# AN INTERACTIVE DATABASE ON AUSTRALIAN STREAM FISHES FOR USE BY ENVIRONMENTAL GROUPS AND EDUCATORS

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## ABSTRACT

Compared to the monitoring of water quality and macroinvertebrates, relatively little attention has been directed towards community-based fish monitoring. However, fish studies are important since fish play a pivotal role in freshwater food webs and fish data provide the basis of several routinely-used indicators of stream health. Fish also have very strong public appeal and play a significant role in attracting community members to environmental groups.

As a prerequisite for locally-based stream management and education, there is a need for a standardised system for the collection and application of data on fish and fish habitats that can be used by community groups. Collaboration between the Freshwater Ecology Group (U.Q.) and Waterwatch (Qld.) has resulted in the development of standardised fish sampling protocols and their successful adoption by several local community groups in south-east Queensland. The protocols have been in use since 2000. Annual "fish snapshots' are carried out in March every year, with additional sampling at other times by some groups. In consequence there is now a framework in place for the long term community-based monitoring of fish diversity, abundance, distribution and habitat quality.

What is now needed is the creation of a publicly accessible data management system for fish/habitat data entry and the flexible retrieval of relevant information – for example, maps of the distribution of particular species over various spatial scales, summaries of changing fish abundance over time, and plots of the occurrence of fish species in different types of stream habitats. An interactive website provides an ideal platform for such activities, and can be designed to include dynamic displays, attractive interpretative graphics and ancillary information such as photographic keys to local fish species. Appropriate safeguards to maintain data security can also be incorporated into the system. The website would constitute a unique resource for increasing public awareness and education, and facilitate involvement in stream management activities by community members and special interest groups. It would act as a repository of local knowledge on stream fish and provide a national framework for the sharing and pooling information between groups and regions. Discussions on website designs and the possible national standardisation of fish sampling protocols are invited.

## INTRODUCTION

In recent decades the biodiversity of Australian and freshwater stream fish has been dramatically reduced by a wide variety of human-mediated threats to habitat quality such as clearing of bank side vegetation, removal of in-stream habitat structure, channelisation, flow modification and invasions by exotic plants and animals. Largely as a result of these environmental impacts, over 50 species of native Australian fish are now listed as endangered,

vulnerable or rare. Fish play a pivotal role in freshwater food webs and fish data provide the basis of several routinely-used indicators of stream health. Fish also have very strong public appeal and play a significant role in attracting community members to environmental groups.

However, compared to the monitoring of water quality and macroinvertebrates, relatively little attention has been directed towards community-based fish monitoring. As a prerequisite for locally-based stream management and education, there is a need for a standardised system for the collection and application of data on fish and fish habitats that can be used by community groups. Collaboration between the Freshwater Ecology Group (U.Q.) and Waterwatch (Qld.) has resulted in the development of standardised fish sampling protocols and their successful adoption by several local community groups in south-east Queensland. The protocols have been in use since 2000. Annual "fish snapshots' are carried out in March every year, with additional sampling at other times by some groups. In consequence there is now a framework in place for the long term community-based monitoring of fish diversity, abundance, distribution and habitat quality.

The development of the protocols has been prompted by the need to address the following management questions:

1. What is the **distribution and abundance** of native and introduced (exotic) fish species?
2. How is the distribution and abundance of **native and exotic fish species changing with time**?
3. What are the **key types of threat** (e.g. habitat degradation, invasions by exotic species) that affect native Australian fish species?
4. Which waterways or sites are **critical conservation areas**?
5. Can particular habitat elements or the composition of fish communities be used as **indicators of overall stream quality**?

## FISH SNAPSHOT SAMPLING PROTOCOLS

The guidelines describe simple, rapid and standardised techniques that can be used to assess the abundance and diversity of stream fish species. The complete sampling protocols can be downloaded from: www.qld.waterwatch.org.au or www.kedronbrook.org.au. Summary data sheets are shown in Appendix 1. Using this method, sampling proceeds as follows:

1 Measurement of a 40m stretch of the stream, with reference points marked every 10m.

2 Bait trapping in different sections of the stream defined by cover and flow, as follows:

| | **No cover** | **Cover** |
|---|---|---|
| **Slow flow/pool** | 2 samples | 2 samples |
| **Fast flow/riffle** | 2 samples | 2 samples |

Areas with significant cover are those with large woody debris, fine branching snags, undercut banks, or floating / submerged / emergent / overhanging vegetation.

3 Description of stream habitat and water quality variables at the site according to Waterwatch guidelines.

4 Dip netting at each marked point (0, 10, 20, 30, 40 m). Working upstream, three samples are collected at each point (one adjacent to each bank and one midstream; total 15 samples). Each sample is taken from a 3m sweep using a rectangular-frame dip net (60 x 40 cm; 25 cm deep bag; 3 mm mesh).

5 Creation of a stream map to record topography, habitat/microhabitat details, depths and water velocities.

## SAMPLING EFFICIENCY

All fishing techniques are selective, certain species and sizes of fish being caught more efficiently than others. The present guidelines were designed for use in shallow creeks in the Brisbane area. In these creeks most stream fish species are quite small (less than 15 cm). To some extent, selection bias can be countered through the use of more than one technique (in this case bait trapping and dip netting). Larger species will be caught less often with the equipment described, but even if not caught they may still be observed at a distance – if so, they can be added to the list of species found at the sampling site. In higher-order, deeper streams it would be advisable to carry out supplementary sampling using other fishing gear (e.g., seine nets).

In 2005 it is planned to examine the efficiency of the present technique in a variety of stream habitats by comparing catch compositions with those obtained using electrofishing. Although in many situations electrofishing is a relatively efficient technique, its use by local community groups is normally impracticable for reasons of cost and the need for users to be authorised to comply with safety regulations.

Given the problems of selective sampling, it is important to maintain a consistent approach to sampling, to enable meaningful comparisons between samples collected at different times and places.

## FISH IDENTIFICATION

Locally-focussed field guides can significantly reduce uncertainties with respect to fish identification. In Brisbane, the development of such a guide, which incorporates keys to local species based on distinctive, highly visible morphological features (Cutmore & Warburton, in press), has proved to be a valuable adjunct to the sampling protocols.

## FISH AS INDICATOR SPECIES

Studies carried out in South-East Queensland indicate that the number of native fish species and the percentage of exotic individuals (i.e., no. of exotics x 100 / total no. of individuals) are good indicators of stream quality (Smith and Storey 2001). With the sampling method described here, up to five or six native species can be collected in a single session in creeks around Brisbane in late summer (March). Additional species may be found as sampling is repeated.

At the other extreme, native fish species may be absent altogether from highly degraded streams. Indicators of stream condition based on fish data should be used in conjunction with other complementary measures based on habitat complexity, macro-invertebrates and water quality variables.

## AN INTERACTIVE DATABASE

What is now needed is the creation of a publicly accessible data management system for the entry and access of standardised fish/habitat data by community groups. This would permit the flexible retrieval of relevant information – for example, maps of the distribution of particular species over various spatial scales, and plots of the occurrence of fish species in different types of stream habitats. An interactive website would provide an ideal platform for such activities, and will be designed to include attractive interpretative graphics, dynamic displays and ancillary information (e.g., photographic keys to local fish species). Appropriate safeguards to maintain data security would also be incorporated into the system. The website would constitute a vital resource for increasing public awareness and education and facilitating the responsible involvement in stream management activities by community groups and industry. A parallel example of web-based input and retrieval of environmental information by community groups and interested individuals is Coralwatch, developed through the Sustainable Tourism CRC (Coral Health Association 2005).

Setting up the database could involve the following activities:

1. Scoping and national standardisation of protocols, involving discussions between IT specialists and Waterwatch officers and fish researchers in different States.

2. Database development.

3. Development of associated resources (sampling protocols, fish identification, guide for users of the website).

4. Interim evaluation of database effectiveness.

5. Workshops and field days with key regional groups to assist implementation

6. Publicity – e.g., newsletter articles

3. Final evaluation and improvements

## DEVELOPING AND HOSTING THE WEBSITE

It is proposed that the Centre for Biological Information Technology (CBIT) at the University of Queensland would develop and implement the data management system. CBIT has also developed relevant ancillary software such as Lucid, which is used for diagnostic identification of organisms. The Faculty of Biological and Chemical Sciences at the University of Queensland is prepared to host the website. Funds are currently being sought to support database development and piloting.

## OUTCOMES

The fish database will provide a number of services:

- A repository of local knowledge on stream habitats and their use by fish;

- A framework for a standardised national network for the sharing and pooling of fish habitat information (a similar system is already in place in New Zealand);
- An evolving resource for tracking long term changes in fish communities and habitats. This will be useful to local government and environmental agencies as well as community conservation groups;
- The provision of core information that will underpin future research and habitat management including:
    - Identification of significant sites for intensive future monitoring and/or stream rehabilitation;
    - Early detection of environmental disturbance and potential loss of biodiversity;
    - Monitoring the impact of adaptive management measures.
- Better public awareness of:
    - Fish diversity and distribution and their crucial dependence on habitat quality;
    - Human impacts on sensitive stream ecosystems;
    - Ecological threats caused by the spread of exotic fish species.
- An educational resource for natural ecosystem studies – e.g., as a vehicle for use by schools- and university-based practical activities.

The database will provide significant benefits for both immediate stakeholders and the broader community. These benefits will include increased empowerment and ownership of the stream management process by community groups, and the creation of an ideal platform for responsible environmentalism by industries in partnership with other stakeholders. Use of the system as a core tool by Waterwatch and other organisations will guarantee its application and ensure continued expansion of the user network into the future. The ultimate success of the database will be measured by indicators such as the number of groups contributing fish data, the number of fish surveys reported, the number of website "hits" for information retrieval, and the range of information that network users request from the system.

## REFERENCES

Cutmore, S. and Warburton, K. In press. *A Field Guide to the Freshwater Fish of the Brisbane Area*.

Smith, M.J. & Storey, A.W. 2001. *Design and Implementation of Baseline Monitoring (DIBM3): Developing an Ecosystem Health Monitoring Program for Rivers and Streams in Southeast Queensland.* Report to the South East Queensland Water Quality Management Strategy, Brisbane.

Coral Health Association. 2005. Coralwatch. Available at www.coralwatch.org (accessed 13.01.2005).

## Appendix 1
## Habitat and Fish Summary Sheet

**Name of sampler**
**Name of group**
**Location / map ref.**
**Date** **Time** **Weather**

***Stream Habitat Ratings (Results sheet for Procedure C)***

| Bank vegetation /10 | Verge vegetation /10 | In-stream Cover /10 | Bank erosion and stability / 5 | Riffles, pools and bends / 5 | **Total Score /40** |
|---|---|---|---|---|---|
| | | | | | |

***In-Stream Plant Species (Results sheet for Procedure D)***

| Latin name/Common Name | Native (N) or exotic (E) | Extensive at the site? (Tick) |
|---|---|---|
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| Total number of species: | | |
| **Number of native species:** | | |

***Fish Species (Results sheet for procedures B and E)***

| Latin name/Common Name | Species code | Native (N) or exotic (E) | Number caught | Seen but not caught (tick) |
|---|---|---|---|---|
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| Total number of species: | | | | |
| Total number of individuals: | | | | |
| **Number of native species:** | | | | |
| **% exotic individuals:** | | | | |

Waterwatch Fish Sampling Data Sheet

Recorder
Name of group
Location / map ref

Date

| | **Bait trapping** | | | | | | | | **Dip netting** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Time at start<br>Time at finish | | | | | | | | Time at start<br>Time at finish | | | | | | | | | | | | | | | |
| | Slow, no cover | | Slow, cover | | Fast, no cover | | Fast, cover | | 0m | | | 10m | | | 20m | | | 30m | | | 40m | | |
| | | | | | | | | | Left | Mid- | Right | Left | Mid- | Right | Left | Mid- | Right | Left | Mid- | Right | Left | Mid- | Right |
| Fish species (code) | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | bank | stream | bank | bank | stream | bank | bank | stream | bank | bank | stream | bank | bank | stream | bank |
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