A Compendium of Ecological Information on Australia's Northern Tropical Rivers

# GENERAL INTRODUCTION

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## Disclaimer

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## 1. Background and context

Australia's tropical river and wetland systems possibly represent a unique landscape and form one of the great river drainage networks globally. Furthermore, the network of rivers and wetlands is largely ecologically intact and has not been overly regulated and fragmented as have many large river systems elsewhere (Finlayson and D'Cruz 2005; Nilsson et al 2005; Arthurton et al 2007). Together and individually, Australia's tropical river and wetland systems constitute an internationally significant ecological and social asset (Finlayson and von Oertzen 1992; Australian Tropical Rivers Group 2004). However, increasing pressure on water supply and river systems in southern Australia is driving strong interest in the potential for greater use for agriculture of the perceived abundant water resources in northern Australia (Gehrke et al 2004). The existence of substantial mineral and energy resources in this region is expected to further add to development pressures and increased demand on fresh water resources in the next few decades.

To achieve sustainable development and growth in northern Australia, utilisation of the water resources of our tropical rivers will need to be balanced with providing appropriate protection of the riverine and wetland ecosystems, and the many benefits they provide to society. It will also require sustained effort to reverse the cumulative impacts of over-grazing, invasion by alien species, and changed fire regimes (Douglas et al 1998; Finlayson et al 2005) and to accommodate differing social perspectives and visions for the future (Finlayson et al 1998). For a community-wide vision of sustainable development to be effectively realised, a better understanding of the aquatic ecosystems – the rivers and the wetlands - is required. However, these ecosystems have yet to be studied in a systematic manner (Australian Tropical Rivers Group 2004) despite the opportunities presented by the acquisition of extensive data from new technologies such as remote sensing and GIS (Milne et al 2000; Lowry and Finlayson 2004; Davidson and Finlayson 2007). Across the Australian tropics it is generally only those catchments with existing mining, urban, or intensive agricultural development that has specific information available on ecology, biology, geomorphology, hydrology and management requirements (Finlayson and von Oertzen 1992; Storrs and Finlayson 1997).

Consequently, the available information is fragmented and insufficient for addressing the management needs of the future (Land & Water Australia 2004). Sustainable management of Australia's tropical rivers and wetlands will require a strategic and integrated information base for assessment of ecological character, status and change, and the development of policy, especially for environmental flows and potentially competing uses of water (Finlayson and Eliot 2001; Finlayson et al 2009). To progress towards this goal the project "Australia's tropical rivers – an integrated data assessment and analysis", more commonly referred to as the Tropical Rivers Inventory and Assessment Project, or TRIAP, was initiated in 2004. The overarching aim of the TRIAP was to establish an integrated information base and framework, built on consultation with stakeholders and analysis of existing information, for assessing status and change of Australia's tropical rivers (i.e. river basins within the Timor Sea and Gulf of Carpentaria drainage divisions; referred to herein as the Northern Tropical Rivers).

Funded by the Natural Heritage Trust II and Land & Water Australia, and building on the information base compiled by NGIS (2004) and previously established strategic approaches (Finlayson and Eliot 1999; Finlayson et al 2009), the TRIAP comprised three Sub-projects:

1. Inventory of the biological, chemical and physical features of aquatic ecosystems;
2. Assessment of the major pressures on aquatic ecosystems; and
3. Development of a framework for the analysis of ecosystem services provided by aquatic ecosystems.

The outcomes of Sub-projects 2 and 3 have been reported separately by Bartolo et al (2008) and De Groot et al (2008), respectively. This report presents the outcomes of Sub-project 1.

## 2. Study Area

The major purpose of this project was to undertake a multiple-scale inventory of the habitats and biota of the rivers, floodplains and estuaries of northern Australia and establish an integrated information base and framework, built on consultation with stakeholders and analysis of existing information, for assessing status and change of Australia's tropical rivers within the Timor Sea and Gulf of Carpentaria drainage divisions. The focus area is shown in Figure 1.

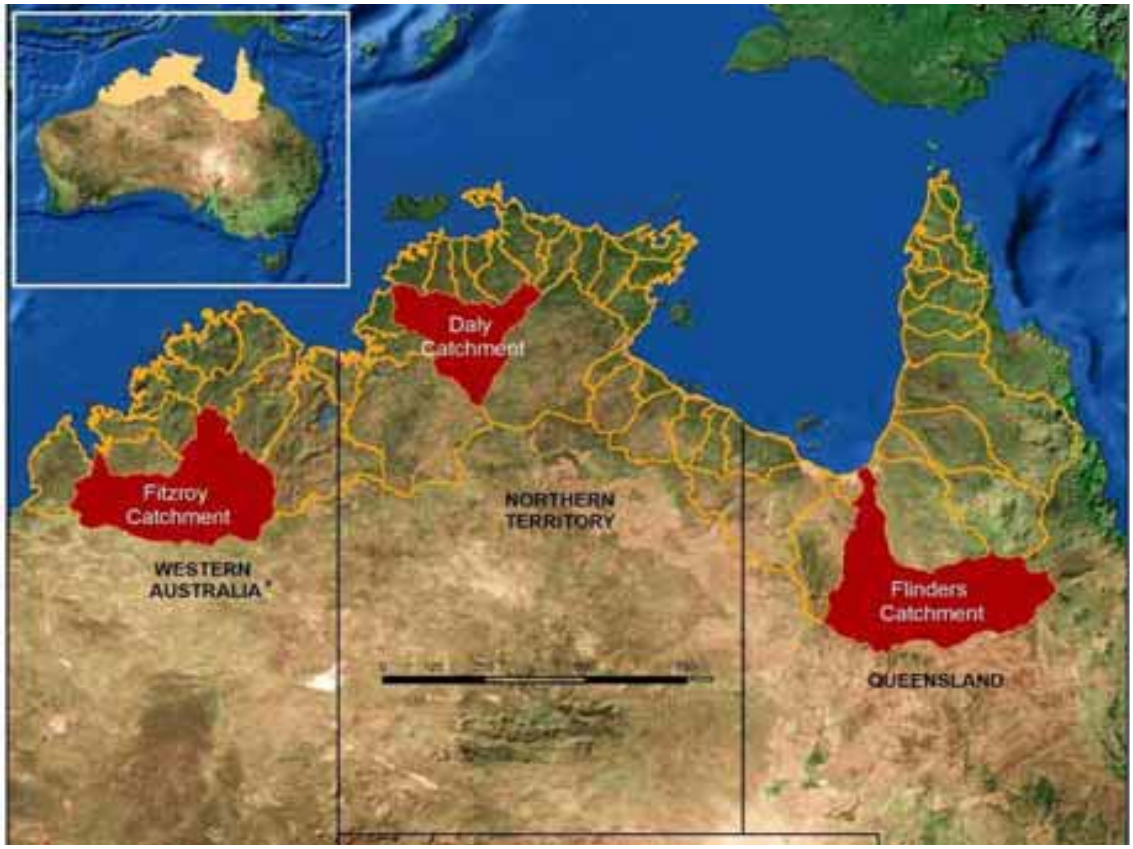


**Figure 1.** **The geographic area for the northern tropical rivers inventory. The three focus catchments are shaded red (from Bartolo et al 2008).**

The geographic area considered in this project was defined by NGIS (2004) and adopted by Land & Water Australia as the geographic coverage for its Tropical Rivers Program (Land & Water Australia 2005). The area encompasses 51 drainage basins across approximately 1.2 million km$^2$ extending from Broome in Western Australia (Cape Leveque Coast catchment) to the northern tip of Cape York in Queensland (Jardine River catchment). The study considered information from the entire geographic region with more detail being sought for three focus catchments, these being the Fitzroy River in Western Australia, the Daly River in the Northern Territory and the Flinders River in Queensland. The focus catchments were chosen after stakeholder consultation and consideration of their ecological and economic importance.

## 3. Strategic Framework

The project was constructed to enable the integration of information from previous data collations and additional published sources to support an initial assessment of the diversity, status and ecological value of aquatic ecosystems across the region. The approach was built around the strategic and multiple-scale framework for integrated inventory, assessment and monitoring developed for the rivers and coastal wetlands in the Alligator Rivers Region of the Northern Territory (Finlayson and Eliot 1999; Finlayson et al 2009).

In collaboration with government agencies, educational institutions and local non-governmental and civil organisations, a strategic hierarchical framework for measuring variation in biophysical processes on the coastal plains of the Alligator Rivers Region as well as further afield in northern Australia had been developed and implemented. Development of the strategy followed an assessment of the vulnerability of wetlands within the Alligator Rivers Region to change in climate and rise in sea level (Bayliss et al. 1997; Eliot et al 1999), with the subsequent development of a program for monitoring coastal change (Waterman et al. 2000). The technical components of the strategy were developed after extensive consultation with stakeholders (Finlayson and Eliot 2001) and investigated through multiple projects and analyses over the subsequent decade (Finlayson et al 2009). The consultation and communication steps from Finlayson and Eliot (2001) outlined below were integrated into the strategic framework used to support the inventory component of TRIAP.

- Establishment and empowerment of an expert centre
- Consultation with and empowerment of key stakeholders
- Identification of major processes and causes of ecological change
- Collation and coordination of available data and information
- Identification of potential collaborators and partners
- Design and implementation of technical assessment projects

The technical steps from Finlayson et al (2009) outlined below were integrated into the framework established for undertaking the inventory and providing information for wetland managers across northern Australia.

- Establish a Geographic Information System structure for data collation, analysis and management
- Establish and adopt standards for geo-referencing of all field information
- Acquire data from i) meteorologic and ii) river gauging equipment from automated recording equipment
- From available information sources, including remotely sensed images, estimate historical changes in the rivers and along the coast
- From available information sources, including remotely sensed images, assess the status and historical changes to the rivers and wetlands
- From available information, including remotely sensed images and biological records, estimate historical change in the distribution of the fauna and flora of the rivers and wetlands
- Incorporate all spatial information and temporal descriptions in the Geographic Information System

- Acquire bibliographic materials and collate information on data sets relating to integrated catchment management in a centralised meta-database
- Provide a map of the major landforms and landcover within the region as a basis for risk assessments of major pressures

Given the differences in jurisdiction across northern Australia it was not anticipated that a single authority or institution would maintain all information required for the above mentioned purposes. With this in mind the strategic framework provided a mechanism for combining information obtained by different parties and making it readily known and available to others, as has been done to date by government agencies, local associations, landowners, managers and scientists. The partnership used to implement the strategic framework was based initially around the organisations involved in the National Centre for Tropical Wetland Research. Implementation comprised individual projects that were combined to support the key components of the framework.

## 4. Conceptual Approach

The conceptual basis for the inventory and assessment undertaken in TRIAP was provided by an integrated framework for wetland inventory, assessment and monitoring (WIAM; Figure 2), the most recent version of which was published by Finlayson et al (2009). The WIAM model, which has been formally adopted and promoted by the Ramsar Wetlands Convention, emphasises that although inventory, assessment and monitoring are discrete components, they are inter-connected and can operate at very different scales. For a given investigation, however, scale should be common across all three components to avoid information collected at one scale being used to make decisions or choices at another inappropriate scale (Finlayson et al 2005). Thus, the multi-scalar nature of the WIAM framework is well-suited for analyses across an area as vast and diverse as northern Australia.

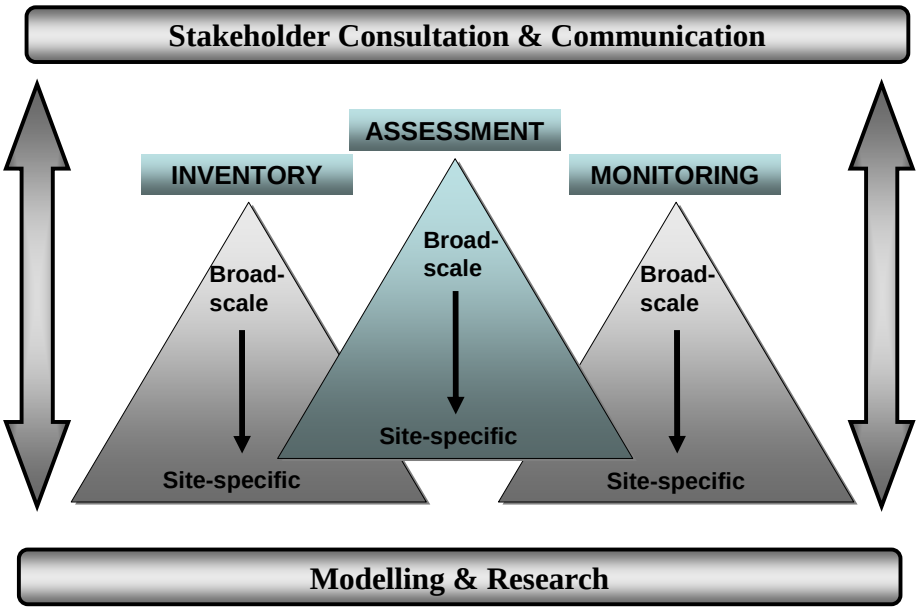


**Figure 2. Conceptual model for integrated wetland inventory, assessment and monitoring (WIAM). Modified from Finlayson et al (in press).**

The conceptual model shown in Figure 2 was developed to provide information that could be used strategically and in a hierarchical manner to describe the ecological character of river/wetland systems. Maintenance of the ecological character of river/wetlands is a core obligation under the Ramsar Convention on Wetlands and entails an integrated approach to data collection/collation, assessment and monitoring backed by stakeholder consultation and

communication as well as modelling and research. The model was introduced and adopted by the Convention after analyses that illustrated the generally non-strategic and incomplete nature of much wetland inventory globally (Finlayson et al 1999). As similar weaknesses existed in wetland inventory across northern Australia (Spiers and Finlayson 1999) the conceptual model was adopted as the basis for undertaking the inventory component of TRIAP and providing an information resource for assessment and monitoring.

Although the existing biophysical information base for the Northern Tropical Rivers is known to be limited (relative to the size of the region), agricultural and mining development is already occurring and future opportunities are being actively and strategically explored on a northern Australian scale (Commonwealth Government of Australia 2007). Consequently, there is a need to rapidly develop through cost-effective assessments a program of inventory, assessment and monitoring. This project is focussed predominantly on the task of bringing together for the first time a broad range of ecological information to form an inventory base for northern Australia. Previous efforts to compile a suitable inventory base have suffered from inadequate resources with narrow and generally provincial views about data collection and ownership leading to a fragmented and uncoordinated information resource (Spiers and Finlayson 1999).

The inventory data collated through this project will be used to illustrate known areas of biodiversity importance and gaps in information. The data will be linked to a river/wetland typology, which will provide a framework for predicting the possible occurrence of specific biota and habitats within previously unsurveyed areas. The inventory will provide information for policy and management implementation at multiple-scales (e.g. regional, catchment, or individual habitat). This will be possible through the use of GIS data layers and presentation of information at appropriate scales.

Application of the principles outlined in the strategic framework and conceptual model will support the aim of TRIAP to collate and provide information on Australia's northern rivers and better inform natural resource managers and decision-makers about the ecological status of the rivers and wetlands in northern (tropical) Australia. The overall aim of the project being to: ***provide an information base for determining management priorities for the rivers and wetlands in northern Australia.*** This aim has been achieved through the collation of a multiple-scale inventory of the habitats and biota of the rivers and wetlands of northern Australia.

## 5. Linkages to other TRIAP Sub-projects

As stated above, this study represents one of three Sub-projects undertaken through the TRIAP. At the outset of the TRIAP, Sub-project 1: Inventory of the Biological, Chemical and Physical Features of the Aquatic Ecosystems of the Northern Tropical Rivers (Lukacs & Finlayson 2008), and Sub-project 2: Ecological Risk Assessments for Australia's Northern Tropical Rivers (Bartolo, Bayliss and van Dam 2008) were strongly linked through the concept of the integrated WIAM framework (Finlayson et al 2005).

The key linkage is that the inventory data (ie. Sub-project 1) should be able to be used directly for the assessment phase (ie Sub-project 2). Thus, the TRIAP GIS database (ERISS 2008) linked both projects. Much of the data and associated analyses from Sub-project 1 were used in Sub-project 2 as information about ecological assets. Data and information on pressures and threats were compiled through the risk assessment study, as well as a considerable amount of additional ecological assets data and information to supplement that acquired from Sub-project 1. The linkage with Sub-project 3: Development of a Framework for the Analysis of Ecosystem Services Provided by Aquatic Ecosystems (De Groot et al 2008), was less formal, given its site-specific 'case study' focus and primary objective of trialing a framework for valuing ecosystem services. Nevertheless, it is not unrelated to this study, and information from Subproject 3 was included in this study where relevant and appropriate.

## 6. Report outline

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| **TECHNICAL REPORT 1** | **Geomorphology** (Mike Saynor, Wayne Erskine & John Lowry) |
| **TECHNICAL REPORT 2** | **Estuaries** (Ian Eliot & Matthew Eliot) |
| **TECHNICAL REPORT 3** | **Hydrology** (Dene Moliere) |
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The spatial (Geographic Information System) data for the analyses has been made available on a DVD (ERISS 2008) that can be obtained from the ERISS website (enquiries_ssd@environment.gov.au).

The general summary presents the main outcomes from the individual technical reports; readers are referred to the individual reports for details of data sources and analyses etc as undertaken.

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