Mulloon Creek Fish Survey
Autumn 2023

Final report to the Mulloon Institute
Centre for Applied Water Science
University of Canberra

Mulloon Institute
For environment, farming and society.

UNIVERSITY OF CANBERRA

Centre for APPLIED WATER Science

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Report prepared for: Mulloon Institute

Authors: Rhian Clear, Ben Broadhurst, Danswell Starrs and Mark Lintermans

Produced by:

Centre for Applied Water Science

Institute for Applied Ecology

University of Canberra, ACT 2601

Telephone: (02) 6206 8608 Facsimile: (02) 6201 5651

Website: http://www.canberra.edu.au/centres/iae/index.php

ABN: 81 633 873 422

Inquiries regarding this document should be addressed to:

Ben Broadhurst

Phone: 0423 363 636 Fax: (02) 6201 5305

Email: ben.broadhurst@canberra.edu.au

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Introduction

Mulloon Creek is in the upper Shoalhaven River catchment, south-eastern NSW. Arising in the Tallaganda State Forest, Mulloon Creek flows in a northerly direction before joining Reedy Creek, which flows into the Shoalhaven River north of Braidwood. The lower half of the Mulloon Creek catchment has been cleared and current land use consists of extensive grazing of sheep and cattle, along with a range of smaller artisanal enterprises. The upper catchment is heavily vegetated with native Eucalypt forest.

The fish fauna of Mulloon Creek should largely comprise species expected to occur in the upper reaches of streams in the coastal catchments of southeastern NSW. Being connected to the Pacific Ocean, a range of diadromous (fish that migrate between freshwater and marine environments) could be expected to occur. However, the construction of Tallowa dam on the Shoalhaven River in 1976 to provide a water supply for Nowra has impeded the upstream and downstream movement of multiple species, leading to extirpations of numerous species upstream of the dam (Bishop and Bell 1978, Gehrke *et al.* 2002). Of note is the apparent extinction of Australian grayling (*Prototroctes maraena*) following the construction of Tallowa dam, and the loss of 10 species of diadromous fish that were predicted to occur upstream of the dam prior to its construction (Gehrke *et al.* 2002). A fish passage structure retro-fitted to the dam wall appears to provide minimal passage for native fish past Tallowa dam. As such, the only diadromous species expected to be upstream of Tallowa dam are the Anguillid eels (Short-finned eel, *Anguilla australis*, and Long-finned eel, *Anguilla reinhardtii*) and two additional species: Climbing galaxias (*Galaxias brevipinnis*) and Australian bass (*Percalates novemaculeata*). Stocking of Australian bass has occurred upstream of Tallowa dam, which theoretically enables them to enter the Mulloon Creek catchment. While they are unlikely to be present now, historically it is plausible that Australian bass occurred in this catchment. To what extent Australian bass may have been present in Mulloon Creek historically is unknown, but it is considered unlikely given that Mulloon Creek is a relatively small, shallow stream very high up in the Shoalhaven River catchment. Climbing galaxias may have been present in the uplands of the Shoalhaven catchment historically, as this species can occur in small streams quite distant from the ocean. Non-diadromous fish that may have occurred upstream of Tallowa Dam include Flat-headed gudgeon *Philypnodon grandiceps*, Dwarf flatheaded gudgeon (*Philypnodon macrostomus*) Empire gudgeon (*Hypseleotris compressa*) and Cox's gudgeon (*Gobiomorphus coxii*).

Mulloon Creek exists near the top of the Shoalhaven catchment, is relatively small, and extensive land-clearing in the lower sections all act to reduce the expected abundance and diversity of fish species likely to be present. Small-bodied native freshwater species that could be expected to occur include Mountain galaxias (*Galaxias olidus*) and possibly carp gudgeons (probably Western carp gudgeon *Hypseleotris klunzingeri*). Additional native

freshwater species that have been reported from the Shoalhaven River catchment upstream of Tallowa dam include Firetail gudgeon (*Hypseleotris galii*), Western carp gudgeon (*Hypseleotris klunzingeri*), Macquarie perch (*Macquaria australasica*) and Australian smelt (*Retropinna semoni*) (Gehrke *et al.* 2002, Lintermans 2008). The taxonomy and field identification of *Hypseleotris* in southeastern Australia is problematic, with recent genetic studies showing that at least four sexual species of carp gudegeon are present in NSW, (Western, Lakes, Midgleys and Murray-Darling) as well as multiple hemi-clonal unisexual lineages of hybrid origin between the latter three species (Bertozzi *et al.* 2000, Schmidt *et al.* 2011). In addition to this, misidentification of male carp gudgeons (in reproductive colouration i.e. with red fins) as Firetail gudgeons (*Hypseleotris galii*) is possible, and the records of *H. galii* from the Shoalhaven catchment upstream of Tallowa Dam may be unreliable.

Additionally, a range of introduced species exist in nearby catchments that are likely to exist in the Mulloon catchment. Carp (*Cyprinus carpio*) are present in the Shoalhaven River upstream of Tallowa dam, and the lower-mid reaches of the Mongarlowe River (Lintermans 2008). Likewise, Goldfish (*Carassius auratus*) have been recorded in the Shoalhaven River catchment (Bishop and Bell 1978). Rainbow trout (*Oncorhyncus mykiss*) and Brown trout (*Salmo trutta*) exist in the Upper Shoalhaven River catchment and may occur in Mulloon Creek. Finally, the Eastern gambusia (*Gambusia holbrooki*) has a wide distribution throughout southeastern Australia and likely occurs in Mulloon Creek, as it has been recorded in the upper Shoalhaven River catchment (Gehrke *et al.* 2002, Lintermans 2008). However, no data previously exists that describes the fish fauna in Mulloon Creek.

This study aims to document the fish fauna present in the Mulloon Creek catchment, with particular focus on the Mulloon Farm area, and immediate vicinity of the constructed leaky weirs and compare findings from the initial survey conducted in 2016 and 2022. To contextualise the findings, and to provide a reference for change in fish community in Mulloon Creek over time, three reference sites were identified and surveyed. This study allows for a comparison to the baseline survey (2016) and follow up survey in 2022 to compare potential future changes in the fish fauna of Mulloon Creek since additional leaky weirs were installed.

Methods

Study sites

As per Starrs and Lintermans (2016) the same nine sites were sampled in autumn 2023. These included six sites on Mulloon Creek (Figure 1) and three reference sites on streams outside the Mulloon creek catchment (Figure 2). Since the initial survey in 2016 several leaky weirs have been installed with the first commencing in 2018 - 2019 from fish site 3 to the kings Highway and stage 2 commenced in late 2019 - mid 2020 from fish site 4 to fish site 5 (Figure 1).

The Mulloon Creek sites were sampled on the 21st March (sites 1 - 3) and the 31st March (sites 4 – 6) and the three reference sites were sampled on 5th April 2023. Unlike the previous year's sampling, rain and high flows were not an issue, so sampling was undertaken in autumn allowing for a better comparison with the baseline data from 2016.

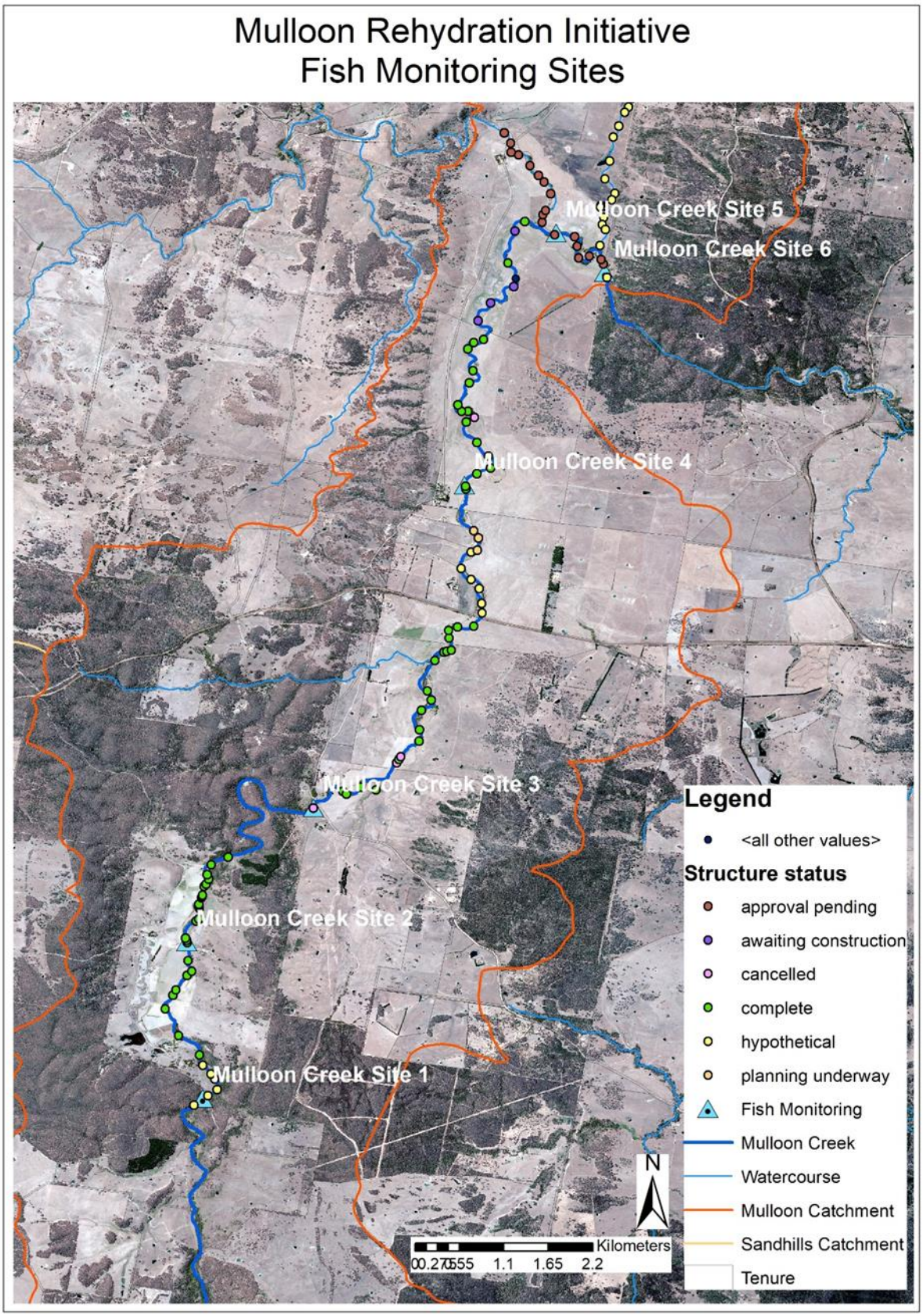

Figure 1. Map showing the six sampling locations and leaky weirs (green dots) along Mulloon Creek.

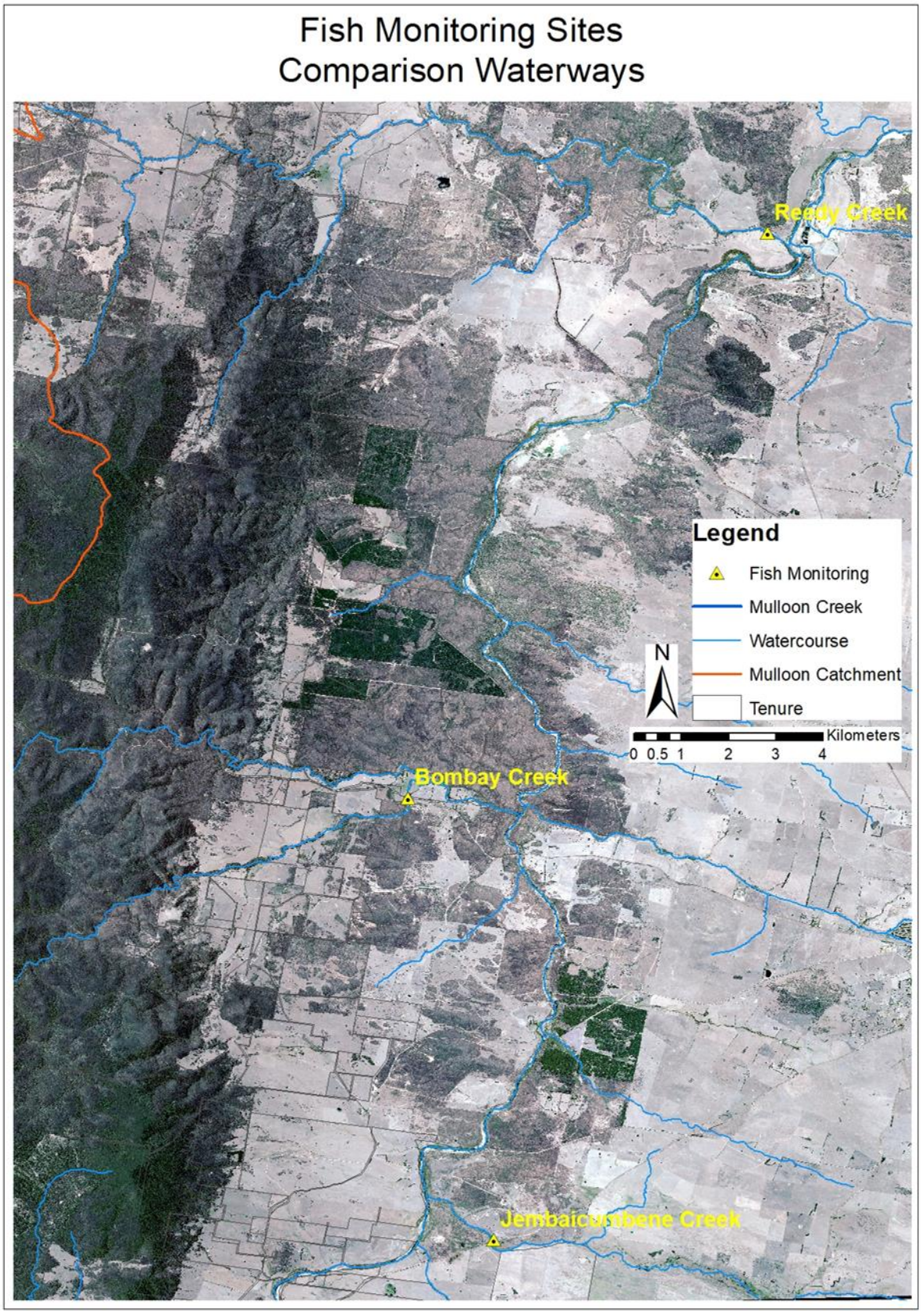

Figure 2. Map showing the three reference sampling locations outside the Mulloon catchment.

Fish sampling - Electrofishing

Backpack electrofishing was conducted in March - April 2023 at the nine sites identified below (Table 1). The same methods were employed following Starrs and Lintermans (2016) where two operators using a Smith and Root LR24 backpack electrofisher with a single anode pole (with net) and rat tail cathode performed all electrofishing operations. Electrofishing was conducted in accordance with the Australian Code of Electrofishing Practice (NSW Fisheries 1997). The first operator carried the backpack electrofisher with anode pole. The second operator carried a 20L plastic bucket and long-handled dipnet with fine mesh for collecting stunned fish. All electrofishing operations were conducted by wading through the stream in a downstream to upstream direction. Both operators used polarising sunglasses to facilitate fish collection.

Table 1. Summary of surveys conducted in autumn 2023 on Mulloon Creek and three nearby reference sites.

Location	Date	Latitude:Longitude	# E-fishing shots	Distance surveyed (m)	Bait-trap set time (hr:min)
Mulloon Creek Site 1	21/03/2023	149.5915E, 35.2964S	5	44m	1:00
Mulloon Creek Site 2	21/03/2023	149.5916E, 35.2705S	5	48m	1:00
Mulloon Creek Site 3	21/03/2023	149.6029E, 35.2638E	5	85m	1:00
Mulloon Creek Site 4	31/03/2023	149.6205E, 35.2262S	5	80m	1:38
Mulloon Creek Site 5	31/03/2023	149.6316E, 35.2012S	5	120m	1:05
Mulloon Creek Site 6	31/03/2023	149.6361E, 35.2042S	5	95m	1:20
Bombay Creek	05/04/2023	149.6973E, 35.4216 S	5	56m	1:20
Jembaicumbene Creek	05/04/2023	149.7102E, 35.5019S	5	64m	1:15
Reedy Creek	05/04/2023	149.7637E, 35.3113S	5	58m	1:36

Electrofishing operations were conducted in accordance with Sustainable River Audit procedures, where practical. A 150 second 'shot' was conducted, determined from the duration of electrical discharge recorded by the electrofishing unit (i.e. 'on time' rather than elapsed time). In addition, distance traversed along the stream was recorded (metres) for each shot using a Bushnell range finder. The entire width of the stream was surveyed in a zig-zag pattern where stream width was less than 10m wide. Attempts were made to survey all major microhabitat features, including around patches of emergent and submerged macrophytes, large woody debris and rocks, cobble and boulder habitats. Between 4 and 5 shots were conducted at each site. After each 150 second shot fish were counted and measured, and then released. Fish that were observed during electrofishing shots but not captured (escaped) were counted as 'observed'. Each fish captured was measured from the tip of the snout to the rear of the centre of the tail to the nearest mm in either total length

(TL) or fork length (FL), where appropriate. Yabbies (*Cherax destructor*) were not measured. A maximum of 50 fish of each species were measured for length at each shot, if more than 50 were captured. Once 50 were measured, all remaining individuals were counted and released.

Following each shot, a rapid assessment of instream conditions were made and recorded. Main attributes examined were water depth, substrate composition and extent of submerged and emergent macrophytes and the presence of large woody debris and other structure.

Fish sampling - Bait trapping

At each site, 10 fine-mesh concertina bait traps were deployed, as per Sustainable River Audit procedures. Traps were deployed unbaited into pools. Traps were placed 2-3m apart, with entrances facing in an upstream-downstream orientation. Traps were deployed whilst electrofishing operations were being conducted and had a soak time of 60 - 98 minutes, before being retrieved and cleared of fish. Each fish caught was identified, measured for length then released.

Data analysis

All analyses were performed using R Statistical Software (v4.1.2; R Core Team 2021). Catch per unit effort was calculated as the mean number of fish captured per shot for each site (then displayed in the figure ± 95% Confidence limits with Bonferroni correction). CPUE was only calculated for Mountain galaxias, due to their numerical dominance of catches. Length frequency histograms were produced for captured Mountain galaxias for each site. Recruits (individuals less than 1 year old) were deemed as individuals less than 50 mm FL (O'Connor and Koehn 1991).

Results

2023 summary

A total of 1490 fish were captured across the nine sites, with 1037 fish being captured from Mulloon Creek. Mountain galaxias (*Galaxias olidus*) was the most abundant species, comprising 1341 of the total catch, with 1028 from Mulloon Creek sites (Table 2). A total of 116 Eastern gambusia (*Gambusia holbrooki*) were captured which came from sites 4 - 6 on Mulloon Creek and the three reference sites (Table 2). Two short-finned eels (*Anguilla australis*) were captured, both from Jembaicumbene Creek, measuring 445 and 1230 mm, respectively. A total of 25 Yabbies were captured coming from site 1 on Mulloon Creek and two reference sites (Table 2). Three common Carp (*Cyprinus carpio*) were captured from Reedy Creek in 2023. A total of 28 Carp gudgeon (*Hypseleotris klunzingeri*) were captured at Reedy Creek which were undetected in the 2022 survey. Ten Mountain galaxias were captured in bait traps, from sites 2 and 4 on Mulloon Creek ranging in size from 25 – 50 mm (FL).

Table 2. Summary of number of fish and yabbies captured at each location by backpack electrofishing. Sub-total is presented for Mulloon Creek, and the grand total is all sites combined. Empty cells indicate that no fish were captured at that location.

Location	*Mountain galaxias*	*Eastern gambusia*	*Short-finned eel*	*Carp*	*Carp gudgeon*	*Yabby*
Site 1	201					2
Site 2	197					
Site 3	357					
Site 4	114	4				
Site 5	89	3				
Site 6	70	2				
Sub total	**1028**	**9**				**2**
Reedy Creek	88	9		3	28	6
Bombay Creek	153	49				
Jembaicumbene Creek	72	49	2			17
Grand Total	**1341**	**116**	**2**	**3**	**28**	**25**

Mountain galaxias dominated the catch at all sites surveyed (Table 2 and Figure 3). Catch rates were highest at site 3 followed by site 1 and 2 on Mulloon Creek (Table 2 and Figure 3). Fish ranged in size from 17 - 84 mm (FL) (Figure 4 and Figure 5). The most dominant size class overall was 40 - 55 mm (FL) (Figure 4 and Figure 5).

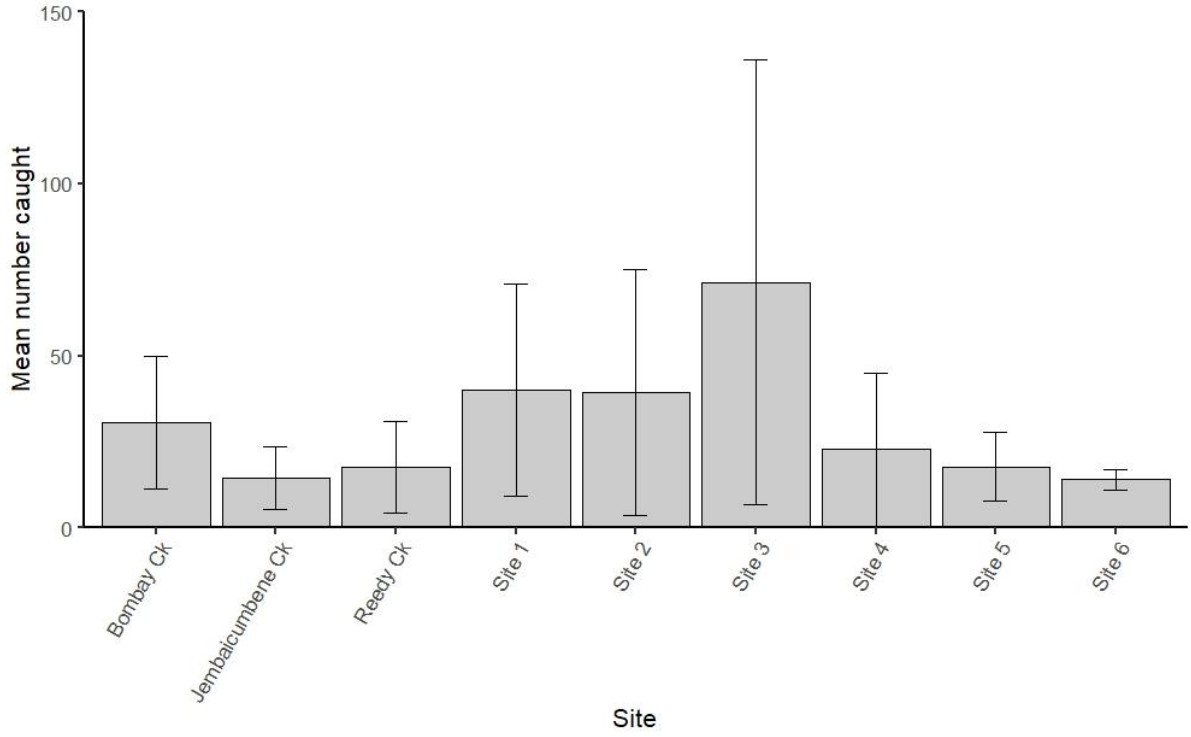

Figure 3. Mean number of Mountain galaxias caught per shot per site by backpack electrofishing March -April 2023. (Bars displayed as mean ± 95% Confidence limits with Bonferroni correction).

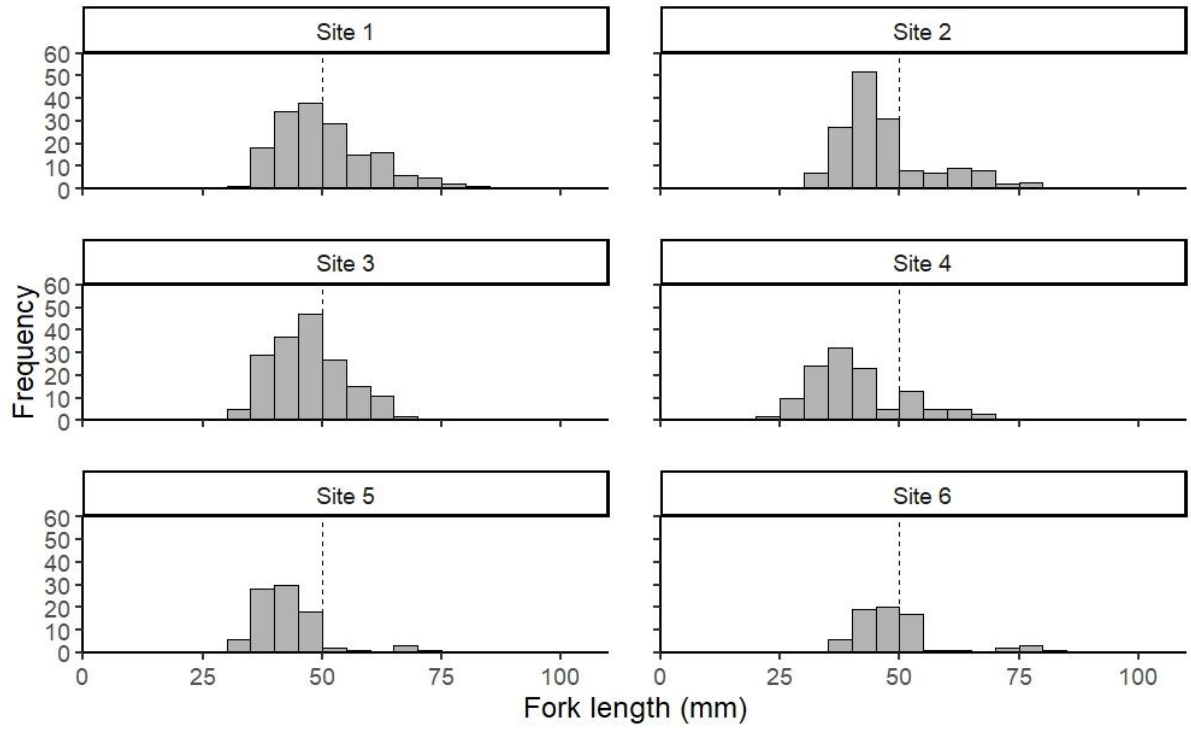

Figure 4. Length frequency of Mountain galaxias caught by backpack electrofishing in Mulloon Creek in March 2023. Dashed line indicates size at young-of-year (following O'Connor and Koehn 1991).

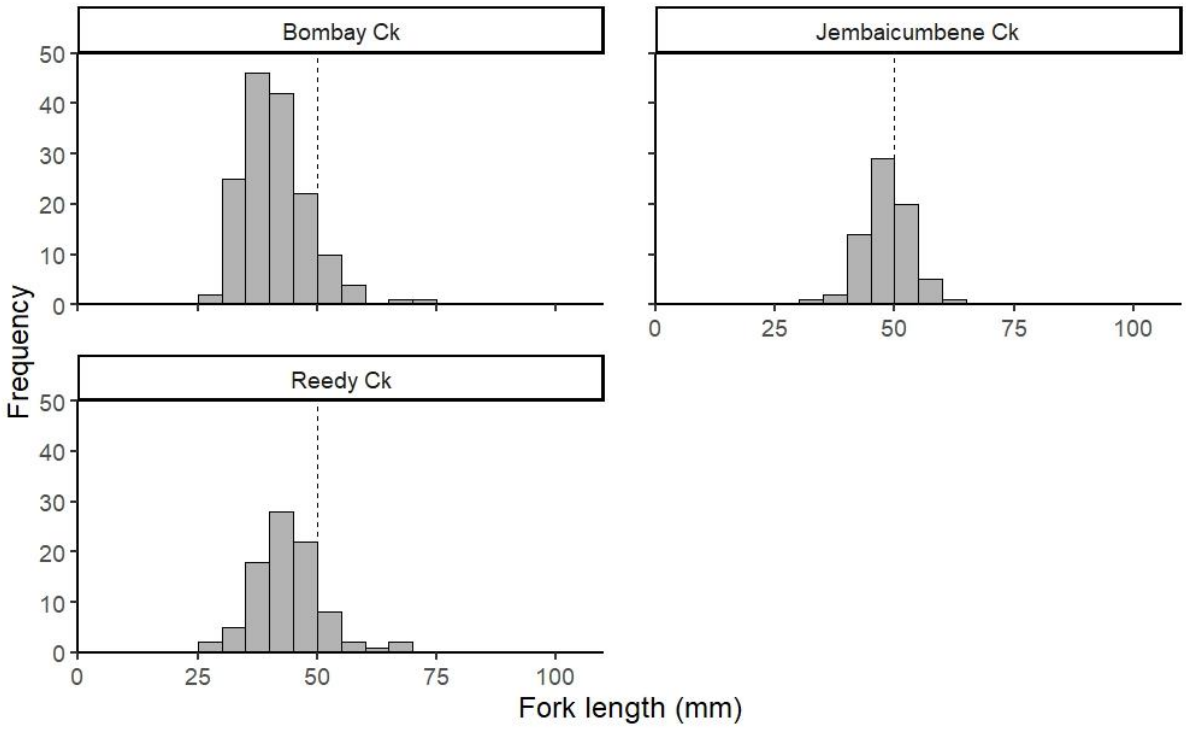

Figure 5. Length frequency of Mountain galaxias caught by backpack electrofishing from the three refence sites in April 2023. Dashed line indicates size at young-of-year (following O'Connor and Koehn 1991).

Figure 6. Mountain galaxias caught from Mulloon Creek.

Figure 7. Carp gudgeon caught at the reference site on Reedy Creek.

Table 3. Water quality measurements taken at each site in autumn 2023.

Site	Date	Temp	Cond	pH	DO mg/L	DO %	Turb
1	21/03/2023	16.82	0.09	6.62	8.11	90.3	5.1
2	21/03/2023	18.32	0.103	6.61	6.98	80.1	6.2
3	21/03/2023	17.51	0.123	7.11	8.02	90	9.4
4	31/03/2023	14.38	0.113	6.92	7.83	85.7	6.3
5	31/03/2023	16.73	0.166	7.09	8.22	92.6	4.4
6	31/03/2023	17.15	0.169	7.16	7.75	88.8	5.3
Reedy Ck	5/04/2023	17.03	0.234	6.71	7.01	77.9	5.9
Bombay CK	5/04/2023	19.93	0.117	7.9	10.06	119	2.4
Jembaicumbene Ck	5/04/2023	18.9	0.13	6.97	8.26	98.3	1.1

Long-term comparison between surveys

The largest difference between the baseline survey (2016) and the subsequent surveys was the reduction in abundance of Eastern gambusia and an increase in abundance of Mountain galaxias. In 2016, a total of 958 Eastern gambusia were captured, compared to just two in 2022 and 116 in 2023. In 2016 a total of 203 Mountain galaxias were caught which double in 2022 to 445 caught in total. In 2023, 1341 Mountain galaxias were caught in total which is three times higher than 2022 and almost seven times higher than 2016. Sites 1 – 3 on Mulloon Creek and the three reference sites had the biggest increase in catch rates in 2023 (Table 2). There was also an increase in Yabby numbers in 2023 with 25 caught compared to one in 2022 (Table 2), although these were still less when compared to 2016 (n = 59).

Figure 8. a) A Carp caught at Reedy Creek and b) a large, Short-finned eel caught at Jembaicumbene Creek.

Discussion

Mountain galaxias were by far the most dominant captures in the 2023 survey. Catch rates increased at all sites on Mulloon Creek in 2023. When compared to Starrs and Lintermans (2016) the number of Mountain galaxias captured in total had more than doubled in 2022 and then increased by almost seven fold and three fold in 2023 when compared to 2016 and 2022, respectively. The overall catch at the three reference sites has also increased in 2023. It's likely that two wet years has increased based flow providing greater refuge during warmer periods, as well as connectivity for Mountain galaxias to thrive in the catchment.

Abundance of Eastern gambusia varied across years. We suspect that this variation is somewhat attributable to water temperature at the time of sampling. The average water temperature across all sites was 8.93°C in 2022 which increased to almost double, 17.41°C, in 2023. The total fish captured in 2023 was still significantly less than 2016 where nearly 10-fold more gambusia were caught (Starrs and Lintermans 2016). Eastern gambusia generally prefer warmer water, with temperatures around 30°C ideal, though they are able to survive and even acclimate to temperatures as low as 5°C (Pyke 2005). However, metabolic rate and swimming speed (ability to capture prey) of Eastern gambusia was found to reduce exponentially at temperatures below 30°C (Wurtsbaugh and Cech Jr 1983, Cech *et al.* 1985). The survey in 2016 was undertaken from mid - late March when water temperatures were 15 – 20 °C and the survey in 2022 was late May and late June with water temperatures of 5 – 12 °C. Ideally, surveys would be conducted at similar times of year to remove any influence of season and water temperature. Unfortunately, heavy rain and associated high river flows prevented sampling at an earlier time in 2022 (Figure 9). Sampling in 2023 was undertaken in late March and early April with water temperatures ranging from 14 - 19°C so as to be more comparable to the 2016 survey. Flows at the time of sampling were back to base flows making it easier to wade through the water while backpack electrofishing and probably suited Eastern gambusia better as they prefer slower flowing habitats.

A total of two short-finned eels were captured in 2023. Both individuals were captured at Jembaicumbene Creek. No other eels were observed during the survey of the nine sites. Like the 2016 survey, Carp and Carp gudgeon were captured at Reedy Creek in 2023, however these two species were not detected in the 2022 survey.

Since the 2016 baseline survey, approximately 36 new leaky weirs have been installed along Mulloon Creek with a significant number proposed to be installed in the future (Figure 1). The results from the 2022 and 2023 surveys indicate that Mountain galaxias numbers have increased significantly and Eastern gambusia abundance has decreased significantly. This may be due to the two years of above average rainfall providing instream conditions more favourable to Mountain galaxias. Conversely higher water velocities and cooler water temperatures are generally unfavourable for Eastern gamsbusia, which is the likely driver

behind the changes in abundances between the three surveys. As climate swings back towards low flows and warmer temperatures, we recommend further monitoring be undertaken to determine if habitat changes associated with leaky weirs have resulted in lasting positive effects on the native fish community.

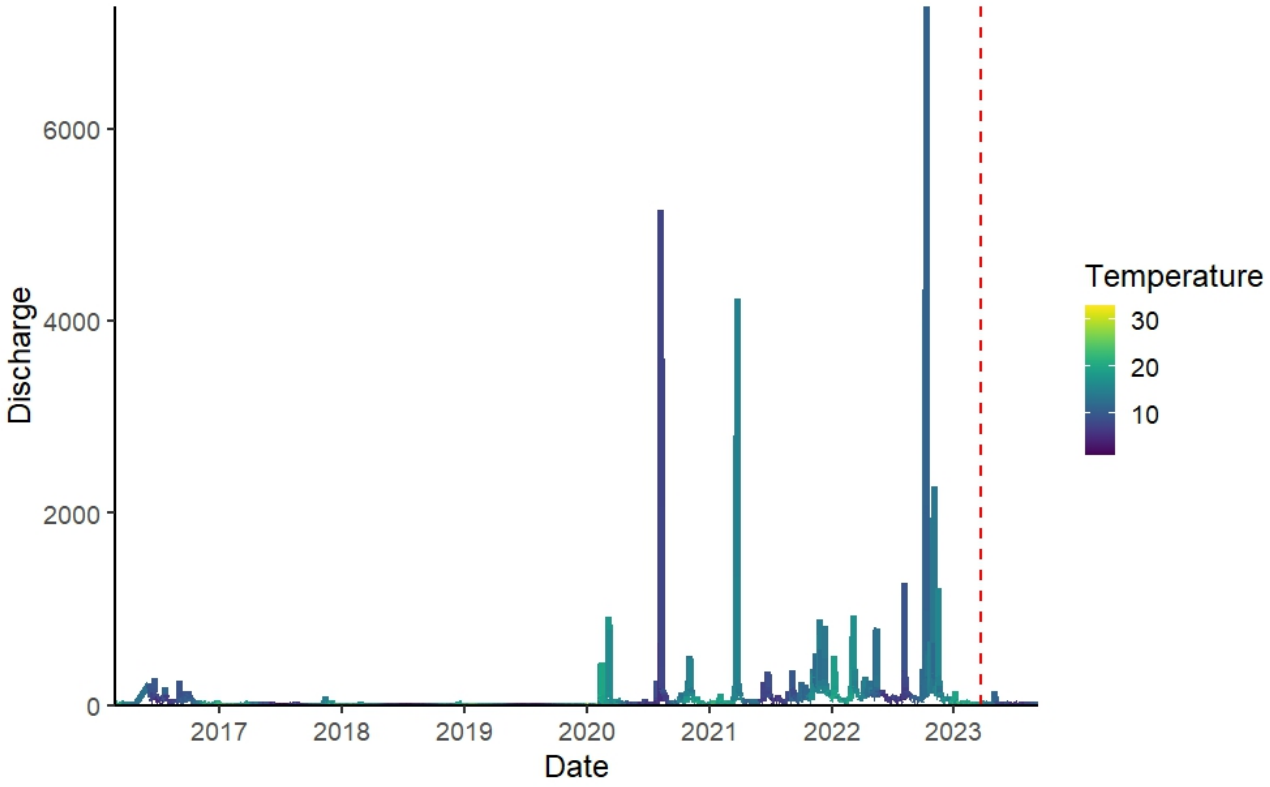

Figure 9. Daily discharge (ML/Day) and temperature of the Upper Mulloon Creek from March 2016 — September 2023.

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Appendix I

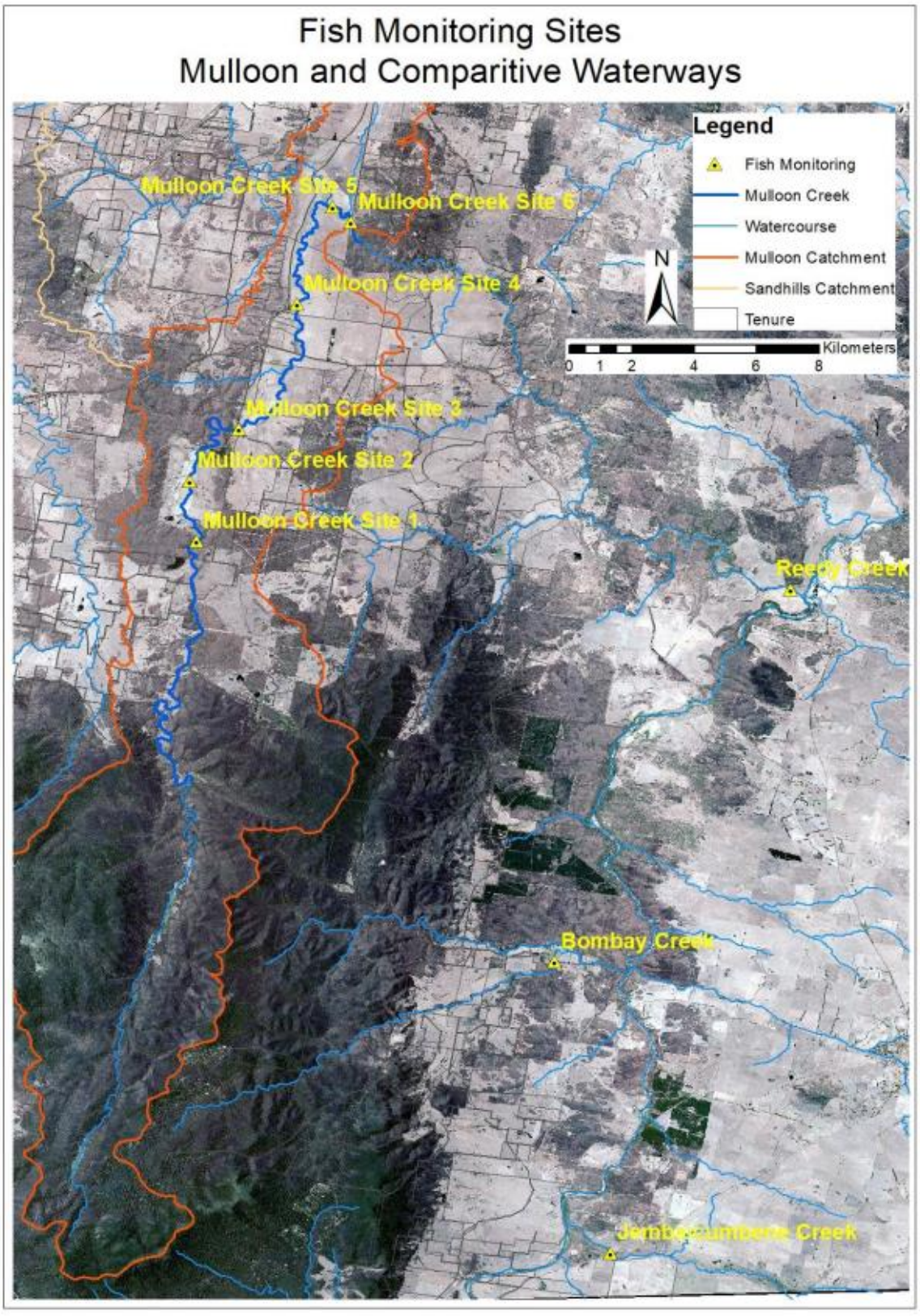

Figure 10. Map showing the reference sites in relation to the six Mulloon Creek sites

Mulloon Creek Site 1

Description: The upstream-most site sampled on Mulloon Creek. This site occurs at the downstream end of a large tract of gorge country. At this point the creek is in a deeply (~15-20m) incised channel. Blackberries are the dominant riparian vegetation along this reach. Stream consisted of long pools, and short riffle sequences. The creek was back to base flows at the time of sampling for all sites on Mulloon Creek.

Elevation: 745m asl

Stream Width: 2-5m wide

Average Stream Depth: 0.75-1m

Substrate Composition: Approximately 50% cobble, 25% sediment and 25% submerged vegetation. Small proportion was bedrock

Emergent Macrophytes: No significant emergent vegetation in this reach

Submergent Macrophytes: Considerable proportion contained submerged vegetation.

Other Structure: Large amounts of drowned timber and large boulders and bedrock structures.

Mulloon Creek Site 1.

Mulloon Creek Site 2

Description: The second site sampled on Mulloon Creek. This site occurs downstream of the homestead and is situated downstream of what was the first leaky weir in the system. It is now situated below an additional 10 leaky weirs since the first survey was conducted in 2016. The weir pool was sampled with the bait traps. Consisted of very long pools and runs, with very minimal riffle habitat. Willows are the dominant riparian vegetation. Considerable stands of tall emergent macrophytes present, and very dense submerged vegetation throughout this reach.

Elevation: 735m asl

Stream Width: ~3-5m wide

Average Stream Depth: 0.5-0.75m

Substrate Composition: Primarily sediment and submerged vegetation. Very small amounts of cobble, with proportionally more cobble in the upstream riffle section of this reach.

Emergent Macrophytes: Large stands greater than 2m wide. Height of the emergent vegetation is greater than 1m.

Submergent Macrophytes: Considerable proportion contained submerged vegetation. Often narrow channel in the middle that was not vegetated.

Other Structure: Minimal structure in-stream. At upstream end larger cobble and boulders were present.

Mulloon Creek Site 2.

Mulloon Creek Site 3

Description: The third site sampled on Mulloon Creek. This reach occurs on the downstream side of Mulloon Road. The bait traps were set in the large pool on the upstream side of the road crossing. This reach is wide with considerable shallow sections. Native vegetation dominates in this reach.

Elevation: 724m asl

Stream Width: ~5-10m wide

Average Stream Depth: 0.75-1m at the downstream end, but shallower (< 0.5m) closer to the road crossing.

Substrate Composition: Sediment, sand and cobble dominated in this reach. Some submerged vegetation in places, and predominantly cobble up near the road crossing.

Emergent Macrophytes: Emergent vegetation present along both banks of the pool on the upstream side of the crossing.

Submergent Macrophytes: Patchy throughout the reach.

Other Structure: Small amounts of wood debris in this reach.

Mulloon Creek Site 3.

Mulloon Creek Site 4

Description: The fourth site sampled on Mulloon Creek. This site is on the north side of the Kings Highway, off Hazeldell Road on Palarang crossing near homestead. The reach is immediately downstream of a leaky weir, with the bait traps set in the weir pool at the upstream end of the reach. This reach was wide and with moderate flow with very dense submerged vegetation in sections. Riparian zone greatly depleted, consisting of willows and blackberries where present.

Elevation: 701m asl

Stream Width: ~8-12m wide

Average Stream Depth: Varied between 0.5-1m at the downstream end, but shallower (< 0.5m) closer to the road crossing.

Substrate Composition: Sediment, cobble and sand dominated in this reach.

Emergent Macrophytes: Emergent macrophytes present along the edges below the weir and dense emergent macrophytes in the weir pool.

Submergent Macrophytes: Very dense in long strips ~ 2 m wide.

Other Structure: No meaningful additional structure found in this reach.

Mulloon Creek Site 4

Mulloon Creek Site 5

Description: The fifth site sampled on Mulloon Creek. This reach occurs near the confluence of Mulloon Creek and Sandhills Creek. The bait traps were set in a pool at the downstream end of the weir and upstream of the crossing. Willows, blackberries and large stands of emergent vegetation dominated the riparian zone.

Elevation: 698m asl

Stream Width: ~3-10m wide

Average Stream Depth: 0.5-1.2m.

Substrate Composition: Substrate highly variable. Cobble present in the previously riffle sections, while pools consisted of sediment, sand and submerged vegetation.

Emergent Macrophytes: Highly variable. Absent in some areas, and patchy in other places.

Submergent Macrophytes: Variable. Absent in places, and extensive in others. Larger pools that were deep tended to have cobble or sand substrates and minimal submerged vegetation.

Other Structure: Minimal large structure.

Mulloon Creek site 5.

Mulloon Creek Site 6

Description: The downstream-most site sampled on Mulloon Creek. This reach occurs downstream of the confluence of Mulloon Creek and Sandhills Creek. The bait traps were set in the pool where the water quality station is located at the downstream end of this reach. Willows, blackberries and large stands of emergent vegetation dominated the riparian zone.

Elevation: 694m asl

Stream Width: ~5-10m wide

Average Stream Depth: 0.75 to >1m.

Substrate Composition: Consisted primarily of silt, sand and cobble and submerged vegetation.

Emergent Macrophytes: Variable. Minimal in some areas where deeply incised banks occurred, and extensive (>2m wide) in places.

Submergent Macrophytes: Variable but generally extensive. Where present it was the dominant feature of the reach.

Other Structure: A few boulders and significant fallen trees present at the top end of this reach.

Mulloon Creek site 6.

Reedy Creek at Mayfield Road crossing

Description: This site occurs on the downstream side of the Mayfield Road crossing of Reedy Creek. This reach is heavily overgrown with native understorey, willows and blackberries. Channel is quite wide in places, but stream greatly restricted within this region. Flow was moderate at the time of sampling.

Elevation: 581m asl

Stream Width: ~5-10m wide

Average Stream Depth: 0.6 - >1m.

Substrate Composition: Consisted primarily of cobble, sand and sediment.

Emergent Macrophytes: Variable. Minimal in some areas where deeply incised banks occurred, and extensive (>2m wide) in places.

Submergent Macrophytes: Highly variable. Non-existent in places and patchy in other areas.

Other Structure: Large amounts of fallen timber in this reach.

Reedy Creek at Mayfield Road crossing.

Bombay Creek at Hoskinstown Road crossing

Description: This site occurs on the downstream side of the Hoskinstown Road crossing of Bombay Creek. This reach has a dense native and willow canopy.

Elevation: 663m asl

Stream Width: ~5-10m wide

Average Stream Depth: 0.75-1m

Substrate Composition: Primarily sediment, with small amounts of cobble and submerged vegetation.

Emergent Macrophytes: Small amounts of emergent vegetation, tending to be <1m wide, and <1m high.

Submergent Macrophytes: Tended to be minimal and made up primarily of clumps within the stream.

Other Structure: Large amounts of fallen timber in this reach.

Bombay Creek at Hoskinstown Road crossing.

Jembaicumbene Creek at Cooma Road crossing

Description: This site occurs on the downstream side of the Cooma Road crossing of Jembaicumbene Creek. The bait traps were set in the pool underneath the bridge and upstream of the bridge. This reach has a Willow canopy and numerous Willows instream and thick blackberry understorey.

Elevation: 655m asl

Stream Width: ~5-10m wide

Average Stream Depth: Deep, >1m.

Substrate Composition: Downstream end consisted primarily of sediment, while upstream end made up of sediment, cobble and submerged vegetation.

Emergent Macrophytes: Large patches on the edge of the upstream side of the bridge (>1m tall).

Submergent Macrophytes: Patches within the pools on the upstream side of the bridge.

Other Structure: Willow roots and trunks extensive in this reach.

Jembaicumbene Creek at Cooma Road crossing