

Fisheries Long Term Monitoring Program

Summary of freshwater survey results: 2000–2005

November 2007



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Acronyms

CPUE	Catch per unit of effort
CREB Track	Cairns Regional Electricity Board Track
DPI&F	Department of Primary Industries and Fisheries, Queensland
LTMP	Long Term Monitoring Program, DPI&F
GPS	Global Positioning System

Summary

This report is a summary of the data collected in the Fisheries Long Term Monitoring Program freshwater fish surveys from 2000 to 2005.

Queensland's freshwater reaches contain a diverse array of freshwater fish fauna. Over 130 native species are recognised in north eastern Australia which is approximately half of the freshwater fish fauna of the Australian continent (Pusey *et al.* 2004).

The sustainability of freshwater fish is highly dependent on suitable riverine habitat as species diversity and populations are closely linked to habitat conditions. Exotic fish species including carp (*Cyprinus carpio*), tilapia (*Tilapia*, *Oreochromis* spp.) and mosquitofish (*Gambusia* spp.) may compete with, or prey on, the eggs and juveniles of native species.

The Department of Primary Industries and Fisheries (DPI&F) Long Term Monitoring Program (LTMP) has monitored the freshwater fish of 10 river systems in Queensland since 2000. The program uses electrofishing sampling techniques to collect annual information on populations of key recreational, commercial and exotic fish species. The program also collects ancillary information on water quality and habitat conditions that may help to correlate changes in fish community structure.

Species diversity in most rivers has remained fairly stable throughout the period of the study. Six exotic fish species have been encountered, with goldfish, European carp and tilapia being of major concern to state agencies.

The six years of sampling has been successful in obtaining a baseline dataset of the fish resources for the ten rivers monitored under the freshwater component of the LTMP.

Long Term Monitoring Program background

The Department of Primary Industries and Fisheries (DPI&F), Queensland, manages the State's fish, mollusc and crustacean species and their habitats. As part of this commitment, DPI&F monitors the condition of, and trends in, fish populations and their associated habitats. This information is used to assess the effectiveness of fisheries management strategies and helps ensure that the fisheries remain ecologically sustainable.

DPI&F uses the information to demonstrate that Queensland's fisheries comply with national sustainability guidelines, allowing exemption from export restrictions under the Australian Government's *Environment Protection and Biodiversity Conservation Act 1999*.

DPI&F initiated a statewide Long Term Monitoring Program (LTMP) in 1999, in response to a need for enhanced data used in the assessment of Queensland's fisheries resources. The LTMP is managed centrally by a steering committee with operational aspects of the program managed regionally from the Southern and Northern Fisheries Centres located at Deception Bay and Cairns respectively. The regional teams are responsible for organising and undertaking the collection of data used for monitoring key commercial and recreational species, and for preparing data summaries and preliminary resource assessments.

A series of stock assessment workshops in 1998 identified the species to include in the LTMP. These workshops used several criteria to evaluate suitability including:

- the need for stock assessment
- the suitability of existing datasets
- the existence of agreed indicators of resource status
- the practical capacity to collect suitable data.

Resources monitored in the program include saucer scallops, spanner crabs, stout whiting, yellowfin bream, sand whiting, dusky flathead, rocky reef fish, eastern king prawns, blue swimmer crabs, sea mullet and tailor in southern Queensland; tiger and endeavour prawns and coral trout and redthroat emperor in northern Queensland; and mud crabs, barramundi, spotted and Spanish mackerel and freshwater fish throughout the state. Various sampling methods are used to study each species.

The LTMP collects data for resource assessment (ranging from analyses of trends in stock abundance indices to more complex, quantitative stock assessments) and management strategy evaluations.

Stock assessment models have already been developed for saucer scallops, spanner crabs, stout whiting, mullet, tailor, barramundi, tiger and endeavour prawns, redthroat emperor, and spotted and Spanish mackerel. In some cases management strategy evaluations have also been completed and the data collected in the LTMP proved integral to these activities.

The assessments and evaluations have allowed for improvements to the management of Queensland's fisheries resources. Enhancements to ongoing monitoring have also been identified, particularly to address the increasing demand for high quality data for dynamic fish population models.

Through the ongoing process of collecting and analysing LTMP data and incorporating these data into regular assessments and refining monitoring protocols as required, DPI&F is enhancing its capacity to ensure that Queensland's fisheries resources are managed on a sustainable basis.

Introduction

Queensland's freshwater reaches contain a diverse array of freshwater fish fauna. Over 130 native species are recognised in north eastern Australia which is approximately half of the fish fauna of the Australian continent (Pusey *et al.* 2004). In addition to these freshwater fishes, many other species from marine or estuarine families utilise freshwater riverine reaches of Queensland during some stage of their lifecycle. These include a number of fish species important to recreational, indigenous and commercial fishing, such as mullet (Mugilidae), barramundi (Centropomidae), mangrove jack (Lutjanidae), bigeye trevally (Carangidae), bream (Sparidae) and some sharks and rays (Carcharhinidae and Dasyatidae).

The sustainability of freshwater fish is highly dependent on suitable riverine habitat as species diversity and populations are closely linked to habitat conditions. Changes in the water quality or temperature of the river can stress fish populations and the loss of riparian and instream vegetation can affect the habitat in which fish live. Barriers such as dams and weirs can impede migrations and movements of fish preventing spawning and access to food. Exotic fish species including carp (*Cyprinus carpio*), tilapia (*Tilapia*, *Oreochromis* spp.) and mosquitofish (*Gambusia* spp.) may compete with, or prey on, the eggs and juveniles of native species.

The majority of recreational, indigenous and commercially important fish in rivers are from wild stocks. These fisheries are therefore dependent on the maintenance of viable river systems and the implementation of appropriate fishing regulations to ensure adequate recruitment of fish into the populations.

The Department of Primary Industries and Fisheries (DPI&F) Long Term Monitoring Program (LTMP) has monitored the freshwater fish of 10 river systems in Queensland since 2000. The program uses fishery independent electrofishing sampling techniques to collect annual information on populations of key recreational and commercial species.

The sustainability of native freshwater fish stocks is highly dependent on the condition of the freshwater habitat. The program collects ancillary information on water quality and habitat conditions, and this may help to correlate changes in fish community structure. Data collected may provide early warning on declines, or show increases in fish numbers. Trends in abundance may be linked to changes in habitat, flow management, construction of fishways or introduction of fisheries regulations.

Noxious fish are monitored as a part of the LTMP surveys to assist in the development of management strategies to control their populations. The information collected during the annual LTMP surveys will be used to develop improved management practices, to target research to solve identified problems, and to provide advice to water managers and land management agencies on the impact of their activities.

Objectives

The objectives of the freshwater monitoring program are to monitor selected rivers for changes in:

- species diversity and abundance
- length structure of key recreational and commercial species
- occurrence of exotic fish species.

The objectives of this report are to provide a summary of:

- the methods used to conduct annual freshwater surveys
- the annual survey results from 2000 to 2005 including trends in the length and relative abundance of key commercial and recreational fish species for each river system, and trends in the water quality and habitat of each system.

Methods

For detailed sampling protocols see the document “Fisheries Long Term Monitoring Program Sampling Protocol – Freshwater: (2000 onwards) Section 1” DPI&F (2006).

Sites

Ten rivers are monitored by the program (Figure 1). In each river, seven reaches, each containing six random locations, are sampled.



Figure 1. Location of river systems monitored by the Long Term Monitoring Program.

Rivers

The river systems were selected based on the following criteria:

- level of recreational angling pressure
- importance to commercial fisheries in adjacent coastal/estuarine areas
- likelihood of changes in the near future (e.g. fishway installation, water infrastructure development)
- previous monitoring at established sites
- representative of a north east coastal, south east coastal, gulf or inland system
- level of modification (at least one relatively unmodified river in each region was chosen).

River systems chosen for monitoring include (Figure 1):

South east coastal drainage

- Noosa River
- Mary River
- Albert/Logan Rivers

West of the Great Dividing Range

- Condamine/Balonne River
- Warrego River

North east coastal systems

- Johnstone River
- Herbert River
- Daintree River

Gulf of Carpentaria drainage

- Gregory River
- Mitchell River

Reach selection and sampling

Sections of each river were selected that were navigable and fishable by an electrofishing boat and normally in the lower two-thirds of the river systems. On all river systems, reaches upstream of any low weirs, which occasionally or regularly drown out, were included. Reaches upstream of major dams were included on the Condamine and Warrego Rivers as yellowbelly (*Macquaria ambigua*), the main angler target species, may have self-sustaining populations upstream of the major dams. However impounded waters, which inundate more than the width of the main river channel, were excluded. On coastal river systems, tidal freshwaters were included if they were known to be consistently fresh. This was indicated by the presence of freshwater aquatic plants, including *Vallisneria gigantea* and by local knowledge.

Selected sections of each river were divided into two kilometre reaches and numbered from the source of the river. Random numbers were used to select seven sampling reaches on each river. If no access was available for a selected reach, the next upstream reach was used. Once reach selection was finalised, Global Positioning System (GPS) coordinates of the upstream and downstream limits were recorded. Reach locations were fixed for all sampling years. Reaches were divided into up to 80 shot locations, 50 m long, and numbered from upstream to downstream alternating from the left to right. Each year, six navigable shot locations were randomly sampled within each reach.

Times

Approximately one week is allocated to sample each coastal river system, including travel between reaches (Table 1).

Table 1. Approximate survey times for the LTMP freshwater surveys in north and south Queensland between 2000 and 2005. Shading indicates the regular sampling periods, and years indicate when sampling has been conducted outside regular sampling times.

River System	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
Noosa River									
Mary River									
Albert-Logan River									
Condamine-Balonne River						2001			
Warrego River						2001			
Daintree River							2000 2001		
Mitchell River							2000 2001		
Gregory River							2000 2001		
Johnstone River							2002	2000 2001	
Herbert River								2000 2001	

On-site procedures

Sampling is conducted using a flat bottomed electrofishing vessel. This method involves an electric current being passed through the water to temporarily stun fish. The current is adjusted at each reach for the prevailing temperature and conductivity.

One standard electrofishing shot covers a 50 m section adjacent to the river bank, with total power on time of 5 minutes. Two parallel bank runs are conducted between 10 and 15 m from the bank or the edge of emergent vegetation, to ensure the capture of mid-water and pelagic species (Figure 2). The 50 m parallel runs are approximately one minute in duration and both are conducted travelling upstream from the same starting point. To minimise pushing fish ahead of the boat the electrofisher power is alternated on and off at 12 second intervals. Ten perpendicular runs are then conducted, one at every five metres (Figure 2). During each run into the bank the boat travels four metres for eight seconds, pauses at the bank for eight seconds and then reverses four metres away from the bank for eight seconds. This sampling method was designed to sample both pelagic and demersal species.

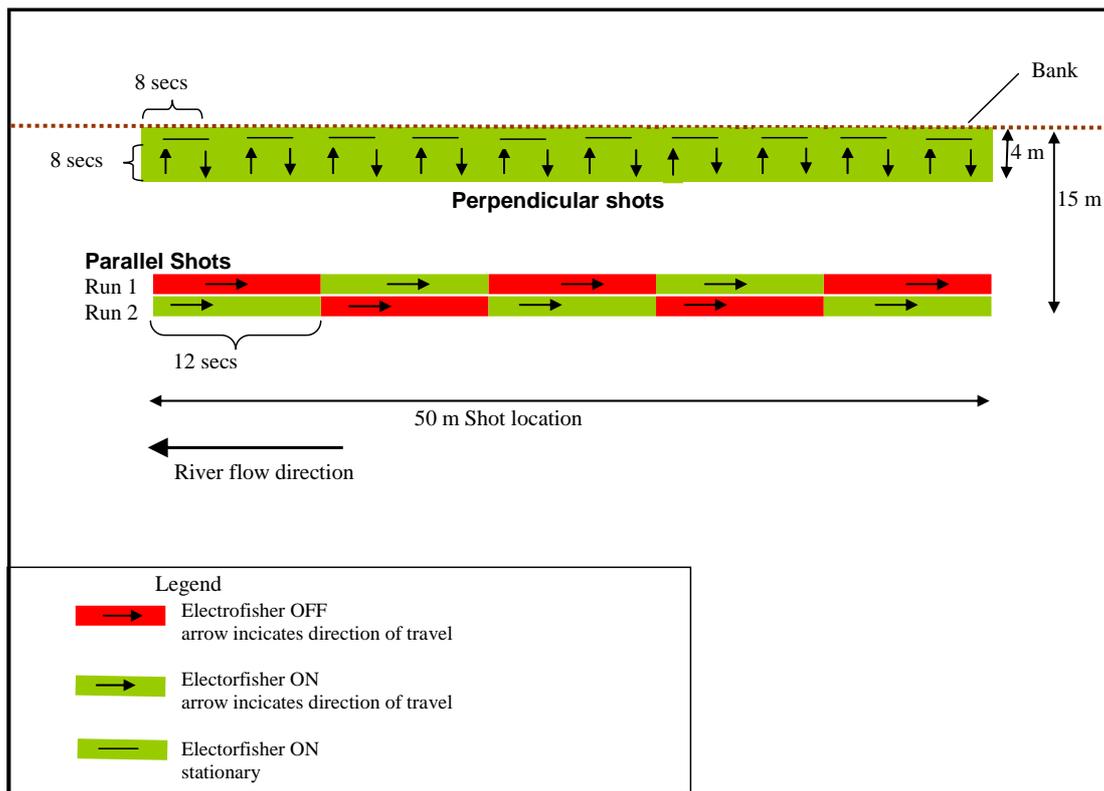


Figure 2. A standard shot, showing the two components: shots parallel and perpendicular to the bank. During the parallel shot, two runs are made, alternating the sections run with the electrofisher on and off. During the perpendicular shot, the electrofisher remains on for the entire 24 seconds of each shot.

Stunned fish are collected during and after electrofishing using soft-material dip-nets and are placed in an aerated holding tank. Abundance data are recorded for all species captured. The lengths of fish are also recorded for all commercial and recreational target species and exotic species.

Water quality is measured at the surface (0.5 m depth), with dissolved oxygen, temperature, salinity, conductivity, turbidity and pH being recorded with a digital analyser. In depths of more than three metres a bottom set of water quality measurements are also recorded. A Secchi depth reading is taken as a measure of water clarity.

For each shot location visual estimates are recorded of:

- stream structure
- water level
- river velocity
- disturbance
- riparian vegetation
- stream habitat
- bank habitat
- substrate
- riparian cover.

Further details of sampling procedures are documented in DPI&F (2006).

Species of interest

The target commercial, recreational and exotic species for which length and abundance information is collected each year are listed in Table 2.

Table 2. List of freshwater commercial or recreational target species and exotic species for which the Long Term Monitoring Program freshwater surveys collect length and abundance data.

Scientific name	Common name
<i>Acanthopagrus australis</i>	yellowfin bream
<i>Acanthopagrus berda</i>	pikey bream
<i>Anguilla australis</i>	Southern shortfin eel
<i>Anguilla obscura</i>	Pacific shortfin eel
<i>Anguilla reinhardtii</i>	longfin eel
<i>Arius berneyi</i>	highfin catfish
<i>Arius midgleyi</i>	silver cobbler
<i>Arrhamphus sclerolepis</i>	snubnose garfish
<i>Bunaka gyrinoides</i>	greenback gudgeon
<i>Carassius auratus</i>	goldfish
<i>Chanos chanos</i>	milkfish
<i>Cyprinus carpio</i>	European carp
<i>Hephaestus carbo</i>	coal grunter
<i>Hephaestus fuliginosus</i>	sooty grunter
<i>Kuhlia rupestris</i>	jungle perch
<i>Lates calcarifer</i>	barramundi
<i>Leiopotherapon unicolor</i>	spangled perch
<i>Liza argentea</i>	goldspot mullet
<i>Lutjanus argentimaculatus</i>	mangrove jack
<i>Maccullochella peeli mariensis</i>	Mary River cod
<i>Maccullochella peeli peeli</i>	Murray cod
<i>Macquaria novemaculeata</i>	Australian bass
<i>Megalops cyprinoides</i>	oxeye herring
<i>Mesopristes argenteus</i>	silver grunter
<i>Mugil cephalus</i>	sea mullet
<i>Neosilurus ater</i>	black catfish
<i>Neosilurus hyrtlii</i>	Hyrtl's catfish
<i>Oxyeleotris lineolata</i>	sleepy cod
<i>Oxyeleotris selheimi</i>	blackbanded gudgeon
<i>Platycephalus fuscus</i>	dusky flathead
<i>Porochilus rendahli</i>	Rendahl's catfish
<i>Scortum hillii</i>	leathery grunter
<i>Selenotoca multifasciata</i>	striped scat
<i>Strongylura krefftii</i>	freshwater longtom
<i>Tandanus tandanus</i>	freshwater catfish
<i>Tilapia mariae</i>	spotted tilapia
<i>Toxotes chatareus</i>	sevenspot archerfish
<i>Trachystoma petardi</i>	pinkeye mullet

Fish species identification in the field and laboratory was facilitated by using several fish identification books and field guides (Allen *et al.* 2002, Herbert and Peters 1995, Johnson 2000, and McDowall 1996). Species that were not identified in the field or laboratory were sent to Jeff Johnson of the Queensland Museum for formal identification.

Data summaries and analysis

Water quality results are presented with 95% confidence intervals.

The unit of effort that fish catch rate data are reported on relates to 30 minutes “on time” of electrofishing. This equates to the amount of electrofishing on time fished at each reach surveyed in this study. The application of on time is strictly regulated to standardise both the amount of power applied and the vessel and netter behaviour during the fishing period. This enables separate teams in different parts of the state to undertake a comparative sampling method.

In this summary report, average catch rates (catch per unit effort [CPUE] is the number of fish per 30 minutes of electrofishing on time) are calculated for each reach and averaged across the river for each year, together with length distribution of selected target species.

The Shannon Weaver diversity index (Zar 1984) was calculated for fish species caught during the electrofishing surveys. Diversity was compared between years for each river system.

Data limitations

While all due care and attention was paid in the collection of these data, caution needs to be applied when using the results of these surveys. Reasons for this include pooling of data and implicit assumptions on the sub-sampling techniques used (e.g. catch randomly sampled).