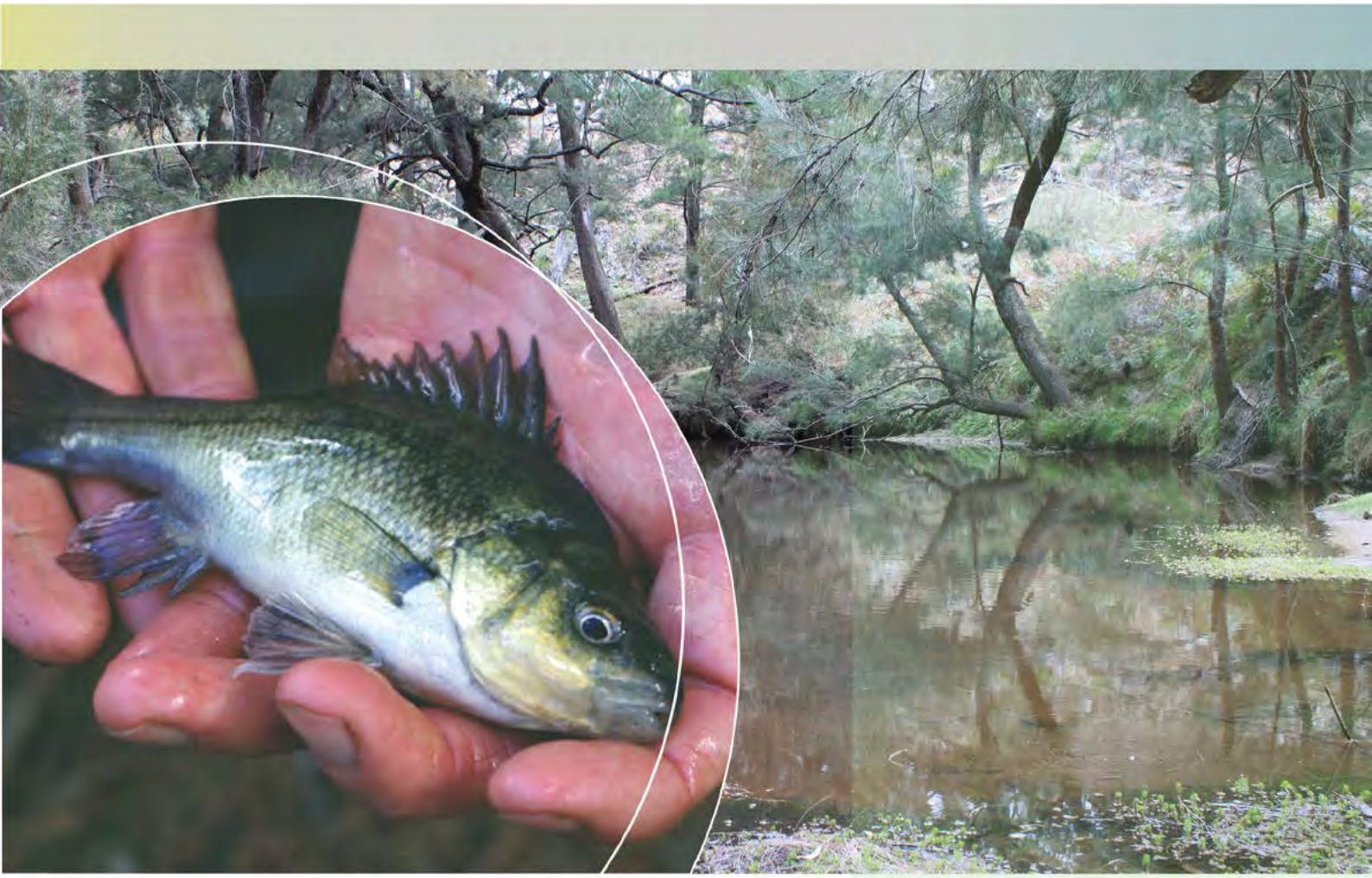
NSW GOVERNMENT

Macquarie Perch refuge project

Final report for the Lachlan CMA



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Non technical summary

The Macquarie Perch (*Macquaria australasica*) is a medium sized native freshwater fish which was historically found in the southern Murray Darling Basin and parts of south-eastern coastal New South Wales (NSW), however the coastal population now appear to be a separate species (Gilligan pers comm). Both the range and abundance of Macquarie Perch has significantly declined with the majority of the remaining populations within NSW being small isolated remnants.

Although the distribution and abundance of Macquarie Perch has significantly declined across their range, the Abercrombie River and its major tributaries within the upper Lachlan catchment still supports a viable and relatively abundant population. This is also the northern most extant population within the Murray Darling Basin. Macquarie Perch are listed as 'endangered' under both the NSW *Fisheries Management Act 1994* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999.*

The introduced species Redfin Perch (*Perca fluviatillis*) was first discovered within the upper Lachlan catchment in 2005. Since the initial discovery, redfin have spread throughout the entire length of the Upper Lachlan River and into Wyangala Dam. While they have been collected in the lower reaches of the Abercrombie River, there is little evidence to suggest they have established resident populations in that part of the catchment. Because their distribution has expanded rapidly throughout the upper Lachlan River, it is highly likely that they will eventually spread further up into the Abercrombie River and its tributaries. Redfin Perch are known to impact on Macquarie Perch by direct predation (especially on eggs, larvae and juveniles) and are also a carrier of the epizootic haematopoietic necrosis virus (EHNV) (Lintermans *et al.* 2007). Macquarie Perch have been shown to be highly susceptible to this disease in laboratory trials (Langdon 1989).

Due to this potentially devastating threat, and with no feasible way of effectively controlling the spread of Redfin Perch, it was decided that a population of Macquarie Perch be taken from the wild and securely housed at the NSW Department of Primary Industries' Narrandera Fisheries Centre. Until a safe refuge site, isolated from the potential impacts of Redfin Perch could be found and used in an attempt to establish a refuge population.

The aim of this project was to identify and assess the streams within the Upper Lachlan and Abercrombie Catchments for their suitability as a refuge habitat for Macquarie Perch, as well as presence of an effective barrier to fish passage that would prevent invasion of the refuge site by Redfin Perch. The refuge site could then to be used to attempt to establish a self sustaining population of Macquarie Perch, where they would be safe from the potential impacts of Redfin. This population would also form an insurance population should Redfin Perch colonise the Abercrombie River and result in the loss of the wild population. The project used the habitat mapping and species-habitat association models developed by Gilligan *et al.* (2010) to assess the suitability of the stream habitat for Macquarie Perch. Only one suitable refuge site was identified in the Retreat River in the Abercrombie catchment.

The opportunity to hold the population of Macquarie Perch is also being used to test novel captive breeding techniques whilst the fish are being held at the Narrandera Fisheries Centre. Historically Macquarie Perch have proven difficult to breed in the hatchery environment, with only limited success achieved in the past by using 'ripe' fish (ready to spawn) captured from the wild. In the past, Macquarie Perch have never been successfully conditioned to spawn within the captive environment.

Captive breeding trials have proven successful to date, with two completed spawning events. The first event occurred in 2010, resulting in 139 fingerlings being released into the Retreat River

refuge site in the upper Lachlan catchment in March 2011. A second spawning event in 2011 produced 7,500 fingerlings which were released into the same refuge site in February 2012.

In total there have been 12 Macquarie Perch re-captured and 3 observed since these releases. These recaptures have been on three separate sampling dates and Macquarie Perch have been captured at all three of the sample sites, despite only being released at one of the sites. All of the Macquarie Perch that have been released have been chemically marked to allow for identification from potential wild fish. The Macquarie Perch that have been captured to date have been positively identified as hatchery bred fish.

Project outline

Background

The Macquarie Perch (*Macquaria australasica*) is a medium sized native freshwater fish which was historically found in the southern Murray Darling Basin and parts of south-eastern coastal New South Wales (NSW), however the coastal population now appear to be a separate species (Gilligan pers comm). Both the range and abundance of Macquarie Perch has significantly declined with the majority of the remaining populations within NSW being small isolated remnants.

Although the distribution and abundance of Macquarie Perch has significantly declined across their range, the Abercrombie River and its major tributaries within the Upper Lachlan catchment still supports a viable and relatively abundant population. This is also the northern most extant population within the Murray Darling Basin. Macquarie Perch are listed as 'endangered' under both the NSW *Fisheries Management Act 1994* and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999.*

The introduced species Redfin Perch (*Perca fluviatillis*) was first discovered within the upper Lachlan catchment in 2005. Since the initial discovery, redfin have spread throughout the entire length of the Upper Lachlan River and into Wyangala Dam. While they have been collected in the lower reaches of the Abercrombie River, there is little evidence to suggest they have established resident populations in that part of the catchment. Because their distribution has expanded rapidly throughout the upper Lachlan River, it is highly likely that they will eventually spread further up into the Abercrombie River and its tributaries. Redfin Perch are known to impact on Macquarie Perch by direct predation (especially on eggs, larvae and juveniles) and are also a carrier of the epizootic haematopoietic necrosis virus (EHNV). Macquarie Perch have been shown to be highly susceptible to this disease in laboratory based trials (Langdon 1989).

Due to this potentially devastating threat, and with no feasible way of effectively controlling the spread of Redfin Perch, it was decided that a population of Macquarie Perch be taken from the wild and securely housed at the NSW Department of Primary Industries' Narrandera Fisheries Centre until a safe refuge site isolated from the potential impacts of Redfin Perch could be found to attempt to establish a refuge population.

Project aims

The aims of this project were to:

1. identify and assess the streams within the upper Lachlan and Abercrombie Catchments for their suitability as a refuge habitat for Macquarie Perch,
2. ensure that the refuge habitat sites also had an effective barrier to fish passage that would prevent the invasion by Redfin Perch, and
3. attempt to establish a self sustaining population of Macquarie Perch in a refuge site where they would be safe from the potential impacts of Redfin Perch.

Methods

Study location

The study location was the Abercrombie and Upper Lachlan Catchment and their major tributaries above Wyangala Dam, located in central-western NSW, Australia (Figure 1). Both rivers have a similar climate, stream order and mean annual flows. However, the maximum altitude, aspect, gradient, geology, land-use and other catchment characteristics of the two rivers are very different (Gilligan 2010). Within the Lachlan catchment, Macquarie Perch historically existed as far downstream as Forbes, approximately 200 km downstream of Wyangala Dam. No Macquarie Perch have been reported downstream of the dam for many decades (Will Trueman, pers. comm.).

Sampling methods

To determine the local fish populations of the refuge site, three sites were randomly- selected and sampled. Each site was sampled using a combination of backpack electrofishing and unbaited traps consistent with sampling methods in the Sustainable Rivers Audit (SRA) (MDBC 2007; Davies *et al.* 2008). Electrofishing consisted of eight operations with an equal power on time of 150 seconds. Ten unbaited bait traps were deployed at each site prior to the commencement of electrofishing and were left for a period of at least two hours. Water quality measurements were taken at each site at a water depth of 20 cm. A range of habitat descriptors were recorded during each electrofishing operation including: flow, substratum, structural habitat, riparian and instream vegetation, stream width and depth. All captured fish were identified to species level and measured to the nearest millimetre. Measurements were obtained as either fork length or total length depending on species caudal fin morphology. Fish that were not captured but could be positively identified during sampling were recorded as 'observed'.

Habitat mapping

Assessment of stream suitability

Initially streams within the upper Lachlan catchment and Abercrombie catchment were assessed for suitability as refuge habitat for Macquarie Perch via a desktop study. Streams or stream sections were identified which provided both suitable habitat and had a barrier downstream which would be effective at preventing access by pest fish species such as Redfin Perch and European Carp. The following selection criteria were applied for this purpose:

- The required habitat variables as identified in Gilligan et al. (2010) including run (area), small complex rocks, riffle (area), undercut banks (length), large simple snags, small complex snags were mapped and then analysed via an Artificial Neural Network model to determine if they were present in proportions that the model predicted were conducive to a high probability of Macquarie Perch occupancy.
- A barrier to fish passage was present (e.g. a natural falls, road crossings) which was likely to prevent invasion by pest fish species across the range of river levels, including major flood events. The barrier had to be of sufficient head loss and or velocity, so as to exclude the passage of Redfin Perch or other pest fish. Sites with a velocity of greater than 0.5m/sec and a distance greater than 2 m were identified (Davis 2000).
- An adequate length of stream was available upstream of the barrier to provide enough viable habitat for a large self-sustaining population to establish to ensure long term maintenance of genetic diversity. A minimum of 15 km of stream above the barrier was identified as the length of stream required to provide sufficient habitat for a viable population (Gilligan. pers. comm.)
- Absence of pest fish species based on sampling results.
- The reach had the support of local landholders and recreational angling clubs.

Once suitable streams were identified via the desk top study, intensive field surveys were conducted to confirm the presence of an effective barrier to fish passage, the quality of the habitat upstream and overall suitability of the potential sites.

After the initial field surveys were completed, detailed aquatic habitat mapping was undertaken on the two most suitable sites to determine if the appropriate habitat requirements for Macquarie Perch were present.

Aquatic habitat above these barriers was mapped for a distance of 5 km upstream of the barrier to determine the suitability of the habitat for Macquarie Perch. Five kilometres was determined to be an adequate representation of the habitat of the chosen reach. The length of stream mapped was also restricted by budgetary constraints. These habitats where mapped using the techniques developed by Gilligan *et al.* (2010).

Substratum, mesohabitat, physical cover, macrophyte beds, willows, eroded and undercut banks and depth were mapped in the field using hand-held PDA units (Dell Axim X51U and MIO Digi-walker pocket PC) with ESRI Arcpad 6.0.3 data acquisition software. Each PDA was linked to a Garmin 72 GPS unit via a bluetooth device (i.e. Trek Bluetooth Battery Adapter) to record positional data. Each PDA was loaded with the 1: 50,000 topographical map (GDA 94_MGA Zone 55) for that region as a background layer at a screen resolution of 1:2,000. Two technicians were each equipped with a mapping kit, and working in pairs, mapped all the habitat features within the bank-full river channel. The data capture system allowed for the recording of positional data in either of two formats: position dependent or position independent, depending on the habitat feature being recorded. All data was uploaded into a GIS for processing.

Predictive modeling

Habitat values for the mapped reaches were pre-processed via Principal Component Analysis PCA and an Artificial Neural Network as described in Gilligan *et al.* (2010) to estimate the probability of Macquarie Perch occupying each potential reach due to the presence or absence of suitable habitat attributes.

Results

1- Streams assessed

The following streams were assessed for their suitability as a refuge site for the re-establishment of a Macquarie Perch population:

Upper Lachlan Catchment

The only stream in the upper Lachlan Catchment that contained the required habitat attributes and showed potential as being a possible refuge site was the Crookwell River. The Crookwell River was mapped by Gilligan *et al.* (2010). This mapping identified that only a small isolated section of the Crookwell River contained the required habitat attributes for the Macquarie Perch. The barriers present on the Crookwell River were also small to medium barriers with less than a metre in head differential and therefore not considered to be effective at preventing the colonisation of pest fish species at higher river levels.

Abercrombie Catchment

Within the Abercrombie catchment several streams showed potential to contain the required habitat attributes and provide possible refuge sites including;

- Wiaborough Creek
- Bolong River
- Retreat River
- Mt Werong Creek
- Isabella River

These streams were inspected to identify potential barriers to fish passage using a combination of Geographic Information Systems (GIS) layers, aerial photography, local knowledge and ground-truthing. Potential barriers were identified on the Retreat River, Bolong River, Mt Werong Creek and the Wiaborough Creek. Further details of each site are summarised below.

Figure 1: Map of the Upper Lachlan and Abercrombie study area

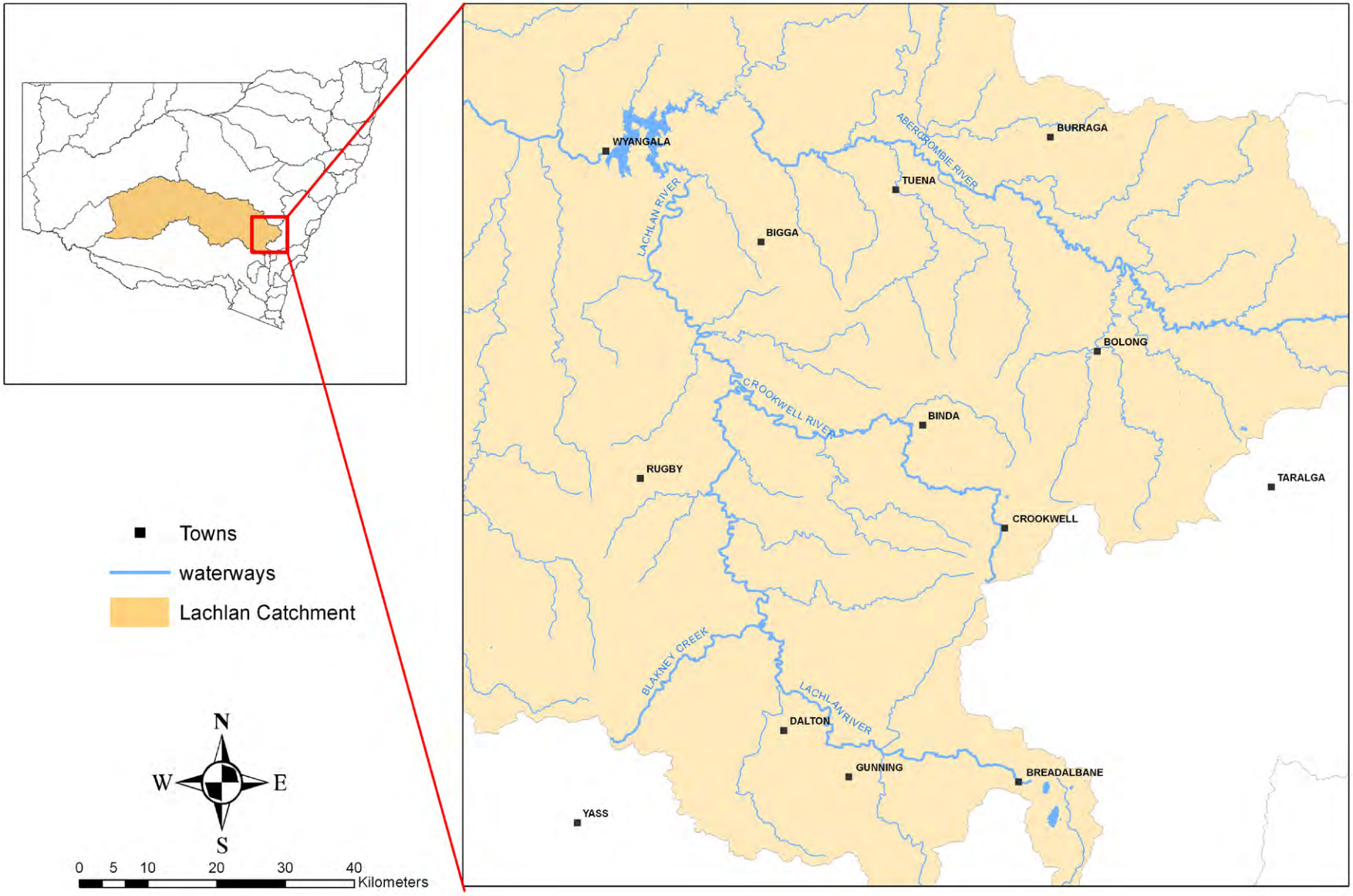
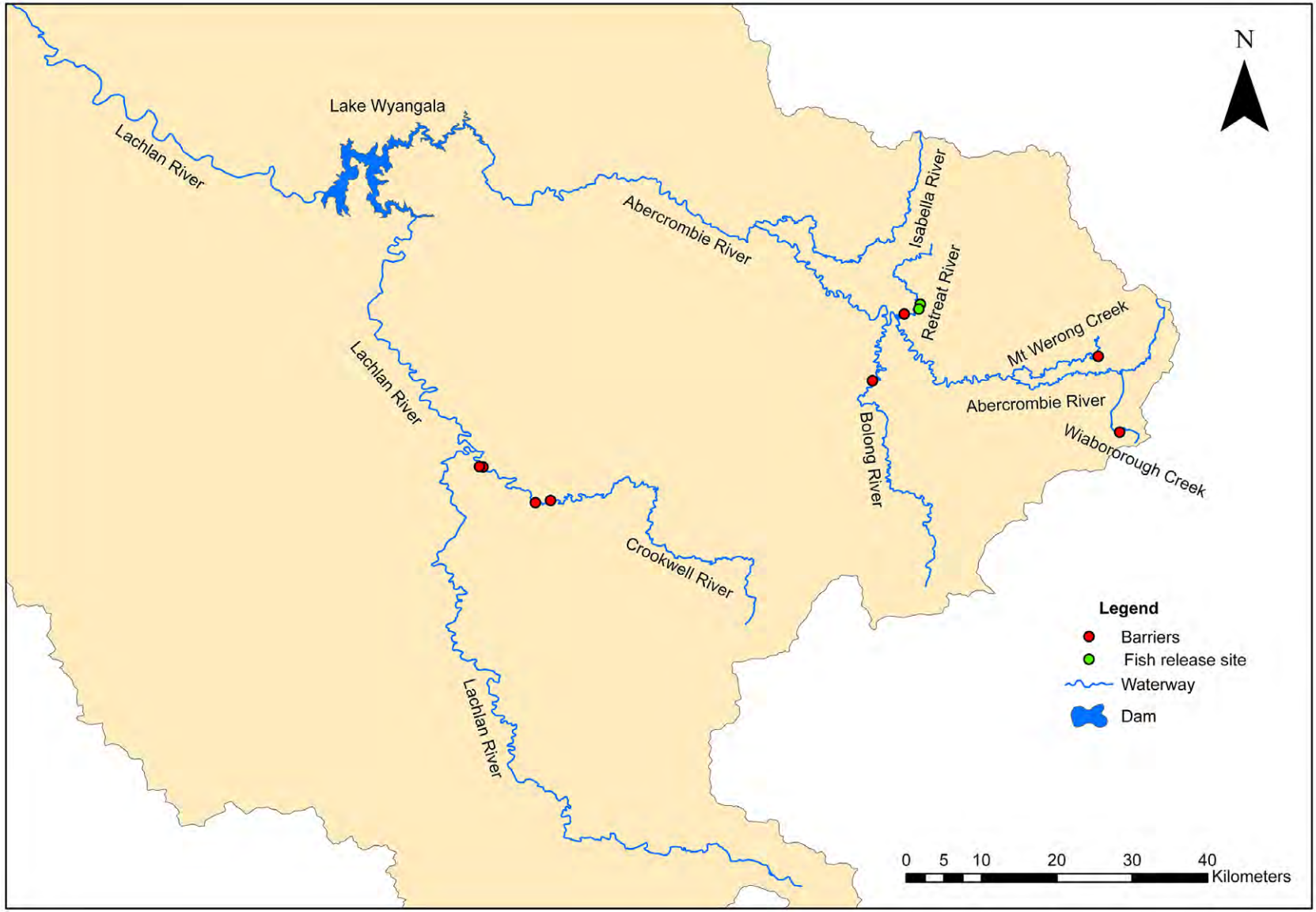


Figure 2: Location of the barriers identified and the release sites.



Retreat River

A set of falls were identified in the Retreat River, approximately 2-3km from its confluence with the Abercrombie River. The falls are a natural barrier to fish passage, with a head loss of approximately 2.5 m, velocities much greater than 0.5m/sec over a significant distance. The barrier is likely to be effective in excluding pest fish from the stream above, even during high flows. The river geomorphology in the area contains steep rocky walls which constricts lateral movement of water during a high flow event (see Figure 3). Even during potential drown-out of the barrier, the velocities in the river would most likely be sufficient to restrict fish passage. Anecdotal advice from local landholders suggests that there are no pest fish species above the falls. The results from the fish sampling also found no pest fish present during any of the three sampling events undertaken as part of this project.

Figure 3: Views of the Retreat River falls at Lat 34.11510S, Long 149.64398E

The Retreat River flows mostly through National Park and is very inaccessible for most of its length. The river has some excellent habitat attributes, including native riparian vegetation for the length of the river.

Figure 4: Views of the Retreat River at Lat 34.091100S, Long 149.65765E

Figure 5: Views of the Retreat River at Lat 34.04902S, Long 149.66119E

Risk Assessment for the Retreat River

The Lachlan Catchment Management Authority (CMA) required a risk assessment be carried out for each of the potential sites to identify potential risks, the likelihood they could occur and the consequences if they did occur.

This risk assessment was carried out using the Lachlan CMA's Risk Assessment Matrix for each of the potential streams.

Identification		Management		
Issue	**Mode of failure**	**Likelihood**	**Consequence**	**Action**
What is the issue?	**How will it fail or cause a risk?**	**What is the likelihood of the risk occurring?**	**What is the level of consequence if the risk occurs?**	**What needs to be done to mitigate against the risk occurring?**
Lack of refuge pools	There are insufficient refuge pools to maintain the fish during dry periods.	Likely	Medium There may be some impact on Macquarie Perch numbers during dry times due to the lack of drought refuges.	There is the possibility of creating more refuge pools by dredging pools. If a population of Macquarie Perch were to be established, there may be some losses of fish during dry times due to the lack of refuge pools. Further mapping of the river may identify more refuge pools in the areas that have not been mapped.
Competition and predation from Salmonids stocked into this area by local anglers	Salmonids may impact on the success of Macquarie Perch stocking in the Retreat River due to competition and predation.	Likely	Medium Stocking effectiveness may be reduced or even rendered ineffective	Negotiate with the local fishing clubs involved in Salmonid stocking to try to avoid stocking the area with Salmonids during the Macquarie Perch establishment period. Cease issuing permits to stock Salmonids into this section of river. Pre-existing population and natural recruitment of Salmonids may prevent successful re-establishment of Macquarie Perch regardless of whether stocking ceases. Removal of the Salmonids from this section, this is likely to be cost prohibitive, ineffective and unpalatable to stake holders (i.e. recreational anglers)

This reach was identified as the best candidate refuge site for release and re-establishment of a potential Macquarie Perch population. It contains all of the required habitat attributes, an appropriate barrier and the required length of stream. However, it has a low number of deep refuge pools to support the fish over dry/drought times. The high populations of Salmonids could also be detrimental to any proposed stocking of Macquarie Perch through either competition or predation. The Retreat River was actively stocked with Salmonids, namely Rainbow Trout, up until 2009 when over 5,500 were stocked per year by the Central Acclimatisation Society (CAS). There is also evidence of natural recruitment occurring due to the presence of different size classes and juvenile Brown Trout which have not been stocked.

The CAS has been involved with this project and fully supports the objectives. The group has actively promoted the project within its regional branches, including those that have historically stocked the Retreat River. The group has agreed to refrain from stocking the Retreat River with Salmonids for the duration of the project to allow the Macquarie Perch juveniles released a greater chance of survival. However, Salmonids will remain in the Retreat River as there is evidence that there is a naturally recruiting population, but the discontinuation of stocking will certainly impact on the number and allow a greater chance for the juvenile Macquarie Perch to survive and establish over time.

Bolong River

The desktop assessment and ground truthing determined that there is a series of falls on the Bolong River over a distance of about 1 km. These falls are locally referred to as “The Bars” (see Figure 6). The falls and the river upstream were assessed as a potential refuge site as part of this project.

Figure 6: Views of the Bolong River at “The Bars” (at Lat 34.19489, Long 149.60602)

The assessment determined that the falls are a barrier to fish passage and the local landholders advise:

- there are no pest fish above the falls,
- Carp do occur at the bottom of The Bars and can often be seen there,
- the large hole below The Bars used to be a good place to catch Macquarie Perch, but none were caught above The Bars.
- There are still resident Salmonid populations above The Bars.

Site inspections determined that above The Bars, the Bolong River flows through cleared farm land and has poor riparian vegetation, with little native vegetation (see Figure 7). The majority of the riparian vegetation is willows, blackberry, broom grass and other weed species. The in-stream habitat values were good with large pools, rocks, rapids and riffles.

Figure 7: Views of the Bolong River upstream of The Bars (at Lat 34.19867S, Long 149.60529E)

Habitat features in the reach above The Bars were mapped but did not have the required habitat attributes that Macquarie Perch require, due to a deficiency of riffles and run mesohabitats. The reach did however have much larger, deeper pools that could provide drought refuge.

The Bolong River has been sampled three times in the past at two separate locations, through other projects. Species caught in these events were Mountain Galaxias, Gambusia and Carp. Phils River has also been sampled in the past and species captured there were Mountain Galaxias, Gambusia and Brown Trout.

The river also has another barrier to fish passage upstream of The Bars in the form of a disused road crossing that has been made redundant by a bridge on the Golspie Road (see Figure 8).

Figure 8: Disused road crossing on the Bolong River (at Lat 34.29718, Long 149.62540)

There is also a barrier on one of the major tributaries of the Bolong-Phils River. This is also a disused road crossing that has been made redundant by a nearby bridge (see Figure 9).

Figure 9: Disused road crossing on Phils River at (Lat 34.22803, Long 149.55521)

Risk assessment for the Bolong River

Identification		Management		
Issue	**Mode of failure**	**Likelihood**	**Consequence**	**Action**
What is the issue?	**How will it fail or cause a risk?**	**What is the likelihood of the risk occurring?**	**What is the level of consequence if the risk occurs?**	**What needs to be done to mitigate against the risk occurring?**
Habitat features did not meet requirements as determined from the Abercrombie habitat mapping assessment	There may not be the required habitat features which Macquarie Perch require for survival.	Likely	High	Further mapping to determine if there is suitable habitat else where in the Bolong River. Further assess and define the habitat requirements that Macquarie Perch require.
Competition and predation from Salmonids	Salmonids may impact on the success of Macquarie Perch stocking due to competition and predation.	Likely	Medium Stocking effectiveness may be reduced or even rendered ineffective	Negotiate with the local fishing clubs involved in Salmonid stocking to try to convince them to not stock the area during the Macquarie Perch establishment period. Cease issuing permits to stock Salmonids into this section of river. Natural recruitment of Salmonids may prevent successful re-establishment of Macquarie Perch regardless of whether stocking occurs.

Wiaborough Creek

Desk topping and ground truthing determined that there is a barrier to fish passage in the form of a road crossing on the Jerrong Road at Lat 34.2504S, Long 149.8727E. The local landholders have advised that there are no pest fish above this road crossing. Due to the relatively low nature of this barrier (<1 m), and the existence of a wide floodplain area, it is likely that during major flood events this barrier would drown out and allow for fish passage either over the structure or around it (see Figure 10).

Figure 10: Views of the road crossing on Wiaborough Creek

The site has very good habitat above this road crossing. Upstream the creek flows through well vegetated, relatively undisturbed native forest, which is both privately and publicly owned (National Park) before running through farmland. There are some excellent habitat features in the forested section of the creek (see Figure 11).

The section of the creek above the barrier is only relatively short and may not be extensive enough to support a viable Macquarie Perch population. There is only approximately 6-7 km of stream habitat above the road crossing in Wiaborough Creek.

Due to the reasons listed above, and the risk assessment below, this site has been ruled out as a potential refuge site at this stage for Macquarie Perch.

Figure 11: Views of habitat in the Wiaborough Creek (at Lat 34.25618, Long 149.90120)

Risk assessment for Wiaborough Creek

Identification		Management		
Issue	**Mode of failure**	**Issue**	**Mode of failure**	**Issue**
What is the issue?	**How will it fail or cause a risk?**	**What is the likelihood of the risk occurring?**	**What is the level of consequence if the risk occurs?**	**What needs to be done to mitigate against the risk occurring?**
Road crossing barrier is upgraded.	If the road crossing is upgraded and complies with current policies to allow fish passage, the barrier will be removed.	Unlikely. Crossing is in good repair and adequately meets transport needs at present. Department would require retention of barrier if this site was chosen and Council subsequently programmed an upgrade.	Medium If the barrier is removed, Redfin Perch and other pest fish will be able to access the upper reaches of the creek.	If Macquarie Perch were established in the upper reaches of the creek then the barrier would need to be maintained. Any upgrade of the road crossing would need to maintain the barrier to fish passage. This would require approval from Fisheries NSW.
Competition and predation from Salmonids	Salmonids may impact on the success of Macquarie Perch stocking due to competition and predation.	Likely	Medium/low Stocking effectiveness may be reduced or even rendered ineffective	Negotiate with the local fishing clubs involved in Salmonid stocking to try to convince them to avoid stocking during the Macquarie Perch establishment period. Cease issuing permits to stock Salmonids into this section of river. Pre-existing population and natural recruitment of Salmonids may prevent successful re-establishment of Macquarie Perch regardless of whether stocking ceases.
Barrier drown out	High stream flows will cause the barrier to drown out and allow for fish passage either over, or around, the barrier.	Likely	High Due to the nature of the road crossing it is likely that drown out would occur during a moderate or major flood event.	Possible works to increase the effectiveness of the barrier or construct a more effective barrier upstream of the existing barrier.
The length of stream not adequate to establish a population	The length of stream above the barrier may not be adequate to support a large enough population to maintain genetic diversity.	Possible	Low If a population was established it may not be self-sustaining.	Need to investigate further the amount of habitat that is required to maintain a genetically viable population of Macquarie Perch.

Mt Werong Creek

Based on desktop and ground truthing work, the Department identified another potential refuge site at Mt Werong Creek. There is a barrier to fish passage in the form of a road crossing where the Jerrong Rd crosses the Mt Werong Creek (see Figure 12). Due to the relatively low nature of this barrier (<1 m), and the existence of a wide floodplain area, it is likely that during major flood events this barrier would drown out and allow for fish passage either over the structure or around it.

The section of the creek above the barrier is only relatively short and may not be extensive enough to support a viable Macquarie Perch population. There is only approximately 6-7 km of stream habitat above the road crossing in the Mt Werong Creek.

Due to the reasons listed above, and the results of the risk assessment below, this site has been ruled out as a potential refuge site at this stage.

Figure 12: Road crossing forming a fish passage barrier on the Mt Werong Creek (at Lat 34.1657, Long 149.8756)

Risk assessment for the Mt Werong Creek

Identification		Management		
Issue	**Mode of failure**	**Likelihood**	**Consequence**	**Action**
What is the issue?	**How will it fail or cause a risk?**	**What is the likelihood of the risk occurring?**	**What is the level of consequence if the risk occurs?**	**What needs to be done to mitigate against the risk occurring?**
Road crossing is upgraded.	If the road crossing is upgraded and complies with current policies to allow fish passage, the barrier will be removed.	Unlikely Crossing is in good repair and adequately meets transport needs at present. Department would require retention of barrier if this site was chosen and Council subsequently programmed an upgrade.	High If the barrier is removed Redfin Perch and other pest will be able to access the upper reaches of the creek and the Macquarie Perch.	If Macquarie Perch were established in the upper reaches of the creek than the barrier would need to be maintained. Any upgrade of the road crossing would need to maintain the barrier to fish passage. This would require approval from Fisheries NSW.
Competition and predation from Salmonids	Salmonids may impact on the success of Macquarie Perch stocking due to competition and predation.	Likely	Medium Stocking effectiveness may be reduced or even rendered ineffective	Need to negotiate with the local fishing clubs involved with Salmonid stocking to try and convince them to avoid stocking during the Macquarie Perch establishment period. Cease issuing permits to stock Salmonids into this section of river. Natural recruitment of Salmonids may prevent successful re-establishment of Macquarie Perch regardless of whether stocking occurs.
Barrier drown out	High stream flows will cause the barrier to drown out and allow for fish passage either over or around the barrier.	Likely	High Due to the nature of the road crossing it is likely that drown out would occur during a major flood event.	Possible works to increase the effectiveness of the barrier or construct a more effective barrier upstream of existing.
The length of stream is not adequate to establish a population	The length of stream above the barrier may not be adequate to support a large enough population to maintain genetic diversity.	Possible	Low If a population was established it may not be self-sustaining	Need to investigate further the amount of habitat that is required to maintain a genetically viable population of Macquarie Perch.

Isabella River

Based on the desk top assessment, there were no barriers to fish passage or good potential habitat identified in the Isabella River, so it has been dismissed as a potential refuge site for the purposes of this project.

2 – Breeding and reintroduction

The original intent of the project was to identify a location for the release of the 122 Macquarie Perch that were captured from the upper Lachlan Catchment to form the refuge population. These fish where held at the Narrandera Fisheries Centre (NFC) during the investigation into potential refuge sites. While these fish were in captivity, the Department took the opportunity to attempt to breed these fish, in order to stock their progeny into the preferred refuge site, once determined. If the captive fish did not successfully breed, then the original fish would also be released at the preferred refuge site.

Historically, Macquarie Perch have not bred successfully under normal hatchery and captive environments. All programs to date have been unsuccessful at rearing large numbers of Macquarie Perch fingerlings for re-introduction (Ingram *et al.* 1994).

Whilst the Victorian Government has produced Macquarie Perch fingerlings for several years, their program has relied on harvesting wild running-ripe females during their annual spawning run (Gooley and McDonald 1988). NSW does not have access to similar impoundment populations of Macquarie Perch that make annual spawning runs, such as those in Dartmouth Dam in Victoria, which would enable a similar program in NSW.

The NSW Government did attempt to produce Macquarie Perch in captivity at the NFC, from 1978 through to 1990 (Ingram *et al.* 1994). Throughout this 12 year period, only one out of 98 female brood fish was successfully induced to spawn (Ingram *et al.* 1994).

Funding for the latest captive breeding program was provided by the Recreational Freshwater Fishing Trust. Techniques trialed involved the development of an artificial stream attached to an earthen pond in which the brood fish were housed. It was hypothesized that lotic habitats provided in the artificial stream may provide physical conditions or behavioral stimuli necessary to trigger gonad maturation and perhaps natural spawning under captive conditions. More conventional hatchery techniques trialed included new products (Ovaplant), or combinations of products (Ovaprim, Folligon and Receptal), to induce ovulation of appropriately conditioned fish.

Results from captive breeding trials in 2009-2010

Most of the Macquarie Perch rescued from the Abercrombie River in Autumn and Winter 2008 were immature when captured. As a result, very few sexually mature fish were available for breeding trials in 2009. Despite this, hatchery staff at NFC were able to demonstrate that viable male gametes could be produced and that some progress towards gonad maturation of mature females was possible. However, the hatchery staff were unable to initiate ovulation of either of the two sexually mature females injected with hormone. They did document evidence that suggested at least one female had spawned naturally within the pond/artificial stream, but were not able to recover any eggs, larvae or juveniles (Gilligan pers. comm.).

Results from captive breeding trials in 2010-2011

By late 2010 a majority of the fish held at NFC were sexually mature. Ovulation was induced for eight females, but only two produced eggs which were fertilised, with a fertilisation rate at 15% and hatch rate of 75%. This was the first time that Macquarie Perch had been bred using captive held brood fish. After nine weeks the fry had grown to 30 mm. By 16 weeks they had grown to 40-50 mm and 1 gram and were ready for release. A total of 137 fingerlings were produced. These fish where released into the preferred refuge site within the Retreat River in March 2011 (see attached media articles in Appendix 1). The release event included representatives from NSW Department of Primary Industries, the Lachlan CMA and the CAS (see Figure 12).

Results from captive breeding trials in 2011-2012

Production improved again during the 2011 breeding season, with 7,500 fingerlings produced from four successful spawning events. All but 50 of these were released into the preferred refuge site within the Retreat River in February 2012. The remaining 50 fingerlings were retained

at NFC to allow collection of data on captive growth rates and to trail release of fish at a larger size. These larger fish where released into the refuge site in October 2012.

Figure 13: Release of the first captive bred Macquarie Perch into the preferred refuge site on the Retreat River by Karl Schaerf (CAS) and Fin Martin (Lachlan CMA), March 2011.

3 – Sampling results

Retreat River sampling results

Desk top and ground truthing analysis of aquatic habitat in the reach above the falls in the Retreat River determined that it contains the habitat attributes required to ensure a high probability of Macquarie Perch occupancy. This reach was then sampled to characterise the existing fish community and to determine if a natural population of Macquarie Perch was present. No Macquarie Perch were sampled in the initial sampling which was carried out in November 2011 (see Table 1-3).

Five fish species have been sampled from the three survey sites over seven different survey dates (Table 1-3). This included three native species (Mountain Galaxias, Australian Smelt and Macquarie Perch) and two alien species (Brown Trout and Rainbow Trout) which are not considered to be pest fish species as they can coexist with Macquarie Perch and do not pose a disease risk.

The standardised sampling yielded a catch of 836 fish and an estimated additional 395 were observed from the three sites over the previous sampling dates. Mountain Galaxias were the most abundant species, making up 70.6% of the total catch. The next most abundant fish was

Australian Smelt, comprising 20.9% of the total sample. These were followed by relatively low abundances of both trout species present, with Rainbow Trout making up 4.5% of the total sample, Brown Trout 2.8% and lastly Macquarie Perch making up 1.2% of all the fish captured and observed.

In total there have been 12 Macquarie Perch captured and 3 observed. These recaptures have been on three separate sampling dates and Macquarie Perch have been captured at all three of the sample sites, despite only being released at the Mid Retreat site. All of the Macquarie Perch that have so far been released have been chemically marked to allow for identification from potential wild fish. All of the Macquarie Perch that have been captured to date have been positively identified as hatchery bred fish.

The largest Macquarie Perch captured to date measured 197mm and weighed 115g, which was captured at the Mid Retreat site on the 20 February 2013. The size if this fish would indicate that it is likely to be a fish from the first stocking in March 2011, however, this is not possible to confirm without killing the fish to age it by examining its otolith.

The number of fish that have been recaptured is an encouraging sign, as it demonstrates that at least some of the stocked fish have survived for a period of almost two years. Secondly it is a good indication that the site has the potential to establish a viable self-sustaining population, but long-term monitoring of the site is required to confirm this outcome.

Tables 1-3: Abundance of fish recorded at each of the sample sites per sample date. Values in parentheses are the number of individuals observed but not collected during sampling.

Mid Retreat

	17/11/09	8/3/11	13/10/12	14/2/12	2/5/12	23/10/12	20/2/13	Total
Mountain Galaxias	48 (10)	87 (13)	17 (9)	17 (0)	28 (7)	9 (0)	136 (0)	342 (39)
Australian Smelt	41 (2)							41 (2)
Rainbow Trout	11 (2)	1 (0)	1 (0)		1 (2)		1 (0)	15 (4)
Brown Trout	3 (0)			1 (0)		2 (0)	3 (0)	9 (0)
Macquarie Perch					1(0)		3 (0)	4 (0)
Total	**103 (14)**	**88 (13)**	**18 (9)**	**18 (0)**	**30 (9)**	**11 (0)**	**143 (0)**	**411 (45)**

The Falls

	18/11/09	10/3/11	12/10/11	18/4/12	23/10/12	20/2/13	Total
Mountain Galaxias	31 (9)	22 (26)	22 (5)	31 (10)	5 (0)	64 (19)	175 (69)
Australian Smelt	49 (160)						49 (160)
Rainbow Trout	7 (2)	1 (0)	1 (0)	0 (1)			9 (3)
Brown Trout				4 (1)			4 (1)
Macquarie Perch				6 (1)	0 (1)	1 (0)	7 (2)
Total	**87 (171)**	**23 (26)**	**23 (5)**	**41 (13)**	**5 (1)**	**65 (19)**	**244 (235)**

The Sink

	17/11/09	9/3/11	13/10/11	3/5/12	24/10/12	19/2/13	Total
Mountain Galaxias	20 (40)	21 (17)	11 (6)	29(30)	7 (0)	46 (17)	134 (110)
Australian Smelt	5 (0)						5 (0)
Rainbow Trout	12 (1)	1 (1)	4 (1)	2(0)	1 (0)	1 (0)	21 (3)
Brown Trout	6 (0)			9(1)	4 (0)	1 (0)	20 (1)
Macquarie Perch				0(1)		1 (0)	1 (1)
Total	**43 (5)**	**22 (18)**	**15 (7)**	**40 (32)**	**12 (0)**	**49 (17)**	**181 (115)**

Conclusions and recommendations

Through the desk top survey, inspections of short-listed sites and local knowledge, six potential refuge streams were identified in the Upper Lachlan and Abercrombie Catchments above Wyangala Dam for the establishment of a refuge Macquarie Perch population. Of these, only one met all the criteria for a potential refuge site; the Retreat River above the falls.

The site has been stocked with hatchery bred Macquarie Perch on two separate occasions. Initial surveys indicate that a portion of these fish have survived and are doing well.

The Retreat River had the necessary habitat requirements as described in Gilligan *et al.* (2010), no existing Redfin Perch or other pest fish present and a barrier to fish passage which was considered likely to prevent their invasion. Other positive aspects of the Retreat River is that the majority of its catchment is within a National Park, there is very limited access to recreational fishing due to the rugged and steep terrain, and there is ongoing support from the local recreational fishing community for the project. The CAS members have voluntarily agreed to refrain from stocking Salmonids into the Retreat River for the duration of the project to demonstrate their support for the project.

In order to secure the viability of the Retreat River population of Macquarie Perch, and the population more generally within the Upper Lachlan and Abercrombie Rivers, the following recommendations are suggested for further investigation/work:

- As a precautionary measure, Salmonid stocking should continue to be voluntarily discontinued by the local Central Acclimatisation Society to minimise the risk of competition and predation on juvenile stocked Macquarie Perch. It is hoped that existing Salmonid numbers may decline over time if the populations are not self-sustaining in the Retreat River. This should be continued until such time as a viable self sustaining population of Macquarie Perch has established.
- It is recommended that there is continued monitoring of the Retreat River population over at least the next five years to determine if the stocked fish have survived and/or are breeding.
- The Retreat River should continue to be stocked with hatchery reared Macquarie Perch fingerlings from NFC until monitoring determines whether there has been successful establishment and recruitment of a Macquarie Perch population, or not.
- If stocking of hatchery reared fish cannot continue, investigate the potential to translocate wild Macquarie Perch directly from the Abercrombie into the Retreat River.
- The continuation of monitoring of the Abercrombie and Upper Lachlan Rivers to determine the status of the remnant Macquarie Perch population, the spread and establishment of Redfin Perch and their impact on the Macquarie Perch population.
- Work should be undertaken to determine other potential refuge sites outside the Upper Lachlan and Abercrombie catchments, particularly those catchments where wild Macquarie Perch are

now considered extinct, such as the Macquarie River catchment. A similar process should be used in these areas to assess the suitability of potential sites prior to releasing any fish.

- If a self-sustaining population is not established in the Retreat River and Redfin Perch spread further up the Abercrombie system and significantly impact upon the remnant population, the option of rescuing and translocating adult or sub-adult fish into the refuge site should be investigated.
- Further habitat mapping of the Bolong River be undertaken to identify reaches that may provide adequate habitat attributes for Macquarie Perch.
- Fish sampling should be undertaken in the Bolong River to determine the fish community present.
- Habitat mapping be undertaken of sections of the Wiaborough and Mt Werong Creeks, if it is determined that there is adequate length of stream to support a viable population. Fish sampling of both these creeks is required to determine the fish populations present.
- Further mapping of the Retreat River should be undertaken to determine the extent of viable habitat and the potential for further drought refuge upstream of the section that has been mapped to date.

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Appendix 1 Media articles

Figure 14: Western Advocate 22 September 2010

Threat to Macquarie perch highlighted

THE protection of the threatened fish species Macquarie perch was highlighted at a presentation to the Central Acclimatisation Society last weekend.

Fishing conservation manager for the Greater Murray, Luke Pearce, addressed the group, on the threatened species and outlined projects that Industry and Investment Fisheries has running to help protect and maintain this species.

Mr Pearce said the last major stronghold for Macquarie perch is the the Abercrombie River, which is under major threat from Red Fin Perch or English Perch.

Red fin and English perch are both introduced species, that have recently been discovered in the Upper Lachlan system. "Red fin perch are a major threat to Macquarie Perch and are know to predate on them and carry a virus that can be lethal to them," Mr Pearce said.

"If they move up the Abercrombie systems, as they have done in the Lachlan, they could severely impact on the Macquarie Perch population there or wipe them out all together."

Mr Pearce discussed what the department is doing to prepare for these potential impacts and how the Central Acclimatisation Society is helping to try and improve areas for the potential establishment of new populations that will be safe from the impact of red fin perch.

MEETING: Greater Murray fishing conservation manager Luke Pearce recently addressed the Central Acclimatisation Society in Bathurst.

HIV virus hides cells

AUSTRALIAN scientists have revealed the most complete picture yet of the way HIV maintains its infectious grip on the body.

The research has explained how the virus hides dormant versions of itself in a reservoir of cells out of the reach of conventional treatments but still able to "wake up" in the future, posing a major hurdle to a total cure for HIV.

The research is published in the journal Proceedings of the National Academy of Science this week.

Cabonne has new mayor

BOB Dowling has been elected mayor of Cabonne after defeating Kevin Duffy seven votes to four at this week's mayoral election.

Councillor Dowling was the only person to challenge Cr Duffy for the top job.

The former Cabonne deputy mayor, Cr Dowling said he had been considering running for the position for the last fortnight to

Figure 15: Canberra Times 11 March 2011

Perched on the edge of extinction

FLOW-ON: Using "electro-fishing", NSW Department of Industry and Investment technician Lachie Jess conducts a census of the Abercrombie River. Photos: GARY SCHAFER

By Christopher Knaus

Deep in the bush of rural NSW, at a quiet and otherwise unremarkable stretch of river, the survival of the endangered Macquarie perch has been given a glimmer of hope.

Just 50 kilometres south-east of Bathurst, 200 tiny captive-bred fingerlings will be released today into the Abercrombie River, in what researchers are describing as a momentous breakthrough in efforts to breed the declining species in captivity.

Once widespread across upland and midland areas of the huge Murray-Darling Basin, the species has been in rapid decline since the mid-1900s.

Habitat degradation, riverbank erosion, the introduction of foreign fish species such as redfin, and dam construction have combined to push the species to the brink of extinction, leaving just six small, isolated populations intact across NSW.

But today's release could signal an end to the species' seemingly irreversible decline.

It is the first time that researchers have been able to create an environment in which a population of Macquarie perch, matured in captivity, have produced young.

NEW HOME: Conservation manager Luke Pearce holds a bag of Macquarie perch fingerlings, left, and a fingerling tagged for release today.

Previous attempts at captive breeding were unsuccessful, but researchers with the NSW Department of Industry and Investment have completely recreated the Macquarie perch's natural breeding environment, causing a breakthrough in captive breeding.

Department of Industry and Investment conservation manager Luke Pearce is in charge of releasing the 200 young Macquarie perch, who are the first product of the successful breeding program.

Mr Pearce said the significance of the breeding breakthrough could not be overstated.

"Given how the decline has gone, without having a successful breeding and reintroduction program, I think that's crucial to the survival of the species," he said.

From here, researchers hope to begin breeding thousands of fish under the program. This will, it is hoped, continue to build strong populations at sites spread across the state.

Yet the 200 fingerlings delivered into the remote river south-east of Bathurst today will remain vital for the assurance of the Macquarie perch's future.

The small body of water at the Abercrombie River remains one of the only areas conducive to Macquarie perch breeding that remains free of the invasive redfin perch.

"It's a little bit like a Noah's Ark I guess, that the redfin won't be able to get to," Mr Pearce said.

"We've had about a two-year project . . . to try and find a site that does have a barrier . . . and all the requirements that the fish need to survive and reproduce," he said.

The fingerlings have been chemically marked, and will be monitored over coming years to check on their progress.

Appendix 2 Photos of recaptured Macquarie Perch

Figure 16:. Macquarie Perch recaptured 18 April 2012

Figure 17: Macquarie Perch recaptured 19-20 February 2013. 122mm, 132mm 140mm and 197mm respectively.