Gladstone Area Water Board Environmental Monitoring Program

Aquatic Ecosystem Monitoring 2004
Fish and Habitat Assessment

V.Rogers and A.Melzer.

Centre for Environmental Management
Faculty of Arts, Health and Sciences
Central Queensland University
Gladstone Q 4680

2004

Central Queensland
UNIVERSITY

Gladstone Area Water Board
Environmental Monitoring Program

Aquatic Ecosystem Monitoring 2004
Fish and Habitat Assessment

Centre for Environmental Management
Faculty of Arts, Health and Sciences
Central Queensland University
Gladstone Q 4680

Table of Contents

List of Tables

List of Figures

List of Plates

1.0 Executive Summary

The sampling of fish and assessment of habitat at four sites downstream of the Awoonga Dam in the Boyne River was carried out from 25/02/04 to 02/03/04. This survey was initiated primarily to determine fish assemblages present following release of environmental flows from the Awoonga Dam in January and February 2004 and to classify habitat features at sites. Techniques employed allow comparison with previous surveys and were specifically directed at targeting *Mugil cephalis* (mullet) and *Lates calcarifer* (barramundi).

A diverse array of fish species was captured across the sites and represented salt and freshwater assemblages with two fish in common to both habitats. One *Lates calcarifer* was captured at an estuary site and several *Mugil cephalis* captured across fresh and salt environments. Several other migratory fish were present including *Megalops cyprinoids* (tarpon/oxeye herring) and *Elops hawaiensis* (giant herring), *Maquaria ambigua* (golden perch) and *Melanotus splendita splendita* (eastern rainbow fish).

2.0 Introduction

The Port Curtis region is situated between the major catchments of the Fitzroy and Kolan River and includes the drainage systems of the Calliope and Boyne Rivers and associated streams. Awoonga High Dam on the Boyne River provides the only major source of water in the Gladstone area with extensive reticulation networks supplying urban and industrial users in the Gladstone and Calliope area and the Callide valley (SKM, 1999).

To advance sustainable development and management of water within the Boyne River basin, Queensland Department of Natural Resources and Mines released a Resource Operations Plan (ROP) for the system in July 2003. Within this document, releases for the environment from the Awoonga Dam include base flow and trigger flow releases. Quantity of base flow (the calculated catchment inflow) determines the quantity of a base flow release (each weekly base flow is released over the following week at a constant rate). Occurrence of a trigger flow (four days of at least 3210ML per day infow into the dam) prompts a trigger flow release (average of at least 3210ML per day for the same number of days inflow met the specified amount) (NR&M 2003). Partial requirements of the ROP include water quality and aquatic ecosystem monitoring which will be used to assist in determining the impacts of Awoonga Dam and of environmental releases on the habitat and biota downstream of the dam (NR&M, 2003).

The current aquatic ecosystem monitoring was undertaken in accordance with Boyne River Basin ROP specifically Hypothesis two, five and six (Table 1) (NR&M 2003). This project was initiated upon occurrence of two trigger flow releases and serves to obtain post flow data on aquatic habitats and fish comparable to past surveys undertaken by the Centre for Environmental Management. The first trigger flow occurred from 15/01/04 to 19/1/04 prompting a trigger flow release of 12,840ML from 21/01/04 to 27/01/04. The second trigger flow occurred from31/01/04 to 07/02/04 prompting a trigger flow release of approximately 25000ML from 08/02/04 to 16/02/04 (Saverin, pers com). The aims of this survey were:

1. to undertake a broad scale inventory of sites to identify habitat types present
2. to identify the diversity, abundance and size structure of fish species at four sites in the Boyne River

3.0 Methodology

Aquatic ecosystem monitoring was undertaken at four sites downstream of the Awoonga Dam on the Boyne River in February/March 2004 (Figure 1). The two upper sites were located at Pikes Crossing (BOYPD1) and Mann's Weir (BOYPD2) and were typically freshwater environments while the two lower sites at Bearably (BOYED1) and upstream of the Boyne River/South Trees confluence (BOYED2) were estuarine in nature. Mann's Weir is a 2m high artificial sand and gravel structure forming the salt/fresh interface of the Boyne River system. This bar is built to wash away during moderate flows and was fully breached throughout both trigger flow releases (overtopping by 40-70cm) (Saverin, pers com 2004). The weir was subsequently rebuilt before this sampling was undertaken. The two upper sites (BOYPD1 and BOYPD2) were sampled on the 25/02/04 and 26/02/04 respectively, and the two lower sites (BOYED1 and BOYED2) on the 01/03/04 and 02/03/04.

3.1 Aquatic Habitat Assessment – Broad scale Inventory

The broad scale inventory of sites involved classifying selected sites using parameters based on State of the Rivers guidelines. These included:

- habitat type

- dimensions and depth of pools
- condition of habitat types – degree of vegetation modification and land uses surrounding the reach
- left and right bank condition – based on instability and susceptibility to erosion
- bed and bar condition – stability of the bed based on substrate characteristics and channel obstructions
- left and right riparian width
- aquatic habitat rating – based on size of the water body, amount of instream debris, macrophytes and other structure

Major physical features were noted and four sets of photographs taken at each site (left bank, right bank, upstream, downstream). Banks were classified right or left always facing downstream.

3.2 Fish Sampling

Gill nets were deployed at each site in order to target barramundi and mullet species. Two three panel nets (1x 1'2'3' and 1x 4'5'6') were positioned across the water body at different locations, at least 20 meters apart, to enable the capture of a range of species and sizes. The nets were set up approximately two hours before and retrieved approximately two hours after dusk and were checked regularly to avoid drowning crocodiles, platypus or turtles.

Eight fish traps baited with dry dog pellets (proven fish attractant) were deployed in shallow areas or areas where complex habitat structure was present to enable the capture of juvenile and small species (i.e. rainbow and gudgeon).

Seine netting (for further capture of small and juvenile fish) was conducted at locations where macrophyte cover did not obstruct netting and where riverbanks were accessible. A standard 10m (out from bank) x 10m (along bank) area was netted. Two hauls of a seine net were undertaken at each location.

All fish species caught were identified, countered and measured (NB in past surveys only target species were measured). Fish were released alive where possible, unless further identification was required. Two specimens of each species were retained for verification of identification by Queensland Museum or the Centre for Environmental Management reference collection.

4.0 Results

4.1 Broad scale Inventory

All sites received a high aquatic habitat rating primarily based on size of the water body (Table 2). Complex instream structure (a secondary consideration) varied including macrophytes, large woody debris or undercuts for freshwater sites and mangroves, rocky ledges and substrate for estuarine sites. Erosion on the right bank of BOYPD2 and both banks of BOYED2 accounted for higher erodibility and instability values at these sites. Site photos are presented in Plates 1-4 (BOYPD1), 2-8 (BOYPD2), 9-12 (BOYED1) and 13-16 (BOYED2). The broadscale inventory is a site classification system and does not require discussion unless compared to previous classifications at these sites.

4.2 Fish Sampling

A total of 248 individuals from 18 species were recorded during the sampling of four sites on the Boyne River. The highest abundance of fish occurred at the upper two freshwater sites (BOYPD1 - 99 and BOYPD2 – 109 individuals) mainly due to the presence of large numbers of *Nematalosa erebi* (bony bream), whereas the lower sites exhibited lower abundance (BOYED1 – 32 and BOYED2 – 9 individuals). Numbers of fish at the two freshwater sites were similar, whereas abundance at estuarine site BOYED1 was higher than BOYED2 (Table 3).

Species richness was less variable between sites; estuarine site BOYED1 had the highest richness value (nine) followed by freshwater site BOYPD2 (seven) and the upper and lower sites (BOYPD1 and BOYED2) each contained six species. Distinct freshwater and estuarine assemblages were apparent although two species were common among the sites. These were *Arius graeffei* (lesser salmon catfish/blue catfish) and *Mugil Cephalus* (sea mullet). Of individual species *Nematalosa erebi* (bony bream) dominated the freshwater environment but no particular species dominated the estuarine sites, although *Mugil Cephalus* was the most abundant at site BOYEDI with 11 individuals caught (Table 3).

Among species mean length varied reflecting the variety of species encountered (Figure 2). Mean lengths varied from 23mm (*Hypseleotris* species 1 - gudgeon) to 714mm (*Carcharhinus leucas* - bull shark). Species with the greatest size variation included *Mugil cephalus* (369mm) *Carcharinus leucas* (245mm) and *Arius graeffei* (lesser salmon catfish – 191mm). The maximum size of fish sampled was 885mm (*Carcharinus leucas*) while the minimum size encountered was 12mm (*Hypseleotris* species 1). Mean length of *Mugil cephalis* was smaller at the estuary than the freshwater site and individual sizes were also smaller. Conversely, mean length of *Arius graeffei* was smaller and individual size more variable within freshwater sites (Figure 3).

Other non-fish species (both vertebrate and invertebrate) caught in this survey are presented in Table 4.

5.0 Discussion

The moderate number of species caught in this study is thought to reflect the small number of sites and one-off sampling approach of this survey and would probably underestimate of the rivers total fish assemblages. Furthermore, the variable nature of fish movements and effects of tide limit the number of species caught at any one time. However, this survey was considered adequate to gain a perspective into use of the river by the representative fish species caught and this section aims merely to provide information and general site comparisons for these species.

Species typical of freshwater and estuarine river systems were present at sites on the Boyne River. Freshwater communities in this region are typically dominated by *Nematalosa erebi* (bony bream) and also contain large numbers of *Arius graeffei* (lesser salmon catfish). Although *Nematalosa erebi* are quite resilient to variations in some water quality parameters (temperature and pH) they have a low tolerance of oxygen depletion and are among species most affected by river flow regulation and alteration (Gehrke and Harris 2001). The occurrence of *Arius graeffei* in both freshwater and estuarine environments in this study is characteristic, as this species frequents fresh, brackish and salt reaches (Allen *et al* 2002). The greater abundance and size range, and smaller mean length of *Arius graeffei* within freshwater suggests these sites are the more favorable habitat within the Boyne River for this species.

Two target species of particular relevance to this study were caught, these being the sole Australian representative of the family Centropomidae, *Lates calcarifer* (barramundi) and

Mugil Cephalus (sea mullet). The life cycle of *Lates calcarifer* is catadromous with adults migrating from freshwater to salt to spawn in the wet season (September to March) and young fish moving upstream into freshwater to grow to adulthood (Native Fish Australia 2004). The single (adult) specimen in this survey was caught in saltwater (BOYED1). *Mugil cephalus* were caught in fresh and saltwater sites including three adults (two at BOYPD2 and one at BOYED1) and ten juveniles (BOYED1). The presence of juvenile mullet highlights the role of the estuarine region of the Boyne River as a grow out area. *Liza vaigiensis* (diamond scale mullet) was present at site BOYED2 but was not a target species of this study.

Also of relevance are the amphidromous species *Megalops cyprinoids* (tarpon/oxeye herring) and *Elops hawaiensis* (giant herring). These fish mainly occur and spawn in marine/estuarine areas but young fish often move upstream during flows and become landlocked. Presence of *Megalops cyprinoids* at a freshwater site confirms that movement by these fish from salt to freshwater is not restricted in times of flow by Mann's Weir.

One potadromous fish species, *Maquaria ambigua* (golden perch – at BOYPD1), was caught in this survey. The conservation status of *Maquaria ambigua* is restricted as it is now considered infrequent in much of its range (Native Fish Australia 2004). Adult fish move considerable distance upstream to spawn if possible and (although migration is not requisite for spawning) rarely spawn in dams. The decline of these fish in the Murray-Darling catchment was attributed to negative effects on recruitment of juveniles due to dams and weirs causing alteration of natural flow regimes and migration barriers (Allen et al 2002; King *et al* 2003; Mellen-Cooper and Stuart, 2003).

Melanotus splendita splendita (eastern rainbow fish), also a potadromous species, was not caught in this study but was sighted by torchlight in large numbers against the concrete base of Pikes Crossing (the upper freshwater site).

Other fish caught at freshwater sites (*Ambassis aggassii* - olive perchlett, *Glossamia aprion* - mouth almighty and *Hypseliotris* sp.1 - carp gudgeon) were purely freshwater species and are generally widespread in drainages within the region. Other fish at estuarine sites (*Acanthopagrus Australia* - sea bream, *Ambassis marianus* - estuary perchlett, *Charcharinus leucas* - bull shark, *Leiognathus bindus* - orange tipped ponyfish, *Pomadasys argenteus* - spotted grunter, *Scatophagus argus* - spotted butter fish and *Scomberoides lysan* - queenfish) were typically marine, except the bull shark, which is known to utilise both marine and freshwater river environments and is considered dangerous to humans.

6.0 Glossary

Diadromous: Truly migratory species of fish that (1) migrate between freshwaters and the sea (2) the movement is usually obligatory and (3) migration takes place at fixed seasons or life stages. Three distinctions include catadromous, amphidromous and anadromous (Marsden and Kerslake 2002).

Catadromous: Applied to the migratory behavior of fish that spend most of their time in freshwater and move to the sea to breed (Allaby and Oxford University Press, 1999).

Amphidromous: Applied to the migratory behaviour of fish moving from fresh water to the sea, and vice versa. Such migration is not for breeding purposes, but occurs regularly at some stage of the life cycle (feeding, over wintering, etc.) (Allaby and Oxford University Press, 1999).

Anadromous: Applied to the migratory behavior of fish that spend most of their lived at sea and move to freshwater to breed (Allaby and Oxford University Press, 1999).

Potadromous: Applied to fish that migrate wholly within freshwater systems ((Allaby and Oxford University Press, 1999).

7.0 Acknowledgements

We would like to thank the CEM Technical Services Group, including Damon Shearer and Andrew Davis for assisting with fieldwork and skippering the research vessels. We gratefully acknowledge the site map by Wayne Boyd (GAWB GIS officer) and the triggerflow information supplied by Clancie Saverin (GAWB environmental officer).

8.0 References

Allaby, M.E., Oxford University Press, (1999). A Dictionary of Ecology Oxford Reference Online. Oxford University Press.

Allen, G.R., Midgley, S.H., Allen, M. (2002) Field Guide to the Freshwater Fishes of Australia. Western Australian Museum. Perth. WA.

Gehrke, P.C. and Harris, J.H. (2001) Regional-scale effects of flow regulation on lowland riverine fish communities in New South Wales. *Regulated Rivers-Research & Management*. 17:369-391

Grant, E. (1999) Grants guide to fishes. Grant PTY LTD, Redcliffe, QLD.

King, A.J., Humphries, P. and Lake, P.S (2003) Fish recruitment on floodplains: the roles of patterns and life history parameters. *Canadian Journal of Fisheries and Aquatic Sciences*. 60: 773-286

Mallen-Cooper, M. and Stuart, I.G. (2003) Age, growth and recruitment of two potadromous fishes in a large seim-arid/temperate river system. *River Research and Application*. 19:697-719

Marsden, T and Kerslake, M. (2002) Fisheries Survey. Department of Primary Industries, Queensland Government, QLD.

Native Fish Australia (2004) Fish Files. http://www.nativefish.asn.au/fish.html

Natural Resources and Mines, Queensland Government (2003) Boyne River Basin resource operations plan. Department of Natural Resources and Mines, QLD.

Saverin, C. (2004) Personal Communication. Gladstone Area Water Board.

Sinclair Knight Merz (1999) Environmental data collection and monitoring program. Sinclair Knight Merz, QLD.

Table 1: Aquatic ecosystems monitoring requirements specified in Resource Operations Plan (NR&M) to be addressed in the aquatic monitoring survey of fish and aquatic habitats in 2004.

hypothesis number	parameter	site location	frequency of sampling
2	aquatic habitat assessment: -identify habitat types -map habitat	Pikes Crossing Pondage & Manns Weir Pondage	twice per year - during September to November and March to May plus after a trigger flow period
5 & 6	fish: - species diversity and abundance -community composition -community age structure	at least three sites, being upstream and downstream of Mann's Weir plus Benaraby Estate, or an alternative estuary site as agreed to by chief executive	at least once per year - in early September prior to a trigger flow even and if a trigger flow even occurs, after that trigger flow event

Table 2: Broadscale inventory classifications of sites in the Boyne River in February/March 2004.

Site	BOYPD1	BOYPD2	BOYED1	BOYED2
Date	26/02/2004	26/08/2001	01/03/2004	02/03/2004
Easting	24.0506	24.0345	24o00.045	24o58.625
Northing	151.3239	151.3202	151o20.358	151o19.543
Width	40-60	50-60	60	160-200
Length	900	1500-2000	2000	2000
Depth	3-5	3-5	3-4	4-5
Disturbance	moderate	moderate	moderate	moderate
Left instability	low	low	low	moderate
Right instability	low	moderate	low	moderate
Left erodibility	low	low	low	moderate
Right erodibility	low	moderate	low	moderate
Bed stability	high	high	high	high
LeftRiparianWidth	20-30	5-15 variable	100	120
RightRiparianWidth	10-15	15-20	60	60
AquaticHabitatRating	high	high	moderate	moderate

Table 3: Species richness and abundance of fish captured during sampling of the Boyne River in February/March 2004.

Scientific Name	Common Name	BOYPD1	BOYPD2	BOYED1	BOYED2	Total
Acanthopagrus australis	Sea bream	0	0	2	3	5
Ambassis agassizii	Olive Perchlet	2	0	0	0	2
Ambassis mariamus	Estuary perchlet/ Glass perch	0	0	4	1	5
Arius graeffei	Blue Catfish or Lesser Salmon Catfish	28	21	4	0	53
Carcharhinus leucas	Bull Shark/Estuary Whaler	0	0	3	1	4
Elops hawaiensis	Giant Herring	0	1	0	0	1
Glossamia aprion	Mouth Almighty	1	3	0	0	4
Hypseleotris species 1	Midgley's Carp Gudgeon	9	9	0	0	18
Lates calcarifer	Barramundi	0	0	1	0	1
Leognathus bindus	Orange-tipped Ponyfish	0	0	0	1	1
Lisa vaigiensis	Diamond-Scale Mullet	0	0	0	1	1
Macquaria ambigua	Golden Perch/Yellowbelly	1	0	0	0	1
Megalops cyprinoides	Oxeye Herring/Tarpon/Bony Mullet	0	1	0	0	1
Mugil cephalus	Sea mullet	0	2	11	0	13
Nematalosa erebi	Bony Bream	58	72	0	0	130
Pomadasys argenteus	Spotted Grunter	0	0	2	0	2
Scatophagus argus	Spotted Butter fish	0	0	1	2	3
Scomberoides lysan	Queenfish	0	0	3	0	3
Abundance		99	109	31	9	248
Species richness		6	7	9	6	18

Table 4: Species richness and abundance of other animals captured during sampling of the Boyne River in February/March 2004.

Scientific Name	Common Name	BOYPD1	BOYPD2	BOYED1	BOYED2	Total
Emydura krefftii	Krefft's river turtle	1	0	0	0	1
Macrobrachium sp.	Freshwater shrimp	0	2	58	0	60
Penaeus merguiensis	Banana prawn	0	0	1	24	25
Scylla serrata	Mudcrab	0	0	2	0	2
Abundance		1	2	61	24	88
Species richness		1	1	3	1	4

Figure 1.

Aquatic Monitoring 2004

Boyne Downstream Localities

Figure 2: Mean length distribution of species captured during sampling of four sites on the Boyne River (maximum and minimum lengths are shown as error bars).

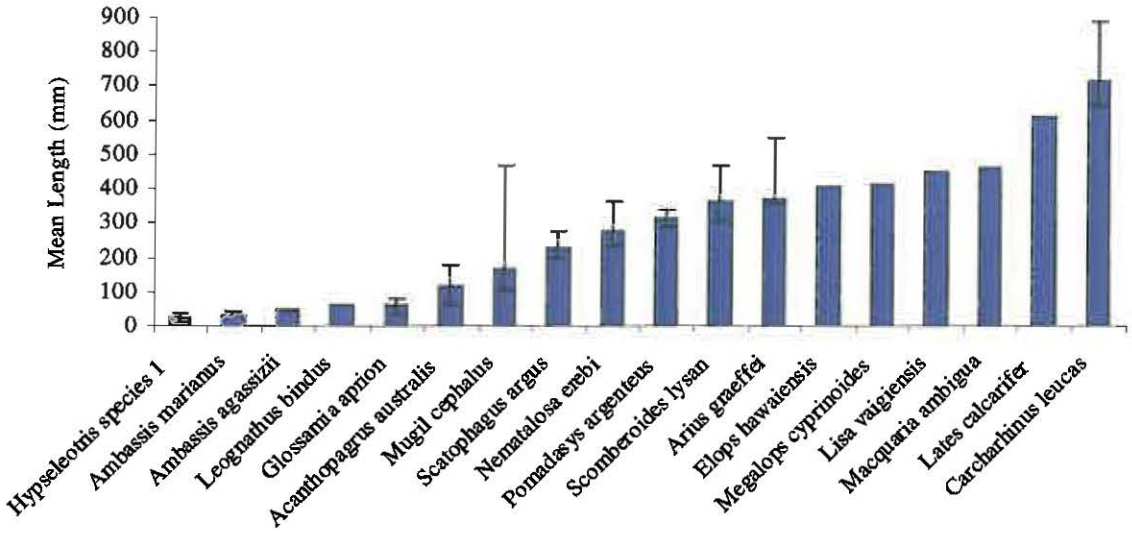

Figure 3: Comparison of mean length distribution of species common to both freshwater and saltwater sites (maximum and minimum lengths are shown as error bars).

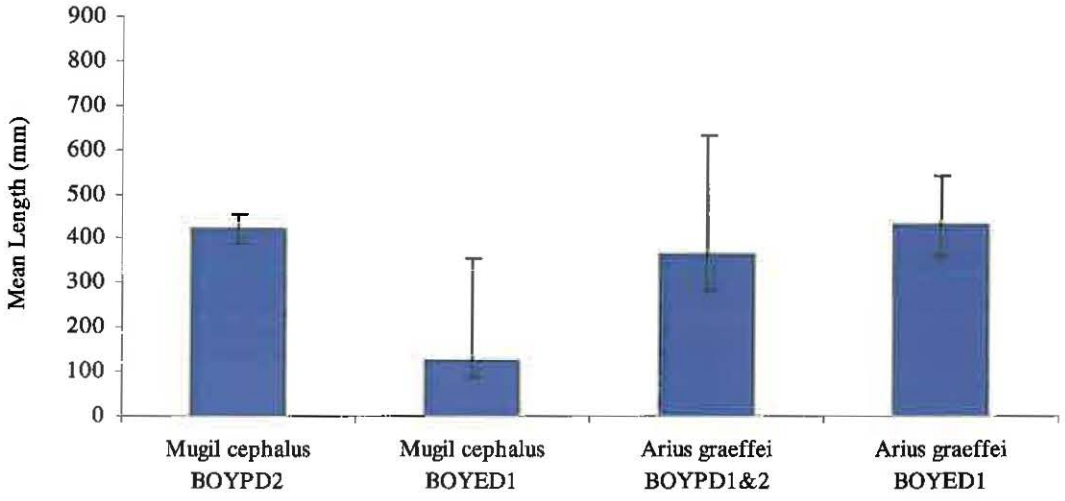

Plate 1: BOYPD1 left bank upstream

Plate 3: BOYPD1 right bank upstream

Plate 2: BOYPD1 left bank downstream

Plate 4: BOYPD1 right bank downstream

Plate 5: BOYPD2 left bank upstream

Plate 6: BOYPD2 left bank downstream

Plate 7: BOYPD2 right bank upstream

Plate 8: BOYPD2 right bank downstream

Plate 9: BOYED1 left bank upstream

Plate 10: BOYED1 left bank downstream

Plate 11: BOYED1 right bank upstream

Plate 12: BOYED1 right bank downstream

Plate 13: BOYED2 left bank upstream

Plate 14: BOYED2 left bank downstream

Plate 15: BOYED2 right bank upstream

Plate 16: BOYED2 right bank downstream