Department of Environment and Resource Management

# Fish Water Quality Guidelines for Fitzroy Basin Freshwaters

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Prepared by:

Healthy Waters Policy

Department of Environment and Resource Management



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## Introduction

This paper outlines the approach and results of a project to derive water quality guidelines for fish species in the Fitzroy River Basin. The derivation of fish guidelines under this paper forms part of a larger process to identify environmental values (EVs) and water quality objectives (WQOs) for waters of the Fitzroy Basin. Ultimately the EVs and WQOs developed can be scheduled under the Environmental Protection (Water) Policy 2009. Further information on the Fitzroy EVs process, including derivation of scheduled EVs and WQOs, is available from <www.derm.qld.gov.au>.

The species richness of fish species has been used on several occasions as an indicator of aquatic ecosystem health (e.g. Stark et al 2000). Usually locations with species richness close to that expected are considered to be in good condition. One approach to comparing species richness between locations is to compare the expected number of species within a catchment with that actually observed. This is often expressed as a ratio of observed to expected species as follows:

- O/E (50) = number of species observed/number of species expected (probability of 0.5 or greater that the species is usually present).

That is, the number of species expected with a probability of 0.5 or greater in a catchment is compared with the number observed at a site sampled. The greater this ratio is (it should be at least one in most samples), the better the aquatic ecosystem health is considered.

Berghuis and Long (1996) have recorded 26 naturally occurring species of fish in the freshwaters of the Fitzroy catchment. Three of these taxa (*Scleropages leichhardti*, *Scortum hilli* and *Macquaria ambigua oriens*) are considered endemic to the Fitzroy (Berghuis and Long 1996), three species (*Poecilia reticulate*, *Gambusia* spp and *Carassius auratus*) exotic to Australia have been recorded (Midgely, 1979; Berghuis and Long, 1996 and Long *pers comm*) and two (*Bidyanus bidyanus*, *Hephaestus fuliginosus*) exotic to the Fitzroy have been recorded (Berghuis and Long, 1996, Long unpublished survey data). Other more recent studies have confirmed the species compositions suggested by these authors.

There have been a number of sampling events across the Fitzroy Basin from 1994 to 2009 conducted by state government officers. These have used a variety of methods including electro-fishing, multi-panel set gill nets and baited fish traps that would be expected to identify the presence of the most common species present. The location of these studies is given in Figure 1. Most of these studies have been conducted on the major trunk streams and the guideline is intended for these main trunk streams. The exception is for floodplain wetlands associated with the Fitzroy delta where a number of studies have been conducted and sufficient information is available to create a guideline.

The distribution of several species, notably those requiring access to salt waters to breed (catadromous species), has been altered as a result of dams and weirs and other migratory barriers (Midgley,1979; Berghuis and Long, 1996; Cotterell and Jackson, 1999). As a result several species have a truncated distribution when compared to that known from the past (see Dunstan,1957; Berghuis and Long, 1996; Cotterell and Jackson, 1999). In response to this, some infrastructure has been retrofitted with fishways and some species stocked as juveniles within the past distributions of the species. This means that the presence of these species is difficult to predict and using them may be misleading in some catchments. They are not included in guidelines for most catchments and a separate list is provided for Fitzroy floodplain waterholes where fish passage barriers and stocking are less likely to influence the species distribution.

Tables in this document describe the species observed to be present for each of the catchments and the probability of occurrence (as percentage occurrence in the samples). A separate list is provided of species which may be present as a result of stocking activities. These species should be excluded in calculations in the catchments stated. Exotic species should also be excluded.

The presence of exotic species is also considered to impact on the natural aquatic ecology of catchments and their presence is also proposed as a measure of the naturalness of the catchments. Thus a list of exotic species recorded in each catchment is provided. It is proposed that the presence of exotic species additional to those recorded would be an indication of departure from current condition.

# Proposed use of the guidelines

## Design of sampling

Methods used for fish sampling should follow methods described by either Berghuis and Long (1996) (multi-panel nylon gill nets of varying mesh sizes combined with fish traps) or the Department of Environment and Resource Management (2011) (electro-fishing). Permanent or semi-permanent reaches of major trunk streams should be sampled over at least three separate sampling events (each at least half a day). Effort needs to be made to sample all habitat types present.

## Analysis

The number of species of native fish observed during sampling (O) should be divided by the number expected (E) (those observed in 50 per cent or more of samples—see highlighted cells given below and species listed in the documents scheduled under the Environmental Protection (Water) Policy 2009). The proposed objective is that this ratio should be ≥ 1.

The exotic species recorded at the site should be compared with those observed in the guideline. The proposed objective is that no new exotic species should be observed.

## References

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Midgley S.H. 1979. 'A fish survey of the Fitzroy River, Queensland' *Queensland Fisheries Service Special Report No. 11*.

Stark JR, Hanson PE, Goldstein RM, Fallon JD, Fong KE, Lee AL, Kroening SE, and Andrews WJ, 2000. 'Water Quality in the Upper Mississippi River Basin, Minnesota, Wisconsin, South Dakota, Iowa, and North Dakota, 1995–98'*: U.S. Geological Survey Circular* 1211, 35 p, on-line at <pubs.water.usgs.gov/circ1211>

**Table 1 Fish species results: Fitzroy River main channel**

| Species | Percentage occurrence in sampling events (Number of sampling events: 7) |
|---|---|
| ***Arius graeffei*** | **100** |
| ***Nematolosa erebi*** | **100** |
| ***Melanotaenia splendida*** | **71** |
| ***Amniataba percoides*** | **57** |
| ***Leiopotherapon unicolor*** | **57** |
| ***Scortum hillii*** | **57** |
| ***Strongylura krefftii*** | **57** |
| *Anguilla reinhardtii* | 43 |
| *Glossamia aprion* | 43 |
| *Hypseleotris sp.* | 43 |
| *Pseudomugil signifer* | 43 |
| *Ambassis agassizii* | 29 |
| *Hypseleotris klunzingeri* | 29 |
| *Mogurnda adspersa* | 29 |
| *Poecilia reticulate* ******* | 29 |
| *Scleropages leichardti* | 29 |
| *Craterocephalus stercusmuscarum* | 14 |
| *Megalops cyprinoides* | 14 |
| *Neosilurus hyrtlii* | 14 |
| *Neosilurus sp.* | 14 |
| *Oxyeleotris lineolatus* | 14 |
| *Tandanus tandanus* | 14 |

Notes: Species with over 50% occurrence are highlighted in bold. Exotic species are marked with ********.

**Table 2 Fish species results: Fitzroy River floodplain waterholes**

| Species | Percentage occurrence in sampling events<br>(Number of sampling events: 9) |
|---|---|
| ***Nematolosa erebi*** | **100** |
| ***Anguilla reinhardtii*** | **89** |
| ***Craterocephalus stercusmuscarum*** | **89** |
| ***Leiopotherapon unicolor*** | **89** |
| ***Melanotaenia splendida*** | **89** |
| ***Lates calcarifer*** | **78** |
| ***Megalops cyprinoides*** | **78** |
| ***Hypseleotris klunzingeri*** | **56** |
| ***Mugil cephalus*** | **56** |
| *Arius graeffei* | 33 |
| *Hypseleotris compressa* | 33 |
| *Hypseleotris sp.* | 33 |
| *Oxyeleotris lineolatus* | 33 |
| *Ambassis agassizii* | 22 |
| *Amniataba percoides* | 22 |
| *Glossamia aprion* | 22 |
| *Mogurnda adspersa* | 22 |
| *Tandanus tandanus* | 22 |
| *Arrhampus sclerolepis* | 11 |
| *Macquaria ambigua oriens* | 11 |
| *Strongylura krefftii* | 11 |
| *Poecilia reticulate* ******** | 11 |
| *Carassius auratus*********** | 11 |

Notes: Species with over 50% occurrence are highlighted in bold. Exotic species are marked with ********.

**Table 3 Fish species results: Mackenzie River main channel**

| Species | Percentage occurrence in sampling events<br>(Number of sampling events: 11) |
|---|---|
| ***Arius graeffei*** | **100** |
| ***Nematolosa erebi*** | **100** |
| ***Melanotaenia splendida*** | **91** |
| ***Scortum hillii*** | **82** |
| ***Amniataba percoides*** | **73** |
| ***Macquaria ambigua oriens*** | **73** |
| ***Scleropages leichardti*** | **73** |
| ***Craterocephalus stercusmuscarum*** | **55** |
| *Hypseleotris sp.* | 45 |
| *Oxyeleotris lineolatus* | 36 |
| *Strongylura krefftii* | 36 |
| *Glossamia aprion* | 27 |
| *Hypseleotris compressa* | 27 |
| *Hypseleotris klunzingeri* | 27 |
| *Tandanus tandanus* | 27 |
| *Lates calcarifer* | 18 |
| *Megalops cyprinoides* | 18 |
| *Neosilurus hyrtlii* | 18 |
| *Ambassis agassizii* | 9 |
| *Anguilla reinhardtii* | 9 |
| *Hephaestus fuliginosus* ********* | 9 |
| *Leiopotherapon unicolor* | 9 |
| *Neosilurus ater* | 9 |
| *Neosilurus sp.* | 9 |

Notes: Species with over 50% occurrence are highlighted in bold. Exotic species are marked with ********.

**Table 4 Fish species results: Lower Dawson River main channel**

| Species | Percentage occurrence in sampling events (Number of sampling events: 23) |
|---|---|
| ***Nematolosa erebi*** | **100** |
| ***Macquaria ambigua oriens*** | **91** |
| ***Scortum hillii*** | **83** |
| ***Amniataba percoides*** | **74** |
| ***Scleropages leichardti*** | **74** |
| ***Arius graeffei*** | **70** |
| ***Tandanus tandanus*** | **70** |
| ***Melanotaenia splendida*** | **65** |
| ***Oxyeleotris lineolatus*** | **65** |
| ***Ambassis agassizii*** | **61** |
| ***Hypseleotris sp.*** | **61** |
| *Carassius auratus* ****** | 43 |
| *Hypseleotris klunzingeri* | 43 |
| *Leiopotherapon unicolor* | 43 |
| *Neosilurus hyrtlii* | 43 |
| *Craterocephalus stercusmuscarum* | 35 |
| *Anguilla reinhardtii* | 22 |
| *Glossamia aprion* | 17 |
| *Lates calcarifer* | 13 |
| *Strongylura krefftii* | 13 |
| *Gambusia holbrooki* ****** | 9 |
| *Philypnodon grandiceps* | 9 |
| *Poecilia reticulate* ****** | 9 |
| *Hypseleotris compressa* | 4 |
| *Neosilurus ater* | 4 |
| *Pseudomugil signifer* | 4 |

Notes: Species with over 50% occurrence are highlighted in bold. Exotic species are marked with ********.

**Table 5 Fish species results: Upper Dawson River main channel**

| Species | Percentage occurrence in sampling events (Number of sampling events: 7) |
|---|---|
| ***Hypseleotris sp.*** | **100** |
| ***Macquaria ambigua oriens*** | **100** |
| ***Tandanus tandanus*** | **100** |
| ***Nematolosa erebi*** | **86** |
| ***Leiopotherapon unicolor*** | **71** |
| ***Ambassis agassizii*** | **57** |
| ***Melanotaenia splendida*** | **57** |
| ***Pseudomugil signifer*** | **57** |
| *Craterocephalus stercusmuscarum* | 43 |
| *Hypseleotris klunzingeri* | 43 |
| *Philypnodon grandiceps* | 43 |
| *Gambusia holbrooki*******| 29 |
| *Anguilla reinhardtii* | 14 |
| *Carassius auratus*********| 14 |
| *Neosilurus hyrtlii* | 14 |
| *Oxyeleotris lineolatus* | 14 |
| *Poecilia reticulate ********| 14 |
| *Scleropages leichardti* | 14 |
| *Scortum hillii* | 14 |

Notes: Species with over 50% occurrence are highlighted in bold. Exotic species are marked with ********.

**Table 6 Fish species results: Lower Nogoa River main channel**

| Species | Percentage occurrence in sampling events (Number of sampling events: 16) |
|---|---|
| ***Melanotaenia splendida*** | **100** |
| ***Nematolosa erebi*** | **100** |
| ***Ambassis agassizii*** | **75** |
| ***Macquaria ambigua oriens*** | **75** |
| ***Scortum hillii*** | **69** |
| ***Tandanus tandanus*** | **69** |
| ***Hypseleotris sp.*** | **56** |
| ***Leiopotherapon unicolor*** | **56** |
| *Craterocephalus stercusmuscarum* | 44 |
| *Hypseleotris klunzingeri* | 44 |
| *Neosilurus hyrtlii* | 44 |
| *Oxyeleotris lineolatus* | 38 |
| *Arius graeffei* | 31 |
| *Amniataba percoides* | 19 |
| *Hypseleotris compressa* | 13 |
| *Mogurnda adspersa* | 13 |
| *Philypnodon grandiceps* | 13 |
| *Poecilia reticulate* ******** | 6 |
| *Strongylura krefftii* | 6 |

Notes: Species with over 50% occurrence are highlighted in bold. Exotic species are marked with ********.

**Table 7 Fish species results: Upper Nogoa River main channel**

| **Species** | **Percentage occurrence in sampling events** (Number of sampling events: 9) |
|---|---|
| ***Hypseleotris sp.*** | **100** |
| ***Macquaria ambigua oriens*** | **100** |
| ***Leiopotherapon unicolor*** | **89** |
| ***Nematolosa erebi*** | **89** |
| ***Melanotaenia splendida*** | **67** |
| ***Scortum hillii*** | **67** |
| ***Hypseleotris klunzingeri*** | **56** |
| ***Tandanus tandanus*** | **56** |
| *Craterocephalus stercusmuscarum* | 33 |
| *Neosilurus hyrtlii* | 33 |
| *Ambassis agassizii* | 22 |
| *Bidyanus bidyanus* | 22 |
| *Hypseleotris compressa* | 11 |
| *Lates calcarifer* | 11 |
| *Neosilurus sp.* | 11 |
| *Philypnodon grandiceps* | 11 |
| *Poecilia reticulate* ********* | 11 |

Notes: Species with over 50% occurrence are highlighted in bold. Exotic species are marked with ********.

**Table 8 Fish species results: Lower Isaac River main channel**

| Species | Percentage occurrence in sampling events (Number of sampling events: 4) |
|---|---|
| ***Arius graeffei*** | **100** |
| ***Melanotaenia splendida*** | **100** |
| ***Nematolosa erebi*** | **100** |
| ***Craterocephalus stercusmuscarum*** | **75** |
| ***Neosilurus hyrtlii*** | **75** |
| ***Scleropages leichardti*** | **75** |
| ***Ambassis agassizii*** | **50** |
| ***Amniataba percoides*** | **50** |
| ***Glossamia aprion*** | **50** |
| ***Hypseleotris sp.*** | **50** |
| ***Scortum hillii*** | **50** |
| ***Strongylura krefftii*** | **50** |
| ***Tandanus tandanus*** | **50** |
| *Hypseleotris compressa* | 25 |
| *Hypseleotris klunzingeri* | 25 |
| *Leiopotherapon unicolor* | 25 |
| *Macquaria ambigua oriens* | 25 |
| *Mogurnda adspersa* | 25 |
| *Oxyeleotris lineolatus* | 25 |
| *Philypnodon grandiceps* | 25 |

Notes: Species with over 50% occurrence are highlighted in bold. Exotic species are marked with ********.

**Table 9 Fish species results: Connors River main channel**

| Species | Percentage occurrence in sampling events (Number of sampling events: 12) |
|---|---|
| ***Melanotaenia splendida*** | **100** |
| ***Nematolosa erebi*** | **100** |
| ***Amniataba percoides*** | **92** |
| ***Craterocephalus stercusmuscarum*** | **92** |
| ***Glossamia aprion*** | **92** |
| ***Leiopotherapon unicolor*** | **75** |
| ***Hypseleotris klunzingeri*** | **67** |
| ***Oxyeleotris lineolatus*** | **58** |
| ***Strongylura krefftii*** | **58** |
| ***Hephaestus fuliginosus*** ******** | **50** |
| ***Hypseleotris sp.*** | **50** |
| ***Scleropages leichardti*** | **50** |
| *Arius graeffei* | 42 |
| *Neosilurus ater* | 42 |
| *Anguilla reinhardtii* | 33 |
| *Macquaria ambigua oriens* | 33 |
| *Neosilurus hyrtlii* | 33 |
| *Ambassis agassizii* | 25 |
| *Scortum hillii* | 25 |
| *Tandanus tandanus* | 25 |
| *Mogurnda adspersa* | 17 |
| *Philypnodon grandiceps* | 17 |
| *Arrhamphus sclerolepis* | 8 |
| *Hypseleotris compressa* | 8 |
| *Neosilurus sp.* | 8 |
| *Pseudomugil signifer* | 8 |
| *Redigobius bikolanus* | 8 |

Notes: Species with over 50% occurrence are highlighted in bold. Exotic species are marked with ********.

**Table 10 Fish species results: Comet River main channel**

| Species | Percentage occurrence in sampling events (Number of sampling events: 3) |
|---|---|
| ***Melanotaenia splendida*** | **100** |
| ***Nematolosa erebi*** | **100** |
| ***Ambassis agassizii*** | **67** |
| ***Hypseleotris sp.*** | **67** |
| ***Macquaria ambigua oriens*** | **67** |
| ***Oxyeleotris lineolatus*** | **67** |
| ***Scortum hillii*** | **67** |
| ***Tandanus tandanus*** | **67** |
| *Craterocephalus stercusmuscarum* | 33 |
| *Hypseleotris compressa* | 33 |
| *Hypseleotris klunzingeri* | 33 |
| *Leiopotherapon unicolor* | 33 |
| *Neosilurus hyrtlii* | 33 |

Notes: Species with over 50% occurrence are highlighted in bold. Exotic species are marked with ********.

**Table 11 Fish species results: Callide Creek main channel**

| Species | Percentage occurrence in sampling events (Number of sampling events: 9) |
|---|---|
| ***Melanotaenia splendida*** | **100** |
| ***Nematolosa erebi*** | **100** |
| ***Glossamia aprion*** | **89** |
| ***Craterocephalus stercusmuscarum*** | **67** |
| ***Leiopotherapon unicolor*** | **67** |
| ***Macquaria ambigua oriens*** | **67** |
| ***Oxyeleotris lineolatus*** | **67** |
| ***Strongylura krefftii*** | **67** |
| ***Amniataba percoides*** | **56** |
| ***Hypseleotris klunzingeri*** | **56** |
| ***Hypseleotris sp.*** | **56** |
| ***Neosilurus hyrtlii*** | **56** |
| ***Scleropages leichardti*** | **56** |
| ***Scortum hillii*** | **56** |
| *Ambassis agassizii* | 44 |
| *Arius graeffei* | 44 |
| *Tandanus tandanus* | 44 |
| *Anguilla reinhardtii* | 22 |
| *Carassius auratus********* | 22 |
| *Anguilla obscura* | 11 |
| *Gambusia holbrooki********* | 11 |
| *Hypseleotris compressa* | 11 |
| *Mogurnda adspersa* | 11 |
| *Neosilurus ater* | 11 |
| *Pseudomugil signifer* | 11 |

Notes: Species with over 50% occurrence are highlighted in bold. Exotic species are marked with ********.

**Table 12 Stocked species**

| catchment | Species stocked |
|---|---|
| Fitzroy | *Lates calcarifer* |
| Mackenzie | *Lates calcarifer, Macquaria ambigua* |
| Lower Nogoa | *Lates calcarifer, Macquaria ambigua* |
| Upper Nogoa | *Lates calcarifer, Macquaria ambigua* |
| Lower Dawson | *Lates calcarifer, Macquaria ambigua* |
| Callide | *Lates calcarifer, Macquaria ambigua* |
| Connors | *Hephaestus fuliginosus* |

**Figure 1 Locations of fish sampling activities in Fitzroy Basin**