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Lagoons Wetlands Fish Community Monitoring- Interim Report

April 2017
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Introduction

Between 2013 and 2016 Catchment Solutions assisted with the design and construction of a series of wetlands and fishways on Lagoons creek, Mackay. Funding for this work was provided by Reef Catchments Limited (RCL) in partnership with the Mackay Regional Council and Department of Transport & Main Roads. A component of the project requires monitoring changes in fish communities that result from the fisheries improvement works. Monitoring is an important component in such projects as it provides information that can be used for a number of purposes, including:

- Meeting requirements of offset funding.
- Assessment of wetland and fishway utilisation.
- Temporal comparison of wetland and fishway utilisation.
- Identification and quantification of the ecological benefits associated with the construction of wetlands and fishways.
- Comparison between different fishway designs used at similar stream and barrier types.
- Optimisation of future wetland and fishway designs.

The following document is an interim report and aims to present a summary results of pre wet-season fish community monitoring data conducted in December 2016, as well as fishway monitoring data obtained from sampling in February 2017. Detailed interpretation will be reserved until the completion of all sampling rounds.

Methods

Electrofishing

Fish community sampling was conducted on December 6th, 2016 at four sites within Lagoons creek. Electrofishing was conducted from a 3.7m vessel ('*Electrolyte*') operating a Smith-Root 2.5GPP electrofisher unit, equipped with a single boom arm, a six-dropper anode array and a hull cathode. Settings were adjusted based on electrical conductivity of the water on site to maximise the efficiency of electrofishing operations. A master and single dip-netter were employed during all sampling activities on *Electrolyte*.

Sampling was conducted at various depths and encompassed all types of instream habitats within the waterbody. The electrofishing methodology used was a combination of power on, power off for the duration of the sampling effort. The sampling effort consisted of a series of 300 second 'shots' where the boat was manoeuvred in and out from the banks as well as parallel to the shore in deeper water. The effective electric field of this unit was approximately 3m radius (centred on the anode). Fish positively identified during electrofishing operations but not captured were also recorded and contributed abundance and assemblage data in this report.

All fish captured during sampling were identified to species level, counted and measured to the nearest millimetre (fork length of forked-tail species, total length for all other species). If large numbers of a species were captured during a single event, a random subset of 50 fish were measured, with the remaining fish counted and contributing to abundance data only. After processing, all native fish were released within the reach or waterbody they were captured from. Pest fish species were euthanised as per Biosecurity Queensland legislation and ANZCCART procedures, and disposed of in an appropriate manner.

Fishway Trapping

Fishway sampling was conducted from the 1st – 10th, February 2017 at the Lagoons Creek rock ramp fishway. The fishway trap used for sampling consisted of a single cone entrance configuration, constructed from 8 mm round bar with shade cloth (4.0 mm mesh size) covering the frame. The trap dimensions were 1400 mm x 1000 mm x 1100 mm. Shade cloth wing walls prevented fish from swimming around the trap on either side, whilst sand bags and star pickets were used to secure the trap and wing walls in place (Figure 1). The fishway trap was positioned in the upper most pool of the fishway in order to capture fish that successfully ascended the rock ramp. Trap sets for periods of between 3- 19 hours before being retrieved.



Figure 1. Lagoons creek rock ramp fishway trap in place, sampling for fish ascending the fishway (left), and discoloured water entering the lower fishway from stormwater runoff during sampling (right).

Water Quality

Water quality parameters including temperature, pH, dissolved oxygen and conductivity were measured using an YSI – Pro Plus multiprobe. The water quality sampling method involved placing the probe into the water at a depth of 0.1m and waiting for the readings to stabilise for a short period of time. After stabilisation, values were recorded for each of the water quality parameters. Three replicates of water quality measurements were recorded from each site electrofished in December. Measurements during fishway trapping were taken from the top and bottom of the fishway at the commencement of each set.

Results and Discussion

Pre Wet-Season Fish Community

During electrofishing fish community assessments across the four sites within Lagoons Creek, a total of 4647 fish, representing 14 native and one introduced species were detected (Table 1). Midgley's carp gudgeon were the most abundant species, making up 49% of the total number of individual fish caught ($n=2282$), whilst flyspecked hardyhead, empire gudgeon, Agassiz's glassfish and eastern rainbowfish were also well represented in the data making up 14.8% ($n=688$), 11.25% ($n=523$), 9.66% ($n=449$) and 8.33% ($n=387$) respectively. Abundances of remaining species ranged from only single individuals surveyed (barramundi, Hyrtl's catfish and mouth almighty), through to 202 individuals detected of the introduced mosquitofish. Photos of several of the species recorded during monitoring are provided in Figure 2.



Figure 2. Several species recorded from Lagoons Creek during pre wet sampling in December 2016. Clockwise from top left - Barramundi, fork-tailed catfish, Hyrtl's catfish and tarpon.

Table 1. Fish species recorded during electrofishing of various sites within Lagoons creek.

Common Name	Species	Botanic Gardens 1		Botanic Gardens 2		Botanic Gardens 3		Racecourse Mill	
		Abundance	Size Range	Abundance	Size Range	Abundance	Size Range	Abundance	Size Range
Agassizis glassfish	<i>Ambassis agassizii</i>	37	24 - 59	32	25 - 55	141	20 - 47	239	27 - 60
Barramundi	<i>Lates calcarifer</i>	-	-	-	-	1	830	-	-
Bony bream	<i>Nematalosa erebi</i>	2	*	-	-	14	183 - 222	-	-
Eastern rainbowfish	<i>Melanotaenia splendida splendida</i>	7	31 - 70	12	65 - 74	263	22 - 86	105	62 - 92
Empire gudgeon	<i>Hypseleotris compressa</i>	-	-	2	65 - 76	521	37 - 78	-	-
Flyspecked hardyhead	<i>Craterocephalus stercusmuscarum</i>	42	25 - 70	42	45 - 75	353	34 - 68	251	35 - 93
Fork tailed catfish	<i>Arius graeffei</i>	1	*	-	-	1	395	-	-
Hyrtil's catfish	<i>Neosilurus hyrtlii</i>	-	-	1	205	-	-	-	-
Long-finned eel	<i>Anguilla reinhardtii</i>	-	-	-	-	10	*	50	*
Midgley's carp gudgeon	<i>Hypseleotris species 1</i>	1165	18 - 42	1091	15 - 30	2	24 - 39	24	22 - 37
Mosquito fish^	<i>Gambusia holbrooki</i>	14	20 - 30	11	23	105	18 - 32	72	18 - 38
Mouth almighty	<i>Glossamia aprion</i>	-	-	-	-	1	150	-	-
Sleepy cod	<i>Oxyeleotris lineolatus</i>	4	175	3	*	1	*	-	-
Spangled perch	<i>Leiopotherapon unicolor</i>	1	57	8	130 - 145	-	-	5	135 - 143
Tarpon	<i>Megalops cyprinoides</i>	-	-	7	187 - 240	6	170 - 240	-	-
	Total	1273	20 - 175	1209	15 - 240	1419	18 - 830	746	22 - 143

* Denotes observed fish that were not measured

^ Denotes introduced pest fish species

Catch per unit effort (CPUE) data shows a total average catch rate of 156.17 fish/minute surveyed over a total of 35.11 minutes of electrofishing across the four sites (Figure 2). Midgley’s carp gudgeon displayed the highest CPUE with an average catch rate of 107.54 fish/minute, due to the very high CPUE experienced for the species at the Botanic Gardens 1 (195.8 fish/minute) and Botanic Gardens 2 sites (232.13 fish/minute).

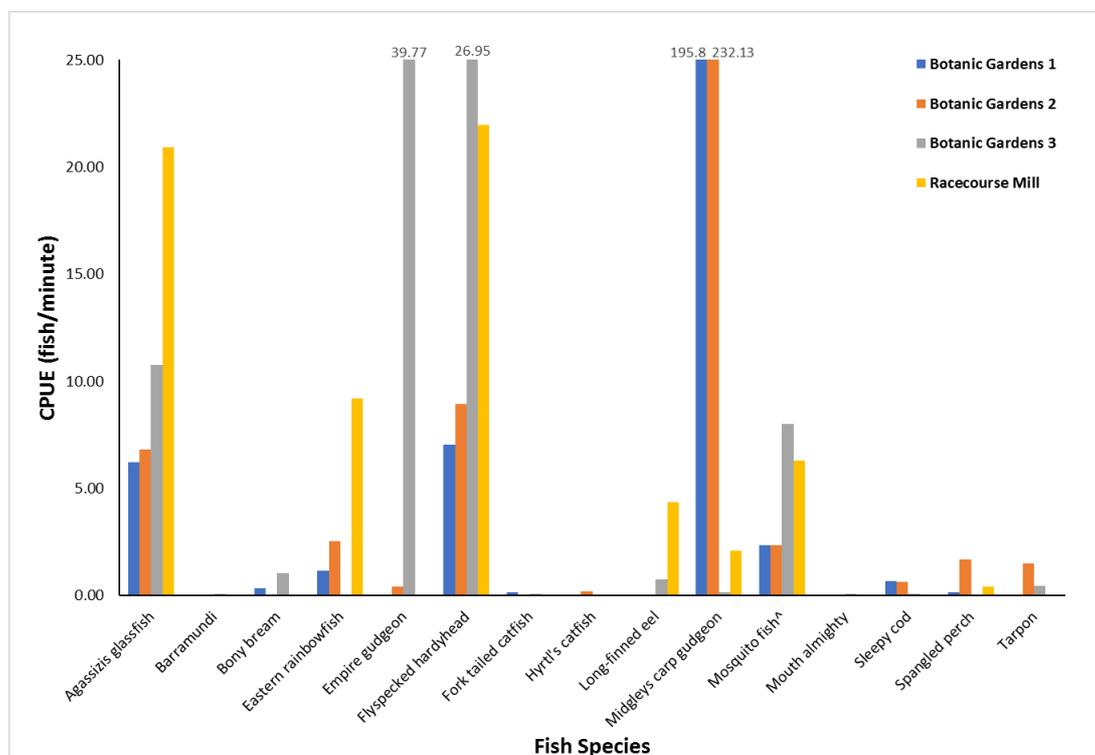


Figure 3. CPUE expressed in fish captured per minute for each species within the four electrofishing sites in Lagoons creek

Fish assemblages surveyed were typical of similar habitat sampled throughout the region. The three sites within the Botanic Gardens reach of the creek showed very similar species compositions between the sites, recording 9-14 species (Table 1). Racecourse Mill recorded 7 species which may be an indication that downstream barriers (culverts and weed choke) are preventing the movement of some species into this newly formed habitat.

Minimum and maximum readings from the fish community sites are provided in Table 2. Generally, results were typical of the habitat, time of day and season, and were all within acceptable levels for fish habitat. Of interest, the Racecourse Mill site recorded higher readings for all parameters with a temperature range of between 33.7-34.4°C, a slightly more alkaline pH range of between 8.97-9.26, higher electrical conductivity of between 395-416us/cm and higher dissolved oxygen saturation of 99.7-158% saturation. Oxygen readings within Botanic Gardens 3 also varied considerably (Table 2).

Table 2. Water quality ranges during electrofishing sampling at Lagoons creek

Site Name	Sample Date/ Time	Temperature °C	pH	EC us/cm	DO %sat
Botanic Gardens 1	06-12-16 9:35	27.3 - 28.3	7.75 - 8.39	176 - 179	25 - 52.9
Botanic Gardens 2	06-12-16 10:25	28.1 - 29.1	8.36 - 8.62	145 - 148	21.2 - 42.7
Botanic Gardens 3	06-12-16 12:30	26.6 - 30.3	7.07 - 7.72	266 - 310	8 - 82
Racecourse Mill	06-12-16 15:00	33.7 - 34.4	8.97 - 9.26	395 - 416	99.7 - 158

Water quality readings varied little between the sites and were typical of the seasonal conditions and habitat type. Racecourse Mill recorded noticeably higher readings for all parameters (Table 2). Temperature, pH and oxygen levels may be attributed to the time of day that samples were recorded and the elevated conductivity may be due to natural sources or possible discharge of treated water from the mill. Also of note was a low oxygen reading from one replicate site in Botanic Gardens 3. This sample was taken from a thick stand of weed in a heavily shaded area. Low oxygen levels are typical in these conditions where oxygen production of aquatic plants and diffusion from the atmosphere is low, and biological oxygen demand is high. While the other reading locations recorded higher oxygen levels, the presence of low oxygen pockets highlights the susceptibility of these types of habitats to critical depletion in oxygen levels. Fish kills have been recorded from this site in the past, with the most recent occurring in 2015.

Fishway Monitoring

During fishway a total of 1953 individual fish representing 12 native and two introduced species were recorded. In total, the fishway was sampled for 4.29 days (103 hours) with a total average of 453.23 fish/day caught. The most abundant species detected was the empire gudgeon which made up over 57% of the total catch (n=1118), and were captured at an average rate of 259.46 fish per day. Following this, the next most abundant species were bony bream (n=331), Midgley's carp gudgeon (n=154) and Agassiz's glassfish (n=152) with a catch per unit of 76.82, 35.74 and 35.27 fish/day respectively. Table 3 shows the abundance and size range of fish sizes that were recorded ascending the rock ramp. The smallest fish trapped was an 11mm empire gudgeon and the largest fish was a 410mm fork-tailed catfish.

Table 3. Fish species recorded during fishway monitoring of the Lagoons creek rock ramp fishway

Common Name	Species	Abundance	CPUE fish/day	Size Range
Agassizi's glassfish	<i>Ambassis agassizii</i>	152	35.27	22 - 55
Bony bream	<i>Nematalosa erebi</i>	331	76.82	30 - 155
Eastern rainbowfish	<i>Melanotaenia splendida splendida</i>	10	2.32	33 - 78
Empire gudgeon	<i>Hypseleotris compressa</i>	1118	259.46	11 - 79
Flyspecked hardyhead	<i>Craterocephalus stercusmuscarum</i>	6	1.39	29 - 48
Fork tailed catfish	<i>Arius graeffei</i>	50	11.60	230 - 410
Hyrtl's catfish	<i>Neosilurus hyrtlii</i>	1	0.23	125
Long-finned eel	<i>Anguilla reinhardtii</i>	2	0.46	270 - 280
Midgley's carp gudgeon	<i>Hypseleotris species 1</i>	154	35.74	15 - 35
Mosquito fish [^]	<i>Gambusia holbrooki</i>	53	12.30	19 - 32
Platy [^]	<i>Xiphophorus maculatus</i>	20	4.64	20 - 44
Rendahl's catfish	<i>Porochilus rendahli</i>	1	0.23	161
Spotted scat	<i>Scatophagus argus</i>	2	0.46	18 - 24
Tarpon	<i>Megalops cyprinoides</i>	53	12.30	28 - 110
	Total	1953	453.23/day	11 - 410

[^] Denotes introduced pest fish species

The size frequency distribution of empire gudgeon are provided in Figure 4. Samples comprised of a distinct juvenile size class – 70% of the catch being between 10-19 mm, while the size distributions for the remaining captures were more typical for a population of this species. The very high proportion of small fish in the captures suggests that the young-of-year were undertaking upstream migration into the wetland habitats. Larger fish that were recorded may be returning from spawning grounds lower in the system, or may be moving back upstream after being washed down during wet season flows.

Capturing high numbers of juvenile empire gudgeons and other small bodied fish during monitoring highlights the ability for small, weaker-swimming fish to ascend rock ramp fishways. In wetlands where barriers exist and fishway are not provided, the number of fish recruiting to upstream habitats will be impacted. Poor recruitment is likely to have flow on affects for higher order fish and bird species, and may also reduce the functionality of the wetlands.

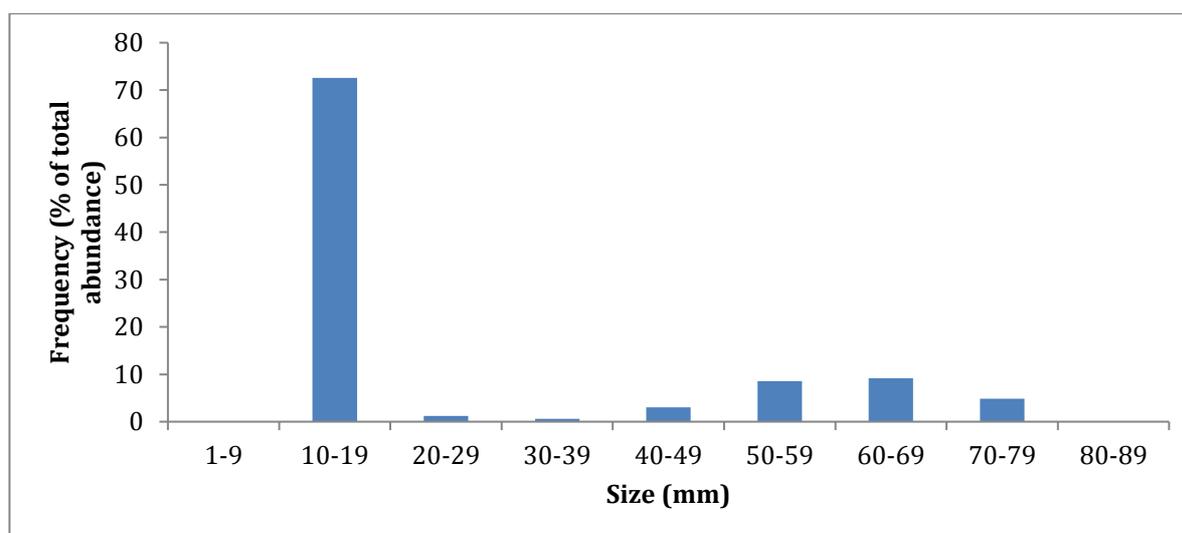


Figure 4. Histogram displaying size distribution frequency as a percentage of total abundance of all empire gudgeons, (*H. compressa*), measured in the fishway trap.

Although not well represented in the abundance and CPUE data compared to other species, the number of fork-tailed catfish caught ascending the fishway was the most experienced in recent fishway sampling efforts. 50 individual fork tailed catfish measuring between 230-410mm (fork length) were captured, which highlights the efficacy of this rock ramp in allowing successful upstream passage to large-bodied native fish. Furthermore, a large number of these fish were above the sexually mature size range (>285mm), and it is possible that these fish were undertaking a migration related to their spawning cycle.

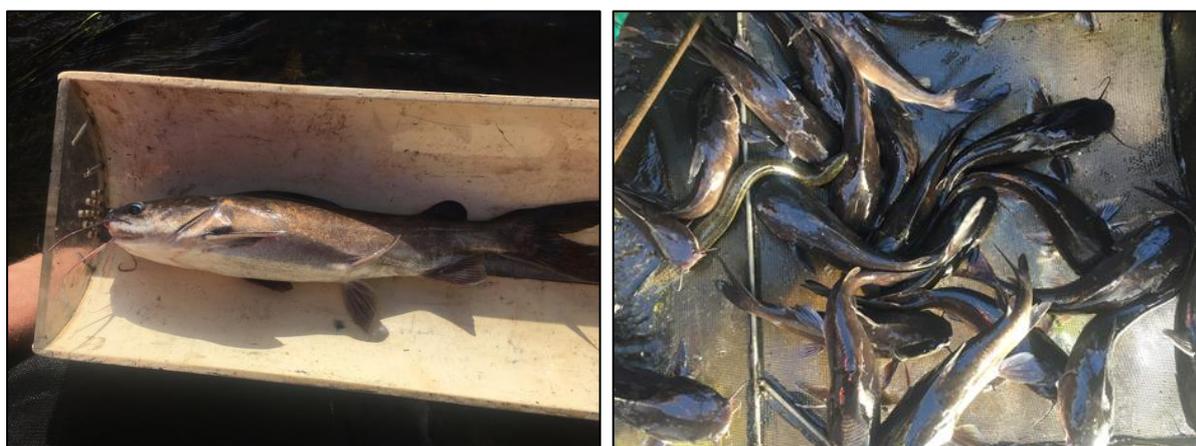


Figure 5. Fork-tailed catfish (*A. graeffei*) caught in the fishway trap after ascending the rock ramp.

Water quality readings recorded during fishway monitoring are provided in Table 4. The results obtained were typical of the habitat, time of day and season, and were all within acceptable levels for fish movement. Upstream of the fishway, parameters ranged between 28-31.5°C, pH 6.95-7.56, conductivity 104-126us/cm and dissolved oxygen saturation 11.3-45% saturation. Downstream of the fishway, parameters ranged between 28.1-31.4°C, pH 6.79-7.36, conductivity 102-127us/cm and dissolved oxygen saturation 12.3-44.9% saturation. Of interest, there is a consistent trend across each day of sampling with the downstream sites showing slightly lower readings for temperature, pH and electrical conductivity and slightly higher dissolved oxygen saturation. This is as expected, due to the turbulence and movement experienced as water flows down the fishway which increases oxygen saturation and can decrease water temperature, pH and conductivity.

Table 4. Water quality data upstream and downstream of fishway recorded whilst fishway trapping

Sample Date/ Time	Temperature °C		pH		EC us/cm		DO %sat	
	US	DS	US	DS	US	DS	US	DS
01-02-17 8:30	29.9	29.8	7.03	7.05	126	127	12.3	13.1
06-02-17 8:45	31.1	31	7	6.87	121	118	27.2	27.9
06-02-17 12:45	28.3	28.3	6.95	6.79	113	113	11.3	12.3
07-02-17 8:00	31.4	31.3	7.1	7	120	119	34.2	34.6
07-02-17 14:40	28	28.1	7.35	7.01	113.1	112.6	17.4	18.9
08-02-17 15:30	31.3	31.4	7.56	7.36	119.7	117.2	40.7	42
09-02-17 9:25	28.6	28.4	7.45	7.25	109.3	107.6	36.5	35.5
09-02-17 14:00	30.4	30.5	7.32	7.17	109.8	108	45	44.9
09-02-17 17:00	30.2	30.1	7.19	7.12	104	102	41.6	41.6
10-02-17 12:10	31.5	31.4	7.2	7.1	108.5	108.5	35.1	37

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