegetation and water quality has been well documented. The sheer bulk of the carp biomass in Murray-Darling waterways is a barrier to healthy populations of large bodied native fish. The carp virus provides a ray of hope for containing carp populations in the longer term.

Irrigation channel offtake screens are an innovative approach to mitigating the risk of fish being sucked into offtakes and either dying or being caught up in irrigation channels, which are generally drained at the end of the irrigation season. A recent study in the Gunbower Creek system indicated that >5500 drifting native fish larvae are being entrained in the Cohuna Channel per day during the peak larval drift period (North Central CMA, 2018). Adult fish also move into irrigation channels. For example, in a tagging study in Gunbower Creek, 20% of tagged golden perch that were released into the Koondrook weir pool were entrained in the No. 5 channel (Stuart & Sharpe, 2015). To address this loss, North Central CMA has constructed Australia’s first self-cleaning irrigation channel diversion screen at Cohuna Weir (Figure 3).



Figure 3: Conical channel offtake screens installed at Cohuna Weir (Photo: AWMA Water solutions)

Flow management

Native species including Murray cod, silver perch and golden perch are stimulated by high flows to move for breeding (spring) and dispersal (autumn). In this waterway system, flows have been seasonally inverted due to the delivery of consumptive water between mid August and mid May. So at the time of the year when flows should be at their highest, low flows or cease-to-flow conditions prevail. In addition, rapid fluctuations in the hydrograph resulting from irrigation demand does not provide the right cues for fish movement.

Environmental water in these systems can be used to smooth out the variations in flow during the irrigation season and provide enough flow in the lower Loddon River to encourage fish movement. An example of the complementary delivery of environmental and consumptive flows in the region can be seen in Gunbower Creek (a TLM icon site) and Pyramid Creek.

Case study – Gunbower Creek native fish hydrograph

Rapid fluctuations of the flow rate in irrigation delivery systems is a problem for movement, recruitment and survival of larvae. Automation to the irrigation system has resulted in a short turn around time for irrigators to call on water, meaning extreme fluctuations in flow over some regulators (Figure 4 [L])

In Gunbower Creek, a conceptual model of the Murray cod life history was used to develop a full year hydrograph to drive environmental flow delivery (Figure 4 [R]). Murray cod were targeted because monitoring revealed a marked decline in the cod population and little evidence of recruitment since the Millennium Drought. The conceptual model identified the following components:

- winter flows – over winter survival
- spring rise – movement and mating
- stable flows – spawning and nesting
- engaging the littoral zone – larval survival and growth
- ramp down – survival and dispersal

The winter flow component is designed to help over-winter survival of young and mature fish by maintaining a sufficient water depth to cover habitat elements. Negotiations with GMW enabled water accounting during the irrigation off-season, with losses deemed against environmental water accounts and water that flowed through the system was re-credited for downstream use in the Murray River.

Irrigation demand and supply generally achieves the spring rise, littoral zone inundation and ramp down flows.

The stable flow component is the most challenging. This uses environmental water to raise the water level, filling the gap between irrigation demand and the target flow rate to achieve the target flow rate, or hydrograph,

to smooth out the overt variation. To counter the variation the target environmental flow rate was set quite high. It was set above the usual irrigation demand so that irrigation operators had the flexibility needed to be able to achieve the stable flows.

The full hydrograph has been delivered over consecutive years between 2013 and 2017. Monitoring during each year delivering the hydrograph showed encouraging signs, with age cohorts of young Murray cod (one – four years old) corresponding to the environmental water delivery of the hydrograph caught in Gunbower Creek. In the last two years, some minor tweaking to the hydrograph has taken place to recognise some of the lessons learnt, but the overall concept remains the same.



Figure 4: Comparison of flows at Cohuna prior to native fish hydrograph (L) and the conceptual model of the fish hydrograph (R)

Case Study - Combined Loddon River-Pyramid Creek fish attracting flow

The objective of combined Loddon-Pyramid flows is to encourage large bodied native fish from the lower Loddon River and Little Murray River to move through a series of fish ways into the mid-Loddon River, Pyramid Creek and high value habitat in Kow Swamp (Figure 5).

This was a complex undertaking in terms of planning, operations and accounting. In planning the flow, travel times, consumptive demand, in-stream and evaporative losses and potential third party impacts were part of the process. A spreadsheet model for the flow mix was developed to test scenarios, with assumptions about travel times, consumptive use and losses included. A ‘pilot’ flow was delivered in autumn 2017, and the learnings from this, in particular related to the assumptions made in the spreadsheet model, informed the planning for the second flow in spring 2017.

Delivery required coordination of releases from a number of weirs and regulators to ensure flows from two different systems were timed to meet concurrently at a given point (Kerang Weir) at a given time, while ensuring there was no impact on consumptive water. The recommended target flow of 700 megalitres per day (ML/d) at Kerang Weir provided a strong signal for fish to move and breed.



Figure 5: Fish ways on Pyramid Creek and lower Loddon River. (L): Kerang Weir (Vertical slot); (C): Loddon River at 'The Chute'(Vertical slot); (R): Box Creek regulator at the outlet from Kow Swamp (Fish lock) (All photos North Central CMA)

Accounting for the flow in Pyramid Creek was based on calculated losses measured at a stream gauge located at the inflow to Kerang Weir. With much of the water delivered being for consumptive uses in the Loddon Valley Irrigation Area, only a comparatively small volume (927 ML) was deemed to Victorian environmental water accounts. The balance of the environmental component of the water was recredited to the Murray River for further use downstream. This demonstrates high level efficiency not only in the use of environmental water to achieve impressive ecological outcomes for minimal water use, but in the re-use of water to provide a range of benefits downstream in the Murray River.

Of course, the objective of the flow was to encourage fish movement. The Arthur Rylah Institute (ARI), under the Victorian Environmental Flows Monitoring and Assessment Program (VEFMAP) monitored fish populations and movement through Loddon River and Pyramid Creek, including at fishways, in autumn and spring 2017 when the fish attracting flows were delivered (ARI, 2017). Golden perch were also tagged with Passive Integrated Transponder (PIT) tags or acoustic tags to track their movement using readers located in the Loddon River and Box-Pyramid Creek.

Monitoring found that both large and small bodied native fish were moving through the system in good numbers. Target species (Murray cod, silver perch, golden perch) were all identified through the system, and small bodied fish that include the vulnerable Murray-Darling rainbow fish, unspecked hardyhead and Australian smelt. Also encouraging was the observation during monitoring that exotic fish, particularly carp, were in lower numbers during the high flow compared to before the flow (ARI, 2017).

Partnerships

The success of the combined flow is testament to a strong partnership between North Central CMA as flow planners and managers, Goulburn-Murray Water as the system operators and the Victorian Environmental Water Holder as the statutory body responsible for environmental entitlements in Victoria. These organisations work together within a complex system before, during and after the flow delivery to ensure all components of the flow are delivered efficiently and effectively. ARI's contribution in terms of monitoring is crucial, providing the data that confirms the objectives of the plan are being met.

Community engagement has been an important part of the project. Traditional Owner groups have been consulted during the development and implementation of the project, sharing their knowledge of the fish ecology and cultural practices of the area. Support from recreational fishing groups such as VRFish, the peak recreational fishing body in Victoria has been key in bringing the community along with the project. In time, the project will create a world class recreational fishery with Murray cod and golden perch the main target species, providing significant economic and social benefits for the area.

Conclusions

The Native Fish Recovery Plan – Gunbower and lower Loddon is a long-term plan aimed at improving native fish populations in a number of anabranches of the Murray River in North Central Victoria. The plan focusses on reinstating habitat, constructing fish passage at barriers such as weirs and regulators, delivering fish-friendly environmental flows and finding ways to manage threats to native fish populations. The plan achieves this by working within the irrigation system rather than trying to change it.

Environmental flows are a key component of this approach. Flows in Gunbower Creek and Box-Pyramid Creek show that smoothing out the consumptive water hydrograph, aligning flows with critical stages of fish life cycles, and delivering flows in conjunction with consumptive water deliveries, can lead to improved outcomes for fish in a regulated water system.

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The partnership between North Central Catchment Management Authority, Goulburn Murray Water, the Victorian Environmental Water Holder, Arthur Rylah Institute and community groups underpins the success of the project, with organisations working together to achieve significant ecological outcomes within a heavily modified system.

The project will, in the long term, have significant social and economic benefits for the area as the waterways become the focus of a world class recreational fishery.

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