Australian Government
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Sunfish Queensland Inc

Freshwater Wetlands and Fish

Importance of Freshwater Wetlands to Marine Fisheries Resources in the Great Barrier Reef

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Cover photographs: Two views of the same Gavial Creek lagoon at Rockhampton showing the extreme natural variability in wetlands depending on the weather.

Information in this publication is provided as general advice only. For application to specific circumstances, professional advice should be sought.

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Map Legend

This legend applies to all maps of wetlands in this report.

Terminology in the Report

1. Acronyms Used in the Report

ACTFR: Australian Centre for Tropical Freshwater Research

AIMS: Australian Institute of Marine Science

ANSA Qld: Australian National Sportfishing Association Queensland Branch

ASS: Acid Sulfate Soils

Coastal CRC: Cooperative Research Centre for Coastal Zone, Estuaries and Waterway Management

DNRM&E: Department of Natural Resources, Mines and Energy

DPI&F: Queensland Department of Primary Industries and Fisheries

DSD: Queensland Department of State Development

EPA: Queensland Environment Protection Agency

GBR: Great Barrier Reef

GBRMPA: Great Barrier Reef Marine Park Authority

GBRWHA: Great Barrier Reef World Heritage Area

JCU: James Cook University

NHT: National Heritage Trust

PASS: Potential Acid Sulfate Soils

QPWS: Queensland Parks and Wildlife Service

RWQPP: Reef Water Quality Protection Plan

SIIP: Sugar Industry Infrastructure Package

SWBTA: Shoalwater Bay (Defence) Training Area

WCA: Wetland Care Australia

WTWHA: Wet Tropics World Heritage Area

2. Definition of Terms Used in the Report

Acid Sulfate Soils: The common name given to naturally occurring sediments and soils containing iron sulfides (principally iron sulfide or iron disulfide or their precursors). The exposure of the sulfide in these soils to oxygen by drainage or excavation leads to the generation of sulfuric acid. Note: ASS generally includes both actual and potential acid sulfate soils. These soils pose a considerable environmental risk when disturbed, as they will become very acidic when exposed to air and oxidised.

Connectivity: Connectivity is the extent to which fish can move between different habitat types. The period of time water flows between wetlands, in-stream pools and estuaries and the extent and effectiveness of barriers determines the level of connectivity.

Drainage works: Man-made alterations to waterways and overland water flows that modify the natural hydrology of an area.

Fisheries values: The extent to which a particular waterway or wetland is important based on its use by fish.

Freshwater wetlands: These include off-stream freshwater bodies outside the banks of a waterway, in-stream freshwater bodies that are within the banks of a waterway but disconnected from adjoining parts of the waterway except during flow periods following rain, and sometimes fresh/sometimes brackish wetlands close to the intertidal zone that are occasionally inundated by tidal influence or flooding.

GBR catchment: The GBR Catchment includes all land areas and streams that drain into the GBR Lagoon.

GBR Lagoon: The lagoon is the relatively open area of the continental sea between the mainland and the part of the seabed where the Great Barrier Reef starts.

Riparian Zone: The land and vegetation immediately adjacent to a waterway including all "bankside and closely surrounding vegetation" (Giller and Malmqvist, 1998, pp 5).

Snags: Trees and other solid vegetation that have fallen into a waterway and provides cover for fish and other aquatic animals.

Water Quality: The quality of the water as measured by parameters such as pH, conductivity, turbidity, dissolved oxygen, temperature and salinity.

Freshwater Wetlands and Fish

3. Executive Summary

Various estimates of loss of freshwater wetlands in developed catchments along the GBR coast range between 70-90% (EPA, 1999) while the condition of the remaining 10-30% range from moderate to no value as fisheries resources. The most significant reason for the reduction in the value of remaining wetlands to fisheries is changed catchment hydrology resulting in loss of connectivity, habitat modification, poor water quality and poor habitat quality. High correlations have been identified between populations of coastal fisheries resources and adverse water quality combined with habitat destruction from modified floodplain hydrology (NSW Fisheries & Agriculture, 1989). Although similar studies have not been done in Central or North Queensland, the impact is likely to be similar for fish species that are dependent on access to fresh water.

Our knowledge of the value of freshwater wetlands to fishery resources has improved rapidly in the past decade and a series of related initiatives are identified in the report that will further improve this knowledge in the next few years, especially in relation to the use of freshwater wetlands by fish.

It is estimated that over 70 species of fish have been identified as spending part of their life cycle in both freshwater and marine habitats of the GBR Lagoon (Russell and Hales, 1993, 1997; Russell *et al*, 1996a, 1996b, 1998, 2000). These species require connectivity to allow movement between marine and freshwater habitats. The species include recreationally and commercially important species such as barramundi, eels, mullet and mangrove jack in addition to numerous smaller species that are an important part of the food chain (Bunn *et al*, 1997). It is likely that more species will be identified in future monitoring and research programs.

A larger number of species that use estuarine and marine habitats, including coral reefs, have been identified in previous studies over the last two decades. Many fish species use a chain of habitats (Cappo *et al*, 1998) from freshwater to the reef with interrelationships between all habitats.

The report provides an overview of freshwater wetlands of importance to fishery productivity from Daintree River to Bundaberg. This includes identification of wetlands and a brief description of their present status for fisheries with particular reference to connectivity, water quality and habitat quality. Reference has been made to invasive weed species where these are considered to impact

on wetland values. Available data on fish habitation is included. This report includes data from published reports, the Suntag tagged fish database and anecdotal information from local anglers and landholders.

Where possible, specific risks and threats to remaining wetlands have been identified. These risks and threats primarily result from continued urban, industrial and rural development and a lack of understanding of the importance of wetlands for the productivity of the fishery (Garrett, 1991) and the management of water quality for water entering the GBR Lagoon by both the general community and decision makers. A summary table of impacts on wetlands identified as important to marine fishery resources is at Table 2.

Whilst all wetlands are important for their hydrological and biological functions and therefore warrant protection, wetlands that are considered to be of high value from a fishery perspective have been identified below. Some wetlands have also been identified as likely to be of high value but their use by fish is unknown. It is considered that these wetlands should be given priority in future research of fish use of wetlands. Wetlands that are considered to have importance to fish but require some remedial action to improve their value to fish have also been identified. The listings are in order from north to south.

Wetlands and waterways considered to be high value:

1. Daintree River
2. Ella Bay Swamp
3. Wetlands of the Tully-Murray floodplain
4. Edmund Kennedy National Park wetlands
5. Barratta Creek wetlands
6. Gorganga Plains wetlands
7. Herbert Creek in Broad Sound
8. Gavial Creek lagoons at Rockhampton
9. Raglan Creek
10. Baffle Creek

Wetlands that could be important, but there is insufficient information on their use by fish:

1. Eubenangee Swamp
2. Hull River/Mt Coom wetlands
3. Barramundi Creek and Red Hill coastal wetlands

Important wetlands, but action is required to restore their fishery values:

1. Cattle Creek wetlands
2. Rocky Dam Creek wetlands at Koumala
3. 12 Mile Creek at Marmor

A number of recommendations are included for future action. Protection of remaining wetlands should be the first priority. There is a need to bring together catchment management groups, community leaders with a focus on changes to land management practices, government decision makers and those with knowledge and expertise of wetlands. At present most of these stakeholders are working in isolation and the benefit of their combined knowledge is compromised.

A more strategic targeted approach is required that includes priority setting based on wetland values, a thematic focus on specific threat types, protection ahead of restoration and specific restoration initiatives if there is to be a shift towards improvement in wetland management and protection. A Wetland Working Group comprising members of these groups should be established to provide guidance for future investment in wetlands.

It is considered that there is a sufficient knowledge base for investment in wetlands to shift from research to on-ground action aimed at protecting and improving high value wetlands. It is suggested that an investment ratio of 80% for on-ground action and 20% for further research and monitoring should be a target used in catchment management investment plans or when funding works on wetlands.

Monitoring needs to go beyond water quality parameters and address the food chain issues that are critical to fishery productivity. Use of biological monitoring will address both habitat issues and provide a better understanding of links to productivity. Regular population surveys should be introduced in all coastal waterways and used as an indicator for the health of wetlands.

Future research needs to focus on filling in the gaps in areas such as the relationship between habitat type and extent and the productivity of the fishery as identified in NSW in 1989. Other shortfalls include the impacts of sub-lethal effects of poor water quality in tropical wetlands and food chain relationships between freshwater and marine environments. Lack of research however, should not stop the restoration catchments to start addressing obvious water quality and connectivity issues.

There is a need to establish an agreed list of assessment criteria of wetland values for fishery resources with an agreed rapid assessment procedure. Factors should include biological diversity of fish populations, adult/juvenile habitat, food chain/productivity contributions, water quality issues and hydrological functions as a minimum. An inventory of wetland resources needs to be established and maintained.

The high value wetlands identified in this report should be targeted and management strategies developed to maintain their values as a priority for future investment in wetlands. Future strategies should include maintenance and improvements to connectivity, water quality and habitat quality. These strategies should also include the use of these wetlands as demonstration and education sites and for communication of wetland values to the wider community. The strategy needs to be community driven rather than government or science driven.

Investment in the improvement of wetlands is a key priority of the Reef Water Quality Protection Plan in terms of the future water quality of the water entering the GBR lagoon. However, further encouragement is required to target wetlands protection to enhance maintenance of fish stocks that use the GBR. It is recommended that priority investment for the GBR catchment area is targeted at wetlands assessed as having a high value from a fishery perspective.

Freshwater Wetlands and Fish

The Importance of Freshwater Wetlands to Marine Fishery Resources in the Great Barrier Reef

4. Introduction

Freshwater wetlands are perhaps the most maligned habitats on earth. To many, they are only swamps inhabitable by less desirable wildlife such as crocodiles, snakes and biting insects. Past and, in some cases, current attitudes towards wetlands can be judged from names such as Dismal Swamp and Bannister's Bog. While some research has been undertaken to establish the dependent linkages between freshwater wetlands and marine fishery resources, most research has focussed on in-stream reaches and off-stream deepwater permanent wetlands. It is likely that fish make use of a much wider range of habitats when they can be accessed.

The fish resources of the GBRWHA are an important part of the values of this world-renowned ecosystem. This is clearly demonstrated by the recent rezoning of the reef to protect over 30% of the GBRWHA from fishing. The protection of fish within the boundaries of the GBRWHA will not necessarily secure future fish stocks. A significant number of fish species found in the waters of the GBRWHA interact with adjacent coastal estuaries and some utilise associated wetlands.

Approximately 70% of marine fishery resources are dependent on estuaries for a part of their life cycle (Halliday and Young, 1996). Therefore the extent and habitat qualities of freshwater wetlands are important, as they contribute to the health of estuaries, adjacent coastal reefs and ultimately to the coral reefs of the Great Barrier Reef (GBR) as well as providing an important part of many species' lifecycles and important food resources at the bottom of the food chain. The concept of a "chain of habitats" (Cappo *et al*, 1998) is particularly appropriate for fish species.

Wetlands that are linked to rivers and estuaries flowing into the GBRWHA are mostly on the coastal plains. This is the area where much of the population resides and is also the area used for manufacturing industries and rural production including intensive agriculture, particularly sugar cane. As a result of agricultural, grazing, residential, and industrial land development, wetlands have been removed, altered, reclaimed or degraded through neglect or through changes to hydrological flows as a result of changed land use in the catchment (GBRMPA, 2001).

There is no reliable estimate available of the loss of wetlands in the GBR catchment; however, various guesstimates of loss range from 70–90% for individual catchments (EPA, 1999). Fisheries values of the remaining 10–30% of wetlands range from moderate to no value. One significant reason for change in value to fisheries is the loss of connectivity from changed catchment hydrology as this prohibits fish movement to and from wetlands. Even degraded wetlands that have some connectivity still show some use by fish.

Part of the reason for the loss of wetlands is the poor understanding of their significance in terms of their role in influencing water quality, the importance of their linkages with adjacent parts of the ecosystem and especially their value to fisheries. In the past decade, understanding and knowledge of water quality issues has significantly improved but there is still appears to be a lack of understanding by decision makers about the importance of freshwater wetlands to fishery resources.

The most noticeable evidence of a wetland becoming unsuitable as fish habitat is when the fish die. Often however, the visible evidence is only a part of the problem and some fish species have been shown to avoid poor water quality whilst migrating at some stages of their development (Kroon *et al*, 2003).

The challenge is to continue to improve the community's understanding of the value of wetlands and to improve land management practices to restore and enhance wetlands. The current knowledge base is sufficient to take action now to improve the connectivity and value of remaining wetlands to fisheries as the next step in ensuring the viability of fish stocks in and adjacent to the GBRWHA.

5. Terms of Reference

The terms of reference for this report are:

1. Document connectivity between freshwater wetlands and the marine environment for fish species.
2. Identify the risks to remaining important wetlands in the Great Barrier Reef catchment with respect to existing or changed connectivity to marine environments and regarding potential water quality and connectivity impacts from surrounding activities.
3. Identify threats to fish species and wetland health with respect to invasive weed species.
4. Identify water quality benefits accruing from healthy wetlands.
5. Identify high value wetlands within the Great Barrier Reef catchment.

6. Scope of the Report

"Freshwater Wetlands and Fish" provides an overview of wetlands on the coastal plains from the Daintree River in the north to Bundaberg in the south (*figure 1*). The report provides a brief description of the status of important or representative wetlands from a fishery perspective with reference to connectivity, water quality and habitat quality. Information provided includes barriers to fish movement, the status of the riparian zone and adjoining landscape, and the extent of terrestrial and aquatic weeds where available. Where possible, risks and threats to these wetlands have been identified.

Not all wetlands were able to be included in the report due to limitations with data, time and resources. Wetlands considered to be high fisheries value have been reported on; however, in some areas a wetland has been included that is representative of other nearby wetlands.

For the purpose of this report wetlands that have been included are off-stream freshwater wetlands that are outside the banks of a waterway, in-stream freshwater wetlands that are within the banks of a waterway but disconnected from adjoining parts of the waterway except during flow periods following rain, and sometimes fresh/sometimes brackish wetlands close to the intertidal zone that are occasionally inundated by tidal influence or flooding. All these types of wetlands are part of the "chain of habitats" used by fish and rely on connectivity to the estuarine parts of the system to allow access by marine fish. All three types of wetlands are often found within the same catchment.

The study was limited by the lack of current survey data. Some of the data such as that for the Johnstone River (Russell and Hales, 1993) was eleven years old when reviewed whilst other survey reports such as Perna (2003) were recent. Additionally, work on sub-lethal effects including habitat denial such as that done by Kroon *et al* (2004), has not been attempted for tropical native fish species whilst other work on the tolerance of fish to poor water quality and the sub-lethal effects on breeding capacity has not been published.

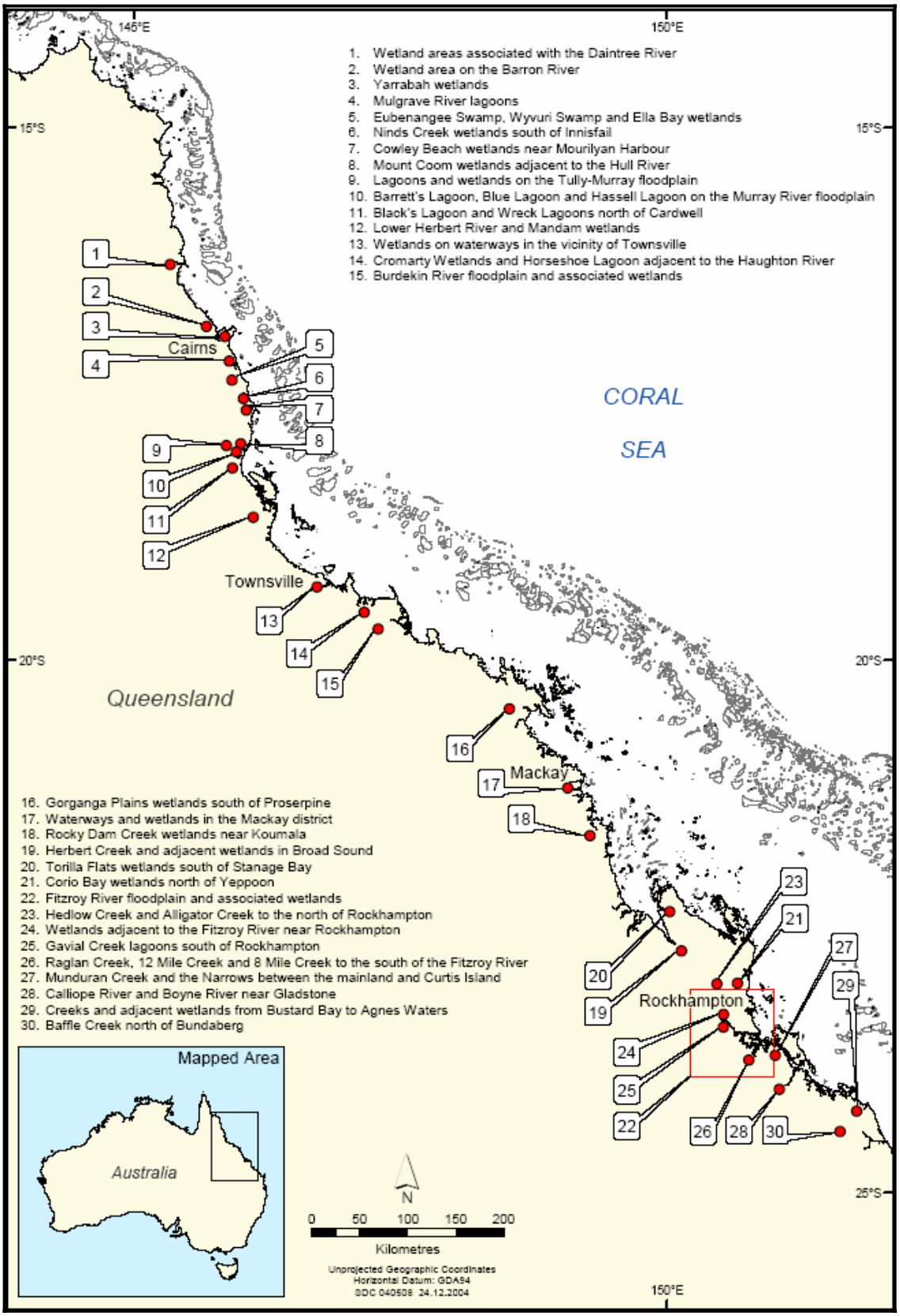

Figure 1: Map showing wetlands covered by this report