Status of the Currimundi Lake fish Community in 2019

Final Report – June, 2019

Document Control

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Cover photographs

Top – Currimundi Lake south arm

Left bottom – Barred javelin fish (*Pomadasys kaakan*)

Right bottom – Bluefin trevally (*Caranx melampygus*)

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Executive Summary

Fishology Consulting (formerly Pitman Research and Consulting) was 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 were previously assessed in 2013, 2015 and 2017. This survey will add to the previous data collected and provide comparable data of 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 creating conditions for either sediment accretion or erosion at the Lake entrance. 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 mostly 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 of 11,460 fish and stingrays representing a total of 55 species. During this survey an additional 10 fish species were recorded, with each subsequent survey within the lake recording new species records and high species turnover. To date a total of 77 fish and ray species have been recorded in all of the surveys of Currimundi Lake (Pitman *et al*. 2013; Pitman 2015 and 2017), it is likely that additional species would be recorded in future surveys.

In the current survey the general structure of the fish community was significantly different to the three previous surveys conducted in 2013, 2015 and 2017. This survey recorded higher abundances of glassfish (both *Ambassis jacksoniensis* and *Ambassis marianus*), southern herring (*Herklotsichthys castelnaui),* Pacific blue eye (*Pseudomugil signifer*), silver biddy (*Gerres subfasciatus*), ornate ponyfish (*Nuchequula gerreoides*), greenback mullet (*Liza subviridis*) and lower abundances of tiger mullet (*Liza argentea)* and sea mullet (*Mugil cephalus*) compared to previous surveys. The high variation in much of the species occupancy and abundance in Currimundi Lake is caused mostly by species that spawn in oceanic or coastal spawning grounds that may be a large distance away (e.g. marine migrants and marine stragglers).

Pooled data from the three surveys (2013, 2015 and 2017) show that there are significant differences in the fish community structure between the creek sites and the lake and canal sites. The lake and canal sites have consistently recorded higher diversity than the creek sites (61 fish species vs 47 fish species), as well as higher abundances of fish. The observed 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. In particular, the creek sites have dense overhanging riparian vegetation, in these areas the breakdown of organic matter combined with low levels of flushing, are likely to be contributing to lower dissolved oxygen readings observed in these sites.

A total of 490 individual fish were caught during the surveys of the two freshwater sampling sites in the north and south arms of Currimundi Lake. These fish represented nine native freshwater fish and two introduced species, the mosquitofish (*Gambusia holbrooki*) and platy (*Xiphophorus maculatus*). Similar number of species have been recorded during each survey, although there has been some variation in the species occurrence in these sites. The current survey did not record several species that were recorded in historical surveys of the lake undertaken by Ray Leggett (1993, 1997 and 2000). Catchment alterations and changes in salinity regimes in Currimundi Lake from the Lake Kawana development may have contributed to the loss of these species.

This survey recorded two juvenile jungle perch (32mm and 27mm long) in the upper reaches of Currimundi Lake, with a single fish being caught in both the Currimundi Creek south and north arms. Two juvenile jungle perch were also recorded in previous surveys in 2015. None of the surveys have recorded adults of the species, possibly indicating that the species may not have been successful in colonising the study area. Over the last three decades numbers of jungle perch have been declining. Riparian clearing, habitat degradation, pest fish and barriers to fish passage are the likely causes of this species decline.

Recommendations

- 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.

- 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.

- To identify if adult jungle perch are present in the study area more intensive sampling effort within the upper catchment is required.

1. Introduction

Fishology Consulting (formerly Pitman Research and Consulting) was commissioned by the Sunshine Coast Regional Council (SCRC) to undertake a fish community 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 make comparisons with previous surveys that have been undertaken in the catchment.

1.2 Study Area

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 characteristics 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 creating an environment for sediment accretion or erosion at the lake entrance. However, Currimundi Lake now receives pumped discharge of water from Lake Kawana; this increased flow has caused the entrance of the lake to be mostly open. The exception to this would be occasional natural closure or if the entrance of the lake was artificially closed to manage biting midge populations.

Over the last 12 years data has been collected by Council on the times when the entrance of Currimundi Lake has been mechanically opened (Figure 1). The lake is mechanically opened to prevent flooding in upstream areas, after natural closing and when it has been artificially closed to manage biting midge populations. Prior to 2018 and during 2019 the lake has had a low frequency of entrance opening, with zero to three openings per year. In 2018 a total of eight mechanical entrance openings were required due to natural lake closure (Figure 8). Total days closed was high during 2018, 2017 and 2012.

The mostly 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. More permanent entrance opening will also provide opportunities for the larvae, juveniles and adults of marine and estuarine fish to enter Currimundi Lake

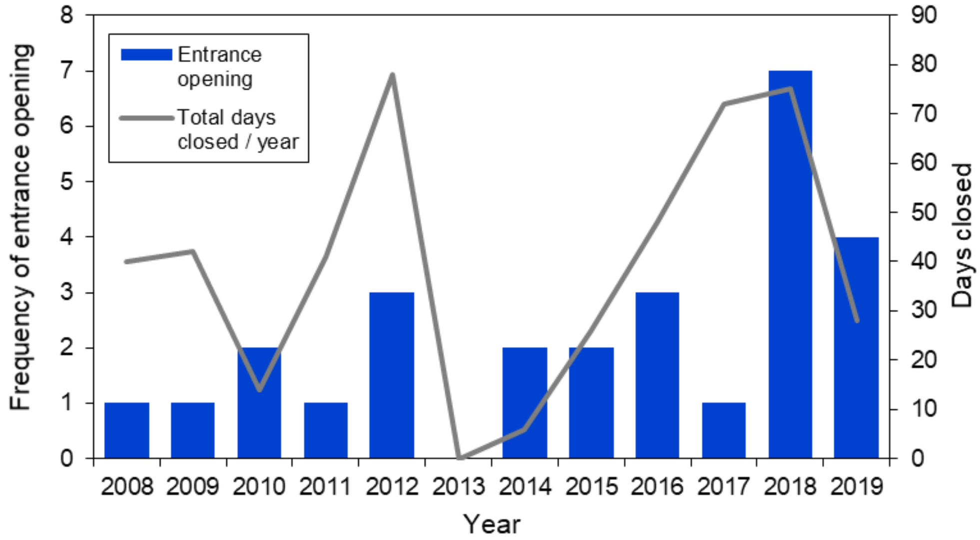

Figure 1. Frequency of entrance opening of Currimundi Lake and total number of days closed per year. These have been triggered by a variety of mechanical and natural entrance closures.

There have been three historical surveys undertaken in Currimundi Lake by Leggett (1993, 1997 and 2000). Within the three historical surveys a variety of sampling equipment was used and a total of 28 fish species were recorded. The results of these surveys are summarised in Pitman (2017). Prior to this current survey there have been three other fish surveys undertaken by the author in 2013, 2015 and 2017 utilising the same study sites, methods and undertaken at the same time of year as the current survey.

2. Methods

2.1 Approach and study sites

The sampling approach used in this study is a replicate of the survey undertaken in previous surveys (Pitman *et al.* 2013; Pitman 2015 and 2017). The locations of the twelve study sites is described in Table 1 and illustrated in Figure 1.

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.

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 198614 (Expiry 30-8-21) and animal ethics approval CA 2018-07-1211 (Expiry 20-11-2020).

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 Connolly 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 semi-circle 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 eight 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 (40m 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 resulting in standardised fishing effort.

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). Several fish samples were sent to the QLD Museum for identification. Juvenile whiting under 100mm were grouped as *Sillago* spp. due to difficulties in separating juvenile *Sillago ciliata* and *Sillago maculata*.

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 approximately 800 seconds of on-time power was used to standardise the effort between sites. All fish species were identified using McDowall (1996).

2.3 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).

Table 1. Site location and description.

Site	Habitat	GPS location	Location Description
1	Lake	26º45’52.36’’ S 153º07’48.29’’ E	Southern bank of Currimundi Lake, 100m east of Westaway Parade boat ramp, opposite Alice Street, Currimundi.
2	Lake	26º45’56.93’’ S 153º07’23.03’’ E	Southern bank of Currimundi Lake, 200m east of Nicklin Way, opposite storm water drainage area known as ‘Oyster Creek’.
3	Lake	26º45’55.73’’ S 153º07’15.07’’ E	Southern bank of Currimundi Lake, 100m west of Nicklin Way opposite Currimundi Villas.
4	Creek	26º45’56.38’’ S 153º06’57.28’’ E	Currimundi Creek south arm, 20m downstream from Creekside Boulevard Bridge, along eastern bank.
5	Creek	26º45’53.72’’ S 153º06’30.52’’ 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	Canal	26º45’37.77’’ S 153º07’00.29’’ E	Eastern bank of Pangali Canal, 20m north of the pontoon at Noel Burns Park.
7	Creek	26º45’28.66’’ S 153º06’54.62’’ E	Northern bank of Currimundi Creek north arm, 200m from the junction with Pangali Canal.
8	Canal	26º45’34.86’’ S 153º07’20.54’’ E	Eastern bank of Baroona Canal, 80m from the end.
9	Canal	26º45’20.13’’ S 153º07’56.33’’ E	Eastern bank of Tokara Canal, at the un-named park.
10	Creek	26º45’17.02’’ S 153º07’35.50 E	Currimundi Lake north arm. 100m above the Kawana way crossing.
11	Freshwater Creek	26º45’50.50’’ S 153º07’59.92’’	Currimundi Lake south arm. Just above culverts at the northern side of Meridan Way overpass of Kawana Way.
12	Freshwater Creek	E26º 45’ 49.90” S 153º 5’ 58.70” E	Currimundi lake north arm. Just above tidal limit above and below the Kawana Wetland stormwater treatment wetland.

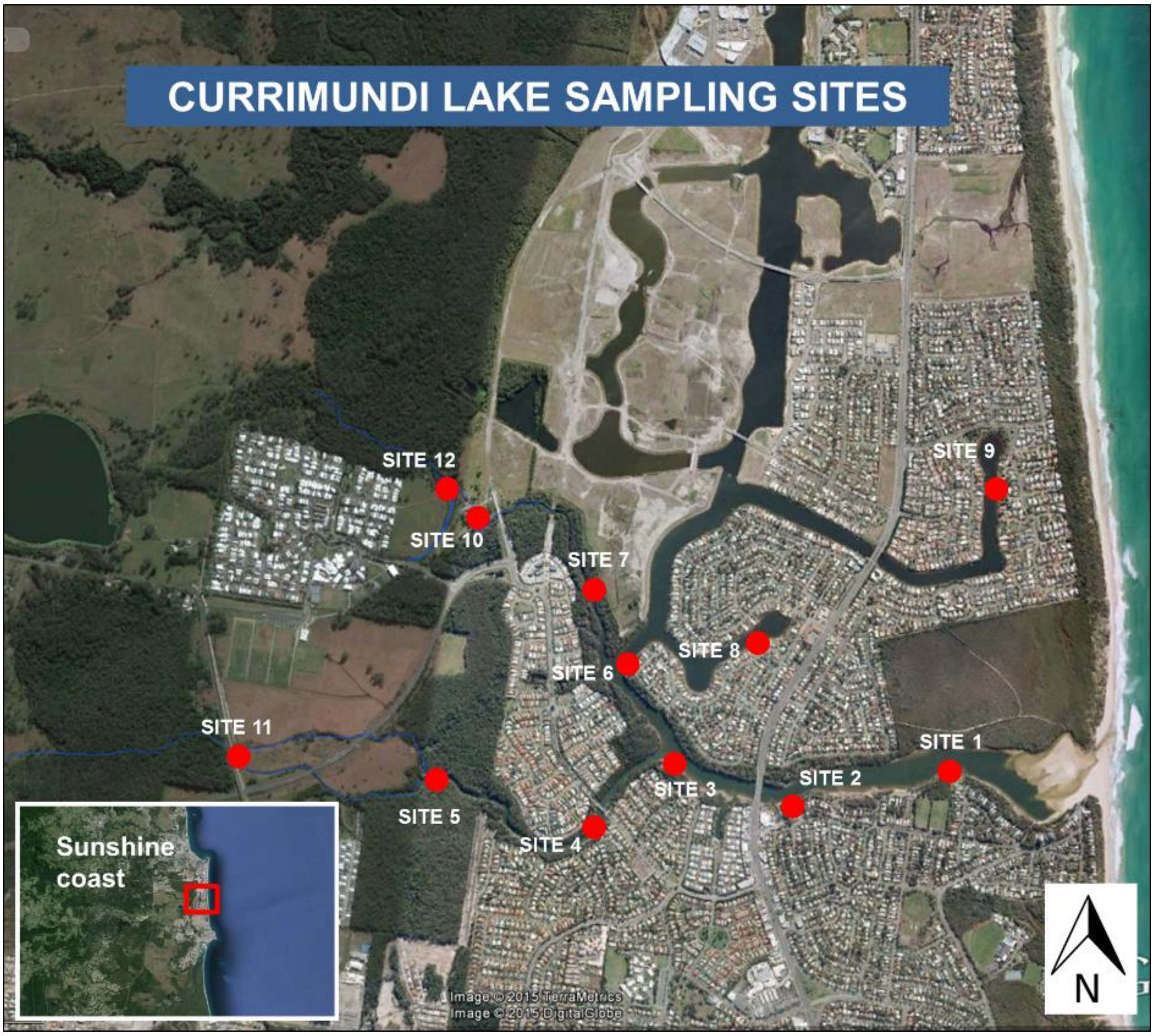

Figure 1. Study sites located in Currimundi Lake.

3. Results

3.1 Fish Community Characteristics in 2019

A total of 11,462 fish and a single stingray were captured during the survey of the ten estuarine study sites located within Currimundi Lake (Table 3). This fish catch was represented by 28 families and a total of 54 fish and ray species, excluding juvenile whiting (*Sillago* spp.) (Table 2). Individual catch data per site is provided in Appendix A.

This 2019 survey of Currimundi Lake recorded eleven new species not previously recorded within the previous three surveys. This included two estuarine resident species (tamar goby*, Afurcagobius tamarensis,* and ornate sand diving goby, *Parkraemeria ornata*)*,* five marine migrants (toothed ponyfish, *Gazza minata*, pink breasted siphonfish, *Siphamia roseigaster,* glassy sprat, *Hyperlophus translucidus,* fan bellied leather jacket, *Monacanthus chinensis* and giant herring, *Elops hawaiensis),* one marine straggler (lined bristletooth*, Ctenochaetus striatus*) and three freshwater species that have been recorded in the upper freshwater sampling sites (Agassiz's glassfish, *Ambassis agassizii,* flat headed gudgeon*, Philypnodon grandiceps* and striped gudgeon*, Gobiomorphus australis*).

The fish fauna within Currimundi Lake recorded exceptionally high abundances of Port Jackson glassfish (*Ambassis jacksoniensis*) (4,920 individual fish or 42.9 % of the total catch) and Southern herring (*Herklotsichthys castelnaui*) (3,612 individual fish or 31.5% of the total catch) (Table 2). In comparison, the majority of other species were recorded in much lower abundances. Six other fish species that were abundant within the survey included estuary perchlet (*Ambassis marianus*) (5.9% of total catch), silver biddy (*Gerres subfasciatus*) (5.2% of total catch), ornate ponyfish (*Nuchequula gerreoides*) (4.1 % of total catch), Pacific blue eye (*Pseudomugil signifer*) (2.7%) and trumpeter (*Helotes sexlineatus*) (1.7% of total catch) (Table 3). A large proportion of the species encountered in this survey were present in low abundances. This included 36 species (65%) that were represented by ten or less individuals each (Table 2).

During the 2019 survey fish community characteristics were different within each of the three habitat types present within Currimundi Lake (Table 3). Lake sites had higher fish diversity, mean abundance and a higher proportion of unique species, this was followed by the canal and creek habitats (Table 3). Higher abundance of fish within the lake and canal sites was primarily due to high abundances of southern herring and estuary perchlet (Table 3). While, higher diversity of fish within the lake sites was driven by high diversity within sites one and two located towards the entrance of Currimundi Lake. The habitat difference influencing fish communities within these sites were the presence of small patches of seagrass (*Zostera* sp.) that were sampled with the small seine net.

Table 3. Fish catch from the four estuarine sampling sites. (*) refers to pest species.

FAMILY Species Name	Common Name	Fish catch	Number of sites	Proportion of total
ACANTHURIDAE				
Ctenochaetus striatus	Lined bristletooth	1	1	0.01
AMBASSIDAE				
Ambassis agassizii	Agassiz's glassfish	5	8	0.04
Ambassis jacksoniensis	Port Jackson glassfish	4,920	8	42.9
Ambassis marianus	Estuary perchlet	671	9	5.9
APOGONIDAE				
Siphamia roseigaster	Pink breasted siphonfish	58	1	0.5
CALLIONYMIDAE				
Repomucenus macdonaldi	Greyspotted dragonet	1	1	0.01
CARANGIDAE				
Caranx melampygus	Bluefin trevally	2	2	0.02
Caranx sexfasciatus	Big eye trevally	3	1	0.03
CLUPEIDAE				
Herklotsichthys castelnaui	Southern Herring	3,612	8	31.5
Hyperlophus translucidus	Glassy sprat	1	1	0.01
DASYATIDAE				
Pastinachus ater	Cowtail stingray	1	1	0.01
ELEOTRIDAE				
Gobiomorphus australis	Striped gudgeon	1	1	0.01
Philypnodon grandiceps	Flathead Gudgeon	11	2	0.1
ELOPIDAE				
Elops hawaiensis	Giant Herring	3	1	0.03
GERREIDAE				
Gerres filamentosus	Threadfin silver biddy	9	4	0.08
Gerres subfasciatus	Silver biddy	593	10	5.2
GOBIIDAE				
Afurcagobius tamarensis	Tamar goby	9	3	0.08
Butis butis	Crazy fish	1	1	0.01
Favonigobius exquisitus	Exquisite sand goby	49	5	0.4
Mugilogobius platynotus	Mangrove goby	3	1	0.03
Parkraemeria ornata	Ornate sand diving goby	1	1	0.01
Periophthalmus argentilineatus	Barred mudskipper	1	1	0.01
Petroscirtes lupus	Sabretooth blenny	5	2	0.04
Psammogobius biocellatus	Estuary goby	1	1	0.01
Pseudogobius sp.	Blue spot goby	58	3	0.5
Yongeichthys nebulosus	Poisonous Goby	7	2	0.06
HAEMULIDAE				
Plectorhinchus gibbosus	Brown sweetlip	1	1	0.01
Pomadasys argenteus	Grunter	9	5	0.08

FAMILY Species Name	Common Name	Fish catch	Number of sites	Proportion of total
Pomadasys kaakan	Barred javelin	1	1	0.01
HEMIRAMPHIDAE				
Arrhamphus sclerolepis	Snub nose garfish	40	4	0.4
LEIOGNATHIDAE				
Gazza munuta	Toothed ponyfish	2	2	0.08
Leiognathus equulus	Common ponyfish	17	2	0.2
Nuchequula gerreoides	Ornate ponyfish	472	6	4.1
LETHRINIDAE				
Lethrinus laticaudis	Grass Emperor	9	2	0.08
LUTJANIDAE				
Lutjanus argentimaculatus	Mangrove jack	2	1	0.02
MONACANTHIDAE				
Monodactylus argenteus	Diamond fish	8	3	0.07
MONODACTYLIDAE				
Monacanthus chinensis	Fan bellied leather jacket	3	2	0.03
MUGILIDAE				
Liza argentea	Tiger mullet	188	8	1.6
Liza subviridis	Greenback mullet	4	2	0.03
Mugil cephalus	Sea mullet	6	5	0.05
PARALICHTHYIDAE				
Pseudorhombus arsius	Large tooth flounder	2	2	0.02
PLATYCEPHALIDAE				
Cymbacephalus nematophthalmus	Fringe-eye flathead	3	1	0.03
Platycephalus fuscus	Dusky flathead	3	2	0.03
POECILIIDAE				
*Gambusia holbrooki**	Mosquito fish	8	1	0.07
PSEUDOMUGILIDAE				
Pseudomugil signifer	Pacific blue eye	314	6	2.7
SIGANIDAE				
Siganus fuscescens	Black spine foot	36	1	0.3
SILLAGINIDAE				
Sillago ciliata	Sand whiting	33	6	0.3
Sillago maculata	Trumpeter whiting	3	2	0.03
Sillago spp.	Juvenile whiting	15	4	0.1
SPARIDAE				
Acanthopagrus australis	Bream	22	6	0.2
Rhabdosargus sarba	Tarwhine	5	4	0.04
TERAPONTIDAE				
Helotes sexlineatus	Eastern trumpeter	191	1	1.7
Terapon jarbua	Crescent perch	11	5	0.10
TETRADONTIDAE				
Arothron hispidus	Stars and stripes puffer	1	1	0.01

FAMILY Species Name	Common Name	Fish catch	Number of sites	Proportion of total
Marilyna pleurosticta	Striped toadfish	2	1	0.02
Tetractenos hamiltoni	Common toadfish	24	7	0.2
Total abundance				**11,462**
Total number of species (excluding *Sillago* spp.)				**55**

Table 2. Characteristics of sampling sites separated into different habitat types.

Characteristics	Lake	Canal	Creek
Fish abundance (site mean)	2,425	969	328
Species per site (site mean)	22	18	12
Total species per habitat	36	31	26
Unique species / habitat	12	10	5
Species found in all habitats	14		
Estuary perchlet abundance	4,009	863	48
Southern herring	1,930	1,568	114

To gain a better understanding of how fish communities varied between the different habitats (lake, canal, and creek) within Currimundi Lake, ordination with non-metric multidimensional scaling (nMDS) using Bray Curtis similarity was used (Figure 2). This analysis showed that there is some broad habitat type grouping in the 2019 survey sites, with the Lake and Canal sites being grouped separate from the creek sites.

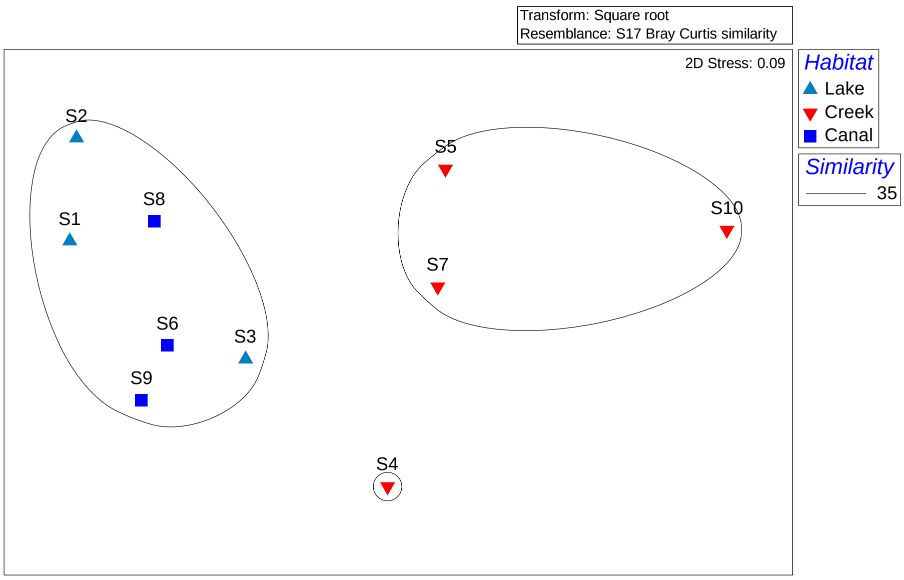

Figure 2. MDS plot of the 2019 data from Currimundi Lake. The number in figure refers to site number (S1-S10).

3.2 Comparison with previous surveys

3.2.1 Species

A total of 77 fish and three ray species have been recorded during the surveys of Currimundi Lake during 2013, 2015, 2017 and 2019. There has been an increase in the numbers of species recorded in each survey, with 41 species being recorded in 2013, 46 species being recorded in 2015, 53 species recorded in 2017 and 53 in the current survey.

During each survey large differences in fish species occurrences have been recorded, with 12 new fish species recorded in 2015, 12 new fish species were recorded in 2017 and 10 new species in the current survey. Fish diversity during this survey was higher than previously recorded in two of the survey sites (sites four and eight). Overall recorded fish species diversity within individual sites has been relatively variable over time (Figure 3).

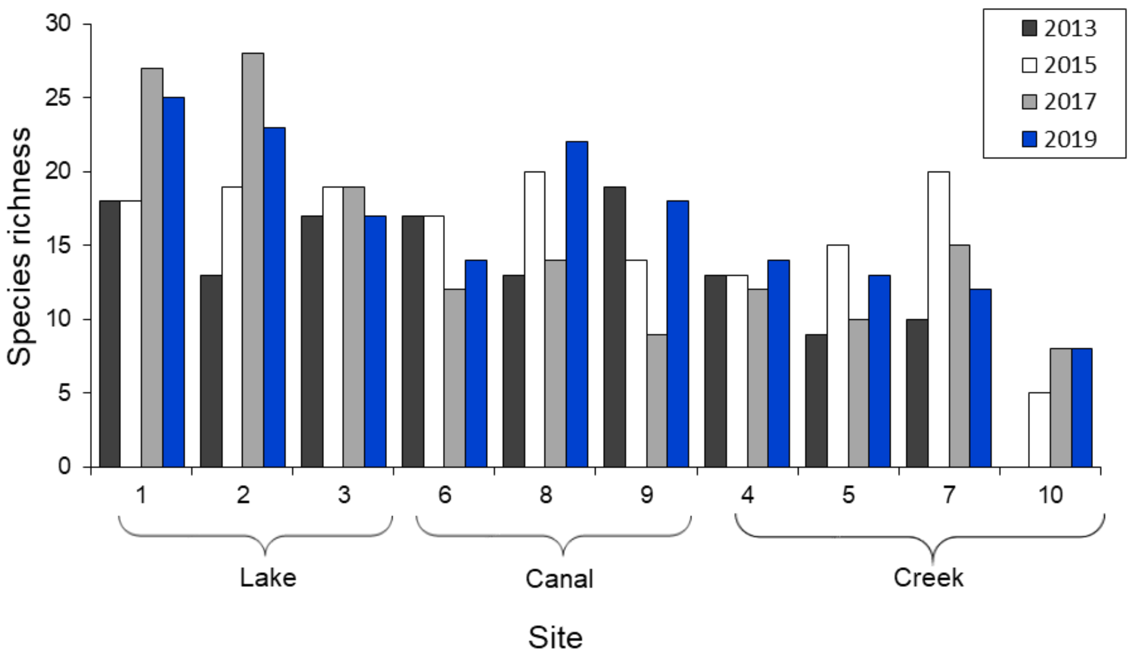

Figure 3. Recorded fish diversity within sites between 2013, 2015 and 2017.

3.2.2 Fish abundance

The current survey of Currimundi Lake recorded much higher fish abundance than all previous fish surveys, with approximately twice as many individual fish being recorded. A mean of 1,146 fish were caught per site during this survey, while a mean of 484 fish per site recorded in 2015, 517 fish per site in 2013 and 495 fish per site in 2017. This observed increases in fish abundance was most noticeable in lower lake and canal sites (sites 1, 2, 6 and 8) where large catches of southern herring and estuary perchlet were made. Over time fish abundance in individual sites has been highly variable between years (Figure 4).

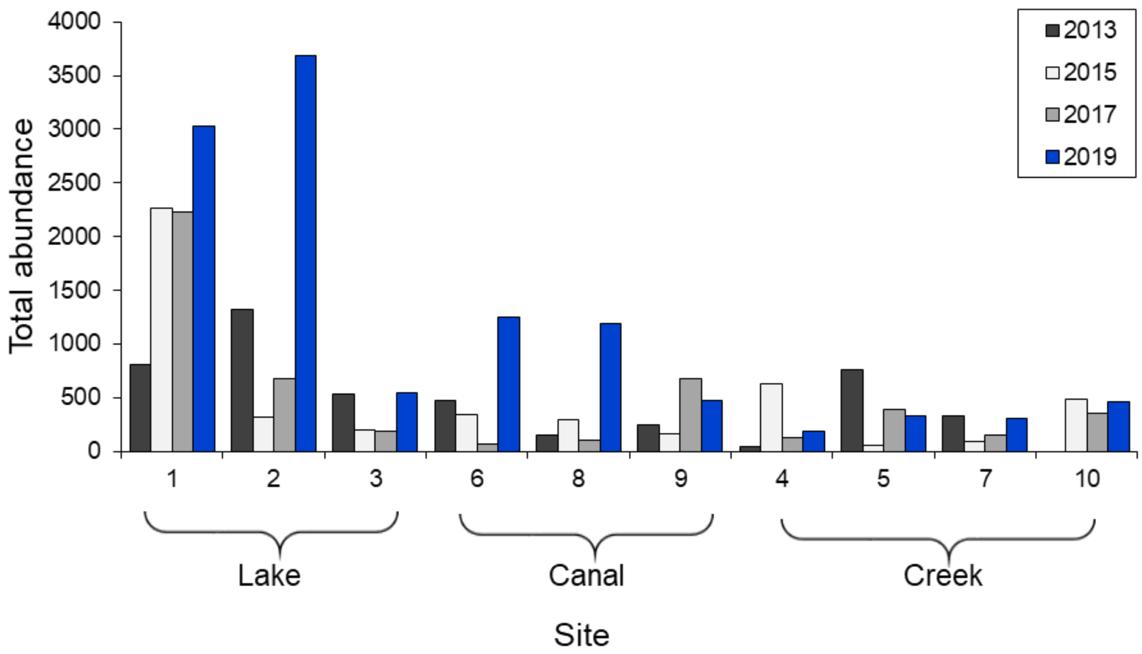

Figure 4. Recorded fish abundance within sites between 2013, 2015 and 2017.

3.2.3 Fish community structure between years

To test for any differences between the four surveys (2013, 2015, 2017 and 2019) undertaken within Currimundi Lake, a one way ANOSIM (Analysis of Similarities) was performed with each year as a factor. This analysis revealed that overall there were significant differences in fish communities between the surveys (r = 0.085, p=0.038). Individual pairwise tests show that the current survey (2019) was different to all the other surveys (2013, 2015, and 2017).

Table 4. Results of one-way ANOSIM tests between sample years. (*) indicates significantly different (p <0.05) result.

Test	R value	P value
Global Test	R = 0.85	0.038*
2013 vs 2015	R = 0.003	0.421
2013 vs 2017	R =0.027	0.291
2013 vs 2019	R =0.201	0.014*
2015 vs 2017	R =0.039	0.662
2015 vs 2019	R =0.243	0.008*
2017 vs 2019	R =0.001	0.0108*

The Similarity Percentages (SIMPER) routine in PRIMER (Clarke 1993) was used to explore the fish species contributing to these differences in fish assemblages between current and previous surveys. Sixty percent of the dissimilarity between the 2019 survey and earlier surveys was attributed to higher abundances of glassfish (*Ambassis* spp. grouped), Southern herring (*Herklotsichthys castelnaui*), Pacific blue eye (*Pseudomugil signifier*), silver biddy's (*Gerres subfasciatus*), ornate ponyfish (*Nuchequula gerreoides*), greenback mullet (*Liza* *subviridis*) and lower abundances of tiger mullet (*Liza argentea)* and sea mullet (*Mugil cephalus*).

3.2.4 Fish communities in lake, canal and creek habitats

Over time the survey fish community characteristics within each of the three habitat types present within Currimundi Lake were examined. A MDS plot of the combined fish community data is shown in Figure 5, this contains data from the 2013, 2015, 2017 and current 2019 survey of Currimundi Lake. Figure 5 shows an approximate separation of the creek sites from the river and canal sites.

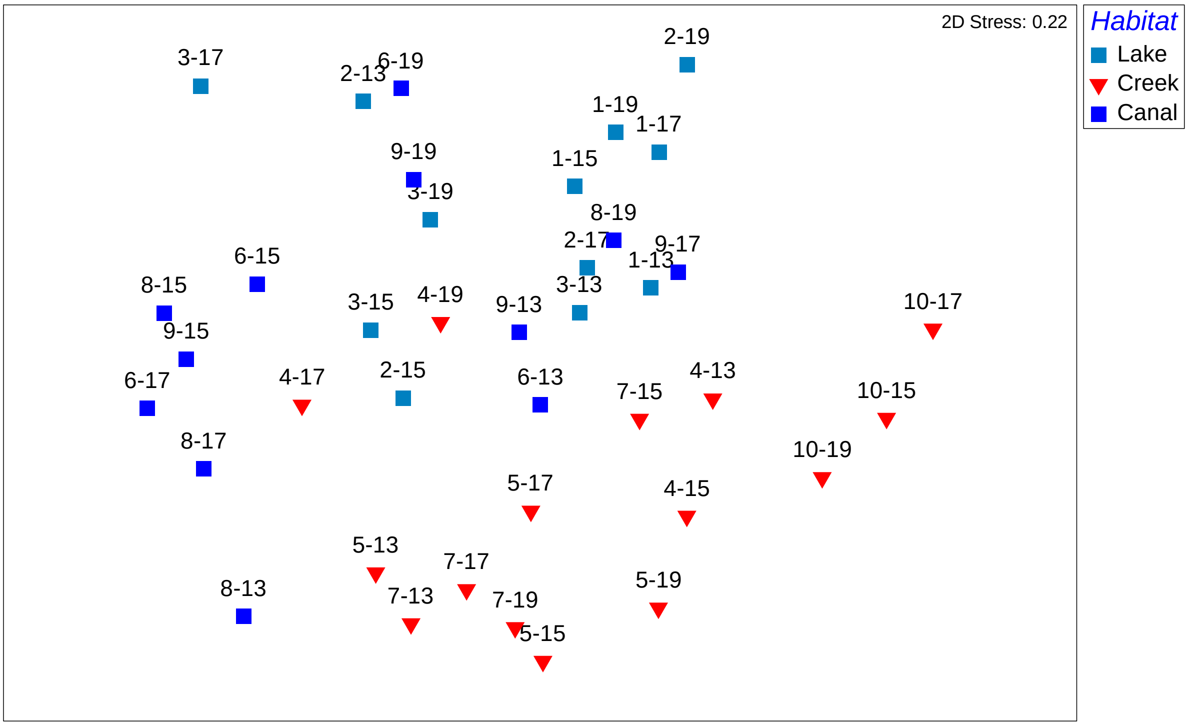

Figure 5. MDS plot of the pooled fish data from Currimundi Lake. The first number of the label refer to the site number (1-10) and the second the year (2013, 2015, 2017 and 2019).

To test for differences between the three broad habitats within Currimundi Lake, a one way ANOSIM (Analysis of Similarities) was performed with each habitat group as a factor. This analysis revealed that there were significant differences in fish communities between sites located in the creeks and sites located both in the lake and canals (Table 4). This analysis shows that the general trends observed in the most recent pooled data is similar to those found in the previous years (Pitman 2017).

Table 4. Results of one-way ANOSIM tests between habitats. (*) indicates significantly different (p <0.01) result.

Test	R value	P value
Global Test	0.301	0.0001*
Lake vs Creek	0.403	0.0001*
Lake vs Canal	0.139	0.027
Creek vs Canal	0.330	0.0003*

The Similarity Percentages (SIMPER) routine in PRIMER (Clarke 1993) was used to explore the fish species contributing to differences in fish assemblages found between creek sites and lake and canal sites in Currimundi Lake. This analysis found substantial differences in the species occurrence and abundance between these different habitats (Table 5). The creek sites recorded 47 fish species while 71 fish species were recorded in the lakes and canal sites. Of the 44 species found in both habitats, 28 species had higher abundances in the lakes and canals and 16 had higher abundances in the creek sites (Table 5).

Of the 77 fish species recorded in Currimundi Lake, 11 fish species contributed to 63% of the dissimilarity between the creek sites and sites located in the canals and lakes. This corresponded with higher abundances of eight fish species (glassfish, Southern herring, tiger mullet, silver biddy, bream, common ponyfish, sand whiting, trumpeter whiting and sea mullet) in the lake and canal sites, and higher abundances of pacific blue eye and greenback mullet in the creek sites (Table 5).

Table 5. Fish abundance (CPUE / catch per site) for eleven species of fish that had the highest dissimilarity between habitat types, two glassfish species were grouped for the analysis. Bold indicates higher abundance. Eleven species accounted for a total dissimilarity of 63%.

Fish species	Lake / Canal sites (n=24)	Creek sites (n=15)	Dissimilarity Contribution
Glassfish (*Ambassis* spp.)	**428**	151	17.3
Herring (*Herklotsichthys castelnaui*)	**269**	39	13.2
Pacific blue eye (*Pseudomugil signifer)*	3	**30**	6.6
Tiger mullet (*Liza argentea*)	**38**	21	5.8
Silver biddy (*Gerres subfasciatus*)	**48**	19	4.5
Bream (*Acanthopagrus australis*)	**8**	0.5	2.6
Common pony fish (*Leiognathus equulus)*	**9**	1	3.0
Greenback mullet (*Liza subviridis*)	5	**10**	2.6
Sand whiting (*Sillago ciliata*)	**5**	0.2	2.6
Trumpeter whiting (*Sillago maculata*)	**5**	0.3	2.6
Sea mullet (*Mugil cephalus*)	**7**	4	2.2
Fish species with higher abundance	28	16	
Total fish diversity (77 in all sites)	71	47	

3.5 Freshwater fish survey results

A total of 490 individual fish were caught and observed during the surveys of the two freshwater sampling sites, representing nine species of native freshwater fish and two introduced species mosquitofish (*Gambusia holbrooki*) and platy (*Xiphophorus maculatus*) (Table 6).

Overall the sites were numerically dominated by empire gudgeons (*Hypseleotris compressa*); (50% of the total catch), striped gudgeons (*Gobiomorphus australis*) (16.3% of the total catch), and mosquitofish (15.7% of total catch). Three other fish species were also relatively abundant including Southern blue eye (*Pseudomugil signifer*) (30 fish), long finned eels (*Anguilla reinhardtii)* (27 fish), and Agassiz's glassfish (*Ambassis agassizii*) (20 fish) (Table 6). The remaining five species were not as abundant with 11 or less individuals being caught (Table 6).

Table 6. Fish fauna from the two 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
AMBASSIDAE				
Ambassis agassizii	Agassiz's glassfish	20	1	4.1
Ambassis marianus	Estuary perchlet	1	1	0.2
ANGUILLIDAE				
Anguilla reinhardtii	Long finned eel	27	2	5.9
ELEOTRIDAE				
Hypseleotris compressa	Empire gudgeon	245	2	50.0
Gobiomorphus australis	Striped gudgeon	80	2	16.3
KUHLIDAE				
Kuhlia rupestris	Jungle perch	2	2	0.4
MUGILIDAE				
Mugil cephalus	Sea mullet	2	2	0.4
PSEUDOMUGILIDAE				
Pseudomugil signifer	Southern blue eye	30	2	6.1
POECILIIDAE				
Gambusia holbrooki #	Mosquitofish	77	2	15.7
Xiphophorus maculatus #	Platy	3	1	0.6
TERAPONTIDAE				
Leiopotherapon unicolor	Spangled perch	1	1	0.2
Total number of fish species				11
Total abundance				490

3.6 Comparison with previous freshwater fish surveys

A total of 19 freshwater fish species have been recorded in the freshwater habitats of Currimundi Lake, during the historical surveys (1993, 1997 and 2000), three previous surveys (2013, 2015 and 2017) and the current fish survey (2019) (Table 7). The fish species included one marine migrant, sea mullet (*Mugil cephalus*) which frequently occurs in freshwater environments. The surveys also recorded one estuarine species, the estuary perchlet (*Ambassis marianus*) and two pest species (Table 7). A single rare species with high conservation significance was recorded, the jungle perch (*Kuhlia rupestris).*

The current study recorded eleven species, this is slightly lower than the three previous surveys. Over the last four years there has been some variation in species occurrence. Six species have been recorded during all three surveys and ten species have not always been recorded.

Table 7. Freshwater fish species occurrences in the freshwater sites of the Currimundi catchment from current study, 2013 and 2015 data (Pitman *et al* 2013; Pitman 2015, 2017) and historical data from Leggett (1993, 1997 and 2000). # indicates introduced species.

Freshwater species	1993	1997	2000	2013	2015	2017	2019
Ambassis agassizii				•	•	•	•
Ambassis marianus					•	•	•
Anguilla reinhardtii				•	•	•	•
Anguilla australis				•	•	•	
Craterocephalus stercusmuscarum	•	•	•	•	•		
Gambusia holbrooki #	•	•	•	•	•	•	•
Gobiomorphus australis				•	•	•	•
Hypseleotris galii	•	•	•	•		•	
Hypseleotris compressa	•	•	•	•	•	•	•
Kuhlia rupestris					•		•
Leiopotherapon unicolor				•			•
Megalops cyprinoides		•	•				
Melanotaenia duboulayi	•	•	•				
Mugil cephalus				•	•	•	•
Myxus petardi	•	•	•				
Philypnodon grandiceps				•	•	•	
Pseudomugil signifer		•			•	•	•
Retropinna semoni	•	•	•				
Tandanus tandanus	•	•	•	•			
Xiphophorus maculatus #					•	•	•
Total species count	8	10	9	12	12	12	11

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).

4. Discussion

4.1 Estuarine fish communities

A total of 11,462 fish and a single stingray were captured during this 2019 survey of Currimundi Lake, representing a total of 55 fish and ray species. This brings the total number of fish species recorded in the lake to 78 species. The species recorded in Currimundi Lake are represented by the groups listed in Table 8. Overall the fish community is dominated by marine migrants (62% of species), reasonable numbers of estuarine species (17% of species) and marine stragglers (12%) and fewer species in the remaining four groups. High proportions of fish that spawn in marine environments are typical in fish assemblages of southern ICOLLs (Neira and Potter 1994) and in temperate to tropical estuarine systems (Blaber 1980; Neira and Potter 1994; Bell *et al*. 1994; Sheaves *et al*. 2013).

Table 8 - Defining the species found in the study area. Adapted from Gillanders *et al.* (2012)

Term	Definition	Number of species
Marine stragglers	Species that spawn at sea and enter estuaries in low numbers. Occur in the lower reaches of estuaries where salinity is close to marine waters	9
Marine migrants	Species that spawn at sea and often enter estuaries as juveniles. Move throughout whole estuary, includes marine estuarine opportunist and marine-estuarine dependent species	48
Estuarine species	Includes estuarine residents that can only complete entire life cycle within estuaries and estuarine migrants in which larval stage occurs outside estuary	13
Catadromous species	Species that spend most of their life in freshwater and migrate to sea to spawn.	3
Freshwater Migrants	Freshwater species found regularly and in reasonable numbers	1
Freshwater stragglers	Freshwater species found in low numbers in estuaries, occur in upper reaches in low salinity	3
Pest fish	Freshwater pest species found in low numbers in estuaries, occur in upper reaches in low salinity	1

Repeat surveys of Currimundi Lake have recorded variable species occurrence, new species records and large variations in the abundance of some species between surveys. In particular, significant differences were found between the fish community 2019 survey compared to the previous surveys in 2013, 2015 and 2017. These differences were due to higher abundances of glassfish, southern herring, Pacific blue eye, silver biddy, ornate ponyfish, greenback mullet and lower abundances of tiger mullet and sea mullet. The high variation in the species occupancy and abundance in Currimundi Lake are mostly attributed to marine migrants and marine stragglers that spawn in oceanic or coastal spawning grounds that may be a large distance away (e.g. marine migrants and marine stragglers) from the lake. Variation in species occurrence and abundance are likely to be influenced by the meteorological and oceanic conditions that influence fish larvae transport and food availability (Norcoss and Shaw 1984). Further study and comparisons of other nearby coastal waterbodies may help determine patterns in fish distribution and occurrence and ecological drivers.

The current fish species diversity recorded in Currimundi Lake is greater than the majority of published fish survey data results from temperate and sub-tropical regions of eastern Australia, and fewer than recent records from Bells Creek in the Pumicestone Passage, the Southport Seaway (highly marine influenced entrance to the Nerang River) and tropical systems (Table 9). It is likely that further sampling will result in an increase in fish species records and further changes in species occupancy from the lake.

Table 9. Table Species diversity from temperate subtropical and tropical estuaries

Study	Region	Location	Species	Author
Mangrove creek	Sub-tropical	McCoy's Creek	30	Pitman 2013a
Burleigh artificial	Sub-tropical	Gold coast	33	Waltham and Connolly 2007
Mangrove	Sub-tropical	Moreton Bay	36	Laegdsgaard and Johnson 2001
Estuarine sand bank	Sub-tropical	Noosa River	38	Miller and Skilleter 2006
Mangrove creek	Sub-tropical	Tin Can Bay	42	Halliday and Young 1996
Seagrass and	Temperate	Pittwater, Sydney	42	Jelbart *et al.* 2007
Artificial canal	Temperate	Southern NSW	43	Lincoln Smith *et al.* 1995
Canal and river	Sub-tropical	Nerang river	44	Morton 1989
Mangrove Creek	Sub-tropical	Serpentine Creek	45	Quinn 1980
Mangrove Creek	Temperate	Botany Bay	46	Bell *et al*. 1984
Canal and river	Sub-tropical	Tallebudgera	51	Morton 1992
Seagrass and	Sub-tropical	Northern NSW	52	Gray *et al*. 1996
Canals and lakes	Sub-tropical	Gold Coast	52	Waltham and Connolly 2007
Estuary	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
ICOLL surveys	Sub-tropical	Sunshine Coast	61	Pitman 2019
Bells Creek Mangrove / grass.	Sub-tropical	Pumicestone Passage	112	Pitman 2019a
Northern QLD	Tropical	4 tropical creeks	102	Sheaves *et al.* 2013
Northern QLD river	Tropical	Alligator Creek	128	Robertson and Duke 1990
Northern QLD	Tropical	4 large estuaries	203	Robertson and Duke 1987
Fish checklist	Sub-tropical	Southport Seaway	404	Johnson 2010

The persistence of healthy *Zostera sp*. seagrass beds within the lake has contributed to higher fish species diversity and abundance within survey sites located near the entrance of

Currimundi Lake. Over the last two survey events these sites have consistently had higher fish abundance and diversity than other survey sites. Within Currimundi Lake certain fish species are only found on seagrass beds, for example, fringe eye flathead, sabre-toothed blenny, trumpeter, pipefish, juvenile black spine foot, fan bellied leather jacket, stars and stripes toadfish and juvenile marine migrants such as the lined bristletooth and juvenile grass emperor. In addition, some common schooling species are highly abundant over seagrass (e.g. Juvenile southern herring and Port Jackson glassfish) as well as species commonly found in adjacent sandy areas. Seagrass habitats are considered an important nursery area for juvenile and other fish, due to its structural complexity providing shelter from predators as well as increased food resources (Gray *et al.* 1996).

Over the previous twelve years the entrance to Currimundi Lake has been mechanically opened 27 times. The lake is mechanically opened to prevent flooding in upstream areas, after natural closing and when it has been artificially closed to manage the biting midge problem. At the time of the 2019 survey the entrance to the lake had closed naturally in the week prior to sampling, this has not occurred during any of the other surveys. It is unknown how a closed entrance affects fish behaviour in the lake and fish distribution, although with increasing water height fish were observed along recently flooded lake margins.

When all the estuarine data was pooled from 2013, 2015, 2017 and 2019 surveys, 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 lake and canal sites. The lake and canal sites have consistently recorded higher diversity than the creek sites (61 fish species vs 47 fish species), as well as higher abundances of fish. A SIMPER analysis found that 11 fish species contributed too much of the dissimilarity between the creek sites and sites located in the canals and lakes. This corresponded with higher abundances of eight fish species (glassfish, herring, tiger mullet, silver biddy, bream, common ponyfish, sand whiting, trumpeter whiting and sea mullet) in the lake and canal sites, and higher abundances of pacific blue eye and greenback mullet in the creek sites.

The observed 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. Water quality recorded at the time of the survey found that dissolved oxygen was consistently lower (mean of 44% saturation bottom reading) within creek sites than in any of the lake and canal sites (mean of 67% saturation bottom reading). In the creek sites dense overhanging riparian vegetation and the breakdown of organic matter combined with low levels of flushing would likely be contributing to lower dissolved oxygen readings in these sites.

4.2 Freshwater fish communities

A total of 490 individual fish were caught during the surveys of the two freshwater sampling sites in the north and south arms of Currimundi Lake. These fish represented nine native freshwater fish and two introduced species, the mosquitofish (*Gambusia holbrooki*) and platy (*Xiphophorus maculatus*). There have been a total of 16 freshwater species recorded during the three freshwater surveys (2013, 2015, 2017 and 2019). Similar number of species have been recorded during each survey, although there has been some variation in the species occurrence in these sites.

The current survey did not record several species that were recorded in historical surveys of the lake undertaken by Ray Leggett (1993, 1997 and 2000). During the older surveys Australian smelt (*Retropinna semoni*), crimson spotted rainbowfish (*Melanotaenia duboulayi*) and freshwater mullet (*Myxus petardi*) were recorded. 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. Catchment alterations including changes in salinity regimes in Currimundi Lake from the Lake Kawana development may have contributed to the loss 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 fish 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 survey recorded two juvenile jungle perch (32mm and 27mm long) in the upper reaches of Currimundi Lake, with a single fish being caught in both the Currimundi Creek south and north arms. Two juvenile jungle perch were also recorded in previous surveys in 2015. None of the surveys have recorded adults of the species, possibly indicating that the species may not have been successful in colonising the study area. Although more rigorous surveys would be required to determine if this was the case.

Over the last three decades numbers of jungle perch have been declining and 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 (Scanlon and Marsden, 2010). Riparian clearing, habitat degradation, pest fish and barriers to fish passage are the likely causes of species decline. In particular, the species is sensitive to waterway barriers, as adults live in freshwater and spawn in the sea.

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.

- 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.

- 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.

- To identify if adult jungle perch are present in the study area more intensive sampling effort within the upper catchment is required.

5. References

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6. Appendix

Appendix A - Fish catch per site (*) refers to pest species.

Fish species	Site 1	2	3	4	5	6	7	8	9	10	Total
Acanthopagrus australis	2		3		1	1		13	2		22
Afurcagobius tamarensis					2	1			6		9
Ambassis agassizii										5	5
Ambassis jacksoniensis	2428	1574	7	3	44		1	839	24		4920
Ambassis marianus	5	218	15	48	17	1	2		7	358	671
Arothron hispidus	1										1
Arrhamphus sclerolepis		1	29					3	7		40
Butis butis	1										1
Caranx melampygus	1	1									2
Caranx sexfasciatus		3									3
Ctenochaetus striatus	1										1
Cymbacephalus nematophthalmus		3									3
Elops hawaiensis								3			3
Favonigobius exquisitus	5			1	9	4		30			49
Gambusia holbrooki *										8	8
Gerres filamentosus	2		2			2		1	2		9
Gerres subfasciatus	93	51	97	47	39	101	19	121	20	5	593
Gobiomorphus australis										1	1
Helotes sexlineatus	4	187									191
Herklotsichthys castelnaui	415	1149	366	6		1041	108	150	377		3612
Hyperlophus translucidus								1			1
Leiognathus equulus						8			9		17
Lethrinus laticaudis	1	8									9
Liza argentea	30	8	1	2	114		20	5		8	188
Liza subviridis	2			2							4
Lutjanus argentimaculatus								2			2
Marilyna pleurosticta		2									2
Monacanthus chinensis	2	1									3
Monodactylus argenteus		2		5			1				8
Mugil cephalus	2	1	1		1			1			6
Mugilogobius platynotus							3				3
Nuchequula gerreoides	1	375		62	3	30		1			472
Parkraemeria ornata								1			1
Pastinachus ater								1			1
Periophthalmus argentilineatus							1				1
Petroscirtes lupus	4	1									5
Philypnodon grandiceps					8					3	11
Platycephalus fuscus								2	1		3

Fish species	Site										Total
	1	2	3	4	5	6	7	8	9	10	
Plectorhinchus gibbosus		1									1
Pomadasys argenteus			1	1			1	2	4		9
Pomadasys kaakan									1		1
Psammogobius biocellatus						1					1
Pseudogobius sp.					40		17	1			58
Pseudomugil signifer			11		51	45	130	3		74	314
Pseudorhombus arsius		1				1					2
Repomucenus macdonaldi									1		1
Rhabdosargus sarba	2		1	1					1		5
Siganus fuscescens		36									36
Sillago ciliata	14		6	1		8		2	2		33
Sillago maculata	2		1								3
Sillago spp.				2		6		2	5		15
Siphamia roseigaster		58									58
Terapon jarbua	2	2	5	1					1		11
Tetractenos hamiltoni	8	8	2		1		1	2	2		24
Yongeichthys nebulosus	6		1								7
Grand Total	3034	3691	549	182	330	1250	304	1186	472	462	11460
Total species	25	23	17	14	13	14	12	22	18	8	54

Appendix B – Estuarine fish species records between survey years.

Estuarine fish species occurrences Currimundi lake estuary sites, from present study, and previous surveys (Pitman *et al*.; 2013; Pitman 2015 and 2017). New species records are highlighted in red. (*) refers to pest species.

Species	Common Name	2013	2015	2017	2019
Acanthopagrus australis	Bream	1	1	1	1
Afurcagobius tamarensis	Tamar goby				1
Ambassis agassizii	Freshwater glassfish				1
Ambassis jacksoniensis	Glassfish			1	1
Ambassis marianus	Estuary perchlet	1	1	1	1
Argyrosomus japonicus	Jewfish	1			
Arothron hispidus	Stars and stripes toad	1	1	1	1
Arrhamphus sclerolepis	Snub nosed garfish	1	1	1	1
Butis butis	Crazy fish	1	1		1
Caranx melampygus	Bluefin trevally		1	1	1
Caranx ignobilis	Giant trevally	1	1	1	
Caranx sexfasciatus	Big eye trevally	1	1	1	1
Centropogon marmoratus	Fortescue			1	
Chanos chanos	Milkfish	1	1		
Ctenochaetus striatus	Lined bristletooth				1
Cymbacephalus nematophthalmus	Fringe eye flathead			1	1
Dasyatis fluviorum	Estuarine stingray			1	
Elops hawaiensis	Giant Herring				1
Favonigobius exquisitus	Exquisite sand-goby	1	1	1	1
*Gambusia holbrooki**	Mosquitofish		1	1	1
Gerres filamentosus	Threadfin biddy	1	1	1	1
Gerres subfasciatus	Common silver belly	1	1	1	1
Glaucostegus typus	Shovel nose shark			1	
Gobiomorphus australis	Striped gudgeon				1
Gobiopterus semivestutus	Glass goby	1			
Herklotsichthys castelnaui	Southern herring	1	1	1	1
Hippichthys penicillus	Beady Pipefish			1	
Hyperlophus translucidus	Glassy sprat				1
Hyporhamphus regularis	River garfish		1	1	
Hypseleotris compressa	Empire gudgeon		1	1	1
Kuhlia rupestris	Jungle perch		1		
Leiognathus fasciatus	Common pony fish	1	1	1	1
Lethrinus laticaudus	Grass emperor		1	1	1
Liza argentea	Tiger mullet	1	1	1	1
Liza subviridis	Greenback mullet		1	1	1
Lutjanus argentimaculatus	Mangrove jack	1	1	1	1
Lutjanus russellii	Moses perch	1	1	1	
Marilyna pleurosticta	Striped toadfish	1	1	1	1
Monacanthus chinensis	Fan bellied leather jacket				1
Monodactylus argenteus	Silver batfish	1	1	1	1
Mugil cephalus	Sea mullet	1	1	1	1
Mugilogobius platynotus	Mangrove goby	1	1		1
Myxus elongatus	Sand mullet	1			
Nuchequula gerreoides	Ornate ponyfish			1	1

Species	Common Name	2013	2015	2017	2019
Pardachirus hedleyi	Sole			1	
Parkraemeria ornata	Ornate sand diving goby				1
Pastinachus ater	Cowtail stingray	1	1	1	1
Pelates sexlineatus	Trumpeter			1	1
Periophthalmus gracilis	Slender mudskipper		1	1	1
Petroscirtes lupus	Sabre blenny	1			1
Philypnodon grandiceps	Flathead Gudgeon				1
Platycephalus fuscus	Dusky flathead	1	1	1	1
Plectorhinchus gibbosus	Brown sweetlip	1			1
Plotosus lineatus	Striped catfish			1	
Pomadasys argenteus	Grunter			1	1
Pomadasys kaakan	Grunter	1	1	1	1
Psammogobius biocellatus	Estuarine goby		1	1	1
Pseudogobius sp. *9*	Blue spot goby		1	1	1
Pseudomugil signifer	Pacific blue eye	1	1	1	1
Pseudorhombus arsius	Large toothed flounder			1	1
Pseudorhombus jenynsii	Small toothed flounder	1		1	
Repomucenus macdonaldi	Spotted stinkfish	1			1
Rhabdosargus sarba	Tarwhine	1	1	1	1
Scomberoides tol	Needleskin Queenfish		1	1	
Selenotoca multifasciata	Striped scat	1			
Siganus fuscescens	Happy moment	1	1	1	1
Sillago ciliata	Sand whiting	1	1	1	1
Sillago maculata	Trumpeter whiting	1	1	1	1
Siphamia roseigaster	Pink-Breasted siphonfish				1
Sphyraena barracuda	Giant Barracuda		1	1	
Sphyraena obtusata	Striped sea pike	1	1	1	
Synaptura nigra	Black sole	1			
Terapon jarbua	Crescent perch	1	1	1	1
Tetractenos hamiltoni	Common toadfish	1	1	1	1
Torquigener pleurogramma	Weaping toado	1	1		
Tripodichthys angustifrons	Yellow tripod fish		1		
Yongeichthys nebulosus	Shadow goby		1	1	1
Number of Species		41	46	53	54
New Species		-	14	12	10
Total Species		41	55	67	77