Coppabella Creek Fish Sampling 2015 Summary of Findings Report

Published by the NSW Department of Primary Industries

Coppabella Creek Fish Sampling 2015 Summary of Findings Report

First published March 2017

More information

Luke Pearce

Aquatic Ecosystems

Albury

luke.pearce@dpi.nsw.gov.au

www.dpi.nsw.gov.au

Acknowledgments

This study was undertaken with funding provided by the Murray Local Land Services.

Thanks Steve Thompson from Murray Local Land Services who assisted with field sampling.

We would like to thank those landholders who granted us permission to access the waterways on their properties.

Sampling was undertaken under Fisheries NSW Animal Care and Ethics Approval No. 05/06.

Contents

Non-Technical Summary

Coppabella Creek Fish Sampling 2015

PRINCIPAL INVESTIGATOR: Luke Pearce

[1] Fisheries NSW

Albury Fisheries Office,

Unit 3/556 Macauley Street, ALBURY NSW, 2640.

Telephone: 02 6042 4213 Fax: 02 6021 0113

Executive Summary

Coppabella Creek in the Upper Murray Catchment near Tumbarumba supports one of only three remaining populations of the endangered Southern Pygmy Perch (*Nannoperca australis*) in NSW.

Murray Local Land Services (MLLS) and formerly Murray Catchment Management Authority (MCMA) have been actively providing funding and undertaking rehabilitation measures aimed at protecting, maintaining and improving the Southern Pygmy Perch population within Coppabella Creek since 2006.

Summary of sampling to date

The Southern Pygmy Perch population within Coppabella Creek suffered significant declines post the catastrophic flooding event that occurred in October 2010. This and subsequent flooding events in both 2011 and 2012 caused major changes to the morphology of the stream, the habitat and the fish community.

As part of a long term monitoring program, a survey of the freshwater fish community of Coppabella Creek was undertaken by Fisheries NSW in November 2015. This survey was aimed at determining the current distribution, and relative abundance of Southern Pygmy Perch within the system as well as population trends over time.

Summary of survey results

Standardised sampling of ten sites spread along the 38km length of Coppabella Creek, yielded a catch of 180 fish and an estimated additional 19 individuals of seven species of fish were observed from the 10 sites. 55 individual Southern Pygmy Perch where captured and 2 observed (from only the upper most site). However dip netting produced a much greater number of Southern Pygmy Perch from this site and another where they weren't identified via the standardised sampling. This is the highest number of Southern Pygmy Perch that have been detected since the 2010 flood events, and shows a marked increase in their abundance. The most abundant species sampled was Common Carp with 73 individuals captured and 17 observed. Southern Pygmy Perch was the second most abundant species captured, followed by River Blackfish with 24 individuals captured; the remaining 4 species were all detected in relatively low abundances.

Summary of key recommendations

- Maintain existing barrier to alien fish passage
- Investigate potential for additional improved barrier downstream of existing barrier
- Investigate the potential removal of pest fish from a section of the creek between barriers
- Stock limitation or exclusion from riparian areas

- Ongoing weed control
- Reestablishment of native vegetation
- Identify potential translocation/reintroduction sites
- Develop translocation/stocking strategies
- Continue to monitor of the current population and any potential translocation sites.
- Establish a captive breeding and re-introduction program.
- Refrain from stocking trout or other predatory fish species into know Southern Pygmy Perch habitats

1. Introduction

Southern Pygmy Perch (*Nannoperca australis* Gunther 1862) is a small freshwater percichthyid fish native to the Lachlan, Murrumbidgee and Murray catchments in NSW, all Victorian tributaries of the Murray River and lower Murray River in South Australia (Kuiter et al. 1996, Allen et al. 2002). It is also present in coastal catchments between the Murray River in South Australia and the Genoa River in far eastern Victoria/south eastern NSW, in Northern Tasmania and on King and Flinders Islands. Recent genetic studies (Unmack et al., 2011) have shown that there are two species within the Southern Pygmy Perch: an eastern coastal species and a species in the Murray-Darling Basin and western Victorian coastal streams (Unmack et al., 2011). The Murray-Darling Basin form likely represents a separate sub species (Unmack et al., 2011).

Since 2000, only five remnant, isolated populations of Southern Pygmy Perch have been identified in NSW: Normans Lagoon, Albury; Millewa Forest, Mathoura; Coppabella Creek, Jingellic; Upper Billabong Creek, Holbrook; and Blakney Creek, Yass (Gilligan et al., 2010). It appears as though the Normans Lagoon and Millewa Forest populations have been lost, with recent extensive surveys of both these sites, specifically targeting Southern Pygmy Perch, failing to detect any individuals (Sharpe & Wilson, 2012; Sharpe et al., 2012). This leaves only three known populations within the NSW portion of the Murray-Darling Basin: Coppabella Creek, Blakney Creek and the Upper Billabong Creek system.

Southern Pygmy Perch were first collected from Coppabella Creek in 1992 and again in 1999 (Gilligan et al., 2010). During the late 1990s and early 2000s, with the continuation of one of the worst droughts in living memory (Murphy & Timbal, 2008; Ummenhofer et al., 2009), grave concerns developed regarding the security of the population within Coppabella Creek. During 2006, surveys at the original collection site identified that Southern Pygmy Perch were still present and abundant. However, the site was heavily drought-affected and, as an emergency response, 122 fish were removed from the shallow remnant pools in January/February 2007. The rescued fish were held in an outdoor earthen pond at the Narrandera Fisheries Centre until flows returned. In February 2008, the 69 remaining fish were returned to the collection site at Coppabella Creek (Gilligan et al., 2010).

Ongoing surveys of Coppabella Creek in 2008 confirmed the presence of Southern Pygmy Perch, however, continued low rainfall throughout 2008 and 2009 resulted in even dryer conditions within Coppabella Creek than were seen in 2007. Many remnant pools known to contain Southern Pygmy Perch were drying rapidly. A second emergency response was enacted, and several thousand Southern Pygmy Perch were again rescued and taken either to the Narrandera Fisheries Centre, or a holding facility at Tumut.

As a result of the ongoing threat from continued drought within Coppabella Creek, a decision was made to map the location and depth of remnant refuge pools within Coppabella Creek and undertake a rapid assessment fish survey within these pools to determine the distribution of Southern Pygmy Perch. Ten survey sites were established along the length of the creek to allow for the undertaking of standard fish assemblage surveys and to assess the status and distribution of fish species along the entire length of the creek (Gilligan et al 2010). The mapping of the remnant pools, rapid fish assessment and standard fish community sampling were to provide greater understanding of the distribution and status of the fish community along the length of Coppabella Creek and allow for more informed management decisions to secure and maintain the Southern Pygmy Perch population within the creek during the drought and beyond.

The subsequent years saw a complete turn-around in the climatic conditions. Significant flooding events occurred in March, September and October 2010, October 2011 and March 2012. The most significant of these was the event in October 2010, with the peak of the flood experienced on the 15th. At its peak, the level on the Jingellic/Coppabella Creek gauge was 3.6 m higher than the previous gauge record in 1975 (estimated >100 year Average Recurrence Interval (ARI)) (Bewshers, 2012).

These flooding events caused major changes to the stream morphology, habitat and fish community within Coppabella Creek, with significant erosion , channel widening and deepening, redistribution and mobilisation of large amounts of sediment and the destruction of the majority of macrophytes . Subsequent sampling of the ten survey sites have shown significant changes in fish abundance and distribution.

The former Murray Catchment Management Authority (Murray CMA) and the current Murray Local Land Services (Murray LLS) have been actively restoring terrestrial and aquatic habitat to improve aquatic biodiversity within the Coppabella/Jingellic area since 2006, with a focus on fish and amphibians and the endangered Southern Pygmy Perch in particular. Fish are good bio-indicators of river health and provide an effective tool to gauge the effects of river restoration and management practices from broad regional scales to small water bodies. Harris (1995) notes that there are several advantages to using fish as bio-assessment tools including:

- Fish are relatively long-lived and mobile, reflecting long-term and broad-scale processes.
- Fish occupy higher trophic levels within stream ecosystems, and in turn, express impacts on lower trophic level organisms.
- Fish are easy to collect and identify as their taxonomy is well documented.
- Fish can be sampled and released alive in the field.
- The ecology and habits of fish are relatively well known.
- Fish are typically present in most waterbodies, including very small streams and polluted waters.
- Biological integrity of fish communities can be assessed easily and interpretation of indicators is relatively intuitive.

This survey aims to provide Murray LLS with an update on the current status of the fish community within Coppabella/Jingellic Creeks, particularly the endangered Southern Pygmy Perch.

2 Methods

2.1 Study sites

The Coppabella Creek catchment lies in southern NSW, due west of the township of Tumbarumba. It is a small (38 km long) tributary of the upper Murray River with a catchment area of 390 km^2. Coppabella Creek originates to the west of the township of Rosewood at an altitude of 650 m. From there it flows in a southerly direction until it meets Jingellic Creek, from where it continues as Jingellic Creek, until its confluence with the upper Murray River, south-west of the township of Jingellic at an altitude of 213 m. A total fall of 437 m over its 38 km length, results in a gradient of 11.5 $m.km^{-1}$. There is currently one major barrier to fish passage on Coppabella Creek, the redundant Clearsprings Weir that was historically used to divert water, via a water race for irrigation purposes. It is a fixed crest concrete and rock structure that has been constructed on bedrock and is located at Latitude -35.791585 Longitude 147.696730 (directly downstream of site 6287 on Figure 1).

Ten established sites (eight sites in Coppabella Creek and two in Jingellic Creek) were surveyed for Southern Pygmy Perch, with eight sites in Coppabella Creek and two in Jingellic Creek from 25 – 26 November 2015 (Figure 1, Table 1). The uppermost site was located at the Coppabella Road bridge and the most downstream site located at Jingellic, approximately 1 km from the confluence of Jingellic Creek and the Murray River. Sites were dispersed roughly equidistantly within this reach.

Table 1. Details of the study sites surveyed using standardised fish community survey protocols (Datum = GDA94).

Site Number	Waterway	Latitude	Longitude	Altitude
6282	Jingellic Creek	-35.92983	147.69299	220
6281	Jingellic Creek	-35.89275	147.69157	222
6288	Coppabella Creek	-35.88203	147.70337	247
6284	Coppabella Creek	-35.85081	147.70799	255
6285	Coppabella Creek	-35.83488	147.70300	279
6283	Coppabella Creek	-35.80697	147.69600	295
6287	Coppabella Creek	-35.79173	147.69673	310
68606	Coppabella Creek	-35.76791	147.71036	342
6286	Coppabella Creek	-35.75689	147.71606	350
8008	Coppabella Creek	-35.74057	147.72560	360

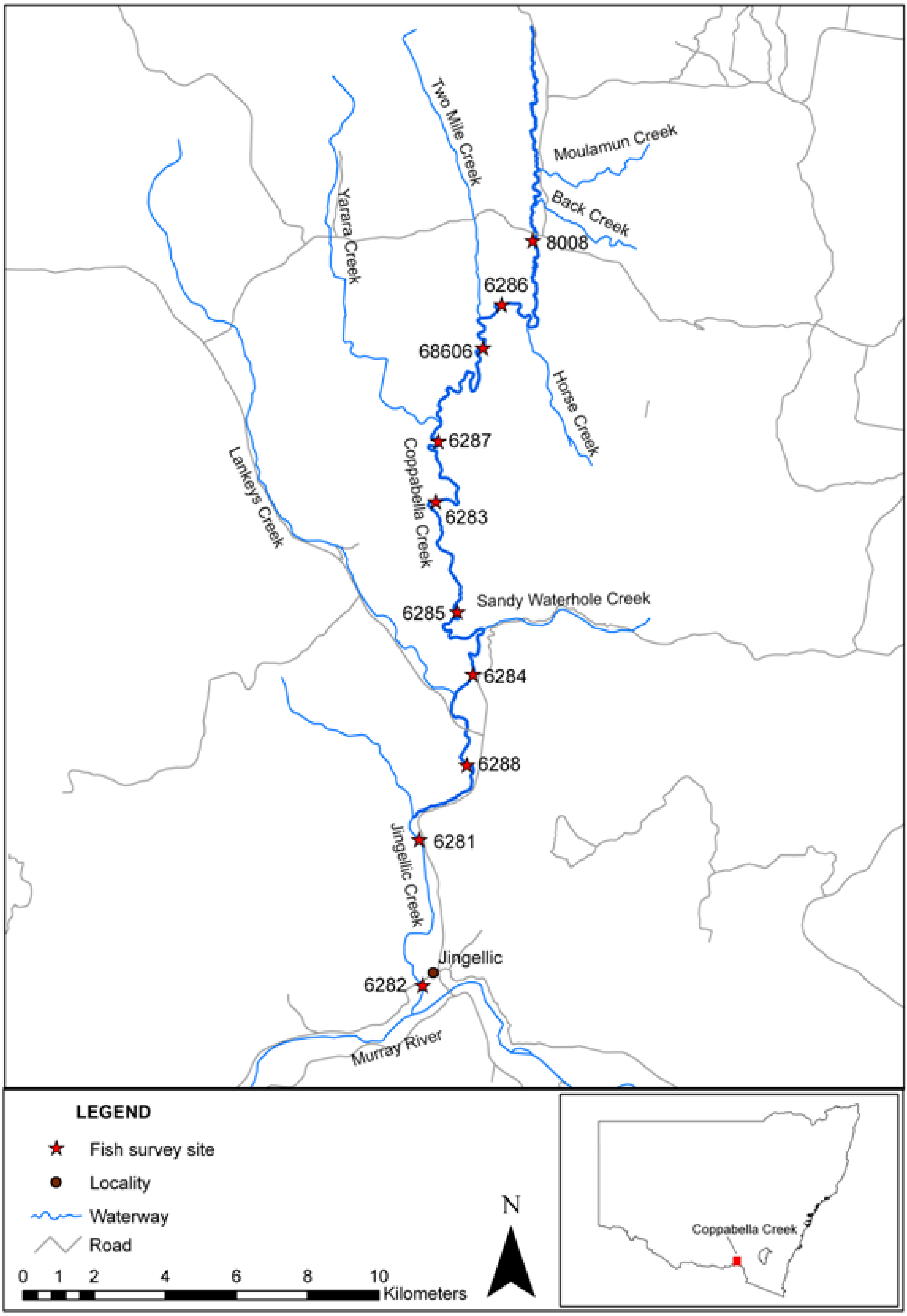

Figure 1. Locations of fish survey sites along Coppabella and Jingellic Creeks sampled by Fisheries NSW in November 2015

2.2 Standardised fish assemblage sampling

Fish sampling protocols used were those developed for the Murray-Darling Basin Authority's Sustainable River Audit – Fish theme (Davies *et al.* 2008, MDBC 2008). These are based on standardised backpack electrofishing in addition to 10 un-baited concertina-type shrimp traps.

At the completion of each electrofishing operation (electrofishing and bait traps), captured individuals were identified, counted, measured and observed for externally visible parasites, wounds and diseases before being released. Rapid habitat assessment of each site included recording characteristics of riparian and instream vegetation, substratum, in-stream cover and meso-habitat (e.g., pool, run, riffle). Water quality data including temperature (°C), dissolved oxygen (mg L^{-1}), pH, conductivity (µS cm^{-1}) and turbidity (NTU) were recorded using a Horiba® U10 water quality meter.

All captured fish were identified to species and measured to the nearest millimetre. Measurements were obtained as either fork length or total length depending to species caudal fin morphology. Fish that were not captured but could be positively identified during sampling were recorded as 'observed'.

2.3 Dip net sampling

In addition to the standardised sampling techniques outlined above a dip net survey was carried out to determine the presence/absence of juvenile Southern Pygmy Perch at sites where adults were detected or suitable habitat existed. The dip net technique involved wading and the use of a sweep net, with a 380 mm x 320 mm opening and 3 mm mesh, which was swept through all available habitats (generally macrophytes), either until Southern Pygmy Perch were detected, all available habitat was sampled or a period of 25 minutes.

2.4 Biomass estimates

Only individuals that were captured and measured were used for biomass estimates. Individual fish weights and overall biomass estimates were calculated using the length-weight relationships of fish based on samples collected by fisheries research agencies in south-eastern Australia (MDBC, 2004):

$\mathrm{Log}_{10}\ W = \mathrm{constant} + \mathrm{slope} * \mathrm{Log}_{10}\ SL$

Where W = weight (g) and SL= standard length (mm).

3. Results

Seven species of fish were sampled from the 10 sites surveyed in Coppabella and Jingellic Creeks

(Table 4). This included three native species (Southern Pygmy Perch, River Blackfish, and Australian Smelt) and four alien species (Common Carp, Redfin perch, Goldfish and Brown Trout). Overall, a total of ten fish species are known to exist within the Coppabella-Jingellic Creek system. Murray Cod, Mountain Galaxias and Gambusia which have been captured in the previous years were not captured in 2015.

Standardised sampling yielded a catch of 180 fish and an additional 19 individuals were observed from the 10 sites. Southern Pygmy Perch were the second most abundant species detected and made up 30.56% of the total catch and 0.26% of the biomass which is an increase from 2.75% and 0.02% in 2014. Southern Pygmy Perch were collected from only the upper most site via standardised sampling, however they were detected at an additional site (site 6287) via dip netting. The most abundant species was Common Carp consisting of 40.56% of the total catch and 96.49% of the biomass. They were collected from the 6 lower sites, all below the Clearsprings Weir, the current upstream limit of their distribution The next most abundant species after Common Carp and Sothern Pygmy Perch was River Blackfish which comprised 13.33% of the total catch and 1.85% of the biomass which were collected from four sites, three of which are upstream of the Clearsprings Weir.

Table 2. Abundance of fish recorded at fish survey sites in Coppabella and Jingellic Creeks by Fisheries NSW in November 2015. Values in parentheses are the number of individuals observed but not collected during sampling.

Common Name	Sampling Sites										
	6282	6281	6288	6284	6285	6283	6287	68606	6286	8008	Total
Southern Pygmy Perch										55(2)	55(2)
River Blackfish						2	12	3	7		24
Australian Smelt	10	3									13
Common Carp*	11(4)	12(5)	5	33 (5)	8(2)	4(1)					73(17)
Redfin*	8	2	1	1		1					13
Goldfish*					1						1
Brown Trout*								1			1
Total	29 (4)	17(5)	6	34(5)	9(2)	7(1)	12	4	7	55(2)	180(19)

*Introduced/non-native fish species

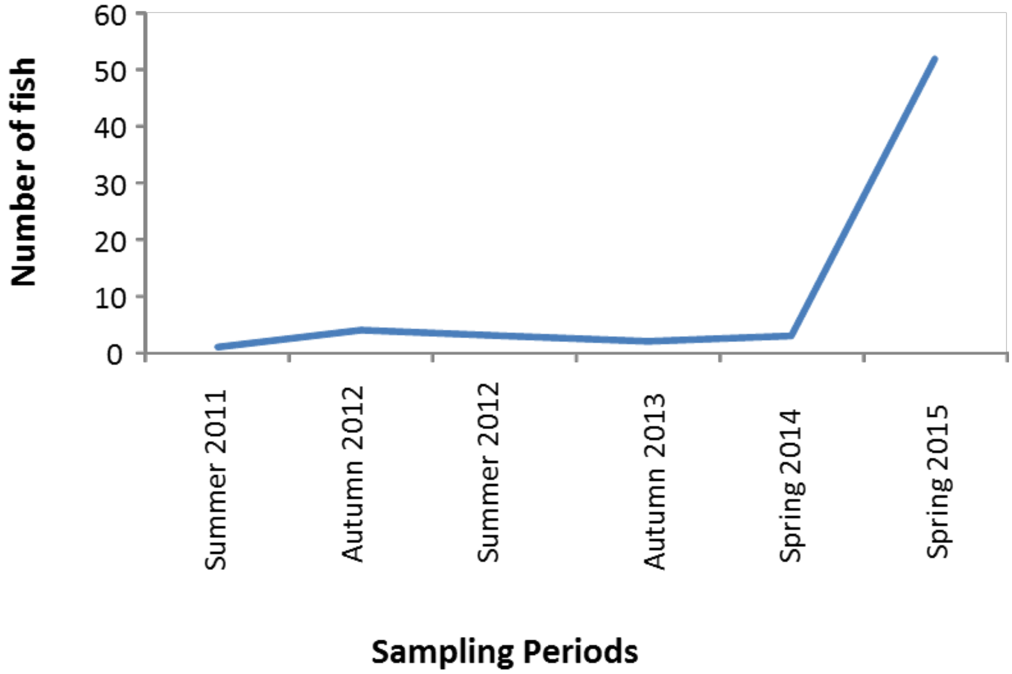

Figure 2. Southern Pygmy Perch catch rates by sample dates.

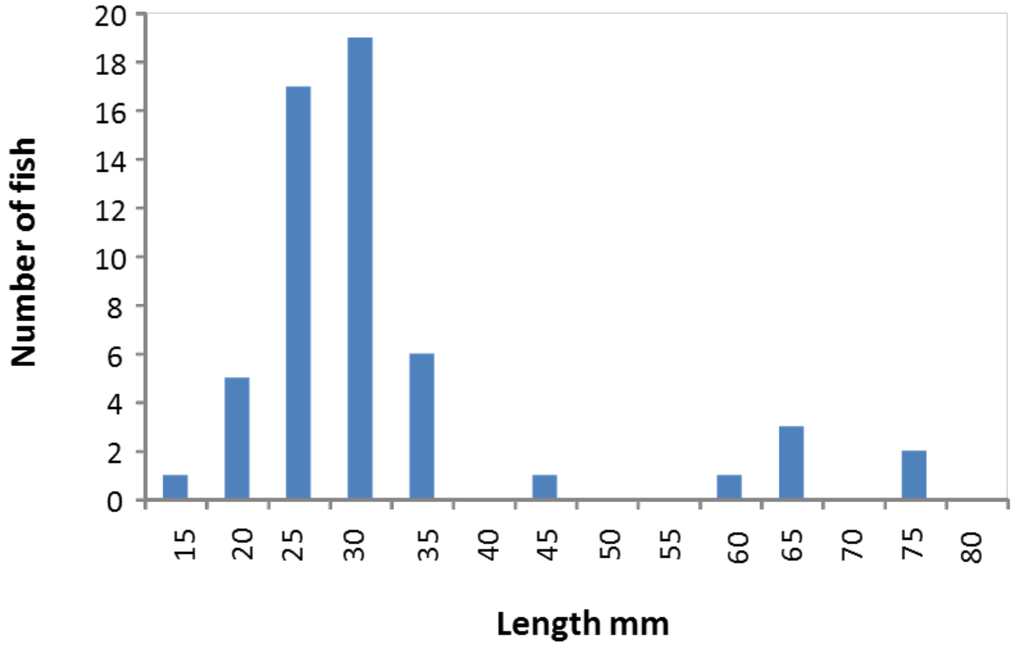

Figure 3. The length-frequency distributions of southern pygmy perch sampled in Coppabella Ck 2015 (n=55)

The aquatic vegetation upstream of the Clearsprings Weir has continued to recover (see Figure 4). Whilst the levels of aquatic vegetation have not returned to the pre flooding levels there has been substantial recovery of many species including *Potamogeton tricarinatus, Vallisneria gigantes, Myriophyllum verrucosum, Scirpus validus* and *Phragmites australis.* These aquatic plants represent the primary structural habitat for Southern Pygmy Perch. There has been very limited or no recovery of the aquatic vegetation downstream of the Clearsprings Weir where carp are present (see Figure 5).

Figure 4. Clearsprings Weir pool showing aquatic vegetation recovery (top) March 2014 (below) November 2015.

Figure 5. Representative site photos downstream of Clearsprings Weir November 2015 showing no aquatic vegetation recovery.

4. Discussion

Standardised sampling only identified Southern Pygmy Perch at one of the 10 sites sampled (site 8008). There was however a large increase in the number of Southern Pygmy Perch sampled compared to other resent sampling events. This is the first substantial increase in Southern Pygmy Perch abundance since the 2010/2012 flood events. On top of this dip netting also identified Southern Pygmy Perch at an additional site 6287, where they were not found via the standardised sampling methods. This increases the number of sites that Southern Pygmy Perch were found to two, which is equal to the distribution that the species has covered since April 2012.

The capture of both YOY and 1+ fish is strong evidence of recruitment in the past two breeding seasons, and a strong cohort coming through from the 2015 breeding season. This is the first time substantial recruitment has been detected since 2009 and is a positive trend.

In 2009 the exclusion of Common Carp appeared to be influencing the distribution of Southern Pygmy Perch, with none being detected below a barrier that existed between sites 6285 and 6284, which was limiting the movement of carp upstream (Gilligan et al 2010). This barrier was destroyed during the 2010 flood event and Common Carp have now progressed upstream as far as a Clearsprings Weir the barrier between sites 6287 and 6283. Consistent with results reported in Gilligan et al 2010 Southern Pygmy Perch have not been found to coexist with Carp within Coppabella Creek. Six separate sampling events have not detected any Southern Pygmy Perch in areas that Carp have recently invaded, where they were previously known to exist prior to the flooding of 2010 and the incursion of Carp.

There has been significant recovery of aquatic plants, the primary habitat of Southern Pygmy Perch above the Clearsprings Weir which is the current barrier and upstream extent of Common Carp distribution within the system, whilst there has been little to no such recovery below this barrier, particularly with submerged species such as *Potamogeton tricarinatus, Vallisneria gigantes, Myriophyllum verrucosum.* There appears to be a direct correlation between the recovery of aquatic plants and the absences of carp within this system, given that carp have been attributed with causing declines in aquatic plants both in Australia and overseas (Crivelli, 1983; Vilizzi et al., 2014; Williams et al., 2002) this is not surprising, however it warrants further investigation.

Trout numbers within the system are currently quite low and as a consequence, their current impacts upon Southern Pygmy Perch are likely to be minimal. Coppabella Creek has historically been stocked with trout. Trout are known to predate on Southern Pygmy Perch (Cadwallader, 1979; Humphries, 1995). Therefore, the stocking of large numbers of predatory trout could seriously jeopardise this population, particularly if it occurred during a recovery phase, when population numbers were low. We therefore recommended that no trout or other predatory fish species be stocked into Coppabella Creek or other areas where Southern Pygmy Perch exist.

These results show that the recovery of Southern Pygmy Perch following a major disturbance is a slow process. They appear to have quite low resilience, and therefore are particularly vulnerable during this prolonged recovery phase.

To ensure the long-term recovery and persistence of this population, ongoing management should aim to protect the current core habitat, the deepest and most permanent pools as identified in (Gilligan et al., 2010) and maintain the exclusion of alien pest fish at the current barrier (Clearspings Weir). Southern Pygmy Perch have been shown to have a close association with aquatic vegetation (Cadwallader, 1979; Humphries, 1995; Llewellyn, 1974; Woodward & Malone, 2002), so habitat works that promote the recovery, retention and regeneration of aquatic macrophytes will be an important component of the management regime to conserve and enhance the Southern Pygmy Perch populations.

Specific on-ground works required to achieve the recovery and maintenance of the Coppabella Creek Southern Pygmy Perch population include:

- Maintain the existing barrier (Clearsprings Weir) to movement of Common Carp and Redfin Perch upstream. The current barrier is only effective over low and medium flow events. Pest fish species could potentially move around the barrier during a high flood event. The structure is in poor repair, with repair works being carried out on the structure in the past three years. The structure is at high risk of failing in even a moderate flood event.
- Establish a more effective and stable barrier to pest fish movement, which is effective over a greater range of flow levels. This barrier could potentially be constructed downstream the existing barrier, thus allowing the removal of carp and other pest fish between the two barriers. This would then establish a buffer between the current Southern Pygmy Perch population, as well as increasing the amount of pest fish free habitat in which they may be able to repopulate.
- Stock exclusion from the riparian zone, particularly during summer months and dry periods when impacts upon the stream and macrophytes will be heightened.
- Ongoing control of willows and blackberries which shade and compete with the native riparian and aquatic plants.
- Re-establishment of native vegetation. However, revegetation should be sufficient distance from the stream to limited amount of shading of the stream so as not to inhibit the beneficial growth of aquatic macrophyte beds.

In addition to the above specific on-ground works focused on Coppabella Creek, there is a need to identify suitable alternative locations for the potential establishment of further Southern Pygmy Perch populations. For establishment to be successful, these alternate sites would need to have, no or very low numbers of alien fish species particularly Common Carp and Redfin Perch, and be relatively secure from the future incursion of pest fish species (i.e. have a barrier to exclude their colonisation), as well as an abundance of macrophytes and a secure water source which persists during droughts.

Specific actions required to establish further populations of Southern Pygmy Perch within the Upper Murray Catchment, to increase their distribution, limit their exposure to stochastic disturbance events and create long term species persistence include:

- Identify potential translocation/reintroduction sites that meet the above criteria.
- Develop translocation strategies and scenarios, including the use of the Southern Pygmy Perch population viability model to identify the level of removal the donor population can sustain and the number of fish and stocking events required to establish a population in a translocation site.
- Continue to monitor the current population and any potential translocation sites.

If no suitable sites exist for potential translocation, consider implementing on-ground works that would improve sites so they meet the criteria identified.

Investigate the potential for the establishment of a captive breeding and re-introduction program for Southern Pygmy Perch.

Refrain from stocking trout or other predatory fish species into known and potential Southern Pygmy Perch habitats and establishment sites.

5. References

Bewshers. (2012). Bewsher Consulting Flood Intelligence Collection and Review for Towns and Villages in the Murray and Murrumbidgee Regions following the October 2010 Flood, Volume 1 Main Report, Final Report. NSW State Emergancey Servcies

Cadwallader, P. L. (1979). Distribution of native and introduced fish in the Seven Creeks River system, Victoria. Australian Journal of Ecology, 4, 361-385.

Crivelli, Alain J. (1983). The destruction of aquatic vegetation by carp. Hydrobiologia, 106(1), 37-41. doi: 10.1007/BF00016414

Gilligan, D. , Rodgers, M., McGarry, T., Asmus, M., & Pearce, L. (2010). The abundance and distribution of the endangered Macquarie perch and Southern pygmy perch in the NSW Upper Murray Catchment and implications of drought on the persistence of the Coppabella Creek population of Southern pygmy perch.: NSW Department of Industry and Investment.

Humphries, P. (1995). Life History, Food and Habitat of Southern Pygmy Perch, Nannoperca australis, in the Macquarie River, Tasmania. Australian Journal of Marine and Freshwater Research, 46, 1159-1169.

Llewellyn, L.C. (1974). Spawnin, Development and Distribution of the Southern Pigmy Perch Nannoperca australis Gunther from Inland Waters in Eastern Australia Australian Journal of Marine and Freshwater Research 25, 121-149.

MDBC. (2004). Murray-Darling Basin Commission, Fish theme pilot audit technical report - Sustainable Rivers Audit. Canberra: Murray-Darling Basin Commission.

Murphy, B. F., & Timbal, B. (2008). A review of recent climate variability and climate change in southeastern Australia. International Journal of Climatology, 28(7), 859-879.

Sharpe, C., & Wilson, E. (2012). Fish surveys at 39 sites throughout Millewa Forest, NSW, with focus on the distribution of Southern pygmy perch (Nannoperca australis). May/June 2012. Summary of Findings Report for the NSW Office of Environment and Heritage.

Sharpe, C., Wilson, E., & Healy, S. (2012). Summary of fish surveys at Normans Lagoon NSW, with focus on the occurance of Southern pygmy perch (Nannoperca australis). June 2012. Summary of Findings Report for the NSW Office of Environment and Heritage.

Ummenhofer, Caroline C., England, Matthew H., McIntosh, Peter C., Meyers, Gary A., Pook, Michael J., Risbey, James S., Gupta, Alexander Sen, & Taschetto, Andréa S. (2009). What causes southeast Australia's worst droughts? Geophysical Research Letters, 36(4), L04706.

Unmack, P. J., Hammer, M. P., Adams, M., & Dowling, T. E. (2011). A Phylogenetic Analysis of Pygmy Perches (Teleostei: Percichthyidae) with an Assessment of the Major Historical Influences on Aquatic Biogeography in Southern Australia. Systematic Biology, 60(6), 797-812.

Vilizzi, L, Thwaites, L. A., Smith, B. B., Nicol, J. M., & Madden, C. P. (2014). Ecological effects of common carp (Cyprinus carpio) in a semi-arid floodplain wetland. Marine and Freshwater Research, 65(9), 802-817. doi: http://dx.doi.org/10.1071/MF13163

Williams, Adrian E., Moss, Brian, & Eaton, John. (2002). Fish induced macrophyte loss in shallow lakes: top–down and bottom–up processes in mesocosm experiments. Freshwater Biology, 47(11), 2216-2232. doi: 10.1046/j.1365-2427.2002.00963.x

Woodward, G.M.A., & Malone, B.S. (2002). Patterns of abundance and habitat use by Nannoperca obscura (Yarra pygmy perch) and Nannoperca australis (Southern pygmy perch). Proceedings of the Royal Society of Victoria, 114, 61-72.