A report prepared for The Townsville City Council

South Townsville Stormwater Drainage Fish Survey

Report No 99/30

November 1999

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SUMMARY

Fish surveys at sites within the Upper Ross Creek and its associated Stormwater Drainage System (the Lakes Development) were done in April, August and September 1999. A total of 39 species were recorded from all sites sampled. Ten species were recorded in the Curralea Lake, 18 species from the Paradise Lake and 34 species from the Upper Ross Creek below the tidal gates. Ninety percent of the fish in samples from the Curralea Lake are considered to be either euryhaline freshwater species (ie., with wide salinity tolerance) or are occasionally known to enter freshwater. Ninety percent of the species from the Curralea Lake were also recorded in the Paradise Lake. Only four species from the combined samples from the Lakes were not recorded from the Upper Ross Creek below the tidal gate.

1.0 INTRODUCTION

Estuaries are dynamic and complex ecosystems with respect to their fish assemblages. Typically, fish species composition, richness, distribution and abundance change continually both spatially (eg. from lower to upper reaches) and temporally (eg. between wet and dry seasons in the tropics). Several surveys of estuarine systems have been done in northern Queensland, including the Ross River (Shepherd 1994), Three Mile Creek, Pallarenda, Townsville (Penridge 1971), Alligator Creek (Sheaves 1992), Trinity Inlet, Cairns (Blaber 1980), the Embley estuary, western Cape York Peninsula (Blaber *et al.* 1989). There have been few surveys of fish species conducted in the Ross Creek Drainage System. During the period 1990-93, a total of 34 spp were recorded from the Curralea Lake and Upper Ross Creek below the tidal gates, with 25 species recorded in the Curralea Lake (Milward and Webb 1990; Webb 1994). This survey will provide current data for an ongoing monitoring program of the fish fauna in the Ross Creek Drainage system, including the artificial impoundments, the Curralea Lake and Paradise Lake, as part of the Townsville City Council's Stormwater Management Plan.

2.0 METHODS

2.1 Description of Study Sites

The Ross Creek has undergone major realignment through reclamation and flood mitigation work to form the South Townsville Drainage System. The Creek is an anabranch of the Ross River to which it is still connected by underground pipe, although its major distribution function is for stormwater runoff. The major outlet is the Woolcock Street drain, which is regulated by a tidal gate at its junction with the Creek. Although, highly modified, the Creek below the tidal gate is lined with a narrow fringe of mangroves dominated by *Avicennia, Ceriops* and *Rhizophora*. Bottom sediments vary from coarse to fine sand with scattered rocks to fine mud. Samples were collected immediately below the tidal gate and above the Boundary Street culvert upstream to Sandy Crossing (Site 1)(Figure 1, 2, 3).

Approximately 500 meters above the tidal gate, the Woolcock Street drain was reconstructed in 1997 to form the Paradise Lake (area: 110,092 sq.m; average depth 1.5m) (Site 2)(Figure 4). The Curralea Lake (Site 3)(Figure 5), located on the opposite side of Woolcock Street to the Paradise Lake, was constructed in 1987 (area 100,000 sq.m, av depth 2.5m). A floodway and underground pipe interconnect the Lakes. There is no natural riparian vegetation associated with Curralea Lake, although there is a narrow regenerating strip of mangroves along the margin at the junction of Paradise Lake and the drainage canal leading to Ross Creek. Bottom sediments in both Lakes are dominated by a thick homogenous layer of black, anoxic mud.

2.2 Sampling methods

Fish surveys at three sites were conducted in April, August and September 1999. Fish were collected using seine nets (mesh size: 4mm, 10mm) and gill nets (mesh size: 5, 7.5, 10, 11.5, 12.5, 15cm) at each site. Repeated seine net samples were taken at several locations within each site on two separate occasions in April and September. Gill net samples were collected in August and September on one occasion only at each site. Nets were set in the Lakes for three hours starting in the late afternoon before dusk and checked after 1.5 hours. At Site 1, below the tidal gate, nets were set on a rising tide about two hours before high tide (2.7m), checked after 1.5 hours and removed after three hours. Fish were identified and released. Salinity and water temperature on each sample day were recorded.

2.3 Results

The salinity and water temperature at each site when samples were collected are presented in Table 1.

Table 1. Salinity and Bottom Water temperature data for the Curralea Lake and Paradise Lake during the survey

Site	Curralea Lake		Paradise Lake		Upper Ross Creek	
Date	24.4.99	29.8.99	24.4.99	6.9.99	25.4.99	
Salinity ‰	1.2	4.5	2.4	9.5	24.6	
Temp. °C	25.9	27.3	25.2	27.5	26.6	

During the sampling period, the salinity in both Lakes was significantly lower (about 2.5 times lower) than that recorded in the Ross Creek below the tidal gate. There was also a significant difference in salinity between the two Lakes, with the salinity in the Curralea Lake about half that of Paradise Lake. The Curralea Lake was effectively a freshwater body during the sampling period with salinity between 1.5 and 4.5‰.
The lists of species recorded at each site are presented in Tables 2 to 4.

Table 2. Fish species recorded in seine and gill net samples from the Curralea Lake, (Stage I Lakes Development)

Hypseleotris compressa	Empire gudgeon
Chanos chanos	Milkfish
Nematolosa erebi	Bony bream
Mugil cephalus	Mullet
Rediogobius bikolanus	Speckled goby
Leognathus equulus	Ponyfish
Lates calcarifer	Barramundi
Elops australis	Giant herring
Anguilla reinhardti	Long finned eel
*Oreochromis mossambicus**	Mozambique mouthbrooder (tilapia)

** introduced species*

Table 3. Fish species recorded from seine and gill net samples from the Paradise Lake (Stage II Lakes Development)

Ambassis vachelli	Glass perch
Lates calcarifer	Barramundi
Mugil cephalus	Mullet
Hypseleotris compressa	Empire gudgeon
Rediogobius bikolanus	Speckled goby
Nematolosa erebi	Bony bream
Pseudomugil signifer	Pacific blue-eye
Tetractenos hamiltoni	Common toadfish
Chanos chanos	Milkfish
Elops australis	Giant herring
Caranx ignobilis	Giant trevally
Scatophagus argus	Spotted butterfish
Selenotoca multifasciata	Striped butterfish
Gerres filamentosus	Spotted silver-biddy
Acanthopagrus berda	Pikey bream
Leognathus equulus	Common ponyfish
*Gambusia holbrooki**	Mosquitofish
*Oreochromis mossambicus**	Mozambique mouthbrooder (tilapia)

** introduced species*

Table 4. Fish species recorded in seine and gill net samples from the Upper Ross Creek (below tidal gate)

Mugil cephalus	Mullet
Ambassis vachelli	Glass perch
Pseudomugil signifer	Pacific blue-eye
Chanos chanos	Milkfish
Nematolosa come	Hairback herring
Gerres filamentosus	Spotted silver-biddy
Gerres ovatus	Common silverbelly
Therapon jarbua	Crescent perch
Acanthopagrus berda	Pikey bream
Acanthopagrus australis	Silver bream
Pomadysys kaakan	Spotted grunter-bream
Strongylura strongylura	Blackspot long-tom
Arrhamphus sclerolepis	Snubnosed garfish
Sardinella gibbosa	Goldstripe sardine
Sardinella fimbriata	Fringescale sardine
Sphyraena jello	Pickhandle barracuda
Platycephalus fuscus	Northern dusky flathead
Platycephalus indicus	Bartailed flathead
Secutor ruconius	Pug-nosed ponyfish
Leognathus decorus	Yellowspot ponyfish
L. equulus	Common ponyfish
Butis butis	Crimson-tipped flathead gudgeon
Gobiid spA	Goby
Rediogobius bikolanus	Speckled goby
Tetractenos hamiltoni	Common toadfish
Sillago sihama	Northern whiting
Lates calcarifer	Barramundi
Lutjanus argentimaculatus	Mangrove jack
Elops australis	Giant herring
Scomberoides tala	Deep leatherskin
Caranx ignobilis	Giant trevally
Siganus guttatus	Golden-lined spinefoot
*Oreochromis mossambicus**	Mozambique mouthbrooder (tilapia)
*Gambusia holbrooki**	Mosquitofish

** introduced species*

A total of 39 fish species was recorded for all three sites during the survey, including two introduced species: tilapia, *Oreochromis mossambicus,* and *Gambusia holbrooki.*
Ten species were recorded in the Curralea Lake, 18 species in the Paradise Lake and 34 species in the Upper Ross Creek below the tidal gate.

The dominant species in the seine net samples in the Curralea Lake were *Hypseleotris compressa* and *O. mossambicus*, while *Nematolosa erebi* was the dominant species in the gill net sample from this

site. The dominant species in seine net samples in the Paradise Lake were *H. compressa* and *Ambassis vachelli* while *N. erebi* was the dominant species, and *Mugil cephalus* and *Chanos chanos* were the sub-dominants in the gill net samples from this site. The dominant species in the seine net samples from the Upper Ross Creek below the tidal gate was *Pseudomugil signifer, Nematolosa come,* and *Leiognathus decorus,* while *N. come* and *M. cephalus* were dominant species in the gill net samples.

Six of the 10 species from the Curralea Lake are considered euryhaline freshwater species (*O. mossambicus, Lates calcarifer, H. compressa, Rediogobius bikolanus, N. erebi, Anguilla reinhardti* , and three species (*C. chanos, M. cephalus, Elops australis*) are known to enter freshwater, ie ninety percent of the fish species recorded have a strong freshwater affinity. Nine of the 10 species in the Curralea Lake were also present in the Paradise Lake, while only five of the species occurring in the combined samples for both Lakes (*N. erebi, H. compressa, A. reinhardti, Selenotoca multifasciata* and *Scatophagus argus)* were not present in the samples from the Upper Ross Creek.

The 34 species recorded from the Upper Ross Creek site was more than the totals for both the Lake sites. Only four species (*L. calcarifer, R. bikolanus, O. mossambicus* and *G. holbrooki*) recorded at this site are considered euryhaline freshwater species (12%), with another seven species occasionally entering freshwater (21%). The remainder are estuarine residents, seasonal marine and opportunistic visitors.

2.4 Discussion

Estuaries are spatially and temporally dynamic systems with respect to their species composition and abundance. A wide range of factors can influence species occurrence such as salinity (Robertson *et al.* 1988; Cyrus and Blaber 1992; Morin *et al.*1992), substrate type and substrate heterogeneity affecting food availability, and also providing refuge, ambush and spawning sites (Robertson and Duke 1987; Rozas and Odum 1988; Cyrus and Blaber 1992; Sheaves 1992).

There were significantly fewer species recorded from the Curralea Lake in this survey (10spp) compared with the period between 1990 and 1993 when 25 species were recorded (Webb 1994), although the latter data were obtained over a much longer time period.
The number of species is similar to that reported in the Lake (11 spp) in 1989 by Milward and Webb (1990), although these data probably reflect the young age of the Lake at the time of sampling.

Besides nutrient triggered bacterial blooms, the reduced number of species and change in species composition are most probably due also to a combination of factors influencing hydrological conditions of the Lake, including low salinity and slow turnover time (flushing rate). During this survey, the salinity in both Lakes was significantly less than the salinity recorded in the Upper Ross Creek site, and there was also a significant difference in salinity between the Lakes. Both the Curralea and Paradise Lakes were effectively freshwater in April (1.2 and 4.5‰ respectively), with salinity increasing to 2.4 and 9.5‰ respectively by August and early September.

The low salinity conditions are reflected in the dominance of euryhaline freshwater species in the Curralea Lake samples and their presence also in the Paradise Lake samples. In contrast, the Upper Ross Creek samples were dominated by resident estuarine species and marine visitors with narrower salinity tolerance ranges. Prior to 1994, only 28 percent of species recorded in the Lake were euryhaline freshwater species and a further 24 percent occasionally recorded from fresh water (Webb 1994). Approximately half the total species, therefore, were estuarine residents or marine visitors, which opportunistically entered the Lake, such as the Barracuda, *Sphyraena jello,* the Leatherskin, *Scomberoides tala,* and the Flatheads, *Platycephalus* spp. In 1999, these species were not recorded in the Lake, but were collected from the Upper Ross Creek site.

The survey of the Paradise Lake is the first for this waterbody since its construction in 1997. The total number of species recorded from the Lake (18spp) is smaller than, though comparable with, the total for the Curralea Lake (25 spp) in its early phase of establishment prior to 1994, although, again, the latter survey was done over a much longer time period. The greater number of species in the Paradise Lake is therefore most probably associated with these differences and reflects the more immediate connection of the Paradise Lake with the upper reaches of the Ross Creek via the Woolcock Street drain.

The Upper Ross Creek site samples contained more species (35 spp) than both Lake samples and more than the number recorded (20 spp) in 1989 by Milward and Webb (1990). This total is comparable with the number of species recorded from the upper reaches of the Embley estuary, western Cape York peninsula (40spp) (see Table 1A, Appendix 1). Unfortunately, none of the other surveys in northern Queensland provided species numbers for different estuarine reaches, although the local surveys (for Three Mile Creek, Ross River and Alligator Creek), provide lists of species which potentially may enter or be present in the Ross Creek estuary.

The upper reaches of the Ross Creek below the tidal gate, at least with respect to the Lakes, provide a diverse and structurally heterogenous habitat with the presence of the mangrove riparian vegetation and greater range of sediment types compared with the Lakes. The significantly higher salinity levels at this site also provides more optimal conditions over a greater period for the majority of stenohaline marine and estuarine fishes which inhabit the estuary. The under-representation of some groups of fishes in the survey, eg. benthic gobiids, may reflect the sampling methods used. Some of these species live in burrows and often are associated with snags, which are difficult to sample with nets. Overnight and unattended baited trapping (for longer than three hours) which may collect such species were not done in this survey because initial setting resulted in loss of traps through theft. Alternative, more secure sampling methods are therefore required to adequately sample these species.

While no adult tilapia were collected in gill net samples in the Curralea Lake during this survey, many juveniles and fry were collected in seine samples. Several adult tilapia were collected in gill nets from the Paradise Lake, although larger numbers of juveniles and fry were also observed. In the period 1989-93, tilapia was the dominant fish species in the Curralea Lake with large catches of adult fish (>50) consistently taken (Milward and Webb 1990; Webb 1994). Several recent fish kills in the Lake associated with cyanophyte blooms have undoubtedly contributed to a reduction in numbers of individuals and species of fish, including tilapia, although some species now appear to be present in relatively large numbers.

In this survey, the dominant large fish recorded in the Lakes was the native detritivore, Bony bream, *N. erebi*. In surveys in the Lake before 1994, Bony bream were present but in much lower numbers of mainly juvenile fish (Milward and Webb 1990; Webb 1994).
Bony bream is an important prey species for many predatory fish, such as Barramundi and Giant herring, which are also in the Lake in good numbers. Other research by the author (A. Webb unpubl. data) indicates that adult Barramundi in the Lake are feeding almost exclusively on small Bony Bream which is consistent with findings for fish collected from other sites (eg. Ross River). At present, there is no evidence to indicate that Barramundi have been instrumental in the reduction of tilapia in the Curralea Lake, or in maintaining the adult population at their current low levels. It is not certain, although possible, that the tilapia population in this Lake will recover to pre-1994 levels.

For future surveys, other sampling techniques can be included besides netting, eg., secure fish traps, and an additional sampling period included (mid to late Wet Season during December to February). While further species could most probably have been added in this survey for the upper Ross Creek site, the data provide a good comparison between this site and the Lakes as a basis for future monitoring of the fish fauna of the South Townsville Stormwater Drainage System. The high

conservation value of the riparian vegetation along the upper reaches of the Ross Creek is demonstrated by the diversity of the fish fauna at this site. Further re-establishment of mangroves around the margins of the Lakes is recommended; along with changes in the flushing rates, such habitat improvements should improve the water quality and value as fish habitat of the two Lakes.

Acknowledgments

I would like to thank I. Lissone for her assistance with fieldwork and thanks to Prof. Richard Pearson (A.C.T.F.R. and Dept Zoology, JCU) for reading the draft of the report. I would also like to thank Marcus Sheaves in help with some fish identification and Sandra Sherrif (Townsville City Council) for providing site description data and reference maps.

References

Blaber, S.J.M. (1980) Fish of the Trinity Inlet System of North Queensland with notes on the ecology of fish faunas of tropical Indo-Pacific estuaries. *Aust. J. mar. Freshw. Res.* **31**: 138-146.

Blaber, S.J.M., Brewer, D.T. and Salini, J.P. (1989) Species composition and biomasses of fishes in different habitats of a tropical northern Australian estuary: their occurrence in the adjoining sea and estuarine dependence. *Est., Coast. and Shelf Sci.* **29**: 509-531.

Cyrus, D.P. and Blaber, S.J.M. (1992) Turbidity and salinity in a tropical northern Australian estuary and their influence on fish distribution. *Est. Coast. Shelf Sci*. **35**: 545-563.

Milward, N.E. and Webb, A.C. (1990) *The status of the introduced tilapia, Oreochromis mossambicus, in the Townsville region: distribution, feeding, and reproduction*. Report for the Townsville City Council. Department of Zoology, James Cook University, Townsville.

Morin, B. Hudon, C. and Whoriskey, F.G. (1992) Environmental influences on seasonal distribution of coastal and estuarine fish assemblages at Wemindji, eastern James Bay, Env. Biol. Fish. 35: 219-229.

Penridge, L.K. (1971*) A study of the fish community of a North Queensland mangrove creek.* Hons thesis. Department of Zoology, James Cook University, Townsville.

Robertson, A.I., Dixon, P. and Daniel, P.A. (1988) Zooplankton dynamics in mangrove and other nearshore habitats in tropical Australia. *Mar. Ecol. Progr. Series* **43**: 139-150.

Robertson, A.I. and Duke, N.C. (1990) Mangrove fish-communities in tropical Queensland, Australia: spatial and temporal patterns in densities, biomass and community structure. *Mar. Biol.* **104**: 369-379.

Rozas, P.L. and Odum, W.E. (1988) Occupation of submerged aquatic vegetation by fishes: testing the roles of food and refuge. *Oceologia (Berlin)* **77**: 101-6.

Sheaves, M.J. (1992) Patterns of distribution and abundance of fishes in different habitats of a mangrove lined tropical estuary, as determined by fish-trapping. *Aust. J. mar. Freshw. Res.* **43**: 1461-79.

Shepherd, G. (1994) *The spatio-temporal distributions of the small fishes of Ross River, a tropical North Queensland estuary*. Hons thesis, Department of Marine Biology, James Cook University, Townsville,

Webb, A.C. (1994) *Ecological aspects of the Mozambique Mouthbrooder, Oreochromis mossambicus, and other introduced cichlids in northern Queensland*. Masters thesis, Department of Zoology, James Cook University, Townsville.

Appendix 1

Table 1A. Summary of estuarine fish surveys conducted in northern Queensland

Reference	Location	No. spp	No. Families	Duration
Penridge 1971	3 Mile Creek, Pallarenda, Townsville	59	30	6 mo
Shepherd 1994	Ross River estuary, Townsville	92	32	6 mo
Robertson & Duke 19	Alligator Creek, Cleveland Bay	128	43	13 mo
Sheaves 1992	Alligator Creek	23	15	6 mo
Blaber 1980	Trinity Inlet, Cairns	54	28	4 mo
Blaber *et al.* 1989	Embley estuary, western Cape York Peninsula	197[181 lower, 69 middle and 40 upper]	-	30 mo

Figure 1. (Site 1) The Ross Creek just below the tidal gates (in the background) at the junction with the Woolcock Street stormwater drain

Note: In left foreground, turbulence as water flows from the upper reaches of Ross Creek (see Figure 2 and 3) on an outgoing tide through two large pipes under Boundary street

Figure 2. (Site 1) The Ross Creek on the upstream side of Boundary Street

Figure 3. (Site 1) The Ross Creek at Sandy Crossing in Hermit Park

Figure 4. (Site 2) Paradise Lake form Woolcock Street

Note: Regenerating mangroves in foreground and absence of riparian vegetation in background around the perimeter of the lake)

Figure 5. (Site 3) Curralea Lake from Woolcock Street

Note: The floodway in foreground and absence of riparian vegetation around the perimeter of the lake, apart from that associated with a private residence on the left)