# Status of fish communities in streams of the Otways coast following the low flow period in 2006-2007

**A report prepared by *environous* for the Corangamite Catchment Management Authority**

**June 2008**

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# Summary

This report provides a summary of fish surveys conducted as a supplement to a drought assessment investigation in 2007. The main purpose of these surveys was to determine the status of important fish communities in streams of the Otways region following an extended low flow period throughout 2006 and 2007.

The main emphasis was to assess the status of threatened fish communities. Three main threatened fish species occur within the Otways region of the Corangamite Catchment region namely Yarra pygmy perch, Australian grayling and Australian mudfish. With so few sites on each system, these brief fish surveys should not be considered as comprehensive fish investigations, but more appropriately as indicative assessments of drought impacts.

A total of 24 sites were surveyed in 12 different river systems throughout the Otway Basin. Sites selected for survey included multiple locations within Thompsons Creek, Painkalac, St. Georges River and Wild Dog Creek, as well as selected locations in the Erskine River, Sheoak Creek, Cumberland River, Wye River, Skenes Creek, Barham River, lower Aire River and the Curdies River.

A total of 803 native fish were captured including 269 common galaxias, 125 short-finned eels, 117 flat-headed gudgeon, 63 spotted galaxias, 55 Yarra pygmy perch, 26 tupong, 13 climbing galaxias, 10 southern pygmy perch, five short-headed lamprey, one Australian smelt and one black bream. Exotic species captured included 31 brown trout and six eastern gambusia. Overall the abundance of fish captured were considered to be low and appeared to be indicative of the impacts of reduced flows over the last two years.

With a projected decrease in overall runoff associated with climate change, the likelihood of extended low flow periods will increase. In low flow conditions the connectivity between pools can be lost and available instream habitat can be greatly reduced. Most native non-migratory fish species appear to be relatively tolerant to the environmental conditions associated with drought including deteriorating water quality. However, if suitable spawning opportunities are not achieved for two or three consecutive seasons, it is very likely that recruitment failure will result. Under such a scenario, the potential decline of the nationally threatened Yarra pygmy perch populations, particularly in the Thompsons Creek, is highly to be likely.

While sites further upstream appear to have been lost as key Yarra pygmy perch populations, pools at Pettavel Road and Horseshoe Bend Road continue to be important refuge sites for Yarra pygmy perch in Thompsons Creek. Significant abundance of aquatic macrophytes and deeper pools provide sustained cover and water depth at these locations.

Management recommendations for Yarra pygmy perch include more targeted and regular surveys in the Curdies River, Thompsons Creek and St Georges River, trials to establish the species maximum salinity and minimum dissolved oxygen tolerances, catchment management strategies such as stock exclusion and appropriate riparian revegetation, specific management of aquatic flora and the development of site specific drought management strategies at key refuge sites.

The absence of Australian grayling and Australian mudfish at previous capture locations indicated that flows have not been conducive to the maintenance of these species within the majority of the Otways streams.

Looking toward the future, the frequency and magnitude of high rainfall events associated with climate change may not decline. Therefore the upstream and downstream movement opportunities for migratory native fish within Otways streams should not be impacted too greatly. However, connectivity and water quality issues need to be addressed for migratory fish species during periods of low streamflow. Isolation of adult migratory fish (including

Australian grayling and Australian mudfish) and a decline in available habitat and water quality may result in a series of indirect impacts such as increased vulnerability to predation and decreased fitness and condition. A reduction in localised reproductive success is likely to follow. Regional population size may not decline, because migratory species have the ability to recolonise a system if there is sufficient flow to enable access. Systems with a greater frequency of high flow events may become important refuges for migratory fish.

Australian Grayling have been recorded in the last 25 years in a number of Otways streams including the Erskine River, Cumberland River, Barham River, Skenes Creek, St. Georges River, Wild Dog Creek, Wye River Carisbrook Creek, Kennett River and Grassy Creek. Management rrecommendations for Australian grayling include additional opportunistic surveys in the events in summer and autumn for migrating adults and spring and summer for juveniles (including at the more likely capture locations including in the St. Georges River, Cumberland River, Wye River, Barham River, and the Ford River). Additional catchment management strategies include incorporating the migratory requirements of Australian grayling into the estuary opening strategies and stock exclusion and riparian revegetation for key river systems.

Australian mudfish have previously been recorded in small drainage channels of the Aire, Calder and Wye Rivers. Management recommendations for Australian mudfish include more targeted and regular surveys in the Aire, Calder and Wye Rivers, catchment management strategies such as stock exclusion and appropriate riparian revegetation, investigation of captive breeding programs and sire specific drought management strategies at key refuge sites.

# Introduction

This report provides a summary of fish surveys conducted as a supplement to a drought assessment investigation funded by the Corangamite Catchment Management Authority (CCMA) in 2007 (Ryan and McGuckin 2007). The drought assessment study provided a snapshot of river condition, key issues affecting aquatic health and categorises waters which are severely stressed, moderately stressed and have minor stress due to the current drought.

The main purpose of this surveys was to determine the status of important fish communities following an extended low flow periods throughout 2006 and 2007.

Three main threatened fish species occur within the Otways region of the Corangamite Catchment region namely Yarra pygmy perch (*Nannoperca obscura*), Australian grayling (*Prototroctes maraena*) and Australian mudfish (*Neochanna cleaveri*) (Table 1). Streams previously known to support Yarra pygmy perch include Thompsons Creek and the Curdies River.

Australian grayling have been recorded in the last 25 years in a number of river systems, including Erskine River, Cumberland River, Barham River, Skenes Creek, St. Georges River, Wild Dog Creek, Wye River Carisbrook Creek, Kennett River and Grassy Creek (Table 1). A limited sites number of sites were selected in streams where Australian grayling have previously been captured.

The Australian mudfish has been recorded in two river systems including the lower Aire River and the Wye River (Table 1). A limited sites number of sites were selected in these systems where Australian mudfish have previously been captured.

**Table 1: Location and last recorded capture of threatened species in streams of the Otways catchments**

| Species | Waterway | Location | Last recorded |
|---|---|---|---|
| Australian grayling | *Erskine River | Upstream of caravan park, Lorne | June 1997 |
| | *Cumberland River | Not supplied | February 1987 |
| | *Barham River | At gauging weir, near Paradise | December 1999 |
| | *Skenes Creek | 1 km upstream of estuary | May 1987 |
| | *St. Georges River | 500-600 m downstream of bridge on Allendale road | April 1997 |
| | *Wild Dog Creek | At 'Binawee homestead', upstream of Great Ocean Road | May 1984 |
| | *Wye River | Upstream of caravan park | April 1984 |
| | Carisbrook Creek | downstream of Carisbrook Falls | April 1997 |
| | Ford River | unknown | 1905 |
| | Kennett River | 5 km upstream of Great Ocean Road | February 1987 |
| | Grassy Creek | Upstream of Cinema Point | February 1987 |
| Australian mudfish | *Wye River | Upstream of caravan park | September 1983 |
| | *Aire River tributary | Upstream of culvert, halfway up drain towards spring in paddock | October 1990 |
| | Calder River tributary | Drain on SW side of Great Ocean Road | October 1990 |
| Yarra pygmy perch | Thompsons Creek | Eight sites on system from upstream of lower diversion weir to upstream reaches | February 2001 |
| | *Curdies River | at stream gauge, immediately downstream of Limestone Creek | December 1999 |

## *Background of Threatened Species*

### ***Yarra pygmy perch*** *(Nannoperca obscura)*

The Yarra pigmy perch is a small perch-like fish which attains a total length of 75mm. Yarra pigmy perch are found in the Maribyrnong basin in southern Victoria, west to the Millicent Coast drainage basin in the south-east of South Australia, including the Barwon, Corangamite, Hopkins, Portland, and Glenelg River basins. Yarra pigmy perch occur in slow flowing or still

waters and are generally associated with systems with high amounts of aquatic vegetation (particularly emergent vegetation) such as lakes, ponds and slow flowing rivers. Spawning occurs from late winter to late spring and like other pygmy perch species (such as southern pygmy perch) eggs are produced in small batches and dispersed within densely vegetated environments. Data on the distribution of Yarra pigmy perch is particularly poor and population numbers, where recorded, often reflect low numbers of individuals. The fragmentation of small populations of this species render them particularly vulnerable to population decline from such activities as habitat destruction through agricultural and grazing practices, as well as the draining of wetlands and swamps and removal of instream vegetation. Yarra pigmy perch (*Nannoperca obscura)* is also considered 'Vulnerable' in Australia (EPBC Act 1999), 'Near Threatened' in Victoria (DSE 2007a) and is listed under the Victorian Flora and Fauna Guarantee Act 1988. The maintenance of instream habitat is crucial for the survival of this species.

### ***Australian grayling*** *(Prototroctes maraena)*

Australian Grayling is a small native species generally 17-19 cm (fork length) but capable of reaching a maximum size of 33 cm. It is amphidromous and after fertilisation, eggs drift downstream and larvae are thought develop within estuarine environments then migrate upstream as juveniles to complete their life cycle. They have an omnivorous diet consisting of algae, cladocerans and other aquatic and terrestrial insects (McDowall 1996). Spawning is thought to occur in the same general area each season (Cadwallader and Backhouse 1983) in summer to early autumn. The freshwater habitat of adults and spawning is thought to be gravel substrates in rivers with moderate flows, where fertilized eggs (~ 1mm) settle and develop (McDowall 1996). It was formally widespread throughout coastal streams in Victoria, Tasmania and southern NSW, however currently it has a discontinuous distribution (Morris et al. 2000). The major causes of decline are thought to be due to river regulation, instream barriers, sand and gravel extraction, increased competition with exotic trout species, loss of riparian vegetation, bank erosion and siltation. Australian Grayling are considered 'Vulnerable' in Australia (EPBC Act 1999), 'Vulnerable' in Victoria (DSE 2007a) and is listed under the Victorian Flora and Fauna Guarantee Act 1988.

### ***Australian mudfish*** *(Neochanna cleaveri)*

Australian mudfish is a small migratory galaxias species found in the lower reaches of coastal streams. While little is known about the breeding ecology migratory habits of the species, it appears to spawn in winter to early spring (McDowall 1980) and it is likely that juveniles spend at least part of their early life in estuarine or marine conditions and return to freshwater at approximately two months of age (Koehn and Raadik 1991). Australian mudfish is also thought to be capable of aestivation (Koehn and Raadik 1991) and is therefore likely to survive some natural drying of its wetland habitat. In 1990 eleven specimens were collected from three sites on private land in the Aire and Calder River valleys (Glen Aire) (Koehn & Raadik 1991), 35km west of the locality on the Wye River where the species was recorded by Koehn & O'Connor in 1990. Major threats to the long term survival of this species include prolonged drying and degradation of coastal swamp habitat, unrestricted stock access, instream barriers to upstream migration and the artificial manipulation of estuarine water level and flow patterns (Skene et al. 2001). Australian mudfish is considered 'Critically Endangered' in Victoria and is listed as a protected species under the *Flora and Fauna Guarantee Act* 1988.

# Methods

## *Aquatic Fauna Assessment*

Electrofishing was conducted according to the Australian Code of Electrofishing Practice using a NIWA EFM300 backpack units. A 100m reach at each site was measured, marked and fenced using fine mesh stop nets. Each site was to be sampled twice for 30 to 45 minutes (two consecutive electrofishing runs, 30 minutes apart). Where possible electrofishing was employed, however excessively low or deep water levels and elevated electrical conductivity necessitated the use of another technique such as dip and fyke netting.

Fyke nets were set overnight at seven sites with appropriate approvals from DPI Fisheries and DSE (FFG Act 1988) and were labelled appropriately and firmly attached with the cod ends clearly above the water to allow for the survival of air breathing animals.

All fish were measured to the nearest millimetre using fork length for fish with forked caudal fins and total length for fish with rounded caudal fins. Where large numbers of individuals were caught, a subset of 20 individuals of each species were measured and weighed, with the remaining fish being counted and bulk weighed. Short-finned eels were counted and generally only the longest and shortest were estimated.
Fish identifications were confirmed with the use of McDowell and Frankenberg (1981) and McDowell (1996).

## *Site Selection*

A total of 24 sites were surveyed in 12 different river systems throughout the Otway Basin. Sites selected for survey included multiple locations within Thompsons Creek, Painkalac, St. Georges River and Wild Dog Creek, as well as selected locations in the Erskine River, Sheoak Creek, Cumberland River, Wye River, Skenes Creek, Barham River, lower Aire River and the Curdies River (Table 2).

Figure 1 provides a schematic representation of the sites selected for the fish surveys in the Otways region.

## Table 2: Fish survey locations in streams of the Otways region

| Site # | Waterway | Date of sampling | Location | GDA94 Latitude | GD94 Longitude | Vicroads Ref. |
|---|---|---|---|---|---|---|
| **1** | Thompsons Creek | 11-12/08/2007 | Pettavel Road, Freshwater Ck | 55 258358 | 5761338 | 93 E6 |
| **2** | Merrigig Creek | 12/08/2007 | Blackgate Road, Freshwater Creek | 55 261427 | 5759594 | 93 F6 |
| **3** | Thompsons Creek | 11-12/08/2007 | Ghazeepore Road, Mount Duneed | 55 263036 | 5760669 | 93 F6 |
| **4** | Thompsons Creek | 12/08/2007 | Surf Coast Highway | 55 266227 | 5760533 | 93 G6 |
| **5** | Painkalac Creek | 9/10/2007 | Immediately below Painkalac Dam | 55 244034 | 5740871 | 93 C9 |
| **6** | Painkalac Creek | 17/5/2007 & 9/10/2007 | Old Coach Road, Fairhaven | 55 246112 | 5740432 | 93 C9 |
| **7** | Painkalac Creek | 9-10/10/2007 | Binbadeen Drive, Fairhaven | 55 246190 | 5742973 | 93 C9 |
| **8** | Erskine River | 12/09/2007 | Upstream of Caravan Park, Lorne | 54 758954 | 57309003 | 101 H2 |
| **9** | Saint George River | 9/10/2007 | 400 m upstream of Allenvale | 54 757746 | 5729224 | 100 H2 |
| **10** | Saint George River | 13-14/09/2007 | Upstream of Allenvale Road | 54 757815 | 5729105 | 100 H2 |
| **11** | Saint George River | 13-14/09/2007 | Upstream of Great Ocean Road | 54 759190 | 5728712 | 100 H2 |
| **12** | Sheoak Creek | 13-14/09/2007 | At picnic reserve, Allenvale, Allenvale | 54 756459 | 5728609 | 100 H2 |
| **13** | Sheoak Creek | 14/09/2007 | Downstream of falls, 300 m upstream of Great Ocean Road | 54 758300 | 5727100 | 100 H2 |
| **14** | Cumberland River | 12/09/2007 | Upstream of caravan park, Cumberland River | 54 756947 | 5726380 | 101 G3 |
| **15** | Wye River | 12/09/2007 | Upstream of caravan park, Wye River | 54 751100 | 5719700 | 101 G4 |
| **16** | Skenes Creek | 13/09/2007 | 200 m reach immediately below road culvert, Upper Skenes Creek Road, Skenes Creek | 54 735254 | 5710871 | 101 D5 |
| **17** | Wild Dog Creek | 13/09/2007 | Private property (Binawee), approximately 1.5 km upstream of the Great Ocean Road | 54 732842 | 5710167 | 101 C5 |
| **18** | Wild Dog Creek | 13/09/2007 | 400 m upstream of Great Ocean Road, alongside Wild Dog Road | 54 733036 | 5709667 | 101 C5 |
| **19** | Wild Dog Creek | 13-14/09/2007 | 100 m reach upstream of Great Ocean Road | 54 733076 | 5709230 | 101 C5 |
| **20** | Barham River West Branch | 13/09/2007 | 400 m upstream of junction of Barham River East Branch | 54 728812 | 5785921 | 101C5 |
| **21** | Barham River East Branch | 13/09/2007 | 80 m reach downstream of gauging weir, Paradise | 54 728102 | 5707121 | 101C5 |
| **22** | Aire River (tributary drain) | 14/09/2007 | 100 m south of the Great Ocean Road through to the Aire River | 54 714000 | 5705500 | 100 J6 |
| **23** | Aire River (tributary drain) | 14/09/2007 | 50 m upstream of culvert on the Great Ocean Road through to the Aire River | 54 714700 | 5706300 | 100 J6 |
| **24** | Curdies River | 16/05/2007 | 10 upstream and downstream of gauging point, immediately below junction with Limestone Creek, near Timboon | 54 671039 | 5742973 | 91 A9 |

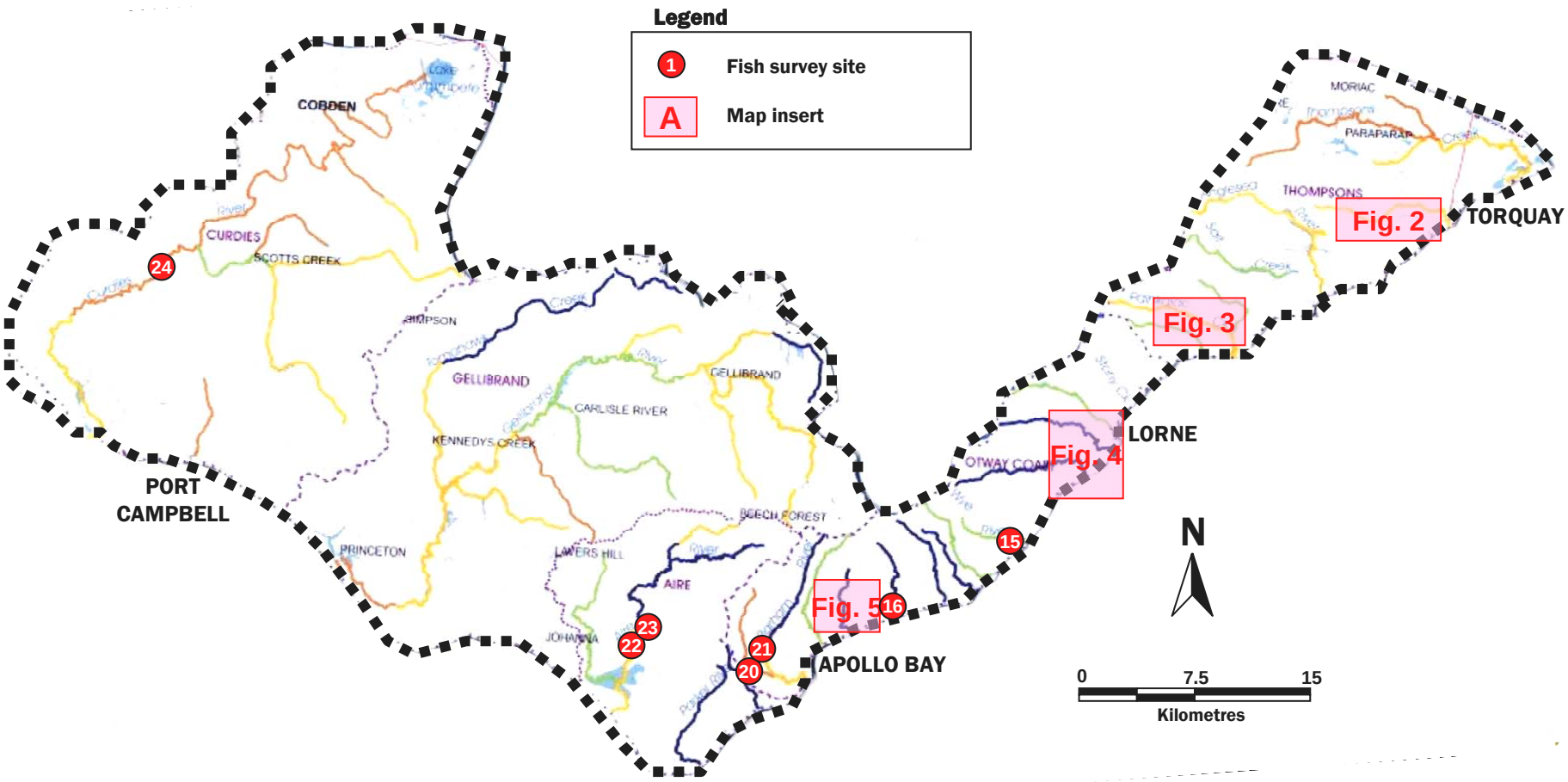



**Figure 1: Fish survey location map of streams in the Otways region.**

*Insert figures include sites 1 to 4 (Fig. 2); sites 5 to 7 (Fig. 3); sites 8 to 14 (Fig. 4); sites 17 to 19 (Fig. 4).*

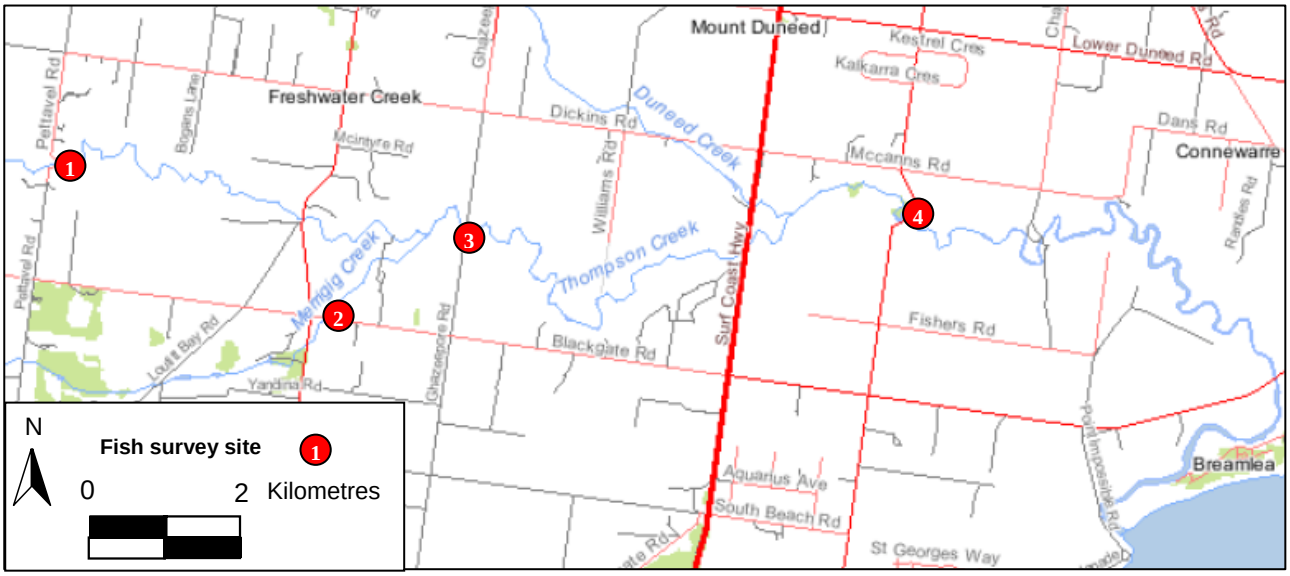
# Fish survey results and relevance to the Otways streams

The following fish survey results provides a summary of the fish captures and briefly discusses the implications and relevance of key findings. Results are provided separately for each river system.

The fish survey results for the Thompson Creek, Painkalac Creek, Erskine River and Saint George River are provide in Table 3. The fish survey results for Sheoak Creek, Cumberland River, Wye River, Skenes Creek, Wild Dog Creek, Barham River, lower tributaries of the Aire River and Curdies River are provided in Table 4. These result tables provide a summary of the fish survey technique and corresponding length and weight of fish species captured and a list of bycatch at each survey location.

### *Thompsons Creek*

Four sites were surveyed in the Thompsons Creek catchment, namely upstream at Pettavel Road (site 1), Merrigig Creek at Blackgate Road (site 2), Ghazeepore Road (site 3) and Horseshoe Bend Road (site 4) to investigate the impact of drought on fish within the waterway, particularly on the important and nationally protected Yarra Pygmy Perch (Figure 2). Locations were based on previously surveyed locations (Zampatti 2001) and also in a small tributary with newly established streamflow (Merrigig Creek).




*(Modified after Victorian Data Warehouse mapping tool) (DSE 2007b)*

**Figure 2: Map of fish survey locations in Thompsons Creek**

Yarra pygmy perch were collected at two of the three sites on Thompsons Creek, where they had previously been recorded in 2001 (Zampatti 2001). They were captured at Pettavel Road (site 1) and Horseshoe Bend Road with a number of sizes from 33 to 62 mm (Table 3). Despite the impact of the prolonged drought these sites appeared to have remained in a healthy state with a large diversity of fish species and including freshwater shrimp. As such, these sites represent important refuges the Thompsons Creek system.

Apart from short-finned eels, no other migratory fish were collected in the survey, which is indicative of a lack of streamflow and connectivity with the lower system and the ocean.

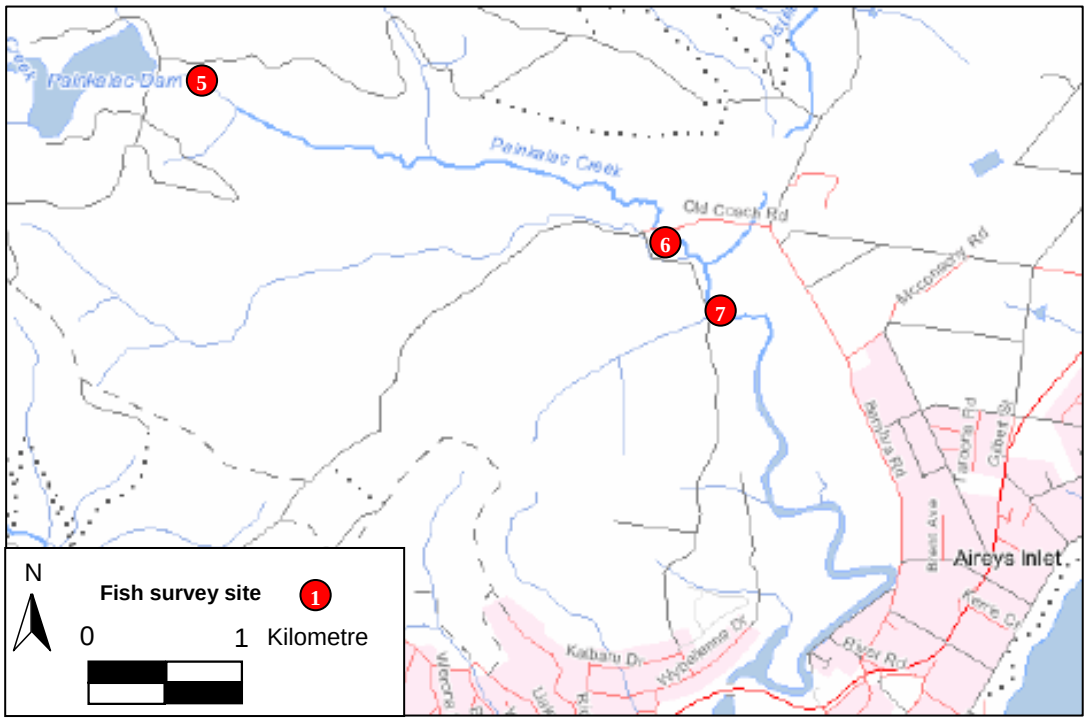
Previously recorded native freshwater fish species in the Thompsons Creek include short finned eels (*Anguilla australis*), common galaxias (*Galaxias maculatus*), spotted galaxias (*Galaxias truttaceus*), Australian smelt (*Retropinna semoni*), southern pygmy perch (*Nannoperca australis*), flat headed gudgeon (*Philypnodon grandiceps*), tupong (*Pseudaphritis urvillii*) and the listed Yarra pygmy perch (Appendix).

### *Painkalac Creek*

Three sites were surveyed on Painkalac Creek, namely downstream from Painkalac Dam (site 5), Old Coach Road (site 6) and approximately 800m downstream of Old Coach Road (site 7). Locations were based on previously surveyed locations (DSE 2007c) (Figure 3).

Captures of short-finned eels, common galaxias and spotted galaxias were indicative of a system with a frequent connectivity to the ocean, while the collection of flat-headed gudgeon and freshwater shrimp suggest that the ecosystem is also suitable to non-migratory aquatic biota.

Other previously recorded species include climbing galaxias, tupong, Australian smelt and pouched lamprey. Climbing galaxias have been recorded further upstream in the Otway State Forest (DSE 2007c) which was not surveyed in this current investigation. The lack of the other three migratory species is likely to have been related to the lack of continuous flow within the system.




*(Modified after Victorian Data Warehouse mapping tool) (DSE 2007b)*

**Figure 3: Map of fish survey locations in Painkalac Creek**

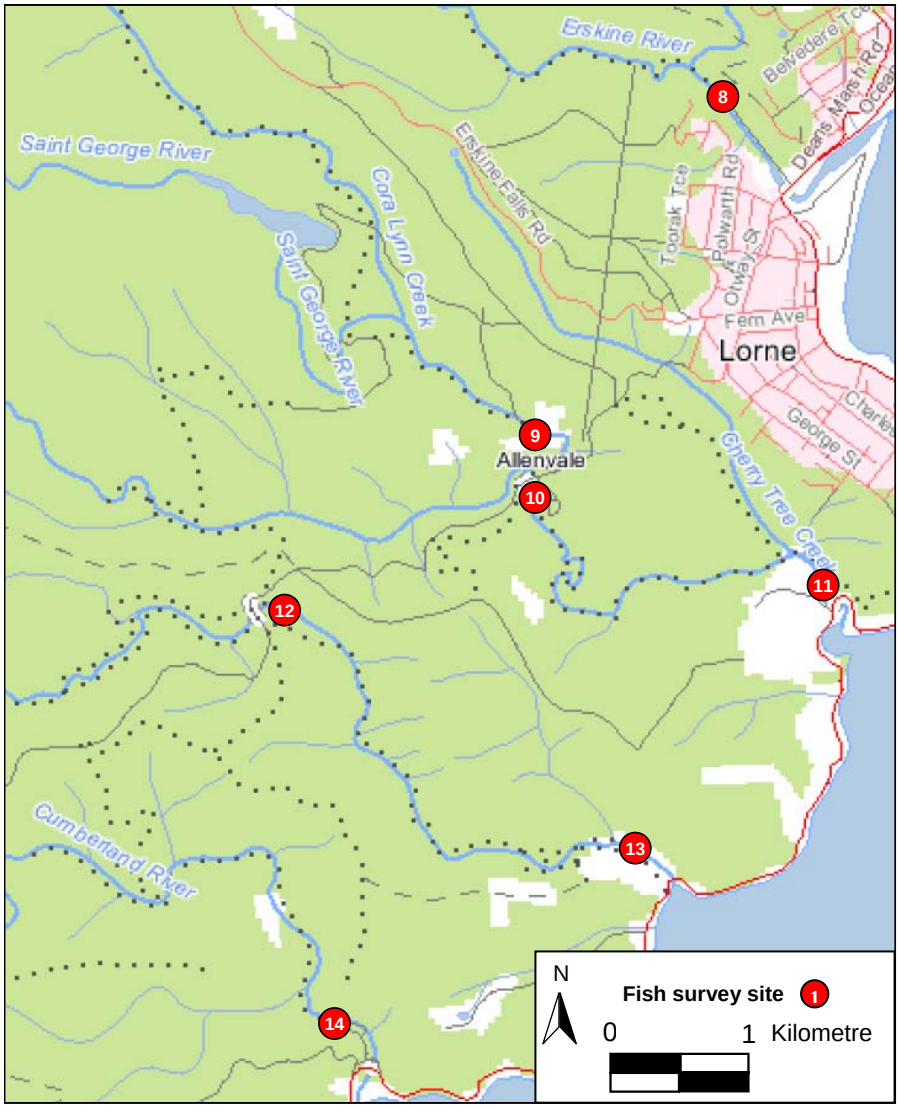
### *Erskine River*

One site, immediately upstream of the caravan park in Lorne (site 8) was surveyed on the Erskine River (Figure 4) to determine drought status of the system and in an attempt to capture Australian grayling, which had previously been captured in this reach up to the Erskine Falls.

Short-finned eels, common galaxias, spotted galaxias and tupong were captured in relatively high abundance and in a range of sizes, indicating favourable conditions (Table 3).

A single brown trout (*Salmo trutta*) captured in the stream indicates that this species remains as a predator of native fish in the system.

Species not captured in this survey included climbing galaxias, short-headed lamprey (*Mordacia mordax*), pouched lamprey and Australian grayling. Climbing galaxias may occur further upstream within the system. While the estuary appears to have remained open, it is likely that the lack of freshwater flows and lack of estuary flushing has resulted in a decline of suitable conditions.




*Modified after Victorian Data Warehouse mapping tool) (DSE 2007b)*

**Figure 4: Map of fish survey locations in the Saint George River**

### *St. George River*

The St. Georges River was surveyed at 3 locations predominantly to determine the presence of the Australian grayling. Previous surveys have recorded the species in the reach from the estuary to Allenvale, the last recording being in 1997 (DSE 2007c). Sites selected were all below Allen Reservoir and included 400 m upstream of Allenvale (site 9), upstream of Allenvale Road (site 10) and upstream of Great Ocean Road (site 11) (Figure 4).

A good diversity of native migratory fish species were collected in the current study including short-finned eels, climbing galaxias, spotted galaxias and short-headed lamprey. The capture of a black bream at the lower site is encouraging and suggests that the estuary may have maintained suitable conditions for estuarine fish. An abundance of freshwater shrimp captured at sites below Allen Reservoir (sites 9 and 10) are indicative of a healthy aquatic ecosystem and add weight to the value of sustained flows.

The single Yarra pygmy perch captured below Allen Reservoir (site 9) is the first record of this species in the system. It is likely that this fish has been washed down from upstream.

**Table 3: Fish survey capture results in streams of the Otways region (east of Lorne)**

| Waterway | Site No. | Technique | Fish captured (scientific name) | Fish captured (common name) | No. fish | Length (mm) | Weight (g) | Bycatch |
|---|---|---|---|---|---|---|---|---|
| **Thompsons Creek** | **1** | 4 fyke nets | *Anguilla australis* | short-finned eel | 9 | 150 - 650 | | 10 FW shrimp |
| | | | *Nannoperca obscura* | Yarra pygmy perch | 47 | 33 - 62 | 0.1 – 3.2 | |
| | | | *Nannoperca australis* | southern pygmy perch | 3 | 55 - 70 | 1.9 – 5.5 | |
| | | | *Philypnodon grandiceps* | flat headed gudgeon | 5 | 33 - 102 | 0.1 – 10.8 | |
| | | | *Gambusia holbrooki* | eastern gambusia | 3 | 22 – 30 | 0.1 – 0.4 | |
| | **2** | Dip net | *Gambusia holbrooki* | eastern gambusia | 3 | 27 - 32 | 0.2 – 0.3 | |
| | **3** | | NO FISH CAUGHT | | | | | |
| | **4** | | *Anguilla australis* | short-finned eel | 4 | 350 - 600 | | |
| | | | *Nannoperca obscura* | Yarra pygmy perch | 2 | 40 - 55 | 0.7 – 2.7 | |
| | | | *Retropinna semoni* | Australian smelt | 1 | 57 | 57 | |
| | | | *Philypnodon grandiceps* | flat headed gudgeon | 12 | 35 - 92 | 0.1 – 5.4 | |
| | | | *Gambusia holbrooki* | eastern gambusia | 3 | 25 - 34 | 0.1 – 0.4 | |
| **Painkalac Creek** | **5** | Electrofish | *Anguilla australis* | short-finned eel | 12 | 750-1000 | | 2 FW shrimp |
| | **6** | Electrofish | *Anguilla australis* | short-finned eel | 1 | 300 | | 25 FW shrimp |
| | | | *Galaxias maculatus* | common galaxias | 15 | 44-107 | <1-7.3 | |
| | | | *Galaxias truttaceus* | spotted galaxias | 1 | 137 | 32.9 | |
| | | Dip net [1] | *Galaxias maculatus* | common galaxias | 3 | 130-150 | 12-15 | 2 FW shrimp |
| | | | *Galaxias truttaceus* | spotted galaxias | 1 | 130 | 26 | |
| | **7** | 3 fyke nets | *Anguilla australis* | short-finned eel | 7 | 200 - 450 | 20 – 995 | 9 FW shrimp |
| | | | *Galaxias maculatus* | common galaxias | 37 | 47 - 53 | 0.1 – 0.3 | 1 FW crab |
| | | | *Philypnodon grandiceps* | flat headed gudgeon | 58 | 38 - 87 | 0.4 – 5.6 | |
| **Erskine River** | **8** | Electrofish | *Anguilla australis* | short-finned eel | 37 | 120-850 | | 450 FW shrimp |
| | | | *Galaxias maculatus* | common galaxias | 11 | 44-124 | 0.5-11 | |
| | | | *Galaxias truttaceus* | spotted galaxias | 22 | 86-139 | 5-31 | |
| | | | *Pseudaphritis urvillii* | tupong | 19 | 107-158 | 12-33 | |
| | | | *Salmo trutta* | brown trout | 1 | 302 | 324 | |
| **Saint George River** | **9** | Electrofish | *Anguilla australis* | short-finned eel | 6 | 135-350 | | 140 FW shrimp |
| | | | *Galaxias brevipinnis* | climbing galaxias | 11 | 76-116 | 3-14.3 | |
| | | | *Nannoperca obscura* | Yarra pygmy perch | 1 | 43 | 1 | |
| | | | *Salmo trutta* | brown trout | 1 | 252 | 187 | |
| | **10** | 4 fyke nets | *Anguilla australis* | short-finned eel | 1 | 650 | | 210 FW shrimp |
| | | | *Galaxias truttaceus* | spotted galaxias | 2 | 151-164 | 31.6-55.2 | |
| | **11** | 4 fyke nets | *Acanthopagrus butcheri* | black bream | 1 | 278 | 451 | |
| | | | *Anguilla australis* | short finned eel | 43 | 170-600 | | |
| | | | *Mordacia mordax* | short headed lamprey | 5 | 370-430 | 53-74 | |
| | | | *Philypnodon grandiceps* | flat headed gudgeon | 37 | 35-74 | <0.1-3.3 | |

[1] - *surveyed on 17 May 2007*

### *Sheoak Creek*

Two sites on Sheoak Creek (sites 12 and 13) were surveyed in an attempt to collect threatened species and to determine its ecological status following the period of extended low flow (Figure 4).

An abundance of short-finned eels, common galaxias and spotted galaxias were captured at two sites below the Sheoak Falls.

Climbing galaxias were not captured but may be present in an inaccessible part of the creek that was not surveyed. Other aquatic taxa previously captured in the system including brown trout and freshwater shrimp were not captured in this survey (Appendix). The lack of brown trout is likely to have been a positive influence in terms of the survival of native fish within the stream and may be related to a lack of streamflow throughout 2006/07. The lack of freshwater shrimp may be indicative of a stressed aquatic ecosystem and a subsequent lack of recruitment.

### *Cumberland River*

One site upstream of the caravan park on the Cumberland River (site 14) was surveyed primarily to determine the presence of Australian grayling (Figure 4).

Five of the seven previously recorded migratory fish species were captured at the site in the Cumberland River (Appendix). The composition and length classes of migratory species collected (short-finned eels, climbing galaxias, common galaxias, spotted galaxias, tupong) indicate a regular connectivity with ocean (Table 4). The installation of the fishway at the Great Ocean Road and recent modifications appears to have been successful.

The capture of flat-headed gudgeon is a new record for the catchment, while the capture of 20 brown trout from 150 to 400 mm also demonstrate that this species continues to thrive in this system (Table 4).

Species previously recorded (DSE 2007c) but not captured in this survey include pouched lamprey, Australian grayling, rainbow trout (*Oncorhynchus mykiss*) and chinook salmon (*Oncorhynchus tshawytscha*) (Appendix).

The lack of Australian grayling and pouched lamprey may be a reflection of a lack of sampling frequency and/or adequate streamflows.

Rainbow trout which were last captured in 1995 (DSE 2007c) were not captured and chinook salmon were not expected to be caught as they have not been recorded since the late 1800's when stocked into the system.

### *Wye River*

The Wye River was surveyed at one location (site 14), immediately upstream of the caravan park (Figure 4). The survey location was chosen as two threatened fish species have recorded in this reach. The Australian grayling was last recorded at this site in 1984 and the Australian mudfish was recorded in 1983 (DSE 2007c).

The flow at the time of the survey was again very low, however, like the Cumberland River, the seasonal flow pattern of the Wye River is expected to be natural with regular winter and spring flushing events.

Six of the eight previously recorded native species were captured, namely short-finned eels, climbing galaxias, common galaxias, spotted galaxias, flat-headed gudgeon and tupong (Appendix).

The absence of the Australian grayling and Australian mudfish in the recent survey does not exclude the possibility of the species in the Wye River system, but presumably if the species still persists numbers are low.

### *Skenes Creek*

Skenes Creek was surveyed at just one location (site 15), immediately downstream of a culvert on Upper Skenes Creek Road (Figure 1). The targeted survey site was chosen specifically because the instream barriers would presumably restrict upstream passage of migratory fish species like the Australian grayling.

In comparison with other streams in the region, the overall catchment condition of this system has been compromised by land clearing, degraded riparian vegetation and unrestricted stock access.

An abundance of short-finned eels and common galaxias was captured with a range of lengths indicative of regular recruitment into the system. Small captures of tupong and brown trout suggest relatively lower abundance.

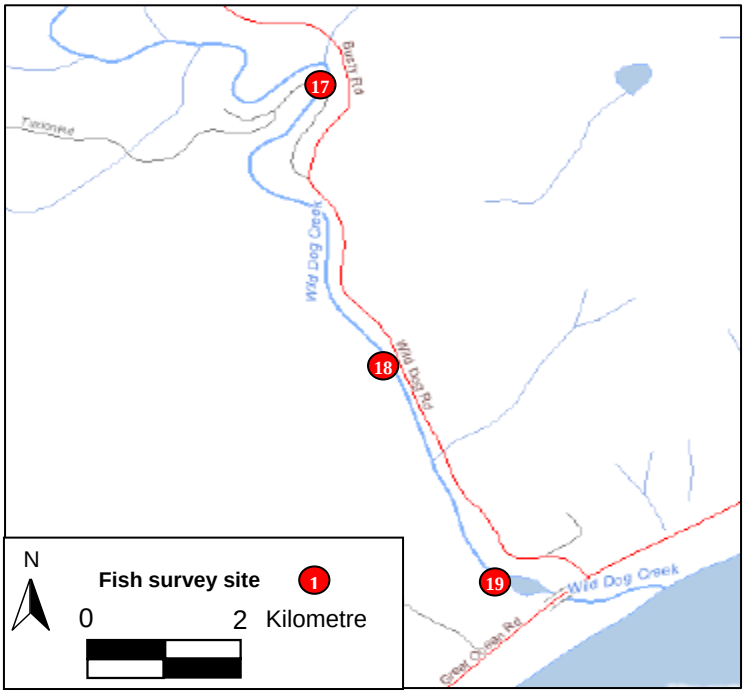
A lack of climbing galaxias and spotted galaxias may suggest a lack of connectivity with the ocean, however further surveys in the middle and upper reaches of the system are likely to capture these two species.

While Australian grayling was not captured it is worth noting that it was last recorded in the system in 1920. It is possible the environmental condition of Skenes Creek has degraded to such an extent that it may no longer be suitable to this species.

### *Wild Dog Creek*

Wild Dog Creek was surveyed at 3 locations in the freshwater reaches between the foothills of the Otways Ranges and the estuary (Figure 4). The upstream location was at a location where Australian grayling were recorded in 1984 (DSE 2007c).

Short finned eel and the common galaxias were the only native species captured in abundance and in a range of sizes, indicating a regular recruitment into the system (Table 4). Brown trout were also found to be in a range of length from 164 to 277 mm (Table 4), which was indicative of a self sustaining population. The system has previously supported five additional native migratory species, namely climbing galaxias, spotted galaxias, short headed lamprey, Australian grayling and tupong (Appendix). The absence of these species in this survey is likely to be a reflection of continued low streamflows and a lack of regular recent connectivity between the estuary and the ocean.




*(Modified after Victorian Data Warehouse mapping tool) (DSE 2007b)*

**Figure 5: Map of fish survey locations in Wild Dog Creek**

### *Barham River*

The Barham River was surveyed at two locations. One site was in the Barham River West Branch (approximately 400 m upstream of the confluence with the Barham River East Branch) (site 20) and the other at the gauging weir at Paradise (site 21) (Figure 1). These two sites were chosen specifically because instream barriers are present, which presumably would restrict upstream passage of migratory fish species like the Australian grayling.

The 4 fish species captured, namely short finned eel, common galaxias, spotted galaxias and tupong are all native migratory species (Table 4).

The apparent absence of the Australian grayling, the short headed lamprey and the pouched lamprey does not exclude the possibility of the presence of these species in the Barham River system, but suggests that if they are present then, numbers are low. Poor recruitment of these species may have occurred in the past few years due to low streamflow.

### *Aire River*

Two sites on the lower tributaries of the Aire River (sites 22 and 23) were surveyed in an attempt to confirm the occurrence of Australian mudfish (Figure 1).

Australian mudfish could not be found in locations where they had been found previously. It is likely that the preferred backwater habitat of this species had completed dried during 2006/07. While these tributaries contained water at the time of the survey, recent prior connectivity with the ocean may have been quite brief and not allowed enough time for the migration of the species into the system.

Another 12 native freshwater fish have previously been recorded in the Aire River, namely short-finned eels, river blackfish (*Gadopsis marmoratus*), climbing galaxias, common galaxias, mountain galaxias, spotted galaxias, pouched lamprey, short-headed lamprey, flat-headed gudgeon, tupong, Australian smelt and Australian grayling (Appendix). Most of these species were not expected to be caught using a dip net in the smaller tributaries, however, it is recommended that a more detailed fish investigation (including specific surveys to target Australian grayling) be conducted in this system in the near future using a full suite of capture methods.

### *Curdies River*

One site on the Curdies River was sampled below Limestone Creek (site 24). This site has the only previous record of Yarra pygmy perch for the catchment (Figure 1).

Dip netting at this location on May 17, 2007 confirmed the occurrence of Yarra pygmy perch and southern pygmy perch within the system following the low flows of 2006/07. Additional flows would be likely to improve the prospects of Yarra pygmy perch conservation in the system.

Another 7 native freshwater fish have previously been recorded in the Curdies River, namely short-finned eels, climbing galaxias, common galaxias, spotted galaxias, flat-headed gudgeon, tupong and Australian smelt. Most of these species would normally be found within the Curdies River and would be likely to recolonise following an increase in streamflow and connectivity with the sea.

## Table 4: Fish survey capture results in streams of the Otways region (west of Lorne)

| Waterway | Site No. | Technique | Fish captured (scientific name) | Fish captured (common name) | No. fish | Length (mm) | Weight (g) | Bycatch |
|---|---|---|---|---|---|---|---|---|
| **Sheoak Creek** | **12** | Electrofish | *Anguilla australis* | short-finned eel | 1 | 300 | | |
| | **13** | Electrofish | *Anguilla australis* | short-finned eel | 9 | 250-500 | | |
| | | | *Galaxias maculatus* | common galaxias | 26 | 70-107 | 1.8-6.9 | |
| | | | *Galaxias truttaceus* | spotted galaxias | 19 | 87-153 | 7.2-47.5 | |
| **Cumberland River** | **14** | Electrofish | *Anguilla australis* | short-finned eel | 14 | 25-650 | | 450 FW shrimp |
| | | | *Galaxias brevipinnis* | climbing galaxias | 1 | 70 | 2.2 | |
| | | | *Galaxias maculatus* | common galaxias | 18 | 51-99 | 0.1-4.5 | |
| | | | *Galaxias truttaceus* | spotted galaxias | 8 | 82-158 | 5.2-48.2 | |
| | | | *Philypnodon grandiceps* | flat headed gudgeon | 4 | 37-78 | 0.2-4.9 | |
| | | | *Pseudaphritis urvillii* | tupong | 1 | 183 | 55.2 | |
| | | | *Salmo trutta* | brown trout | 20 | 150-400 | | |
| **Wye River** | **15** | Electrofish | *Anguilla australis* | short-finned eel | 4 | 250-600 | | 250 FW shrimp |
| | | | *Galaxias brevipinnis* | climbing galaxias | 1 | 87 | 5.2 | |
| | | | *Galaxias maculatus* | common galaxias | 12 | 50-97 | <0.1-3.2 | |
| | | | *Galaxias truttaceus* | spotted galaxias | 9 | 116-132 | 14.5-21 | |
| | | | *Philypnodon grandiceps* | flat headed gudgeon | 1 | 45 | <0.1 | |
| | | | *Pseudaphritis urvillii* | tupong | 1 | 98 | 6.2 | |
| | | | *Salmo trutta* | brown trout | 1 | 235 | 154 | |
| **Skenes Creek** | **16** | Electrofish | *Anguilla australis* | short finned eel | 45 | 150-920 | | 620 FW shrimp |
| | | | *Galaxias maculatus* | common galaxias | 74 | 43-104 | <0.1-6.4 | |
| | | | *Pseudaphritis urvillii* | tupong | 2 | 101-244 | 6.8-127 | |
| | | | *Salmo trutta* | brown trout | 2 | 174-397 | 58-666 | |
| **Wild Dog Creek** | **17** | Electrofish | *Anguilla australis* | short finned eel | 7 | 300-600 | | 450 FW shrimp |
| | | | *Galaxias maculatus* | common galaxias | 26 | 72-97 | 2.1-6.5 | |
| | **18** | Electrofish | *Anguilla australis* | short finned eel | 8 | 120-500 | | 210 FW shrimp |
| | | | *Galaxias maculatus* | common galaxias | 15 | 44-97 | <0.1-3.6 | |
| | | | *Salmo trutta* | brown trout | 3 | 164-277 | 56-233 | |
| | **19** | 4 fyke nets | *Anguilla australis* | short finned eel | 12 | 350-950 | | 100 FW shrimp |
| | | | *Galaxias maculatus* | common galaxias | 5 | 45-81 | 0.3-2.9 | |
| | | | *Salmo trutta* | brown trout | 3 | 183-276 | 62-217 | |
| **Barham River** | **20** | Electrofish | *Anguilla australis* | short-finned eel | 14 | 300-650 | | 150 FW shrimp |
| | | | *Galaxias maculatus* | common galaxias | 17 | 72-134 | 2.2-13.3 | |
| | | | *Galaxias truttaceus* | spotted galaxias | 1 | 128 | 25 | |
| | **21** | Electrofish | *Anguilla australis* | short-finned eel | 6 | 200-700 | | 140 FW shrimp |
| | | | *Galaxias maculatus* | common galaxias | 2 | 84-96 | 2.5-3.9 | |
| | | | *Pseudaphritis urvillii* | tupong | 3 | 170-197 | 20-66 | |
| **Aire River (lower tributaries)** | **22** | Dip net | *No fish* | | | | | |
| | **23** | Dip net | *Galaxias maculatus* | common galaxias | 8 | 65-85 | | |
| **Curdies River** | **24** | Dip net [2] | *Nannoperca australis* | southern pygmy perch | 7 | | | |
| | | | *Nannoperca obscura* | Yarra pygmy perch | 5 | | | |

[2] - *surveyed on 18 May 2007*

# Discussion

## *Impact of prolonged low flows on fish*

Prolonged low flows in the Otways streams in 2006 and 2007 are likely to have lead to a loss of connectivity between pools, restricted localised movement opportunities and reduced available instream habitat for native fish species. While most native species are likely to have experienced low flow conditions before, successive years of low flow is likely to have long lasting impacts on many species.

Small spring and summer freshes are critical for the native fish in these streams as they dilute and freshen the water quality, provide opportunity for localised movement and stimulate most non-migratory fish into spawning condition. Non-migratory native fish (including Yarra pygmy perch, southern pygmy perch, Australian smelt and flat-headed gudgeon) spawn from late winter to summer. Without refreshing inflows during this time and with limited available habitat, the success of the spawning events for these species is likely to be compromised. The abundance and diversity of available habitat is greatly reduced and therefore if spawning had occurred the possibility of escaping predation (by species such as eastern gambusia) would be greatly reduced.

Deterioration of water quality is also a likely consequence during periods of low flow. Without adequate mixing of the water column, dissolved oxygen levels are likely to decrease and without adequate shading water temperatures are likely to increase. Without the dilution of inflowing freshwater, saline ground water influences may also lead to an increase in the salinity and electrical conductivity within the remnant pools.

With an estimated reduction in runoff in the Otways region between 5% and 30% by the year 2030 due to climate change (Jones and Durack 2005), extended low to zero flow periods are likely to become more common and are likely to have a significant impact on native fish populations. Strategies such as maintaining habitat features of key refuge pools and the provision of additional water should be developed to help important fish communities through these periods of low flow.

## *Lack of season high flow freshes*

The recruitment of most migratory fish in these coastal systems appears to have been impacted more than first thought. With a lack of seasonal high flows in 2006 and lower flows throughout the first six months of 2007, it appears that most systems would not have provided suitable conditions for migration, spawning and recruitment of native fish species. Without high flow events (20 - 200 Ml/day) in each season the opportunities for spawning and recruitment for many species are greatly reduced. Most migratory fish species are triggered into spawning condition and provided upstream and downstream passage with high flow events in autumn and winter. For example, adult Australian grayling have previously been recorded migrating upstream in summer and autumn presumably in an attempt to find suitable spawning grounds. While little is known of the breeding biology of Australian mudfish, high flow events in autumn and winter are likely to be required to inundate low lying coastal margins and drainages. Adult pouched and short-headed lamprey migrate upstream into coastal rivers to spawn in spring and summer. Adult common galaxias and tupong undertake downstream spawning migrations in autumn and winter to the lower reaches and estuaries. Climbing galaxias and spotted galaxias appear to be dependant on flow events in autumn and winter to induce spawning condition and provide the necessary environment for spawning.

The larvae of coastal fish species (including Australian grayling, spotted galaxias, climbing galaxias) are also reliant on high flow events to flush them into the lower estuary or out to sea.

The majority of the upstream migrations of juvenile fish (including Australian mudfish, Australian grayling, climbing galaxias, common galaxias, spotted galaxias, short-finned eels and tupong) are undertaken in spring and summer. In drought conditions these higher flows are noticeably absent thereby reducing the potential for upstream migration of these juvenile fish.

The accumulation of sediment on the substrate is also a likely consequence of a lack of higher flow events and can reduce available habitat solid substrate for adhesive fish eggs.

### *Considerations for the management of Yarra pygmy perch*

Thompsons Creek is an ephemeral system with a history of extended low streamflows. While extended low flows are not uncommon for this system, with notable low flows also in 1999/2000 and 2005/2006 the prolonged low flows in 2006/07 appeared to be more devastating than previous events. Without significant streamflows and with a blocked estuary mouth, the conditions of the lower estuary deteriorated significantly throughout 2006/07 and in late February resulted in a fish kill (Ryan and McGuckin 2007). The majority of the system had been reduced to a series of isolated pools and although the lower system should be able to recover and be recolonised by migratory fish species, the impacts on the upper reaches may be more devastating, particularly for the population of Yarra pygmy perch that had previously been recorded at 8 locations in the middle and upper reaches (Ryan and McGuckin 2007).

The fish survey concentrated on important refuge sites for the remaining fish populations. Yarra pygmy perch have survived the low flow period, however, the distribution range of the Yarra pygmy perch in the system appears to have been reduced in conjunction with the reduction in habitat. For example no fish were recorded at Ghazeepore Road (site 3) which was indicative of this river reach drying out completely. The last survey in 2001 captured Australian smelt, flat-headed gudgeon, Yarra pygmy perch and eastern gambusia at this site (Zampatti 2001).

Saline groundwater also has a significant impact on the water quality within the catchment. Without streamflows to dilute the intruding saline groundwater, many pools within the Thompsons Creek catchment could become too saline for fish species, including Yarra pygmy perch. The conductivity on 12/08/07 was 6,700 µS/cm after the creek was likely to have just recommenced flowing following local rainfall. The electrical conductivity at Ghazeepore Road was 15,370 µS/cm at the time of the 2001 survey (Zampatti 2001), which indicated the intrusion of saline groundwater into the stream. This result also indicates that Yarra pygmy perch (along with the other species captured) are capable of surviving in water up to this level of electrical conductivity and salinity in the short term. The long term survival of the species in this population may however be compromised as the eggs and larvae may be much more sensitive. The recruitment of the Thompsons Creek population is likely to have been impacted over the last two years as a result of a reduction in instream habitat.

While sites further upstream appear to have been lost as key Yarra pygmy perch populations, pools at Pettavel Road and Horseshoe Bend Road continue to be important refuge sites for the species. Significant abundance of aquatic macrophytes and deeper pools provide sustained cover and water depth at these locations.

While Yarra pygmy perch appear to be relatively tolerant to high salinity and low dissolved oxygen, laboratory trials should be conducted as a matter of urgency to determine the maximum tolerances to enable management criteria to be determined. Trials should be conducted on different life stages including eggs, larvae, juvenile and adult fish.

The species has also adapted to low flow environments and is capable of persisting in off stream backwaters. Access to offstream habitats is likely to be an important requirement for Yarra pygmy perch. Shallow offstream wetlands and isolated pools provide the necessary habitat diversity to ensure the longer term survival of this species. Maintenance of these billabongs and anabranches should include fencing off and revegetation where possible.

Perhaps the most important environmental requirement for Yarra pygmy perch is the submerged aquatic vegetation. All aspect of the life cycle of Yarra pygmy perch are reliant on submerged vegetation. Management of this vegetation should be adopted as a surrogate to the management of Yarra pygmy perch. It is important to maintain the diversity and abundance of the aquatic macrophyte species. Submerged and emergent vegetation is utilised for shelter, feeding and spawning. Populations in the Corangamite catchments were strongly associated with dense aquatic vegetation including *Triglochin* sp. and *Potamogeton* sp. The maintenance of diverse instream vegetation ensures that Yarra pygmy perch have more opportunities to avoid the competitive and predatory impacts of large populations of eastern gambusia.

Stock access had noticeably impacted the quality of instream habitat at a number of locations on Thompsons Creek and as a result the diversity and abundance of aquatic vegetation has been greatly reduced.

While it is difficult to drought proof the Thompsons Creek system, strategies should be developed to protect important fish communities such as the Yarra Pygmy perch populations, including emergency drought strategies and drought recovery protocols. Important drought monitoring sites would include all six road crossings surveyed in the current study, including important refuge pools upstream and downstream of each locations.

### *Considerations for the management of Australian grayling*

The streams and locations of previous Australian grayling captures were targeted to determine if the species was attracted to the Otways streams following the prolonged low flow period of 2006/07. No Australian grayling were captured which indicates that more sustained freshwater flows are required to flush the river systems and attract this species to migrate upstream.

Zampatti et al. (2003) reported that Australian grayling were in the proximity of Dights Falls in the Yarra River from October to December 2001, corresponding with the tail end of two large flow peaks (3000 and 5000 ML/day). High flows of 100 to 200 ML/day in spring and autumn are likely to be required to attract Australian grayling back into and the Otways streams and enable upstream migration to preferred habitat.

A high streamflow event in early November 2007 is likely to have flushed many Otways streams and allowed passage for migratory fish, including Australian grayling. It is possible that juvenile and adult Australian grayling may have recolonised many of the river systems following this high flow event.

In conclusion it appears that surveys for Australian grayling need to be more opportunistic in nature to ensure that they are conducted immediately after high stream flow events occur.

### *Considerations for the management of Australian mudfish*

The lower tributaries of the Aire River system were surveyed in an attempt to determine the persistence of the Australian mudfish. While these small tributaries may have dried out completely earlier in 2007, at the time of the survey (14/9/07) they contained some water. The connectivity with the main Aire River may not have been maintained and therefore not

provided Australian mudfish an opportunity to recolonise the system. If the Australian mudfish were also capable of aestivating in the drying tributaries, there was no evidence of them having emerged from the substrate.

In accordance with the Action Statement for the Australian mudfish (Skene et al. 2005), more intensive surveys are required to determine more detailed information on the life cycle of the species. Specifically more information is required to determine the sequence and timing of events necessary for successful reproduction, and what adaptability the fish may have for environmental variations.

Following the re-inundation of shallow coastal swampland in the region surveys should be conducted, and include electrofishing and setting small bait traps and fykes nets to take advantage of the species nocturnal habits. Targeted surveys are required in the lower Barwon River catchment (in vicinity of Belmont Common and other potential locations such as Reedy Lakes), and at Wye River and Glen Aire.

Stock exclusion fencing and the maintenance of coastal tea tree vegetation and drainage lines is essential for the survival of this species. Suitable floodplain habitat for Australian mudfish is rapidly disappearing in coastal regions that are under urban development pressure.

## *Other Catchment considerations*

### *Thompsons Creek*

Low flow barriers in the lower reaches (such as Thompsons Creek weir and at Horseshoe Bend), impact of eastern gambusia, saline groundwater, clearing of riparian vegetation and lack of stock exclusion fencing have further compromised the suitability of Thompsons Creek catchment for native fish species.

The lower Thompsons Creek weir and rock ramp fishway was also inspected on 12/08/07. The fishway was seen to have been completed blocked by silt and weed growth and was therefore not functioning as it should have been. Many of the potential migratory species would be unable to pass this barrier. A more intensive survey utilising the sites investigated in 2001 (Zampatti 2001) is recommended to reconfirm the effectiveness of the fishway on the lower weir and to determine if the estuary has recovered from the impacts of low flow.

### *Painkalac Creek*

Like the Thompson Creek, the Painkalac system also has an irregular flow pattern with a number of previous low flow periods, including between 1992 and 1999. While passing flows from Aireys Inlet Reservoir have been designed to match inflows during the drier period (December to April) in the past, larger flow events can be absorbed by the dam without passing the environmental benefits downstream. The recent drought assessment investigation noted that Painkalac Creek downstream of Aireys Inlet Reservoir was drought stressed with a noticeable lack of freshwater fish and with an excessive algal growth (Ryan and McGuckin 2007).

A lack of most of the migratory native fish fauna in this system may only be temporary given the recent flood which reopened the estuary mouth. Streamflow recommenced in the system in June 2007 and recolonisation of migratory fish species would have been possible with this flushing.

Estuarine species previously captured in Painkalac Creek include numerous black bream, estuary perch (*Macquaria colonorum*), sea mullet (*Mugil cephalus*), yelloweye mullet, longsnout flounder, salmon species *(Arripis* spp.), small mouth hardyhead, Tamar River goby (*Afurcagobius tamarensis*), luderick (*Girella tricuspidate*), soldierfish (*Gymnapistes marmoratus*), and smooth toadfish *(Tetractenos glaber*) (DSE 2007c). The drought conditions

would have impacted the suitability of the estuary for recreationally important species such as black bream and estuary perch and made the stream less attractive for migratory species such as the galaxias species, tupong and lamprey species.

An environment flow study for the Painkalac system was completed in 2007 and attempts to address these issues by the allocation of a low flow minimum and low flow freshes (from summer to autumn) and high flow allocations in autumn, winter and spring (Doeg et al. 2007). Cease to flow provisions were also developed and stipulate that from November to April a maximum of two cease to flow spells of 7 days maximum duration occur each year (Doeg et al. 2007). The incorporation of these environmental flow measures should encourage a sustainable native fish community within the Painkalac Creek and provide a certain degree of drought proofing. This may have the potential to provide drought refuge for native fish populations, including Australian grayling in the future. The high volume of large woody debris and number of deeper pools in the reach downstream of the Old Coach Road has further potential to act as refuge during drought. Stock exclusion fencing and revegetation of the riparian zone in this reach would provide much greater cover and protection.

### *St Georges River*

A redundant weir 400 m downstream from the Allenvale Bridge represents a significant impediment to upstream migration under moderate to low flow events. The removal of this weir would open up approximately five kilometres (up to the bottom of Allen Reservoir) of good quality riverine habitat suitable for most migratory fish species.

The single Yarra pygmy perch captured below Allen Reservoir (site 9) represents the first record of this species in the system. Further investigations are warranted in the upper reaches of the catchment, including within Allen Reservoir to determine the status of the Yarra pygmy perch population.

Other freshwater fish species previously captured in St. Georges River include common galaxias, tupong, and Australian grayling (DSE 2007c) (Appendix). The lack of these species may indicate a lack of connectivity with the sea about the time of the survey. Without sufficient water depth at the mouth of the St. George River, these species have been excluded from the system. This pattern is likely to be short lived and the next large flow event should allow, these species to re-colonise the system.

### *Wild Dog Creek*

Although streamflow may have ceased in Wild Dog Creek, oxygen levels appeared to have remained sufficient for the survival of brown trout, which is a high oxygen dependent fish species. The common galaxias captured at the lower site on Wild Dog Creek were juvenile fish and were indicative of recent migrations into the river.

The high abundance of short-finned eels and brown trout represent a significant predatory impact on small migratory species within the system.

With the recommencement of streamflow in April 2007 and the November 2007 flood, recolonisation of some of the fish species formally recorded in Wild Dog Creek can be expected.

The instream habitat of Wild Dog Creek is relatively poor with a lack of large woody debris, overhanging native vegetation and consists of largely unconsolidated stream banks. Stock exclusion fencing and revegetation of the riparian zone is necessary in the lower and middle reaches of this system.

# Conclusion

With the projected decrease in overall runoff associated with climate change, the likelihood of extended low flow periods is likely to increase. In low flow conditions the connectivity between pools can be lost and available instream habitat can be greatly reduced. Most native non-migratory fish species appear to be relatively tolerant to the environmental conditions associated with drought including deteriorating water quality. However, if suitable spawning opportunities are not achieved for two or three consecutive seasons, it is very likely that recruitment failure will result. Under such a scenario, the potential decline of Yarra pygmy perch populations is highly likely.

The frequency and magnitude of high rainfall events associated with climate change may not decline. Therefore the upstream and downstream movement opportunities for migratory native fish within Otways streams should not be impacted too greatly. However, connectivity and water quality issues need to be addressed for migratory fish species during periods of low streamflow. Isolation of adult migratory fish (including Australian grayling and Australian mudfish) and a decline in available habitat and water quality may result in a series of indirect impacts such as increased vulnerability to predation and decreased fitness and condition. A reduction in localised reproductive success is likely to follow. Regional population size may not decline, because migratory species have the ability to recolonise system if there is sufficient flow to enable access. Systems with a greater frequency of high flow events may become important refuges for migratory fish.

# Recommendations

### *Yarra pygmy perch*

- Conduct regular surveys of the Yarra pygmy perch population in the Thompson River to assess abundance and recruitment (at least every three years, but more regularly drought periods)
- Survey and assess the Yarra pygmy perch population the upper St. Georges River, including Allen Reservoir;
- Conduct a thorough investigation of the Yarra pygmy perch population in the Curdies River, assessment potential environmental impacts on the population and recommend priority management actions to ensure its survival
- Conduct salinity and dissolved oxygen tolerance trials to establish management target guidelines;
- Stock exclusion fencing should maintain a 30 metre buffer wherever possible and include as much creek frontage as possible including backwaters and anabranches;
- Manage the diversity and abundance of aquatic plants to maintain the available habitat for Yarra pygmy perch;
- Develop a drought management strategy to incorporate important sites such as the pools downstream of Horseshoe Bend and Pettavel Road crossings.

### *Australian grayling*

- Conduct opportunistic surveys targeting Australian grayling immediately after high flow events in summer and autumn for migrating adults and spring and summer for juveniles (including at the more likely capture locations including in the St. Georges River, Cumberland River, Wye River, Barham River, and the Ford River).
- Incorporate the migration seasons for Australian grayling into the Estuary opening strategies of the Otways Streams to where possible provide upstream passage during high flow events of juveniles in spring and summer and the downstream progression of larvae during high flow events in autumn and winter.
- Undertake stock exclusion fencing and riparian revegetation in the lower and middle reaches of catchments (as listed above) that are likely to be important to Australian grayling.

### *Australian mudfish*

- Conduct regular surveys of the Australian mudfish population to assess abundance and recruitment (at least every three years, but more regularly during extended drought periods)
- Stock exclusion fencing should maintain a 30 metre buffer wherever possible and include as much creek, swamp and backwater habitat as possible including backwaters and anabranches;
- Investigate captive breeding options in other isolated locations; and
- Develop a drought management strategy to incorporate important sites on the lower floodplains of the Aire, Calder, Wye and Barwon River systems.

# Acknowledgements

Greg Peters, Simone Wilkie and Denis Lovric from CCMA are thanked for their assistance in this project. Greg and Simone were instrumental in deciding upon the streams that needed to be assessed in this study. Denis Lovric is especially thanked for his field assistance and valued local knowledge.

Sabine Schreiber and Paul Bennett are thanked for providing some background information on the impacts of drought in streams in Victoria including notes from a meeting held in October 2006.

Access for many sites required assistance from a number of different land managers. Thanks to Graeme McKenzie for access to Painkalac Creek and Parks Victoria (Lorne) for access to the St.Georges River.

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# Appendix: Comparison of previous fish distribution records and observation made in 2007

| **Species** | Thompsons Creek | Painkalac Creek | Erskine River | St. Georges River | Sheoak Creek | Cumberland River | Wye River | Skenes Creek | Wild Dog Creek | Barham River | Aire River | Curdies River |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number of sites | 4 | 3 | 1 | 3 | 2 | 1 | 1 | 1 | 3 | 2 | 2 | 1 |
| Techniques | F, D | F, D, E | E | F, E | E | E | E | E | F, E | E | D | D |
| | | | | | | | | | | | | |
| **Native fish species** | | | | | | | | | | | | |
| *Anguilla australis* | x | x | x | x | x | x | x | x | x | x | | |
| *Gadopsis marmoratus* | | | | | | | | | | | | |
| *Galaxias brevipinnis* | | | | x | | x | x | | | | | |
| *Galaxias maculatus* | | x | x | | x | x | x | x | x | x | x | |
| *Galaxias olidus* | | | | | | | | | | | | |
| *Galaxias truttaceus* | | x | x | x | x | x | x | | | x | | |
| *Geotria australis* | | | | | | | | | | | | |
| *Mordacia mordax* | | | | x | | | | | | | | |
| *Nannoperca australis* | x | | | | | | | | | | | x |
| *Nannoperca obscura* [1] | x | | | x | | | | | | | | x |
| *Neochanna cleaveri* [2] | | | | | | | | | | | | |
| *Philypnodon grandiceps* | x | x | | x | | x | x | | | | | |
| *Prototroctes maraena* [3] | | | | | | | | x | | | | |
| *Pseudaphritis urvillii* | | | x | | | x | x | x | | x | | |
| *Retropinna semoni* | x | | | | | | | | | | | |
| **Exotic fish species** | | | | | | | | | | | | |
| *Cyprinus carpio* | | | | | | | | | | | | |
| *Gambusia holbrooki* | x | | | | | | | | | | | |
| *Oncorhynchus mykiss* | | | | | | | | | | | | |
| *Oncorhynchus tshawytscha* | | | | | | | | | | | | |
| *Perca fluviatilis* | | | | | | | | | | | | |
| *Salmo trutta* | | | x | x | | x | x | x | x | | | |
| *Tinca tinca* | | | | | | | | | | | | |
| **Crustacean** | | | | | | | | | | | | |
| *Paratya australiensis* | x | x | x | x | | x | x | x | x | x | | x |

*Grey squares indicate previous records, while 'X' indicates a capture of current survey.*

*Fishing techniques: F = fyke nets D = dip net E = backpack electrofishing*

*Conservation status (DSE 2007a): 1. 'Near Threatened' in Victoria (FFG Act) and 'Vulnerable' in Australia (EPBC Act)*
*2.'Critically Endangered' in Victoria (FFG Act)*
*3. 'Vulnerable' in Victoria (FFG Act) and 'Vulnerable' in Australia (EPBC Act)*