Rehabilitation of Waurn Ponds Creek, Victoria, for Yarra Pygmy Perch (*Nannoperca obscura*) and Other Native Freshwater Fishes

A report to

The Corangamite Catchment Management Authority

Paul Close, Erin Webb & Wayne Koster

Freshwater Ecology
Arthur Rylah Institute for Environmental Research

July 2002

State Government Victoria
Department of Natural Resources and Environment

Title: Rehabilitation of Waurn Ponds Creek, Victoria, for Yarra Pygmy Perch (*Nannoperca obscura*) and Other Native Freshwater Fishes

Produced by **Paul G. Close, Erin Webb & Wayne M. Koster**

Arthur Rylah Institute for Environmental Research
Department of Natural Resources and Environment
PO Box 137 Heidelberg Victoria 3084
Telephone: (03) 9450 8600
Facsimile: (03) 9450 8730

Produced for **Corangamite Catchment Management Authority**

Contact John Turner

CCMA
64 Dennis Street
Colac 3250
Telephone: (03) 5232 9123

Date July 2002

Publication Details

Close, P.G., Webb E. & Koster, W.M. (2002). Rehabilitation of Waurn Ponds Creek, Victoria for Yarra Pygmy Perch (*Nannoperca obscura*) and Other Native Freshwater Fishes. Report to Corangamite Catchment Management Authority. Freshwater Ecology, Department of Natural Resources and Environment.

Cover Photographs (top to bottom)

- Catchment dams in the upper reaches of Waurn Ponds Creek catchment (Photo: P. Close)
- Endangered Yarra Pygmy Perch, *Nannoperca obscura* (photo: Rudi Kuiter)
- Culverts and drains downstream of Waurn Ponds Shopping Centre Weir (photo: Paul Close)

TABLE OF CONTENTS

1. INTRODUCTION

As part of the Waurn Ponds Creek rehabilitation project, the Corangamite Catchment Management Authority (CCMA) commissioned the *Freshwater Ecology Section* of the Department of Natural Resources and Environment to undertake an assessment of the current ecological status of fish assemblages in Waurn Ponds Creek. Waurn Ponds Creek is a short tributary stream of the lower reaches of the Barwon River in southwest Victoria. The catchment is highly modified from its natural state by agricultural development in the mid to upper reaches and urban development in the mid to lower reaches. Increases in urbanisation and the intensification or diversification of agriculture may all represent substantial risk to the integrity and sustainability of biodiversity in aquatic ecosystems (Klein 1979; Growns *et al.* 1998; Sonneman *et al*. 2001; Wash *et al.* 2001; Close 2001).

Despite this, the intrinsic value of streams that flow through agricultural and urban areas is high and there is substantial effort increasingly being afforded to rehabilitate these systems. This is especially true for Waurn Ponds Creek which has potentially high aesthetic and biodiversity values in the mid to lower catchment and high resource values in the upper catchment with regard to supply of water for agricultural demand (pers. observ). Nevertheless, limited information on the ecology of urban and metropolitan watersheds has until recently hindered rehabilitation efforts.

Biodiversity values in Waurn Ponds Creek may include potentially high diversity of fish species including populations of several threatened freshwater fish, namely Yarra pygmy perch (*Nannoperca obscura*) and Australian mudfish (*Neochanna cleaveri*). Due to the small size of these and other native fish species that typically inhabit coastal drainages in southeast Australia such as Waurn Ponds Creek, their requirements in rehabilitation plans are not often considered. However, small freshwater fish species often comprise the majority of species diversity in such systems. An understanding of their distribution, abundance and viability throughout the region is therefore crucial to sustaining native fish species diversity through stream rehabilitation efforts.

This study aimed to provide information on the diversity, distribution and abundance of freshwater fish species in Waurn Ponds Creek. In particular, the distribution and population dynamics of Yarra pygmy perch and Australian mudfish were investigated. We have used knowledge of fish assemblages combined with the identification of anthropogenic factors potentially impacting on freshwater fish to set priorities for the design and establishment of a rehabilitation plan for Waurn Ponds Creek.

2. METHODS

2.1 STUDY AREA

Waurn Ponds Creek is a short low altitude tributary of the lower reaches of the Barwon River. From its source at 160 metres above sea level the creek flows generally east for approximately 20 kilometres towards its confluence with the Barwon River. In the upper reaches the creek flows through undulating coastal hill slopes which have been mostly cleared for agricultural purposes. In this region the creek is characterised by cleared riparian vegetation and degraded instream habitats. In the lower reaches the catchment is urbanised and the stream channel has been artificially incised and straightened to mitigate against flooding. In this region riparian vegetation has been mostly cleared although substantial replanting of native riparian vegetation has occurred between Grovedale and Barwon Heads road. Numerous factors impacting on environmental condition and more specifically on aquatic fauna assemblages in the catchment were identified in this study. In general these disturbances relate to the entire catchment and include:

- altered flow regimes;
- degradation of riparian (streamside) vegetation;
- degradation of instream habitat;
- channel modification and;
- instream barriers.

2.2 STUDY SITES

A total of nine survey sites were selected within the study region (Table 2-1). All sites were selected to represent the available habitat types within the catchment. Five sites were located in urban reaches and four sites were located in predominantly agricultural reaches. At each site, a single survey reach was established to represent the available habitat attributes including flow types and cover elements. The location of each survey reach was defined by Australian Map Grid Reference (AMG) from topographic 1:100,000 scale maps (Table 2-1).

Table 2-1. The location of survey sites on Waurn Ponds Creek

Site	Location	AMG (1:100 000)*
1	Henty Main Road	7721-55-253400-5769200
2	Downstream of Anderson Road crossing	7721-55-255300-5768600
3	Upstream of Devon Road crossing	7721-55-256700-5769000
4	Downstream of Cochran's Road crossing	7721-55-260900-5768100
5	Jarvis Oval	7721-55-263100-5768000
6	Downstream of Grovedale Road crossing	7721-55-265500-5768600
7	Rotary Peace Park	7721-55-266500-5769400
8	Camdell Court	7721-55-267500-5769400
9	Downstream of Barwon Heads road	7721-55-268300-5770100

*AMG notation: map-zone-eastings-northings. D/s – Downstream, U/s – Upstream.

2.3 QUANTIFICATION OF HABITAT ATTRIBUTES

2.3.1 Hydrology

For each survey reach, the mean width (m) was calculated from at least five measurements. Mean depth (m) within each survey reach was calculated from measurements that were recorded across at least five transects strategically positioned to incorporate a representative sample of depths. Spot measurements of water quality parameters were recorded within each survey reach. Water temperature (°C) and electrical conductivity ($\mu S.cm^{-1}$) were measured with a WTW LF 320 meter, dissolved oxygen ($mg.l^{-1}$) with a WTW OXI 320 meter, turbidity (NTU) with a HACH 2100P Turbidimeter and pH with a WTW pH 320 meter.

2.3.2 Cover Elements

The relative abundance (% of wetted area) of hydraulic biotypes, habitat attributes and cover elements was estimated for each survey reach. Hydraulic units at each site were defined using the categories; cascade, rapid, riffle, glide, run, pool or backwater (after Anderson & Morrison 1989; Anderson *et al.* 1989). Streambed geology was described in terms of percentage composition of various substrata, namely boulder (particle size > 256 mm), cobble (64-255 mm particle size), pebble (16-63 mm particle size), gravel (2-15 mm particle size), sand (0.1-2 mm particle size) and silt/clay (particle size < 0.1 mm). The relative abundance of dominant cover elements including substratum, woody debris (logs, branches), organic debris (leaves, bark), overhanging bank, overhanging vegetation and aquatic vegetation was recorded.

2.4 Survey Methodology

2.4.1 Fish Collection

Aquatic fauna surveys were conducted between February 19th and 22nd using a single-pass bank-mounted (Smith-Root® 7.5GPP electrofishing unit) electrofishing technique. The operator fished in an upstream direction, fishing all wadeable habitats along the stream margins and mid-channel, stunning and retrieving fish. An assistant followed the operator collecting any animals missed by the operator. The exact length of survey reach electrofished was measured to the nearest metre and the fishing time taken to complete each pass recorded.

2.4.2 Sample Processing

All fish collected were identified, counted and measured for length (to the nearest 1 mm - length to caudal fork) and weight (wet weight to the nearest 0.1 g for weights < 100 g and 1 g for weights > 100g). Nomenclature for fish species follows Allen (1989) and Paxton *et al.* (1990). For samples containing many (>30) individuals of a single species, a representative subsample of 20 specimens was identified counted and measured for length and weight and the number and/or bulk weight for additional individuals of each species was also recorded.

3. RESULTS

3.1 WATER QUALITY PARAMETERS

Physico-chemical water quality parameters are shown in Table 3-2 and 3-3. Water temperature was highest in the upper catchment and ranged from 16.7 °C at site 8 to 24.2 °C at the second most upstream site (site 2). Similarly, electrical conductivity concentrations ranged from 2970 µs/cm at the most downstream site (site 9) to 8460 µs/cm at the second most upstream site (site 2). Dissolved oxygen concentrations varied spatially and ranged from 1.5 mg/L at site 3 to 12.5 mg/L at site 4. Turbidity ranged from 3.2 NTU at the fifth most upstream site (site 5) to 17.6 NTU at the second most upstream site (site 2). At all sites pH was alkaline and ranged from 7.8 at Site 6 to 8.2 at site 4.

3.2 SITE CHARACTERISTICS

Site 1- Henty Main Road

This site was dry.

Site 2- downstream of Anderson Road Crossing

This reach extended 100m downstream from Anderson Road Crossing. The mean width and depth were 2 m and 0.1 m respectively. Hydraulic habitats included pool (80%) and run (20%). The streambed comprised predominantly fine substrata including sand (20%), silt (40%) and clay (40%). Instream habitat available as cover to aquatic fauna was dominated by aquatic vegetation (80%). Streamside disturbances included a cleared riparian zone and catchment dams immediately upstream.

Figure 3-1. Waurn Ponds Creek downstream of Anderson Road Crossing

Table 3-2. Instream habitat structure for survey sites on Waurn Ponds Creek. Substrata and instream cover are defined in the text.

Habitat Survey Characteristics	Site 1	Site 2	Site 3	Site 4	Site 5
Reach characteristics					
Mean stream width (m)	-	2	1.5	2	1.5
Mean depth (m)	-	0.1	0.15	0.1	0.4
Max depth (m)	-	0.9	1.2	0.45	1.5
Water quality					
Temperature (˚C)	-	24.2	19.3	20.5	19.7
Electrical conductivity (µS/cm)	-	8460	6880	5540	5510
Dissolved oxygen (mg/L)	-	6.4	1.5	12.5	5.9
Turbidity (NTU)	-	17.6	11.9	5.1	3.2
pH	-	8.1	8.1	8.2	8.1
Substrate composition (% of wetted area)					
Sheet rock	-	0	0	0	0
Boulder	-	0	10	30	5
Cobble	-	0	0	0	0
Pebble	-	0	0	0	0
Gravel	-	0	0	0	60
Coarse Sand	-	0	20	40	0
Fine Sand	-	20	20		10
Silt	-	40	20	15	15
Clay	-	40	30	15	10
Instream cover (% of wetted area)					
Substrate (Rock)	-	0	5	25	30
Logs/Log jams	-	0	0	0	1
Branches/Branch piles	-	0	0	0	0
Leaves, organic debris	-	0	0	0	5
Bank overhang	-	0	0	0	10
Vegetation overhang	-	0	0	0	0
Urban rubbish	-	80	0	0	0
Aquatic vegetation	-	0	30	85	40
Hydraulic habitat (% of wetted area)					
Rapid/cascade	-	0	0	0	0
Run	-	20	40	0	0
Riffle	-	0	0	75	30
Glide	-	0	0	0	20
Pool	-	80	60	25	50
Backwater	-	0	0	0	0

Table 3-3. Instream habitat structure for survey sites on Waurn Ponds Creek. Substrata and instream cover are defined in the text.

Habitat Survey Characteristics	Site 6	Site 7	Site 8	Site 9
Reach characteristics				
Mean stream width (m)	2	1.5	1.5	2
Mean depth (m)	1.0	0.7	0.7	0.7
Max depth (m)	1.3	2	1.2	1.4
Water quality				
Temperature (˚C)	17.6	20.1	16.7	18.6
Electrical conductivity (µS/cm)	4910	5670	5340	2970
Dissolved oxygen (mg/L)	5.7	8.1	7.5	11
Turbidity (NTU)	6.25	5	5.1	3.4
pH	7.8	7.9	7.9	7.9
Substrate composition (% of wetted area)				
Sheet rock	0	0	0	0
Boulder	0	2	0	5
Cobble	0	0	0	5
Pebble	0	0	0	15
Gravel	0	0	60	30
Coarse Sand	0	0	0	0
Fine Sand	10	50	0	0
Silt	70	38	40	45
Clay	20	10	0	0
Instream Cover (% of wetted area)				
Substrate (Rock)	0	0	0	0
Logs/Log jams	2	1	0	0
Branches/Branch piles	0	0	30	0
Leaves, organic debris	0	2	5	0
Bank overhang	2	20	0	10
Vegetation overhang	2	2	15	0
Urban rubbish	0	0	20	0
Aquatic vegetation	80	20	0	40
Hydraulic habitat (% of wetted area)				
Rapid/cascade	0	0	0	0
Run	85	85	30	30
Riffle	5	5	0	0
Glide	0	0	0	10
Pool	10	10	70	60
Backwater	0	0	0	0

Site 3- upstream Devon Road Crossing

This survey reach extended from 10m to 60m upstream of Devon Road Crossing. The mean width and depth of the survey reach were 1.5 m and 0.15 m respectively. Hydraulic habitat comprised run (40%) and pool (60%). The streambed comprised clay (30%), silt (20%), fine sand (20%), coarse sand (20%) and boulder (10%). Instream habitat available as cover to aquatic fauna was dominated by aquatic vegetation (30%) and small areas of coarse substrate (5%). Streamside disturbances included a cleared riparian zone and a culvert.

Figure 3-2. Waurn Ponds Creek upstream of Devon Road Crossing

Site 4- Cochran's Road Crossing

This reach extended from 30m upstream to 28m downstream of a ford approximately 500m downstream of the Cochran's Road crossing. The mean width and depth were 2m and 0.1m respectively. Hydraulic habitats comprised riffle (75%) and pool (25%). The streambed comprised largely of coarse substrata including sand (40%) and boulder (30%). Instream habitat available as cover to aquatic fauna consisted of aquatic vegetation (75%) and coarse substrate (25%). Streamside disturbances included a mostly cleared riparian zone and an instream barrier.

Figure 3-3. Waurn Ponds Creek at Cochran's Road Crossing

Site 5- Jarvis Oval Bridge

This reach extended from 55 m downstream to approximately 21m upstream of Jarvis Oval Bridge. The mean width and depth of the survey were 1.5m and 0.4m respectively. Hydraulic habitats comprised riffle (30%), glide (20%) and pool (50%). The streambed comprised gravel (60%) silt (15%), clay (10%), sand (10%) and small areas of boulder (5%). Instream habitat available as cover to aquatic fauna consisted predominantly of aquatic vegetation (40%) and coarse substrate (30%). Streamside disturbances included a culvert and a partly cleared riparian zone.

Figure 3-4. Waurn Ponds Creek at Jarvis Oval Bridge

Site 6- downstream Grovedale Road Crossing

This reach extended from approximately 350m to 400m downstream of Grovedale Road Crossing. The mean width and depth were 2m and 1m respectively. Hydraulic habitats comprised run (85%), pool (10%) and riffle (5%). The streambed comprised silt (70%), clay (20%) and sand (10%). Aquatic vegetation dominated the available habitat for aquatic fauna (80%). Streamside disturbances included stream channelisation and incision.

Figure 3-5. Waurn Ponds Creek downstream of Grovedale Crossing

Site 7- Rotary Peace Park

This reach was located at Rotary Peace Park, and extended for a length of 60m. The mean width and depth were 1.5m and 0.7m respectively. Hydraulic habitats comprised run (85%), pool (10%) and riffle (5%). The streambed comprised predominantly sand (50%) and silt (38%). A variety of instream habitats were present including bank overhang (20%) and aquatic vegetation (20%). Streamside disturbances included stream channelisation and incision.

Figure 3-6. Waurn Ponds Creek at Rotary Peace Park

Site 8- Camdell Court

This reach was located off Camdell Court, and extended for 52m. The mean width and depth were 1.5m and 0.7m respectively. Hydraulic habitats comprised pool (70%) and run (30%). The streambed comprised gravel and sand (60%) and silt/clay (40%). Instream habitat comprised predominantly branches (30%), urban rubbish (20%) and vegetation overhang (15%). Streamside disturbances included stream channelisation and incision.

Figure 3-7. Waurn Ponds Creek at Camdell Court

Site 9- Barwon Heads Road

This reach extended from the Barwon Heads Road Bridge to 43m downstream. The mean width and depth were 2m and 0.7m respectively. Hydraulic habitats comprised pool (60%), run (30%) and glide (10%). The streambed comprised predominantly fine sand, silt and clay (45% combined) and gravel (30%). Aquatic vegetation dominated the available habitat (40%). Streamside disturbances included two instream barriers (two fords with culverts), stream channelisation and incision.

Figure 3-8. Waurn Ponds Creek downstream of Barwon Heads Road

3.3 FISH SURVEYS

3.3.1 Distribution and abundance

A total of 461 individual fish representing eight species (six native and two exotic) were recorded (Table 3-4). Species diversity and abundance tended to increase with increasing distance downstream from source. Species diversity ranged from two species in the upper reaches (site 2 and 3) to seven species at site 4. The number of individual fish recorded at each site also varied, ranging from 22 individuals at site 2 to 88 individuals at the most downstream site (site 9).

Common galaxias (*Galaxias maculatus*) were the most abundant species recorded, comprising 46% of the total catch, and were also one of the most widespread species, being recorded at all survey sites with the exception of two sites in the upper reaches (site 2 and 3). Yarra pygmy perch comprised 21% of the total catch, and were also one of the most widespread species, being recorded at the same six sites where common galaxias were recorded.

Short finned eel (*Anguilla australis*) were the most widespread species, being collected at all sites surveyed, although total abundance was low with only 23 individuals collected representing 5% of the total catch. Southern pygmy perch (*Nannoperca australis*) were collected at five sites and represented 13% of the total catch. Spotted galaxias (*Galaxias truttaceus*) were collected in low numbers from four sites. Flat-headed gudgeon (*Philypnodon grandiceps*) were recorded in low numbers from the most downstream site (site 9).

Exotic fish species were collected only in the upper catchment. Here water quality parameters displayed the highest temperature, electrical conductivity and turbidity (Table 3-2, 3-3). Eastern gambusia (*Gambusia holbrooki*) were collected in low numbers at three sites representing 10% of the total catch. One goldfish (*Carassius auratus*) was also collected.

Table 3-4. Total abundance of species collected in Waurn Ponds Creek.

	Site								
Species	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Total**
Native teleost species									
Anguilla australis	1	2	1	7	2	2	7	1	**23**
Philypnodon grandiceps								7	**7**
Galaxias maculatus			27	30	22	46	41	45	**211**
Galaxias truttaceus			1	3	1	12			**17**
Nannoperca australis			9	26	10		8	5	**58**
Nannoperca obscura			11	1	15	12	29	30	**98**
Exotic teleost species									
Gambusia holbrooki	21	23	2						**46**
Carassius auratus			1						**1**
Total number of fish	**22**	**25**	**52**	**67**	**50**	**72**	**85**	**88**	**461**
Total number of fish species	**2**	**2**	**7**	**5**	**5**	**4**	**4**	**5**	**8**

3.3.2 Assemblage structure

Catch per unit effort (CPUE) varied between sites and tended to increase with increasing distance downstream from source (Figure 3-9). At site 2 and 3 located in the upper reaches of the catchment, the exotic eastern gambusia dominated fish assemblages with relative abundances of 95% and 92% respectively (Table 3-4). Short-finned eel were also recorded in low abundances (Table 3-4). In the mid- to lower reaches of the catchment species diversity and abundance increased compared to the upper reaches. Fish assemblages were typically dominated by common galaxias (41-68% relative abundance), and to a lesser extent Yarra pygmy perch and/or southern pygmy perch (Table 3-4, Figure 3-9). Spotted galaxias were also relatively abundant at site 7 in the lower reaches, comprising 17% of the fish fauna recorded at this site (Table 3-4, Figure 3-9). Exotic species were collected only from the three most upstream sites.

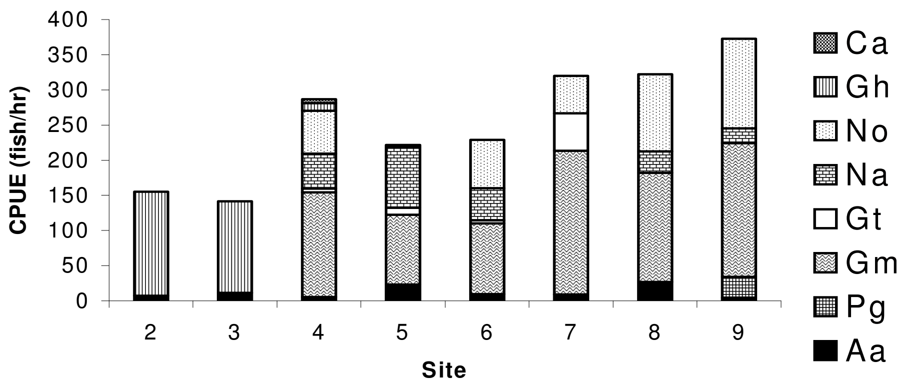

Figure 3-9. Catch Per Unit Effort (fish.hr-1) for surveys at sites on Waurn Ponds Creek.

Abbreviations denote species as: Ca, *Carassius auratus* (goldfish); Gh; *Gambusia holbrooki* (Gambusia); No; *Nannoperca obscura* (Yarra pygmy perch); Na, *Nannoperca australis* (southern pygmy perch); Gt; *Galaxias truttaceus* (spotted galaxias); Gm, Galaxias maculatus (common galaxias); Pg, *Philypnodon grandiceps* (flat-headed gudgeon); Aa, *Anguilla australis* (short-finned eel).

3.3.3 Length-frequency distribution of Yarra pygmy perch

A length-frequency histogram was constructed for Yarra pygmy perch collected during surveys on Waurn Ponds Creek. Length frequency histograms provide information on the size structure of populations from which population viability may be inferred.

The length of Yarra pygmy perch collected from sites on the Waurn Ponds Creek ranged from 10-65mm (Figure 3-10). Length frequency of Yarra pygmy perch is generally bimodal and shows two distinct cohorts; adults and young-of-year. An adult population ranging in length from 40-65mm, and a young-of-year cohort ranging in length from 20-30mm, is visible. The young-of-year cohort probably represents last years spawning between October and September.

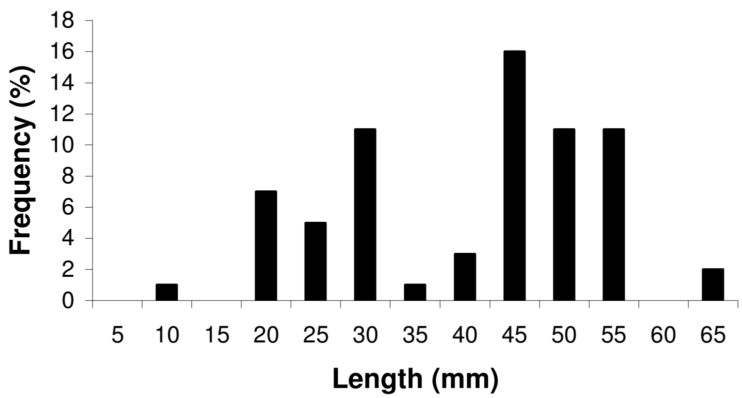

Figure 3-10. Length-frequency distribution for Yarra pygmy perch (n=68).

4. DISCUSSION

4.1 SPECIES DIVERSITY, DISTRIBUTION AND ABUNDANCE

The current aquatic fauna assemblage in Waurn Ponds Creek is considered depauperate relative to what may be expected to occur naturally. There are numerous other native fish species that may have been expected to inhabit Waurn Ponds Creek, namely, river blackfish (*Gadopsis marmoratus*), broad-finned galaxias (*Galaxias brevipinnis*), spotted galaxias (*Galaxias truttaceus*), dwarf galaxias (*Galaxiella pusilla*), pouched lamprey (*Geotria australis*), short-headed lamprey (*Mordacia mordax*), Australian mudfish, Australian grayling (*Prototroctes maraena*), tupong (*Pseudaphritis urvillii*) and Australian smelt (*Retropinna semoni*). Seven of these species migrate between freshwater and marine environments at some stage in their life cycle (Koehn and O'Connor 1990).

The diversity of native fish species observed in the current study declined with increasing distance upstream. Although species diversity may decline as distance inland increases, owing to factors such as availability of suitable habitats and migratory ability (McDowall 1998), in Waurn Ponds Creek stream accessibility has been artificially reduced by human disturbance (e.g. instream barriers and stream channelisation). The relative dominance of native and exotic fish species varied throughout the study area. In general, fish communities in the upper reaches are dominated by exotic species, whereas in the mid- to lower reaches native species dominate fish assemblages. The diversity, distribution and abundance of fish observed in this study is likely to be a result of numerous anthropogenic factors in the catchment. These are discussed in more detail below.

4.2 SIGNIFICANT SPECIES

Yarra pygmy perch were found in the mid- to lower reaches of Waurn Ponds Creek and were abundant at five out of the six sites where it was collected (11-30 fish). The species is common in only a few places in Victoria but is generally not known to be abundant (most records of less than 10 fish) (Kuiter *et al.* 1996). An exception is in the nearby Thompson's Creek catchment where Zampatti (2001) collected 25-45 fish at four sites.

Yarra pygmy perch typically prefer aquatic vegetation (Koehn and O'Connor 1990) and have been collected in a range of water quality conditions, including low dissolved oxygen concentrations and high salinities (Zampatti 2001). Similarly, in Waurn Ponds Creek we collected Yarra pygmy perch predominantly in association with aquatic vegetation and in a range of water quality conditions.

Due to the wide distribution and abundance of Yarra pygmy perch in Waurn Ponds Creek it is likely that the Waurn Ponds Creek population is significant in southeastern Australia. Furthermore, the length frequency analysis presented here suggests that Yarra pygmy perch have successfully spawned and recruited into the adult population in recent years. Nevertheless, a number of factors may have a negative impact on Yarra pigmy perch and other native fish species in the catchment. These are discussed in section 4.3.

Although Australian mudfish has not been recorded in Waurn Ponds Creek, the species has been recorded from the Barwon River catchment (DNRE 2002) and we consider that under natural conditions the species may have potentially inhabited reaches of Waurn Ponds Creek. Australian mudfish is classified as 'endangered' in Victoria and is listed as a protected species under the *Flora and Fauna Guarantee Act* 1988. Due to the threatened status of Australian mudfish and the possibility that it may inhabit Waurn Ponds Creek, this species should be considered in the rehabilitation plan for Waurn Ponds Creek. Threatening processes that may impact on Australian mudfish are discussed below.

4.3 THREATENING PROCESSES IMPACTING ON AQUATIC FAUNA IN WAURN PONDS CREEK

Alteration of habitat through agricultural and grazing practices and, interaction (predation and competition) with exotic fish species have been previously recognised as key threatening processes to Yarra pygmy perch in southeastern Australia (Saddlier 1993). In addition, degradation of riparian vegetation, degradation of instream habitats (sedimentation, snag removal), reduced water quality (particularly dissolved oxygen and salt), alteration to the natural flow regime, modification to the stream channel (channelisation for flood mitigation) and instream barriers have also been identified as potentially impacting on populations of Yarra pygmy perch (Zampatti 2001) as well as other native freshwater fish (Koehn and O'Connor 1990).

Yarra pygmy perch, as well as other native freshwater fish species in Waurn Ponds Creek are likely to be affected by a similar interaction of threatening processes including:

- altered flow regimes;
- degradation of riparian (streamside) vegetation;
- degradation of instream habitat;
- channel modification and;
- instream barriers.

These impacts are discussed in more detail below.

Altered flow regimes

Alteration to the natural flow regimes of rivers and streams is considered a major threat to the health of waterways, aquatic flora and fauna communities and the maintenance of essential (instream) ecosystem processes (SAC 1992). For example, alterations to key components of the natural flow regime including flow magnitude, seasonality and variability are regarded as key factors responsible for the decline in distribution and abundance of many native freshwater fish species throughout Victoria (Koehn and O'Connor 1990). Alteration to natural flow regimes has been identified as a potentially threatening process under the Victorian *Flora and Fauna Guarantee Act* 1988 (SAC 1992) and has been nominated as a key threatening process under the *Environment Protection and Biodiversity Conservation Act* 1999.

Natural flow regimes may be altered through diversion of water for irrigation or stock and domestic use, catchment dams and on onstream storages, regulated releases from major headworks and catchment imperviousness in urbanised catchments or subcatchments, and stream channel modification.

In Waurn Ponds Creek, catchment dams, diversion of water, catchment imperviousness (lower reaches – Waurn Ponds), and channel modification may impact on aquatic fauna populations. Catchment dams may reduce flow magnitude and eliminate important components of the natural flow regime including freshes during summer months, which provide for critical ecological processes (eg. water quality maintenance over the low flow period and spawning keys for native fish species). Irrigation development may lead to reduced flow magnitude especially over the summer months, and an increase in the frequency and duration of low flow events. Although low flows are a natural component of the flow regime, an increase in their frequency and duration may represent a substantial increase in the risk to aquatic fauna populations through a reduction in water quality, available habitat and in food resources.

Catchment imperviousness in urbanised reaches of catchments results in alteration to natural run-off characteristics. Rapid rises and falls in water level and stream discharge are characteristic of these reaches and may physically displace aquatic fauna and habitat (e.g. large woody debris) and conversely, result in some biota becoming stranded when water levels recede rapidly. These affects are exacerbated in areas where the stream channel has been modified to reduce flooding (e.g. lower reaches of Waurn Ponds Creek). These channelised sections are designed to convey flood waters downstream and as a result areas of low water velocity in which aquatic biota can take refuge are rare. These stream modifications have also resulted in a reduction (possibly elimination) in the frequency of flood plain inundation. Flood plain habitats and off channel wetlands are important habitats for some species (e.g. Australian mudfish) and the inundation of floodplains is thought to provide a rich source of nutrients for instream ecological processes.

Although the degree of alteration to the natural flow regime was not investigated in this study, alteration the natural flows should be considered in the Waurn Ponds Creek rehabilitation plan.

Instream barriers

In the coastal drainages of south-eastern Australia up to 70% of native freshwater fish species may migrate between fresh and estuarine/marine waters at some stage during their life cycle (Harris 1984). A similar figure would be expected for Waurn

Ponds Creek. In Victoria however, nearly 2200 artificial structures in rivers and streams have been documented as potentially restricting fish movement (McGuckin and Bennett 1999). These structures include barriers such as stream gauging stations, on-stream dams and weirs, fords and culverts.

Unimpeded passage of fish throughout streams is crucial for spawning migrations, recolonizations, general movement and habitat selection (Koehn and O'Connor 1990) and is therefore considered important in sustaining biodiversity in stream fish assemblages. Fish movement is protected by Victoria legislation through a number of Acts (*Water Act* 1999, *Fisheries Act* 1995, *Flora and Fauna Guarantee Act* 1988, *Conservation, Forests and Lands* 1987) and "…the prevention of passage of aquatic biota as a result of instream structures…" is identified as a potentially threatening process (*Flora and Fauna Guarantee Act* 1988).

Numerous barriers (fords, culverts and drop structures) which likely restrict movement (migrations and localised movements) of fish were identified on Waurn Ponds Creek. The restricted distribution of native fish species observed in this study as well as the absence of many native migratory species expected to occur in the catchment may be a result of numerous barriers to fish movement. Unimpeded passage for native freshwater fish should be considered in the Waurn Ponds Creek rehabilitation plan.

Degradation of riparian vegetation

Riparian (streamside) vegetation provides important links between the aquatic and terrestrial environments. For example, streamside vegetation acts as a buffer zone for the instream environment and filters sediment input as well as other diffuse source pollutants e.g. nutrients, pesticides etc. Streamside vegetation also contributes to instream habitat (leaf litter, stick fall) and provides an important source of terrestrial invertebrate prey for aquatic biota.

Waurn Ponds catchment has been extensively cleared for agriculture in the upper reaches and is urbanised in the lower reaches. Much of the streamside vegetation has been removed and critical ecological process (see above) reliant on it have been disrupted. Some revegetation has occurred in the lower reaches of the catchment and already appears to be benefiting aquatic biota. For example, of the few spotted galaxias collected in fish surveys in Waurn Ponds Creek, most individuals were collected from a revegetated reach from habitat created as a result of this revegetation (overhanging leaves and woody debris from recent stick fall).

Intact and healthy riparian vegetation is critical for instream biota and should be considered in the Waurn Ponds Creek rehabilitation plan.

Degradation of instream habitat

The complexity and diversity of instream habitat is critical for supporting a diversity of aquatic fauna. A variety of processes including those discussed above interact to reduce habitat complexity and availability in Waurn Ponds Creek. As a result of clearing of catchment and riparian vegetation, large quantities of sediment have accumulated in Waurn Ponds Creek channel. This sediment smothers complex habitats (cobbles, rocks, large woody debris, aquatic vegetation) and reduces the habitat available for aquatic fauna. Stream channelisation has also reduced instream habitat complexity.

This study has identified numerous factors impacting on environmental condition and more specifically on aquatic fauna assemblages in the catchment. Consideration of these issues in the rehabilitation plan for Waurn Ponds Creek will help to maintain and restore aquatic biodiversity in Waurn Ponds Creek, including populations of the threatened Yarra pygmy perch. Based on the information collected in this study and the discussion of issues presented above, we recommended the following priority issues for consideration in the Waurn Ponds rehabilitation plan:

- degradation of instream habitat;
- barriers to fish migration;
- degradation of riparian (streamside) vegetation;
- changes to stream channels and;
- changes to natural flow patterns.

5. ACKNOWLEDGEMENTS

Thanks are extended to John Turner (CCMA) for coordinating this project. Thanks also to Ruth Lennie and Pete Fairborther (Freshwater Ecology Section) for their assistance with fieldwork.

6. REFERENCES

Allen, G.R. (1989). *Freshwater fishes of Australia*. TFH Publications, New Jersey, USA.

Anderson, J.R. and Morrison, A.K. (1989). *Environmental flow studies for the Wimmera River, Victoria. Part B. Fish habitat assessment.* Arthur Rylah Institute for Environmental Research, Technical Report Series No. 74. Department of Conservation, Forests and Lands, Victoria.

Anderson, J.R., Hill, J.M. and Morison, A.K. (1989). *Environmental flow studies for the Wimmera River, Victoria. Part E. Technical appendices.* Arthur Rylah Institute for Environmental Research, Technical Report Series No. 77. Department of Conservation, Forests and Lands, Victoria.

Close, P. Koster, W. and Lyon, J. (2001). *An assessment of the aquatic fauna in four Western Port sub-catchments (Victoria): Cardinia, Gum Scrub, Toomuc and Deep creeks.* Report for Melbourne Water. Arthur Rylah Institute for Environmental Research. Department of Natural Resources and Environment, Melbourne.

DNRE (2002). *Victorian Aquatic Fauna Database*. Department of Natural Resources and Environment, Victoria.

Growns, I.O. Pollard, D.A. and Gherke, P.C. (1998). Changes in river fish assemblages associated with vegetated and degraded banks, upstream of and within nutrient enriched zones. *Fisheries Management and Ecology*. **5,** 55-69.

Harris, J.H. (1984). A survey of fishways in streams of coastal south-eastern Australia. *Australian Zoologist* **21**(3): 219-233.

Klein, R.D. (1979). Urbanisation and stream quality impairment. *Water Resources Bulletin*. **15**, 948-963.

Koehn, J.D. and O'Connor, W.G. (1990). *Biological information for management of native freshwater fish in Victoria*. Department of Conservation and Environment, Arthur Rylah Institute for Environmental Research, Victoria.

McDowall, R. M. (1998). Fighting the flow: downstream-upstream linkages in the ecology of diadromous fish fauna in West Coast New Zealand rivers. *Freshwater Biology*. **40**: 111-122.

McGuckin, J. and Bennett, P. (1999)*. An Inventory of fishways and potential barriers to fish movement and migration in Victoria*. Waterways Unit, Department of Natural Resources and Environment, Victoria.

Paxton, J. R., Hoese, D. F., Allen, G. R. and Hanley, J. R. (1989). *Zoological catalogue of Australia.* Volume 7. Pisces. Petromyzontidae to Carangidae. Australian Government Publishing Service, Canberra.

SAC (1992). *Final recommendation on a nomination for listing. Alteration to the natural flow regimes of rivers and streams (potentially threatening processes).* Flora and Fauna Guarantee – Scientific Advisory Committee, Victoria.

Saddlier, S.R. (1993). *A research recovery plan for Yarra pygmy perch Edelia obscura in south-eastern Australia*. Flora and Fauna Branch, Department of Conservation and Natural Resources, Victoria.

Sonneman, J.A., Walsh, C.J., Breen, P.F. and Sharpe, A.K. (2001). Effects of urbanisation on streams of the Melbourne region Victoria, Australia, II. Benthic diatom communities. *Freshwater Biology*. **46**: 535-551.

Walsh, C.J., Sharp, A.K., Breen, P.F. and Sonneman, J.A. (2001). Effects of urbanisation on streams of the Melbourne region Victoria, Australia, I. Benthic macroinvertebrate communities. *Freshwater Biology*. **46**: 553-565.

Zampatti, B.P. (2001). *Distribution of Yarra pygmy perch in the Thompson's Creek catchment and a preliminary assessment of a rockramp fishway*. Report to Corangamite Catchment Authority. Department of Natural Resources and Environment, Melbourne.