Status of the Currimundi Catchment Fish Community in 2015

Final Report

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Executive Summary

Pitman Research and Consulting was been commissioned by Sunshine Coast Regional Council to undertake a fish community assessment of the Currimundi catchment, located on the Sunshine Coast. The fish communities of Currimundi catchment had previously been assessed by Ray Leggett in 1993, 1997 and 2000 and previously by Pitman Research and Consulting in 2013. This survey will add to the previous data collected and provide comparable data that can be used as a future baseline the fish communities in the catchment.

Prior to its connection to Lake Kawana Currimundi Lake was considered an Intermittently Closed and Open Lake and Lagoon (ICOLL) where the entrance of the lake would have opened and closed depending on freshwater inflows and storm events. However, since 2005 Currimundi Lake has received pumped water from Lake Kawana, this increased flow has caused the entrance of the lake to be maintained as being permanently open. This has changed the water quality and habitat features in the lake causing it to become more marine dominated.

Ten estuarine sites were sampled in Currimundi Lake, revealing a total catch of 4,840 fish and two stingrays, this catch was represented by a total of 45 fish and a single stingray species. The general structure of the fish community was similar to the previous 2013 survey, with similar fish abundances and only slightly higher diversity of fish. The fish community was dominated by the same two species, the estuary perchlet (*Ambassis marianus*), and southern herring (*Herklotsichthys castelnaui*). However, there were large variations in presence and absence of large numbers of fish species compared to the previous survey in 2013. For example, 11 new fish species were recorded and 10 species were absent that were previously caught in 2013. This high variation in species occupancy is typical in estuarine systems, where a mix of freshwater species, habitat generalists, estuarine residents, offshore spawners and marine migrants mix together. The factors relating to the abundance and diversity of these groups of species are different, with estuarine species responding more to conditions within the lake and the marine species populations responding to processes outside the lake.

A total of 61 fish species have been recorded over all of the four surveys of Currimundi Lake (1993, 1997, 2000, 2013 and 2015). The diversity of fish species caught in the lake has increased consistently over the five surveys, with substantially more fish species caught in the previous two surveys compared to the others. It is highly likely that the observed increase in fish species diversity over time is likely to be related to an increase of entrance opening, which is changing habitat types present and caused the system to become more marine dominated. Studies conducted in NSW have also found that ICOLL's with more frequent marine connectance are likely to support more estuarine and coastal species and have higher fish diversity.

Pooled data from the two surveys (2013 and 2015) show that there are significant differences in the fish community structure between the creek sites and the river and canal sites. This difference was caused by greater fish diversity in the canal and lake sites (49 species) compared to the creek sites (17 species). In addition, eleven fish species had greater mean abundances in the creek sites, while 14 had greater abundances in the creek and canal sites. The differences in fish community between the different habitats in the lake may be explained by differences in water quality and habitat between the two areas.

A total of 814 individual fish were caught during the current surveys of two freshwater sampling sites. These fish represented ten native freshwater fish and two introduced species, the mosquitofish

(*Gambusia holbrooki*) and platy (*Xiphophorus maculatus*). Sampling revealed that three species of freshwater fish are not present that were consistently found in historical surveys, including Australian smelt (*Retropinna semoni*), crimson spotted rainbowfish (*Melanotaenia duboulayi*) and freshwater mullet (*Myxus petardi*). The loss of these species from the Currimundi Catchment suggests that the freshwater environments may have become unsuitable for those species since they were last recorded in 2000. Increases in salinity in the upper areas of the lake may have caused these habitats to be unsuitable for recruitment and persistence of these species.

Sampling below the Kawana Forest Wetland on the Currimundi Creek north arm revealed that the stormwater wetland has been constructed on the main creek channel and forms a barrier to fish passage. The outlet structure consists of a small pipe approximately 200mm wide and at the time of sampling approximately 10,000 juvenile empire gudgeons (10-15mm long) were congregating below it. It would be beneficial to fish passage if an open rocked drain was continued to the wetland outlet structure instead of a pipe.

This study recorded the presence of two juvenile (29mm and 34mm) jungle perch (*Kuhlia rupestris*), with one being caught in both the Currimundi Creek south and north arms. Over the last three decades numbers of jungle perch have been declining and recent surveys have revealed that major populations are now restricted to the wet tropics and only a small number of remnant groups exist south of Townsville. Riparian clearing, habitat degradation, pest fish and barriers to fish passage are the likely causes of reductions to the species. In particular, the species is sensitive to waterway barriers, as adults live in freshwater and spawn in the sea. Free passage from estuaries to freshwater reaches is required by juveniles returning to colonise new habitats.

Recommendations

This study adds considerable understanding of the fish communities present within Currimundi Lake. The following recommendations have been made based on the findings of this report.

- Additional long term annual monitoring of the Currimundi catchment would provide an on-going assessment of the status of the fish community and the health of the ecosystem.

- Periodic mapping of mangrove and seagrass habitats would also inform how the lake habitats may be changing in response to lake openings and general ecological condition.

- It is recommended that any future assessments of the catchment include areas which have not been surveyed previously. For example, Lake Kawana has never been surveyed for fish and additional survey sites would provide a benchmark of the ecological condition of this area.

- Intermittently Closed and Open Lake and Lagoons in south eastern QLD remain an understudied habitat type in sub-tropical Australia, with little or no available information on the fish communities of these systems on the sunshine coast. Baseline assessments of other ICOLL systems on the sunshine coast is recommended to build a greater understanding of the communities in these systems, so they can be adequately understood and managed.

1. Introduction

Pitman Research and Consulting (PRC) have been commissioned by the Sunshine Coast Regional Council (SCRC) to undertake a fish assessment of the Currimundi catchment. This study will focus on both the freshwater and estuarine reaches of the catchment; provide a brief report on the results and any future recommendations arising from the study.

The Currimundi catchment has previously been surveyed in 2013 (Pitman *et al.* 2013) and three times by Ray Leggett in 1993, 1997, and 2000. These surveys provided a brief but insightful study of the fish communities, invertebrate, and aquatic habitats of the catchment. This current study will be undertaken at the same sites and same time of year as the 2013 survey. This will provide a comparable data set that can be used as a future baseline the fish communities of the Currimundi catchment.

This project was performed with the assistance of the Currimundi Catchment Care Group Volunteers, staff from the Sunshine Coast Regional Council and the local member Jarrod Bleijie. Over a five day period (13th April to the 17th April, 2015) 12 sites were surveyed. The project had local WIN and 7 news coverage, and was also featured in Caloundra Weekly, Currimundi Lake Catchment News and CCCG's website.

1.2 Current conditions

The Currimundi catchment is small and highly urbanised with an overall length of 8 kilometres in the east-west direction, covering an area of approximately 40 square kilometres. The catchment is bordered by the Mooloolah River to the north and west and Little Mountain to the south. Development in the catchment in the 1980s and 1990s has seen the construction of three canals (Baroona, Pangali and Tokara canal) that now form part of the tidal waterway of the Lake (Tomlinson *et al.* 2010). Lake Kawana has also been constructed in the upper section of the catchment.

The building of Lake Kawana has substantially changed the charactertics of Currimundi Lake. Lake Kawana has stable water levels maintained by a weir set at 0.6m AHD. Flushing of the lake is maintained by pumping estuarine water from the Mooloolah River into the lake. Prior to its connection to Lake Kawana in 2005 Currimundi Lake was considered an Intermittently Closed and Open Lake and Lagoon (ICOLL) where the entrance of the lake would have opened and closed depending on freshwater inflows and storm events. However, Currimundi Lake now receives pumped discharge of water from Lake Kawana; this increased flow has caused the entrance of the lake to be maintained as being permanently open. The exception to this would be if the entrance of the lake was artificially closed to manage the biting midge problem. With the current nearly closed entrance conditions the lake receives a tidal variation of around 0.3m.

The permanent opening of Currimundi Lake has influenced the water quality and habitat conditions within the lake. This is clearly shown by the consistent high salinity readings throughout the lake and the emergence of habitat features that would more typically be found in estuarine systems including mangroves and seagrass beds. The historical surveys undertaken by Leggett (1993, 1997 and 2000) were during the period when the lake opened and closed. During two of his surveys (1993 and 2000) he commented that the lake was open which accounted for the "would account for the good range of saltwater fish species caught" (Leggett 1993). Any extended period of opening will provide opportunities for the larvae and juveniles of marine and estuarine fish to enter Currimundi Lake.

1.2 Aims and objectives

The overall aim of this study was to undertake a fish assessment of the freshwater and estuarine reaches of Currimundi catchment. This information will characterise the current state of the system and how it may have changed since previous assessments.

The specific objectives of the study were to;

- Repeat all the sampling sites with a replicated sampling methodology, record water quality and habitat features.

- The study also aimed to document any habitat changes and provide any recommendations arising from the study.

2. Methods

2.1 Approach

The sampling approach used in this study is a replicate of the survey undertaken in 2013 (Pitman *et al*. 2013). However, one additional estuarine site was added to the survey (in Currimundi Creek north arm) and only two freshwater sites were sampled, one each in Currimundi Creek north and south arms just above the tidal limit.

The locations of the majority of the survey sites are based on those used in historical surveys undertaken by Ray Leggett (Leggett 1993, 1997, and 2000). These old surveys used a combination of scoop, seine and gill nets. However, the reports lacked any detail of fish abundance data, methodology, net dimensions and specific use of each gear type. Therefore it was impossible to replicate the previous surveys. Despite these limitations, the species lists from these studies will be used as a comparison to the current study.

The sampling regime used in this study in both freshwater and estuarine environments was designed to collect a representative sample of the fish community, using a standardised sampling protocol. This enables all sites to be directly comparable so that any differences between sites can be clearly demonstrated. This approach will also allow direct comparisons with any future fish surveys undertaken in the catchment.

Standardisation will be achieved through a number of means; firstly, sites will be selected where the fish sampling gear will have similar effectiveness. Secondly, the same gear types and effort will be used at all sites. However, different gear types will be used for the freshwater creek and the estuarine sampling sites, accordingly these different habitats are analysed separately.

2.2 Fish sampling

Different approaches were used to effectively sample the different aquatic environments present in the Currimundi catchment. These are outlined in the following sections. This project was undertaken under General Fisheries Permit number 152671 and animal ethics approval CA 2012/01/579.

2.2.1 Estuarine fish sampling

Seine nets were used in this study, as they are very effective at sampling estuarine fish communities and are also non-destructive so that fish can be released unharmed (Morton 1989 and 1992; Gray *et al.* 1996; Pillans *et al.* 2007; Waltham and Connelly 2007). Two different sized nets were used in each site to adequately capture a wide variety of fish species and fish sizes. At each site a standardised sampling approach was used so that any differences in the composition of fish communities between sites could clearly be demonstrated.

To obtain a representative sample of larger bodied fish, a single shot of a large pocket seine net (80m by 4m by 32mm) was used. A single shot involved running the net out from the bank in a semicircle with a boat and slowly pulling it in. The net has a pocket that is designed to trap fish as the net is pulled in. Once the net is retrieved, all fish were transferred immediately into large tubs that contained aerated water. This large net was used in seven of the estuary sites, where there was sufficient room to utilise it effectively. In two of the three Currimundi creek sites (north and south arm) a medium seine net was used (30m by 2m by 32mm) due to the limited area preventing the use of the larger net. Two shots of this net were performed to account for the smaller size of this gear type.

To effectively sample smaller fish, a small pocket seine net (8m by 1.5m by 2mm) was used. At each site two 8-10m hauls were made through representative habitat. This net was used in all estuarine sites and the catches from the two nets were pooled to represent these fish communities. All fish species were identified using Kuiter (1996), Allen (1997), Hutchinson and Swainson (1986) and McDowall (1996).

2.2.2 Sampling freshwater fish

The freshwater sampling methods used in the survey followed those methods utilised in the Ecosystem Health Monitoring Program (EHMP) as they have been tested for their effectiveness in river health assessments in Queensland waters (Kennard *et al*. 2001).

This methodology uses a combination of backpack electrofishing and, where possible, seine netting. Backpack electrofishing is commonly used during freshwater stream sampling due to its ability to effectively sample complex structures, aquatic vegetation, and depths of less than 0.5m (Dauble and Gray 1980; Vadas and Orth 1993). Electrofishing is an extremely effective way to capture and study freshwater fish populations and has been used in Australia for over 40 years (NSW Fisheries 1997). Electrofishing works by the creation of an electric field in the water, to which fish respond by some form of immobilisation, making them easy to capture. Seine netting was not considered suitable for use in either of the two freshwater sites of this study.

Where possible an entire pool, riffle run sequence is sampled, incorporating as much hydraulic and habitat diversity as possible. If only one hydraulic unit is present then two or three habitat units are sampled. This usually equates to 75m to 100m of stream length (EHMP 2004). At each site 800 seconds of on-time power was used to standardise the effort between sites. All fish species were identified using Kuiter (1996), Allen (1997), Allen *et al.* (2002); Hutchinson and Swainson (1986) and McDowall (1996).

2.2.3 Water quality

Water quality was measured at both surface and bottom levels of the water at each site using a council supplied Hydrolab MS5 multi-probe meter. The water quality parameters recorded included temperature (℃), pH, dissolved oxygen (mg/L), turbidity (NTU), and conductivity (mS/cm).

2.3 Study sites

This survey consisted of ten estuarine sites and two freshwater sites. The locational data of the 12 study sites is shown below in Table 1. The specific locations of sites were selected so that they corresponded with the locations of the sites previously surveyed by Leggett (1993, 1997 and 2000) and Pitman (2013). Photos of each site can be seen in Plate 1 and maps of the estuarine and freshwater sites are shown in Figures 1.

Table 1. Site location and description.

Site	Habitat	GPS location	Location Description
1	Estuarine lake	26°45'52.36'' S 153°07'48.29'' E	Southern bank of Currimundi Lake, 100m east of Westaway Parade boat ramp, opposite Alice Street, Currimundi.
2	Estuarine lake	26°45'56.93'' S 153°07'23.03'' E	Southern bank of Currimundi Lake, 200m east of Nicklin Way, opposite storm water drainage area known as 'Oyster Creek.
3	Estuarine lake	26°45'55.73'' S 153°07'15.07'' E	Southern bank of Currimundi Lake, 100m west of Nicklin Way opposite Currimundi Villas.
4	Estuarine creek	26°45'56.38'' S 153°06'57.28'' E	Currimundi Creek south arm, 20m downstream from Creekside Boulevard Bridge, along eastern bank.
5	Estuarine creek	26°45'53.72'' S 153°06'30.52'' E	Upper reaches of Currimundi Creek south arm, both west and eastern bank, 20m downstream from fork (right arm Kawana Way left arm Halcyon Park).
6	Estuarine canal	26°45'37.77'' S 153°07'00.29'' E	Eastern bank of Pangali Canal, 20m north of the pontoon at Noel Burns Park.
7	Estuarine creek	26°45'28.66'' S 153°06'54.62'' E	Northern bank of Currimundi Creek north arm, 200m from the junction with Pangali Canal.
8	Estuarine canal	26°45'34.86'' S 153°07'20.54'' E	Eastern bank of Baroona Canal, 80m from the end.
9	Estuarine canal	26°45'20.13'' S 153°07'56.33'' E	Eastern bank of Tokara Canal, at the un-named park.
10	Estuarine creek	26°45'17.02'' S 153°07'35.50 E	Currimundi Lake north arm. 100m above the Kawana way crossing.
11	Freshwater Creek	26°45'50.50'' S 153°07'59.92''	Currimundi Lake south arm. Just above culverts at the northern side of Meridan Way overpass of Kawana Way.
12	Freshwater Creek	E26° 45' 49.90" S 153° 5' 58.70" E	Currimundi lake north arm. Just above tidal limit above and below the Kawana Wetland stormwater treatment device.

SITE 1

SITE 2

SITE 3


SITE 4


SITE 5


SITE 6


SITE 7


SITE 8


SITE 9

PLATE 1. Sampling sites in the Lake, Creek, canal and freshwater habitats of Currimundi Lake.

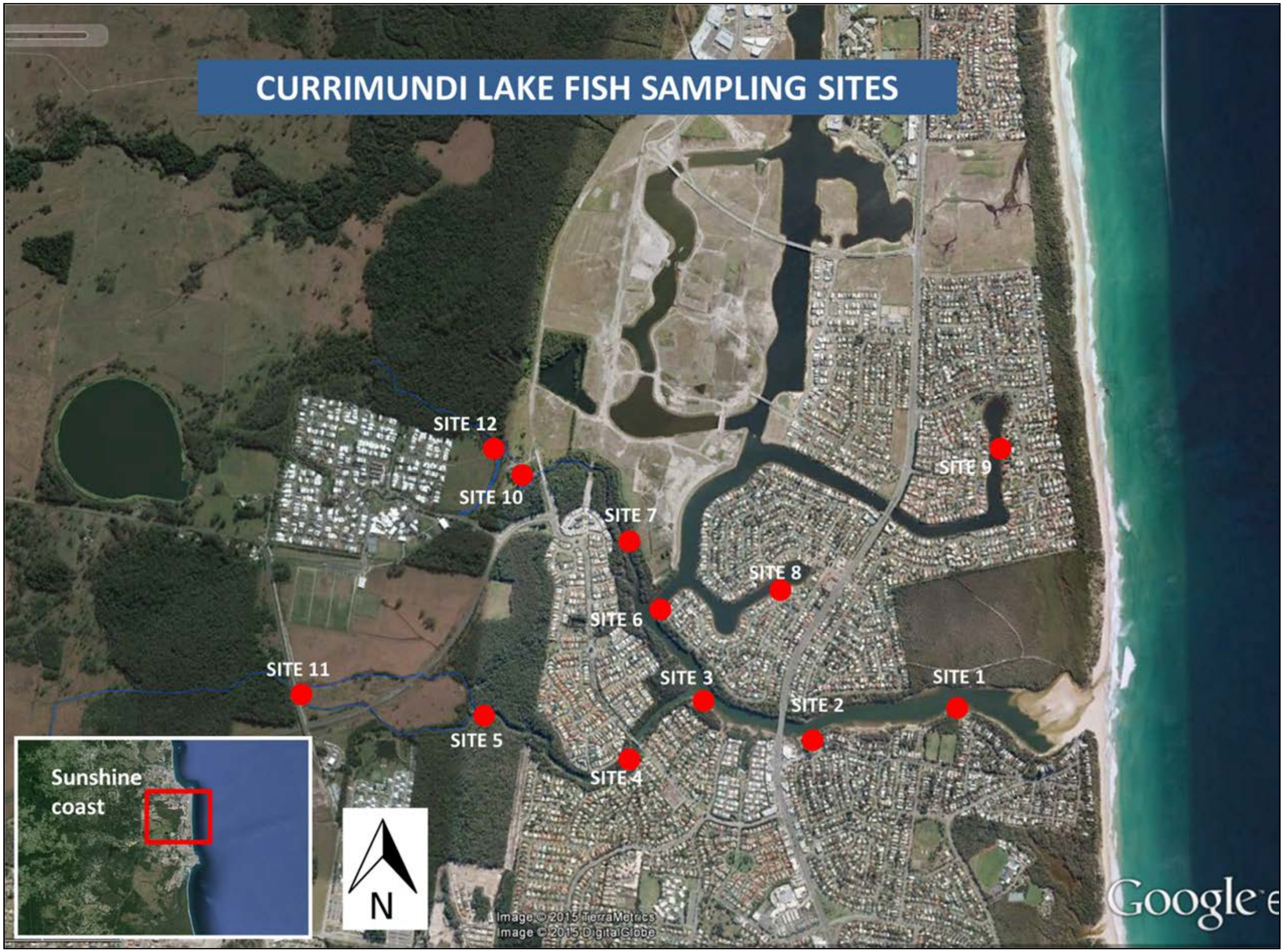

Figure 1. Study sites located in Currimundi Lake.

2.4 Data Analysis

In order to examine trends in fish assemblage composition, multivariate statistics were used to identify differences in fish abundance and the presence or absence of fish species between sites and also between the current and historical surveys. All statistical analysis was undertaken using PRIMER v6 (Plymouth Routines in Multivariate Ecological Research). All statistical routines were as advised by Clarke and Warwick (2001) and following Clarke and Gorley (2006).

Ordination by non-metric multidimensional scaling (nMDS), and hierarchical clustering analysis, using Bray–Curtis similarity between the total abundances of each species at each site was carried out using PRIMER v6 (Plymouth Routines in Multivariate Ecological Research).

Differences in the composition of fish assemblages (i.e. the abundance and type of taxa present) were then compared between the sites using Analysis of Similarity (ANOSIM). The taxa contributing most to any of the differences were compared using the Similarity Percentages (SIMPER) routine in PRIMER (Clarke 1993).

3. Results

3.1 Site Characteristics

The site characteristics of each of the ten estuarine and two freshwater study sites are provided in Table 2. The sites located towards the entrance of the lake were the widest (70-100m) followed by the canals (65-70m) and creeks which were much smaller (10-35m). The depth of the estuarine sites show that the majority of the sites had deep water that ranged between 1.1 and 4.5 metres. The majority of the sites lacked large shallow intertidal sand flats, except sites one and three which had larger areas of shallow habitat nearby (Table 2).

Seagrass habitat was only found at the entrance of the system in sites one and two. A small patch (approximately 5m by 8m) of very sparse seagrass was present within site 1, while two small patches (approximately 4m by 2m) were present near site 2. Several other small patches were also observed within 1200m of the lakes entrance. The seagrass was not identified but it was likely to be *Zostera sp.* Seagrass coverage and density was less than previously found in 2013.

The creek sites all had mud banks while all other sites had sandy intertidal areas. The in-stream sediment was very soft and silty at the majority of sites. Coffee rock was evident throughout the system, and prevalent as habitat in several sites (Table 2).

Mangroves are not common in Currimundi Lake, but seem to be actively colonising some areas of Currimundi Lake. There are some areas of more established grey mangroves (*Avicennia marina*) in sites two and three. There are also small stands of juvenile red mangroves (*Rhizophora stylosa*) present along the banks especially in Currimundi Creek north Arm (PLATE 2). The numbers of juvenile mangroves seems to have increased in the north arm since 2013.

Table 2. Site characteristics of the 12 survey sites in currimundi catchment. Depths recorded in the estuarine sites are at high tide. (L) refers to lake site, (Ck) refers to creek site and (Can) refers to canal site.

Site features	Estuarine sites										Fresh sites	
	1	2	3	4	5	6	7	8	9	10	11	12
	L	L	L	Ck	Ck	Can	Ck	Can	Can	Ck		
Mean Depth (m)	1.2	1.8	1.0	1.5	1.2	1.5	1.0	1.9	1.5	0.8	0.8	0.7
Max Depth (m)	2.1	2.6	2.2	2.1	1.7	4.5	1.8	3.1	2.4	1.1	1.2	1.2
Wetted width	100	70	85	35	30	60	30	65	75	10	15	12
Seagrass habitat (%)	5	2	0	0	0	0	0	0	0	0	n/a	n/a
Rocky habitat (%)	10	0	0	10	10	0	10	0	0	30	n/a	n/a
Mangrove bank (%)	0	5	5	0	0	0	15	0	0	5	n/a	n/a
Saltmarsh (%)	0	5	10	0	0	0	0	0	0	0	n/a	n/a
Intertidal beach (%)	100	100	100	0	0	100	0	100	100	0	n/a	n/a
Mud bank (%)	0	0	0	100	100	0	100	0	0	100	n/a	n/a

PLATE 2. Red mangrove colonisers near site three in Currimundi Lake.

3.2 Water Quality

The water quality data from the survey is presented in Table 3. All of the Currimundi Lake sampling sites had high conductivity readings, ranging from nearly full marine (53.3 mS or 35 ppt) at the entrance of the lake to three quarters marine (42.9 – 41.8 mS or 27-28 ppt) at the freshwater estuarine interface, of both of the Currimundi Creek south and north arms (Table 3).

Table 3. Water quality readings from the 12 survey sites for each sampling event. In site 12 two readings were taken below (a) and above (b) the stormwater wetland. Only a single reading was collected in sites 10-12.

Site	DO (% sat)		pH		Conductivity (mS/cm)		Temp (°C)		Turbidity (NTU)	
	top	*bottom*	*top*	*bottom*	*top*	*bottom*	*top*	*bottom*	*top*	*bottom*
1	98.9	108.3	8.2	8.4	48.5	53.3	26.3	24.8	4.1	7.5
2	95.8	98.6	8.3	8.4	47.7	53.3	26.6	24.5	16.5	18.9
3	87.2	94.6	8.3	8.4	48.1	52.8	25.1	24.0	11.6	12.6
4	84.2	81.7	8.1	8.3	47.9	52.4	27.4	25.3	12.0	15.7
5	47.1	51.1	7.7	8.1	49.3	52.2	27.6	25.9	8.0	10.2
6	98.5	94.2	8.2	8.4	45.0	51.8	26.2	25.3	16.8	20.6
7	105.7	81.0	8.1	8.3	44.1	51.3	26.8	26.2	12.4	11.5
8	101.5	82.1	8.2	8.3	48.7	51.8	24.9	25.5	12.3	9.4
9	100.3	78.8	8.1	8.3	42.9	51.6	25.4	25.2	12.0	15.7
10	45.3		7.1		41.8		28.0		15.5	
11	15.9		6.5		0.156		20.4		8.0	
12a	32.2		6.9		0.244		23.2		10.5	
12b	4.7		7.0		0.243		21.5		13.0	

All of the estuarine survey sites showed stratification of water quality. This included stratification of conductivity with marine water present on the bottom and freshwater water on the surface (Table 3). Stratification of dissolved oxygen was also evident in many of the sampling sites, with sites one to three and five had higher dissolved oxygen on the bottom while the remaining sites had lower dissolved oxygen on the bottom of the water column (Table 3). The upper Currimundi creek south and north arm sites and the freshwater sites had low dissolved oxygen levels.

3.3 Estuarine fish survey results

A total of 4,840 fish and two stingrays were captured during the survey of the ten study sites in Currimundi Lake, creeks and canals (Table 4). This fish catch was represented by a total of 45 fish species and a single stingray species (Table 4). A single jungle perch (*Kuhlia rupestris*) was collected in site 10 on the Currimundi Creek north arm, this species is rare in southern QLD. It was once found all down the Queensland coast now restricted to isolated pockets north of Townsville and on Frazer Island.

The fish fauna of the Currimundi estuarine sites was dominated by two species, the estuary perchlet (*Ambassis marianus*), and southern herring (*Herklotsichthys castelnaui).* These two species accounted for 70% of the total fish catch for all estuarine sites (Table 4). The other fish species that were reasonably abundant included tiger mullet (*Liza argentea*) with 8.2% of the total catch and common silver belly (*Gerres subfasciatus*) with 3.8% of total catch, common pony fish (*Leiognathus fasciatus*) with 3.3% of total catch and pacific blue eye (*Pseudomugil signifer*) with 2.3% of total catch (Table 4).

Many of the species encountered in the survey were present in low abundance. For example, 21 of the 46 species were represented by less than ten individuals (Table 4). Ninety three percent or 4,510 of the total catch were accounted for by nine species (Table 4). Of the 46 fish species encountered within Currimundi Lake, creeks and canals, 24 of these are considered to have economic importance, this represents over half (52%) of the fish species and individuals (2,489 fish) caught (Table 4).

3.4 Estuarine fish community structure

To gain a better understanding of how fish communities varied between sites, ordination with non-metric multidimensional scaling (nMDS) and hierarchical clustering analysis using Bray–Curtis similarity was used. Firstly a cluster analysis was performed (refer to Figure 2) and this was over laid on an nMDS plot of the fish community data in each site (Figure 3).

The analysis revealed some broad site structure with the habitat type of each site (Lake, creek and canal) explaining some of the differences (Figures 2 and 3). The most obvious was the separation of the creek sites from the lake and canal sites, with site 10 having a very different fish community to the other sites. It also showed a high similarity of lake sites (sites one, two and three) and a loose grouping of canal sites (sites six, eight and nine) (Figures 2 and 3).

Table 4. Fish fauna from the ten estuarine sampling sites. The species marked with an (*) are economically important.

FAMILY *Species Name*	Common Name	Fish catch	No. Sites	Proportion of total
AMBASSIDAE				
Ambassis marianus	Estuary perchlet	1905	8	39.3
CARANGIDAE				
*Caranx ignobilis**	Giant trevally	2	2	0.04
*Carangoides ferdau**	Banded trevally	5	1	0.1
*Caranx sexfasciatus**	Big eye trevally	10	4	0.2
*Scomberoides tol**	Needleskin Queenfish	9	5	0.2
CHANIDAE				
*Chanos chanos**	Milkfish	10	3	0.2
CLUPEIDAE				
*Herklotsichthys castelnaui**	Southern herring	1489	7	30.8
DASYATIDAE				
Pastinachus sephen	Cowtail stingray	2	2	0.04
DINOLESTIDAE				
*Sphyraena obtusata**	Striped seapike	1	1	0.02
*Sphyraena barracuda**	Giant Barracuda	1	1	0.02
ELEOTRIDAE				
Hypseleotris compressa	Empire gudgeon	20	2	0.4
GERREIDAE				
*Gerres subfasciatus**	Common silver belly	282	9	5.8
Gerres filamentosus	Threadfin biddy	3	2	0.1
GOBIIDAE				
Butis Butis	Crimson-tipped gudgeon	3	3	0.1
Favonigobius exquisitus	Exquisite sand-goby	5	3	0.1
Mugilogobius platynotus	Mangrove goby	4	2	0.1
Periophthalmus gracilis	Slender mudskipper	23	3	0.5
Pseudogobius sp. 9	Blue spot goby	33	2	0.7
Psammogobius biocellatus	Sleepy goby	3	2	0.1
Yongeichthys nebulosus	Shadow goby	1	1	0.0
HAEMULIDAE				
*Pomadasys kaakan**	Grunter	3	2	0.1
HEMIRAMPHIDAE				
*Arrhamphus sclerolepis**	Snub nosed garfish	16	5	0.3
*Hyporhamphus regularis**	River garfish	4	1	0.1
PLATYCEPHALIDAE				
*Platycephalus fuscus**	Dusky flathead	2	2	0.04
POECILIIDAE				
Gambusia holbrooki	Mosquitofish	17	2	0.4
PSEUDOMUGILIDAE				
Pseudomugil signifer	Pacific blue eye	110	4	2.3
LEIOGNATHIDAE				
Leiognathus fasciatus	Common pony fish	159	5	3.3
LETHRINIDAE				
*Lethrinus laticaudus**	Grass emperor	1	1	0.02
LUTJANIDAE				
*Lutjanus argentimaculatus**	Mangrove jack	12	4	0.2
*Lutjanus russellii**	Moses perch	13	3	0.3
MONODACTYLIDAE				

FAMILY *Species Name*	Common Name	Fish catch	No. Sites	Proportion of total
Monodactylus argenteus	Silver batfish	9	5	0.2
MUGILIDAE				
*Liza argentea**	Tiger mullet	396	8	8.2
*Liza subviridus**	Greenback mullet	57	6	1.2
*Mugil cephalus**	Sea mullet	57	8	1.2
SIGANIDAE				
Siganus fuscescens	Happy moment	3	1	0.1
SILLAGINIDAE				
*Sillago ciliata**	Sand whiting	28	6	0.6
*Sillago maculata**	Trumpeter whiting	33	5	0.7
SPARIDAE				
*Acanthopagrus australis**	Bream	55	7	1.1
Rhabdosargus sarba	Tarwhine	2	2	0.04
TETRAODONTIDAE				
Tetractenos hamiltoni	Common toadfish	32	8	0.7
Marilyna pleurosticta	Striped toadfish	3	2	0.1
Arothron hispidus	Stars and stripes toad	3	1	0.1
Torquigener pleurogramma	Weaping toado	1	1	0.02
TERAPONTIDAE				
*Kuhlia rupestris**	Jungle perch	1	1	0.02
Terapon jarbua	Crescent perch	13	6	0.3
TRIACANTHIDAE				
Tripodichthys angustifrons	Yellow tripodfish	1	1	0.02
Total species				**46**
Total abundance				**4,842**

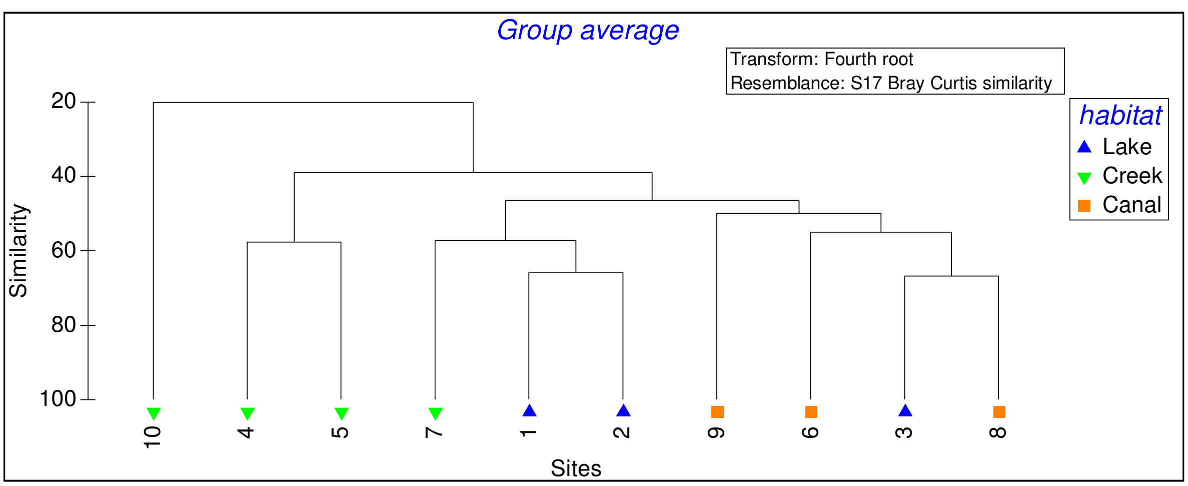

Figure 2. A cluster analysis showing the similarity percentages of the nine sites

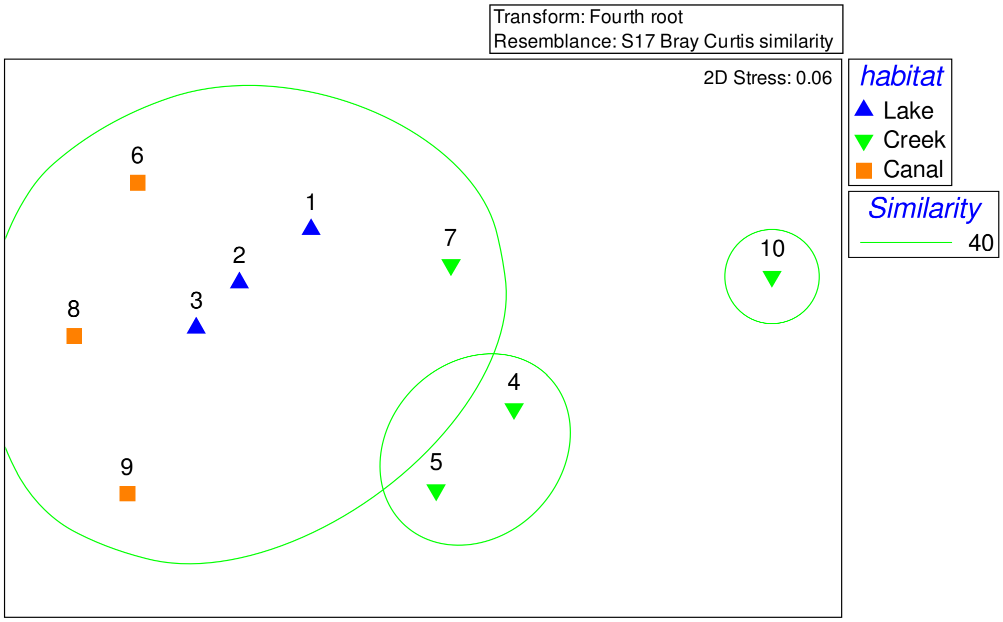

Figure 3. A MDS analysis plot with the cluster similarities overlaid.

3.5 Comparison with 2013 fish survey

3.5.1 Species

A total of 55 fish species have been recorded during the surveys of Currimundi Lake during both 2013 and 2015. There was an increase in the numbers of recorded species with 46 species being recorded in 2015 compared to 41 species being recorded in 2013 (Table 5).

There was a high species turnover between the two sampling events with only 34 species being recorded in both the 2013 and 2015 surveys. The large differences in species occurrences was due to 11 new fish species recorded in 2015 and 10 species that were only caught in 2013 (Table 5).

Between both surveys there were a similar number of dominant species with 6 species dominating in both years. Of these species the estuary perchlet and southern herring dominated during both years and similar proportions of these species were collected during both years (72% in 2013 and 70% in 2015).

3.5.2 Fish abundance

Total abundance of fish was also similar with a mean of 484 fish recorded in 2015 and 517 fish per site in 2013. Fish abundance in individual sites was highly variable (Figure 4). The highest fish abundance recorded was near the entrance to the lake where 1323 southern herring were caught in 2015. Higher fish abundance was recorded in six of the sites sampled (Figure 4).

In 2015 the recorded fish species richness increased in two of the lake sites, one of the canal sites and two of the creek sites. Three sites recorded the same diversity and only a single site had fewer fish species recorded than in 2013 (site 9) (Figure 5).

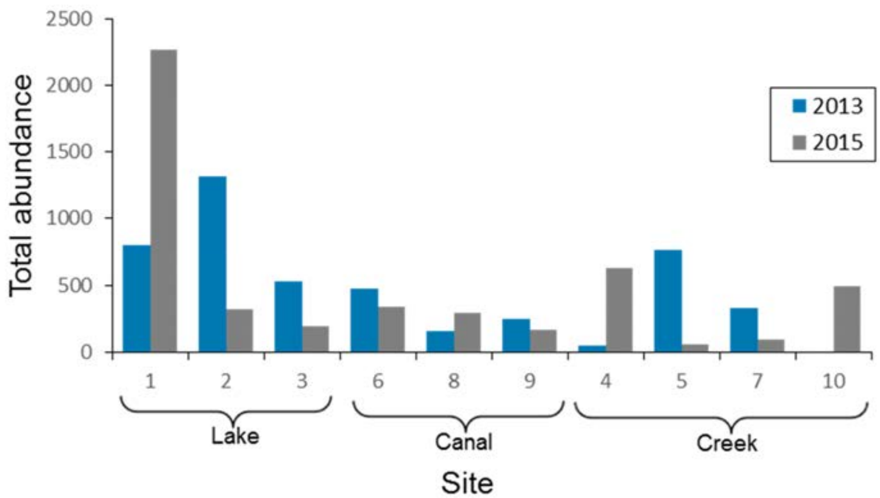

Figure 4. Total fish abundance within all the sampling sites between 2013 and 2015. Site 10 was only sampled in 2015.

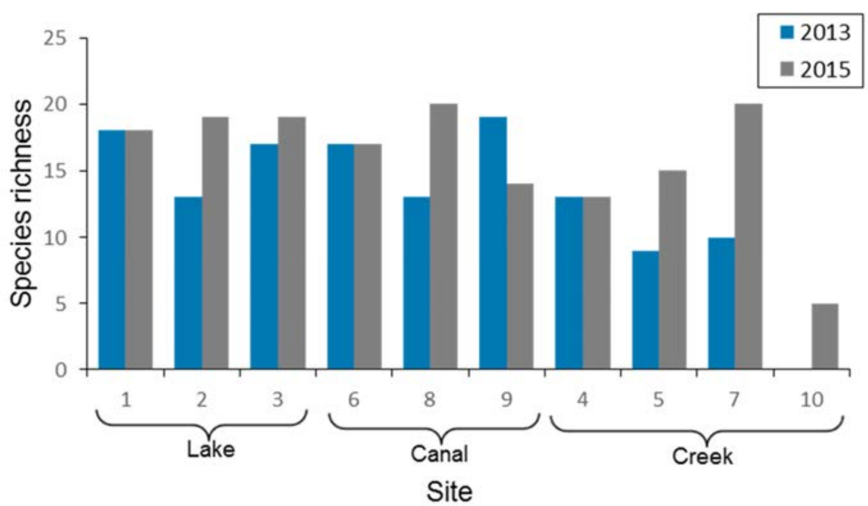

Figure 5. Total species richness within all sampling sites. Site 10 was only sampled in 2015.

3.5.3 Fish community structure

A MDS plot of the combined fish community data is shown in Figure 6. This shows that there is distinct separation of the creek sites from the river and canal sites. A subsequent analysis found that there were significant differences between the creek and the other sampling sites (ANOSIM $r = 0.673$, $p = 0.0002$).

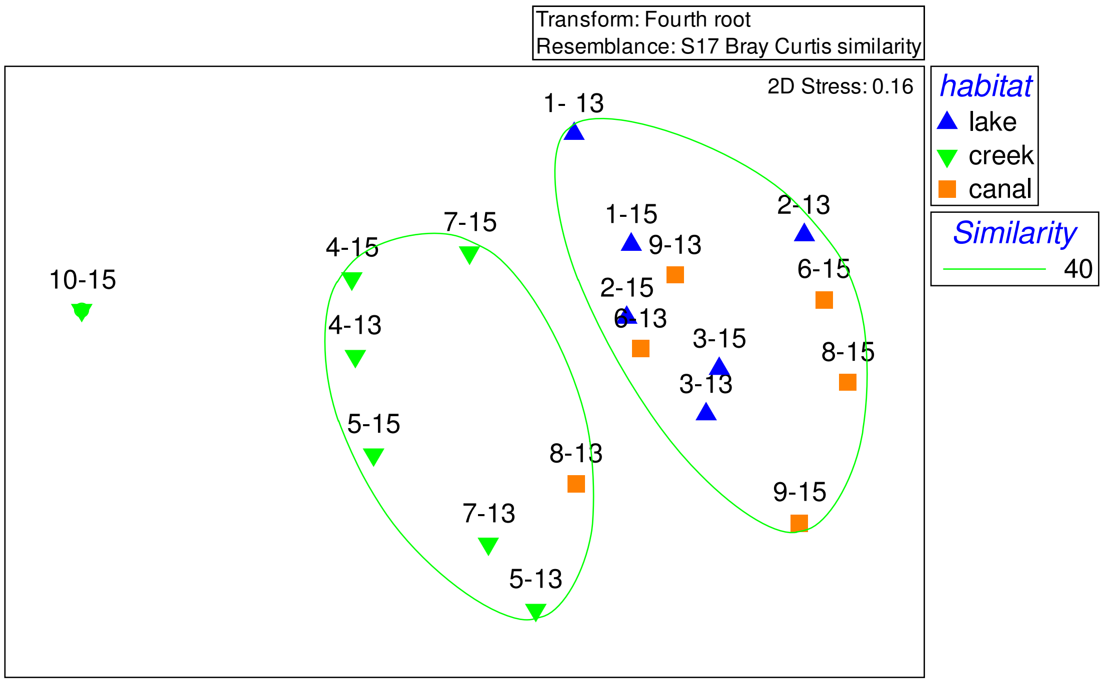

Figure 6. MDS plot of the pooled fish data from Currimundi Lake. The first number of the label refer to the site number (1-10) and the second the year (2013 or 2015).

There were no significant differences in fish community between the two sampling years (ANOSIM r=0.099, p = 0.098). Nor were there any significant fish community differences between the canal sites (ANOSIM r=0.059, p = 0.265) and lake sites (ANOSIM r = -0.073, p = 0.735).

The fish species responsible for the significant differences between the creek sites and the lake and canal sites were explored using a SIMPER analysis. The results of this analysis are shown presented in Appendix A. Overall it was found that the diversity was greater in the canal and lake sites (49 species) compared to the creek sites (17 species). Seventeen fish species had greater mean abundance in the creek sites while 37 had greater abundance in the creek and canal sites.

3.6 Comparison with historical estuarine fish surveys

A total of 64 fish species have been recorded from Currimundi Lake, including the three historical surveys, the 2013 survey and the current survey (Table 5). During the current survey an additional 10 fish species were recorded, including three predominately marine species, two freshwater species and five estuarine species (Table 5).

The diversity of fish species caught in the lake has increased consistently over the five surveys, with substantially more fish species caught in the last two surveys compared to the others (15, 16, 20 and 41 and 46 fish species respectively) (Table 5).

Of the 64 species only four species were recorded in all four sampling occasions; these included milkfish (*Chanos chanos*), snub nosed garfish (*Arrhamphus sclerolepis*), silver batfish (*Monodactylus argenteus*) and bream (*Acanthopagrus australis*) (Table 5). There were a total of nine species that were recorded in the historical surveys that do not appear in the previous two surveys. In addition, there were 39 fish species recorded in the most recent surveys (2013 and 2015) that were not found in the historical surveys (Table 5).

Table 5. Estuarine fish species occurrences Currimundi lake estuary sites, present study, Pitman (2013) and historical data from Leggett (1993, 1997 and 2000).

Estuarine fish species	Common Name	1993	1997	2000	2013	2015
Ambassis marianus	Estuary perchlet	•		•	•	•
Petroscirtes lupus	Sabre toothed blenny				•	
Repomucenus calcaratus	Spotted stinkfish				•	
Caranx ignobilis	Giant trevally				•	•
Caranx sexfasciatus	Big eye trevally				•	•
Carangoides ferdau	Banded trevally					•
Gnathanodon speciosus	Golden trevally	•				
Chanos chanos	Milkfish	•	•	•	•	•
Herklotsichthys castelnaui	Southern herring				•	•
Hypseleotris compressa	Empire gudgeon					•
Pastinachus sephen	Cowtail stingray				•	•
Sphyraena obtusata	Striped seapike				•	•
Gerres subfasciatus	Common silver belly		•	•	•	•
Gerres filamentosus	Threadfin biddy				•	•
Favonigobius exquisitus	Exquisite sand-goby				•	•
Mugilogobius platynotus	Mangrove goby			•	•	•
Butis butis	Crimson-tipped gudgeon				•	•
Gobiopterus semivestutus	Glass goby				•	
Pomadasys kaakan	Grunter	•			•	•
Plectorhinchus gibbosus	Brown sweetlip				•	
Arrhamphus sclerolepis	Snub nosed garfish	•	•	•	•	•
Hyporhamphus regularis	River garfish			•		•
Pseudorhombus jenynsii	Small toothed flounder				•	
Platycephalus fuscus	Dusky flathead	•	•		•	•
Pseudomugil signifer	Pacific blue eye	•	•		•	•
Leiognathus fasciatus	Common pony fish				•	•
Lutjanus argentimaculatus	Mangrove jack	•			•	•
Lutjanus russellii	Moses perch				•	•
Monodactylus argenteus	Silver batfish	•	•	•	•	•
Liza argentea	Tiger mullet				•	•
Liza subviridus	Greenback mullet					•
Mugil cephalus	Sea mullet				•	•
Myxus elongatus	Sand mullet				•	
Myxus petardi	Freshwater mullet	•	•	•		
Siganus fuscescens	Happy moment				•	•
Sillago ciliata	Sand whiting		•	•	•	•
Sillago maculata	Trumpeter whiting				•	•
Argyrosomus japonicus	Jewfish	•			•	
Selenotoca multifasciata	Striped scat				•	
Synaptura nigra	Black sole				•	
Acanthopagrus australis	Bream	•	•	•	•	•
Rhabdosargus sarba	Tarwhine		•	•	•	•

Estuarine fish species	Common Name	1993	1997	2000	2013	2015
Tetractenos hamiltoni	Common toadfish			•	•	•
Marilyna pleurosticta	Striped toadfish			•	•	•
Arothron hispidus	Stars and stripes toad				•	•
Torquigener pleurogramma	Weaping toado				•	•
Terapon jarbua	Crescent perch		•	•	•	•
Rhinogobius sp.	Marine goby	•	•	•		
Craterochalus sp.	Hardyhead	•	•	•		
Diagramma picta	Painted sweetlip	•				
Trygonoptera testacea	Common stingray		•			
Trachurus maccullochi	Yellowtail		•	•		
Megalops cyprinoides	Oxeye herring		•	•		
Pseudogobius sp. 9	Blue spot goby			•		•
Redigobius bikolanus	Large mouthed goby			•		
Tripodichthys angustifrons	Yellow tripodfish					•
Yongeichthys nebulosus	Shadow goby					•
Gambusia holbrooki	Mosquitofish					•
Kuhlia rupestris	Jungle perch					•
Lethrinus laticaudus	Grass emperor					•
Periophthalmus gracilis	Slender mudskipper					•
Psammogobius biocellatus	Sleepy goby					•
Scomberoides tol	Needleskin Queenfish					•
Sphyraena barracuda	Giant Barracuda					•
Total species	64	15	16	20	41	46

3.7 Freshwater fish survey results

A total of 811 individual fish were caught during the surveys of the three freshwater sampling sites, representing ten species of native freshwater fish and two introduced species, mosquitofish (*Gambusia holbrooki*) and platy (*Xiphophorus maculatus*) (Table 6). A single Jungle perch was captured in site 12 on the Currimundi Creek south arm; this is a rare species in southern QLD.

Overall the sites were numerically dominated by empire gudgeons (*Hypseleotris compressa*); with these species representing 59.4% of the total catch. There were also high proportions of mosquitofish (25.8% of total catch). All of the other species were in lower abundance with seven species being represented by 10 or less individuals.

3.8 Comparison with previous freshwater fish surveys

Table 7 presents the freshwater fish species occurrences over all the previous surveys (1993, 1997, 2000, 2013 and 2015) and the results from the current study. There have been a total of 18 freshwater fish species recorded including one marine migrant, the sea mullet (*Mugil cephalus*) which frequently occurs in freshwater environments.

The current study recorded nine species. This is three fewer than recorded in 2013 and similar (plus or minus one species) to that recorded in the historical surveys. The reason for the missing species in the current survey was that the ring tank was not sampled this year, spangled perch, eel-tailed catfish and flathead gudgeons were all caught in the ring tank site (Pitman *et al*. 2013)

Four species were captured in the historical surveys, but do not appear in the current survey. These include Oxeye herring (*Megalops cyprinoides),* freshwater mullet (*Myxus petardi*), Australian smelt (*Retropinna semoni*) and Crimson spotted rainbow fish (*Melanotaenia duboulayi*) (Table 7).

Table 6. Fish fauna from the three freshwater sampling sites. These numbers of fish include those that were positively identified during the electrofishing surveys. The species marked with an (#) are introduced.

FAMILY Species Name	Common Name	Fish catch	No. Sites	Proportion of total
ANGUILLIDAE				
Anguilla reinhardtii	Long finned eel	29	2	3.6
Anguilla australis	Short finned eel	5	1	0.6
ATHERINIDAE				
Craterocephalus stercusmuscarum	Fly specked hardyhead	2	1	0.25
CHANDIDAE				
Ambassis agassizii	Olive perchlet	10	2	1.23
Ambassis marianus	Estuary perchlet	57		7.03
ELEOTRIDAE				
Hypseleotris compressa	Empire gudgeon	482*	2	59.4
Gobiomorphus australis	Striped gudgeon	3	2	0.37
MUGILIDAE				
Mugil cephalus	Sea mullet	10	1	1.23
PSEUDOMUGILIDAE				
Pseudomugil signifer	Southern blue eye	4	1	0.5
POECILIIDAE				
Gambusia holbrooki #	Mosquitofish	209	2	25.8
Xiphophorus maculatus #	Platy	2	1	0.25
TERAPONTIDAE				
Kuhlia rupestris	Jungle perch	1	1	0.12
Total number of fish species				**12**
Total abundance				**814**

Table 7. Freshwater fish species occurrences in the freshwater sites of the Currimundi catchment from current study, Pitman *et al.* (2013) and historical data from Leggett (1993, 1997 and 2000). # indicates introduced species.

Freshwater species	Common Name	1993	1997	2000	2013	2015
Ambassis agassizii	Olive perchlet				•	•
Anguilla reinhardtii	Long finned eel				•	•
Anguilla australis	Short finned eel				•	•
Craterocephalus stercusmuscarum	Flyspecked hardyhead	•	•	•	•	•
Gobiomorphus australis	Striped gudgeon				•	•
Hypseleotris galii	Firetail gudgeon	•	•	•	•	
Hypseleotris compressa	Empire gudgeon	•	•	•	•	•
Leiopotherapon unicolor	Spangled perch				•	
Megalops cyprinoides	Oxeye herring		•	•		
Melanotaenia duboulayi	Rainbow fish	•	•	•		
Mugil cephalus	Sea mullet				•	•
Myxus petardi	Freshwater mullet	•	•	•		
Philypnodon grandiceps	Flathead gudgeon				•	
Retropinna semoni	Australian smelt	•	•	•		
Pseudomugil signifer	Southern Blue eye		•			•
Tandanus tandanus	Eel-tailed catfish	•	•	•	•	
Kuhlia rupestris	Jungle perch					•
Gambusia holbrooki #	Mosquitofish	•	•	•	•	•
Xiphophorus maculatus #	Platy					•
Total species count	(18 total species)	8	10	9	12	9

4. Discussion

4.1 Estuarine fish communities

A total of 4,840 fish and two stingrays representing 45 fish and a single stingray species were captured during surveys of the ten estuarine study sites in Currimundi Lake. This brings the total number of fish species recorded in the lake in the last two surveys to 51 fish species (and one stingray) and a historical total to 62 fish species (and two stingray species). The most recent total species pool is comparable to many other estuarine systems in sub-tropical Australia (Table 8) while the historical total is comparable to areas with higher diversity such as the Pumistone Passage and more tropical systems (Table 8).

Table 8. Table Species diversity from temperate subtropical and tropical estuaries

Study	Region	Location	Species diversity	Author
Mangrove creek Gold Coast	Sub-tropical	McCoys Creek	30	Pitman 2013
Tooway Lake ICOL	Sub-tropical	Sunshine coast	37	Hydrobiology 2004 and 2005
Mangrove and seagrass	Sub-tropical	Moreton Bay	36	Laegdsgaard and Johnson 1995
Estuarine sand bank	Sub-tropical	Noosa River	38	Miller and Skilleter 2006
Canal and lake	Sub-tropical	Currimundi Lake	41	Pitman 2013b
Mangrove creek	Sub-tropical	Tin Can Bay	42	Halliday and Young 1996
Seagrass and	Temperate	Pittwater, Sydney	42	Jelbart *et al.* 2007
Mangrove Creek	Sub-tropical	Serpentine Creek	45	Quinn 1980
Mangrove Creek	Temperate	Botany Bay	46	Bell *et al.* 1984
Canal and river sites	Sub-tropical	Tallebudgera	51	Morton 1992
Seagrass and sand	Sub-tropical	Northern NSW	52	Gray *et al.* 1996
Canals and lakes	Sub-tropical	Gold Coast	52	Waltham and Connolly 2007
River	Sub-tropical	Nerang River	50	Australian Wetlands 2012
Northern QLD river	Tropical	Lockhart River	50	Robertson and Duke 1990
Northern QLD river	Tropical	Escape River	52	Robertson and Duke 1990
Estuary mangrove	Sub-tropical	Clarence river	53	Kroon and Ansel 2006
Mangrove Creek	Tropical	Cape York	55	Vance *et al.* 1996
Marine reserves	Sub-tropical	Pumicestone	60	Pillans *et al.* 2007
Mangrove creek with seagrass.	Sub-tropical	Pumicestone Passage (Bells ck)	73	Pitman 2015
Northern QLD river	Tropical	Alligator Creek	128	Robertson and Duke 1990

The general structure of the fish community found in this study was similar to the previous survey in 2013, with similar fish abundances and slightly higher diversity of fish (4 species). The fish community was also dominated by the same two species, the estuary perchlet (*Ambassis marianus*), and southern herring (*Herklotsichthys castelnaui*), with similar proportions of these species being collected during both years (72% in 2013 and 70% in 2015).

This survey found a significant fish species turnover compared to the 2013 survey. A total of 11 new fish species were recorded and 10 species were not recorded that were previously caught in 2013. A total of 34 species were recorded in both surveys. Similar rates of species turnover have also been found in nearby Bells Creek in the Pumicestone Passage with 10 to 15 new species being recorded during every sampling event (Pitman 2014 & 2015). This high variation in species occupancy is caused by the presence of transient species that have different life history patterns and levels of recruitment, including freshwater stragglers, habitat generalists, estuarine residents, offshore spawners and marine migrants (Quinn 1980; Bell *et al*. 1984; Robertson and Duke 1990; Smith and Sinerchiab 2004; Sheaves *et al.* 2013). The factors relating to the abundance and diversity of these groups of species are different, with estuarine species responding more to conditions within the lake and the marine species populations responding to processes outside the lake.

When all the estuarine data was pooled from both 2013 and 2015, it was found that there were some consistent trends in the fish community. The main trend was a significant difference in the fish community structure between the creek sites and the river and canal sites. A SIMPER analysis revealed that this relationship was caused by differences in species occurrences and abundance between the two habitat types. For example, the diversity was greater in the canal and lake sites (49 species) compared to the creek sites (17 species). Furthermore, eleven fish species had greater mean abundances in the creek sites, while 14 had greater abundances in the creek and canal sites. The differences in fish community between the different habitats in the lake may be explained by differences in water quality and habitat between the two areas.

A total of 62 fish species have been recorded over all of the four surveys of Currimundi Lake (1993, 1997, 2000, 2013 and 2015). The diversity of fish species caught in the lake has increased consistently over the five surveys, with substantially more fish species caught in the previous two surveys compared to the others (15, 16, 20, 41 and 46 species, respectively). It is highly likely that the observed increase in fish species diversity over time is likely to be related to an increase of entrance opening, which is changing habitat types present and caused the system to become more marine dominated. Studies conducted in NSW have also found that ICOLL's with more frequent marine connectance are likely to support more estuarine and coastal species and have higher fish diversity (Pollard 1994; Gray 2001; Gray and Kennelly 2003; James *et al.* 2007).

The high prevalence of marine dominated conditions throughout the lake, canal and creek habitats may have increased the diversity of marine and estuarine fish, but it has also likely caused the loss of other freshwater species. The continued absence of freshwater mullet (*Myxus petardi*) from the current (2013 and 2015) surveys supports the theory that the system has become more marine dominated, with conditions no longer suitable for this freshwater fish to inhabit the Lake, creek and canal sites.

Although the lake has become more marine dominated there are many aspects of the lake ecosystem that make it dissimilar to normal estuarine environments. One of the main difference is the low diversity of invertebrate species caught in the survey, including prawns and shrimps. Fish monitoring in nearby Bells Creek (Pitman 2014 and 2015) found very high abundances of Paste shrimp (*Acetes sibogae*) and bay prawns (*Metapenaeus bennettae*) and lower numbers of four other species. Further investigation is required, but smaller areas of mangrove habitat, lower tidal flow (0.3m in Currimundi Lake), differences in food webs and potentially higher rates of urbanisation in Currimundi Lake are potential causes in the lower numbers of invertebrates.

4.2 Freshwater fish communities

A total of 814 individual fish were caught during the current surveys of the two freshwater sampling sites. These fish represented ten native freshwater fish and two introduced species, the mosquitofish (*Gambusia holbrooki*) and platy (*Xiphophorus maculatus*). There have been total of 18 freshwater species recorded over all of the four freshwater surveys (1993, 1997, 2000, 2013 and 2015). Fewer species of native freshwater fish were recorded in the present study, compared to 2013. This is because the ring tank site was not surveyed.

The loss of two sensitive fish species, including Australian smelt (*Retropinna semoni*) and crimson spotted rainbowfish (*Melanotaenia duboulayi*), from the Currimundi Catchment suggests that the freshwater environments may have become unsuitable for those species since they were last recorded in 2000. The loss of sensitive fish species often indicates that a system is under stress and may have experienced habitat degradation and/or a reduction in water quality. It may also be because the upper areas of the lake are no suitable for the species due to higher prevalence of high conductivity. Since Lake Kawana came on-line in 2004 the lake has become more saline (Tomlinson *et al*. 2010) and the results of WQ testing in this study show high conductivity readings right up to the freshwater interface.

Sampling below the Kawana Forest Wetland on the Currimundi Creek north arm revealed that the stormwater wetland has been constructed on the main creek channel and forms a barrier to fish passage. The outlet structure consists of a small pipe approximately 200mm wide and at the time of sampling approximately 10,000 juvenile empire gudgeons (10-15mm long) were congregating below it. It would be much more beneficial to fish passage if an open rocked drain was continued to the wetland outlet structure instead of a pipe.

This study recorded the presence of two juvenile (29mm and 34mm) jungle perch, with one being caught in both the Currimundi Creek south and north arms. Over the last three decades numbers of jungle perch have been declining and recent surveys have revealed that major populations are now restricted to the wet tropics and only a small number of remnant groups exist south of Townsville (Scanlen and Marsdern 2010). Riparian clearing, habitat degradation, pest fish and barriers to fish passage are the likely causes of reductions to the species. In particular, the species is sensitive to waterway barriers, as adults live in freshwater and spawn in the sea. Free passage from estuaries to freshwater reaches is required by juveniles returning to colonise new habitats.

4.3 Recommendations

This study adds considerable understanding of the fish communities present within Currimundi Lake. The following recommendations have been made based on the findings of this report.

- Additional long term annual monitoring of the Currimundi catchment would provide an on-going assessment of the status of the fish community and the health of the ecosystem.

- Periodic mapping of mangrove and seagrass habitats would also inform how the lake habitats may be changing in response to lake openings and general ecological condition.

- It is recommended that any future assessments of the catchment include areas which have not been surveyed previously. For example, Lake Kawana has never been surveyed for fish and additional survey sites would provide a benchmark of the ecological condition of this area.

- Intermittently Closed and Open Lake and Lagoons in south eastern QLD remain an understudied habitat type in sub-tropical Australia with little or no available information on the fish communities of these systems in the sunshine coast. Baseline assessments of other ICOLL systems on the sunshine coast is recommended to build a greater understanding of the communities in these systems, so they can be adequately understood and managed.

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6. APPENDIX

Appendix A. Contributions between the significant differences between the creek and canal sites (estuarine sites only). Dissimilarly values are from SIMPER analysis, the species with higher abundance in each habitat type are highlighted in bold. The higher the dissimilarity the higher contribution the fish species had to the differences between the creek and the lake and canal sites. Data includes both 2013 and 2015.

Common name	Species	Dissimilarity	CPUE Canal and Lake	CPUE Creek
Estuary perchlet	*Ambassis marianus*	6.7	177.83	**214.00**
Pacific blue eye	*Pseudomugil signifer*	6.7	0.00	**20.86**
Southern herring	*Herklotsichthys castelnaui*	5.9	**243.67**	24.57
Tiger mullet	*Liza argentea*	5.6	**72.67**	39.00
Common pony fish	*Leiognathus fasciatus*	4.2	**14.17**	1.86
Bream	*Acanthopagrus australis*	4.0	**8.42**	0.57
Sand whiting	*Sillago ciliata*	3.8	**3.50**	0.00
Common toadfish	*Tetractenos hamiltoni*	3.5	**3.50**	0.71
Sea mullet	*Mugil cephalus*	3.2	**9.42**	3.14
Trumpeter whiting	*Sillago maculata*	3.1	**3.67**	0.00
Common silver belly	*Gerres subfasciatus*	2.8	**32.83**	10.43
Snub nosed garfish	*Arrhamphus sclerolepis*	2.7	**1.67**	0.00
Greenback mullet	*Liza subviridus*	2.2	**4.50**	0.43
Sand mullet	*Myxus elongatus*	2.2	0.25	**6.71**
Crescent perch	*Terapon jarbua*	2.1	**1.25**	0.71
Exquisite sand-goby	*Favonigobius exquisitus*	2.0	0.58	**1.57**
Big eye trevally	*Caranx sexfasciatus*	2.0	1.00	1.00
Tarwhine	*Rhabdosargus sarba*	1.9	**0.83**	0.00
Silver batfish	*Monodactylus argenteus*	1.8	**0.75**	0.71
Mangrove jack	*Lutjanus argentimaculatus*	1.8	0.42	**1.14**
Threadfin biddy	*Gerres filamentosus*	1.7	**0.58**	0.00
Giant trevally	*Caranx ignobilis*	1.7	0.42	**0.57**
Crimson-tipped gudgeon	*Butis butis*	1.6	0.50	**0.57**
Slender mudskipper	*Periophthalmus gracilis*	1.6	**0.42**	0.00
Mangrove goby	*Muligobius platynotus*	1.6	0.00	**0.86**
Dusky flathead	*Platycephalus fuscus*	1.6	0.33	**0.43**
Moses perch	*Lutjanus russellii*	1.6	0.25	**1.57**
Milkfish	*Chanos chanos*	1.5	**0.92**	0.14
Blue spot goby	*Pseudogobius sp. 9*	1.5	0.00	**4.71**
Needleskin Queenfish	*Scomberoides tol*	1.5	**0.58**	0.29
Empire gudgeon	*Hypseleotris compressa*	1.4	0.00	**2.86**
Glass goby	*Gobiopterus semivestutus*	1.4	0.33	**0.57**
Mosquitofish	*Gambusia holbrooki*	1.2	0.00	**2.43**
Grunter	*Pomadasys kaakan*	1.2	**0.50**	0.14
Happy moment	*Siganus fuscescens*	1.0	**0.58**	0.00
Stars and stripes toad	*Arothron hispidus*	1.0	**0.50**	0.00
Striped toadfish	*Marilyna pleurosticta*	1.0	**0.25**	0.14
Striped seapike	*Sphyraena obtusata*	0.9	**0.25**	0.00
Cowtail stingray	*Pastinachus sephen*	0.8	**0.25**	0.00
Weaping toado	*Torquigener pleurogramma*	0.6	**0.17**	0.00

Jungle perch	*Kuhlia rupestris*	0.6	0.00	**0.14**
Sleepy goby	*Psammogobius biocellatus*	0.5	**0.25**	0.00
Banded trevally	*Carangoides ferdau*	0.4	**0.42**	0.00
River garfish	*Hyporhamphus regularis*	0.4	**0.33**	0.00
Striped scat	*Selenotoca multifasciata*	0.4	**0.25**	0.00
Sabre toothed blenny	*Petroscirtes lupus*	0.4	0.42	**2.57**
Giant Barracuda	*Sphyraena barracuda*	0.4	**0.08**	0.00
Jewfish	*Argyrosomus japonicus*	0.3	**0.08**	0.00
Shadow goby	*Yongeichthys nebulosus*	0.3	**0.08**	0.00
Small toothed flounder	*Pseudorhombus jenynsii*	0.3	**0.08**	0.00
Black sole	*Synaptura nigra*	0.3	0.00	**0.14**
Brown sweetlip	*Plectorhinchus gibbosus*	0.3	**0.08**	0.00
Spotted stinkfish	*Repomucenus calcaratus*	0.3	**0.08**	0.00
Grass emperor	*Lethrinus laticaudus*	0.3	**0.08**	0.00
Yellow tripod fish	*Tripodichthys angustifrons*	0.2	**0.08**	0.00
Diversity			49	32
Fish with higher abundance			37	17