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# Fish surveys in the Upper Barwon Catchment



Prepared for: Corangamite CMA

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## 1 Introduction

Ecology Australia was commissioned by the Corangamite CMA to undertake aquatic fauna surveys, targeting two EPBC-listed fish species, little galaxias *Galaxiella toourtkoort* and Yarra pygmy perch *Nannoperca obscura*. Surveys were conducted at a combination of historic sites with known records for the target species and newly selected sites established within the Upper Barwon Flagship Program area, including the East and West Barwon River and a number of tributaries within the catchment.

A series of projects under the Upper Barwon Flagship Program aim to improve the health of waterways within areas of the catchment with significant impacts from riparian invasive species, such as willows *Salix* sp. and reed sweet grass *Glyceria maxima*. The presence of these species can result in lower instream habitat quality together with inhibited water flow and localised flooding. Locations within the flagship program area that support little galaxias and Yarra pygmy perch are prioritised, however knowledge on the current distribution and status of these threatened species in the sub-catchment is inadequate. This project aimed to address that knowledge gap.

### 1.1 Project objectives

The objectives of this project include:

- Undertake desktop review of previous records of little galaxias and Yarra pygmy perch, previous survey locations, and areas of potentially suitable habitat
- Select and prioritise fish survey sites in consultation with CCMA, including all historic sites for both species, aside from those recently surveyed (e.g. by ARI)
- Undertake fish surveys using appropriate sampling regime to detect both the target species and other species of interest including pest species, and assess habitat quality at each site
- Submit data to the Victorian Biodiversity Atlas (VBA)

### 1.2 Relevant background information on existing records

Yarra pygmy perch and little galaxias have previously been recorded within the Upper Barwon catchment during aquatic fauna surveys in 2000, 2008, 2011 and 2013, in addition to an eDNA record for little galaxias in 2018 (Table 1). The primary objective of this project is to confirm the presence of these two species at sites where they have previously been recorded. Yarra pygmy perch have previously been recorded at one site within and the Upper Barwon Flagship Program area and little galaxias have been recorded at four sites.

**Table 1 Historical records of little galaxias and Yarra pygmy perch in the Upper Barwon catchment. \* denotes eDNA record**

Species	Location	Latitude	Longitude	Year
Little galaxias	Unnamed tributary of East Barwon River up and downstream of Seven Bridges Road Gerangamete	-38.4793	143.7441	2018*
Little galaxias	Unnamed tributary of East Barwon River - upstream Railway Embankment Gerangamete	-38.4698	143.744	2013
Little galaxias	Unnamed tributary of East Barwon River - downstream Railway Embankment Gerangamete	-38.4699	143.743	2013
Little galaxias	Gosling Creek Wetland Upstream of Division Road Murroon	-38.4431	143.8179	2011
Little galaxias	Gosling Creek at Division Road Murroon	-38.438	143.8174	2008
Yarra pygmy perch	Barwon River downstream Colac-Lorne Road Birregurra	-38.3887	143.7696	2000
Yarra pygmy perch	Barwon River at Kildean Road Winchelsea	-38.2994	143.9375	2000
Yarra pygmy perch	Pennyroyal Creek off Bushs Road	-38.4088	143.8585	2008

### 1.3 Study Area

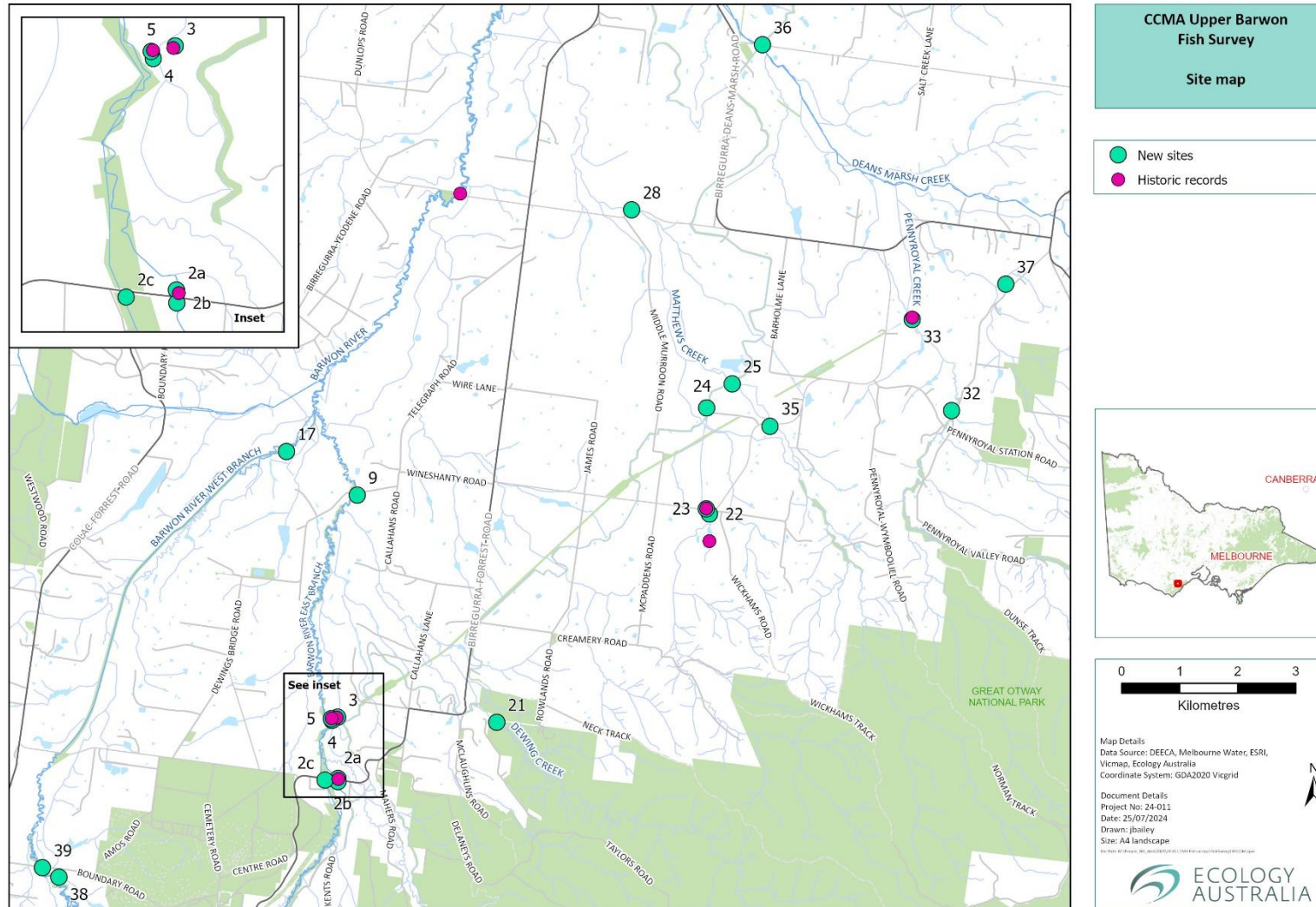
The study area for this project encompasses the East Barwon and West Barwon River branches, and Dewings Creek, together with a number of smaller tributaries including Pennyroyal Creek, Gosling Creek, and Matthews Creek. Sample locations included several historical record locations, in addition to new sites selected in conjunction with the CCMA (Table 2, Figure 1).

**Table 2 Sites selected for survey. \* denotes sites with a previous target species record.**

Site number	Site name	Latitude	Longitude	Catchment
<b>2a</b>	East Barwon wetlands downstream Birregurra-Forrest Road Barwon Downs	-38.4792	143.7440	East Barwon
<b>2b</b>	East Barwon wetlands upstream Birregurra-Forrest Road Barwon Downs	-38.4797	143.7440	East Barwon
<b>2c</b>	East Barwon main channel at Birregurra-Forrest Road Barwon Downs	-38.4794	143.7415	East Barwon
<b>3</b>	East Barwon Forrest Railway Abutment Refuge SE	-38.4697	143.7441	East Barwon
<b>4</b>	East Barwon Forrest Railway Abutment Refuge SW	-38.4702	143.7430	East Barwon



Site number	Site name	Latitude	Longitude	Catchment
5	East Barwon Forrest Railway Abutment Refuge NW	-38.4699	143.7429	East Barwon
9	East Barwon at Dewings Bridge Road	-38.4350	143.7479	East Barwon
17	West Barwon Paleo-Channel Confluence 2	-38.4283	143.7347	West Barwon
21	Dewings Creek upstream of Griffins Road	-38.4708	143.7755	Dewings Creek
22	Gosling Creek 50 m upstream of Division Road Murroon	-38.4389	143.8180	Gosling Creek
23	Gosling Creek downstream of Division Road Murroon	-38.4381	143.8174	Gosling Creek
24	Gosling Creek downstream Wurdi Boluc Channel	-38.4224	143.8177	Gosling Creek
25	Matthews Creek at Wurdi Boluc Channel	-38.4187	143.8228	Matthews Creek
28	Matthews Creek at Deepdene Road	-38.3915	143.8034	Matthews Creek
32	Pennyroyal Creek downstream Pennyroyal Station Road Pennyroyal	-38.4233	143.8660	Pennyroyal Creek
33	Pennyroyal Creek at BW Diversion Deans Marsh	-38.4091	143.8585	Pennyroyal Creek
35	Matthews Creek upstream of Murroon Road	-38.4254	143.8302	Matthews Creek
36	Pennyroyal Creek at Rifle Butts Road Whoorel	-38.3662	143.8296	Pennyroyal Creek
37	Unnamed Tributary of Pennyroyal - Deans Marsh Bird Hide	-38.4038	143.8770	Pennyroyal Creek
38	West Barwon 500 m upstream of Boundary Road Forrest (avulsion area from pump offtake pool)	-38.4939	143.6887	West Barwon
39	West Barwon upstream of Boundary Road Forrest (site of recent eDNA record)	-38.4924	143.6855	West Barwon



**Figure 1** Sites selected for survey within the Upper Barwon Catchment

## 2 Methods

### 2.1 Desktop assessment and site selection

A desktop assessment was conducted using the Victorian Biodiversity Atlas (VBA) and relevant previous survey reports (Ryan and McGuckin 2007; Ryan and McGuckin 2008; Saddler *et al.* 2009; Ryan *et al.* 2013) to confirm the locations within the Upper Barwon Flagship Area where the two target species have previously been recorded. This search included the Upper Barwon flagship program area which includes the Barwon River East Branch, Dewing Creek downstream of Great Otway National Park, and Barwon River West Branch downstream of West Barwon Reservoir to Dewing Creek confluence. A second search included the broader catchment including Pennyroyal Creek, Gosling Creek, Matthews Creek and Deans Marsh Creek.

Sites were selected using QGIS, including aerial imagery layers as provided by the CCMA for years 2007, 2013, 2014, 2016, and 2020. Water levels appeared lowest in the 2007 aerial imagery layer due season (summer) and it being from within the millennium drought. So, this layer was used to identify possible refuge pools on relevant tributaries and floodplain wetlands, particularly where high amounts of aquatic vegetation were evident in any of the aerial images. Potential sites were identified and in conjunction with Anthony Byrne (CCMA), final sites were selected. From the list of approximately 40 sites, site inspections were undertaken to eliminate less suitable surveys sites including those with unsuitable habitat or insufficient water levels. A total of 19 sites were selected and subsequently surveyed. Site inspection and identification of refuge pools was aided by the use of a drone (DJI Phantom 3 Pro) where applicable (e.g. large waterbodies, significant walking distances from access point or predominantly dry channels). Two additional sites were surveyed in mid-July, to investigate the positive eDNA record at Boundary Road on the Barwon West Branch.

### 2.2 Field assessment

Sampling approaches varied from site to site (Table 3) dependent on a range of factors including water depth, aquatic vegetation characteristics and conductivity. At most sites, 'Rapid backpack electrofishing assisted dip netting' was undertaken using a Smith Root LR20B or LR24 backpack electrofisher. This comprised 3-4 x 150 second shots, with a focus on dense aquatic vegetation to draw out the target species. Vigorous dip netting through the electrical field occurred immediately following cessation of 'power on' time, to capture any stunned fish from within dense aquatic vegetation.

Up to twelve bait traps were deployed overnight amongst aquatic vegetation, with a yellow glow stick placed inside to serve as an attractant. Bait traps were uniform, with 2 mm stretched mesh and a 40 mm entrance funnel. At one site (Site 23), where the water depth was too deep and salinity levels were outside the range for backpack electrofishing to occur, a larval fyke net was set to determine the presence of pest fish species. This larval fyke net had dual wings (2.5 m wing length and 1.25 m wing drop) and contained a rigid 50 x 50 mm rigid mesh exclusion grid. Only one net was set due to lack of suitable depth in all other areas of the site. Larval fyke nets are normally used to target small-bodied fish, but it was used in this instance to target pest fish (including large-bodied fish) due to depth suitability and the larger wing drop compared with standard nets. The potential for large specimens (e.g. large carp or redfin) to be excluded by the 50 x 50 mm exclusion grid was and is acknowledged as a limitation, although a range of smaller size classes would not have been excluded.

All fish captured were recorded by site and gear replicate. All individuals of the target species were measured per site to the nearest millimetre (total length). Adult and subadult Yarra pygmy perch were also weighed to the nearest 0.1 g. For other native fish species, up to 30 per site were measured to the nearest mm for fork length or total length as appropriate. Eels were not weighed, and their lengths were estimated. Eastern gambusia were counted but not measured. Any diseases and deformities were recorded.

Instream habitat assessment was undertaken at each site including notes and estimates on biological and physical attributes (e.g. wetted instream cover features, depth and flow characteristics, riparian vegetation and shading, aquatic vegetation characteristics, and substrate composition), potential and obvious sources of disturbance, and standard in situ water quality measurements (temperature, dissolved oxygen, electrical conductivity, pH and turbidity) were collected using a calibrated Horiba U52 water quality meter.

**Table 3 A summary of survey effort conducted at each site.**

Site number	Total effort
<b>2a</b>	4 shots of backpack electrofishing
<b>2b</b>	3 shots of backpack electrofishing
<b>2c</b>	4 shots of backpack electrofishing
<b>3</b>	3 shots of backpack electrofishing and overnight deployment of 6 bait traps
<b>4</b>	7 shots of backpack electrofishing and overnight deployment of 6 bait traps
<b>5</b>	Overnight deployment of 6 bait traps
<b>9</b>	Overnight deployment of 12 bait traps
<b>17</b>	Overnight deployment of 12 bait traps and 6 mins of dip netting
<b>21</b>	4 shots of backpack electrofishing
<b>22</b>	Overnight deployment of 12 bait traps
<b>23</b>	Overnight deployment of 12 bait traps and 1 larval fyke net
<b>24</b>	Overnight deployment of 12 bait traps
<b>25</b>	4 shots of backpack electrofishing
<b>28</b>	Overnight deployment of 12 bait traps
<b>32</b>	4 shots of backpack electrofishing
<b>33</b>	4 shots of backpack electrofishing
<b>35</b>	4 shots of backpack electrofishing
<b>36</b>	3 shots of backpack electrofishing and overnight deployment of 12 bait traps
<b>37</b>	4 shots of backpack electrofishing
<b>38</b>	8 shots of backpack electrofishing (2 shots in the side channel next to pool)
<b>39</b>	3 shots of backpack electrofishing

## 3 Results

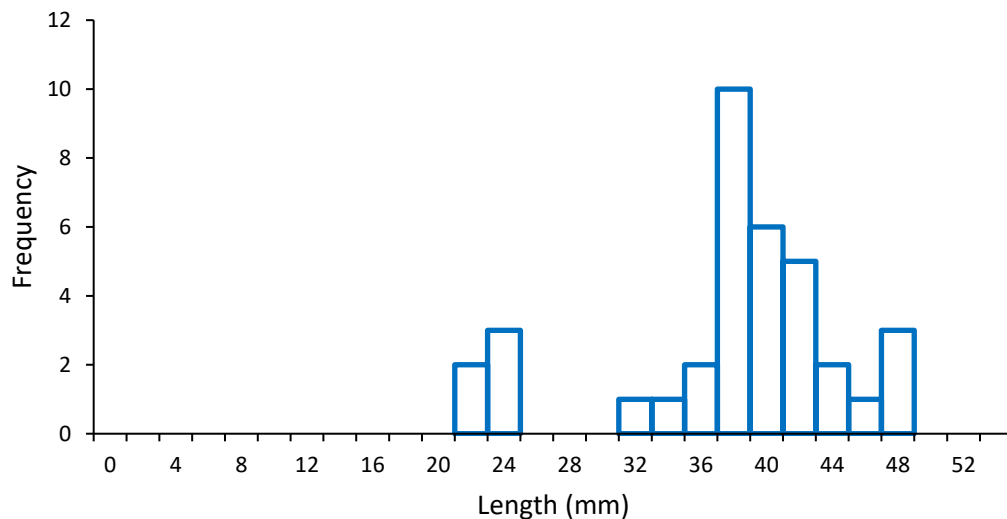
### 3.1 Field surveys

A total of 37 little galaxias were captured across six sites, confirming the continued presence of the species at three previously recorded sites, in addition to three new locations (Figure 4). Two new sites were in close proximity to previously recorded sites, while the third new location represented the first record from an area of the catchment where the species had not been detected before (site 36 in Pennyroyal creek at Rifle Butts Road). Little galaxias were not detected at two sites where previous records exist (Site 5 and site 2a). A total of 36 Yarra pygmy perch were captured at a single site on Pennyroyal creek – the only known historical site for the Upper Barwon Flagship Program area. Little galaxias could not be detected at a former site (200 m upstream of Division Road) but were located at a new site close by (50 m upstream of Division Road) (Figure 4). Little galaxias were not detected at the two additional survey sites on the Barwon River West branch, where the positive eDNA record was found and at the proposed avulsion area works site 500 m upstream.



**Figure 2** Target species Yarra pygmy perch (top) and Little galaxias (male) (bottom) captured during the study.

The Yarra pygmy perch size distribution varied considerably across the individuals captured, with a small portion being a much smaller cohort (22–24 mm total length) and considered likely to be young of year (0+ year old) fish (Figure 3). The majority of Yarra pygmy perch captured however were between 36 and 44 mm.



**Figure 3** Length frequency histogram for Yarra pygmy perch captured during the survey (n = 36).

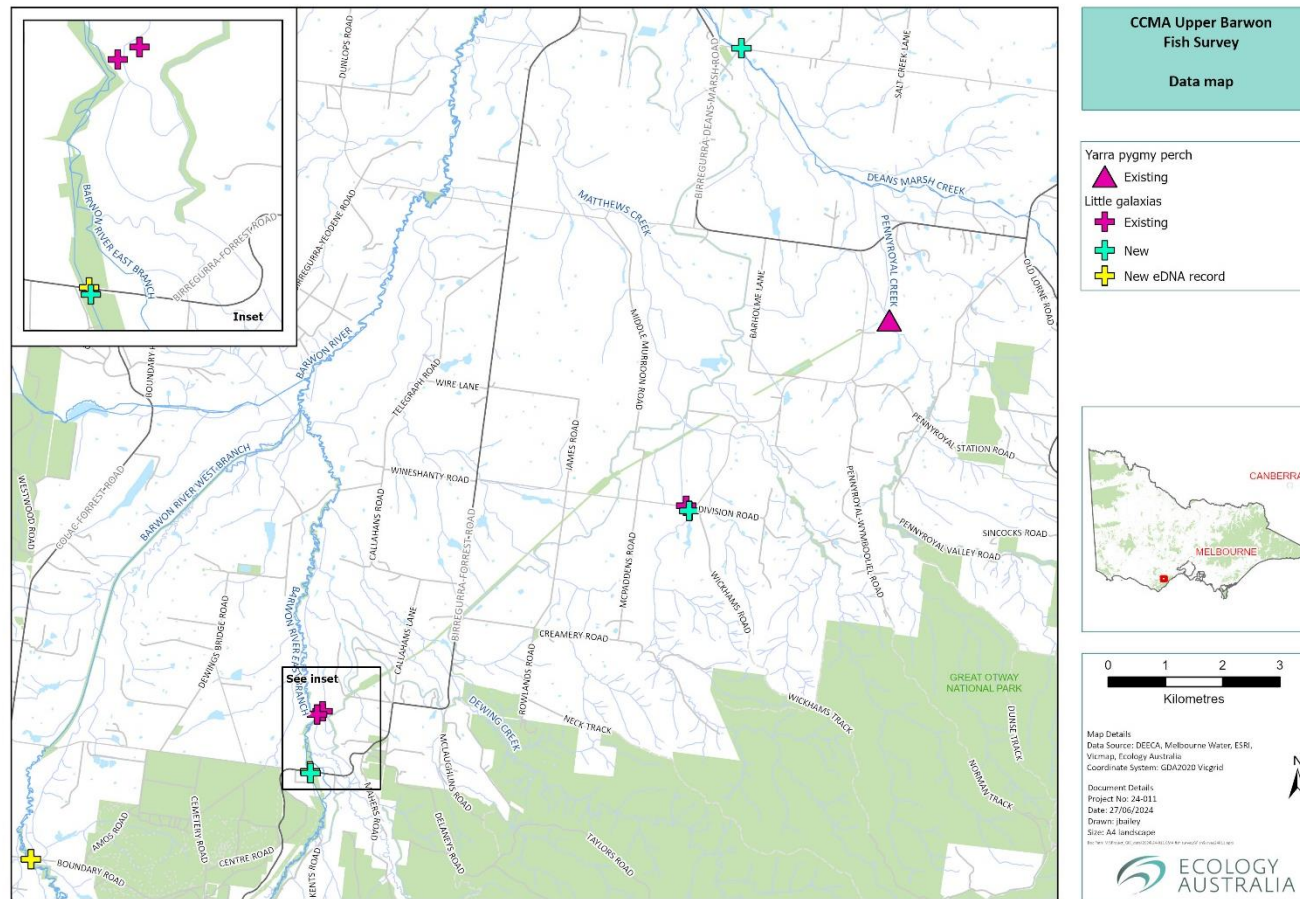
Other native species captured included southern pygmy perch *Nannoperca australis* (captured at all sites surveyed) and ornate galaxias *Galaxias ornatus* (captured at 8 sites) (Table 4). Pest fish were captured at a number of sites across the catchment, with eastern gambusia *Gambusia holbrooki* caught at 11 sites surveyed. Roach *Rutilus rutilus* and Tench *Tinca tinca* were also captured at one site each.

**Table 4 Total catch numbers for surveys conducted. Bold denotes target species and \* denotes invasive species.**

Common name	Scientific name	Site																					Total
		2a	2b	2c	3	4	5	9	17	21	22	23	24	25	28	32	33	35	36	37	38	39	
<b>Little galaxias</b>	<b><i>Galaxiella toourtkoourt</i></b>			3	7	1					8	17							1				37
<b>Yarra pygmy perch</b>	<b><i>Nannoperca obscura</i></b>																36						36
Ornate galaxias	<i>Galaxias ornatus</i>							4		11		53		6	3		1				2	1	81
Southern pygmy perch	<i>Nannoperca australis</i>	1	3	43	7	205	60	59	81	21	28	107	54	10	1	65	21	1	125	17	46	7	962
Short-finned eel	<i>Anguilla australis</i>	5	26		3	2				2				15		4	3	3		1			64
Eastern gambusia*	<i>Gambusia holbrooki</i>		8	2	23	529	122	4	440							5	2			12	27		1174
Roach*	<i>Rutilus rutilus</i>													1									1
Tench*	<i>Tinca tinca</i>								2														2
Total		6	37	48	40	737	182	67	523	34	36	177	54	32	4	74	63	4	126	30	75	8	2357

**Table 5 Catch Per Unit Effort (CPUE) results for the sites where target species were detected, where 'EF' denotes fish captured per minute ('power on' time) of backpack electrofishing and 'BT' denotes fish captured per trap per night.**

Common name	Scientific name	2c		3		4		22		23		33		36	
		EF (BP)	BT	EF (BP)	BT	EF (BP)	BT	EF (BP)	BT	FN (larval)	BT	EF (BP)	BT	EF (BP)	BT
<b>Little galaxias</b>	<b><i>Galaxiella toourtkoourt</i></b>	0.30		0.40	0.67	0.06			0.67	6.00	0.92			0.13	0.00
<b>Yarra pygmy perch</b>	<b><i>Nannoperca obscura</i></b>											3.60			
Eastern gambusia*	<i>Gambusia holbrooki</i>	0.20		0.80	2.83	29.60	1.83					0.20			



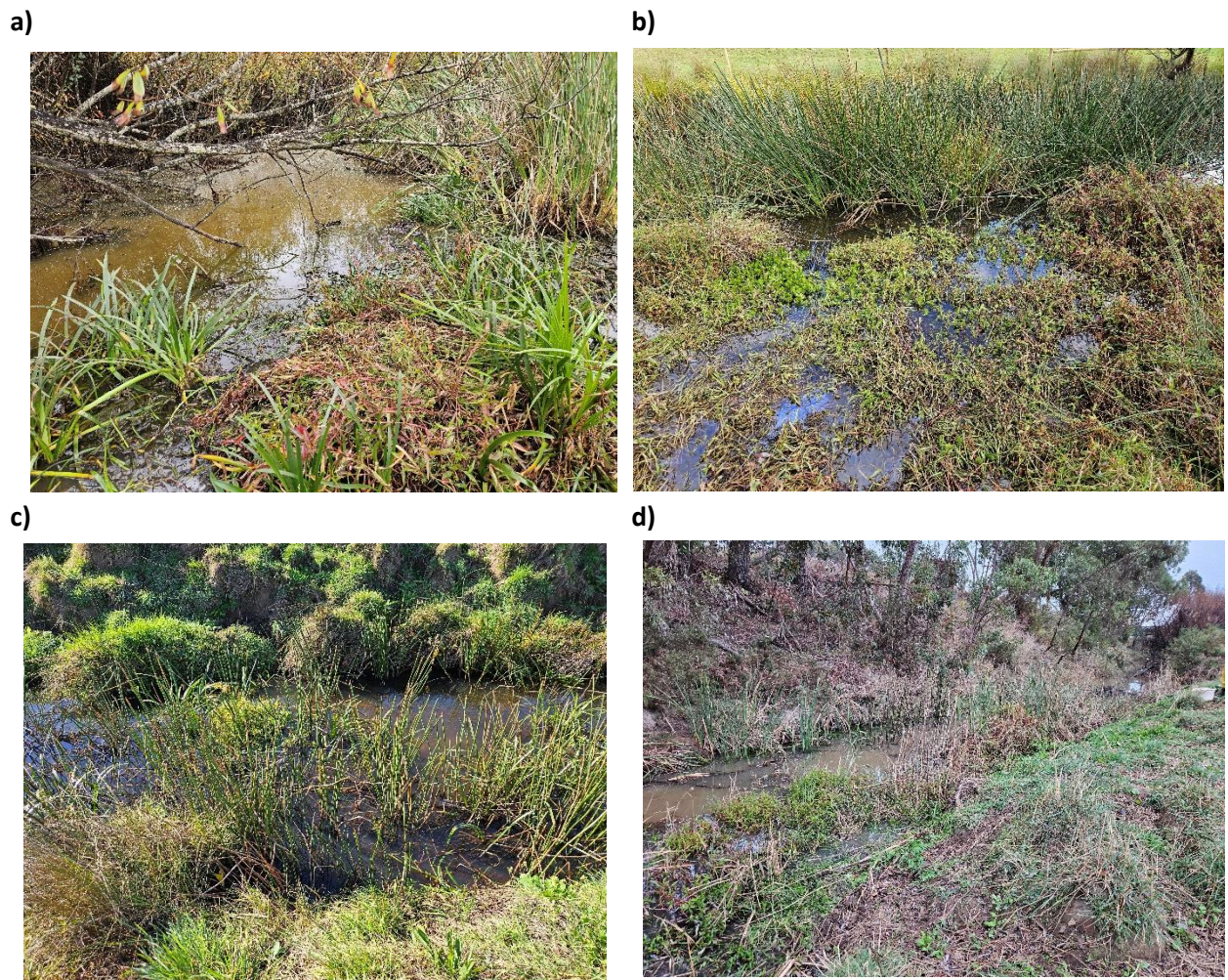
**Figure 4** Map of sites where little galaxias and Yarra pygmy perch were captured, where pink denotes location of known sites where the target species was confirmed to still be present, and green denotes new locations for target species from this study. Yellow denotes locations of positive eDNA detection.



### 3.2 Habitat assessment

**Table 6 A summary of habitat assessment for survey sites where target species were caught.**

Site Number	Target species caught	Pest species caught	Aquatic vegetation present	Waterbody characteristics
<b>2c</b>	Little galaxias (low abundance)	Eastern gambusia (low abundance)	<i>Persicaria decipiens</i> (providing scattered cover), <i>Myriophyllum</i> sp., <i>Eleocharis acuta</i> , <i>Carex</i> sp., <i>Triglochin</i> sp., <i>Ranunculus</i> sp.	<10% riparian shading, 25-40% shading provided by aquatic veg., average depth of 0.4 m, water temp of 11.64 °C
<b>3</b>	Little galaxias (moderate abundance)	Eastern gambusia (moderate abundance)	<i>Triglochin</i> sp., <i>Carex</i> sp., <i>Persicaria decipiens</i> , <i>Juncus</i> sp., <i>Typha</i> sp., <i>Crassula</i> sp., <i>Eleocharis</i> sp.	Up to 50% riparian shading provided by willows, approx. 25% coverage provided by aquatic veg., average depth of 1 m, water temp of 13.40 °C
<b>4</b>	Little galaxias (very low abundance)	Eastern gambusia (very high abundance)	<i>Persecaria decipiens</i> , <i>Myriophyllum</i> sp., <i>Triglochin</i> sp., <i>Juncus</i> sp., <i>Typha</i> sp.	25-40% riparian shading, up to 50% shading provided by aquatic veg. (dense <i>Typha</i> ), average depth of 1 m, water temp of 14.14 °C
<b>22</b>	Little galaxias (moderate abundance)	None	<i>Triglochin</i> sp., <i>Crassula</i> sp., <i>Lemna</i> sp., <i>Ranunculus</i> sp., <i>Eleocharis</i> sp., <i>Phragmites</i> sp.	No shade coverage in main pool from riparian veg., 10% coverage provided by aquatic veg. (dense <i>Phragmites</i> ), average depth of 1 m however deep pool in parts, water temp of 10.33 °C.
<b>23</b>	Little galaxias (moderate abundance)	None	<i>Charax</i> sp., <i>Juncus</i> sp., <i>Triglochin</i> sp., <i>Potamogeton</i> sp., <i>Eleocharis</i> sp., <i>Persecaria decipiens</i> , <i>Phragmites</i> sp., <i>Centella</i> sp.	No shading provided by riparian veg., good coverage provided by aquatic veg. (dense <i>Phragmites</i> ), average depth of 1.5 m, water temp of 14.67 °C.
<b>36</b>	Little galaxias (very low abundance)	None	<i>Persecaria decipiens</i> , <i>Triglochin</i> sp., <i>Eleocharis</i> sp., <i>Typha</i> sp., <i>Phragmites</i> sp.	25% shade coverage from riparian veg. (including willows), 15% coverage provided by aquatic veg. particularly on edges, average depth of 1 m, water temp of 10.65 °C.
<b>33</b>	Yarra pygmy perch (moderate abundance)	Eastern gambusia (low abundance)	<i>Carex</i> sp., <i>Potamogeton</i> sp., <i>Eleocharis</i> sp., <i>Triglochin</i> sp.	<10% shading from riparian veg., sufficient aquatic veg. to provide shading (40-50%), average depth of 0.5 m, low turbidity (23.50 NTU)



**Figure 5** Habitat at sites where target species were captured a) Site 3, b) Site 2c, c) Site 33 & d) Site 36.

## 4 Discussion

This study confirmed the continued presence of the threatened species little galaxias and Yarra pygmy perch in the Upper Barwon catchment, although only one population of Yarra pygmy perch is currently known to persist. Additionally, although little galaxias were detected at six sites, many are in close proximity and are likely only sub-populations, meaning that there are essentially only two known populations of little galaxias confirmed to persist in the catchment. One new population of little galaxias was detected as part of this project, which requires further investigation as detailed below. The small number of populations and confirmed sites (i.e. sub-populations) makes both species, but particularly Yarra pygmy perch (only one confirmed site/population), highly vulnerable to extirpation in these catchments in the absence of appropriate and ongoing management.

Little galaxias were confirmed to persist at three existing sites on tributaries of the Barwon River East Branch and Gosling Creek. While some new sites were found in close proximity to these known sites (likely sub-populations of a single population or metapopulation), one existing site in close proximity was too shallow to offer suitable habitat (site 2a) and another couldn't be sampled effectively due to extreme levels of siltation (200 m upstream of Division Road). One little galaxias was captured on Pennyroyal Creek at Rifle Butts Road, which represents the first record of this species in the sub-catchment. As the habitat at this site appeared only marginally suitable for this species, abundance was very low and as little galaxias are not known to disperse long distances (Coleman *et al.* 2019), this suggests a source population potentially exists nearby. Further survey effort within this sub-catchment is therefore a high priority to locate the source population and determine the extent of distribution in the area. Excluding sub-populations, there are currently only two populations of little galaxias known from the Upper Barwon catchments, with only one of these considered to be secure in terms of the absence of eastern gambusia (Gosling Creek at Division Road). Therefore, the discovery of an additional population in this area of the catchment is significant, as is the importance of determining and documenting the abundance, distribution, habitat quality and threats this population faces. Recent eDNA results indicate the potential for the presence of another population on the Barwon River West Branch at Boundary Road. However, following additional survey effort at the location of eDNA sampling, little galaxias could not be detected and so this positive record cannot be verified.

One population of Yarra pygmy perch remains within the Upper Barwon catchment, on Pennyroyal Creek. This remains the only population historically recorded in the Upper Barwon Flagship Program area. Our survey indicated that this population is currently likely to be quite large, based on 36 being captured with limited effort (4 shots of electrofishing), with a good population structure suggesting ongoing and recent recruitment. Maintaining this last known population in the catchment is obviously a high priority, as is establishing new populations in appropriate habitats. Given the potential for this population to be relatively large, this population could be used as a source for translocation to assist with reestablishment of Yarra pygmy perch at additional locations within the region. It is recommended that the CMA explore the idea of utilising farm dams that are free from pest fish and with sufficient aquatic vegetation to support a Yarra pygmy perch translocation project (Raymond *et al.* 2019). A similar approach is also recommended for little galaxias, considering only one population (Gosling Creek) is currently secure in terms of an apparent absence of eastern gambusia, a pest species heavily implicated in the species decline (Saddler *et al.* 2010). The low genetic diversity of the Gosling Creek population of little galaxias has already been documented (Coleman 2014) and it is likely that the genetic diversity of the Pennyroyal Creek Yarra pygmy perch population is also low. The additional benefit of establishing

new populations in secure locations such as surrogate farm dams, is that the genetic diversity of these populations can be supplemented with source fish from multiple locations known from the same genetic lineage (Brauer *et al.* 2013; Coleman *et al.* 2015) to increase genetic fitness and improve the potential for subsequent translocations from these 'founder fish' to be successful. All translocations should be genetically appropriate, with a translocation plan developed and informed by analyses of the fin clips collected during this study and comparisons with previously analysed populations (Brauer *et al.* 2013; Coleman *et al.* 2015).

While clearing invasive willows from stream banks and floodplains is an important form of restoration, particular care should be taken in the vicinity of known little galaxias sites to ensure they are removed progressively (e.g. thinned with interspersed re-establishment of native trees) to reduce potential impacts including increased sedimentation (due to a temporary decrease in bank instability), and a reduction in shade. The latter is particularly relevant at sites where little galaxias have been recorded alongside eastern gambusia, as higher levels of riparian shading appear to play a key role in keeping water temperatures cooler and suppressing eastern gambusia abundance and their impacts on little galaxias. Disturbance caused by stock access to both the riparian zone, and fringing and floodplain aquatic vegetation was evident at several survey sites. One site where little galaxias had previously been recorded at a natural wetland upstream of Division Road on Gosling Creek showed severe degradation to the wetland (including vegetation damage and sedimentation) due to excessive stock access. Sedimentation at this site was so extreme that the site was unable to be surveyed for safety reasons (deep sediment and floating islands). It is suggested that the CCMA consider conducting field education events (in conjunction with Landcare) for local landholders whose land adjoins waters supporting existing populations (or are situated nearby) to foster an awareness of this species and a willingness to protect these populations.

Finally, given the importance of these isolated populations of threatened fish species, it is recommended that regular monitoring occurs into the future. The new record found for little galaxias on Pennyroyal Creek at Rifle Butts Road highlights the lack of historical survey effort and monitoring in the Upper Barwon catchment. The populations of Yarra pygmy perch and little galaxias that remain and any additional populations or sub-populations that are found, will require more regular monitoring in addition to ongoing management to mitigate potential threats.

## 5 Recommendations

The following are recommendations made to Corangamite CMA for consideration:

- Undertake follow up investigations to determine the size and distributional extent of little galaxias populations in Pennyroyal Creek at Rifle Butts Road.
- Undertake regular monitoring and actively manage threats at existing sites and any new sites in the catchment.
- Establish secure (i.e. offline and off floodplain) populations of both threatened species in permanent waterbodies with abundant aquatic vegetation and no pest fish (e.g. farm dams).
- Undertake genetic analyses of fin clips collected during this study and if appropriate, supplement the genetic diversity of these translocated populations with additional source fish from other genetically appropriate locations.
- Engage with and educate landholders and improve management of stock access to waterbodies known to support threatened fish populations/sub-populations.
- Undertake willow removal sensitively, particularly at sites where little galaxias co-occur with eastern gambusia (i.e. the shading provided by willows is important).
- Investigate options (i.e. landholder agreements), that enable flooding of riparian land through delivery of environmental flows.
- Investigate infrastructure options to enable managed inundation of little galaxias habitat that supports breeding (during winter) and habitat through dry conditions.
- Include little galaxias habitat and species/population values in the updated Environmental Water FLOWS study and identify species/shared benefit flow components that support this nationally listed aquatic species within the FLOWS reach.

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