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Preface

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Marine and Freshwater Research, 2009, **60**, i–iii

Integrated research to improve water quality in the Great Barrier Reef region

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Introduction

Coastal catchments and adjacent marine aquatic ecosystems are intricately connected through hydrological, ecological and socio-economic processes (Caddy 2000; Lotze *et al*. 2006). Hence, to understand and manage catchment-based impacts on coastal ecosystems, research needs to be integrated across both the catchment-to-coast continuum and the relevant scientific disciplines (Parker *et al*. 2002; Hughes *et al*. 2005). Worldwide, management plans for coastal systems are now being prepared acknowledging the catchment-to-coast connections, the biophysical and socio-economic linkages, the spatial and temporal scales of connecting processes, and the interface between science and management (e.g. Boesch 2006; see also Pirrone *et al*. 2005). However, few practical examples of integrated research across scales and disciplines, resulting in tangible outcomes for catchment management and coastal ecosystem health, exist (Parker *et al*. 2002).

This Special Issue presents selected research that has underpinned the development of the Tully Water Quality Improvement Plan (WQIP) in the Great Barrier Reef (GBR) region from 2005 to 2008. The development of this plan provided a significant opportunity to integrate biophysical, socio-economic and institutional research at the catchment scale into inter-disciplinary understanding of catchment management for water quality improvement in the GBR lagoon. This integration resulted in the development of scientifically validated, cost-effective and socially acceptable management actions for coastal conservation, with recommendations from this WQIP, as well as other WQIPs, now being implemented across the GBR region. While focusing on the GBR, the approaches and implications presented in this Special Issue extend to research and management of all coastal ecosystems where human activities alter water quality and ecological processes against a background of population growth and climate change.

The Great Barrier Reef

The GBR extends over 2000 km and covers an area of ~348 000 km^2 along Australia's north-eastern coast (Fig. 1). In 1982, the GBR was inscribed on the World Heritage List in recognition of its outstanding and universal natural values. In addition to its World Heritage values, the economic contribution of the GBR is estimated at AU$6.9 billion per year (gross product) to the Australian economy (Access Economics 2007). This economic contribution depends on the maintenance and enhancement of the environmental values of the GBR ecosystems. Hence, integrated management of the GBR catchment and coastal systems is a fundamental requirement to conserve and protect the GBR World Heritage Area and the economic contributions that depend on it.

The Reef Water Quality Protection Plan

To protect the GBR and its environmental values from land-based sources of pollution, the Australian and Queensland Governments jointly launched the Reef Water Quality Protection Plan in 2003 (the Reef Plan; State of Queensland and Commonwealth of Australia 2003; Baker 2003). This Plan aims to reverse the decline in water quality entering the Reef within 10 years, and supports the development and implementation of WQIPs for individual coastal catchments (Fig. 1). These WQIPs are primarily concerned with reducing anthropogenically sourced sediment, nutrient and pesticide loads in the waters entering the GBR lagoon. Specifically, each WQIP identifies the critical water-quality issues that may affect the GBR, estimates and compares current and sustainable target loads for pollutants, and describes the most cost-effective and timely management actions needed to achieve progress towards sustainable target loads (e.g. Kroon 2008).

Main study area

Most of the research presented in this Special Issue was conducted to support the development of the Tully WQIP. The Tully–Murray basin is one of 35 basins discharging into the GBR World Heritage Area (Fig. 1), and was identified as a high-risk catchment under the Reef Plan (State of Queensland and Commonwealth of Australia 2003). The high rainfall, combined with near-coastal steep topography and extensive fertilised land use on the floodplain, provide a major potential for erosion and pollutant transport to the receiving waters (Kroon 2008). Moreover, increased run-off rates and volumes, owing to removal of wetlands and floodplain vegetation and the installation of land drainage systems in coastal floodplains, mean that higher sediment and nutrient loads may now reach receiving waters

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10.1071/MF09216 1323-1650/09/11000i

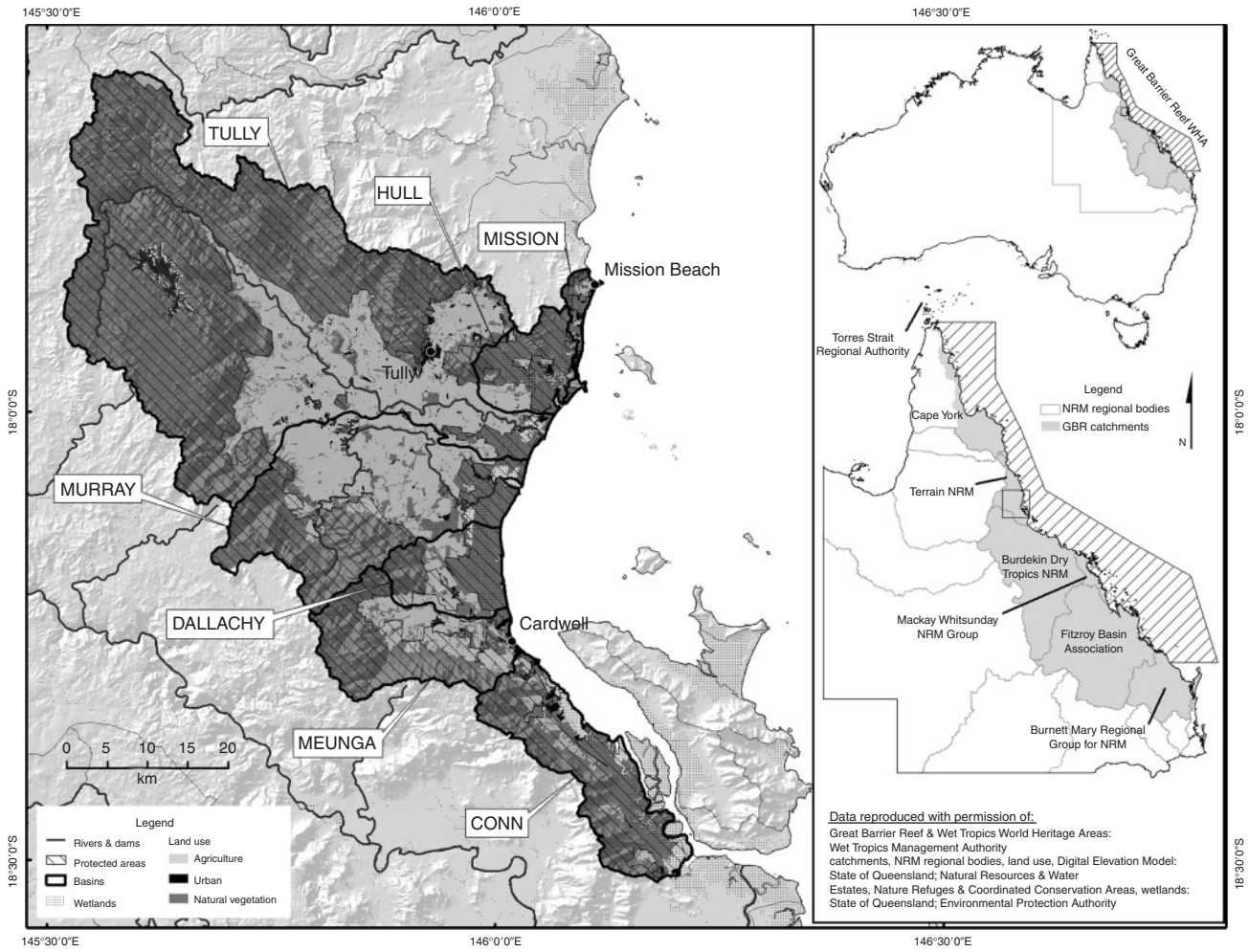

Fig. 1. Location of the Tully–Murray basin in Queensland and Australia, in relation to the Great Barrier Reef World Heritage Area. Water Quality Improvement Plans (or their equivalents) are being developed and implemented for catchments in the six Natural Regional Management (NRM) regions shown in the Queensland map.

(Kroon 2008). Combined, these elevated loads are likely to have a detrimental impact on water quality and GBR ecosystems (Furnas 2003; Fabricius 2005; Fabricius *et al*. 2005).

Structure of Special Issue

The papers in this Special Issue are organised following the key components of a WQIP. First, to establish pollutant load targets for end-of-catchment to achieve water quality improvement in the GBR lagoon, the *key pollutants and critical sources* were identified through a series of studies on water quality monitoring and modelling. Second, to examine the economic and environmental effects of *changes in land uses and land management* for water quality improvement, land-use and management practice patterns that most cost-effectively achieve specified pollutant load targets were explored. Finally, to support the development of WQIPs, as well as the transition from WQIP development to implementation, the *planning frameworks and processes* for water quality management were evaluated in the context of current decentralised approaches to complex environmental management issues. The final paper of this Special Issue synthesises the main research findings, places them into an international context and provides recommendations for future research.

Acknowledgements

I thank the authors of the 13 publications that were submitted for consideration for the Special Issue, as well as the many referees who reviewed these manuscripts in a timely and constructive manner. Thanks go to Caroline Bruce for assistance with map production, and to Peter Roebeling, Peter Stone, Jim Wallace and Tony Webster for comments on earlier versions of this manuscript. CSIRO's Water for a Healthy Country Flagship Program provided financial support to guest-edit this Special Issue.

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Manuscript received 3 September 2009, accepted 23 September 2009