Distribution and Habitat Of River Blackfish (*Gadopsis marmoratus*) in McCallum and Tullaroop Creeks, north-central Victoria

A report to

North Central Catchment Management Authority

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Freshwater Ecology
Arthur Rylah Institute for Environmental Research

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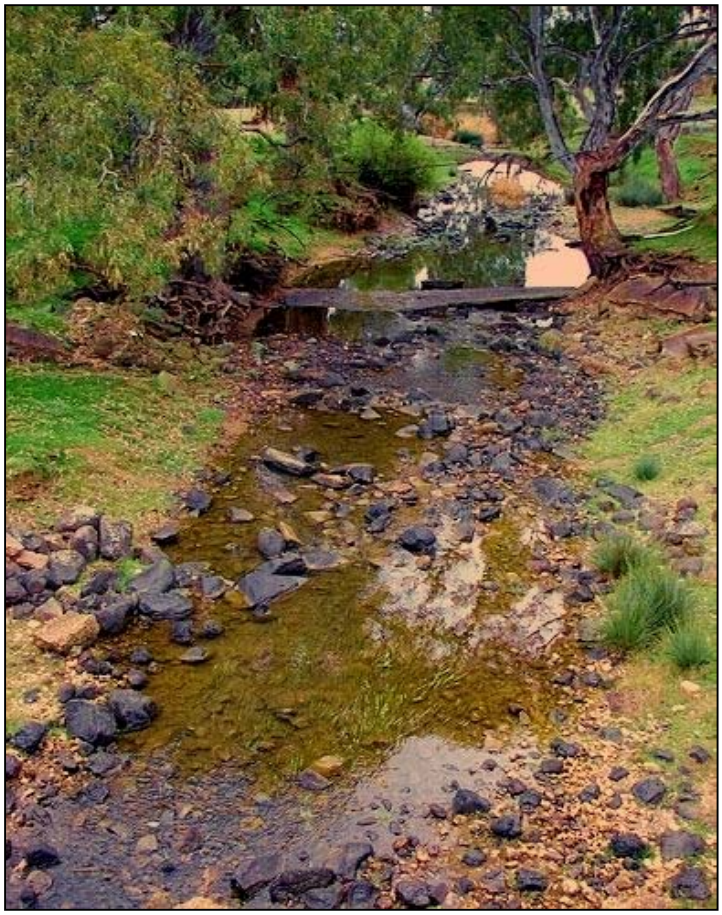

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Cover images (clock-wise from top-left): McCallum Creek (site Mc 4), McCallum Creek (site Mc 5); River Blackfish (*Gadopsis marmoratus*) from Tullaroop creek site T-3. All images by K. Pitman.

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SUMMARY

This study was commissioned by the North Central Catchment Management Authority (NCCMA) to assess the distribution and habitat of River Blackfish (*Gadopsis marmoratus*) in McCallum and Tullaroop Creeks. The aim of the project was to provide information on the distribution, abundance, and habitat of River Blackfish within McCallum Creek and Tullaroop Creek, in particular downstream of Tullaroop Reservoir, to aid riverine and fish fauna management.

Aquatic surveys were conducted at 12 sites on McCallum and Tullaroop Creeks. All sites were electrofished using a backpack electrofishing unit, following a standard sampling design. Observations of habitat use by River Blackfish were made whilst fishing to assess the habitat requirements of the species. A total of eight freshwater fish species were caught during surveys of Tullaroop and McCallum Creeks. Of these, four species are native and four species were introduced. River Blackfish were found at 58 % of sites. At most sites River Blackfish were present in very low abundances; the exception to this was in site three on Tullaroop where 14 individuals were caught. The relatively large population of River Blackfish found at this site is possibly being maintained by the presence of relatively healthy instream habitat features, leading to healthy localised recruitment.

River Blackfish were caught at depths ranging from 0.2 - 0.7 m and were associated with five main habitat types: submerged macrophytes, undercut banks, emergent aquatic vegetation, woody habitat, and rocky habitats. Of all habitat types River Blackfish had a higher frequency of occurrence in areas of woody habitat. Based on these observations all sites appeared to have suitable habitat for River Blackfish, however, this prediction did not match the actual sampled distribution of the species within the systems. Reasons for the absence and low abundances of River Blackfish are possibly due to a combination of factors including the presence of alien fish, regulated and reduced flows, low dissolved oxygen levels, increasing salinity, siltation, and stream drying.

River Blackfish were present, albeit often in very low numbers, in Tullaroop Creek downstream of Tullaroop Reservoir. A previous recommendation to translocate River Blackfish into this section of river is not supported. Management actions to improve the

River Blackfish populations within the system are made, which include enhancement and protection of riparian zones and exclusion of stock. Amelioration of important water quality issues, in particular high water electrical conductivity and low dissolved oxygen levels, should be investigated by potentially altering the regulated flows particularly in McCallum Creek.

1.0 INTRODUCTION

The North Central CMA commissioned the Freshwater Ecology Section of the Department of Sustainability and Environment to undertake an assessment of the distribution and habitat of River Blackfish (*Gadopsis marmoratus*) in McCallum and Tullaroop Creeks.

The purpose of this assessment was to determine whether River Blackfish (*Gadopsis marmoratus*) are present in Tullaroop Creek downstream of the Tullaroop Reservoir and the nearby McCallum Creek, to inform decisions regarding a potential translocation program for this species. An assessment of River Blackfish habitat preference is also required to assess if habitat is a limiting factor for the species distribution. Knowledge of the habitat preference of a species may also be required to direct stream rehabilitation efforts in the future (Bond and Lake, 2003).

As such this study aimed to provide information on the distribution and abundance of River Blackfish and other fish species in McCallum and Tullaroop creeks. In particular, the habitats of River Blackfish were investigated. Information gained from this study and from literature was used to identify natural and anthropogenic factors impacting fish faunas. Priorities for fish fauna management and rehabilitation measures are recommended.

2.0 METHODS

2.1 Study Sites

North Central CMA selected twelve study sites for surveying. The locations of each survey reach including Australian Map Grid references (AMG) from topographic survey maps is shown in Figure 1 and Table 2.

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

Site Number	Date surveyed	Description	Altitude (m)	AMG Reference (1:100 000)#
T - 1	14/7/05	Tulleroop creek @ Forbes road	180	755400 5912300
T - 2	14/7/05	Tulleroop creek @ Mullins Bridge	180	754200 5909900
T - 3	15/7/05	Tulleroop creek @ Hoopers Bridge	180	752500 5904700
T - 4	12/7/05	Tulleroop creek upstream of road bridge @ Carisbrook	200	750600 5896100
T -5	11/7/05	Tulleroop creek upstream of quarry off Dorans road	200	753600 5984300
T - 6	11/7/05	Tulleroop creek below dam on private property	210	754700 5891700
Mc -1	12/7/05	McCallum Creek above confluence with Tulleroop creek	190	750300 5895800
Mc -2	12/7/05	McCallum Creek @ Rodborough road	195	748900 58912 00
Mc - 3	12/7/05	McCallum Creek bridge	215	746300 5887300
Mc - 4	13/7/05	McCallum Creek @ Talbot Majorca road	225	743700 5831600
Mc - 5	13/7/05	McCallum Creek 200m below Ballarat Maryboruogh road crossing	250	743700 5831600
Mc - 6	13/7/05	McCallum Creek 50m below Old Ballarat road crossing	290	737800 5873800

AMG notation: sites 1 – 3 map 7624, sites 4 –12 map 7623:, all zone 54, eastings-northings

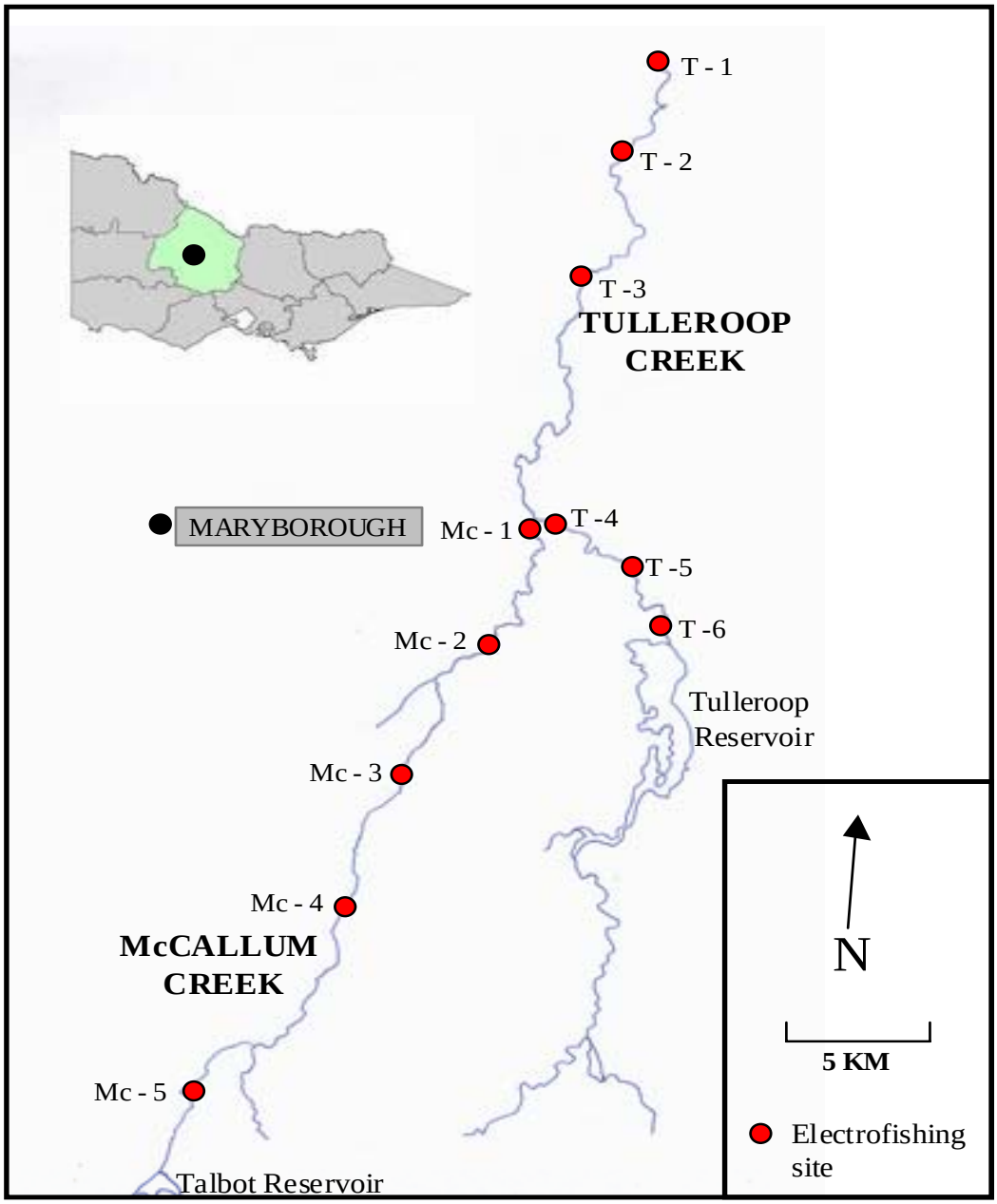

Figure 1 – Map of study area showing sites creeks, reservoirs and position within Victoria.

2.2 Fish Collection Methods

To determine the distribution of River Blackfish and other fish species within the McCallum and Tullaroop creeks 12 sites were fished at major road crossings with backpack electrofishing. At the selected sites single pass backpack elecrofishing (Smith-Root model 12 B) was used to sample of 100m stretch of river containing representative habitat types. A standardised approach was used so that the fish catch can be compared between sites and habitats. Future surveys will be able to make comparisons based on fish catch per 100 metre stretch or catch per electrofishing seconds.

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 300-400 volts at 30-60 pulses per second. All captured fish were identified, counted, measured and weighed. In some sites 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.

2.3 Habitat

To determine the habitat preferences of River Blackfish within the McCallum and Tullaroop creeks, qualitative descriptions of aquatic habitat including physical and cover components were made where River Blackfish were caught. These habitat features include depth, substrata characteristics, flow type and percentage of in-stream cover (small and large woody habitats, aquatic vegetation, leaf litter, algae, overhanging vegetation, undercut banks). In each site general habitat features were also described or measured including extent of 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.

The frequency of habitat types in which River Blackfish was associated with (frequency ‘used’) was divided by the frequency occurrence of the same habitat type (frequency ‘available’) (Humphries, 1995). Values over 1 indicate that River Blackfish were present

in the habitat type and values less than 1 indicate that River Blackfish was associated with a habitat type in a lesser frequency than it was present in the habitat type (Humphries, 1995). Based on the habitat types River Blackfish were caught in, five categories were used in the above analysis including emergent vegetation, submergent macrophytes, undercut banks, rocky habitat and woody habitats. Based on the preferences found in the habitat study the suitability of in-stream and riparian vegetation at each site was assessed to gauge its suitability for River Blackfish.

2.4 Water Quality

Water quality parameters including temperature (^{o}C), dissolved oxygen (mg/L), pH, electrical conductivity (µs cm $^{-1}$) and turbitity (NTU) were recorded for each site sampled. Water quality readings in sites with deep pools included readings taken at the surface and 20cm off the bottom.

2.3 Historical Data

To obtain historical fish data for Tullaroop and McCallum Creek a search was conducted on the DSE Fish Fauna Database (DSE aquatic fauna database, 2004).

3.0 RESULTS

3.1 Historical Data

Some historical fish fauna data is available for Tullaroop creek and only anecdotal information for McCallum Creek. The studies that are available on Tullaroop creek have mostly been located above the Tullaroop reservoir (Hume, 1978; Tunbridge *et al.* 1981; Baxter 1985; Baxter, 1988; McGuckin 1995). From the records that do exist six native species have been recorded in the study area of approximately 17 native species historically found in the Loddon catchment (DSE aquatic fauna database).

Three species of native fish, including Macquarie perch, Murray cod and Golden perch have been stocked in Tullaroop creek below the reservoir on various occasions. 1500 Golden perch were stocked from 1990 –1995 (DSE aquatic fauna database). Part of 200 Macquarie perch were stocked in 1955 (Cadwallader, 1981; 1984) and 300 Murray cod were stocked in 1987 (Barnham 1990). There have been no recent records of these fish species in Tullaroop creek.

River Blackfish have been recorded from a number of studies above the reservoir on Tullaroop creek and Birches creek (Hume 1979; Tunbridge *et al.* 1981; Baxter 1985; Baxter 1987; McGuckin 1995). Anecdotal evidence from the 1760's indicate that River Blackfish were very abundant in McCallum Creek (J. Mackenzie personal communication, 2005).

Six exotic fish species have been recorded from the study area (Table 3). Three decapod crustaceans, common to freshwater systems in the Murray Darling basin have been recorded from McCallum Creek (DSE aquatic fauna database).

Table 2. Native and alien freshwater fish, and native decapod crustacean species previously recorded from Tullaroop and McCallum Creek, including their conservation status. Conservation status for native fish follows VDSE (2003).

Species	Common Name	Conservation Status	Reference
Native Fish Species			
Gadopsis marmoratus	River Blackfish	Common and widespread	Hume 1979; Tunbridge *et al.* 1981; Baxter 1985; McGuckin 1995.
Galaxias sp. 1	Obscure Galaxias	Common and Widespread	DSE 2005
Philypnodon grandiceps	Flat-headed Gudgeon	Common and widespread	Baxter 1985
Macquaria australasica	Macquarie perch	Threatened	Cadwallader 1981 Cadwallader *et al.* 1984
Maccullochella peelii peelii	Murray cod	Vulnerable	Cadwallader *et al.* 1984; Barnham 1990
Retropinna semoni	Smelt	Common and widespread	Baxter *et al*. 1988 Baxter 1985;
Alien Fish Species			
Carassius auratus	Goldfish	-	Tunbridge *et al*. 1981
Gambusia holbrooki	Gambusia	-	DSE 2004
Perca fluviatilis	Redfin		Hume1979;McGuckin 1995; Koehn *et al.* 1991
Salmo trutta	Brown Trout	-	Hume 1979; Baxter 1985; Koehn *et al*. 1991
Oncorhynchus mykiss	Rainbow Trout	-	Hume 1979
Tinca tinca	Tench	-	DSE 2004
Native Decapod Crustaceans			
Cherax destructor	Common Yabby	Common and widespread	DSE 2004
Macrobrachium australiense	Freshwater Prawn	Common and widespread	DSE 2004
Paratya australiensis	Freshwater Shrimp	Common and widespread	DSE 2004

3.2 Site Characteristics

Site T-1 –Tulleroop Creek, Forbes Road

This reach extended from 50m downstream to 50 m upstream of Forbes Road.. The mean width and depth were 10 m and 0.6 m respectively. Hydraulic habitat included pool (80%) and run (20%). The streambed comprised sand (80%) and silt (20%). Instream habitat available as cover to aquatic fauna was dominated by logs, emergent vegetation and branches. Streamside disturbances included riparian clearing and erosion from stock access. Elecrofishing effort = 1397 seconds.

Site T-2 – Tulleroop Creek, Mullins Bridge

This reach extended 100m upstream from Mullins Bridge. The mean width and depth were 5 m and 0.6 m respectively. Hydraulic habitat included pool (90%) and run (10%). The streambed comprised sand (70%) and silt (30%). Instream habitat was dominated by logs, branches, submergent and emergent vegetation and undercut banks. Streamside disturbances included a cleared riparian zone. Elecrofishing effort = 1043 seconds.

Site T-3 – Tulleroop Creek, Hoopers Bridge

This reach extended from 50 m downstream to 50 m upstream of Hoopers Bridge. The mean width and depth were 6 m and 0.7 m respectively. Hydraulic habitat included pool (70%) and run (30%). The streambed comprised clay (40%), sand (30%), boulder (10%), cobble (10%) and silt (10%). Instream habitat available included logs, branches, submergent and emergent vegetation, rocks and undercut banks. The site had a low disturbance rating with a fenced riparian zone in good condition. Elecrofishing effort = 1116 seconds.

Site T-4 – Tullaroop Creek, Carisbrook

This reach extended 100m upstream of the confluence with McCallum Creek. The mean width and depth were 5 m and 0.4 m respectively. Hydraulic habitat included pool (20%) and run (80%). The streambed comprised sand (80%) and silt (20%). Instream habitat was dominated by submergent macrophytes, logs, branches, and emergent vegetation. This site had a moderate disturbance rating with abundant exotic trees and riparian clearing. Elecrofishing effort = 826 seconds

Site T-5 – Tulleroop Creek, Doran Road

This reach extended 100 m upstream from a pump located upstream of the quarry. The mean width and depth were 5.5 m and 0.3 m respectively. Hydraulic habitat included run (90%) and pool (10%). The streambed was comprised of sand (90%) and silt (10%). Instream habitat was dominated by submerged aquatic vegetation, organic matter, logs, branches, and emergent vegetation. The site had a moderate disturbance rating with a partially cleared riparian zone, exotic trees, flow regulation and a pump inlet. Elecrofishing effort = 987 seconds.

Site T-6 – Tullaroop Creek below Tullaroop Reservoir

This reach is located approximately one Km downstream of the dam wall. The mean width and depth were 4.5 m and 0.5 m respectively. Hydraulic habitat included run (60%), pool (30%) and riffle (10%). The streambed was comprised of silt (40%), sand (25%), clay (30%) and cobbles (5%). Instream habitat was dominated by logs, braches, undercut banks submerged aquatic vegetation and organic matter. The site had a low disturbance rating, although flows are highly regulated due to the reservoir. Elecrofishing effort = 980 seconds.

Site Mc-1 - McCallum Creek above confluence with Tullaroop Creek

This reach is located upstream of the junction with Tullaroop Creek. The mean width and depth were 5.5 m and 0.6 m respectively. Hydraulic habitat included pool (100 %). The streambed comprised predominantly fine substrata including silt (90%), and sand (10%). Instream habitat was dominated by organic matter logs, braches, undercut banks and emergent aquatic vegetation. The site had a moderate disturbance rating, containing riparian clearing and exotic trees. Water was stagnant and anoxic. Elecrofishing effort = 637 seconds.

Site Mc-2 - McCallum Creek, Rodborough Road

This reach is located upstream of the junction with Tullaroop Creek. The mean width and depth were 6.0 m and 0.5 m respectively. Hydraulic habitat included pool (100 %). The streambed comprised sand (90%), and silt (10%). Instream habitat was dominated by logs, braches and organic matter. The site had a low disturbance rating. This site looked as though it had only just filled with water from recent rain. Riparian clearing and stock damage were evident. Elecrofishing effort = 600 seconds.

Site Mc-3 – McCallum Creek, Dunach-Eddington road

This reach is located upstream and downstream of the Dunach-Eddington road crossing. The mean width and depth were 5.5 m and 0.5 m respectively. Hydraulic habitat included pool (60 %) and run (40%). The streambed comprised silt (70%), sand (20%) and cobble (10%). Instream habitat was dominated by undercut banks and emergent aquatic vegetation. The site had a moderate disturbance rating, including riparian clearing and exotic trees. Elecrofishing effort = 980 seconds.

Site Mc-4 - McCallum Creek, Talbot - Majorca Road

This reach is located upstream and downstream of the road bridge. The mean width and depth were 5.0 m and 0.4 m respectively. Hydraulic habitat included pool (60 %) and run (40%). The streambed comprised cobble (40%), sand (30%), boulder (10%) and silt (20%). Instream habitat was dominated by rocks, submergent aquatic vegetation and undercut banks. The site had a low to moderate disturbance rating, containing some riparian clearing. Elecrofishing effort = 960 seconds.

Site Mc-5 - McCallum Creek, Ballarat/Maryborough road

This reach is located 200 m downstream of the road bridge. The mean width and depth were 3.0 m and 0.4 m respectively. Hydraulic habitat included pool (50 %), run (40%) and riffle (10%). The streambed comprised boulder (5%), cobble (5%), pebble (20%), gravel (20%), sand (40%), and silt (10%). Instream habitat was dominated by undercut banks, rocks, submergent aquatic vegetation and logs. The site had a low disturbance rating, however upstream areas had stock access and bad erosion problems. Elecrofishing effort = 936 seconds.

Site Mc-6 - McCallum Creek, 50m below Old Ballarat Road

This reach is located 200 m downstream of the road bridge. The mean width and depth were 4.5 m and 0.4 m respectively. Hydraulic habitat included pool (100%) The streambed comprised boulder (5%), cobble (10%), pebble (5%), sand (10%), and silt (70%). In stream habitat was dominated by aquatic vegetation, emergent vegetation undercut banks, organic matter, and braches. The site had a low disturbance rating. Elecrofishing effort = 843 seconds.

3.3 Water Quality

Water electrical conductivity levels were high at all sites with the highest levels recorded from the higher elevation sites in McCallum Creek (Table 3). Water temperature and pH levels at sites were relatively stable between all sites on both creeks (Table 3). Turbidity levels varied between sites (Table 3). Dissolved oxygen readings were high in most sites, the exception was Mc-7 which had low surface and bottom readings and Mc-6 which had a low bottom reading (Table 3-2).

Table 3. Water quality readings showing high conductivities and low dissolved oxygen readings in sites 7 and 12.

Site	Conductivity @ water temperature (µs cm $^{-1}$)	Temp	DO (mg L^{-1}) surface	DO (mg L^{-1}) bottom	Turbidity (NTU)	pH
T-1	1122	7.3	10.2	9.5	4.3	7.6
T-2	1044	7.6	10.6	9.6	10.0	7.8
T-3	1078	7.8	9.3	-	2.0	7.8
T-4	766	8.2	7.6	-	13.7	7.1
T-5	1010	7.8	10.9	-	19.0	7.9
T-6	934	8.2	11.3	-	10.1	8.2
Mc-1	901	7.0	1.8	1.1	5.0	7.4
Mc-2	1300	7.4	6.4	4.5	11.6	7.4
Mc-3	1496	7.1	8.8	7.5	5.3	7.5
Mc-4	1459	7.5	10.4	-	4.7	7.5
Mc-5	1310	7.6	10.6	9.8	14.3	7.7
Mc-6	1383	7.9	10.7	1.2	3.3	7.7

3.4 Fish Catch

A total of 367 fish from eight families and eight species were caught during surveys of Tullaroop and McCallum Creeks (Table 3). Of these, four species were native and four species Redfin (*Perca fluvialtilis*), Goldfish (*Carassius auratus*), Gambusia (*Gambusia holbrooki*) and Tench (*Tinca tinca*) were alien species (Table 3). All native species are considered common and widespread (Table 4).

Table 3 – Fish species collected in Tullaroop and McCallum Creeks in the present study and their conservation status. Conservation status for native fish follows VDSE (2003).

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			
Percidae	*Perca fluvialtilis*	Redfin	-
Cyprinidae	*Carassius auratus*	Goldfish	-
Cyprinidae	*Tinc tinca*	Tench	-
Poeciliidae	*Gambusia holbrooki*	Gambusia	-

3.5 Distribution and Abundance of Fish

River Blackfish were recorded at seven of the 12 sites surveyed, three sites on McCallum Creek and four sites in Tullaroop creek (Table 3). In most sites River Blackfish were present in very low abundances, with only one or two individuals being caught per site. The exception was in site three on Tullaroop, where 14 individuals were caught (Table 3).

The obscure galaxias (*Galaxias sp.1*) were the most abundant and most widely distributed species recorded, compromising 60.5 % of the total catch and being found in 75% of sites (Table 3). Smelt (*Retropinna semoni*) had the second highest abundance but were only found in 17% of sites (Table 3). Flat headed gudgeons (*Philypnodon graniceps*) comprised 22% of the total catch and occurred in three sites. Redfin comprised 23 % of the total catch and were found in three sites in Tullaroop Creek (Table 3). Goldfish (*Carassius auratus)*, Mosquito fish (*Gambusia holbrooki)* and tench (*Tinca tinca*) all had small contributions to the total catch and were found in few sites (Table 5).

Table 5 – Fish catch in each site and size and weight ranges for all fish caught

Site	*Gal sp.*	*Ret sem*	*Gad mar*	*Phi gra*	*Per flu*	*Car aur*	*Gam hol*	*Tin tin*
T-1				2	11	4		
T-2					11	2	2	
T-3	13		14					
T-4	28		1				1	
T-5	7		1	1				2
T-6	2		2	12	1			
Mc-1	1	1						
Mc-2								
Mc-3	21	65	1					
Mc-4	96							
Mc-5	33		2	6				
Mc-6	21		1					
No. sites	9	2	7	4	3	2	2	1
Total catch	222	66	23	22	23	6	3	2
Catch (%)	60.5	18	6.3	6	6.3	1.6	0.5	0.8
Length range (mm)	55-147	45- 66	88 -238	60-82	84-279	66-100	28-31	185-385
Weight range (g)	1.4-23.5	0.3-2.0	5.3-77	21-4.0	6.4-384	7.5-15.7	0.2-0.4	105-928

*Total catch included fish observed whist electrofishing.

3.6 River Blackfish Habitat

River Blackfish were associated with five habitat types including woody habitat, undercut banks, submergent macrophytes and rocky habitats. River Blackfish were found to have a more frequent association with woody habitat than the other four habitat types. River Blackfish were caught in depths ranging from 0.2 - 0.7 m. The mean depths for each habitat type reveal that submerged macrophytes had the highest mean depth and emergent vegetation had the lowest mean depth.

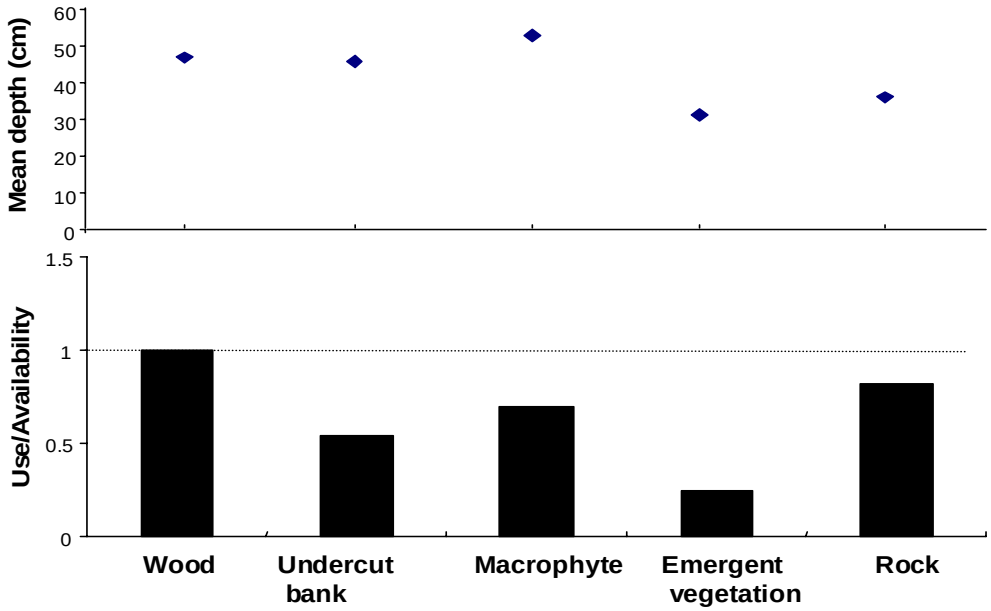

Figure 2 – Mean depth and habitat associations of River Blackfish caught in Tullaroop and McCallum Creeks (n = 21)

All sites surveyed had two or more in-stream habitat features that River Blackfish are found to be associated with including woody habitat, undercut banks, submergent macrophytes and rocky habitats (Table 6). The presence of these habitats varied between sites with logs and branches (83.3% of sites) and aquatic vegetation (75% of sites) being the most widespread habitat types. Based on these observations all sites appeared to have suitable habitat for River Blackfish, however, this prediction did not match the actual sampled distribution of the species within the systems.

Table 6 – Distribution of dominant habitat types present in sample sites. B indicates the presence of blackfish within a site.

Site		*Rocks*	*Logs and braches*	*Emergent Vegetation*	*Aquatic Vegetation*	*Undercut Banks*
T-1			♦	♦	♦	
T-2			♦	♦	♦	♦
T-3	B	♦	♦	♦	♦	♦
T-4	B		♦	♦	♦	
T-5	B		♦	♦	♦	
T-6	B		♦		♦	♦
Mc-1			♦			♦
Mc-2			♦			
Mc-3	B			♦		♦
Mc-4		♦			♦	♦
Mc-5	B	♦	♦		♦	
Mc-6	B		♦	♦	♦	♦
No. sites		3	10	7	9	7
Proportion of sites (%)		25.0	83.3	58.3	75.0	58.3

3.7 Size Frequency of River Blackfish

Size frequency distributions of River Blackfish caught reveal a wide range of size distributions among River Blackfish caught in Tullaroop and McCallum Creeks. River Blackfish sizes in Tullaroop Creek ranged from 88 to 238 mm with a mean size of 146mm. In McCallums Creek River Blackfish sizes ranged from 192 to 238 mm and had a mean size of 224mm.

All small fish (88 – 108mm) came from site T-3 on Tullaroop Creek, and all fish at sites T-4, T- 5, T- 6, Mc-3 and Mc-5 were over 114 mm in length. This trend suggests that there is little recruitment in the majority of sites in Tullaroop and McCallum Creeks with the population being dominated by larger and older fish.

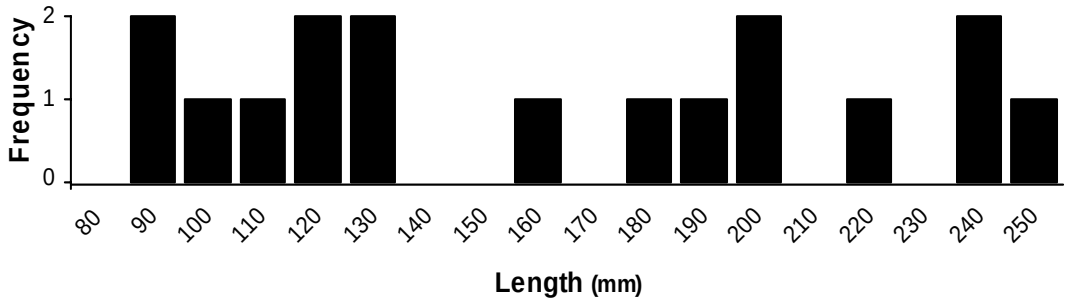

Figure 3 – Size frequency of River Blackfish caught in the surveys of Tullaroop and McCallum Creeks.

4.0 DISCUSSION

This study found that River Blackfish were only found in 66.6% of sites sampled in Tullaroop Creek and 50% of sites McCallum Creek. River Blackfish were present in very low abundances in the majority of sites with a single good population being found in Tullaroop Creek in a downstream reach (site T-3). This finding is consistent with a previous assessment of Tullaroop Creek that suggested that River Blackfish populations in Tullaroop Creek upstream of the McCallums Ck confluence were poor and that downstream populations were in better condition (Loddon River Environmental Flows Scientific Panel, June 2002). However, the extent of this downstream population seems to be limited with no blackfish being found in the two lowermost sites of Tullaroop Creek (T-1 and T-2).

4.1 Factors influencing distribution and abundance of River Blackfish

Anecdotal information on River Blackfish reveals that McCallum Creek had very good populations of River Blackfish in the 1960's and 1970's, indicating that there have been large declines of River Blackfish abundance in the study area (J. Mackenzie personal communication, 2005). A reduction of the abundance of River Blackfish has also been reported throughout other areas of their range (Jackson *et al.* 1996). Poor land management practices resulting in the siltation of rivers and streams, snag removal activities and reductions in water temperatures due to stream regulation and cold water releases during spring and summer spawning seasons are likely to have contributed to the observed declines (Cadwallader and Backhouse, 1983; Merrick and Schmida, 1984; Jackson *et al.* 1996).

Almost half the sites had riparian and stream edge stock damage and erosion problems, while 75 % of sites had some degree of riparian clearing. The effects of stock damage, riparian clearing and associated erosion problems can result in large quantities of sediment accumulating in the stream channel, smothering complex habitats (cobbles, rocks, large woody debris, aquatic vegetation) and reducing the habitat available for aquatic fauna. High levels of sediment may also build up in regulated streams due to a lack of flushing flows. Large sediment loads in rivers are thought to reduce recruitment

and abundance of River Blackfish (Jackson *et al.* 1996). River Blackfish lay adhesive eggs in log hollows and require clean sites for attachment. High sediment loads may prevent attachment and reduce recruitment through egg smothering and high mortalities of juvenile fish (Koehn and O'Connor, 1990a, b; Jackson *et al.* 1996). The highest abundance of River Blackfish found occurred in site T- 3 that had low levels of siltation present (10%). This low level of silt was likely a contributing factor in the occurrence of a strong population in this site.

River Blackfish were absent from the two lower-most sites on Tullaroop Creek. These sites had the highest abundance of redfin and goldfish out of all sites sampled. Redfin are an aggressive predator, often forming large populations that have been known to consume small native Australian freshwater fish (Backhouse and Gooley, 1989; Woodward and Malone, 2002). Redfin occupy a similar niche to that of River Blackfish and may also compete for food and habitat resources (Backhouse and Gooley, 1989). Therefore, exotic fish such as redfin may influence the distribution and abundance of River Blackfish.

In most sites River Blackfish were present in very low abundances, the exception to this was in site three on Tullaroop Creek where 14 individuals were caught. Site three had excellent instream habitat including logs, branches, submergent and emergent vegetation and undercut banks. Reasons for the observed differences in abundance of River Blackfish within sites may be related to mortality and recruitment variability. River Blackfish probably undergo very localised recruitment with success or failure of recruitment each year leading to wide variations in population size between sites (Merrick and Schmida, 1984; Koehn and O'Connor, 1990b). The good condition and habitat features of this site may have contributed to healthy localised recruitment.

The low abundances of River Blackfish at most sites may also be the result of the lack of suitable spawning sites. It has been documented that River Blackfish spawn inside hollow logs, which were not available in high abundances the sites surveyed (Jackson, 1978). However, authors have argued that River Blackfish may use alternative sites in the absence of hollow logs. For example, in many agricultural streams with modified riparian zones and a lack of woody habitats, River Blackfish may utilise complex undercut banks with associated root mats (Khan *et. al*. 2004).

Fish were absent from site eight on McCallum Creek, this site was relatively shallow and sandy and probably had only recently filled after drying in response to a seasonal summer dry spell. These trends may be partly natural as McCallum Creek has been classified as an intermittent creek which partially dries (McGucken and Doeg, 2000). Despite the intermittent nature of the creek it should be noted that diversion of water for irrigation, stock and domestic use and onstream storages act to regulate flows and may exacerbate drying in low flow events. The alteration of natural flow regimes has been responsible for the decline in distribution and abundance of many native freshwater fish species throughout Victoria (Koehn and O'Connor 1990).

All sites sampled in McCallum and Tullaroop creeks had high conductivity levels ranging from 901 – 1383 µs/cm $^{-1}$ clearly indicating that the creeks may be suffering from inputs of saline water. Generally most native Australian freshwater fish including River Blackfish have high tolerances to salinity (Koehn and O'Connor, 1990). However, the effects of salinity increases may indirectly effect native fish through ecosystem changes including effects to aquatic plants, riparian vegetation, invertebrates and microalgae (Hart, 2003).

Another factor that may have limited the distribution and abundance of River Blackfish in the study area was the incidence of very low dissolved oxygen in two sites in McCallum Creek. In site seven dissolved oxygen readings were as low as 1.1 mg/L^{-1} while site 12 had a reading of 1.1mg/L^{-1} in a deep pool. 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). The extinction of River Blackfish from stretches of creeks can be long lasting, due to the low mobility and recolonisation rates of the species (Bond and Lake, 2003; Khan *et. al*. 2004).

4.2 River Blackfish Habitat

It was found that River Blackfish were associated with five main habitat types including submerged macrophytes, undercut banks, emergent aquatic vegetation, woody habitat and rocky habitats. Out of all the habitats River Blackfish had a higher frequency of

occurrence in woody habitats and were caught in depths ranging from 20 to 70 cm. This is consistent with other studies that also found close associations between River Blackfish and woody habitats (Lake, 1967; Jackson, 1978; Cadwallader, 1979; Dobson and Balwin, 1982). However, other studies have found that River Blackfish were positively associated with organic matter (Koehn, 1986) and other habitats such as undercut banks, boulders and instream vegetation (Khan *et. al*. 2004). These differences are not unusual as riverine fish species such as River Blackfish can often utilise several types of cover, with the selection of cover being related to habitat availability (Bond and Lake, 2003).

Of all habitat types River Blackfish had a higher frequency of occurrence in areas of woody habitat. Based on these observations all sites appeared to have suitable habitat for River Blackfish, however, this prediction did not match the actual sampled distribution of the species within the systems. Reasons for the absence and low abundances of River Blackfish are possibly due to a combination of factors including the presence of alien fish, regulated and reduced flows, low dissolved oxygen levels, increasing salinity, siltation, and stream drying.

4.2 Recommendations for Riverine and Fish Fauna Management

A major impetus for this study was to assess the distribution of River Blackfish within Tullaroop creek below the Tullaroop reservoir and to assess whether a translocation program should be considered if River Blackfish were absent. The results of the study found that River Blackfish were present, albeit often in very low numbers. Therefore it is considered that reintroduction of River Blackfish into Tullaroop Creek is not needed.

Water quality issues including high conductivity in all sites and low dissolved oxygen readings in McCallum Creek have or will continue to influence the aquatic systems of McCallum and Tullaroop Creeks. The low dissolved oxygen readings from McCallum Creek are likely to be from low flows and stagnating water, the extent of how natural this phenomenon is should be investigated in relation to regulated flows out of Evansford and Talbot Reservoirs. Alteration to the natural flow regimes of rivers and streams is considered a major threat to the health of aquatic ecosystems (SAC, 1992).

This study has found that some good remnant populations of River Blackfish do exist in Tullaroop Creek and that these are probably being maintained through the presence of good habitat features, lack of exotic fish, low silt levels and riparian disturbances, which has led to healthy localised recruitment. Management actions that may be considered include protection of riparian zones from stock access and riparian enhancement (e.g. tree planting). In addition, in the short term the reintroduction of log hollows for spawning sites and habitat may be beneficial to River Blackfish populations in some areas until riparian management actions has effect. Healthy riparian zones contribute to a fully functioning riverine ecosystem through improving bank stabilisation, input of woody habitats and organic matter, input of invertebrates, nutrient flux, sediment buffering and storage, pool formation and shading (Cummins, 1993). These influences maintain key physical and biological elements that stream biota are adapted to and an enhancement of these features will benefit the aquatic fauna of McCallum and Tullaroop Creeks.

Table 7 below summarises the threats to River Blackfish populations observed in Tullaroop and McCallum Creeks during the current study and outlines suggested management actions.

Table 7. Threats identified in the current study, the effects on River Blackfish populations and suggested management action.

Threat	Effect on River Blackfish population	Management Action
Stock access	• Siltation of habitat and spawning sites • Reduction of riparian regrowth • Direct damage to aquatic vegetation	• Fencing of riparian zone • Provision of off-stream watering points or provision of stabilised in-stream watering points
Cleared riparian zone	• Increased siltation, unstable banks, reduced shading, less input of invertebrates for food reduction of undercut banks, woody habitats and organic matter	• Tree planting • Weed management
Exotic trees in riparian zone	• Deciduous trees dumping large volumes of leaves in Autumn reducing water quality and	• Exotic tree removal and replacement with native trees

	adversely effecting natural macroinvertebrate community (food source) • Willow root mats choking stream flow	
Lack of hollow logs for spawning sites	• Reduced recruitment and population sizes	• Re-introduction of log hollows
Increasing salinity	• Unknown but likely to effect entire aquatic ecosystem including aquatic vegetation aquatic invertebrates on which River Blackfish are reliant	• Salinity Management in catchment and provision of flushing flows to creeks
Predation by exotic fish	• Direct reduction of blackfish through predation, particularly smaller size classes	• Establish links with appropriate fisheries agency to ensure that introduced fish such as trout and redfin are not stocked into areas with blackfish
Increased nutrient input from catchment runoff	• Increased potential for algal blooms and aquatic vegetation growth	• Management of riparian zones to include provisions of effective filtration (buffer) strips through tree planting restriction of stock access (source of direct nutrient input)
Anoxic water	• Can lead to localised extinctions of fish fauna including River Blackfish due to low tolerance of dissolved oxygen • Reduced recruitment of River Blackfish due to reduced success of eggs and juveniles	• Higher water allocation from reservoirs during low flows

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