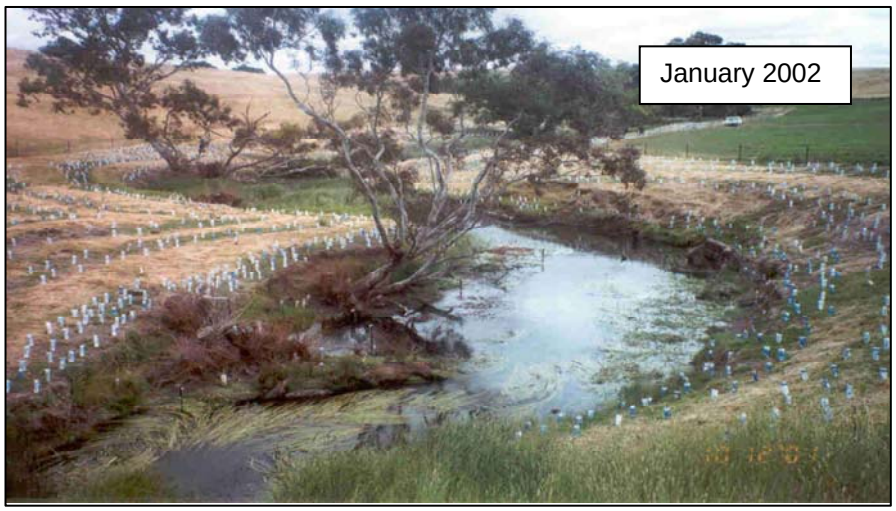
Survey for River Blackfish post rehabilitation works in Birches Creek, Central Victoria



A report for
The North Central Catchment Management Authority

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Cover images: Rehabilitation site before and after. All images by S. Saddlier and K. Pitman

TABLE OF CONTENTS

SUMMARY

Birches Creek in Central Victoria has been identified as having a regionally significant population of river blackfish (*Gadopsis marmoratus)*. In 2002, rehabilitation works to improve aquatic habitat for river blackfish on a section of the creek was undertaken; this included fencing sections of riparian zones to restrict cattle access, riparian planting, re-snagging and the installation of river blackfish spawning tubes. This study investigated the effect of the rehabilitation works on river blackfish and the fish community by comparing a pre-rehabilitation survey in 2002, to a survey in 2006. A total of seven sites surrounding the rehabilitation section were selected and sampled with backpack electrofishing. In 2006, a total of 785 fish from four fish species were recorded including the native obscure galaxias (*Galaxias* sp.1), river blackfish and two exotic fish species, brown trout (*Salmo trutta*) and tench (*Tinca tinca*). There were some large differences between the distribution and abundances of fish species between the 2002 and 2006 survey. These differences in 2006 included lower abundances of river blackfish in sites dominated by Canadian pondweed (*Elodea canadiensis*). There were also lower recruitment levels of blackfish detected in 2002. It is not clear wether the introduced Canadian pondweed infestation has reduced the catchability of river blackfish, or that the habitat changes or water regime changes have reduced the recruitment and abundance of the species. In this study the benefits of rehabilitation were obscured by habitat changes. This unexpected result should not discourage any further active riparian and instream habitat rehabilitation efforts, as rehabilitation will directly benefit the aquatic ecosystems of Birches Creek.

1.0 INTRODUCTION

Birches Creek is a medium sized stream that flows into the Tullaroop Creek located in the upper Loddon Catchment and is regulated by Newlyn reservoir. Birches Creek has been identified as containing a regionally significant population of river blackfish (*Gadopsis marmoratus*). Elsewhere in the Loddon Catchment the species has a limited distribution (McGuckin and Doeg, 2000) and where it does occur it is often in low abundances (Pitman and Tinkler, 2005).

The identification of the significance of the Blackfish population in Birches Creek led to the initiation of a project to help protect the aquatic environment of Birches Creek. The project was a collaborative effort between the North-Central Catchment Management authority (NCCMA) and the Department of Sustainability and Environment. The Ullina Landcare Group, Clunes and Smeaton Primary Schools, Wesley College (tree planting) and various landholders also gave assistance. The project was based on a section of creek above and below Nelsons Bridge just out of the Township of Clunes. The project had a number of educational and on-ground works, including;

- Freshwater Ecology information days and demonstrations for local primary and secondary school students from Clunes/Smeaton Primary Schools and Wesley College.
- Fencing sections of Birches Creek to restrict cattle access
- Revegetation of riparian zones with indigenous species
- Installation of artificial spawning tubes to assist the spawning success of river blackfish
- Introduction of snags to increase habitat available to river blackfish and other fish species.
- A fish and habitat survey that encompassed 15 sites along Birches creek.

To assess the effect of rehabilitation on river blackfish and the broader fish communities in Birches Creek, a total of seven sites were sampled. These sites include the rehabilitation site situated upstream and downstream of Nelsons Bridge, as well as two sites situated downstream and four sites upstream of the rehabilitation site (figure 1). This report was commissioned by the North Central Catchment

Management Authority (NCCMA) and details the results of the 2006 fish survey and comparisons with the 2002 pre rehabilitation survey.

2.0 METHODS

2.1 Study Sites

To make an assessment of the riparian and instream works seven of the previously surveyed 15 sites were revisited. These were chosen to give the best spatial comparison to the regeneration site (site 13) within the given project budget. The locations of each survey reach including Australian Map Grid references (AMG) from topographic survey maps are shown in Figure 1 and Table 1.

Table 1. Location of sampling sites in the McCallum and Tullaroop Creek catchments.

Site Number	Date surveyed	Description	Distance upstream from Tullaroop Creek (km)	Map and Map Reference #
15	1/3/2006	Track at the end of private property off Foleys road	1	7623-2-4 7457754 5872116
14	28/2/2006	At Jorgensen's Bridge	3	7623-2-4 748388 5871293
13	28/2/2006	**Rehabilitation site** upstream and downstream of Nelsons Bridge	5.3	7623-2-4 749259 5869490
12	1/3/2006	At end of track approximately 300 m N of "Omaru" homestead	9.2	7623-2-2 751417 5869157
11	1/3/2006	At the end of Nicholsons track	13	7623-2-4 754252 5867934
10	2/3/2006	Private property behind "Clover Hill" and Vale Hill property.	15.2	7623-2-1 755434 5866998
9	2/3/2006	At Wheeler Bridge	17.5	7623-2-1 756320 5865378

All grid references are in zone 54 and eastings-northings are in the GDA 94 datum.

2.2 Fish sampling

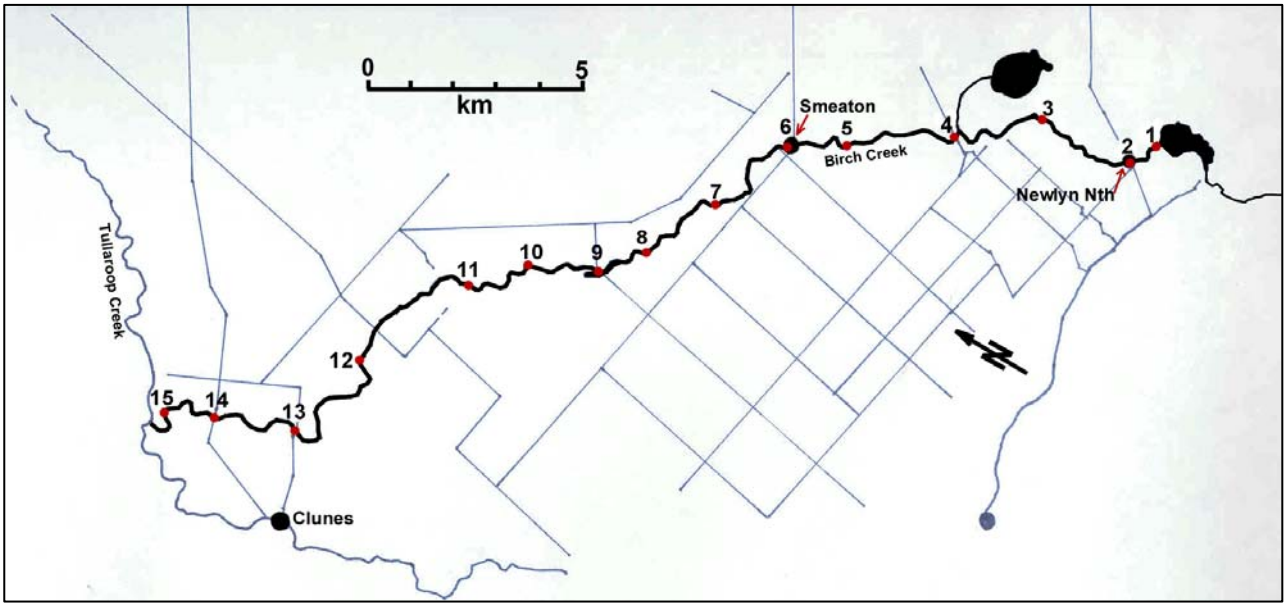
Electrofishing involves the stunning of fish with a pulsed DC current. During the elecrofishing operations, a dip-netter removes all electrofished individuals, which are then placed in a bucket. All fish that could not be dip-netted but could be positively identified were recorded as observed.

The settings used with the backpack electrofisher varied from 300 – 300 volts at 70 pulses per second. All fish captured were identified, counted, measured and weighed. At sites where large numbers of fish (other than blackfish) were captured, a

sub-sample of fish were weighed and measured. Length measurements of fish were measured to the caudal fork or total length, depending on the fish species.

At each site 100m of stream was fished using backpack elecrofishing. An effort was made to repeat the same 100m stretch that was fished in 2002 so that the surveys were comparable. To measure the length of the 100m section a hip-chain was fastened at the start of sampling and the 100m section was accurately measured.

Figure 1. Map of Birches Creek showing the location of sites 1-15 surveyed during January - February 2001. The sites re-sampled in 2006 include sites 15 – 9, the rehabilitation site is site 13.



2.3 Habitat observations and water quality

In each site general habitat features were described or measured including percentage of in-stream cover (small and large woody habitats, aquatic vegetation, leaf litter, algae, overhanging vegetation, undercut banks), riparian cover, disturbance characteristics, landuse type, mean stream width and depth. Substrata characteristics at each site were subjectively categorised as bedrock, boulder, cobble, gravel, sand mud/silt or clay. Water quality perimeters were also recorded for each site sampled including temperature (^{o}C), dissolved oxygen (mg/L), pH, electrical conductivity and turbitity.

3.0 RESULTS

3.1 Fish species

A total of four fish species from four families were recorded in the 2006 fish survey. Two of these are native including the obscure galaxias (*Galaxias* sp.1) and river blackfish *(Gadopsis marmoratus*) (Table 2). Two exotic fish were also recorded including brown trout (*Salmo trutta*) and tench (*Tinca tinca*) (Table 2). The current fish survey caught less fish species than the 2001 survey where four additional fish species were caught including the native species Australian smelt (*Retropinna* semoni) and flat headed gudgeon (*Philypnodon grandiceps*) as well as two exotic species roach (*Rutilus rutilus*) and redfin (*Perca fluvialtilis*) (Table 2). All native fish recorded in Birches Creek are considered common and widespread (Table 2).

Table 2. All fish species recorded in Birches Creek and their conservation status. Conservation status for native fish follows VDSE (2003). (*) Indicates species that were not recorded in current survey.

Family	Species	Common Name	Conservation Status
Native Fish Species			
Galaxiidae	*Galaxias sp.1*	Obscure Galaxias	Common and widespread
Retropinnidae	*Retropinna semoni*	Australian Smelt*	Common and widespread
Gadopsidae	*Gadopsis marmoratus*	River blackfish	Common and widespread
Eleotridae	*Philypnodon grandiceps*	Flathead Gudgeon*	Common and widespread
Alien Fish Species			
Salmonidae	*Salmo trutta*	Brown trout	-
Percidae	*Perca fluvialtilis*	Redfin*	
Cyprinidae	*Rutilus rutilus*	Roach*	-
Cyprinidae	*Tinc tinca*	Tench	-

3.2 Fish catch

A total of 785 individual fish and 791 yabbies *(Cherax destructor*) were caught and over 1900 *paratya* shrimp were observed during the surveys of the seven sites in

Birches Creek. The obscure galaxias dominated the catch with 646 individuals caught, representing 82.3 percent of the total catch (Table 3). River blackfish were the second most abundant fish caught with 104 individuals caught, representing 13.3 percent of the total catch (Table 3). There were two exotic fish species caught; these two species represented fewer than five percent of the total catch (Table 3). The number of fish species present at each site varied from two to four.

Table 3. Fish catch in 2006 including proportions and totals.

Site / Fish species	15	14	**13***	12	11	10	9	% Total	**Grand Total**
Obscure Galaxias	26	43	166	90	36	115	170	82.3	646
River blackfish	29	40	13	5	1	6	10	13.3	104
Brown trout	2	3	-	-	13	-	1	2.4	19
Tench	9	4				1	2	2.0	16
Total no. species / site	4	4	2	2	3	3	4		785

Note: (*****) represents rehabilitation site

3.3 Comparison between 2001 and 2006 survey

Some variation in the distribution and abundance of fish species was observed between the 2002 and 2006 survey. In the 2006 survey, no smelt or redfin were caught, while in 2002 smelt were recorded from site ten and redfin were caught from sites ten and 15 (Tables 4 and 5). Furthermore, in the 2006 survey, brown trout were also recorded in two additional sites and tench were recorded in one additional site (Tables 4 and 5).

The major differences in the abundance of fish between the 2002 and 2006 surveys was due to more river blackfish being captured during the 2002 survey, while more obscure galaxias were captured during the 2006 survey (Tables 4 and 5). In 2002, river blackfish were more abundant in five of the seven sites including the pre-rehabilitation site (sites 11, 12, 13, 14 and 15) (Tables 3 and 4). Alternatively there were more obscure galaxias caught in the 2006 survey, with the species being more abundant in all seven sites (Tables 4 and 5). In the 2006 survey there were also more yabbies caught in all sites and more brown trout in four sites (Tables 4 and 5).

Table 4. Table of 2006 fish survey, # Indicates rehabilitation site.

Site	*River blackfish*	*Obscure Galaxias*	*Smelt*	*Brown trout*	*Redfin*	*Roach*	*Tench*	*Yabbies*
9	10	170		1				206
10	6	115					2	136
11	1	36		13			1	23
12	5	90						108
13#	13	166						101
14	40	43		3			4	117
15	29	26		2			9	206
Total	104	646	0	19			16	897

Table 5. Fish catch from 2002 fish survey. # Indicates rehabilitation site. Roach were recorded in sites not re-sampled in 2006.

Site	*River blackfish*	*Obscure Galaxias*	*Smelt*	*Brown trout*	*Redfin*	*Roach*	*Tench*	*Yabbies*
9	6	88					1	>100
10	2	42	2		6			89
11	6	15						~40
12	28	13						3
13#	129	11						7
14	48	38		1			4	>200
15	75	9		1	1		4	>200
totals	294	216	2	2	7	0	9	>639

3.4 Size frequency of river blackfish

Size frequency distributions of river blackfish caught reveal a wide range of size distributions among river blackfish caught in Birches Creek. In 2002, river blackfish sizes ranged from 48 to 296mm with a mean size of 137 mm, while in 2006 river Blackfish ranged from 55 to 268 mm and had a larger mean size of 166 mm.

In 2002, small fish (45 – 74mm) were present at the three lowest sites (15, 14 and 13) and two higher elevation sites (10 and 6). Small fish had a reduced distribution in 2006 with fish of size range 55 – 88mm being caught in sites 15 and 14. The smallest fish at other sites ranging from 101mm –151mm

A comparison of the 2002 and 2006 blackfish length frequencies indicated a reduction in overall fish numbers. This observation is predominantly due to a reduction in the numbers of smaller size class fish captured during the 2006 survey. In 2002, year classes were evident between 50 –90mm, 110-150mm, 150 –170mm, 170mm –220 and less abundant larger fish above 220mm. The smaller size classes were also evident in 2006 with smaller size classes present at 50-70mm and 100-120mm, probably representing one and two year old fish respectively.

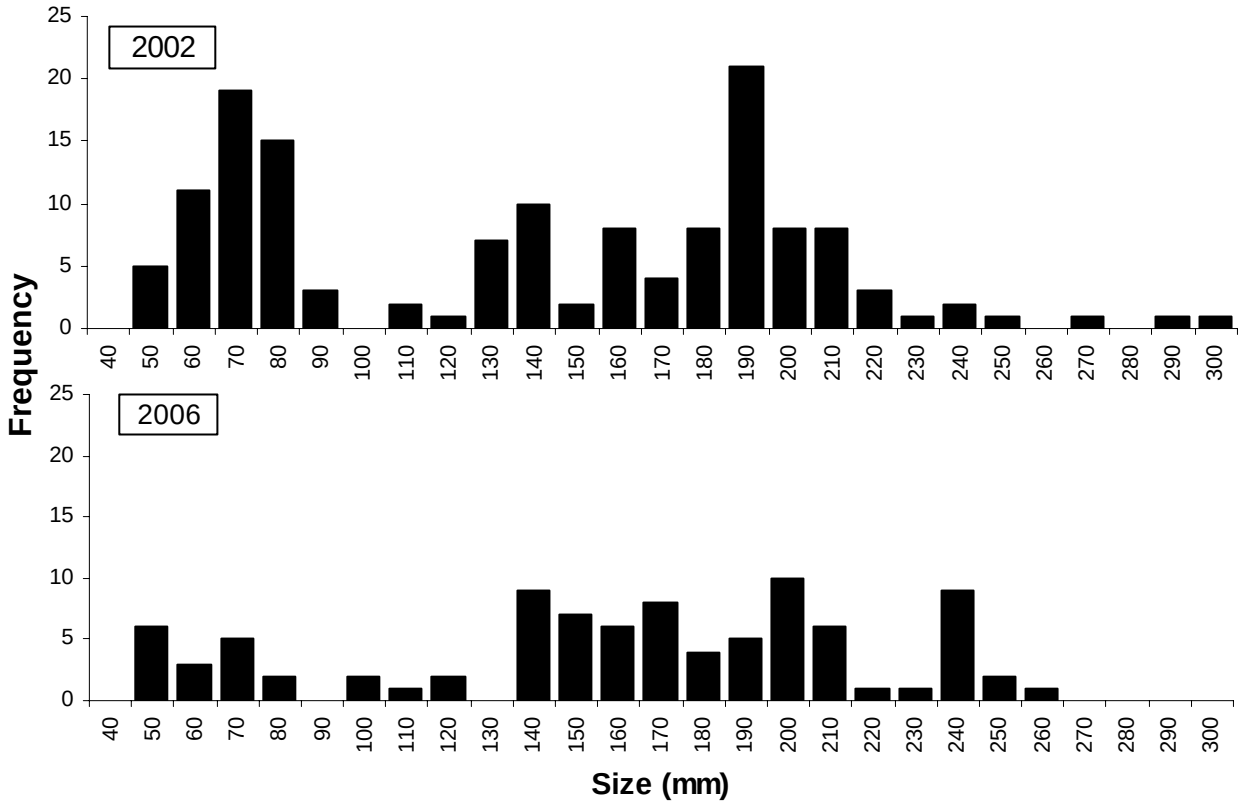


Figure 2. Size frequency distributions between survey years. Note the differences in numbers of fish between graphs and fewer small fish.

3.5 Habitat availability for River blackfish

The habitat present within sites on Birches Creek varied with some habitat types being more common than others (Table 6). Aquatic vegetation dominated sites 15, 13 (rehabilitation site) as well as site 12 and was present in lower abundances in sites nine, 10, 14 and 15 (Table 6). Rocky habitats were also common and dominated sites nine and ten (Table 6). Sites 14 and 15 had the highest habitat diversity throughout the survey area (as well as the highest numbers of river blackfish).

Table 6 – Distribution of dominant habitat types present in sample sites, all site scores refer to the percentage cover of stream, and for overhanging vegetation and percentage of stream edge for overhanging vegetation and undercut banks.

Site	*River blackfish catch*	*Rock*	*Logs/ braches*	*Leaves/organic debris*	*Undercut bank*	*Overhanging veg*	*Aquatic vegetation*
9	10	80		10	15		10
10	6	50		10	5	10	30
11	1		5	5	5		50
12	5		5	5	15	10	75
13#	13	15	5	5	30		80
14	40	20	5	5	10	5	20
15	29	20	5	10	10	5	80
No. sites	7	5	4	7	6	3	7
% of sites	100	71.4	57.1	100	85.7	42.8	100

Note: Accumulative percentage values for habitat may be greater than 100% due to multiple habitat layers within the water column.

3.6 Canadian pondweed and river blackfish abundance

The sites with the most pronounced changes in river blackfish abundance between surveys also had had the highest cover of Canadian pondweed (Figure 3). These sites include the rehabilitation site (sites 12, 13 and 15) (Figure 3). In the remaining sites the differences in abundances of river blackfish between surveys was lower (sites 9, 10, 11 and 14) (Figure 3).

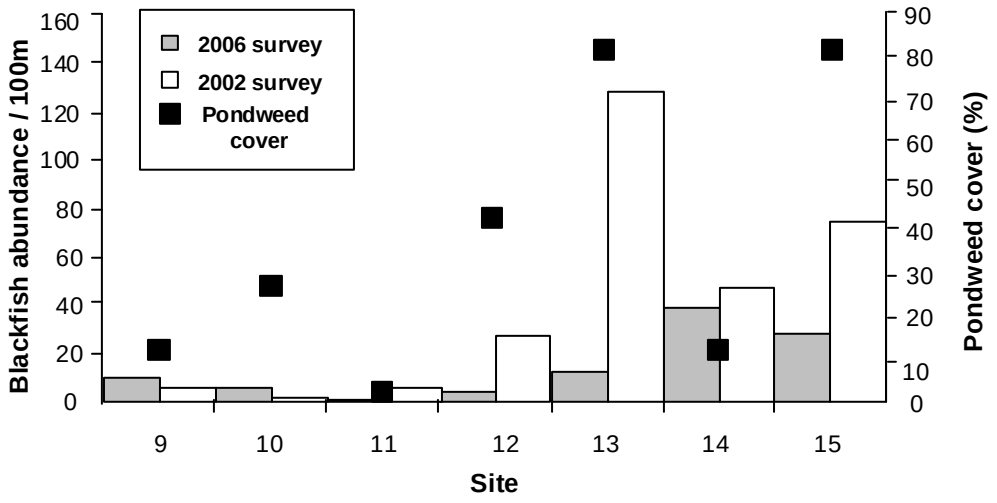


Figure 3. Pondweed cover and the changes in river blackfish abundance between surveys, note the largest changes in river blackfish abundance in sites with high pondweed cover**.**

3.7 Water Quality

Table 7 contains results of water quality parameters recorded from the seven sites surveyed during 1996. Results from this table indicate that water electrical conductivity levels were high at the lower sites with the highest level recorded from the lowest elevation site in Birches Creek. Water temperature and pH levels at sites were relatively stable between all sites. Turbidity levels varied between sites with high readings observed at sites 11 and 10. Dissolved oxygen readings were high in all sites.

Table 7. Water quality readings

Site	Conductivity (µs cm^{-1})	Temp	DO (mg L^{-1}) surface	DO (% saturation)	Turbidity (NTU)	pH
15	1185	17.0	9.80	92.6	1.6	8.0
14	1176	19.0	8.09	95.4	1.5	7.8
12	660	17.3	7.46	95.5	2.1	7.5
13	993	17.5	9.04	95.9	2.5	7.6
11	437	19.4	8.61	93.3	10.7	7.5
10	383	16.5	8.72	90.8	22.8	7.7
9	336	19.3	9.01	98.4	4.6	7.6

4.0 DISCUSSION

The major differences between the 2002 and the current 2006 survey are that blackfish were less abundant, particularly in sites that were dominated by Canadian pondweed (*Elodea canadiensis*). In the 2002 survey pondweed cover was noticed in moderate abundance in the rehabilitation site and was either absent or present in low abundances in the remaining sites. Now pondweed has infested many areas of the creek, and has significantly altered the habitat available to fish. It is not clear whether the introduced Canadian pondweed infestation has reduced the catchability of river blackfish, or that the habitat changes have reduced the abundance of the species. The presence of large dense stands of Canadian pondweed will reduce the dissolved oxygen concentrations at night when the plants respire. River blackfish prefer highly oxygenated environments and may be unable to survive these low concentrations (Dobson and Balwin, 1982; Koehn and O'Connor, 1990b). This was shown in a study conducted in the upper Goulbourn catchment where river blackfish were absent from sites with high summer temperatures and low dissolved oxygen levels (Bond and Lake, 2003).

Pondweed is native to North and South America and is considered an aquatic pest in many countries around the world. Canadian pondweed in a prohibited plant in South Australia (GSA 2006), Western Australia (GWA, 2006), Northern Territory (Flanagan, 1998) and Tasmania (Weed Management act 1999). In Australia there are only male flowering plants present and the plants reproduce vegetatively when stems break off (Saintly and Jacobs, 2005). This reproductive strategy allows good downstream colonisation, facilitating the spread of this species to areas further downstream (Riis and Jemsen, 2006).

Possible control measures include listing the plant as a noxious species to prevent further introductions from the aquarium trade and promote education. Other control measures include physical removal and the use of herbicides, however the benefits of removal may be less than the disturbance caused from chemical and physical control. There is currently no information on the effects of Canadian pondweed on fish communities in Victoria or Australia and a further detailed investigation is therefore required to identify the effects on Australian aquatic ecosystems.

The increase in pondweed may have a benefit to some fish species within Birches creek. For example, there has been a marked increase in the abundance of the obscure galaxias, especially in sites that are now dominated by pondweed. The increase in pondweed may provide good cover and protection from predation by piscivorous brown trout and may benefit the recruitment of the species. Increases in the abundance of obscure galaxias compared to river blackfish in the presence of pondweed may be related to behavioural differences between the species. The obscure galaxias were occupying the surface of the water column during the survey and were relatively easy to catch compared to river blackfish, which are a cryptic species and take cover during the day.

There were fewer blackfish recruits detected in the 2006 survey compared to 2002. This variation may be due to a range of factors including the effect of regulated flow on instream habitat condition and interactions with increases in pondweed cover. In regulated streams such as Birches Creek, a lack of flushing flows can cause high levels of sediment to accumulate. Large sediment loads in rivers are thought to reduce recruitment and abundance of river blackfish (Jackson *et al*. 1996). High sediment loads may prevent attachment of blackfish eggs and reduce recruitment through egg smothering and mortalities of juvenile fish (Koehn and O'Connor, 1990a, b; Jackson *et al*. 1996). Flushing flows which mobilise these sediments are observed more frequently and at higher intensities in unregulated river systems. Increases in pondweed cover may be further exacerbating the increases in sediment loads by slowing down water flow and allowing sediment to drop out of the water column. This theory was supported during the 2006 survey when disturbance of pondweed while electrofishing released plumes of sediment into the water column. A converse situation was observed at sites supporting low abundance of pondweed (sites, 9, 10 and 11) where higher turbidity levels were recorded.

Graphic representation of flow volumes in Birches Creek since 1998 (measured at Smeaton) can be observed in appendix 1 (Victorian Water Resources Data Warehouse). From these graphs, it is evident that only one substantial flushing flow has been observed during this period (during the months of October and November 2000). These elevated flows would have scoured much of the sediment blanketing the study sites and may have contributed to increased recruitment observed during the 2002 survey. The value of flushing flows as a tool in maintaining the ecological condition of systems such as Birches Creek is well known and environmental flow regimes should incorporate flushing flows to scour sediments and organic materials

deposited within the creek (Swales, 1994). These flows benefit the life history of native fish by improving spawning surfaces and enhancing juvenile fish recruitment.

Minimum routine maintenance flows (environmental flows) are released from Newlyn Reservoir from 15 Aug to 15 May. Additional water releases also occur during this period according to the demands of irrigators situated downstream of Newlands Reservoir (Ivan Stuart, pers. comm.). It is unknown whether changes in water temperature regimes (caused by water released for irrigation from Newlyn Reservoir) effect the spawning time and success of blackfish in Birches creek. Spawning generally occurs in November and October when water temperatures exceeds 16^{o}C (Merrick and Schmida 1984). Cold water pollution in regulated rivers has been identified as a threatening process to our native fish and investigation of the water temperatures leading up to (and including) the blackfish spawning period should be investigated to ensure that this is not an issue within Birches Creek

It is worth noting that at site 11 (where significantly lower numbers of blackfish were captured), there was a substantial increase in the numbers of Brown Trout (*Salmo trutta*) captured. Brown trout are known to prey on blackfish (Butcher 1954, Fletcher, 1979 and Cadwallader, 1978, 1979). It is likely that the lower numbers of blackfish captured at this site is directly due to predation from this species.

There were some large differences between the distribution and abundances of fish species between the 2002 and 2006 survey. The 2006 survey failed to catch three species that were recorded in the 2002 survey. These included smelt (*Retropinna semoni*), roach (*Rutilus rutilus*) and redfin (*Perca fluvialtilis*). However, the absence of these species was not surprising, as they were mostly restricted to the high elevation sites that were not surveyed in 2006. Additionally, very low numbers of these species were caught in the 2002 survey and given the general increase in the distribution and abundance of Canadian pondweed, it is likely that species represented in very low numbers would be under-represented in catch results.

In this study, it is likely that the benefits of rehabilitation were obscured by habitat changes as a result of the dominance of Canadian pondweed. This unexpected result should not discourage any further active riparian and instream habitat rehabilitation efforts, as rehabilitation will directly benefit the adjacent aquatic ecosystem. For example, studies have shown that areas adjacent to vegetated banks contain greater numbers of species and fish abundance than those adjacent to bare

banks (Growns *et. al.* 1998). Many other studies have also found close associations between river blackfish and woody habitats (Lake, 1967; Jackson, 1978; Cadwallader, 1979; Dobson and Balwin, 1982) and organic matter (Koehn, 1986) derived from healthy riparian zones. These habitats provide cover, habitat and spawning sites for river blackfish and other fish species and the benefits of the riparian zone will increase as the trees mature. Furthermore, a healthy riparian zone will shade the creek and potentially reduce the pondweed abundance. Healthy riparian zones also contribute to aquatic ecosystem health through bank stabilisation, input of invertebrates, nutrient flux, sediment buffering and storage and pool formation (Cummins, 1993).

The temporal differences in fish assemblages observed in the comparison between the 2002 and 2006 surveys in Birches Creek are typical of temperate streams where changes in habitat and other factors lead to variable recruitment of the fish species present. In the future a better assessment of the effects of rehabilitation works on fish should take into account these temporal effects and sample more regularly. This study has also not taken into account any water management changes that may have taken place during the study period. Records of irrigation releases from Newlyn Reservoir have not been recorded in the past, however recent works by Goulburn-Murray Water include an automated gauging station downstream of the reservoir (Bill Viney, pers. comm.). Changes in water delivery frequency, timing and temperature can impact on fish community structure over time and may explain some of the observed trends (Walker and Thoms, 1993). Environmental flows, especially high flows would help control Canadian pondweed and would benefit the aquatic communities of Birches Creek.

4.1 Recommendations

- That future study of rehabilitation works are monitored more frequently to take into account temporal variability of fish communities.
- Investigate distribution of pondweed in the Loddon Catchment.
- Investigate the link between increased pond weed densities and the decrease in blackfish catch rates to determine whether pondweed is causing a direct decrease in blackfish densities or a decrease in catchability for this species.
- Investigate control measures for pondweed and environmental effects of control measures.

- Recommend listing pondweed as a noxious species to prevent further introductions from the aquarium trade and promote education.
- Investigate current water management and water temperature regimes in Birches Creek and incorporate flushing environmental flows if possible.
- Continue to monitor Birches Creek to gain a better understanding of the effects of pondweed and temperature regimes on fish communities.

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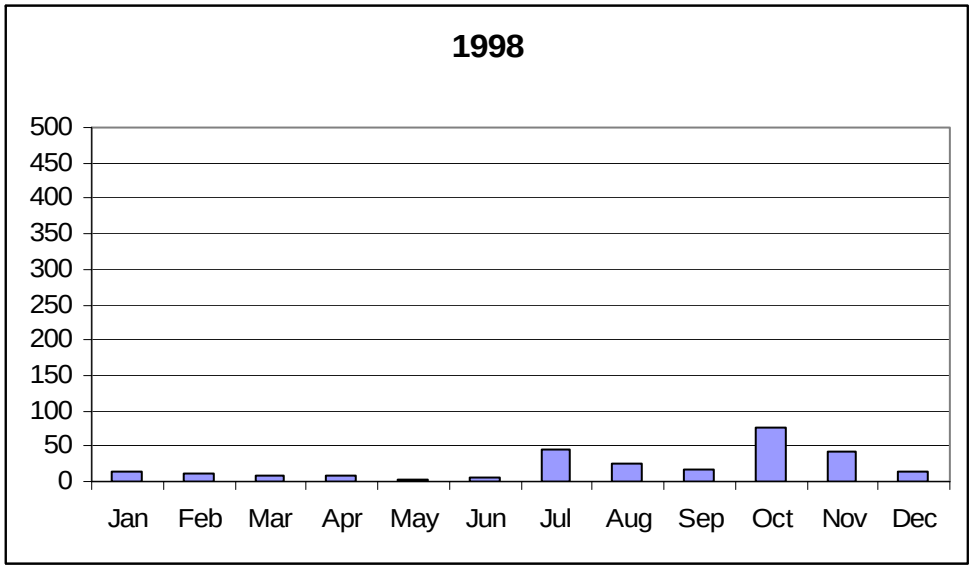
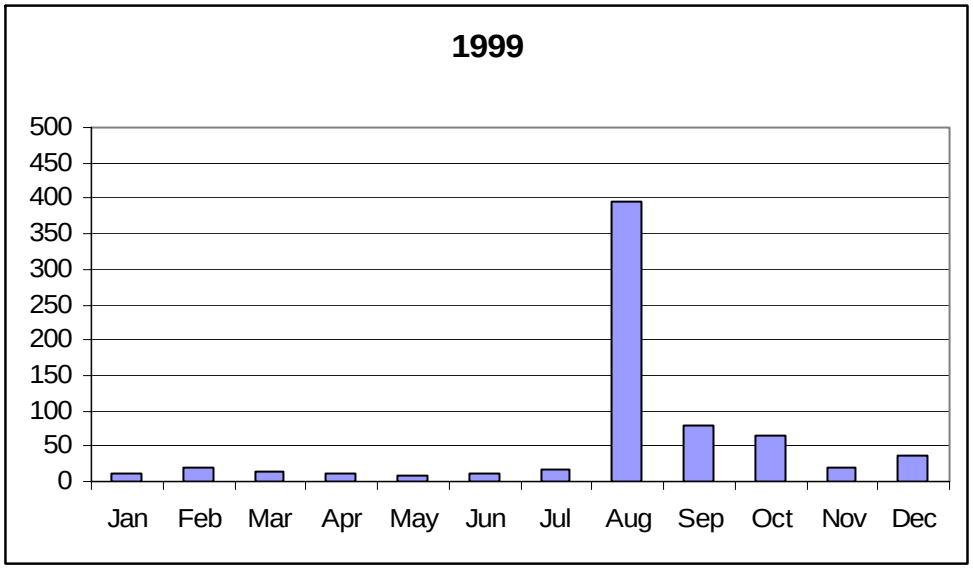
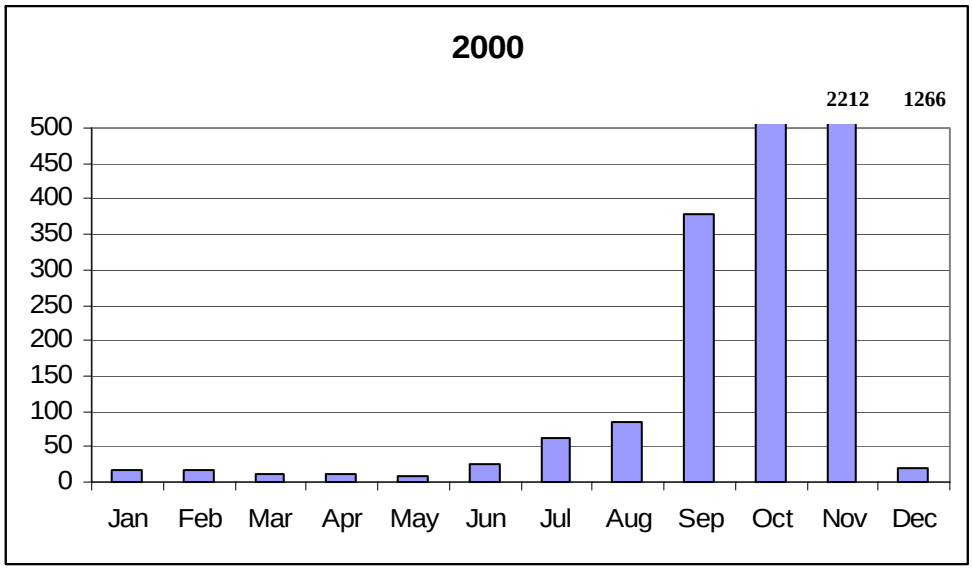
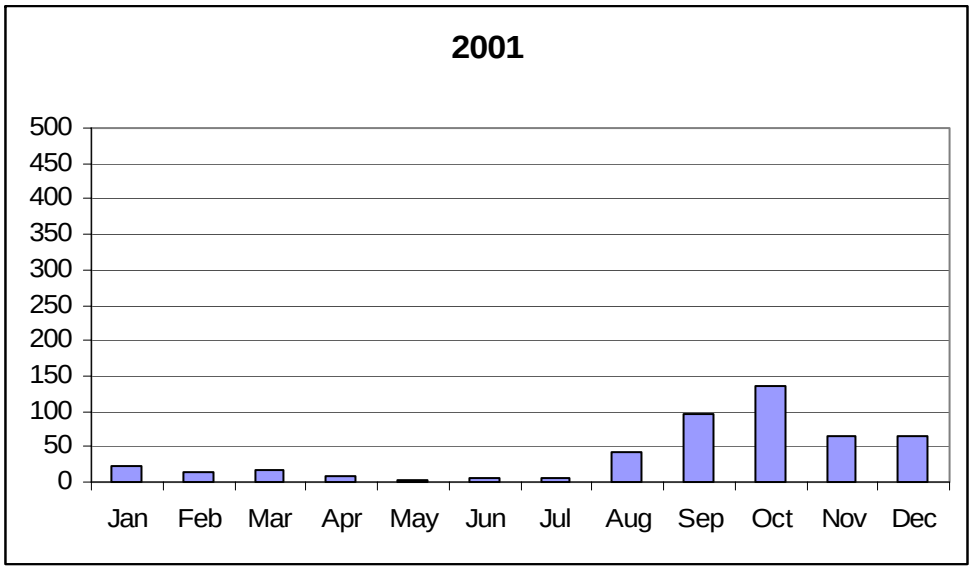
Appendix 1. Birches Creek monthly flows (megalitres) measured at Smeaton for the years 1998 to 2005









Appendix 1 (cont.)