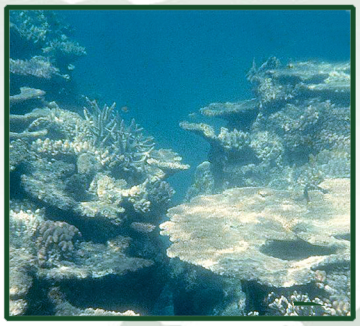

Sustaining the Wet Tropics

Condition Report: Biodiversity Conservation

Rainforest CRC

FNQ NRM LTD

A Regional Plan for NRM

Volume 2A

SUSTAINING THE WET TROPICS:

A REGIONAL PLAN FOR NATURAL RESOURCE MANAGEMENT

VOLUME 2A CONDITION REPORT: BIODIVERSITY CONSERVATION

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January 2004

Cover Photos:
Top: Geoff McDonald
Centre: Doug Clague
Bottom: Great Barrier Reef Marine Park Authority

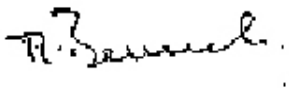
PREFACE

Managing natural resources for sustainability and ecosystem health is an obligation of stakeholders at all levels. At the State and Commonwealth government level, there has been a shift over the last few years from the old project-based approach to strategic investment at a regional scale. To oversee this investment, regional natural resource management (NRM) bodies have been established across Queensland and Australia. The new NRM Board for the Wet Tropics region, called FNQ NRM Ltd, was appointed in late 2003. The aim of this community-based Board is to take the Wet Tropics to the forefront of conservation and sustainable use of natural resources through strengthened community participation.

One of the first tasks of the new Board is the preparation of a new NRM Plan for the Wet Tropics to strategically focus investment while incorporating the outcomes of previous planning in the region. At a high-level regional science meeting, held in November 2002, it was agreed that the Plan should be based on a clear documentation of the state of resources in the region. While there is a wealth of research publications on the region, there has been no synthesis of this material into a document for the consultation and plan preparation processes. This is the purpose of the current report. The information in this report deals with the first of the three overarching objectives that will direct decision-making under the extension of the NHT Program, namely *biodiversity conservation.* It is the second of a series of documents that will be co-produced as supporting information to the Plan (see introduction to this report).

The principal authors of this report were Nigel Weston (Rainforest CRC, Cairns) and Steve Goosem (Wet Tropics Management Authority, Cairns). The authors wish to acknowledge the contribution made by others, including Nigel Stork (CEO, Rainforest CRC, Cairns and Chair, Wet Tropics Regional Science Panel), who edited the preliminary draft, as well as those who reviewed the document as organisational representatives. The Commonwealth and State governments should also be thanked for their support through the NHT Program extension.

This report is designed to be used by planners and decision-makers involved in the development of the Wet Tropics NRM Plan. It should also be of use to others involved in NRM in the private sector and at the local, State and Commonwealth government levels. Indigenous and community groups, students and the public generally should also find the report, and those that follow, a valuable resource. I take pleasure in presenting it to the regional community.



Mike Berwick
Chair, FNQ NRM Ltd

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LIST OF ACRONYMS

ACTFR	Australian Centre for Tropical Freshwater Research
AFFA	Department of Agriculture, Fisheries, Forestry (Australia)
AIMS	Australian Institute of Marine Science
AHD	Australian Height Datum
ANCA	Australian Nature Conservation Agency
ANZECC	Australian and New Zealand Environment and Conservation Council
AQIS	Australian Quarantine Inspection Service
ASS	Acid Sulfate Soil
ATSIC	Aboriginal and Torres Strait Islander Commission
BMP	Best Management Practice
BOM	Bureau of Meteorology
BVG	Broad Vegetation Group
CAFNEC	Cairns and Far North Environment Centre
C4	Community for Cassowary and Coastal Conservation
CMA	Cooperative Management Agreement
COTS	Crown-of-Thorns Starfish
CPA	Cairns Port Authority
CRC	Cooperative Research Centre
CRRP	Community Rainforest Restoration Program
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CVA	Conservation Volunteers Australia
CYPLUS	Cape York Peninsula Land Use Study
DOGIT	Deed of Grant in Trust
DCILGPS	Queensland Department of Communication, Information, Local Government, Planning and Sport (now DLGP)
DEH	Queensland Department of Environment and Heritage (now EPA)
DLGP	Queensland Department of Local Government and Planning
DNR	Queensland Department of Natural Resources (now NR&M)
DPA	Dugong Protection Area
DPI	Queensland Department of Primary Industries
DSD	Queensland Department of State Development
EIU	Einasleigh Uplands
EPA	Queensland Environmental Protection Agency
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cwlth)
ESD	Ecologically Sustainable Development
FHA	Fish Habitat Area
FNQROC	Far North Queensland Regional Organisation of Councils
FNQ 2010	Far North Queensland Regional Planning Project
FNQ RPAC	Far North Queensland Regional Planning Advisory Committee
GBR	Great Barrier Reef
GBRMPA	Great Barrier Reef Marine Park Authority
GBRWHA	Great Barrier Reef World Heritage Area

GIS	Geographic Information System
IBRA	Interim Biogeographic Regionalisation of Australian
IDAS	Integrated Development Assessment System
IGA	Intergovernmental Agreement
ILUA	Indigenous Land Use Agreement
IPCC	International Panel for Climate Change
IUCN	International Union for the Conservation of Nature
IMCRA	Interim Marine and Coastal Regionalisation for Australia
IMO	International Maritime Organisation
IUCN	International Union for Conservation of Nature (now World Conservation Union)
IPA	*Integrated Planning Act 1997* (Qld)
JCU	James Cook University
LGA	Local Government Authority
LGAQ	Local Government Association of Queensland Inc
LIPS	Low Isles Protection Society
MoU	Memorandum of Understanding
NAP	National Action Plan for Salinity and Water Quality
NCA	*Nature Conservation Act 1992* (Qld)
NHT	Natural Heritage Trust
NLWRA	National Land and Water Resources Audit
NOAA	National Oceanic and Atmospheric Administration (US)
NP	National Park
NRM	Natural Resource Management
NR&M	Queensland Department of Natural Resources and Mines
OECD	Organisation for Economic Cooperation and Development
OESR	Office of Economic and Statistical Research
PMP	Pest Management Plan
PSSR	Particularly Sensitive Sea Area
QFMA	Queensland Fisheries Management Authority
QFPS	Queensland Forest Practices System
QFRI	Queensland Forest Research Institute
QFS	Queensland Fisheries Service
QPWS	Queensland Parks and Wildlife Service
RCMP	Regional Coastal Management Plan
RE	Regional Ecosystem
RPAC	Regional Planning Advisory Committee
SF	State Forest
SLATS	Statewide Landcover and Trees Study
SPP	State Planning Policy
SoE	State of Environment
TKMG	Tree Kangaroo and Mammal Group
RVMP	Regional Vegetation Management Plan
TREAT	Trees for the Evelyn and Atherton Tableland

UNCLOS	United Nations Convention on the Law of the Sea
UNESCO	United Nations Educational, Scientific and Cultural Organisation
USL	Unallocated State Land
VMA	*Vegetation Management Act 1999* (Qld)
WHA	World Heritage Area
WPSQ	Wildlife Preservation Society of Queensland
WRP	Water Resource Plan
WTMA	Wet Tropics Management Authority
WTWHA	Wet Tropics World Heritage Area
WWF	Worldwide Fund for Nature

1. INTRODUCTION

1.1. THIS REPORT

A new Natural Resource Management Plan (NRM Plan) is currently being prepared for the Wet Tropics region to meet new planning guidelines for community-based programs such as the Natural Heritage Trust (NHT).

In the past, community-based programs such as Integrated Catchment Management and the NHT have been criticised for being ad hoc and not necessarily focused on strategic resource management priorities. They have also been criticised for being too bureaucratic for local people and not responsive enough to local issues and needs. Recent changes in NRM policy have addressed these criticisms and changed from a project-based approach to one that emphasises strategic investment at a regional scale.

In particular, the extension of the NHT Program will have a clear emphasis on regional outcomes. Key elements of this new emphasis will be:

- Regional empowerment and ownership through an integrated regional planning approach to natural resource management;
- Funding that will focus on the natural resource management outcomes to be achieved;
- Establishment of measurable and achievable resource condition and management action targets; and
- Actions based on sound science.

This requires the best possible use of available data and scientific knowledge. At a high-level regional science meeting, held in late November 2002, it was agreed that the plan should be based on a clear documentation of the state of resources in the region. While there is a wealth of research publications on the region, there has been no synthesis of this material into a document for the consultation and plan preparation processes. This is the purpose of the current report.

The information in this report deals with the first of the three overarching objectives that will direct decision-making under the $1 billion NHT extension, namely **biodiversity conservation**. Companion reports will be produced for the other two overarching objectives: **sustainable use of natural resources** and **community capacity building and institutional change**. While every effort has been made to ensure the accuracy and reliability of information in this study, it is not intended to be a fully comprehensive, scientific review.

1.2. BIODIVERSITY – WHAT IS IT?

Biodiversity is the variety of all life forms – the different plants, animals and microorganisms, the genes they contain and the ecosystems of which they form a part. Farmer-Bowers (1997) suggested that it might be more helpful to think of biodiversity as ‘native flora and fauna in sufficient quantities to ensure the natural variations in communities are maintained’, although it must be noted that the relationships between species and the physical environment are dynamic and collectively provide essential ecosystem functions across landscapes and in marine areas.

Values of Biodiversity

Beattie (1995) identified three overlapping reasons for the conservation of biodiversity: beauty, utility and profit. Other values might include spiritual enrichment (possibly a subset of beauty) and the intrinsic right of species to exist (see Purdie 1995). In short, biodiversity contributes to the continued existence of a healthy planet, our own well-being and economies (Burbidge & Wallace 1995). Accordingly, the conservation of biodiversity is now legally mandated in many places throughout the world, including Australia. This is especially relevant in the context of the current study because the Wet Tropics NRM Region is considered to be a biodiversity ‘hotspot’ of global importance

(Davis *et. al.* 1995; see also Myers *et. al.* 2000). The listing of the Wet Tropics of Queensland and Great Barrier Reef World Heritage Areas bears testimony to this.

'The Wet Tropics, Australia's biological crown jewels' – T. Low (1999), Feral Future

Aboriginal Cultural Values of Biodiversity

Aboriginal people have occupied and used their land and sea country in the Wet Tropics NRM Region for thousands of years (WTMA 2003). To the Aboriginal Traditional Owners, the region is a series of 'living' and dynamic cultural landscapes (Review Steering Committee 1998). This means that the landscape and its natural features and resources are central to Aboriginal people's spirituality, culture, social organization and economic use, including food, medicines and tools (Review Steering Committee 1998, WTMA 2003). Within Australia the term 'country' by Aboriginal peoples has been used to describe the cultural landscapes of Aboriginal and Torres Strait Islander Peoples.

There are at least 23 Traditional Owner groups in the Wet Tropics NRM region. Although most identify as 'Rainforest Aboriginal people' they are culturally diverse, and belong to several language groups. They are*: Bandjin, Bar Barrum, Djabugay, Djiru, Girramay, Gulnay, Gunggandji, Jirrbal, Kuku Yalanji, Western Yalanji, Ma:mu, Manbarra, Muluridji, Ngadjon Jii, Nwaigi, Warrgamay, Warangnu, Tableland Yidindji, Gimuy Yidinji, Goldsborough Valley Yidinji, Mandingalbay Yidinji, Lower Coastal Yidinji* and *Yirrigandji.* They express a strong and continuing sense of belonging to, and responsibility for their country and have obligations for the management of these estates as defined by that Traditional Owner group's custom and tradition (Review Steering Committee 1998).

The significance of biodiversity for Aboriginal people of the region is bound to the spiritual origins of the landscape, which includes, the sea as well as the flora and fauna and the people that inhabit them (Smyth 1994). Thus, the values of biodiversity are inextricably linked to the Aboriginal cultural values. For example, various flora and fauna species are culturally significant in traditional law and ceremony, for food and medicinal resources, cultural artifacts and in creation stories.

Some Indigenous cultural values of biodiversity:

- Belief systems about the origins of landscapes, geographic features and species;
- Understanding of the inter-relatedness of components of rainforest ecosystems;
- Knowledge and practices relating to the use of rainforest resources;
- Knowledge, rights, responsibilities and practices relating to the practical and ceremonial management of rainforest environments;
- Knowledge of affiliations of the names of stories associated with sacred sites, dreaming tracks and other places throughout the rainforests;
- Knowledge of affiliations of particular groups of Aboriginal people with particular rainforest country; and
- Knowledge and use of languages, which are specific to particular groups of people and their country, and which contain and transmit so many aspects of culture.

(Source: Smyth 2003a)

Another example is the Aboriginal languages of the region, which represent a storehouse of knowledge and tradition about the environment and biodiversity. Knowledge of the environment is encoded in the language that Indigenous people use to describe the land, animals and plants (Lennon *et. al.* 2001). The role of language in Indigenous knowledge systems, and in particular environmental and ecological knowledge is very significant.

It is important to acknowledge that the biodiversity of the WetTropics NRM Region has evolved over thousands of years through active Aboriginal interaction with the land and sea and the management of its resources, and the ongoing survival of rainforest Aboriginal people was based on an intimate knowledge of the environment (WTMA 2003). For example the controlled use of fire by Aboriginal groups was responsible for maintaining local scale ecological boundaries such as sclerophyll woodland patches

within the Wet Tropics (Hill 1998, cited in Horsfall 2002). The traditional land management practices were altered dramatically with the arrival of European settlers and the removal of Aboriginal people from their lands (Fourmile *et. al.* 1995).

For Aboriginal people knowledge about the environment comes through direct observation and utilisation, and is handed down through generations (Webb 1995). It is important to note here the relationship between the **maintenance** of biodiversity and the **use** of the resources. Aboriginal peoples' rights to access traditional lands and make use of biodiversity are important in maintaining Aboriginal environmental knowledge and continual connection to culture (Schnierer *et. al.* 2001). The continued use of resources and allows Aboriginal people to pass on cultural knowledge, to use and maintain places of cultural value, and to benefit their well-being.

The special relationship, values, the traditional knowledge of the environment, the rights and interests and the land and sea management regimes that the Aboriginal Traditional Owners have had, and continue to have, are recognised as being of national and international significance (see International Convention for the Conservation of Biological Diversity; see also National Strategy for the Conservation of Australia's Biological Diversity). It has also been recognised as a key issue in the forthcoming Wet Tropics NRM Plan, and as such an Indigenous (*Bama*) Cultural and Natural Resource Management Plan[1] is being developed for the Wet Tropics NRM Region.

1.3. AIMS OF THE REPORT

As the first survey of the biodiversity resources of the Wet Tropics NRM Region, this report aims to establish a continuing information base for developing sound environmental strategies and management and for assessing the sustainable use of natural resources. It attempts to:

- Identify existing knowledge on the state of biodiversity, including the main socioeconomic factors affecting it;
- Identify key indicators and data requirements for long-term monitoring;
- Identify gaps in the available information;
- Develop an appropriate reporting methodology;
- Provide information on biodiversity trends in the region; and
- Create a system for tracking progress in environmental management and providing direction for policy development.

More information on how this report links to the new NRM Plan being developed for the region is given in Section 4.

1.4. REPORT THEMES

The report addresses biodiversity conservation in two parts:

1. Coastal and Marine Biodiversity; and
2. Terrestrial Biodiversity.

These follow State of the Environment (SoE) reporting themes and although they are treated in separate Sections, many subjects are interrelated. Most are discussed largely within a single Section to avoid undue duplication although certain material can logically be discussed in more than one Section. Care has been taken to identify links and provide cross-references.

[1] *Bama* is the term used by a large proportion (but not all) of the Aboriginal people in the Wet Tropics NRM Region to refer to an Aboriginal person.

1.5. CONDITION-PRESSURE-RESPONSE FRAMEWORK

The report uses the condition-pressure-response framework used for SoE reporting in most Australian jurisdictions. The concept was originally developed by the Organisation for Economic Cooperation and Development (OECD), and has been widely adopted in a modified form by the OECD countries and a wide range of other organisations. The framework organises information into three broad categories:

- Information about the *condition* of biodiversity resources (i.e. quality and the functioning of important processes);
- Information about human activities that affect these resources, or *pressures*. Pressures do not necessarily imply harm, especially if the activity is appropriately managed; and
- Information about human efforts to address biodiversity conservation issues, or *responses*.

1.6. REPORT PREPARATION

The Rainforest CRC and the Wet Tropics Management Authority (WTMA) compiled the report with the assistance of the Great Barrier Reef Marine Park Authority (GBRMPA). Nigel Weston (Rainforest CRC) and Steve Goosem (WTMA) were the principal authors, with Gary Wilson (Queensland Herbarium, EPA) and Libby Larsen (Rainforest CRC) providing specialist input.

Nigel Stork (CEO, Rainforest CRC and Chair, Wet Tropics Regional Science Panel) edited the preliminary draft, which was reviewed by other experts and officers of relevant government departments, research institutions and community groups. In particular, the authors gratefully acknowledge the contributions made by Donna Audas, Jo Johnson, Matt Ryan (GBRMPA), Anne Withell (Department of the Environment and Heritage, Canberra), Steve Garnett, Tony O'Malley, Mike Trenerry, Bruce Wannan (EPA, Cairns), Gabriel Crowley, Alastair Freeman, Peter Latch, Keith McDonald, Keith Smith, (EPA, Atherton), Lachlan Hurse (EPA, Brisbane), Kim Campbell (DLGP, Cairns), Stuart Campbell (DPI, Cairns), Mark Annandale (DSD, Cairns), Mila Bristow (QFRI, Walkamin), Daryl Killen (DPI, Atherton), Jim Kernot, Joe Rolfe, Kev Shaw (DPI, Mareeba), Roz Burtenshaw, Jim Teitzel (AgForce North), Geoff Borschmannn (Greening Australia), Brad Congdon, Jon Nott (JCU), Garry Werren (ACTFR/JCU) and Andrew Ford (CSIRO).

A sub-committee of the regional NRM body (FNQ NRM Ltd) comprising the following Board members: Ken Atkinson, Ray Byrnes, Caroline Coppo, Colin Hunt and Peter Stanton reviewed the final draft as did Rowena Grace, the Board's biodiversity officer. Peter Gilbey and Helen McLaughlin (NR&M) also provided comments on sections of the final draft. Sharlene Blakeney and Peter Bannink (Spatial Products & Analysis, NR&M, Mareeba) and Peter Horne and Geoff Mills (Cartography, NR&M, Cairns) provided GIS support. Jann O'Keefe and Shannon Hogan (Rainforest CRC) assisted with production of the final report.

1.7. DATA ACQUISTION

A large volume of information, drawn from a wide range of sources, was collated, interpreted and used in this report. Principal sources include the State of the Wet Tropics Report 2001-2002 (WTMA 2002), the State of the Great Barrier Reef World Heritage Area 1998 report (Wachenfeld *et. al.* 1998), the Queensland State of Environment Report 1999 (Environmental Protection Agency 1999a) and the Australian Terrestrial Biodiversity Assessment 2002 (NLWRA 2002) and associated database (referred to in this report as Australian Natural Resources Atlas Version 2.0). Several of these documents are currently being updated and will be available in the near future.

Published reports cited in the text are to be found in the reference list at the end of the report. Other unpublished sources are acknowledged by the use of organisational abbreviations. Data that appear without acknowledgement or citation were provided by the principal authors and/or expert reviewers.

2. COASTAL AND MARINE BIODIVERSITY

2.1. INTRODUCTION

The Queensland *Coastal Protection and Management Act 1995* (Coastal Act) defines the 'coastal zone' as 'coastal waters and all areas to the landward side of coastal waters in which there are physical features, ecological or natural processes or human activities that affect, or potentially affect, the coast or coastal waters'. This definition acknowledges that zone limits cannot be set and that a range of human activities and natural processes influence land and sea along the 'coast' (EPA 1999a).

The coastal zone of the Wet Tropics encompasses all State waters between the Bloomfield River and Crystal Creek (Photo: Geoff McDonald).

The coastal zone of the Wet Tropics region encompasses, with the exception of the Palm Island Group, all State coastal islands and waters between the Bloomfield River and north of Crystal Creek (i.e. the northern boundary of Douglas Shire and southern boundary of Hinchinbrook Shire respectively). This is analogous to the Queensland coastal planning units of the Wet Tropical Coast and Cardwell-Hinchinbrook. Within this zone, a range of landforms and habitats can be identified on spatial scales ranging from metres to hundreds of kilometres. The major physically distinct shore types and environments of the coastal zone are sandy beaches, mud flats, estuarine and freshwater wetlands and tidal channels. In places, the World Heritage-listed Wet Tropics rainforests cascade down steep mountain ranges to the coast, where 'the rainforest meets the reef'. Numerous offshore continental islands are also dotted along the coast, including the internationally renowned Hinchinbrook Island.

The Great Barrier Reef, which consists of coral reefs, shoals and other formations, is the most significant feature of the coastal zone and extends the entire length of the plan area. On the basis of its outstanding natural, cultural and historical features and integrity as a self-perpetuating ecological system, much of the Reef was inscribed on the World Heritage List in 1981. Although the seaward boundary of the region had not been defined at the time of writing (January 2004), it includes areas of the Great Barrier Reef World Heritage Area (GBRWHA), the Great Barrier Reef Marine Park and state marine parks (Cairns and Townsville/Whitsunday).

Many factors affecting the ecological processes of the coastal zone originate from outside these areas and it is important to remember that the catchments (or river basins) that make up the Wet Tropics NRM Region are collectively catchments of the Great Barrier Reef as well. These catchments are the Daintree/Mossman (incorporating the Bloomfield), Barron, Russell/Mulgrave, Johnstone, Tully/Murray and Herbert Rivers as well as Trinity Inlet (see Map 1 of Volume 1 in this series, available at <http://www.rainforest-crc.jcu.edu.au>).

Resources and Values

The values of the GBRWHA are outlined in *The Outstanding Universal Value of the Great Barrier Reef World Heritage Area* (Lucas *et. al.* 1997). Much additional information for the NRM Plan region was collected as part of the regional coastal management planning processes undertaken for the Wet Tropical Coast and Cardwell-Hinchinbrook. Specific information on Aboriginal cultural values for sea country will be provided in the forthcoming Indigenous (*Bama*) Plan (Volume 3 of this series).

2.2. CONDITION

Coastal and marine biodiversity within the Wet Tropics region is considered below in terms of:

- regional seascape diversity;
- regional ecosystem diversity; and

- regional species diversity.

2.2.1. REGIONAL SEASCAPE DIVERSITY

The Great Barrier Reef Marine Park is the world's largest marine protected area. It incorporates a large number of different habitats and environmental regimes because of its large size (Stokes & Dobbs 2001). Within the plan area, the Reef is divided into four marine biogeographic regions (bioregions) (after Thackway & Cresswell 1998) (see Map 2 of Volume 1 of this series). These are discussed further below.

Marine Bioregions

The Commonwealth, States and Territories developed an *Interim Marine and Coastal Regionalisation of Australia* (IMCRA) as a regional framework for planning resource development and biodiversity conservation in marine and coastal areas (Thackway & Cresswell 1998). Two provincial level regionalisations provide the coarsest or top layer of information: the Demersal Provinces and Biotones Regionalisation (the inshore waters of the NRM Region and the offshore waters north to about Cairns are contained within the North Eastern Province, while the offshore waters north of Cairns are in the North Eastern Biotone) and Pelagic Provinces and Biotones Regionalisation (waters north of Hinchinbrook Island are contained within the Northern Pelagic Province, while those south are in the Eastern Pelagic Biotone).

BIOREGIONS

Bioregions represent the primary level of biodiversity classification in Queensland (Sattler & Williams 1999). A bioregion is defined as:

> *'A complex area (land/sea) composed of a cluster of interacting ecosystems that are repeated in similar form throughout. Region descriptions seek to describe the dominant land/sea scape in terms of a hierarchy of interacting biophysical attributes. Bioregions vary in size, with larger regions found where areas have more subdued environmental gradients. These are defined and delineated at the meso-scale (i.e. 100s to 1,000s of km).'* (Thackway & Cresswell 1998:27)

Existing bioregional classifications provide a useful system for the description of both the land and seascapes of the Wet Tropics NRM Region (or plan area).

The seaward margin of marine bioregions (after Thackway & Cresswell 1998) is the 200 metre isobath and they generally form a continuous, narrow segmented band around the continent. The boundary between bioregions usually extends perpendicular to the coastline. This pattern is varied in the vicinity of the Great Barrier Reef where several parallel bands extend out from the coast. The marine part of the Wet Tropics NRM Plan area is contained within four bioregions: the *Wet Tropic Coast*, *Lucinda-Mackay Coast*, *Ribbons* and *Central Reef*. These bioregions are described in Table 1 below (see also Map 2 of Background Report, Volume 1 of this series).

Table 1: IMCRA Bioregion detailed descriptions (after Thackway & Cresswell 1998).

IMCRA Bioregion	Location	Percentage representation in NRM Region	Remarks
Central Reef	Mid-shelf and offshore reefs from Cruiser Pass to mid-shelf north of Bowen, extending to offshore reefs north of the Hard Line.	~45%	Offshore region including the mid- and outer-continental shelf characterized by mostly sandy sediments of carbonate origin with some mud content in midshelf areas. Reefs in earlier stages of development, poorly developed at the shelf margin.

IMCRA Bioregion	Location	Percentage representation in NRM Region	Remarks
Lucinda-Mackay Coast	Coastal and island waters from Lucinda to approximately Mackay, including the Whitsunday and Cumberland groups.	<5%	Inshore coastal region including complex high-island groups (Whitsundays and Cumberlands), sandy-mud substrates, less complex and diverse mangrove communities and lower littoral fauna diversity than regions to the north. Large tidal range, especially in the south.
Ribbons	Offshore east Cape York, from north of Yule entrance to the southern extent of the ribbon reefs at Cruiser Pass.	~5%	Offshore region extending to the edge of the continental shelf, eastern margin comprised of ribbon reefs and detached reef complexes, with small, poorly developed reefs behind. Sandy sediments of carbonate origin.
Wet Tropics Coast	Coastal and island waters from approximately Cooktown to Lucinda, including Hinchinbrook Island.	~90%	Inshore coastal region dominated by very complex and extensive mangrove forests and very high littoral faunal diversity. Sediments very muddy, of terrestrial origin, from very high but seasonal rainfall. Poorly developed inner shelf reefs.

2.2.2. REGIONAL ECOSYSTEM DIVERSITY

The Great Barrier Reef Marine Park Authority (GBRMPA) is further defining regions at the micro-scale within the GBRWHA through its Representative Areas Program. Although termed 'bioregions', they are more or less the marine equivalent of the more familiar regional ecosystems (or REs, see Section 3) and are mapped and described using biophysical data. Each represents an area where the known animal and plant assemblages, and the physical features, are sufficiently distinct from the surroundings and the rest of the WHA.

As of March 2001, there are seven GBRMPA reef bioregions, eight GBRMPA non-reef bioregions and three GBRMPA deeper offshore areas mapped within the Wet Tropics NRM Plan area (see GBRMPA 2001). These are described in Table 2. To help ensure the maintenance of biodiversity, GBRMPA aims to include examples of all bioregions and, as far as practicable, all habitats in highly protected areas (IUCN Categories I or II) (GBRMPA 1999).

Table 2: GBRMPA Bioregions (Source: GBRMPA 2001).

Bioregions	Description
Reef	
RE2 Coastal Northern Reefs	Higher species richness and more *Sargassum* than in RE3. Low soft coral cover, but higher richness than RE3. Silty in sheltered areas. Sediment resuspension during south-east trade winds. Biologically distinct patches of reef.
RF1 Northern Open Lagoon Reefs	Small islands and low vegetated isles with fringing reefs. Muddy influence from wet tropical rivers. Distinct in terms of reef size and assemblages (soft coral, fish and algae).

Bioregions	Description
RE3 Coastal Central Reefs	Biologically distinct, patchy reefs; more exposed to prevailing winds than RE2. Very low soft coral diversity and cover, but rich in gorgonians on deeper reef slopes. Influenced by episodic Burdekin River plumes and other annual river plumes. Very muddy in sheltered areas and on deeper slopes. Sediment resuspension during south-east trade winds.
RG1 Sheltered Mid Shelf Reefs	Sheltered by outer barrier reefs. Reefs may form lagoons. Distinct hard and soft corals, fish and algae. Octocoral assemblages diverse, mostly clear water species and some coastal species.
RG2 Exposed Mid Shelf Reefs	Fairly exposed to Coral Sea with clear water and strong wave action on outer area. Reefs may form lagoons. Episodic Burdekin flood plumes may reach inner reefs, resulting in greater cross-shelf variation than in many other bioregions.
RA2 Outer Barrier Reefs	Distinct geomorphology, coral and fish. Coral Sea influence. Mosaic of steep, exposed, high-energy fronts and current-swept channels. Leeward reef benthos have a mix of clear-water and coastal species.
RA3 Outer Shelf Reefs	Distinct geomorphology, with more submerged reefs than elsewhere. Transition zone. Open matrix of reefs allows greater Coral Sea influence, little coastal influence.
Non-reef	
NA1 Coastal Strip	Sand rather than mud, low carbonate and low nutrient. Dry tropic influence from land. Very dense seagrasses in places – some areas important for dugong and turtle feeding. Boundaries along the coast match changes in shoreline type.
NB3 Inner Shelf Seagrass	Very sandy area with distinct invertebrate and fish communities. Seasonal seagrass patches. Distinct gorgonian fauna, associated with low wooded islands. Boundary for sponges and gorgonians extends south to Cape Grafton only.
NB5 Inner Mid Shelf Lagoon	Coarse sediment from land influences (medium-high land input). Sparse seagrass.
NL2 Outer Shelf Seagrass	Shelly sands (very coarse) with smaller areas of seagrass and algal gardens (low density).
NL3 Outer Shelf Inter Reef – Central	Shelly sands with very sparse algae and seagrasses.
NTW Western Pelagic Platform	Gentle broad slope, number of sediment drifts (mobile sand banks formed under East Australian Current); mostly fine pelagic sediments punctuated by many coral shoals. Oceanic sharks and large bluespot trout present.
NR Queensland Trough	More moderate slope compared to NQ; mostly fine pelagic sediments.
NS Intermediate Broad Slope	Widening of slope with lower gradient; mostly fine pelagic sediments.
Deeper Offshore Areas	
Outer Central Inner Reef	Deep water, offshore areas that extend from the edge of the continental shelf to the eastern border of the Great Barrier Reef WHA.
Offshore Queensland Trough	
Central Offshelf	

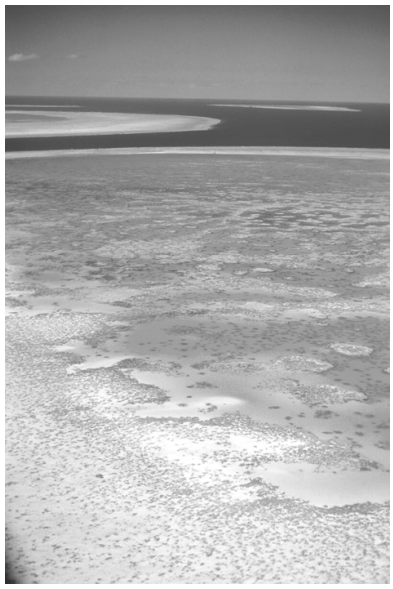
2.2.3. REGIONAL SPECIES DIVERSITY

The Great Barrier Reef is the largest coral system on the planet has extraordinary species diversity, including (Australian State of the Environment Committee 2001):

- six of the world's seven species of marine turtles;

- 54% of the world's mangrove diversity;
- 359 species of hard coral;
- more than 1,500 species of fish;
- 1,500 species of sponges (30% of Australia's diversity);
- 800 species of echinoderms (13% of the world's diversity);
- over 5000 species of molluscs; and
- over one-third of the world's species of soft coral and sea-pens.

More detailed information follows below. It is derived from the report *State of the Great Barrier Reef World Heritage Area 1998* (Wachenfeld *et. al.* 1998) unless otherwise stated. GBRMPA is obliged to prepare these reports every five years and the updated *State of the Great Barrier Reef World Heritage Area* report is available on-line at <http://www.gbrmpa.gov.au/corp_site/info_services/publications/sotr/>. While the 1998 report was a static published document, the State of the Great Barrier Reef on-line is a dynamic product based on the Internet. The State of the Great Barrier Reef on-line will allow the GBRMPA to continuously update information and increase user flexibility and access to this information.



The Great Barrier Reef is the largest coral system on the planet (Photo: ©GBRMPA).

Flora and Vegetation

Tidal Coastal Wetlands

Bruinsma (2001) assessed the tidal coastal wetland resources from Cape Tribulation to Bowling Green Bay (near Townsville). She found that these communities are characterised by high species diversity and an absence of saltpans in the majority of areas. The warm climate and large volume of freshwater entering the estuaries due to high rainfall within the catchments support a large number of mangrove species and mangrove associates throughout the intertidal zone. Closed *Rhizophora* is the dominant community type, followed by Closed Mixed and Closed *Ceriops* (see Table 3). However, within individual estuaries the dominance of these community types may be quite varied. Diverse Closed Mixed communities dominate some areas, particularly those wetland systems in high rainfall catchments (e.g. Tully catchment). Although a single species (e.g. *Ceriops tagal*) may be quite common throughout the intertidal zone in these areas, mappable monospecific communities consisting of just this species (e.g. Closed *Ceriops*) are rare. The largest contiguous area of tidal coastal wetland vegetation within the plan area can be found in the Hinchinbrook Channel region, where high rainfall promotes the growth of many mangrove species and communities that reach heights of up to 30 m (Bruinsma 2001).

Table 3: Tidal coastal wetland communities of the Plan Region (Hinchinbrook, Cardwell, Johnstone, Cairns, *Yarrabah* Aboriginal, and Douglas Local Government Areas) (Source: de Vries *et. al.* 2002).

Coastal Wetland Community	Area (ha)	Percent of total
Closed *Avicennia*	800	2
Closed *Avicennia/Ceriops*	13	0
Closed *Bruguiera*	1,770	4
Closed *Ceriops*	8,894	20
Closed Mixed	9,574	22
Closed *Rhizophera*	18,820	43
Closed *Rhizophera/Avicennia*	28	0
Open *Avicennia*	28	0
Open *Avicennia/Ceriops*	5	0
Open *Ceriops*	237	1
Saline Grassland	863	2
Samphire-dominated Saltpan	466	1
Saltpan	2,032	5
Total	**43,530**	**100**

Unfortunately, no estimates of the area of tidal coastal wetlands existing before European settlement of Australia have been made. Studies documenting changes to wetland habitats in the region (see Russell *et. al.* 1996a 1996b, 2000; Russell & Hales 1993) identified few large net losses in wetland communities. The major loss of mangrove and saltpan communities occurred in the Barron catchment due to the construction of the Cairns International Airport (Bruinsma 2001). Area of tidal coastal wetland has actually increased in some catchments due to mangrove colonisation at the

mouths of creeks or rivers (see Table 4). Possible explanations include increased tide levels, a decrease in freshwater runoff as a result of agricultural drainage, an increase in storm surges or by changes in tidal flushing patterns caused by dredging (Bruinsma 2001).

Table 4: Estimated mangrove cover in selected Wet Tropics catchments (Source: GBRMPA 2001c).

Catchment	Past Area 1952 (ha)	Present Area 1996 (ha)	Estimated loss (%)
Johnstone	176	202	+
Herbert (lower floodplain)	14000	13500	0.36
Moresby	2233	2873	+
Russell-Mulgrave	775	787	+

Freshwater Wetlands

Freshwater wetlands serve to slow the flow of water into coastal areas, thereby trapping sediment and nutrients that have the opportunity to settle out of the water column. Freshwater wetlands are also capable of detoxifying pollutants by processing some compounds and incorporating them into the system. Therefore these wetlands provide a filtering and detoxifying service to estuarine and marine environments. Clearing from Cairns to Ingham (Barron, Russell-Mulgrave, Johnstone, Murray and Herbert Rivers) has resulted in the loss of 60-70% of melaleuca wetlands and a significant proportion of sedgelands (Johnson *et. al.* 1998; Russell & Hales 1994).

Estimates of both tidal coastal and freshwater wetland decline in selected Wet Tropics GBR catchments are given in the *Great Barrier Reef Water Quality: Current Issues* Report (GBRMPA 2001c, p15). The conservation and rehabilitation of these wetlands is important for the protection of water quality in river systems and downstream in the Great Barrier Reef WHA. Incorporation of any wetland mapping data and identification of priority wetlands for conservation and rehabilitation is integral to protecting the values of the region and the GBR. The Wet Tropics region has about one-fifth of Queensland's Wetlands of National and State Significance. Many regionally significant wetlands also occur. This is discussed further in Section 3.

The FNQ Regional Plan (Steering Committee Report on the Environment) (Regional Environment Strategy Steering Committee 1997) identified coastal melaleuca swamps (Types 15a, 18) and mosaics of coastal wetlands with rainforest and sclerophyll (especially melaleuca and palm forest) (Types 17, 18, 19, 20, 23a) as regional conservation priorities. The consolidation and repair of fragmented seasonally inundated swamplands including fan palm, feather palm and melaleuca wetlands was identified as a regional rehabilitation priority.

The following coastal vegetation communities were also identified as regional conservation priorities in the Steering Committee Report on the Environment:

- lowland complex mesophyll vine forest (Type 1a);
- coastal palm rainforest (Types 3a, 3b); and
- vine forest types on beach sand (Types 7 and 2b).

More information on FNQ 2010 biodiversity and rehabilitation priorities is provided later in Section 3. Meanwhile, the draft *Wet Tropics Conservation Strategy* (WTMA 2003) aims to conserve and rehabilitate where necessary the following waterways and wetlands:

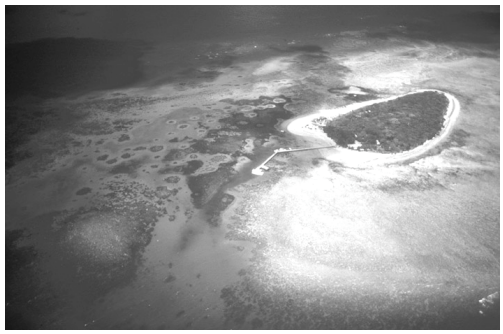
- Russell/Mulgrave rivers and lowland swamp areas;
- Daintree River and associated wetlands, including Alexandra Bay Wetlands;

- Eubenangee Swamp;
- Liverpool Creek;
- Murray River; and
- Wyvuri Swamp.

Section 3 provides further information on wetland habitats throughout the NRM Region (including nationally important wetlands).

Continental Islands

The flora and vegetation of the continental islands (and coral cays) of the GBRWHA are exceptionally diverse given the small area of land involved. There is a total of 2211 plant species on the more than 550 continental islands throughout the entire GBRWHA. This is about a quarter of the total number of species for Queensland in only 0.1% of the area of the State. This island plant community is dominated by rainforest species (48% of species present) together with open-forest species (46%) and coastline species (6%).



Island and cay flora is diverse, given the small area of land involved (Photo: ©GBRMPA).

Floristic analysis of the continental island flora gives five floristic regions in the GBRWHA (Batianoff 1998). The Wet Tropics NRM Region straddles two of these:

1. Northern Region (Cape York to Dunk Island); and
2. Wet Tropics Region (from Dunk Island to north of Magnetic Island including Hinchinbrook Island).

The Northern Region is the second most diverse of the five regions (with 976 spp, behind Whitsunday Region with 1141 spp), while the Wet Tropics, with 656 species, is the least diverse. Hinchinbrook Island alone has 600 species (Batianoff 1998).

The Northern Region has the largest concentration of rare and threatened species with 27, followed by the Wet Tropics with 24. Generally, there is an increase in the herbaceous plants and a decrease in woody plants from north to south – this trend is closely related to the presence of woody rainforest species recolonising the northern islands from the close tropical rainforests (Batianoff & Dilleward 1995). The distribution of littoral margin flora is similar from north to south (Batianoff 1998).

Introduced plant species are present on the continental islands of the World Heritage Area, but in lower numbers than usually found on developed islands in other regions. In different areas of the Great Barrier Reef the percentage of introduced species on islands varies from 4.7 to 14.4%.

Coral Cays

Floristic analysis of the coral cay flora discriminates two regions: northern and southern (Batianoff 1998). The northern region is home to many rainforest species and relatively few (only 15%) introduced ones, whereas the southern region has a relatively large number (55%) of introduced species. Coral cay vegetation, particularly the Pisonia rainforest, provides important nesting sites for seabirds.

Seagrasses

Seagrasses are productive flowering plants that can live completely submerged beneath marine waters (Mateer 1998, in Bruinsma 2001). Large seagrass beds mainly occur in sheltered bays and estuaries of the plan area, although habitat can also be found on coral reef platforms and in areas of more than 60 metres depth between reefs. Seagrasses are of great ecological importance as food sources for threatened species such as green turtles and dugongs, as nursery areas for juvenile commercial prawns and fish and crab species, and as substrate stabilisers (Bruinsma 2001).

Broadscale studies of seagrass distribution from Cape York to Cairns were conducted in November 1984 (Coles *et. al.* 1985) and from Cairns to Bowen in 1987 (Coles *et. al.* 1992). More detailed, complementary studies have recently been undertaken in Cairns Harbour and Trinity Inlet in 1993 (Lee Long *et. al.* 1996), 2001 (Campbell *et. al.* 2002) and 2002 (Campbell *et. al.* 2003), the Hinchinbrook region (from Dunk Island to Cleveland Bay) in October 1996 (Lee Long *et. al.* 1998) and Oyster Point, Cardwell between 1995 and 1998 (Lee Long *et. al.* 1999).

These surveys can only be considered as 'snapshots' of seagrass distribution, owing to the natural seasonal and annual variability in the species composition, density and biomass of seagrass communities. However, as these regions have supported seagrass communities in the past, it is possible that they will do so in the future, provided the environmental conditions for colonization and maintenance of the meadows (e.g. temperature, water turbidity, sediment stability and nutrient levels) remains favourable (Bruinsma 2001).

The Wet Tropics coast contains some of the richest seagrass assemblages in the GBRWHA, with 12 species recorded in the Dunk Island and coast region, 10 in Cairns Harbour and 9 around Hinchinbrook Island and Channel (Lee Long *et. al.* 1993) (see Table 5). A total of 13 species have been recorded along the coast between Cape Tribulation and Bowling Green Bay (near Townsville) (for species list, see Bruinsma 2001).

Table 5: Localities of high seagrass diversity along the Wet Tropics coast (Source: Lee Long *et. al.* 1993).

Location	Species number recorded
Bedford Bay – Cape Tribulation	8
Cairns Harbour	10
Barnard Island	5
Dunk Island and coast	12
Hinchinbrook Island and Channel	9

Macroalgae

Macroalgae are a universal component of coral reef communities and play a complex role in reef ecology. They display a variety of growth forms including turfs, encrusting calcareous algae and larger fleshy algae, otherwise known as seaweeds. The macroalgae of the GBRWHA have high diversity and low endemism. The exact number of macroalgal species is unknown because of taxonomic uncertainty and limited geographical surveys, but 400-500 species are estimated to occur in the World Heritage Area. It is not known how many occur along the Wet Tropics coast.

Under natural conditions, algal communities show high spatial and seasonal variability. Natural disturbances, the presence of herbivorous fish and large regional climatic fluctuations all influence the presence of macroalgae. Algal blooms can also result from human activity, such as overfishing or increased sediment and nutrient runoff from landuse (CRC Reef *n.d.*).

On the Great Barrier Reef, there are large differences in the amount and type of seaweeds found between fringing reefs, around inshore islands and on reefs further offshore (CRC Reef *n.d.*). Inshore reefs usually have abundant and conspicuous macroalgal growth, in particular the tall brown fleshy alga Sargassum. Fleshy macroalgae also occur on offshore reefs where red algae are most common and Sargassum is virtually absent. The high abundance of Sargassum on inshore relative to offshore reefs has been attributed to isolation of inshore reefs from fish grazing pressure, rather than the direct enhancement of algal growth by higher nutrients in coastal waters. Algal turfs are widespread and abundant, and their cross-shelf distribution is influenced by fish grazing and water quality. Within a particular reef, the reef-flat and back-reef areas are often dominated by macroalgae.

Macroalgae are also abundant in the deepwater, inter-reefal areas of the northern part of the World Herigage Area. Large mounds formed from the green calcareous alga Halimeda cover up to 2,000 km^2 in this region and may be up to 20 m high. These mounds, which start at the ribbon reefs just north of Port Douglas and continue to just below Pandora Entrance near Cape York, are the most extensive actively calcifying Halimeda beds in the world (Drew 1998).

Fauna

Corals

The Great Barrier Reef is part of a global centre of coral diversity located in the Indo-Pacific and possesses more than 70 hard coral genera. The Reef has some 350 individual species compared with a global maximum of about 450 species in Indonesian and Philippine waters. Most of the hard coral species on the Reef are also found in other reef areas, but 10 species are considered endemic to the Reef.

WHAT IS A CORAL?

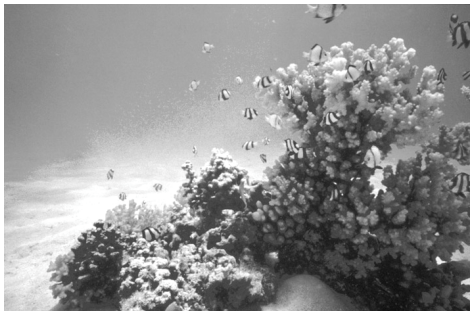
*'Corals belong to the group of animals (Cnidarians) that also include anemones, jellyfish, bluebottles and hydroids. This group of animals is quite simple, with a body plan that includes a central cavity. The basic structure shared by all corals is the coral **polyp**. This is the basic building block of a coral colony. The polyp is a small tube-like structure, with a central space opening via a mouth. The mouth of the polyp is surrounded by six (or a multiple of six) tentacles. A coral polyp resembles a small anemone. Most soft corals lack hard external skeleton, and their polyps have eight tentacles. In hard corals, the polyp sits in a small limestone cup (corallite) that it secretes and that protects the soft polyp tissue.'*

(Source: http://www.reef.crc.org.au/aboutreef/coral/coralwhatis.html).

The following account deals primarily with hard corals since this group has been the most comprehensively studied. Soft corals are also an important component of many reefs. Their taxonomy is not well documented and even less is known about their ecology and current status.

Spatial Distribution Patterns

Extensive surveys over the last two decades have demonstrated that corals (like fishes, sponges and macroalgae) show a marked change in species composition as one moves from sheltered inshore fringing reefs to the exposed shelf-edge reefs of the outer barrier in clear nutrient-poor water. Inshore reefs are often characterised by the relatively high abundance of non-Acropora corals such as Galaxea, Montipora and Goniopora, compared to mid-shelf reefs that have more plate-forming Acropora species, and outer-shelf reefs that are frequently dominated by digitate or sub-massive Acropora species.



The Great Barrier Reef is part of a global centre of coral diversity (Photo: ©GBRMPA).

This cross-shelf pattern is correlated with an increase in wave exposure and light availability from inshore to offshore reefs. In terms of species diversity, the innermost mainland fringing reefs or platform reefs within a few kilometres of the coast have the lowest diversity (100-150 species), but this rises rapidly away from the coast so that fringing reefs around high island groups have over 300 species. Platform reefs further offshore in mid- and outer-shelf areas have high cover but somewhat lower species counts. Coral cover is extremely variable between reefs but surprisingly, highest cover is often found on nearshore reefs. However, this high cover can be set back to nearly zero by disturbances, such as cyclones and human activity.

North-south variations in hard corals also exist but are less conspicuous than the cross-shelf differences. In particular, species diversity tends to decrease from north to south along the eastern Australian coast, although most of this variation occurs south of the WHA.

Table 6: Hard coral diversity in the GBRWHA (Source: Veron 1998).

Region	Corresponding GBRMP Section	Recorded Species
Northern GBR	Far Northern and Cairns Sections	324
Central GBR	Central Section	343
Capricorn-Bunker	Mackay/Capricorn Section	244
Pompey and Swain Reefs	Mackay/Capricorn Section	163

Coral diversity is largely related to the diversity of habitats within an area (Veron 1998). The central region of the GBRWHA, with complex high island archipelagos including the Palm group, is the most diverse with 343 recorded species, followed by the northern region. Species diversity drops off significantly around the Capricorn-Bunker reefs at the southern end of the Great Barrier Reef (see Table 6). This implies that the Wet Tropics coast has very high hard coral diversity, given that it straddles the north and central regions.

Natural Variation

Although some systematic cross-shelf and north-south trends can be found among the reefs of the Great Barrier Reef, a striking feature is the natural variation that can exist between nearby reefs, and the variation that can occur over time on a single reef. Three separate long-term studies of corals have emphasised this variability through time. In one study covering six reefs in the central and northern Great Barrier Reef between 1980 and 1995, substantial changes occurred in terms of the numbers of areas dominated by corals, bare substrate or other organisms, but by the end of the study period, the proportions were similar to those at the beginning (Figure 1).

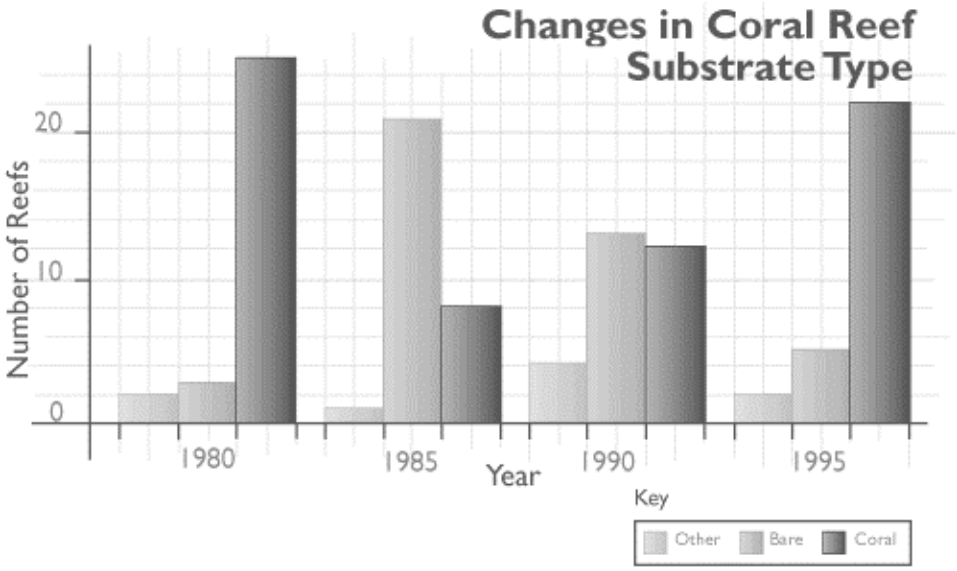


Figure 1: Categorisation of 30 study areas according to dominant substrate type. Most sites were established in areas with high coral cover. By 1985, many had suffered coral mortality resulting mainly from predation by crown-of-thorns starfish or bleachings. By 1995, the overall relative abundance of sites in each category had returned to close to the 1980 situation, but many individual sites were markedly different to their 1980 state (Source: Wachenfeld *et. al.* 1998).

Overall, long-term studies show that coral cover, coral growth and coral degradation can vary considerably over time in the absence of any direct human impacts. There is no clear evidence in any of these studies that there has been a major decline in coral status with increasing European influence in the region. Indeed two more recent monitoring programs (which cover a shorter period) suggest that most reefs have exhibited an increase in coral cover over the last three to ten years. Nevertheless, the monitoring studies reported here cover barely a fraction of the reefs in the Great Barrier Reef, and it is quite possible that serious but undocumented declines have indeed occurred in some areas.

Fishes

The GBRWHA fish fauna exhibits a huge range of diversity in form, shape, colour and size, and the behaviour of fishes individually, and in schools, adds a further dimension of diversity (Cappo & Williams 1998). The exact number of fish species is unknown, but estimates range from 1200 to 2000, with 1500 often being taken as a reasonable estimate (Cappo & Williams 1998). Coral reef habitats exhibit the greatest species richness, followed by mangrove and estuarine environments. Seagrass and inter-reefal areas are likely to exhibit lower levels of species richness than coral reef environments,

but the fishes of these habitats are poorly known (Cappo & Williams 1998). For the purposes of this report, fishes are divided into three groups: coral reef, inshore and estuarine, and pelagic.

Coral Reef Fishes

The GBRWHA is close to the centre of coral fish diversity, namely the Indo-West Pacific region. The majority of coral reef species are cosmopolitan species distributed throughout this region, accordingly endemism is low (~3%) (Cappo & Williams 1998).

The GBRWHA fish fauna exhibits a huge range of diversity (Photo: ©GBRMPA).

The Australian Institute of Marine Science (AIMS), particularly as part of the Long-term Monitoring Program, has carried out broadscale studies of distribution of coral reef fishes. Findings indicate strong spatial patterns in distribution of fishes, particularly across the continental shelf. Scientists are uncertain as to what causes these patterns but several factors may be involved, including:

- the degree of exposure to waters bearing high nutrient and sediment loads close to the mainland;
- the degree of exposure to waters bearing low nutrient; and
- sediment loads and fish larvae from the Coral Sea, and the degree of exposure to wave action.

Latitudinal patterns are also present, but are weaker than cross-shelf patterns. Many species are long-lived and recruitment of new juveniles varies markedly from year to year. Thus, when a particular year has an unusually high recruitment event, that age-class can dominate the population. It is a feature of reef fish populations that they decline slowly over time, but increase rapidly after a good recruitment season. These slow declines and rapid increases are not synchronised between species because good recruitment seasons happen in different years for different species and may be widely separated.

For the most part, information about the state of species that are targeted by the reef fish line fishery has been derived from studies comparing fished and unfished reefs or studying the effects of fishing.

Studies of closed reefs that have been re-opened to fishing can show immediate effects of drastic reduction of numbers of legal size coral trout (one of the species targeted by the fishery). When Bramble Reef (east of Lucinda) was re-opened to fishing, the effects on the population of legal size coral trout were rapid with 57% of the legal size stock removed within two months and 78% within one year.

Juvenile recruitment pulses (as described above) can also dramatically affect the stock size on both closed and open reefs. During the closure of Bramble Reef, densities of legal size coral trout increased by over 300%. Increases, although smaller, also occurred on three nearby reefs that were open to fishing. A large pulse of juvenile recruitment drove these increases in the first year of closure. As these juveniles grew, they increased the population of legal size coral trout in the following years on all reefs. However, as they reached legal size, they were vulnerable to being caught on the reefs open to fishing and numbers of legal size trout did not increase as much on the open reefs as they did on Bramble Reef.

Most studies comparing nominally closed reefs with those open to fishing have failed to find significant differences in total numbers of coral trout. Findings in such studies may be affected by the history of fishing pressure, the strength of the age classes that are supporting the fishery and the amount of illegal fishing in protected areas. However, several surveys have found differences in the size structure of coral trout populations on open and closed reefs. Results indicate that open reefs often support higher numbers of below legal size coral trout and lower numbers of above legal size trout than closed reefs. These differences between open and closed reefs can be as much as twofold.

A major problem with interpreting results from most studies that have compared open and closed reefs is that studies did not quantify the actual amount of fishing pressure on reefs. Reefs were simply classified as fished or unfished, according to their status in the zoning plan and results were analysed according to this classification. If nominally open reefs are only subject to low levels of fishing and/or nominally closed reefs are subject to illegal fishing pressure, then interpretation of these results is difficult. There is much anecdotal and some circumstantial evidence of illegal fishing on closed reefs, but no solid data about the true extent of such infringements. Further problems with interpreting such studies come from the apparent speed with which effects of fishing become apparent (as discussed above). Thus, the major effects of line fishing over much of the Great Barrier Reef may have occurred before any scientific studies into those effects began.

Another important source of information about coral reef fishes targeted by the line fishery are the data from the compulsory commercial reef-line logbooks kept by the Queensland Fisheries Management Authority (QFMA). Available catch, effort and catch per unit effort data are variable from year to year, but show no consistent trends at a regional scale. There is considerable anecdotal evidence of localised overfishing, particularly between Innisfail and Port Douglas. These views are shared by fishers from all fishing sectors but are not supported by the available scientific data.

Scientists from the NSW Fisheries Research Institute and the Australian Museum have prepared a Conservation Overview and Action Plan for the Natural Heritage Divison of the Department of the Environment and Heritage. It reviews the biological characteristics and conservation status of 114 species of threatened and potentially threatened Australian marine and estuarine fishes, and outlines some of the constraints encountered in carrying out this task (Pogonoski *et. al.* 2002). Thirty-six species from the Wet Tropics NRM Region, including several reef species, are included in the Conservation Overview and Action Plan (see Section 3).

Inshore and Estuarine Fishes

Little information has been published about inshore and estuarine fish species. While present levels of commercial harvest are considered to be sustainable, the resource is considered to be fully utilised. A major information gap that has been identified is that relating to stock assessment of all exploited species. Another gap is the lack of information on recreational catch. While recreational catch rates are unknown, they are believed to be declining, particularly adjacent to population centres (Wachenfeld *et. al.* 1998).

Pelagic Fishes

Pelagic fishes typically spend their lives in open waters and are seldom, if at all, associated with the seabed. The degree to which individual species are associated with the seabed varies. The inshore shelf waters of the Great Barrier Reef Lagoon are the major nursery and feeding areas for the black marlin, especially areas near major mangrove lined bays in the plan region like Dunk Island and Cairns. Other species, such as Spanish mackerel, are often found close to coral reefs. Information on the state of populations of pelagic fishes is scarce, even for those that are commercially exploited. More information on fisheries is included in the Sustainable Use Condition Report (Volume 2B of this series).

Marine Reptiles

The reptiles found along the Wet Tropics coast fall into three major groups: crocodiles, marine turtles, and sea snakes.

Crocodiles

Estuarine crocodiles (*Crocodylus porosus*) are an important part of the Wet Tropics coastal zone. They occur in all coastal waterways and specific regions, such as the Daintree River, provide important areas of crocodile habitat (Miller 1998). Crocodiles also occur in low numbers on islands within the GBRWHA – they have been recorded

from approximately 25% of the islands north of Cairns, on both continental and reefal islands (Miller & Bell 1995). They have been recorded from inner-, mid- and outer-shelf locations.

Until 1974, crocodiles were hunted commercially in Queensland and their numbers declined significantly. They are now protected in Australia but estuarine crocodiles continue to be threatened by habitat loss from urban, rural, residential and agricultural development. Although estuarine crocodiles are a valued part of Australia's natural and cultural heritage, they are also large and dangerous predators.

The extension of human settlement into crocodile habitat has brought humans and crocodiles into increasing contact and several recent crocodile attacks have occurred in the plan area. Crocodiles at popular beaches north of Cairns have concerned local residents and are considered detrimental to the tourist industry (Crocodile Specialist Group Newsletter Vol. 19, No. 1, Jan-Mar 2000). Although it is generally perceived that the crocodile population has increased, there are no conclusive data to prove this. But, according to QPWS crocodile expert Mark Read, the proportion of larger crocodiles is increasing. These so-called 'boss crocs' are forcing out smaller and weaker specimens that often set up house beside boat ramps, jetties and other areas of intensive human traffic where crocodiles have hitherton been absent (Hoy 2003).

Marine Turtles

Of the world's seven species of marine turtles, six are found in Wet Tropics coastal waters. They are the green, hawksbill, loggerhead, flatback, Olive Ridley and leatherback turtles. All six are known to feed in the region. Low density nesting by green turtles (*Chelonia mydas*) and sporadic nesting by flatback turtles (*Natator depressus*) occurs on the mainland and some offshore islands. Low density nesting by flatback turtles takes place on mainland beaches from Cairns south to Bundaberg. This species is of special significance as it is endemic to Australia and has only been recorded nesting within continental shelf waters, mainly on the beaches of inshore continental islands.

Six of the world's seven species of marine turtles are found in Wet Tropics coastal waters (Photo: ©GBRMPA).

On a global scale, marine turtle populations are under threat. The hawksbill is listed as 'critically endangered' by the IUCN. This means that this species is at 'extremely high risk of extinction in the immediate future'. Green, Olive Ridley, loggerhead and leatherback turtles are listed as 'endangered', meaning that they are at 'high risk of extinction in the near future'. Flatback turtles are listed as 'vulnerable', meaning that this species is at 'high risk of extinction in the medium-term future'.

In Australia, marine turtles are also in a vulnerable position. Apart from the flatback turtle, all species of marine turtles found in Australian waters are listed under the EPBC Act; the loggerhead turtle (*Caretta caretta*) as 'endangered' and the four other species as 'vulnerable'.

In the GBRWHA most scientific studies of turtle populations have concentrated on green and loggerhead turtles. The loggerhead is of particular concern. Since surveys began in the late 1970s the number of nesting females has declined by up to 90% (C. Limpus, *pers. comm.* in *Draft Recovery Plan for Marine Turtles in Australia*). Although the trends for green and hawksbill turtles are not as clear as those for loggerheads, there is evidence that populations of these species are also declining in the GBRWHA. There are no indications that flatback turtles are in decline. Olive Ridley and leatherback turtles are uncommon in the Great Barrier Reef and have been the subject of little scientific research. The long-term trends in the populations of these species are unknown. More information on rare and threatened species of the plan area is provided in Section 3.

For Aboriginal and Torres Strait Islanders, turtles are an essential element of the living maritime culture and demonstrate connection with sea country. The social, cultural and economic values that Indigenous peoples place upon resources such as turtle give strength to culture and demonstrate affiliation with tradition and traditional areas (Hunter & Williams 1997).

Sea Snakes

Seventeen species of sea snakes have been reported from the GBRWHA. Some species are found mostly on and around coral reefs whereas others are found over sandy and muddy areas of seabed. Although 48% of the 31 species found in northern Australian waters are endemic, there are no species endemic to the GBR.

There have been few studies of sea snake populations in the GBR and the status of populations is unknown. Even in the Gulf of Carpentaria, where there have been estimates of numbers of sea snakes killed in trawl nets, the impact of this mortality on the populations is uncertain. Ward (2000) found that most by-catch species occur in areas that are not subjected to extensive trawling, and there are no data to suggest that this fishery seriously threatens any population of sea snake. However, sea snakes may be more vulnerable to trawler-induced effects than most other by-catch species, and formal assessment of the status of populations is needed.

Birds

The bird species of the GBRWHA can be divided into three groups based primarily on habitat use: shorebirds, land birds, and seabirds.

Shorebirds

There are seven internationally significant areas for shorebirds in or adjacent to the GBRWHA (Watkins 1993), although none occurs along the Wet Tropics coast. One site of at least regional significance is the Port of Cairns and Trinity Inlet. This site is on one of the migratory pathways for waders which breed in Arctic Siberia and Alaska (Blackman *et. al.* 1996). Seventeen species have been recorded as regular feeders and 29 species as occasional visitors. The following species are the most commonly recorded:

- Red-necked stint (*Calidris ruficollis*);
- Great knot (*C. tenuirostris*);
- Sharp-tailed sandpiper (*C. acuminata*); and
- Bar-tailed godwit (*Limosa lapponica*).

It is probable that the population of great knot regularly using the site represents c.1% or more of the national population of this bird (Blackman *et. al.* 1996). Driscoll (1997) contends that Trinity Inlet is of national and perhaps international significance for the whimbrel (*Numenius phaeopus*). It is also an important winter refuge for non-breeding shorebirds such as the eastern curlew (*N. madagascariensis*) (B Congdon, *pers. comm.*). These shorebirds and their habitats are protected under international migratory bird agreements.

Isolated beaches along the Wet Tropics coast (e.g. Hinchinbrook Island, Casuarina Point) also provide important breeding sites for the beach stone curlew (*Esacus neglectus*). This species is thought to be sensitive to human disturbance, and predation by cats, dogs and feral pigs may reduce breeding success (Garnett & Crowley 2000). This species is listed as ‘vulnerable’ under the Queensland Nature Conservation Act.

Land birds

The avifauna of the continental islands of the GBRWHA is similar to the fauna of comparable habitats of the adjacent mainland (Kikkawa & Hulsman 1993). However, the GBRWHA is particularly important to a number of land birds, including the pied

imperial-pigeon (*Ducula bicolor*). The Brook Islands, near Hinchinbrook Island, are a significant breeding habitat for this species (GBRMPA Website).

Seabirds

Between 1.4 and 1.7 million seabirds from 22 species breed on islands in the GBRWHA each year. The population of non-breeding birds may add a further 425,000, giving a total seabird population that may exceed two million. This represents more than 25% of Australia's tropical seabird breeding population.

While the northern and southern quarters of the WHA are the most important for breeding seabirds due to the abundance of suitable islands for nesting, there are still significant bird sites within the plan area (see Table 7). For example Michaelmas Cay, near Cairns, is considered to be the second most important site for seabird breeding in the GBRWHA (K. Hulsman *pers. comm.* in Stokes *et. al.* 1998).

Table 7: Significant seabird sites along the Wet Tropics coast (Source: M. Short, EPA, *pers. comm.*).

Wet Tropical Coast RCMP Region	North Barnards South Barnards Michaelmas Cay Beaver Cay Low Isles
Cardwell-Hinchinbrook RCMP Region	Dunk (Coonanglebah) Island Spit Mound (Purtaboi) Woln Garin Smith (Kurrambah) Mung-um-Knackum Kumboola Battleship Rock (Pee Rahm Ah) Islands Brook Islands Eva Island Agnes Beach (east coast Hinchinbrook Island)

Even under natural conditions, seabird populations on islands are highly variable and intensive monitoring is required to identify trends in populations. One such seabird study involved monthly bird censuses over a ten-year period at Michaelmas Cay, near Cairns. The study identified a 46% decrease in the number of nesting pairs of common noddy (*Anous stolidus*) between 1984 and 1994 and a 26% decline in the sooty tern (*Sterna fuscata*) population. Reasons for these declines are not known with certainty, but increasing levels of human visitation are considered the most likely cause (Hulsman *et. al.* 1997, cited in EPA 1999a).

Marine Mammals

Dugongs

Dugongs (*Dugong dugon*) are marine mammals that are specialised for feeding on seagrasses. They range throughout the tropical and sub-tropical coastal waters of the Indo-West Pacific, although they have been reduced to relict populations over much of this area. The waters of northern Australia, including the GBRWHA, contain a significant proportion of the world's dugong population with an estimated 15% of Australia's population being found in the GBRWHA. Dedicated aerial surveys of dugong populations have been commissioned by GBRMPA and carried out by James Cook University since 1984.

For the purposes of the dugong surveys, the GBRWHA has been subdivided into two parts: north of Cooktown and south of Cooktown. Surveys north of Cooktown in 1986-1987, 1992 and 1994 indicated a stable dugong population while those south of Cooktown documented a distinct decline (Figure 2). Indeed, the 1994 population

estimate was only about 48% of the 1986-87 estimates. The results of the 1999 survey indicate that dugong numbers in the southern GBR were significantly higher than the corresponding estimate in 1994, but not significantly different from that obtained in 1986-87 (Marsh & Lawler 2001).

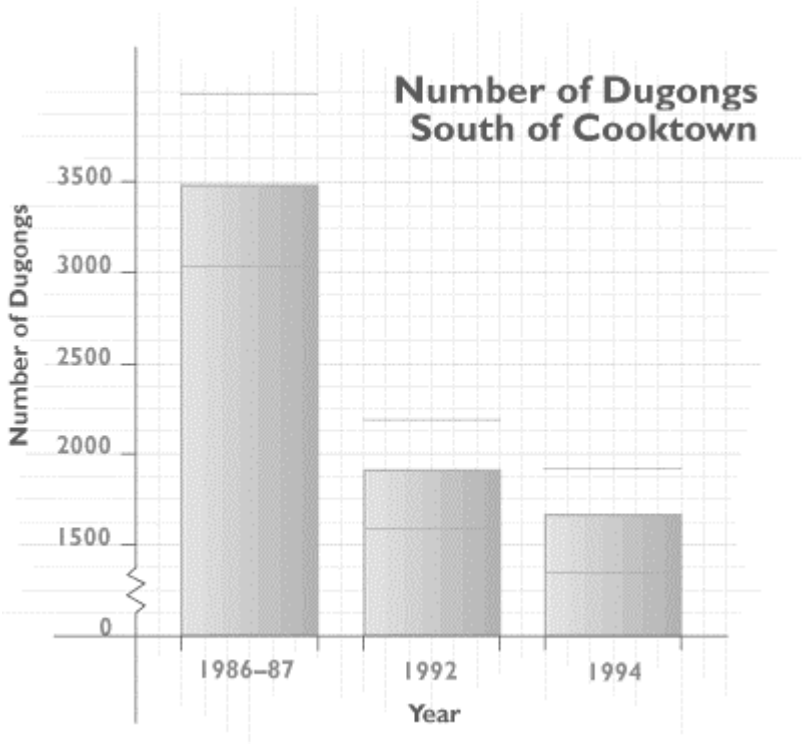


Figure 2: The number of dugongs in the GBRWHA south of Cooktown has fallen by about 50% since surveys started in 1986-87. The lines above and below each bar show the standard error, an indication of the uncertainty associated with the measurement (Source: GBRMPA 1998).

Shark control records also hindcast a serious decline in dugong numbers off the urban coast of Queensland (Marsh *et. al.* 2001). If the bycatch of dugongs in shark nets is a reliable index of changes in dugong abundance, the results of Marsh *et. al.* (2001) suggest that by 1999, dugong numbers in the local regions of the shark nets (including Cairns) had declined to about 3% of their 1960 value. Suggested reasons for this decline include habitat loss, traditional hunting and incidental drowning in commercial gill and mesh nets and in the shark nets set for bather protection (Marsh & Corkeron 1998).

On a global scale, the dugong is listed as 'vulnerable' by the IUCN. This means that this species is at 'high risk of extinction in the medium-term future'. The dugong is also listed as 'vulnerable' under the Queensland Nature Conservation Act but it is not listed under the Commonwealth EPBC Act. The Hinchinbrook Island area is recognised as an important site for this species (Marsh & Corkeron 1998).

Whales and Dolphins

At least 26 species of whales and dolphins visit or are resident in the GBRWHA, a level of diversity that is probably typical of other coastal regions in the Indo-West Pacific (Marsh & Corkeron 1998). Most species are classified by the IUCN as 'insufficiently known', reflecting the paucity of knowledge of the group generally.

One species that regularly visits the Wet Tropics coast during the winter months is the humpback whale (*Megaptera novaeangliae*). Sheltered waters of the GBR region are described as an important calving area for the east Australian humpback population and anecdotal information suggests that the numbers of humpbacks are increasing in the inshore waters of the Cairns region (Vang 2002). This population was brought to the brink of extinction by large-scale, industrialised whaling between 1949 and 1962 (when the industry collapsed), by which time its numbers had plummeted from 10000 to 200-

500 animals. The most recent estimate of the size of east Australian population is 4000 animals in 1998 (Vang 2002). The humpback is still classified as 'vulnerable' by the IUCN, which means that it remains at 'high risk of extinction in the medium-term future'. The species is also listed as 'vulnerable' under both the EPBC Act and the Queensland *Nature Conservation Act*.

MIGALOO

Migaloo is a white humpback whale that was first observed in 1991 off Byron Bay when it was estimated to be 3-5 years of age. In most years since then it has been recorded undertaking the winter migration into eastern Australia. In addition to sightings in Tasmania, Victoria and New South Wales, Migaloo has been recorded to as far north as Hinchinbrook Island in north Queensland. It has been recorded 'singing' in 1998 and 2003, indicating that it is an adult male. In August 2003 when he was 15-17 years of age, he was hit by a sail-boat off Townsville. He received a small wound and associated abrasions.

(Source: EPA Website).

Another species that visits the Wet Tropics coast during winter is the dwarf minke (*Balaenoptera acutorostrata*). In fact, the region is an important habitat for this species and it is regularly sighted on the Ribbon Reefs between Cairns and Lizard Island in June and July (Marsh & Corkeron 1998). Nevertheless, it remains one of the 'insufficiently known' species, as does Bryde's whale (*Balaenoptera edeni*), which also occurs in the region (see Section 2.3.3.).

Three species of dolphins from the GBRWHA are classified as inshore species: Indo-Pacific humpbacked, Irrawaddy River and bottlenose dolphins. However, bottlenose dolphins (*Tursiops truncatus*) are found throughout the GBRWHA, not just inshore. Limited information on numbers of dolphins is available from observations made during dugong aerial surveys, however such surveys are often unable to identify what species, or even genus, of dolphin is seen. Thus counts may amalgamate as many as four genera. This lack of taxonomic resolution makes these counts of very limited use in assessing stocks of dolphins.

There is concern about apparent declines in populations of Indo-Pacific humpbacked dolphins (*Sousa chinensis*) and Irrawaddy River dolphins (*Orcaella brevirostris*) throughout much of Southeast Asia. Populations of these species around Australia may be the only ones that will survive into the next century. Consequently, they are considered to be the world's only remaining viable populations. However, there are two major problems with this contention. First, there is only very limited information on exactly how many of these animals are in Australian waters. Therefore, it is impossible to know for certain whether populations are increasing, remaining stable or decreasing. The only available information, on numbers of groups of humpback dolphins (not actual population estimates) sighted during aerial surveys, indicates that the population is probably declining. Second, there is strong evidence that Australian populations (at least of Irrawaddy river dolphins) are genetically isolated from those in other parts of the world (e.g. south-east Asia), so the conservation of the Australian stock does not compensate for the loss of other populations. Both species are still commonly sighted along the Wet Tropics coast, even in built up areas (e.g. Cairns northern beaches). They are listed as 'rare' under the Queensland *Nature Conservation Act*.

Other whale and dolphin species reported from the GBR include spinner dolphins, pantropical spotted dolphins, false killer whales, killer whales, short-finned pilot whales, sperm whales and various beaked whales. Nothing is known of the status of

these species in the GBRWHA, other than that they occur there. Some species, for example Longman's beaked whale, are known only from a single record (near Mackay).

Rare and Threatened Species

Flora

Sixty-two of the plant species found on the continental islands and coral cays of the GBRWHA are currently listed as rare or threatened under the Queensland Nature Conservation Act 1992. Three are found only on continental islands in the WHA, one of which - *Habenaria divaricata* – is found in the plan area (see Appendix A). It is an orchid endemic to Dunk Island (Lucas *et. al.* 1997). Many other plant species found along the Wet Tropical coastal zone are similarly considered to be of conservation significance. These species are discussed further in Section 3.

Fauna

The GBRWHA has a total of 34 animal species officially listed as either rare or threatened (Stokes & Dobbs 2001). Rare and threatened fauna known from the marine part of the plan area include four mammals, two seabirds, six marine turtle species and the estuarine crocodile (see Appendix A). These are listed in Table 8 below. It should be noted that the gazetted status of individual species may vary and that the EPBC Act does not carry a 'rare' designation. Further, different provisions of the EPBC Act cover marine and migratory species, whilst all native mammals (with the exception of the Dingo), birds, reptiles and amphibians are protected as 'common wildlife' under the NCA. Some freshwater fish and butterfly species are also protected under the NCA, whilst additional protection may be given to some fish species under the Queensland *Fisheries Act* or bag limits may apply.

Table 8: Rare and threatened animals known from the marine part of the Wet Tropics NRM Region.

Scientific name	Common name	Conservation status	
		EPBC Act	NCA
Marine mammals			
Dugong dugon	Dugong	No status	Vulnerable
Megaptera novaeangliae	Humpback whale	Vulnerable	Vulnerable
Orcaella brevirostris	Irrawaddy river dolphin	No status	Rare
Sousa chinensis	Indo-Pacific humpback dolphin	No status	Rare
Seabirds			
Phaethon rubricauda	Red-tailed tropicbird	No status	Vulnerable
Sterna albifrons	Little tern	No status	Vulnerable
Reptiles			
Natator depressus	Flatback turtle	Vulnerable	Vulnerable
Chelonia mydas	Green turtle	Vulnerable	Vulnerable
Eretmochelys imbricata	Hawksbill turtle	Vulnerable	Vulnerable
Dermochelys coriacea	Leatherback turtle	Vulnerable	Endangered
Caretta caretta	Loggerhead turtle	Endangered	Endangered
Lepidochelys olivacea	Olive ridley turtle	Endangered	Endangered
Crocodylus porosus	Estuarine crocodile	No status	Vulnerable

A list of rare and threatened plant species from the plan area is included at Appendix A and rare and threatened animals at Appendix B. Appendix C provides information on those species listed in Australian action plans that are likely to occur in the plan area (both marine and terrestrial).

2.3. PRESSURE

As reported by the EPA (1999a), one of the greatest barriers to biodiversity conservation is an acute lack of knowledge about biodiversity and the processes that maintain it. We have a good inventory of vertebrates and an almost complete inventory of flowering plants in the Wet Tropics NRM Region. For these two groups, we even have a fairly good knowledge of their distribution. Much less information is available for microorganisms, fungi and marine and non-marine invertebrates, with the exception of a few taxa such as butterflies and dung beetles.

The paucity of information about the current status of biodiversity makes it inappropriate to consider any habitat type not worth saving or any species, species interaction, behaviour or natural product not worth conserving (Beattie 1993, cited in EPA 1999a). This precautionary approach to biodiversity conservation is a key principle of several relevant statutory and policy instruments including the National Strategy for the Conservation of Australia's Biological Diversity, *The 25 Year Strategic Plan for the Great Barrier Reef World Heritage Area*, Wet Tropics Management Plan, FNQ Regional Plan and the Local Government Biodiversity Strategy. Lack of knowledge means that we may lose attributes of biodiversity without even knowing they existed. Few of our land and water use practices have been evaluated fully in terms of their impact on the environment, so the impacts of our activities on biodiversity values remain largely unknown.

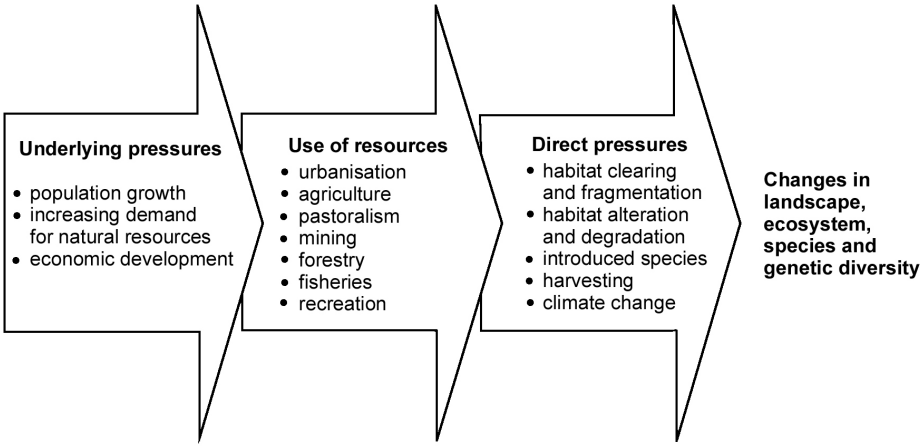


Figure 3: Underlying pressures create demand for land, water and biological resources that result in activities that directly threaten biodiversity (Source: EPA 1999a).

While activities such as land clearing directly contribute to biodiversity loss in the Wet Tropics NRM Region, they arise from the demands – economic, resource and lifestyle-related – of an increasing population. These demands, underlying pressures on bioidiversity, are very complex and embedded in society's social, economic and value systems. Underlying pressures lead to use of land, water and associated biological resources, placing direct pressure on biodiversity (see Figure 3). In coastal areas especially, changing weather patterns can be regarded as another underlying pressure. Although some extinctions and declines in biodiversity are part of natural evolutionary processes, human-induced acceleration of these is contrary to the goal of achieving ecologically sustainable development. More information on climate and population growth as underling drivers of change in the coastal zone is given below, followed by a discussion of the resultant direct (human-induced) pressures.

2.3.1. CLIMATE

An equable climate is what makes the coastal zone of the Wet Tropics popular with residents and tourists alike (EPA 1999a). This is especially so in the dry season, when temperature and humidity is largely in the human 'comfort range', hours of sunshine are high and rainfall is low. The climatic regime is also an important factor in determining the diversity and abundance of coastal wildlife. The Wet Tropics climate is also

conducive to supporting a diversity of marine life forms including temperature-sensitive reef-building corals.

Year to year variability in Queensland's climate, particularly rainfall is influenced to a considerable extent by the occurrence of El Nino and La Nina events. These events influence cyclone activity, the summer monsoon being enhanced during La Nina events. However, El Nino events have increased in frequency in the last 20 years, resulting in lower than average rainfall and river flow over the region in this period. An analysis of cyclone activity in the GBR region between 1958 and 1992 indicates that during El Nino years an average of two tropical cyclones will occur in the region. During La Nina years activity increases to about 7.5 tropical cyclones.

Commonly associated with tropical cyclones is the phenomenon of storm surge – where the sea level rises above the normal tidal level. The combination of storm surge with astronomical tide is known as storm tide. Increased frequency and storm surge height could be a result of climate change and therefore monitoring such events can be a useful means of detecting trends in climate. Table 9 lists some notable storm surges recorded in the Wet Tropics region.

Table 9: Notable storm surges recorded on the Wet Tropics coast (Source: EPA 1999a).

Year	Place	Estimated central pressure (hPa)	Surge height (m)
1918	Innisfail	928	>3.0
1920	Cairns	988	>1.5
1934	Port Douglas	968	>1.8

THE ISSUE OF STORM TIDES AND MARINE INUNDATION

'Coastal lands less then 5 m above mean sea-level or Australian Height Datum (AHD) along the wet tropical coast of Queensland may be subject to marine inundation during severe tropical cyclones. Marine inundation includes storm tide (surge plus tide) and also wave set-up, wave run-up and wave action. Marine inundation includes the effects of waves on top of the storm tide. Sandy sections of coast are likely to be severely eroded up to the 5 m contour (AHD) level during severe tropical cyclones due to wave action on top of the storm tide. Queensland has not experienced severe cyclones (category 4 and 5) since 1918 (Innisfail cyclone) and there are no recent bench marks from which to gauge the impact of these severe cyclones on the Queensland coast. Wave action during recent category 5 cyclones in Western Australia has eroded the coast to the level of the marine inundation or wave run-up. It is very likely that the same impacts would occur in Queensland during the same intensity cyclones.

To date coastal development zones, and demarcation of erosion prone areas, do not consider the impacts of erosion during a severe, or 1 in 100 year, cyclone event. Erosion prone areas that consider the effects of marine inundation and waves on the sandy coast need to be developed and incorporated into planning policies for the wet tropical coast, and indeed the entire Queensland coast.'

(Source: Jon Nott, JCU, *pers. comm.*)

While extreme climatic events occur, often with devastating consequences to human and natural systems, such impacts are seldom permanent. Natural ecosystems have adapted to tolerate some degree of climatic variability, and therefore recover after such events. However the release of high concentrations of greenhouse gases by human activity is now widely believed to be causing global warming. This could result in a rapid change in the climate and a change in sea level, with potentially severe consequences (see box, 'Climate Change').

CLIMATE CHANGE

The region's climate is strongly influenced by the surrounding oceans and weather systems such as the monsoon and tropical cyclones. As reported by the Australian State of the Environment Committee (2001), high year-to-year variability obscures any short-term background trends. Most of these variations are linked to large-scale events such as the ENSO (El Niño -Southern Oscillation) phenomenon. The Southern Oscillation is a two to five year sequence of differences in atmospheric pressure and changes in sea temperatures between the tropical central or eastern Pacific and the tropical eastern Indian Ocean or northern Australian region. El Niño causes below-normal rainfall, and often drought, over much of Australia. The reverse effects occur during La Niña. These effects are additionally influenced by changes that occur in the Pacific over decades.

Although the world's climate has gone through dramatic past cycles of change, there is increasing evidence that human activities are altering our climate at an unprecedented rate. We now know that the build up of energy-trapping gases from human activities is contributing to the present accelerated rate of global warming observed over the last 100 years. Since pre-industrial times (1700s), global atmospheric concentrations of greenhouse gases have grown significantly. Carbon dioxide concentrations have increased by 30%, methane by 145% and nitrous oxide by 15%. Based on Antarctic ice core data, current levels of these gases appear to be unprecedented in at least the last 400,000 years (Intergovernmental Panel on Climate Change [IPCC], Third Assessment Report, 2001: <http://www.ipcc.ch/>).

Almost nothing is known about how global warming will impact the region's unique ecosystems and biodiversity. The anticipated changes in global climate are expected to occur at a rate most biologists acknowledge as simply too fast for evolutionary processes, such as natural selection, to keep pace. Such constraints on the ability of species to adapt to their rapidly changing habitat could substantially increase their probability of extinction.
In addition, landscape fragmentation related to human activities will markedly limit the opportunity for some species to migrate. It has been suggested that habitat destruction and climate change will act together, setting the stage for greater rates of extinction than when considering human encroachment alone. Predicted warming for coastal north east Queensland is 1.4 to 5.8^{o} C by 2100, relative to 1990 with +4% to –10% changes in rainfall per degree of warming (Walsh *et al* 2000). More El Nino-like conditions through this century are likely and tropical cyclone intensity may increase (Walsh & Ryan 2000). Computer simulations suggest that the relative humidity surface will shift upwards on tropical mountains by hundreds of metres during the winter dry season (Still *et al* 1999) and upland cloud forests are particularly likely to display climate change effects in the very near future (Foster 2001).

Due to this predicted rapid climate change and the increasing frequency of severe climatic events such as cyclones, floods and droughts, the biodiversity and locally endemic and spatially restricted species that are keystone elements of the region's environmental values are predicted to be under severe threat over the next few decades. Preliminary analyses by CSIRO (Hilbert *et al* 2001) suggest that the rainforests of the Wet Tropics are extremely sensitive to climate change. Preliminary modelling results presently indicate that it is possible that up to 66% of all the Wet Tropics endemic vertebrate faunal species may be lost over the next 50 to 100 years (Hilbert & Williams pers com). Climate change and other stress factors have also been linked with coral bleaching and mortality on the Great Barrier Reef (Lally & Berkelmans 1999).

At present we do not know the full extent of what might be threatened by rapid climate change, where the threats might be greatest, the long term effects of these threats, how climate change might interact with other threats such as regional clearing and fragmentation patterns, weeds and feral animals, and whether or where some areas may provide continued habitat or new areas of habitat in the future.

Climate change will affect the region's biodiversity and it presents serious challenges for wildlife management. Several of the potential changes arising as a result of climate change that may directly or indirectly affect the region's biota include:

- changing weather patterns;
- increased number, range and severity of cyclones;
- changes in rainfall and run-off;
- changes in cloudiness;
- greater probability of large and damaging floods;
- changes in soil moisture during the growing season;
- shifts in bioclimatic zones;
- changes in the distribution and abundance of native flora and fauna;
- local and regional extinction of species;
- increased plant growth due to CO_2 fertilisation;
- increase in diseases;
- increased frequency of natural hazards such as bush fires;
- elevated sea surface temperatures; and
- increased coral bleaching and mortality.

(Source: WTMA 2002)

Sea level has been recorded at locations along the Queensland coast for many years. Sea level trends for five Queensland Ports calculated by the National Tidal Facility (cited in EPA 1999a) reveal that all ports show a positive trend (rise). Based on over 8,000 days of record, these data indicate that sea level in Cairns is rising at a rate of 3.25 mm/year. More detailed data on the annual average rate of change of sea level in the region over twenty years are to be published in the *Queensland State of Environment Report 2004* (*in prep.*). These data, from tide gauges at Cairns, Mourilyan, Clump Point, Cardwell, and Lucinda, show there is a rising trend but the duration of observation is too short to estimate long-term sea level rise (L. Hurse, EPA, *pers. comm.*).

Average temperatures have increased significantly over the last century (EPA 1999a). Similarly, sea temperatures in the tropics have increased by almost 1°C over the past 100 years and are currently increasing at the rate of approximately 1-2°C per century (Hoegh-Guldberg 1999). The full implications of such changes to human and natural systems are not yet fully understood, although Hoegh-Guldberg (1999) reported that sea temperatures calculated by all model projections show that the thermal tolerances of reef-building corals are likely to be exceeded within the next few decades. As a result of these increases, bleaching events such as those described below are set to increase in frequency and intensity.

Coral Bleaching

Coral bleaching is the loss of colour from corals. It is a response to stressful environmental conditions in corals and is caused when the small, brownish-coloured algae that live inside the bodies of most corals (their zooxanthellae) are ejected. Some corals can recover from bleaching by regaining their zooxanthellae, but others may die (CRC Reef Website).

The GBR experienced widespread coral bleaching in the first half of 1998 and again in 2002. High water temperatures appear to have been the main cause, although the longitudinal and latitudinal pattern of bleaching and mortality rates differed between the two events.

The majority of GBR reefs showed full recovery by the end of 1998, with the inshore reefs being worst affected and showing only patchy recovery. The greatest impact of the 1998 bleaching event was on two hard coral families: the Acroporidae (staghorn and plate corals), which suffered a 91% relative decline and the Milliporidae (fire corals), which suffered greater than 99.9% decline (GBRMPA Website).

The unusually hot, still and cloudless summer in 2002 gave rise to the most severe coral bleaching event ever recorded on the GBR. A comprehensive monitoring program was implemented by GBRMPA in collaboration with AIMS, CRC Reef and NOAA and included aerial and underwater surveys. Aerial surveys found that coral bleaching was evident from the air at almost 60% of the 641 reefs surveyed. Underwater surveys at 190 reefs along the Wet Tropics coast (between 15° and 19°S) found that few reefs had completely escaped the effects of coral bleaching with 83% of these reefs bleached to some extent, however, the majority of reefs showed signs that they were likely to survive with only minimal coral death. Extensive mortality was recorded on only a few of the inshore reefs surveyed, where up to 90% of corals were dead, and unlike the 1998 event many offshore reefs were also affected. The effects of bleaching were highly variable, varying from negligible to severe, even between reefs that were similar distances offshore. Bleaching was generally most severe in shallower water, and there were strong interspecific differences in the effects of coral bleaching (GBRMPA Website).

Detailed SCUBA surveys were conducted at nine reefs along the Wet Tropics coast using line intercept transects - three inshore, three mid-shelf and three offshore reefs - at two depth contours. The resulting data show that few reefs escaped without at least minor coral mortality. The analysis of detailed impact surveys was due for release in mid-2003.

2.3.2. POPULATION GROWTH

The number of people living in the coastal zone is one of the most important factors influencing the severity of human pressure on coastal resources. If population increases, the pressure on coastal resources can also be expected to increase. Population in the coastal zone and the rate of growth are thus good general indicators of pressure on coastal resources. They indicate the overall trend in pressure and where pressure is increasing most rapidly.

The Background Report (Volume 1 of this series) shows that the number of people living along the Wet Tropics coast continues to rise. The combined average growth rate of the coastal LGAs (Cairns, Cardwell, Douglas, Hinchinbrook and Johnstone) between 1996 and 2001 was 1%. By contrast, the combined growth rate of the Tablelands shires (Atherton, Eacham, Herberton and Mareeba) was just 0.4%. The population of Cairns increased from 113,507 to 120,433 persons between 1996 and 2001, a growth rate of 1.2% (cf. growth rate in Queensland of 1.7%). The highest growth rate in the Wet Tropics was recorded in Cardwell Shire (3.4%) and although the increase in real terms was relatively small (1,630 persons), this growth rate was the third highest of any coastal LGA in the state, behind only Noosa (3.8%) and the Gold Coast (3.6%) (OESR Website). Douglas Shire had the next highest growth rate in the Wet Tropics with 2%.

The Background Report shows that Cairns City will remain the most populous Local Government Area, with a projected population of 187,565 persons in 2021. Its share of the region's population is expected to increase from 55.6% in 2001 to 60.2% in 2021. The highest annual average growth within the region between 2001 and 2021 is projected to occur in Douglas Shire (2.3%), followed jointly by Cairns City (2.0%) and Cardwell Shire (2.0%). Furthermore, each year nearly two million domestic visitors and one million international visitors come to the region and this number is also expected to increase.

2.3.3. DIRECT PRESSURES

Land Use Change and Building Activity

Change in land use - particularly the initial change from 'natural' to 'developed'- is one of the most significant direct pressures on the coastal zone. A trend towards increasing the intensity of development of coastal land is apparent along the major part of the Wet Tropics coast, particularly north of Cardwell-Hinchinbrook. Land use is changing from natural to agriculture to urban/built infrastructure. This trend is most apparent near major coastal urban centers that have reached an advanced stage of land development (e.g. Cairns, Innisfail, Ingham). More remote areas are progressing from a natural state to a more developed state that supports agriculture and tourism development (e.g. Cardwell, Mission Beach, Port Douglas and the Daintree region). Such change is expressed in this section as the area of native vegetation cleared (after EPA 1999a).

Clearing of natural vegetation has affected most of the Wet Tropics coastal zone to some degree. For example, about 29% of the tropical lowland plant communities (6,892 ha) has been cleared in the southern Tully-Murray catchment (i.e. extending north and south of Cardwell). Their total area was reduced from 23,916 ha in 1942 to 17,024 ha in 1992 (Skull 1996, cited in EPA 1999a). The vegetation types most affected are tall eucalypt open woodlands (78% cleared), low open woodlands (56% cleared) and melaleuca woodlands (41% cleared).

Drainage and dredging have also changed the nature of large areas of the coastal zone. Land drainage for agriculture or urban development has affected wetlands, floodplains and mangroves. When drainage is on acid sulfate soils, the periodic release of sulfuric acid from the soil after rainfall or flooding adversely affects local aquatic ecosystems. Acid sulfate soils (see box 'Acid Sulfate Soils') are common along the entire Wet Tropics coast.

Changes to Wetlands

The loss of wetland communities, including mangroves, saltmarsh and freshwater wetlands, is a particularly important impact of coastal land use change. In the Wet

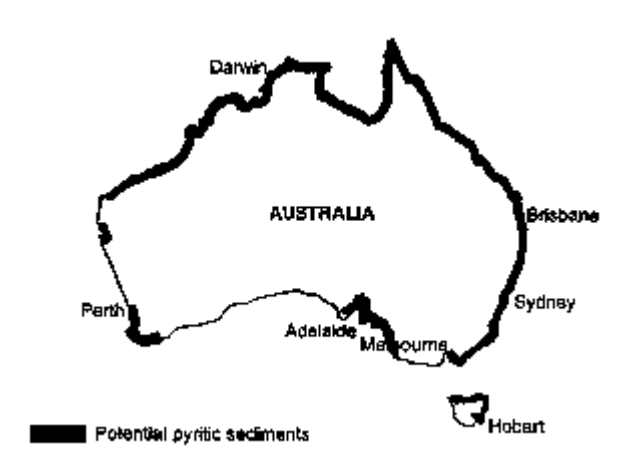
Tropics, large areas have been destroyed or severely modified and this trend continues. The greatest losses are attributable to agriculture, urban and industrial development, and tourism and maritime transport facilities and services.

ACID SULFATE SOILS

Acid sulfate soil (ASS) is the common name given to naturally occurring soil and sediment containing iron sulfides, principally the mineral iron pyrite, or containing acidic products of the oxidation of sulfides. When sulfides are exposed to air, oxidation takes place and sulfuric acid is ultimately produced when the soil's capacity to neutralise the acidity is exceeded. As long as the sulfide soils remain under the water table, oxidation cannot occur and the soils are quite harmless and can remain so indefinitely.

ASS were first identified in the Netherlands nearly 260 years ago. These soils have since been found to occur worldwide and occupy over one million square kilometres, with major occurrences in Asia, Australia, Africa and Latin America. It has been estimated conservatively that Australia has over 40,000 km^2 of ASS, containing in excess of one billion tonnes of pyrite.

Their presence in Australia was recognised only 45 years ago. They were mainly ignored until a massive fish kill in 1987 decimated 23 km of the Tweed River in northern New South Wales and focused attention on the impacts of these soils.



Indicative distribution of coastal acid sulfate soils in Australia (Source: *National Strategy for the Management of Coastal Acid Sulfate Soils 1999*).

Coastal ASS occur in every Australian state and the Northern Territory. Using information on conditions necessary for the formation of ASS, together with the known geomorphology of the Australian coastline, it can be predicted that ASS should be found in coastal embayments and estuarine back swamps, with surface elevations less than about 10 m above mean sea level (10 m AHD). Extensive occurrences of ASS are found along the eastern and northern coastline of Australia with smaller areas in southern Western Australia, South Australia, Victoria and Tasmania.

Along the Wet Tropics coast, shallow ASS occupy very fragile and ecologically important areas that are the subject of development pressure from agriculture, aquaculture, sand extraction and urbanization, including canal development. The most well known example of ASS is at East Trinity, 1 km east of the Cairns CBD (see Sustainable Use Condition Report).

Source: National Strategy for the Management of Coastal Acid Sulfate Soils 1999

Studies of the Russell-Mulgrave, Moresby and Johnstone Rivers (reported in EPA 1999a) show that 9,306 ha of freshwater wetland communities were destroyed between 1951-52 and 1992. The area of mangrove wetlands increased by 678 ha, largely in the Moresby River catchment due to saltwater intrusion into previously non-tidal areas. A net loss of 8,655 ha (47%) of the original wetland area over 40 years is apparent in these river catchments (Table 10). Meanwhile Sunfish NQ, in its submission to the Hinchinbrook Channel Inquiry, claimed that the Sugar Industry Infrastructure Package for the Murray-Riversdale area has allowed the development of 11,000 hectares of ground that was previously wetland (Paliament of Australia Website).

Table 10: Areas of wetland habitat types in three coastal catchments in the Wet Tropics in 1951/52 and 1992, determined from aerial photographs (Source: EPA 1999a, based on Russell & Hales 1993; Russell *et. al.* 1996a, 1996b).

Wetland type	1951/52 area (ha)	1992 area (ha)	Change (ha)
Russell-Mulgrave Rivers catchment			
Mangrove	775	787	+12
Melaleuca	3,860	1,808	-2,052
Palm forest	1,766	738	-1,028
Rainforest	1,759	308	-1,451
Sedge swamp	1,077	562	-515
Mixed melaleuca	666	319	-347
Total	9,903	4,522	-5,381 (-54%)
Moresby River catchment			
Mangrove	2,233	2,873	+640
Freshwater	3,363	1,175	-2,188
Total	5,596	4,048	-1,548 (-28%)
Johnstone River catchment			
Mangrove	176	202	+26
Melaleuca	1,277	282	-995
Mixed melaleuca	462	258	-204
Palm forest	439	160	-279
Swamp	499	225	-274
Total	2,853	1,127	-1,726 (-60%)
Grand total	18,352	9,697	-8,655 (-47%)

Aquaculture

In the last two decades, the aquaculture industry has grown and continues to grow rapidly. The major aquaculture activities in the Wet Tropics region include the growout of marine prawns, freshwater crayfish and fish (largely barramundi).

This industry has the potential to become a significant pressure on coastal resources as a result of habitat loss associated with pond construction and wastewater discharges. However, such discharges are subject to environmental controls.

Hydrologic Developments

Water flowing downstream transports significant quantities of fine particles (suspended sediment), nutrients and organic matter to estuarine and coastal waters. During floods, the quantities carried increase greatly. This periodic influx of sediment and nutrients plays a critical role in the physical, chemical and biological processes of nearshore waters. Altered flow regimes resulting from dams and barrages potentially have significant implications for coastal ecosystems due to changes in the timing and magnitude of such inputs. In addition, barrages can prevent fish migrating and so disrupt natural breeding cycles.

In view of Queensland's variable and generally low rainfall, harvesting water has been a priority throughout its recent history. Although the full ecological implications of flow regulation are not known, flow regulation affects important physical and ecological processes. Activity that changes the natural hydrologic regime is considered a pressure on both coastal and terrestrial ecosystems.

Reduced Water Quality

Sediment Supply Changes

Waves and currents transport sediment from rivers along the coast. Changes to sediment supply patterns might significantly influence rates of coastal erosion and deposition, with consequent impacts on coastal resources. Human activities changing natural sediment supply regimes can be regarded as a pressure on coastal resources. These include catchment activities that affect riverine sediment supply and transport rates, and dredging and dumping activities.

Catchment activities affect riverine sediment supply and transport rates along the Wet Tropics coast (Photo: Geoff McDonald).

On a regional scale, riverine sediment supply to nearshore environments is controlled primarily by climatic and drainage basin characteristics. Climatic factors are largely beyond the influence of human acitivity and therefore variability due to rainfall is not a concern. However, drainage basin characteristics are subject to human interference. Changes in land use, vegetation type and cover and flow regime can influence catchment sediment yield. Consequently, the influence of human activity is reflected in changes in sediment yield per unit runoff. This can increase significantly as a result of certain land use activities

In February 2003, the Productivity Commission released a research report into *Industries, Land Use and Water Quality in the GBR Catchment* (Productivity Commission 2003). It found that water quality in rivers entering the GBR lagoon has declined because of *diffuse* pollutants, especially sediments, nutrients and chemicals from cropping and grazing lands in relatively small areas of the adjacent catchments. In particular it found that:

- 14 million tonnes of sediment is estimated to be discharged into the GBR lagoon from the catchment annually;
- the main potential impacts from grazing arise from soil erosion; and
- the main potential impacts from cropping arise from nutrient runoff.

Estimates of annual sediment and nutrient exports from mainland GBR basins are included in Table 2.2 (pg 21) of the Productivity Commission report. This includes Wet Tropics GBR basins. Pollutant loads for Wet Tropics GBR basins have been identified by Brodie *et. al.* (2003) and these are set out in Table 11, below. The table shows that Wet Tropics basins are estimated to export just under 2 million tonnes of sediment annually, along with 14,256 tonnes of nitrogen and 2,009 tonnes of phosphorous.

The CRC Reef consensus (Appendix D, Productivity Commission report) outlines the present state of knowledge from leading scientists in the field of catchment and reef management:

- runoff of sediments and nutrients to the GBR has increased several fold as a result of past and current land use practices;
- the areas of most concern are those between Port Douglas and Hinchinbrook (as well as Bowen to Mackay);
- runoff has clear detrimental impacts on freshwater aquatic ecosystems; and
- there is significant risk that this impact is currently or may in future damage areas of high exposure along the Wet Tropical (and Central Queensland) Coast of the GBRWHA.

Table 11: Estimates of annual sediment and nutrient exports from Wet Tropics GBR basins (Source: Brodie *et. al.* (2003) and *pers. comm.*).

Basin Name	Pollutant (/yr)		
	Sediment (000t)	Nitrogen (TN t)	Phosphorous (TP t)
Daintree	167	1170	175
Mossman	49	279	30
Barron	76	636	109
Russell-Mulgrave	283	2,853	485
Johnstone	388	3,781	548
Tully	191	2,080	224
Murray	54	638	68
Herbert	682	2,819	370
Total	1,890	14,256	2,009

NB. The table shows that the Barron River exports relatively low amounts of sediments and nutrients per year. The reason for this is that although the Barron tends to be thought of as a big river, it is not. Its mean annual flow is less than one third of the Russell-Mulgrave, one third of the Daintree and one sixth of the Johnstone. The export numbers reflect this. Because the river is near Cairns it tends to get more press than it deserves in terms of size and importance (J. Brodie, ACTFR, *pers. comm.*).

Nearshore marine water quality studies have documented chlorophyll *a* concentrations for the Port Douglas and Cairns areas, with inshore lagoon waters showing significantly higher concentrations than offshore waters. Chlorophyll *a* is a good indicator of nutrient status in the water column and the GBRMPA chlorophyll monitoring program collected monthly data from 1992 until 2000 (results summarised in Section 3, GBR Catchment Water Quality Action Plan, available at <http://www.gbrmpa.gov.au/corp_site/key_issues/water_quality/action_plan/>).

The impacts of pollutant loads depend on their delivery through flood plume flows and frequency, which are documented in *Flood Plumes in the GBR: Spatial and Temporal Patterns in Composition and Distribution, GBRMPA Research Publication No. 68.* The area that experiences the greatest frequency of flood plumes is the inshore GBR lagoon between Port Douglas and Hinchinbrook, which experiences on average seven flood plumes per year (See Figure 31 of the GBRMPA report, available at <http://www.gbrmpa.gov.au/corp_site/info_services/publications/research_publications/rp68/index.html>).

Based on frequency, direction of flow and proximity to reefs and seagrass the inshore areas that are therefore at the highest risk from terrestrial inputs have been identified and include the entire inshore GBR lagoon of the Wet Tropics region (Figure 30, *Great Barrier Reef Water Quality Current Issues*, 2001). In this region, Snapper, Green, Double, High, Normanby, Russell and Fitzroy Islands all are affected by flood plumes annually and therefore are at highest risk from terrestrial activities and runoff. Upolo Reef experiences flood plume events every 2-3 years while the following reefs are affected by flood plumes every 4-6 years: Tongue, Batt, 16-027, Michaelmas, Arlington, Sudbury and Scott (See Figure 35 of the GBRMPA report).

More information on sediment supply changes is included in the Sustainable Use Condition Report (Volume 2B of this series).

Contaminants

Contaminants entering estuarine and marine waters are of many types and come from many sources. Some are highly toxic while others are relatively benign. In view of the potential to affect marine life adversely, their input is regarded as a pressure. Contaminants can enter coastal waters from discrete, identifiable sources such as

industrial and sewage discharges (point sources) and from diffuse sources such as catchment runoff and groundwater infiltration. Available data are only indicative. No data about concentrations of specific toxicants such as heavy metals in domestic and industrial effluent discharges are available.

Point-Source Inputs

Industrial and domestic wastewater discharges have considerable potential to degrade the environment near an effluent outfall. The extent of any impact is influenced by factors such as volume and toxicity and the dilution and flushing characteristics of the receiving water body. Point source discharges occur wherever human settlements occur. They tend to be seen as locally significant but of lesser significxance to water pollution in the GBR lagoon than agriculture (see, for example, *Great Barrier Reef Water Quality Current Issues*). They also tend to be more tightly regulated than diffuse sources (Productivity Commission 2003).

Domestic Wastewater

According to GBRMPA (2002), sewage discharges contribute only a few percent of the 'new' nutrients to the coastal waters of the GBR (see Figure 3 of the GBRMPA report) however they can be significant on a local scale (Brodie 1995). A majority of the large coastal cities and most of the smaller coastal settlements adjacent to the GBRWHA have secondary treatment sewage systems, although some have gone to tertiary in the Wet Tropics region. There have been noticeable reductions in larger plants - since 1999, up to 80% reduction in N and 93% reduction in P from wastewater treatment plants at Gordonvale, Babinda, Atherton, Port Douglas (L Hurse, EPA, *pers. comm.*).

Many of these treatment plants use a proportion of the effluent for land irrigation and several have sewage outfalls, as point-source discharges, either into coastal streams or directly into the GBRWHA. The operation of treatment plants (greater than 21 equivalent persons capacity) is regulated by the Queensland *Environmental Protection Act 1994*. Problems may arise from these point-source discharges, particularly in dry season conditions, where discharge into a stream may constitute the total stream flow. Under these conditions eutrophication, algal blooms and anoxia in the vicinity of the point-source discharge may result. In some areas with significant urban populations septic systems are still in operation, for example, most of the Mission Beach residential area. Plans to upgrade the sewage systems in these communities are being investigated.

Domestic wastewater contains many substances potentially harmful to aquatic life, although most occur in very small quantities. The most important substances in terms of potential impacts are organic matter, nutrients (nitrogen and phosphorous) and pathogenic organisms. As a result of increasing concern over the potential impact of these nutrients, some large treatment plants remove nitrogen (e.g. Smithfield-Marlin Coast, Cairns North, Cairns South, Edmonton, Gordonvale and Babinda) (M. Gwynne, Cairns City Council *pers. comm.*).

Street stormwater probably contributes significantly to the 'new' nutrients of the coastal waters of the GBR although data are lacking to assess this.

Industrial Wastewater

Industrial wastewater is any wastewater other than from a sewage treatment plant, and includes effluent from sources such as power stations, food processing plants, abattoirs and aquaculture farms.

Industrial activity generates considerable quantities of wastewater. In many cases, the major pollutants are heat (industrial plants), organic matter (food processing) and suspended solids (washing plants). Although they are not without adverse impacts, they are neither highly toxic nor persistent in the environment. Consequently, the presence of industrial wastewater does not necessarily indicate the presence of toxic compounds.

However, a range of industries does discharge wastewater containing an array of chemical compounds used in modern industrial processes. These can include heavy

metals such as mercury, cadmium and chromium, polychlorinated biphenyls (PCBs), organochlorine insecticides and polyaromatic hydrocarbons (PAHs). Even at very low levels, these substances can persist in the environment, move considerable distances from their source and accumulate in living organisms.

Pesticides and Herbicides

Pesticide and Herbicides including organochlorine compounds have had extensive current and past application by Queensland's intensive coastal agricultural industry (for the control of insects and weeds) as well as for a wide range of domestic, public health and agricultural purposes in urban areas (Haynes *et. al.* 2000a).

Pesticides

Broad scale surveys have also detected the pesticides lindane, dieldrin and DDT (and its breakdown product DDE) in nearshore samples collected along the Wet Tropics coast in 1998 and 1999 (Haynes *et. al.* 2000a):

- Dieldrin was detected in the mouth of both the Barron and Johnstone Rivers (0.09 – 0.37 micrograms kg^{-1} dry weight) and in sediments from Halifax Bay;
- Dieldrin is still commonly detected in crabs (*Scylla serrata*) collected from estuaries adjacent to agricultural catchments between Moreton Bay and Cairns (Mortimer 2000);
- DDT and its metabolites (DDE) were detected in low concentrations at the mouth of the Barron, Johnstone and Tully Rivers and in Halifax Bay (Haynes *et. al.* 2000a); and
- Concentrations of DDE exceeded those of DDT at all sampling sites.

Dieldrin is also detectable in marine fish tissue (liver) collected from the central Queensland Coast adjacent to agricultural activity (Von Westernhagen & Klumpp 1995). Where dieldrin was detected, its sediment concentration exceeded both the low effects range (ER-L) and median effects range (ER-M) for observed biological impacts (Kennicutt *et. al.* 1994) to marine sediment infauna (Table 8 from the *Great Barrier Reef Water Quality Current Issues* – Comparison of ER-L and ER-M and GBR sediment pollutant concentrations). Consequently, it may present a localised threat to nearshore marine organisms along the Wet Tropics coast (Haynes *et. al.* 2000a).

Herbicides

Broadscale surveys of sediment concentrations in nearshore GBR waters during 1998 and 1999 detected both atrazine and diuron (Haynes *et. al.* 2000a):

- Atrazine was only present in sediments collected in the vicinity of the mouth of the Herbert River (0.1- 0.3 micrograms kg^{-1}dry weight);
- Low concentrations of diuron (0.2-10.1 microgram kg^{-1} dry weight) were found to be widely distributed in marine sediments along the wet tropics coastline between Port Douglas and Lucinda;
- Highest concentrations of diuron were detected adjacent to the mouths of the Johnstone and Herbert Rivers; and
- Based on observed sediment concentrations, portioning models predict that chronic water column diuron concentrations near the mouths of most wet tropics rivers are likely to range from 0.1 to 1.0 microgram L^{-1}.

Seagrass samples were also collected from 16 Queensland intertidal sites during 1997 (Haynes *et. al.* 2000a):

- Diuron was the only contaminate detected in intertidal seagrass samples;
- Of the contaminates detected, the herbicide diuron is of most concern as the concentrations detected have some potential to impact local seagrass communities;

- Diuron was detected at Cairns (0.6 microgram kg^{-1} dry weight) and Cardwell (1.1 microgram kg^{-1} dry weight); and
- All the sampling locations (with the exception of Cairns and Low Isles) are near important habitat of the dugong, a seagrass grazing marine mammal that has become endangered.

Summary results for Diuron are available in Table 7 - *Great Barrier Reef Water Quality Current Issues* - Potential Great Barrier Reef diuron water column concentrations (Haynes *et. al.* 2000a).

Dioxins

Dioxins are a group of 210 chlorinated compounds consisting of chlorinated dibezzo-parapdioxins (PCDDs) and chlorinated dibenzofurans (PCDFs). The concentrations of 2,3,7,8 substituted dioxins and furans (PCDDs and PCDFs) were determined in sediment samples collected from sites along the east coast of Queensland (Muller *et. al.* 1998; Muller *et. al.* 1999; Gaus *et. al.* 2001). PCDDs were detectable in all sediment samples, while PCDFs were comparatively uncommon (Table 9, *Great Barrier Reef Water Quality Current Issues* Report). As shown in the box (Pollutants in marine mammals) below, PCCDs appear to be the most significant organochlorine pollutant bioaccumulated in dugong.

Heavy Metals

Table 6 of the *Great Barrier Reef Water Quality Current Issues* report shows a comparison between the Great Barrier Reef nearshore metal concentration ranges compared with the Australian sediment metal guidelines (Haynes 2000). Increases in cadmium and arsenic concentrations in marine sediments in the Hinchinbrook region resulting from the use of phosphate fertilisers naturally enriched in these elements have been noted adjacent to areas with extensive cropping (Tesiram 1995; Ridd 1999).

POLLUTANTS IN MARINE MAMMALS

Tissue samples were collected from 53 dugong (*Dugong dugon*) carcasses stranded along the Queensland coast between 1996-2000 (Haynes *et. al.* 2001b). The liver tissue was analysed for a range of heavy metals and blubber samples were analysed for organochlorine compounds and polychlorinated biphenyls. The results found:

- Liver concentrations of chromium, copper, iron, nickel and zinc were often higher than concentrations usually present in marine mammals;
- The liver concentration of chromium, mercury and nickel were elevated in a number of animals collected from the Wet Tropics coastline (Ingham to Cairns) in comparison to levels previously reported in Australia;
- Dieldrin, DDT and/or heptachlor-epoxide were detected in 59% of dugong blubber samples;
- Concentrations of organochlorine were similar to those reported 20 years ago and low in comparison to marine mammal tissue analysed elsewhere in the world;
- Concentrations of octachlorinated dioxin were found to be high in dugong fat tissues compared to concentrations detected in marine mammals elsewhere. (Figure 23, Current Issues Report); and
- Polychlorinated dibenzodioxins (PCDDs) appear to be the most significant organochlorine pollutant bioaccumulated in dugong.

The Stranding Database maintained by the Queensland Parks and Wildlife Service (contact researcher Col Limpus) records the main causes of death reported for whales, dolphins, dugong and turtles for the entire Queensland coast and would be a useful resource when determining appropriate management strategies.

More information on contaminants is included in the Sustainable Use Condition Report (Volume 2B of this series).

Shipping and Boating

General Shipping Information

Cairns is the east coast of Australia's most northern 'first port of entry' and deep-water passage through the Great Barrier Reef is available via Grafton Passage from the east, or the inner reef passage via Torres Strait from the north. Other major ports in the Wet Tropics NRM Region include Mourilyan and Lucinda, which are trading ports for the export of primary products (mainly sugar). The following information applies to the entire GBR region:

- Over 3,000 vessels (> 50 m in length) per annum transit the GBRWHA, carrying export products such as coal, sugar and iron ore and imported products such as oil and other products;
- Of all the vessels transiting the GBR region, less than 10% are oil or chemical tankers;
- The majority of crude oil is transported to southern ports via routes outside the GBRWHA (the Outer Route); and
- Approximately 75 % of all vessels transiting the GBR region use the Inner Route, with the remainder using Grafton, Palm and Hydrographers Passages.

Shipping Incident Statistics

Since 1985, over 600 shipping and boating incidents have been reported in the GBR region, including ship groundings, collisions, sinkings and minor oil spill pollution events. During this period, only 33 reported incidents were considered major and these included 11 collisions and 22 groundings. Fortunately, none of these incidents have resulted in a major oil spill pollution event.

Shipping Incident Impacts

Maritime incidents have the potential to significantly impact on the GBRWHA environment. Fuel or cargo spills, whether the result of vessel operations or accidental spillage, are likely to cause impacts within a short period of time yet have long lasting effects.

Groundings may result in collateral damage and anti-foulant paint (i.e. Tributyl tin – TBT) impacts to coral reef and seagrass ecosystems. These incidents may also result in oil spills, with serious ramifications for the environment in terms of damage to corals, mangroves, shorelines, dugongs, turtles and seabirds.

Some of the plastic found in the stomach of a Bryde's whale stranded off Cairns in August 2000 (Photo: QPWS).

Litter

As reported on the GBRMPA website, dumping of rubbish and other debris from ships into the marine environment has become an increasingly serious problem. Discarded debris can have a range of environmental consequences. It can entangle wildlife, causing death, limb amputation, drowning or strangulation in larger marine animals. Debris can also be ingested and cause internal blockages (especially in turtles) resulting in starvation and other complications. A stark example of this occurred on 25 August 2000, when a female Bryde's whale was stranded on a mudbank off Cairns and died before it could be returned to open water. The autopsy on the dead whale revealed that it had swallowed about 25 plastic items although a definitive diagnosis of the whale's death due to ingestion of plastic was not possible (EPA 2000).

There is also an economic impact of debris and rubbish accumulation on beaches, predominantly the cost of removal and the loss of aesthetic values in recreational areas that are reliant on tourism-generated income.

Vessel Sewage

Marine sewage contains pathogens that can affect human health by spreading hepatitis, gastrointestinal disease, causing skin infections and contributing to respiratory problems. The high concentration of nutrients in sewage can also effect coral reef and near shore environments by contributing to algal blooms, algal overgrowth and weakening of the coral skeleton (GBRMPA Website).

The amount of sewage discharged from vessels within the GBRWHA is increasing. Currently, approximately 80,000 registered recreational vessels and roughly 3000 registered commercial vessels have access to the GBRWHA. The number of recreational vessels that can access the GBRWHA has grown at a rate of 4-7% per annum in recent years. This could lead to an increase in nutrient and coliform load on the GBRWHA ecosystem, particularly in frequently visited areas (GBRMPA Website).

Exotic and Displaced Species

Coastal and marine environments in the Wet Tropics are under pressure from exotic and displaced species. At least 122 exotic species, including 18 species of algae and 104 species of fish, molluscs, arthropods and polychaetes have been introduced into Australian waters (CSIRO 1996 in EPA 1999a). Fifteen introduced species have been recorded for Queensland Ports (GBRMPA Website). Introductions have been both intentional (for aquaculture) and accidental (through hull fouling or ballast water). In addition, crown-of-thorns starfish outbreaks continue to be a major disturbance to reef ecology. On land, exotic terrestrial plant species have been introduced to coastal environments and some, like thunbergia, hymenachne and pond apple, threaten coastal plant communities in the region. More information is provided on these issues below.

Marine Species

As reported on the GBRMPA website, introduction of exotic marine species via ships' ballast water (used to alter the draft, trim and stability of a ship when steaming and during cargo loading and unloading operations at port and at sea) has become a major environmental concern as it poses threats to local biodiversity, fisheries and aquaculture. The majority of overseas bulk carriers that arrive in Queensland ports are from Korea and Japan. These bulk carriers pose a relatively low risk of introducing a pest species as they originate from ports that contain relatively cool waters, and the pest species would not be expected to survive in Queensland tropical waters (Hilliard & Raaymakers 1997). The exceptions are shipping arriving from the Southern Japanese ports, and ports in Singapore and Taiwan. These ports are all located in warmer waters and present a greater risk to sourcing species with the ability to survive in warmer tropical waters and become a local pest. Table 12 below gives estimates of ballast water dischsraged to major ports within the Wet Tropics NRM Region.

Table 12: Estimates of ballast water discharged to major ports within the Wet Tropics NRM Region (Source: Hilliard & Raaymakers 1997).

Port	No. of ships	Ballast water discharged (t)
Cairns	27	225,000
Mourilyan	25	194,000
Lucinda	17	168,000

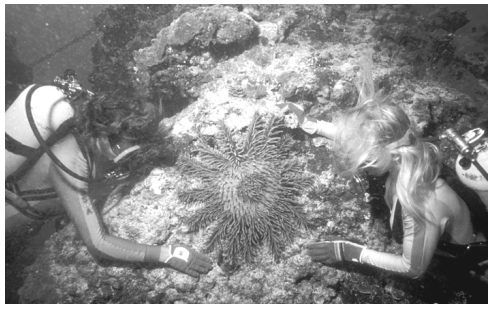
Exotic organisms can also be introduced by hull fouling (see Floerl & Inglis 2001). For example, the Asian green mussel (*Perna viridis*) has recently been detected on the hulls of some vessels in Trinity Inlet, Cairns. If the Asian green mussel becomes established, it has the potential to seriously harm our native marine ecosystem. The EPA has initiated an emergency response to minimise the likelihood of the mussel becoming established in Trinity Inlet (see Section 2.4.1.). The risk of successful exotic

introductions is likely to increase as the currently low volume of international shipping traffic in the region increases.

Accidental releases from aquaculture facilities have also occurred in the region. One example is the release of large numbers of 'Weipa' barramundi (*Lates calcarifer*) in the Hinchinbrook Channel. These fish are genetically different from the Wet Tropics barramundi populations (EPA 1999a).

Crown-of-Thorns Starfish

As reported by Wachenfeld *et. al.* (1998), the crown-of-thorns starfish (*Acanthaster planci*) is one of a few animals that feed on living coral tissue. It gets its name from the dense covering of long sharp spines covering its upper surface. At low densities this animal is just another part of the ecology of a coral reef. However, when the crown-of-thorns starfish (COTS) reaches densities at which it eats corals faster than they can grow and reproduce, this can lead to major reductions in coral cover and result in major disturbance to the whole ecology of a reef. This threshold density is estimated to be 30 mature COTS per hectare. Populations that exceed this density are known as 'outbreak populations'.



The crown-of-thorns starfish is one of a few animals that feed on living coral (Photo: ©GBRMPA).

The first COTS outbreak to be noticed and described was at Green Island and nearby reefs offshore from Cairns in 1962. Over the next 14 years this outbreak slowly spread southwards as far as reefs offshore from Mackay, where it gradually petered out. A second outbreak, probably again beginning to the north of Cairns and spreading southwards, occurred between 1979 and 1991. Both outbreaks were mostly confined to mid-shelf coral reefs. The second outbreak affected approximately 17% of the more than 2800 coral reefs in the WHA, with 5% of reefs having severe outbreaks. It is thought that the apparent southward spread of outbreaks is due to COTS larvae being transported from one reef to another by the East Australian Current.

In 1993, the first stages of another outbreak were detected. Since then this outbreak has developed, with increasing numbers of COTS being found and increasing numbers of reefs being affected. Surveys of the Cairns Section of the Marine Park in 1994-95 found only two out of 27 surveyed reefs (7.4%) had reef-wide outbreaks. In 1996-97 this figure was seven out of 28 (25%). Thirteen reefs had outbreaks over part of their area (spot outbreaks), leaving only eight that were completely free from outbreaks. In addition, the proportion of observed COTS that were sexually mature increased every year, indicating that the outbreak will increase in severity and geographic range. As in the first two outbreaks, this outbreak spread southwards, decimating reefs in the Mission Beach Area before moving on to Townsville.

The effects of a COTS outbreak on a reef can be highly variable. In the second outbreak episode, about 57% of reefs that experienced an outbreak suffered 30% to over 50% coral mortality over at least one-third of their perimeters. However, not all reefs were so badly affected. On average, this outbreak episode caused a 3.4-fold increase in the amount of dead coral on affected reefs.

The AIMS Reef Monitoring project provides long-term quantitative data on coral reefs spanning much of the GBR (see AIMS Website, <http://www.aims.gov.au/pages/research/reef-monitoring/ltm/ltm20021023-gbr.html>). Each year, information is gathered on corals, algae and reef fish from 48 reefs, and COTS are surveyed on about 100 reefs. The Cairns and Innisfail sectors were last surveyed from 13 October - 11 November 2002. Survey results are summarised below.

Cairns Sector:

- Seventeen reefs were surveyed using manta tows[2];
- No COTS were observed on any of the reefs during this recent survey;
- Green Island was the only inshore reef surveyed using manta tows in the Cairns sector; Green Island is currently classified as recovering from COTS outbreaks observed prior to 1984. Reef Wide coral cover has remained low (0-10%) showing little sign of recovery since that time; and
- Persistent low levels of COTS populations through the mid 1990's, coral bleaching events in 1998, 2000 and 2002 and the effects of cyclone Rona in 1998 are all likely to contribute to the lack of recovery of coral communities on this reef.

Innisfail Sector:

- Three mid-shelf reefs (Feather, Ellison, and Beaver) and Wardle an outer shelf reef were surveyed in the Innisfail sector using manta tows;
- No COTS were recorded on any of these reefs during recent surveys and all reefs are currently classified as recovering from prior COTS activity; and
- Reef wide coral cover on all four reefs remains low (0-10%) following declines due to COTS activity between 1999 and 2001.

Following a decade of research, scientific understanding of the biology and ecology of COTS has advanced, but the cause of outbreaks is still unknown. Human activities have been implicated, but no conclusive evidence linking the two has been presented. Conversely, there is no conclusive evidence excluding human influence and proving that outbreaks are an entirely natural phenomenon (EPA 1999a).

As the State of the GBRWHA 1998 report points out, the COTS is an organism that can be viewed from two different perspectives. Firstly, it is a component of the coral reef ecosystem. As such we can consider the issues of state, pressure and response as they relate to the starfish itself. Secondly, the COTS can be considered as a direct pressure on hard corals (because it feeds on them) and an indirect pressure on other reef organisms (such as many fishes) that are reliant on hard corals for food or shelter. The degree to which this pressure is stimulated by disturbance is still not known, hence it is unclear whether this pressure is exacerbated by human activity or not.

Weeds

Batianoff (1997) found a strong and direct relationship between human habitation and weed invasions. Urban sprawl and the location of tourist developments in previously isolated areas appear to be important factors facilitating the spread of exotic weeds in the coastal zone. Riparian zones appear to be the most susceptible landscape elements (Werren *et al.* 2002). Coastal islands are also susceptible to weed invasion. Once a species is established on the mainland, its spread to islands and from one island to another is facilitated by human activities. Batianoff and Dillewaard (1996) reported that 5.5-13% of flora on the continental islands of the GBR is exotic.

Possibly the most widespread invasive exotic is *Lantana camara*, recorded on most continental islands. However, the most problematic environmental weedsalong the coast are probably thunbergia, hymenachne (also an agricultural weed) and pond apple (G. Werren, ACTFR, *pers. comm.*). These species are discussed further in Section 3.

[2] Manta tows involve towing a snorkel diver (observer) at a constant speed behind a boat. The observer holds on to a 'manta board' attached to a small boat by a 17 metre length of rope. This person makes a visual assessment of specific variables during each manta tow (2 minutes duration), and records these data when the boat stops, on a data sheet attached to the manta board (AIMS Website).

Fishing, Hunting and Collecting

The direct and indirect impacts of fishing, hunting and collecting activities are an immediate pressure on the plants and animals of coastal waters, because they involve direct harvesting of living resources (EPA 1999a).

Fishing is one of the most significant human pressures on certain fish stocks in the region which is not surprising given that Cairns has the largest fishing fleet in Australia (see Background Report, Volume 1 of this series). Indirect impacts of fishing, such as bycatch and disturbance to the seabed, might be a significant pressure on other species and communities. More information on fishing is provided in the Sustainable Use Condition Report (Volume 2B to this series).

Hunting is largely restricted to Indigenous hunting of dugong and marine turtles. While not widespread, it is a human-induced pressure on target species (see box 'Traditional Hunting'). Collecting tends to target shells, corals and certain fishes for the aquarium trade and is a significant pressure on some species. Wildlife and wildlife products are also illegally exported from the region – a recent high profile case involved the removal of coral from an island on the GBR by a contestant of the reality television show *Suvivor*. However, the impact on wildlife is considered to be small in comparison to other harvesting practices.

Bioprospecting (the search for active compounds in biological material that can be developed into commercial products) represents an emerging pressure on GBR resources.

TRADITIONAL HUNTING

The contribution of traditional hunting to the cultural, social and economic well being of Indigenous communities is considered substantial (Larsen 1999). Hunting is inseparable from the social, spiritual and practical dimensions of traditional Aboriginal reality. It is also associated with the transmission of knowledge about country whereby the older generations must teach the younger ones how to take care of country. In this way, Aboriginal people generally regard hunting and gathering as part of the practice of caring for their traditional country (Smyth 1998, cited in Larsen 1999).

There has been much controversy over the impact Indigenous hunting within the region, which in part has stemmed from differing opinions about and what constitutes 'traditional hunting' (Ponte 1994). The Australian Law Reform Commission (1986) found that the determination on whether an activity is traditional should focus on the purpose of the activity rather than the method, so that the incorporation of new materials and hunting methods would not prevent an activity from being classed as traditional. Hence, dugong hunting with the aid of twentieth century technology remains a traditional practice, provided that it is undertaken by the culturally appropriate people, in culturally appropriate places (Smyth 2003).

Nevertheless, little is currently known about the level of harvest in the region or the impact it has on target species. Some authors (Marsh *et. al.* 2001; Marsh & Lawler 2001; Environment Australia 2003) consider it to be a contributing factor in the decline of some species (e.g. dugong, marine turtles) along the Queensland coast. To ensure the recovery of these species, customary harvest needs to be managed in a culturally sensitive manner so that it is ecologically sustainable.

Tourism and Recreation

Tourism is the main commercial use of the Great Barrier Reef Marine Park, contributing at least $770 million annually and bringing 1.6 million visitors to the area (see Background Report, Volume 1 of this series). The marine tourism industry is a major contributor to the regional and Australian economy. While the environmental impact of tourism and tourists is variable and case-specific, the sheer size of the industry inevitably places pressure on the environment.

There is a diverse range of tourism operations in the Great Barrier Reef. These include:

- day tours;
- overnight and extended tours;

- diving and fishing charters;
- long range roving tours;
- aircraft or helicopter tours;
- bareboats (self-sail);
- cruise ships;
- beach hire;
- watersports; and
- passenger ferries.

Tourism is the main commercial use of the Great Barrier Reef Marine Park (Photo: Quicksilver).

In 2002 there were approximately 730 permitted tourism operators and 1500 vessels and aircraft permitted to operate in the Great Barrier Reef Marine Park (GBRMPA Website).

The tour vessels used by operators range in size from small sailing vessels, which typically take fewer than 20 people, to the large luxury wave-piercing catamarans, which carry up to 400 people. There is also an increasing number of cruise ships and superyachts cruising the reef. Around 40% of Great Barrier Reef tourists are serviced by the 10 largest operations. Destinations include a variety of coral reefs, continental islands and coral cays. Over 85% of visitors go to the offshore Cairns/Port Douglas and Whitsunday areas which make up less than 10 % of the Great Barrier Reef Marine Park. In Cairns, the tourism industry focuses on day visits to pontoons and moorings and extended diving and fishing charters to offshore reef destinations (GBRMPA Website).

This concentration of visitation is placing significant pressure on the survival of coral reef environments, and other habitats such as sea grass, from anchor damage, poor diving practices, waste disposal, reef walking, and collecting (GBRMPA Webiste). Other pressures include disturbance of turtles and seabirds, especially during nesting season. It has already been reported that increasing levels of human visitation are considered the most likely cause of seabird declines on Michaelmas Cay, near Cairns. These pressures also impact upon the cultural values of the Great Barrier Reef to Indigenous people.

2.4. RESPONSE

Responses are those programs, activities and achievements by people and public authorities directed at resolving resource management issues or problems. Individuals, organisations, the community and governments are involved in managing the coastal zone in many ways.

2.4.1. GOVERNMENT INITIATIVES

The United Nations played an important role in placing environmental issues on the international, national and local agenda (Duncan 1993). Indeed, the first global environmental summit in 1972 highlighted evidence of the rapid depletion of biodiversity, among other things. Since then, government regulation of the environment has become something of an international growth industry (Duncan 1993).

Many laws and policies now influence the way we use and conserve biodiversity in the coastal zone. Responsibility extends across the three levels of government, and involves numerous agencies and organisations and more than 30 Queensland Acts. International agreements and conventions also influence the way certain resources are managed or used. Responses therefore cover scales that range from local to global. They are also hierarchical, local actions often complementing and implementing national and international initiatives.

Two years after the first global environmental summit, Australia became one of the first of 140 countries to commit to the identification, protection and conservation and presentation of World Heritage properties when it adopted the *Convention Concerning the Protection of the World Cultural and Natural Heritage* (World Heritage Convention). The World Heritage Committee on behalf of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) administers the World

Heritage List under the World Heritage Convention. As already reported, two of Australia's 13 listed sites, the Great Barrier Reef and Wet Tropics of Queensland, are located in the Wet Tropics NRM Region. World Heritage Areas are outstanding examples of the world's natural or cultural heritage and both sites were listed for their outstanding natural universal values under all four of the natural heritage criteria[3] For more information, see <http://whc.unesco.org/world_he.htm>.

The *International Convention on Biological Diversity*, which deals at a global level with biodiversity conservation, its sustainable use and the fair and equitable sharing of the benefits arising from this use, was ratified by Australia in 1993. This followed the 1992 signing of the *Intergovernmental Agreement on the Environment* by the Australian Commonwealth, the States and the two Internal Territories and the Australian Local Government Association. The conservation of biodiversity was a fundamental consideration in the Intergovernmental Agreement, designed to provide a mechanism by which to facilitate:

- a cooperative national approach to the environment;
- a better definition of the roles of the respective governments;
- a reduction in the number of disputes between the Commonwealth and the States and Territories on environment issues;
- greater certainty of Government and business decision making; and
- better environment protection.

Then, in 1996, the Commonwealth Government released its *National Strategy for the Conservation of Australia's Biological Diversity*. This Strategy aimed to 'bridge the gap between current activities and those measures necessary to ensure the effective identification, conservation and ecologically sustainable use of Australia's biological diversity' (ANZECC 1996). It was reviewed in 2001 by ANZECC, who found that Commonwealth initiatives including NHT programs as well as many initiatives in individual jurisdictions have all assisted in progress towards achieving the aim of the Strategy (ANZECC 2001).

Australia's Oceans Policy

One of the Commonwealth initiatives referred to above is Australia's Oceans Policy. Released in December 1998, the Policy focuses on the coordination and management of marine-based activities. It provides a strategic framework for the planning, management and ecologically sustainable development of fisheries, shipping, petroleum, gas and seabed resources while ensuring the conservation of the marine environment. At the core of the Oceans Policy is the development of Regional Marine Plans, based on large marine ecosystems, which will be binding on all Commonwealth agencies. The first Regional Marine Plan was developed for the southeastern region of Australia's Exclusive Economic Zone. Broadly, includes waters off Victoria, Tasmania, southern New South Wales and eastern South Australia. A second plan, for the northern planning area, is currently being developed. This area covers the Torres Strait, the Gulf of Carpentaria and eastern Arafura Sea to a line 133°23' east. The Wet Tropics coastal zone falls within the Northeast planning region (see Figure 4). The

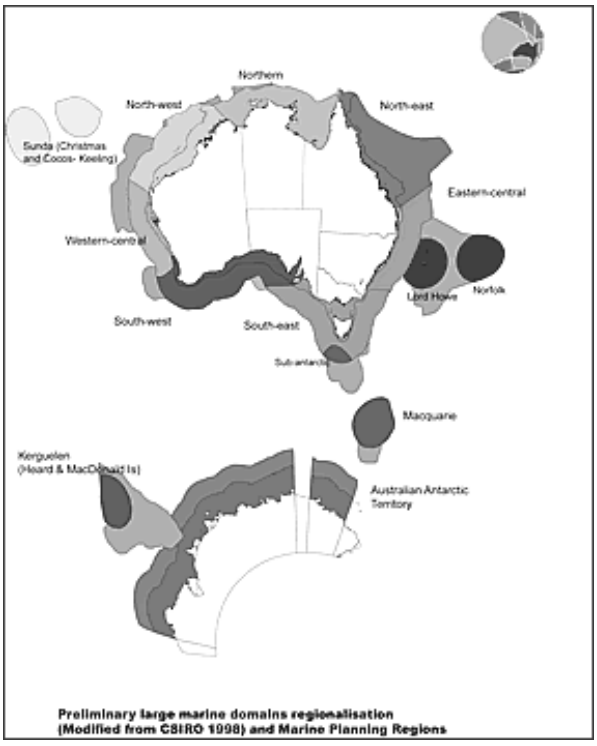


Figure 4: Oceans Policy Marine Planning Regions (Source: National Oceans Office Website).

[3] The world heritage values of both areas are documented in their original nominations (and in subsequent publications, e.g. Lucas *et. al.* 1997).

National Oceans Office is the key organsiation for implementing the Oceans Policy.

Great Barrier Reef World Heritage Area

The Great Barrier Reef World Heritage Area (GBRWHA) is the world's largest World Heritage Area (bigger than the total area of UK and Ireland combined, or equal to the total area of Japan). Integrated management is provided by a variety of means, including:

- a single independent agency (GBRMPA) with an Act (*Great Barrier Reef Marine Park Act 1975*) which, if necessary, provides overriding powers;
- strong cooperation with the State (Queensland) Government through formal agreements, various departments (particularly EPA), industry, research institutions and universities (especially through the CRC Reef Research Centre);
- complementary legislation for most adjoining State waters; and
- strategic zoning plans and site-specific management plans.

The Commonwealth *Great Barrier Reef Marine Park Act 1975* was the first legislation enacted by the Commonwealth in relation to an area that forms one of the World Heritage Areas within Australia. It provides for the establishment, control and development of a marine park in the Great Barrier Reef region and includes reefs, shoals and islands owned by the Commonwealth. The Great Barrier Reef Marine Park Authority was established under this Act.

Another major piece of Commonwealth legislation, which is relevant to the Wet Tropics coastal zone, is the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). This Act establishes management principles intended to promote national standards of management, planning, environmental impact assessment, community involvement, and monitoring for all of Australia's World Heritage properties. It is discussed in greater detail in Section 3.

Coastal Protection and Management Act 1995 (Qld)

The Queensland *Coastal Protection and Management Act* (Coastal Act) is administered by the EPA and provides for the protection, conservation, rehabilitation, management and ecologically sustainable development of the coastal zone. A coordinated and integrated management framework, a key component of which is the State Coastal Management Plan, facilitates achievement of these objectives. The Plan describes how the coastal zone is to be managed.

Regional Coastal Management Plans

The Coastal Act requires regional coastal management plans (RCMPs) to be produced for each part of Queensland's coast. These plans must describe how the coastal zone is to be managed and identify the coastal management districts in particular regions. RCMPs will implement the State Coastal Management Plan's policy framework at the regional level and identify key coastal sites requiring special management within the region.

The Queensland coastline has been divided into eleven regions with an RCMP to be prepared for each region. As reported in the Background Report (Volume 1 of this series), the coastal zone of the Wet Tropics NRM Region is analogous to the regional coastal management planning units of the Wet Tropical Coast and Cardwell-Hinchinbrook (see Map 2 of Background Report). The Cardwell-Hinchinbrook RCMP commenced on 13 January 2004 and the Wet Tropical Coast RCMP commences on 1 March 2004. More information on the RCMPs is provided below.

As indicated above, both RCMPs identify key coastal sites requiring special management. They also identify coastal localities wholly within these sites that have unique coastal amanagement issues that do not apply to the whole key coastal site (Table 13). The RCMPs provide desired coastal outcomes for each key coastal site and

coastal locality. The RCMPs can be viewed on the EPA Website (go to <http://www.epa.qld.gov.au/environmental_management/coast_and_oceans/coastal_management/regional_coastal_management_plans/>).

Table 13: Key RCMP Coastal Sites and Localities (Source: EPA 2003a,b).

Wet Tropical Coast	Cardwell-Hinchinbrook
1. Mission Beach 1.1. Walter Hill Range – North 1.2. Granadilla Valley 1.3. Clump Point 1.4. Walter Hill 1.5. Mount Edna	1. Hull 1.1. Wongaling Beach to South Mission Beach 1.2. Tam O'Shanter Point 1.3. Hull River wetlands 1.4. Hull Heads 1.5. Tully Heads
2. Kurrimine 2.1. Maria Creek 2.2. Kurrimine dunes and wetlands	2. Family Islands 2.1. Dunk (Coonanglebah) island Spit and associated freehold land 2.2. Thorpe (Timana) island 2.3. Richards (Bedarra) Island
3. Moresby 3.1. Cowley dunes 3.2. Moresby headlands 3.3. Moresby wetlands 3.4. North Barnards	3. Kennedy 3.1. Tully-Murray wetlands and dunes 3.2. Barretts Lagoon 3.3. Warringha 3.4. Dallachy Airstrip 3.5. Lower Meunga 3.6. Meunga Creek wetlands and dunes
4. Innisfail 4.1. Ninds Creek 4.2. Moresby Range	4. Hinchinbrook 4.1. Garden (Tindappah Island) 4.2. Port Hinchinbrook 4.3. Hinchinbrook Channel scenic rim 4.4. Hinchinbrook Channel 4.5. Hinchinbrook Island
5. Port of Mourilyan	5. Herbert 5.1. Gentle Annie wetlands 5.2. Dungeness 5.3. Lucinda 5.4. Taylors Beach wetlands and dunes
6. Ella Bay 6.1. Flying Fish Point	6. Ripple Creek 6.1. Ripple Creek wetlands
7. Bramston 7.1. Joyce wetlands and dunes 7.2. Bramston Beach 7.3. Wyvuri 7.4. East Russell	7. Halifax 7.1. Forrest Beach wetlands and dunes 7.2. Cassady Beach dunes 7.3. Allingham/Mungalla 7.4. Forrest Beach to Crystal Creek wetlands
8. Grahan Range 8.1. Eubenangee 8.2. Mutchero 8.3. Russell Heads	

Wet Tropical Coast	Cardwell-Hinchinbrook
8.4. Mount Josey	
9. Frankland Islands 9.1. Russell Island	
10. Malbon Thompson 10.1. Russell Heads North 10.2. Eastern Malbon Thompson 10.3. Western malbon Thompson 10.4. Yarrabah Peninsula 10.5. Fitzroy Island	
11. Trinity Inlet 11.1. Trinity	
12. Cairns Airport and Seaport 12.1. Barron River Delta	
13. Northern Cairns 13.1. Machans and Holloways Beaches 13.2. Barr and Redden Creeks 13.3. Yorkeys South and North 13.4. Northern coastal headlands	
14. Macalister Range 14.1. Double Island & Haycock Island 14.2. Macalister south scenic rim 14.3. Hartley 14.4. Macalister north 14.5. Yule Point	
15. Mossman 15.1. Dickson 15.2. Dicksons Inlet 15.3. Flagstaff Hill	
16. Dagmar Range	
17. Daintree 17.1. Daintree wetland-dune complex 17.2. Snapper Island 17.3. Low Isles 17.4. Daintree north 17.5. Shipwreck Bay 17.6. Cow Bay 17.7. Bailey Creek complex 17.8. Thornton footslopes 17.9. Noah Creek 17.10. Mason Creek 17.11. Noah Head to Bloomfield 17.12. Bloomfield Road 17.13. Zig Zag	

According to the Wet Tropical Coast RCMP, the key challenges for coastal management within the region (i.e. between the Bloomfield River and Mission Beach) come from development pressures associated with a growing population and growing tourism industry, and agricultural intensification, particularly for sugarcane and bananas.

Specific challenges include:

- accommodating the growing demand for tourism development at Mission Beach, Cairns northern beaches, Port Douglas, and the Daintree to Cape Tribulation lowlands, while protecting the unique natural and cultural resources and values in the region that generate this demand;
- resolving conflicts arising from increased levels of urban development in coastal towns and agricultural intensification, that may adversely impact on the water quality of the region, particularly the GBRWHA, as well as remnant coastal habitat areas;
- reducing threats to the outstanding biodiversity significance of the region's remnant coastal habitat areas, which provide important wildlife habitat and corridors for endangered wildlife including the southern cassowary; and
- conserving the region's coastal wetlands, which are critical for fisheries productivity.

Key initiatives in the Wet Tropical Coast RCMP include:

- describing and mapping the region's significant coastal resources and their values;
- ensuring new development is appropriately sited to avoid significant coastal resources, such as areas of high biodiversity;
- promoting improved management of urban and rural land (including improved management of wastewater and farming practices) to reduce pollutants in stormwater runoff to wetlands, coastal waters and the GBRWHA;
- protecting coastal wetlands, remnant native vegetation and wildlife corridors, including habitats for rare and endangered species such as the southern cassowary;
- supporting voluntary conservation agreements on private land, and the identification and management of conservation values on State land on the coast, to protect significant biodiversitry values; and
- providing guidance for protecting the region's outstanding scenic coastal landscapes and Indigenous Traditional Owner cultural resources when considering new coastal development.

The key challenge for coastal management within the Cardwell-Hinchinbrook region (i.e. between Mission Beach and Crystal Creek) is managing future development (associated with residential, tourism and recreational needs, and agricultural intensification) so that the region's significant coastal resources and their values are protected. In managing future development in the region, specific challenges include:

- accommodating the growing demand for urban and tourism development at Wongaling Beach, South Mission Beach, Cardwell, Dungeness, Lucinda and Forrest Beach;
- minimising pollutants in stormwater runoff to wetlands, coastal waters and the Great Barrier Reef World Heritage Area from urban and rural land use;
- balancing coastal land use with the protection of the region's outstanding scenic coastal landscapes and Indigenous Traditional Owner cultural resources;
- conserving remnant coastal vegetation, much of which provides important habitat or corridors for endangered wildlife; and
- conserving the region's coastal wetlands, which are critical for fisheries productivity.

Key initiatives in the Cardwell-Hinchinbrook RCMP include:

- describing and mapping the region's significant coastal resources and their values; and
- providing improved direction for managing development and land use activities in the region to protect significant coastal resources and their values.

Specific regional direction includes:

- promoting improved management of urban and rural land (including improved management of wastewater and farming practices) to reduce pollutants in stormwater runoff to wetlands, coastal waters and the Great Barrier Reef World Heritage Area;
- identifying constraints to new urban and other development to retain areas with high biodiversity and scenic coastal landscape values;
- recognising the need to appropriately involve Indigenous Traditional Owners in the identification and management of their cultural resources;
- promoting voluntary conservation agreements on private land to protect significant biodiversity values and habitat for rare and/or threatened species; and
- providing guidance for the management of conservation values on State land on the coast.

State Planning Policies

The State Coastal Management Plan and subsequent RCMPs have the status of State Planning Policies (SPPs) for the purpose of making and amending planning schemes and assessing and deciding development applications. Other relevant SPPs are described below:

State Planning Policy 2/02: Planning and Managing Development Involving Acid Sulfate Soils

This SPP sets out the State's interests concerning development involving acid sulfate soils in low-lying coastal areas. It aims to ensure that development involving acid sulfate soils is planned and managed to avoid the release of potentially harmful contaminants to the environment.

Draft State Planning Policy for Natural Disaster Mitigation

This draft SPP aims to minimise the potential adverse impacts of flood, bushfire and landslide on people, economic activity and the environment. It is noted that the consequences of cyclones are regarded as separate hazards and that storm tide inundation is addressed under the State Coastal Management Plan and is therefore excluded from this draft SPP.

Under the *Integrated Planning Act 1997* (see Section 3), these SPPs will have effect when development applications are assessed, when planning schemes are made or amended and when land is designated for community infrastructure.

Far North Queensland Regional Plan

The Far North Queensland (FNQ) Regional Plan is a non-statutory policy document that puts forward a long-term plan for the region's development and management. It provides essential advice to the regional community and to public-decision makers when undertaking their planning, budgetary, infrastructure provision and resource management responsibilities. The Regional Plan deals with many issues of significance for the conservation of biodiversity in the coastal zone and is discussed in greater detail in Section 3.

Local Government

The NRM plan area wholly or partly covers eleven Local Government Areas, five of which occur along the coast (see Map 3 in Background Report). Local government responsibility for land use planning and development is the most significant mechanism through which councils contribute to biodiversity conservation. Mechanisms in place include strategic plans, development control plans, land use designations, local planning policies, by-laws and vegetation protection ordinances. A National Local Government Biodiversity Strategy, which represents an agreed Local Government poitstion at the national level on the management of biodiversity, is also in place. More information is provided in Section 3.

Fishing and Fisheries

The Commonwealth *Fisheries Management Act 1994* operates in combination with the Queensland *Fisheries Act* (see below) to regulate fisheries in waters surrounding Queensland. The Act implements several international treaties and is administered by the Australian Fisheries Management Authority (McGrath 2002).

The Queensland *Fisheries Act,* administered by the Queensland Fisheries Service, a part of DPI, provides the current legislative basis for managing and protecting the state's fisheries resources. Its objectives include ensuring that fisheries resources are used in an ecologically sustainable way, achieving the optimum community and economic benefits, and ensuring that access to fisheries resources is fair. The *Fisheries Act* established the Queensland Fisheries Management Authority (QFMA) and the Queensland Fisheries Policy Council and set their powers and functions. The QFMA's primary function is to ensure the appropriate management, use, development and protection of fisheries resources. This is to be achieved largely by regulations, management plans (e.g. *Fisheries (East Coast Trawl) Management Plan*) and declarations of closed seasons, closed waters and the protection of fish habitat areas and marine plants. For more information, see Sustainable Use Condition Report (Volume 2B of this series).

Marine Pests

The Commonwealth Government is supporting actions by all levels of government, industry, scientists and the community to control and eradicate introduced marine pest species. The $4.5 million Introduced Marine Pests Program is a central part of the Government's response through NHT to combating the introduction of exotic marine pests. Government funding helps stakeholders determine the impacts of exotic marine species and activities that allow pests to take hold, and the best ways to counter these threats. The program's funding priorities are to:

- improve understanding of the impacts of pest species;
- implement technology and techniques that contribute to control and eradication;
- respond to selected incidents of new pest incursions; and
- increase community awareness of and participation in introduced marine pest issues.

The Program complements the barrier controls set in place by the Australian Quarantine and Inspection Service under the Australian ballast water management system. The mandatory ballast water management system was introduced in July 2001, building on existing quarantine arrangements. The Australian shipping industry contributed $2 million towards developing these arrangements via an industry levy funding arrangements including contributions from the private sector and potential polluters (Environment Australia Fact Sheet, *Introduced Marine Pests: Prevention and Management*).

The Australian Government's commitment to develop a national response capability to combat introduced marine pest outbreaks was made in Australia's Oceans Policy. A National System for the Prevention and Management of Introduced Marine Pests is

being established. The main levels of managing introduced marine pests include prevention systems to reduce the risk of importation and further translocation; emergency response to new incursions and translocations; and ongoing control of introduced marine pests already in Australia. Important supporting aspects of the System include monitoring, research, public participation, education and training, a statutory framework and secure funding arrangements including contributions from the private sector and potential polluters (Environment Australia Fact Sheet, *Introduced Marine Pests: Prevention and Management*). In Cairns, the state Government has initiated an emergency response to minimise the likelihood of the Asian green mussel becoming established in Trinity Inlet (EPA Website). More information on marine pests is provided in the Sustainable Use Condition Report (Volume 2B of this series).

Shipping and Ship-Sourced Pollution

Shipping Management

The shipping industry, and particularly vessel movements within the GBRWHA, are governed by International, National and State legislation. The United Nations Convention on the Law of the Sea (UNCLOS) states, 'all foreign vessels have the right of innocent passage through international and territorial waters'. In recognition of the significance of the GBRWHA, the International Maritime Organisation (IMO) declared the GBR region a *Particularly Sensitive Sea Area* (PSSA) in 1990. The GBR was the first area in the world to be recognised in this way. This declaration allows the Australian Government to implement initiatives to manage the environmental impact of shipping activities on the GBRWHA.

Contingency plans are in place in the event of oil spills (Source: ©GBRMPA).

The Commonwealth and Queensland Governments have committed to developing strategies to better manage shipping activities within the GBRWHA. A recent review of ship safety and pollution measures in the Great Barrier Reef identified several recommendations and a Shipping Management Group was established to implement these recommendations. Several of these recommendations have been implemented, including the provision of further compulsory pilotage areas within certain areas of the GBRWHA, a mandatory ship reporting system called REEFREP, and Differential Global Positioning System coverage over the entire Great Barrier Reef WHA. In addition, new technologies such as the Automatic Ship Identification systems are being considered as part of the development of a coordinated Shipping Management Plan for the GBRWHA.

The Environmental Policy for Queensland's Ports guides port authorities in the operation and responsible environmental management of port areas. The Cairns Port Authority (CPA) has developed its own Environment Policy that outlines CPA's corporate commitment to environmental management. CPA is developing an Environmental Management System based on the ISO 14000 standard, which will cover all airport and seaport operations. CPA currently has an EPA approved Integrated Environmental Management System (IEMS) which covers significant environmental aspects of marina operations (CPA operates three marinas in the port), contract dredging, and regulated waste storage and transportation. The IEMS contains specific objectives and strategies to protect and enhance water quality in Cairns Port. All major works undertaken by CPA or on behalf of CPA require an Environmental Management Plan, which specifically addresses protection of water quality as a key objective. The plans must be approved prior to works commencing (Productivity Commission 2003).

Waste Management

Vessel-sourced sewage legislative requirements commenced on 1 January 2004 to help minimise the likelihood of impacts from sewage generated onboard vessels. The sewage management requirements are detailed in the Queensland *Transport Operations (Marine Pollution) Act 1995* and *Transport Operations (Marine Pollution) Regulation 1995* (Regulation). These requirements affect all vessels that have a toilet fitted and can discharge sewage (Maritime Safety Queensland Website).

The first phase will apply to identified nil-discharge waters. These areas include marinas, boat harbours, canals and designated areas of state marine parks. From 1 January 2004 vessel owners will need to ensure that no sewage is discharged in these waters. Sewage management measures can include, always using onshore toilets when docked, encouraging passengers to use onshore facilities before heading out, containing sewage in a sewage holding device, and being aware of the designated areas in marine parks where discharge is prohibited. More extensive onboard sewage management requirements will commence on 1 July 2004. For further information, go to the Maritime Safety Queensland website at <http://www.transport.qld.gov.au/qt/maritime.nsf/index/msq_sewage>.

The ANZECC Strategy to Protect the Marine Environment aims to reduce the impacts of shipping operations and enhance protection of the marine environment through improved waste management and reduced pollution from shipping. The Best Practice Guidelines for the Provision of Waste Reception Facilities at Ports, Marinas and Boat Harbours in Australia and New Zealand provide information about planning, establishing and managing waste reception services and facilities.

Oil Pollution

The National Plan to Combat Pollution of the Sea by Oil came into operation in 1973 and underwent a major review in 1991. Its purpose is to maintain a national capability to respond effectively to oil pollution incidents, in accordance with Australia's obligations under the International Convention on Oil Pollution Preparedness, Response and Cooperation in 1990. Complementary regional contingency plans detail the operational procedures, strategies and actions to be initiated in the event of oil spill in waters off the Queensland Coast. In the Wet Tropics, these include REEFPLAN and the Queensland Coastal Contingency Action Plan.

Environmental Protection

The Mandatory Ship reporting System for the Torres Strait and the GBR Inner Route aims to improve the safety of shipping operations in the hazardous waters of the Torres Strait and GBR regions.

Reduced Water Quality

Wastewater Discharges to Coastal Waters

In many developed coastal areas, sewage treatment plants and industries discharge to coastal waters. As already discussed, the standard of this effluent and the quality of receiving waters and their capacity to absorb additional nutrients and other contaminants varies along the Wet Tropics coast. These discharges can have adverse impacts on coastal resources and their values. The *Great Barrier Reef Marine Park Act 1975* and regulations made under this Act control sewage discharges into coastal waters. The State Coastal Plan sets out the following policy:

'For coastal waters where nutrients have been identified as a problem, sewage treatment works are designed and managed to enable appropriate nutrient removal within the following periods:

- for discharge of effluent from islands into coastal waters – by 2005; and
- for discharge of effluent from the mainland into coastal waters – by 2010.

While point-source discharges are relatively well regulated (see Sustainable Use Condition Report), the opposite is true of diffuse sources of pollution (sediment, nutrients, and chemicals). These pollutants are primarily from agricultural and land clearing activities. As reported in the Sustainable Use Condition Report (Volume 2B of this series), the Queensland Land Act, Water Act, and the Soil Conservation Act are primarily designed to protect degradation of the land and water resources through appropriate regulations in-order to maintain the long term sustainability. The State Department of Natural Resources and Mines is assigned with this task. However, water

quality is really a collective responsibility in a sub-catchment or a catchment. In this regard, the regional bodies operate in collaboration with community groups.

Manging Diffuse Sources of Pollution

Reef Water Quality Protection Plan

The Reef Water Quality Protection Plan (for catchments adjacent to the GBRWHA) is an initiative of the Queensland and Commonwealth Governments, who aim to facilitate a sustainable and integrated natural resource management approach to achieving improvement in the quality of water entering the Reef. The goal of the Reef Water Quality Protection Plan is '*Halting and reversing the decline in water quality entering the Reef within 10 years'*. The Plan will focus on diffuse sources of pollution arising through land use activities in the catchment. The majority of actions identified in the Plan will be undertaken as part of the NAP and NHT programs. Regional NRM bodies will play an important role in delivering the objectives and delivering on the goal of the Reef Water Quality Protection Plan.

The EPA conducts various monitoring programs throughout the State (Figure 5). Some are managed by the EPA alone, but many are partnership programs with NR&M, local government and catchment groups. Water Quality information for selected sites in the Wet Tropics NRM Region is available at <http://www.epa.qld.gov.au/environmental_management/water/water_quality_monitoring/current_water_quality_in_queensland/>.

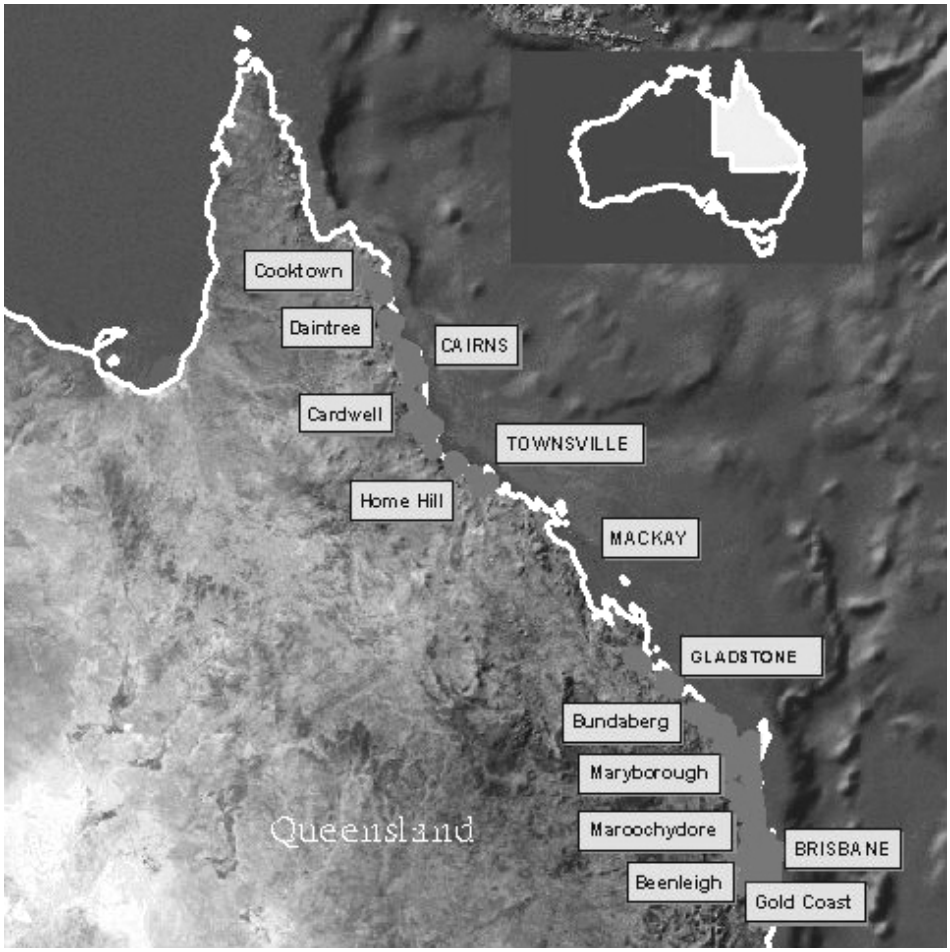


Figure 5: EPA Queensland monitoring site areas (Source: EPA Website).

Additional water quality initiatives in progress in the Wet Tropics include the $150,000 Douglas Shire Water Quality Improvement Plan and the $2.25 million Rainforest CRC and CRC Reef Joint Program *Catchment to Reef: New Tools for Mitigation and Monitoring of Water Quality and Ecosystem Health*. The Trinity Inlet Coordinating Committee has also conducted an ambient water quality-monitoring program in the

Inlet over the past 10 to 15 years. For further information see Summaries of Water Quality Monitoring Programs of GBR Partner Organisations, NR&M, December 2001 (see also Sustainable Use Condition Report).

Trinity Inlet

Detailed water quality objectives and standards have been set for Trinity Inlet under the Queensland *Environmental Protection (Water) Policy*. These objectives and standards are actually above those recommended in the ANZECC Water Quality Guidelines and in some cases are regularly exceeded (ambient water quality monitoring data were presented earlier in this report). A review of the water quality objectives and standards for Trinity Inlet may be required to ensure consistency with future water quality targets set through current processes.

Coastal and Marine Reserves

Marine Reserves

One of the most significant responses aimed at protecting certain coastal resources is declaring reserves. Declarations of marine reserves in the Wet Tropics coastal zone are made under three Acts (Table 14). Several types of reserve are provided for, depending on the level of protection required and the particular resources or attributes to be protected.

Table 14: Functions of legislation for declaring marine reserves (Source: EPA 1999a).

Title of Act	Function of Act
Great Barrier Reef Marine Park Act 1975 (Cwlth)	Provides for the protection and conservation of the Great Barrier Reef Marine Park. Provides for the development of zoning plans to regulate use of the marine park.
Marine Parks Act 1982 (Qld)	Provides for the declaration of marine parks over Queensland tidal waters or tidal land and development of zoning plans to regulate use.
Fisheries Act 1994 (Qld)	Provides for the management, use, development and protection of fisheries resources and fish habitats, and for the declaration of fish habitat areas.

The *Great Barrier Reef Marine Park Act 1975* (Cwlth) provided for the establishment, control, care and development of the Park and established GBRMPA. Zoning plans regulate the purpose for which areas of the marine park can be used or entered in accordance with the following objectives:

- Conservation of the GBR;
- Regulation of use of the marine park to protect the GBR, while allowing the reasonable use of the GBR region;
- Regulation of activities that exploit the resources of the GBR region to minimise the effect of those activities on the GBR; and
- Preservation of some areas of the GBR in their natural state undisturbed except for the purposes of scientific research.

GBRMPA's Representative Areas Program has mapped the marine diversity of the GBR into more than 40 bioregions (see above). To help ensure the maintenance of biodiversity, GBRMPA aims to include examples of all bioregions and, as far as practicable, all habitats in highly protected areas. To this end, it is currently working to increase the number of Green Zones in the Marine Park.

The Queensland *Marine Parks Act 1982* is the marine equivalent of the *Nature Conservation Act* (see Section 3) and provides for the setting apart of tidal lands and waters as marine parks. The Act is closely associated with the zoning scheme

established under the *Great Barrier Reef Marine Park Act 1975* (Cwlth). Although administered by the QPWS, the Act is linked to the Queensland *Fisheries Act 1994* and is essentially intended to protect fish and 'marine products' (James & Mora 1997).

There are two State Marine Parks located along the Wet Tropics coast, namely Cairns (Jeannie River to Mission Beach) and Townsville/Whitsunday (Dunk Island to Repulse Bay). These are managed by the EPA and provide complementary management of areas within or adjacent to the GBR Marine Park.

Fish Habitat Areas

The Wet Tropics has an extensive network of protected tidal wetlands gazetted as Fish Habitat Areas (FHAs) under the *Fisheries Act 1994*. FHAs have been declared to enhance existing and future fishing activities and to protect the habitat upon which fish and other aquatic fauna depend. Management levels 'A' and 'B' apply to FHAs according to their respective values to fisheries productivity and level of acceptable disturbance in each (Zeller 1998).

There are eight Management 'A' FHAs declared along the Wet Tropics coast. These are: Trinity Inlet, Hull River, Murray River, Tully River, Dallachy Creek, Wreck Creek, Meunga Creek and Hinchinbrook. There are six Management 'B' FHAs, namely Half Moon Creek, Yorkey's Creek, Barr Creek, Halifax, Palm Creek and Cattle Creek.

Dugong Protection Areas

Measures to protect the declining dugong populations in the GBR were announced by the Federal and Queensland Governments in August 1997. Central to these measures was the establishment of a system of 16 dugong protection areas (DPAs), declared in legislation under the Queensland *Fisheries Regulations 1995*. The initiative took into account the best available scientific advice on dugongs and seagrass and represented a significant step towards halting the decline in dugong numbers over a huge length of coast. The Wet Tropics Region has two declared DPA, the Hinchinbrook Dugong Sanctuary 'A' and the Taylors Beach Dugong Sanctuary 'B'. Queensland-wide Zone 'A' DPAs include significant dugong habitats (consistently containing over 50% of dugong numbers in the southern GBR population stock) and healthy seagrass habitat. In these areas, the use of offshore set, foreshore set and drift nets are prohibited, and in the Hinchinbrook DPA the use of river set nets are also prohibited. Other netting practices such as ring, seine, tunnel and set pocket netting which are not considered to pose a serious threat to dugong are unaffected. In zone 'B' DPAs mesh netting practices are allowed to continue, but with more rigorous safeguards and restrictions than before. Zone 'B' DPAs have been shown to contain about 22% of dugongs in the southern GBR population stock.

Terrestrial Reserves

Many protected areas declared under the *Nature Conservation Act 1992* are in the coastal zone on the mainland and islands of the Wet Tropics. Major national parks along the coast include Daintree National Park (76,000 ha), Wooroonooran National Park (79,000 ha) and Lumholtz National Park (168,000 ha). Others include Grey Peaks, Russell River, Eubenangee Swamp, Ella Bay (which has one of the best naturally protected freshwater wetland areas along the Wet Tropical Coast - P. Stanton, *pers. comm.*), Moresby Range, Kurrimine Beach, Maria Creek, Clump Mountain, Hull River, and Edmund Kennedy. Island national parks include Hinchinbrook (at 39,900 ha the largest island national park in Australia), Snapper, Green, Fitzroy, Frankland Group, Barnard Group, Dunk, Family Group, Goold and Brook Islands.

Significant additions to the protected area estate have been made in recent years, reflecting a positive response to increasing concern over the conservation status of coastal habitats. Nevertheless, in the context of the size of the coastal zone, the area reserved is small. The lack of protection of wetland habitats in reserves is particularly evident.

Threatened Species

The Commonwealth and State under the EPBC Act and *Nature Conservation Act* manage threatened species in the marine and coastal zone, while GBRMPA also has responsibilities under its legislation (see also Section 3).

Of particular relevance to this Section, the EPBC Act gives special conservation protection to listed marine and migratory species, most of which occur in the coastal zone. Migratory species are those that occur on the appendices to the Bonn Convention or are subject to bilateral conservation agreements between Australia and Japan (JAMBA) and China (CAMBA). The marine species include:

- sea snakes (Families Hydrophiidae, Laticaudidae);
- crocodiles (Genus *Crocodylus*);
- dugongs (Genus *Dugon*);
- marine turtles (Families Cheloniidae, Dermochelidae);
- birds (Class Aves); and
- seahorses, sea-dragons, pipefish (Families Syngnathidae, Solenostomidae).

Cetaceans (whales and dolphins) require special consideration in view of the requirements for management under the EPBC Act and their conservation status within the WHA is considered in the *Whale & Dolphin Conservation Policy for the Great Barrier Reef Marine Park* (GBRMPA 2000). The state has also prepared conservation plans for whales and dolphins as well as dugongs under the *Nature Conservation Act 1992*.

A *Recovery Plan for Marine Turtles in Australia* has been prepared (by the Marine Species Section, Approvals and Wildlife Division, Environment Australia in consultation with the Marine Recovery Team, July 2003). Actions outlined in the plan are designed to identify and reduce the threats to marine turtles, determine levels of mortality and reduce that mortality. The need to make informed decisions based on the best available information is also acknowledged as a principle activity of this plan. Additionally, a *Turtle and Dugong Conservation Strategy* has been prepared for the GBRWHA (GBRMPA 1994).

As reported by Environment Australia (2003), trawlers operating in the Great Barrier Reef Marine Park incidentally catch marine turtles – the main species being loggerhead, green and flatback turtles. The bycatch of turtles was part of the justification used to list otter trawling as a key threatening process under the EPBC Act. Under current zoning, about 50% of the GBR Marine Park is closed to trawling and within the Park the use of turtle excluding devices is compulsory. This requirement has been extended throughout the East Coast Otter Trawl Fishery. There is also a requirement for fishers to report all interactions with marine turtles. More information is provided in the Sustainable Use Condition Report.

Aboriginal Community Based Management Initiatives for Dugong and Marine Turtles

Management of turtle and dugong hunting under traditional customary law has been carried out for thousands of years. Indigenous cultural practices enforce correct protocol such as who is permitted to hunt turtles, restrictions on take numbers of turtles and eggs, and seasonal closure of hunting areas. Hunter and Williams (1997) argue that for contemporary management of Indigenous hunting to be effective it must be driven at a local level and thus be sensitive to the needs of each community. They maintain that management should be initiated, monitored and maintained by the communities themselves – thus empowering local Indigenous people (see box ‘Case Study: Ku Ku Yalanji Traditional Owners).

CASE STUDY: KU KU YALANJI TRADITIONAL OWNERS

The Traditional Owners of Mossman established a Marine Resource Committee for the management of traditional hunting permits issued by the QPWS and GBRPMA. The Committee was established to regulate the government permits issued for hunting turtle within heir traditional hunting area.

The process has enabled the community to assess permit applications and monitor hunting practices thus investing control in the community. The Committee made the decision to prohibit dugong-hunting permits because of declining numbers of dugong in the Great Barrier Reef. This was prior to any recognition of a decline in dugong numbers and before the Great Barrier Reef Ministerial Council decision, of June 1997, to not issue permits for traditional hunting in the Great Barrier Reef Marine Park. They have also had a major influence in deterring illegal hunting and played an important educational role both Indigenous and non-Indigenous communities.

Other roles of the Marine Resource Committee include:

- Protection of endangered species and sites of cultural significance to Kuku Yalanji;
- Protection of Kuku Yalanji culture and country for future generations;
- Protection of the rights of the Kuku Yalanji and sure that traditional practices continue;
- Education Kuku Yalanji about issues affecting them; and
- Education of government agencies about traditional management.

Community-based management can prove to be effective because the process provides the means for community monitoring at a grassroots level and invests control in the hands of the Traditional Owners via a management mechanism that is community driven. Hence, Traditional Owners regulate who, if, and where people can hunt.

Source: Hunter & Williams 1998; Walker, L & Kuku Yalanji Aboriginal Corporation, *un pub*..

Management of Estuarine Crocodiles

In response to public concerns, the Queensland Government introduced the Trial Intensive Management Area for Crocodiles (TIMAC) program in May 1998. The goals of the program are:

- to remove estuarine crocodiles from a zone between Cairns Airport and Wonga Beach, making the beaches and waterways in these areas safer for water-based recreation;
- to increase scientific knowledge of estuarine crocodiles to improve their conservation and management in Queensland; and
- to teach people about crocodiles and promote safe behavior in crocodile habitat.

The program has four parts: crocodile removal, surveys and monitoring, research and public education. Under some circumstances, removed crocodiles are put 'back in the wild' but most are offered for sale to crocodile farms under prices set by statute and government regulations: $110 per metre in length or part thereof for males, and $220 for females (Hoy 2003). Local Crocodile Management Advisory Committees are now operating in Cairns City, Cooktown and Johnstone Shire.

A list of rare and threatened plant species from the plan area is included at Appendix A and rare and threatened animals at Appendix B. Appendix C provides information on those species listed in Australian action plans that are likely to occur in the plan area (both marine and terrestrial).

Other Species of Significance

The Queensland Parks and Wildlife Service (QPWS), in collaboration with James Cook University, is continuing investigations into seabird declines and their potential causes (e.g. human visitation, broad climatic factors). QPWS has in place a management

strategy on Michaelmas Cay, including fencing and reducing visitor usage (B. Congdon, *pers. comm.*).

Stokes and Dobbs (2001) list several other species of special interest within the GBR Marine Park (i.e. those species considered to be of concern). These include:

- sharks, rays and skates;
- other marine fishes;
- marine invertebrates; and
- marine plants.

The list at Appendix C includes 38 estuarine and marine fishes (e.g. pipefishes) that are not designated as rare or threatened but are considered to have conservation significance nonetheless (after Pogonoski *et. al.* 2002).

Coastal Wetlands

Queensland Coastal Wetland Mapping Project

The mapping of Queensland's coastal wetland environments by the Queensland Department of Primary Industries (DPI), Queensland Fisheries Service (QFS) has been an ongoing process, underway since the mid-1990s. Mapping of the region from Cape Tribulation to Bowling Green Bay (see report, Bruinsma 2001) marked the completion of the spatial assessment of the coastal wetland resources of the entire Queensland coastline. This systematic exercise was undertaken using a standard protocol that was developed by the QFS (Danaher 1995a) and was recognised (Ward *et. al.* 1998) as an appropriate model for a national approach to coastal wetland mapping.

The coastal wetlands of the NRM Region have been mapped by the DPI (Photo: Geoff McDonald).

Funding from the Cape York Peninsula Land Use Strategy (CYPLUS), GRBMPA through Ocean Rescue 2000 and Environment Australia through the NHT Coasts and Clean Seas Marine Protected Areas Program supported the QFS Queensland Coastal Wetland Mapping Project. The project was undertaken in a number of phases. The Bruinsma (2001) study formed the last stage of a three-year phase that was supported by funding from Environment Australia through the NHT.

The Bruinsma (2001) report provides key resource data for the ongoing assessment of the requirement for additional Marine Protected Areas (e.g. FHAs under the Queensland *Fisheries Act 1994*) in regions of high fish habitat value in northern Queensland from Cape Tribulation to Bowling Green Bay (i.e. the Wet Tropics coast). The study also provides baseline information on the coastal wetlands within this study area for consideration in the Ramsar site nomination process. The project aimed to:

- document and map the coastal wetland communities of the Study Area;
- document levels of existing disturbance to and protection of the wetlands;
- examine existing recreational, indigenous and commercial fisheries resources in the region; and
- evaluate the conservation values of the areas investigated from the viewpoint of fisheries productivity and as habitat for important and/or threatened species for future FHA/MPA declaration.

The Australian Wetlands Policy

The Australian Wetlands Policy, commenced in early 1997, comprises a series of objectives, principles and strategies to guide the Commonwealth Government's actions relating to the 'wise use' of wetlands in Australia, and sets a framework for the

Commonwealth Government to work cooperatively with State and Territory Governments. Funding is supposed to be available through the Natural Heritage Trust to support locally based efforts to rehabilitate degraded wetlands. The policy covers coastal and inland wetlands. More information on wetland management is provided in Section 3.

2.4.2. MARINE RESEARCH AND MONITORING

State of the Reef Report

Much of the information in the current study was derived from the *State of the Great Barrier Reef World Heritage Area 1998* report (Wachenfeld *et. al.* 1998). The 2002 State of the Reef Report was launched on-line in mid 2003. Sections that refer to the biological and biophysical condition of the GBR include: Coral Reefs, Inter-reef Lagoonal Benthos, Water Quality and Fisheries. The information incorporated into the report is a synthesis of research and monitoring undertaken by the Australian Institute of Martine Science (AIMS), CRC Reef Research Centre, CSIRO, JCU and other research providers.

Data Collection and Collation

The work of AIMS is particularly relevant to the Wet Tropics coastal zone. Research is conducted in the strategic areas of:

- The ocean environment – understanding the circulation of water, nutrients and sediments;
- Marine biodiversity – characterizing species richness and genetic variety;
- Marine living resources – identifying valuable marine organisms;
- ESD – understanding natural changes and human impacts; and
- Technological innovation – developing advanced instruments and techniques.

In addition, the CRC Program provides about $12 million a year for marine-related research. The CRC Reef Research Centre (Cooperative Research Centre for the Great Barrier Reef World Heritage Area) and its partners (including AIMS, Great Barrier Reef Research Foundation and JCU) is an internationally recognised focus of expertise and experience in coral reef science, technology and management. It provides research solutions to protect, conserve and restore the world's coral reefs by ensuring industries and management are sustainable and that ecosystem quality is maintained. The needs of end-users are incorporated into the design, instigation and progress of research.

The six programs of the CRC Reef Research Centre are:

1. Conserving World Heritage values;
2. Sustainable industries;
3. Maintaining ecosystem quality;
4. Reef futures;
5. Education and communication; and
6. Commercial and international.

The CRC, AIMS and GBRMPA are all involved in extensive monitoring programs of the Reef environment. The CRC Reef has just joined with the Rainforest CRC in a $2.25 million three-year joint research project to explore the impact agriculture and other land-based activities have on the GBR lagoon. The Brisbane-based CRC for Coastal Zone Estuary and Waterway Management (Coastal CRC) is also involved in research in the Wet Tropics.

Many organisations are involved with research into the sustainable management of the region's fisheries. The Department of Primary Industries monitors the condition and trend in Queensland fisheries habitats and produces reports on the status of and trends in

Queensland's fisheries resources. This includes work on climate, habitat, fish passage and so on. A new DPI/CRC Reef research project will focus on the effects of capture depth, release treatment, hook characteristics and handling techniques on the survival of a suite of reef fish species (*Post-release survival project* information sheet). More information (including a gap analysis of research needs) is provided in the Sustainable Use Condition Report (Volume 2B of this series).

Several other initiatives are directed at improving coordination of marine and coastal data and information. Access to data is being enhanced through better electronic management information systems and databases. These include the development of a coastal atlas and the continuing development of the National Marine Information System.

The Global Coral Reef Monitoring Network was established in 1996. Australia is one of its seven member nations. The network is monitoring the occurrence of coral bleaching incidents and human-related impacts on coral reefs, including pollution, sedimentation and overfishing.

Great Barrier Reef Marine Park Authority

As already reported, the Great Barrier Reef Marine Park Authority (GBRMPA) was established under the *Great Barrier Reef Marine Park Act 1975*. It is the lead agency for GBRWHA issues. The Authority is the principal adviser to the Commonwealth Government on the care and development of the GBR Marine Park.

The goal of GBRMPA is '*To provide for the protection, wise use, understanding and enjoyment of the Great Barrier Reef in perpetuity through the care and development of the Great Barrier Reef Marine Park.'* (GBRMPA Website).

GBRMPA and the Queensland Parks and Wildlife Service (QPWS) are jointly responsible for the day-to-day management of the Great Barrier Reef Marine Park and World Heritage Area. Field operations and routine day-to-day activities are primarily delivered through the QPWS by Marine Parks Officers - professional rangers and conservation staff working with industries and coastal communities.

Protection of the values of the Reef against illegal activities is also achieved through strategic alliances with the Queensland Boating and Fisheries Patrol (QBFP), Queensland Water Police, Coastwatch and the Australian Maritime Safety Authority (AMSA).

The QPWS Marine Parks Officers manage the GBR Marine Park and World Heritage Area through:

- Resource protection programs;
- Visitor education and services;
- Park monitoring; and
- Surveillance and enforcement.

Management of Tourism Impacts

Maintaining the diversity, integrity and productivity of the GBR is essential for sustainable tourism use. The impacts of tourism also need to be managed. Particular attention is given to:

- Protecting coral reefs and other habitats such as seagrass from anchor damage, poor diving practices, waste disposal, reef walking and collecting;
- Protecting turtles and sea birds from disturbance, especially during nesting seasons;
- Respecting the cultural importance of the GBR to Aboriginal and Torres Strait Islanders; and
- Minimising conflicts in access within the multiple use Marine Park.

More information on management of the GBR Marine Park and World Heritage Area by GBRMPA can be found on-line at <http://www.gbrmpa.gov.au/corp_site/management/index.html>.

2.4.3. COASTAL COMMUNITY INVOLVEMENT

Coastcare

Coastcare is a program to promote community involvement in identifying and managing natural and cultural resources of the coastal zone. Established in 1995, the program is the result of a tripartite agreement between the Commonwealth and Queensland Governments and the Local Government Association of Queensland. It was one of 23 programs of the Natural Heritage Trust. The Australian Government in working with State and Territory Governments to make the Trust more effective, has consolidated the twenty-three Trust programs to four - Landcare, Bushcare, Rivercare and Coastcare. The Coastcare Program will invest in activities that contribute to protecting coastal catchments, ecosystems and the marine environment (more information is available online at <http://www.nht.gov.au/extension/framework/coastcare.html>). An example of the types of projects funded through the Coastcare Program in the Wet Tropics is shown in Table 15.

Table 15: Wet Tropics Coastcare Projects (Source: R. Clear, *pers. comm*)

Project	Proponent	Amount
'Save our Saltwater Creek (SOS)	CLEAN	$19,500.00
Heath Point Foreshore Rehabiliation	Johnstone Shire (WTTPS) Community Revegetation Unit	$7,571.00
Cowley Beach Foreshore Rehabilitation - Stage 2	Johnstone Community Revegetation Unit	$19,665.00
Holloways Beach Coast Care Project	Holloways Beach Coast Care Group	$11,520.00
Southern end Lucinda Beach Revegetation and Fencing Project	Lucinda Coastcare Group	$7,160.00
Coastal Cassowary Information Signage along Wet Tropics Coast	Chair CAG	$16,000.00

SEAGRASS-WATCH: THE DEVELOPMENT OF A SCIENTIFICALLY CREDIBLE COMMUNITY-BASED MONITORING PROGRAM.

Seagrass ecosystems are impotant marine coastal habitats supporting fish, prawn turtle and dugong populations. *Seagrass-Watch* is a community-based monitoring program developed by the *Seagrass-Watch* Team at Queensland's Department of Primary Industries (QDPI) in conjunction with the CRC for Reef Research, Queensland Parks and Wildlife Service and community groups. Key community groups are involved in program that aims are to raise awareness on the condition and trend of nearshore seagrasses throughout Queensland and provide an early warning of major changes in seagrass abundance, distribution and species composition. In Queensland *Seagrass-Watch* programs have been established at 120 sites from Cooktown to Morteon Bay involving more than 300 volunteers.

Seagrass-Watch developed out of recognition that a new approach was required to monitor the trend and condition of seagrass meadows in Queeensland. Limited resources mean that it is logistically impossible for government agencies alone to address state-wide inquiries on seagrass issues. Coastal communities are not only concerned about the condition and loss of seagrasses in their regions but are keen to play a primary information gathering role and work in partnership with government agencies. Industry and community groups are also aware of the vital links between seagrasses and important fish, turtle and dugong populations. *Seagrass-Watch* has captured this interest and facilitates links between community networks, government agencies and local industry groups to provide scientific advise on critical seagrass resources.

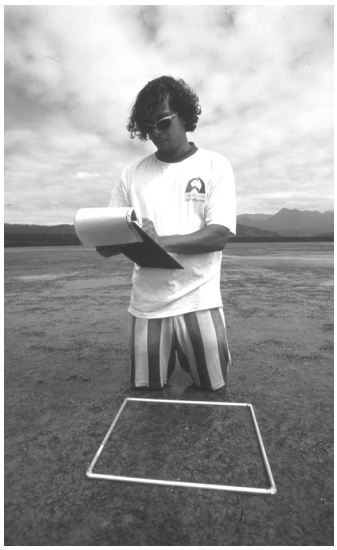
Although monitoring is occurring we still have limited knowledge of the distribution of seagrass habitats in some areas, especially the Wet Tropics region between Innisfail and Cape Tribulation.

Source: S. Campbell, DPI Northern Fisheries

Aboriginal Peoples' Rights and Responsibilities in Management of Sea Country

Traditional Management of Sea Country

Smyth (2003b) describes Aboriginal and Torres Strait Islander peoples' traditional management practices of sea country in his issues paper titled *Saltwater Country Aboriginal and Torres Strait Islander Interest in Ocean Policy Development and Implementation.* He maintains that marine environments were managed through a variety of strategies and cultural practices, including:



Linc Walker monitoring seagrass, *Kuku Yalanji* Coastcare Project (Photo: Coastcare).

- Conducting of ceremonies (songs, dances, story telling and other rituals) with the purpose of nurturing the welling being of particular places, species and habitats;
- Control of entry into marine clan estates by outsiders - restricting resource use to clan members and others by agreement;
- Seasonal exploitation of particular marine resources; the opening and closure of seasons were marked by ecological events, such as the flowering of particular plants or the arrival of a migratory bird;
- Restriction on the harvesting of particular species based on age, gender, reproductive conditions, health, fat content etc of individual animals;
- Restrictions on resource use and distribution by clan members and others based on age, gender, initiation status, marital status and other factors;
- Restrictions on the use of particular animals and plants of totemic significance to individual clans; each clan usually identified closely with at least one natural element (usually animal or plant), the use of which was often highly restricted or prohibited; and
- Prohibition of entry to certain areas on land and sea, often associated with storms or other sources of danger; entry and/or hunting and fishing in the these areas was believed to cause severe storms or other forms of danger, not only to the intruders but also to other people in the region.

Together these strategies and practices resulted in a system of marine exploitation which was conservative and which enabled the local population to live within the carrying capacity of the local environment. Today, these types of practices are still important for Aboriginal people of the region in the management of sea country.

GBRMPA Indigenous Policy and Liaison Unit

The Indigenous Policy and Liaison Unit at GBRMPA commenced operation in 1995. It provides both a cultural policy advisory service to the Authority as well as a vital link to engaging Aboriginal people in management arrangements (GBRMPA 2003). Along with information dissemination, the unit facilitates the involvement of Aboriginal and Torres Strait Islanders in major GBRPMA projects including Representative Areas Program, species conservation, fisheries management and other permit and planning processes. It also works to develop co-operative management arrangements (GBRMPA August 2002).

The Great Barrier Reef 25 Year Strategic Plan also recognises Aboriginal and Torres Strait Islander interests and rights. It details a vision for a future of:

> *'...a community which recognises the interests of Aboriginal and Torres Strait Islanders so that they can pursue their own lifestyle and culture, and exercise responsibility for issues, areas of land and sea, and resources relevant to their heritage within the bounds of ecologically sustainable use…'*

The interests and rights of Indigenous Traditional Owners of the Wet Tropics coastal zone are recognised in other planning instruments such as *inter alia* the State Coastal Plan and regional coastal management plans. Other legislation, policy and management

arrangements for Indigenous people relating to the use and management of biodiversity will be discussed in Section 3.

3. TERRESTRIAL BIODIVERSITY

3.1. INTRODUCTION

This chapter investigates the current state or 'condition' of terrestrial (land-based) biodiversity in the Wet Tropics NRM Region and the human-induced threats or 'pressures' acting upon it. It concludes by looking at the institutional and individual actions, policies and programs that directly affect the state of biodiversity or influence those human activities that exert pressure on biodiversity in the region.

3.2. CONDITION

The condition of terrestrial biodiversity in the Wet Tropics region is discussed below under the following headings:

- regional landscape diversity;
- regional vegetation diversity;
- regional ecosystem diversity;
- regional species diversity; and
- regional genetic diversity.

3.2.1. REGIONAL LANDSCAPE DIVERSITY

Two terrestrial bioregions converge in the plan area (after Thackway & Cresswell 1995; Sattler & Williams 1999):

- the humid coastal part occurs within the *Wet Tropics* (tropical wet coastal ranges and plains; rainforests and forests); and
- drier country to the west belongs to the *Einasleigh Uplands* (high plateau of Paleozoic sediments, granites and basalts; dominated by ironbark woodlands).

These terrestrial bioregions are further broken down into sub-regions (or provinces) and regional ecosystems (REs). This hierarchical framework, that enables biodiversity to be examined from continental to regional scales, is discussed in more detail below.

Terrestrial Bioregions

Bioregionalisation in Australia had its genesis in the work of Stanton and Morgan (1977), who first described Queensland's natural regions (or bioregions). This approach was adopted and expanded in the *Interim Biogeographic Regionalisation for Australia* (IBRA), which was developed as an ecological framework to underpin the development of a national system of conservation reserves (Thackway and Cresswell 1995). Returning to the state level, the above work has been further augmented by the EPA's description of sub-regions and regional ecosystems for each bioregion in Queensland (Sattler & Williams 1999).

Terrestrial bioregions are based on broad landscape patterns that reflect major structural geologies, climate, floristic and faunal assemblages. They are mapped at a scale of approximately 1:1,000,000-1:2,500,000. Each of these is subdivided into sub-regions (referred to as provinces in Sattler & Williams 1999) based on finer variations in the above attributes. A regional ecosystem (RE) is defined as a vegetation community consistently associated with a particular combination of geology, landform and soil within a bioregion (Sattler & Williams 1999).

Sub-Regions of the NRM Plan Region

The Wet Tropics bioregion has been divided into nine sub-regions. All of the sub-regions are represented in the NRM Plan region to some extent. Four sub-regions (Tully, Innisfail, Kirrama-Hinchinbrook and Bellenden Ker-Lamb) are wholly

contained within the Plan region. Wet Tropics bioregional sub-regions within the Plan region are shown on Map 1 and summarised in Table 16.

The northern part of the Daintree/Bloomfield sub-region and southern part of the Paluma/Seaview sub-region are not contained within the Wet Tropics NRM Region. This is because the regions are catchment-based (see discussion on boundaries in Backround Report, Volume 1 of this series) and they occur in the Cape York and Burdekin-Dry Tropics NRM regions respectively.

TERRESTRIAL BIOREGIONS OF THE PLAN AREA

Wet Tropics

The Wet Tropics bioregion in the tropical east coast of northern Queeensland contains rugged mountain ranges.

- Dominated by large areas of rainforests and vine thickets with eucalypt open forests.
- The low lying coastal plain support melaleuca and eucalypt communities.
- Tussock grasslands are scattered throughout the region.

Twenty-four percent of the bioregion has been cleared – large areas have been cleared inland for dairying and on the coastal plains for dryland (sugar cane) and irrigated cropping. Large areas of rainforest are protected in national parks and state forests within the WTWHA.

Photo: WWF

Einasleigh Uplands

This bioregion contains undulating to hilly land with some rugged ranges and plateaus. It has a warm to hot climate.

- Dominated by eucalypt woodland and open woodland with significant patches of rainforest and vine thickets.
- It contains small areas of acacia forests and woodlands and tussock grasslands and a large area of eucalypt open forests in the east.

The bioregion is largely intact, with 97 percent of its original tree vegetation remaining. The bioregion is mainly used for cattle grazing with some horticulture and cropping and small localised areas of grazing of modified pastures.

Photo: WWF

(**Source**: Australian National Land and Water Audit 2001)

It was noted above that existing bioregional classifications provide a useful system for the description of the Wet Tropics NRM Region. This remains true of the Wet Tropics despite the exclusion of these two outlying areas from the Plan area. This is because these areas represent the limit of the biogeographic range of many plant and animal species confined to the region and total biodiversity diminishes relative to the distance from its bioclimatic core, the Atherton sub-region (Nix & Switzer 1991; Australian Natural Resource Atlas V2.0)[4]. On the other hand, the inclusion of a large part of the Einasleigh Uplands bioregion to the west (i.e. that part which falls within the upper Herbert catchment) adds a number of species not usually associated with the Wet Tropics and contributes markedly to the total biodiversity of the Plan area.

The Einasleigh Uplands bioregion has been divided into six sub-regions, four of which, the Herbert-Wairuna, Undara-Toomba Basalts, Kidston, and Hodgkinson Basin, are represented to some extent in the Wet Tropics NRM Region. Einasleigh Uplands sub-regions within the Plan region are shown on Map 1 and summarised in Table 16.

[4] Although the suite of endemic fauna associated with the algae-covered boulder fields of the Black Trevethan Range, near Cooktown, is a notable exception.

In total, then, the Wet Tropics NRM Region contains all or part of 13 bioregional sub-regions (Map 1).

The Australian Natural Resources Atlas V2.0 provides a summary of the overall condition and trend of each of Australia's 85 terrestrial bioregions (after Thackway & Cresswell 1995), incorporating their 384 component sub-regions (see box 'Summary of the Overall Condition and Trend of the Bioregions (and Sub-Regions) of the Plan Area').

SUMMARY OF THE OVERALL CONDITION AND TREND OF THE BIOREGIONS (AND SUB-REGIONS) OF THE PLAN AREA.

Wet Tropics

Areas not within the World Heritage Area and the protected area estate are in fair condition, requiring significant intervention. The condition of these areas is declining due to fragmentation and loss of remnants, as a result of agricultural and urban expansion.
The continental landscape stress classes range from 5 and 6 in the areas significantly protected through legislative means, to 2 and 3 in the lowlands that have been extensively developed for cropping as assessed by the Landscape Health report (1 is most stressed, 6 is least stressed).

Einasleigh Uplands

The overall condition of the bioregion is declining, and significant intervention is required to prevent further loss of the biodiversity values of the area. Grazing pressure, changes in fire regime and exotic weeds are the major threatening processes. Broad scale tree clearing is identified as a threatening process in the Herberton Wairuna sub-region but this is questionable given the relatively small amount of clearing that has taken place to date. Kidston sub-region has intact mid and upper layer vegetation but there has been significant decline in the ground layer condition and diversity from grazing pressure.
The continental landscape stress classes of the sub-regions are predominately 5, with 4 in the Hodgkinson Basin as assessed by the Landscape Health report (1 is most stressed, 6 is least stressed).

(Source: Australian Natural Resources Atlas V2.0)

Table 16: Subregions of the Study area (based on Sattler & Williams 1999).

Bioregion	Province	Percentage representation in Plan area	Geology	Landform	Soils	Vegetation
WET TROPICS	1. Herbert	~80%	Quaternary alluvium	Marine plains, salt pans, alluvial plains with relic stream channels, low stream levees and prior streams.	Alluvia, gleyed podzolics, humic gleys, red earths, red podzolics, yellow earths.	Estuarine mangroves; open forests dominated by paperbark *Melaleuca quinquenervia*, pink bloodwood *Corymbia intermedia*; woodlands dominated by paperbark *Melaleuca viridiflora*, poplar gum *Eucalyptus platyphylla*, forest red gum *E. tereticornis.*
	2. Tully	100%	Quaternary alluvium	Marine plains, tidal flats, low beach ridges and swales, alluvial plains, channels, levees, lagoons	Siliceous sands, alluvia, gleyed podzolics, humic gleys, red earths, red podzolics, yellow earths.	Mesophyll rainforests; estuarine mangroves; coastal dune vegetation; paperbark *Melaleuca quinquenervia* forest; fan palm *Licuala ramsayi* and feather palm *Archontophoenix alexandrae* swamp; woodlands dominated by paperbark *M. viridiflora*, forest red gum *E. tereticornis*.
	3. Innisfail	100%	Quaternary alluvium	Low beach ridges and swales, alluvial plains, channels, levees, lagoons, low hills	Alluvia, gleyed podzolics, humic gleys, red earths, red podzolics, yellow earths.	Mesophyll rainforest ± *Acacia* spp., *Eucalyptus* spp; estuarine mangroves; coastal dune vegetation; paperbark *Melaleuca quinquenervia* forest; fan palm *Licuala ramsayi* and feather palm *Archontophoenix alexandrae* swamp; woodlands dominated by paperbark *M. viridiflora*, forest red gum *E. tereticornis*, carbeen *E. tessellaris*, pink bloodwood *Corymbia intermedia*.
	4. Atherton	~90%	Pliocene – Holocene Atherton Basalts	Plains, low hills, scarps	Krasnozems	Complex and semi-deciduous mesophyll and notophyll rainforests; forest red gum *Eucalyptus tereticornis* tall open forests; woodlands dominated by white stringybark *E. phaeotricha*, molloy red box *E. leptophleba*.
	5. Paluma-Seaview	~50%	Lower Permian to Middle Carboniferous Granites Middle Palaeozoic metamorphics.	Ranges, high hills and mountains.	Lithosols, podzolics, red earths, solodics, xanthozems, yellow earths.	Notophyll rainforests with rose gum *Eucalyptus grandis*, turpentine *Syncarpia glomulifera* or hoop pine *Araucaria cunninghamii*; rose gum tall open forest; woodlands dominated by pink bloodwood *Corymbia intermedia*, white mahogany *E. acmenoides*, forest red gum *E. tereticornis*.
	6. Kirrama-Hinchinbrook	100%	Middle Carboniferous acid volcanics (Glen Gordon Volcanics) and Middle Carboniferous Tully Granite Complex.	Low hills, ranges, high hills and mountains.	Lithosols, podzolics, red earths, yellow earths.	Mesophyll, notophyll and microphyll forests ± turpentine *Syncarpia glomulifera*, kauri pine *Agathis robusta*; woodlands dominated by forest red gum *Eucalyptus tereticornis*, molloy red box *E leptophleba*, white mahogany *E. acmenoides*, pink bloodwood *Corymbia intermedia*, tall open forests dominated by rose gum *E. grandis*, red mahogany *E. resinifera*.

Bioregion	Province	Percentage representation in Plan area	Geology	Landform	Soils	Vegetation
WET TROPICS	7. Bellenden Ker-Lamb	100%	Lower Permian Mareeba, Tinaroo, and Bellenden Ker Granites.	High hills, high mountains.	Lithosols, podzols, yellow podzolics, yellow earths.	Complex-simple mesophyll, notophyll and microphyll rainforests ± *Acacia* spp., rose gum *Eucalyptus grandis*, turpentine *Syncarpia glomulifera*, cadaghi *E. torelliana*; tall open rose gum and red mahogany *E. resinifera* forests, woodlands dominated by gympie messmate *E. cloeziana*, pink bloodwood *Corymbia intermedia*, lemon-scented gum *C. citriodora*.
	8. Macalister	~75%	Middle Palaeozoic metamorphics (Hodgkinson Formation) and Lower Permian Mareeba Granites.	Low hills and ranges.	Humic gleys, red podzolics, xanthozems, yellow earths, yellow podzoilcs	Notophyll and mesophyll rainforests ± *Acacia* spp., kauri pine *Agathis robusta*; woodlands dominated by forest red gum *Eucalyptus tereticornis*, molloy red box *E. leptophleba*, pink bloodwood *Corymbia intermedia*, Melville Island bloodwood *C. nesophil*a.
	9. Daintree-Bloomfield	~75%	Palaeozoic Finlayson Granites and metamorphics (Hodgkinson Formation).	Plains, low hills, ranges, high hills and mountains.	Lithosols, red earths, yellow earths, humic gleys, red podzolics, xanthozems, yellow earths, yellow podzolics.	Complex, simple and semi-deciduous mesophyll, notophyll and microphyll rainforests ± *Acacia* spp., *Eucalyptus* spp., kauri pine *Agathis robusta*; deciduous microphyll vine thickets; estuarine mangroves; fan palm swamps, tall open rose gum *E. grandis* and red mahogany *E. resinifera* forests, woodlands dominated by paperbarks *Melaleuca* spp., forest red gum *E. tereticornis*, messmate E. tetrodonta, poplar gum *E. platyphylla*, red stringybark *E. pellita*, Melville Island bloodwood *C. nesophila*.
EINASLEIGH UPLANDS	2. Kidston	0.35%	Pre-Cambrian metamorphics, Pre-Cambrian and Palaeozoic granites, Carboniferous volcanics, areas of Mesozoic sandstones.	Undulating to hilly, with areas of rugged ranges.	Lithosols and podzolics, with areas of earths and clays.	*Eucalyptus crebra* woodlands and *E. shirleyi/Corymbia peltata* low woodlands. Small areas of *E. brownii* woodlands, and in the west, *E. microneura* low woodlands.
	3. Hodgkinson Basin	4.25%	Silurian-Devonian sediments and basic volcanics, and Permian granites. Some Mesozoic sandstones.	Hilly, with areas of rugged ranges.	Lithosols and shallow loams.	Primarily *Eucalyptus cullenii* low woodlands. Areas of vine thicket.
	5. Undara-Toomba Basalts	2.4%	Tertiary and Quaternary basalts.	Plains, with occasional scarps and hillocks.	Krasnozems, cracking clays and lithosols.	*Eucalyptus crebra* woodlands and open forests, grasslands and vine thickets. Areas of *E. orgadophila* open woodlands.

Bioregion	Province	Percentage representation in Plan area	Geology	Landform	Soils	Vegetation
EINASLEIGH UPLANDS	6. Herberton-Wairuna	60%	Tertiary and Quaternary deposits, with areas of Palaeozoic granites, acid volcanics and sediments, and Tertiary basalts.	Plains with areas of hills and rugged ranges.	Earths, lithosols and podzolics.	Mixed open forests including *Eucalyptus drepanophylla* and *Corymbia citriodora*; areas of *E. leptophleba* woodland.

3.2.2. REGIONAL VEGETATION DIVERSITY

Wet Tropics Bioregion

The forests of the Wet Tropics bioregion occur across a diverse range of rainfall, geology, drainage, altitude and evolutionary history. As a result there is a spectrum of plant communities and habitats. The rainforests of the region have been classified into 16 major structural types and 30 broad community types correlated with climatic zones and soil parent material (Tracey & Webb 1975; Tracey 1982). These rainforest types are fringed and dissected by a range of sclerophyll forest and woodland types, mangroves and swamp communities. For simplicity, similar forest structural types are summarised and amalgamated in Table 17.

Table 17: Vegetation diversity within the Wet Tropics bioregion and its representation within the WHA (Source: WTMA 2002, based on Tracey & Webb 1975; Olsen 1993).

Broad Forest Types	Regional Extent ('000 ha)	WHA Extent ('000 ha)
Rainforests		
complex mesophyll	36	16
mesophyll	348	283
complex notophyll	71	52
notophyll	203	193
microphyll	20	17
semi-deciduous	5	1
deciduous microphyll	8	0.5
with sclerophyll emergents	144	106
Sclerophyll Forests & Woodlands		
tall open forest	54	37
medium and low open forst and woodland	852	135
Vegetation Complexes		
shrublands	19	7
swamp communities and coastal complexes	113	22
mangroves	43	14

A similar high-level broad grouping (although with less emphasis on sub-classifying rainforest groups) is used in the *Australian Native Vegetation Assessment* NLWRA 2001). Twenty-three 'Major Vegetation Groups' were identified across the country and the state, ten of which were represented to some extent in the Wet Tropics bioregion. These are displayed in Table 18, along with information on their pre-clearing and 1997 remnant areas.

Table 18: Pre-clearing and 1997 remnant area by major vegetation group in the Wet Tropics bioregion (Source: National Land and Water Audit 2001).

Major Vegetation Group	Pre-European Area (ha)	Circa 1997 Area (ha)	% remaining relative to pre-European area
Rainforest and vine thickets	1,102,568	850,152	77.1
Eucalyptus open forest	543,016	376,612	69.4
Eucalyptus woodlands	76,720	59,392	77.4
Melaleuca forest and woodlands	25,540	14,736	57.7
Other forests and woodlands	900	900	100
Eucalyptus open woodlands	8,312	8,260	99.4

Tussock grasslands	163,872	162,068	98.9
Other grasslands, herblands, sedgelands and rushlands	228	220	96.5
Chenopod shrub, samphire shrub and forblands	25,336	25,336	100
Mangroves, tidal mudflat, samphire and bare areas, claypan, sand, rock, salt lakes, lagoons, lakes	11,084	11,060	99.8
Total	1,984,280	1,508,736	76

The NLWRA groupings shown in Table 18 broadly coincide with those of Wilson *et. al.* (2002), who used an amalgamation of regional ecosystems (REs) to form Broad Vegetation Groups (BVGs). The authors amalgamated 1160 REs across all of Queensland into 18 Broad Vegetation Groups (BVGs) and, once again, ten were represented in the Wet Tropics bioregion (Table 19).

Table 19: Pre-clearing and 1999 remnant area by BVG in the Wet Tropics bioregion (Source: Wilson *et. al.* 2002).

Broad Vegetation Group (BVG)		Pre-clearing area (km^2)	% remaining of pre-clearing extent
No	Name		
1.	Eucalypt woodlands on ranges	4,243	85
2.	Eucalypt open forest	964	53
3.	*E. tetrodonta* woodlands/open forest	343	70
6.	Mixed eucalypt woodlands	592	97
8.	*E. leucophloia* low open woodlands	31	15
9.	Riparian eucalypt woodland	513	46
15.	Rainforests and vine thickets	10,885	81
16.	Wetlands	1,302	14
17.	Mangroves and strand communities	804	97
18.	Heath or mixed shrublands	161	73
Total		19,838	77

Einasleigh Uplands Bioregion

There is a wide spectrum of plant communities in the Einasleigh Uplands bioregion but the constituent species are not well documented. The reason for the diversity is the wide range of geology and landforms, altitude and climate in the bioregion (Henderson & Stephenson 1980).

In contrast to the comments made in Morgan (1999), the vegetation of all of the bioregion, including the parts of the four sub-regions included in part or whole in the Wet Tropics NRM Region, has now been mapped at a 100,000 scale by staff of the Queensland Herbarium. This is in addition to limited larger scale vegetation mapping of dry rainforests by Fensham (1995) and Fensham and Streimann (1997), springs (Fensham & Fairfax, submitted) and of the Princess Hills section of Lumholtz National Park (Cumming 1992). The Herbarium mapping activities in the bioregion report only on areas of five or greater hectares and the detailed sites associated with the mapping are selected to sample representative vegetation types and are limited by time available for sampling and the ability to access the vegetation types.

Biophysical data from detailed sites are included in the Queensland Herbarium CORVEG database and information about plants collections made at the sites and later integrated into the Queensland Herbarium collection are entered in to the HERBRECS database. The results of the constraints and methodology employed in the mapping-

related detailed sites mean that the data from them do not represent the total floristic diversity of the survey region. The site and collections data from the recently completed vegetation mapping of the Einasleigh Uplands bioregion is currently being entered into the Herbarium databases.

While specific data on the new regional ecosystems (REs) is not included in this report, data showing the extent of the land zones occupied by them in the NRM Plan area are presented in Table 20 and Figure 6. These data take account of the recent changes in bioregion and sub-region boundaries.

Table 20: Area in hectares of land zones and percentage of total area in the Wet Tropics NRM Region of the Einasleigh Uplands bioregion.

Land zone	Area (Ha.) in Plan area	Percentage representation in Plan area
3	65,997	11.82
5	203,785	36.48
7	9,639	1.73
8	89,722	16.06
11	57,217	10.24
12	132,220	23.67
Total	558,580	100

The following descriptions (based on Morgan 1999) provide an overview of the vegetation diversity of those parts of the Einasleigh Uplands sub-regions within the Wet Tropics NRM Region.

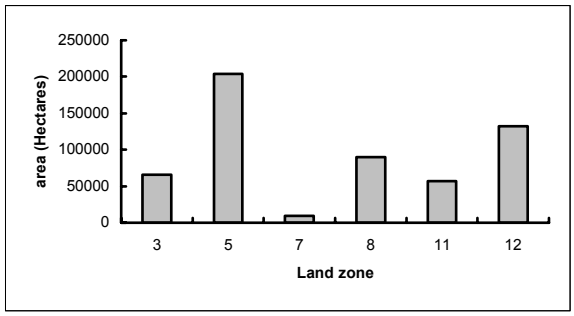


Figure 6: Area in hectares of the Wet Tropics NRM Region in the Einasleigh Uplands bioregion.

Herberton-Wairuna

This sub-region is dominated by grasslands, tall woodlands and open forests of *Eucalyptus* species (RE 9.5.5), and extensive seasonal and permanent lakes and wetlands (9.3.7). The eastern section of the subregion in the NRM Region contains extensive areas of ecotone forest vegetation from the Wet Tropics bioregion.

This portion of the Wet Tropics NRM Region includes the Princess Hills section of the Lumholtz National Park. The higher ranges in the north of the sub-region are poorly known scientifically, but include: lemon scented gum (*Corymbia citriodora*) and ironbark (*Eucalyptus drepanophylla*) open forest on shallow soils of hills and ranges (RE 9.11.4), and ironbark (*Eucalyptus granitica*), white mahogany (*Eucalyptus acmenoides*) and lemon scented gum (*Corymbia citriodora*) open forest on shallow soils of hills and ranges (RE 9.12.2) that are subject to logging and contain rare and threatened plant species.

Hodgkinson Basin

In the Wet Tropics NRM Region, this subregion is characterised by ironbark *Eucalyptus cullenii* woodlands (REs 9.11.3, 9.12.7) and, on sediments near the Wet Tropics bioregion boundary, by poplar gum *Eucalyptus platyphylla* (9.11.7) and box *E. leptophleba* (9.3.2) woodlands. Low lying areas on duplex soils support shrub lands of *Melaleuca* species and on alluviums along creeks and streams tall woodlands and open forest dominated by *E. tereticornis* or *E. camaldulensis* (9.3.1).

Undara-Toomba Basalts

The small area of this subregion in the Wet Tropics NRM Region is characterised by narrow-leaf ironbark *Eucalyptus* spp. woodlands with areas of low woodlands and grasslands. A portion of the Forty Mile Scrub National Park included in the Plan area

contains an important, but much affected by fire and weeds (Fensham 1994), area of dry rainforest thicket (RE 9.8.3).

Kidston

This subregion is dominated hills and ranges covered in narrow-leaved ironbark *Eucalyptus* species. The area of small intrusion of this subregion into the Wet Tropics NRM Region is characterised by a complex geology including serpentinite rocks and restricted habitats with many geographically restricted or endemic plant species in the current RE 9.11.10 (Eucalypt woodland on serpentinites and other restricted habitats). Although this RE is designated as 'not of concern' under the *Vegetation Management Act*, Morgan (1999) notes that it is 'little known' and requires 'urgent botanical survey'.

Based on an amalgamation of current REs (after Wilson *et. al.* 2002), ten Broad Vegetation Groups (BVGs) are likely to occur in the Einasleigh Uplands part of the Plan area. These are listed in Table 21. The only new BVG cf. Table 19 is BVG 14 (Native grasslands). Of course, BVG 17 (Mangroves and strand communities) drops out. According to Wilson *et. al.* (2002), BVG 1 (Eucalypt woodlands on ranges) is the most extensive BVG in the Einasleigh Uplands bioregion but it is also the most extensively cleared, at an average annual rate of 7 km^2 per year.

Table 21: Broad Vegetation Groups likely to occur in the Einasleigh Uplands part of the Plan area (Source: after Wilson *et. al.* 2002).

Broad Vegetation Group (BVG)	
No.	***Name***
1.	Eucalypt woodlands on ranges
2.	Eucalypt open forest
3.	*E. tetrodonta* woodlands/ open forest
6.	Mixed eucalypt woodlands
8.	*E. leucophloia* low open woodlands
9.	Riparian eucalypt woodland
14.	Native grasslands
15.	Rainforests and vine thickets
16.	Wetlands
18.	Heath or mixed shrublands

The vegetation of the Wet Tropics NRM Region, based on the Tracey and Webb (1975) survey and work by the Queensland Herbarium and Tropical Savannas CRC (Fox *et. al.* 2001), is shown on Map 5 of the Background Report (Volume 1 of this series).

3.2.3. REGIONAL ECOSYSTEM DIVERSITY

As reported above, REs are defined as vegetation communities consistently associated with a particular combination of geology, landform and soil within a bioregion (Sattler & Williams 1999). The National Land and Water Resources Audit (NLWRA) (2002) describes ecosystems, perhaps more helpfully, as integrated units of vegetation including the dominant species in the principal stratum and structural formation, geology or soils and landform.

The scale of identification of REs is generally 1:100,000-1:250,000, allowing most REs to be readily discernible from remote sensing data. At this scale small communities such as patches or linear strips may be included within a broader RE. The concept of REs now forms the scientific basis of Queensland's conservation planning, biodiversity management and tree clearing guidelines (Sattler & Williams 1999).

Numbering

REs in Queensland are given a three-part number (Sattler 1999):

- the first number is the bioregion;
- the second number is the geomorphic category or land zone that the ecosystem falls within (e.g. all regional ecosystems occurring on basalts are grouped);
- the third number is the ecosystem number, and relates to the dominant vegetation (see Figure 7).

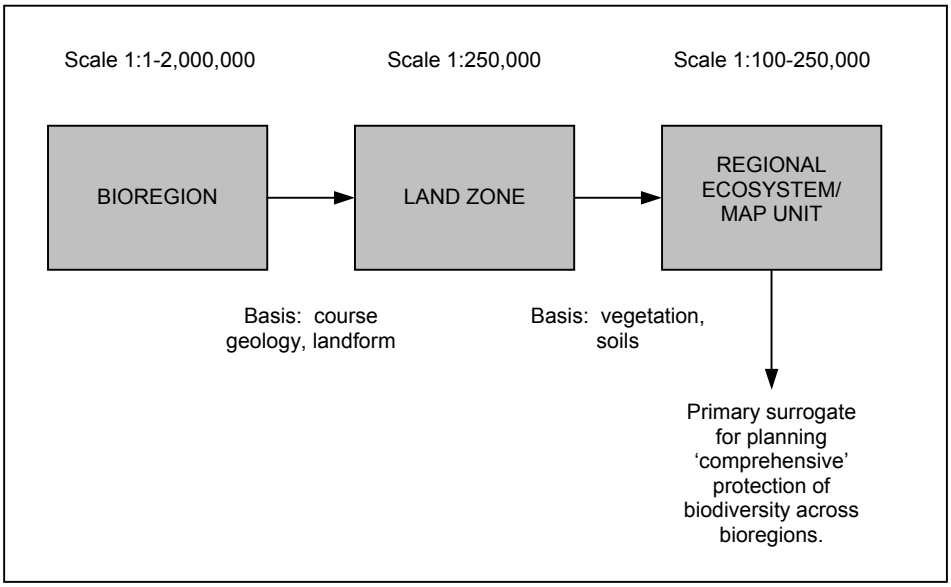


Figure 7: Landscape classification showing derivation and scale of bioregions, land zones and regional ecosystems (adapted from Sattler & Williams 1999).

LAND ZONES OF THE WET TROPICS NRM REGION

Twelve land zones are recognised in Queensland. Each represents a significant difference in geology and in the associated landforms landforms, soils and physical processes that gave rise to distinctive landforms or continue to shape them. Generally speaking, the land zones correspond to broad geological categories, or groupings of these, and can be readily identified on geological maps. Those that occur in the Wet Tropics NRM region are described below, along with information on their sub-regional representation.

Land Zone 1: Quaternary marine deposits, subject to periodic inundation by saline or brackish marine waters. Includes mangroves, salt pans and marine plains. Soils are predominantly saline muds or solonchaks. Subregions: WET1,2,3,8,9.

Land Zone 2: Quaternary coastal dunes and beaches. Includes associated dunes, swales and swamps. Soils are predominantly siliceous or calcareous sands and podzols. Subregions: WET1,2,3,8,9.

Land Zone 3: Quaternary alluvial plains and piedmont fans. Includes terraces, levees, swamps and channels. Soils include acid peats, gleyed podzolics, humic gleys and poorly developed alluvial soils. Subregions: WET1,2,3,4,5,6,7,8,9; EIU2,3,5,6.

Land Zone 5: Cainozoic sand deposits, usually forming extensive, uniform near-level or gently undulating plains. Includes small remnants of these surfaces. Soils are usually sands, earths of texture contrast and often overlie laterite profiles. Includes extensive sand plains of uncertain origin overlying weatherd or unweathered bedrock. Excludes exposed duricrust (land zone 7). Subregions: EIU6.

Land Zone 7: Cainozoic duricrusts formed on a variety of rock types. Includes exposed ferruginous and mottled horizons, and associated footslopes. Usually low mesas and scarps. Soils are usually skeletal, with shallow texture contrast soils on the adjacent colluvial fans, and shallow red earths on plateau margins and on larger mesas. Subregions: EIU6.

Land Zone 8: Cainozoic basalts. Predominantly flood basalts forming extensive plains and occasional low scarps, hills, cones and plugs. These igneous rocks have diverse origins such as flows, pyroclastics, plugs, explosion craters, cinder cones and dykes. Soils are krasnozems of generally moderate to high fertility. Subregions: WET3,4,9; EIU3,5,6.

Land Zone 11: Palaeozoic metamorphosed sediments and interbedded volcanics. Ranges, hills and lowlands with shallow texture contrast soils, podzols and earths. Includes low- to high0grade metamorphics such as shales, slates, schists, greywacke, phyllite, greenstone and minor areas of quartzite and serpentine. Subregions: WET2,3,5,6,7,8,9; EIU2,3,6.

Land Zone 12: Carboniferous to Permian igneous rocks. Ranges and hills with shallow texture contrast soils, earths, podzolics and lithosols. Predominantly granites, granodiorites, adamellites, andersites and rhyolites. Subregions: WET1,2,3,4,5,6,7,8,9; EIU2,3,5,6.

Diversity

Although it is Queensland's third smallest bioregion, the Wet Tropics has a very high number of REs with 105 (Table 22). A major mapping program currently underway (Stanton *in prep.*) is further refining these REs, particularly in the more rugged sub-regions[5]. The Einasleigh Uplands, by comparison, originally had only 46 REs recognised (Table 22), even though it is nearly seven times the size of the Wet Tropics.

Not surprisingly, Morgan (1999) indicated that the Einasleigh was one of the most poorly described bioregions in Queensland and this is reflected in the small number of regional ecosystems described for it by Morgan. Concurrently with the comment by Morgan (1999), Dr John Neldner, then head of mapping with the Queensland Herbarium, in a briefing of staff commencing work in the bioregion, expressed the expectation that, after the Wet Tropics bioregion, the Einasleigh was likely to prove to be the most diverse of the northern bioregions. Recently completed work by the Queensland Herbarium has proven Neldner's supposition true. In addition, it should be noted that both the boundaries of Einasleigh Uplands and western margin of the Wet Tropics bioregions and those of subregions in the Einasleigh have been recently modified.

Table 22: Summary of the status of Queensland's bioregional ecosystems (Source: WTMA 2002, from Sattler & Williams 1999).

Bioregion	Area ('000 ha)	# Regional Ecosystems	Endangered Ecosystems		'Of Concern' Ecosystems	
			No	%	No	%
New England Tableland	341	21	2	10	4	19
Central Queensland Coast	1,151	37	4	11	10	27
Wet Tropics	1,850	105	24	23	17	16
Desert Uplands	6,882	58	17	29	20	34
Northwest Highlands	6,950	41	3	7	13	32
Southeast Queensland	8,231	145	11	8	44	30
Cape York Peninsula	11,548	211	6	3	8	4
Einasleigh Uplands	12,808	46	1	2	21	46
Mulga Lands	19,097	66	5	8	22	33
Gulf Plains	21,377	83	3	4	26	31
Mitchell Grass Downs	22,787	53	2	4	10	19
Channel Country	24,594	56	2	3	5	9
Brigalow Belt	35,158	163	27	17	43	26
Total	172,774	1,085	107	10	243	22

A list of REs based on a GIS clipout for the Wet Tropics NRM Region (current to mid 2003) is included as Appendix D. It shows that a total of 136 REs (based on original descriptions) were recognised from the NRM Region. This comprised 98 Wet Tropics REs, 35 from the Einasleigh Uplands and three normally associated with the Cape York bioregion (i.e. REs 3.3.1, 3.3.6 and 3.8.3) (for descriptions, see Sattler & Williams 1999). Importantly, Appendix D also includes derivative REs (e.g. REs 9.3.1a, 9.3.1b, 9.3.1e, etc.), which brings the number of 'interim' REs recognised from the NRM Region to 257 (164 Wet Tropics, 90 Einasleigh Uplands and 3 Cape York).

[5] The new mapping will also strengthen an inherent weakness in the existing approach by reporting on features other than the dominant species in the principal stratum e.g. understorey (P. Stanton *pers. comm.*).

Conservation Status

The conservation status of regional ecosystems in Queensland is largely determined by a comparison of remnant vegetation mapping and Landsat images on a two-year cycle. The conservation status of regional ecosystems has been assessed in terms of three classes, **endangered**, **of concern** and **no concern at present**. These classifications are enshrined in legislation and used in considerations of applications to clear vegetation on both freehold and leasehold land in Queensland. The conservation status of regional ecosystems is dynamic and subject to change depending on the rate of clearing of them. A summary of the classes and their criteria is presented in Table 23.

It is important to note, however, that the conservation status of REs recognised by the EPA (Sattler & Williams 1999) may differ from that prescribed for vegetation management purposes under Queensland legislation. This is because the EPA conservation status of REs is not just based on their remaining extent in the bioregion but also takes into account their condition and the presence of threatening processes.

Table 23: Summary of classes and criteria of conservation status of regional ecosystems in Queensland (adapted from Sattler 1999).

Class	Description
Endangered	Less than 10% of pre-European extent remains in an intact condition across the bioregion, or its distribution has contracted to less than 10% of its former range.
Of concern	10-30% pre-European extent remains in an intact condition in the bioregion.
Not of concern	Over 30% of pre-European extent remains in an intact condition in the bioregion.

A disproportionately large percentage (68%) of the Wet Tropics REs have 'endangered' or 'of concern' conservation status (after Sattler & Williams 1999) (see Table 24). All are represented within the NRM Region (Table 24, see also Appendix D).

Table 24: 'Endangered' and 'of concern' Wet Tropics REs in the Plan area. Code: S&W (Sattler & Williams 1999); VMR (*Vegetation Management Regulation 2000* [Qld]); E (Endangered); OC (Of concern).

RE	Summary	Province	Conservation status	
			S&W	VMR
7.1.3	Bulkuru *Elaeocharis dulcis* swamp on poorly drained acid peats	1,2,3	OC	OC
7.2.1	Mesophyll rainforest on coastal beach sands	3,9	E	E
7.2.2	Notophyll rainforest with acacia emergents on coastal beach sands	8	E	E
7.2.4	Open forests and woodlands on old dune ridges	1,2,3	OC	OC
7.3.1	Sedgeland ± grassland freshwater swamp on coastal lowlands	1,2,3,9	E	E
7.3.2	Sedgeland ± grassland freshwater peat swamps of volcanic craters	4	E	E
7.3.3	Alexandra palm *Archontophoenix alexandrae*, on poorly drained lowlands	1,2,3,9	E	E
7.3.4	Fan palm *Licuala ramsayi*, swamp rainforest on poorly drained lowlands	2,3,9	E	E
7.3.5	Swamp paperbark *Melaleuca quinquenervia*, on poorly drained lowlands	1,2,3,9	OC	OC
7.3.6	Melaleuca open forest/rainforest complex on poorly drained lowlands	1,2,3,9	E	E
7.3.7	Eucalyptus/Melaleuca open forest complex on poorly drained lowlands	1,2,3	E	E
7.3.10	Complex mesophyll rainforest on well drained fertile lowland alluvials	2,3,9	E	E

RE	Summary	Province	Conservation status	
			S&W	VMR
7.3.12	Forest red gum *Eucalyptus tereticornis*, on well-drained lowland alluvials	2,3,9	E	E
7.3.13	*Corymbia nesophila* woodland on well drained lowland gravelly alluvial soils	9	E	E
7.3.22	Complex mesophyll riparian rainforest on well drained lowland alluvial levees	2,6,9	E	E
7.3.23	Semi-deciduous notophyll riparian rainforest on well drained alluvial levees	1,5,8	OC	OC
7.3.24	Red tea tree *Melaleuca dealbata*, riparian open forest on lowland alluvia	1,2	E	E
7.3.25	Melaleuca, eucalypt and notophyll rainforest spp. riparian forest	1	E	E
7.3.26	River oak *Casuarina cunninghamiana*, riparian forest	1	E	E
7.3.27	Eucalypt and swamp mahogany *Lophostemon suaveolens*, riparian forest	1,2,3	OC	OC
7.3.28	Herbfield and shrubland of river sandbars and river beds	1,2,3,9	E	E
7.8.1	Complex mesophyll rainforest on basalt lowlands and foothills	3,4,9	OC	OC
7.8.2	Complex mesophyll rainforest on basalt uplands	4	E	E
7.8.3	Complex notophyll rainforest on basalt lowlands, foothills and uplands	4,9	E	E
7.8.4	Complex notophyll rainforest on basalt uplands and highlands	4	OC	OC
7.8.6	Semi-deciduous mesophyll rainforest on basalt foothills	3,9	E	E
7.8.7	Forest red gum *Eucalyptus tereticornis*, open forest on basalt uplands and highlands	4	E	E
7.8.8	White stringybark *Eucalyptus phaeotricha*, woodlands on basalt uplands and highlands	4	E	E
7.8.9	Molloy red box *Eucalyptus leptophleba*, woodland on dry basalt uplands	4	OC	OC
7.11.2	Fan palm *Licuala ramsayi*, forest on poorly drained metamorphic tablelands	8	E	E
7.11.8	Notophyll rainforest with acacia on metamorphic lowlands and foothills.	2,3,8	E	E
7.11.16	Tall open pink bloodwood woodlands	5,6	OC	OC
7.11.20	*Corymbia nesophila* forest on metamorphic lowlands and foothills	9	OC	OC
7.12.2	Fan palm *Licuala ramsayi*, mesophyll rainforest on poorly drained granite foothills	3,9	OC	OC
7.12.10	Notophyll rainforest with hoop pine *Araucaria cunninghamii* on granite uplands	5	OC	OC
7.12.12	Notophyll rainforest with acacia emergents on granite lowlands and foothills	5,8	E	E
7.12.18	Microphyll rainforest with hoop pine *Araucaria cunninghamii* on granite uplands	5	OC	OC
7.12.21	Rose gum *Eucalyptus grandis*, forest on granite and rhyolite uplands	5,6,7,9	OC	OC
7.12.22	Red mahogany *Eucalyptus resinifera*, forest on granite and rhyolite uplands	5,6,7,9	OC	OC
7.12.23	Pink bloodwood *Corymbia intermedia*, woodland on granite and rhyolite uplands	5,6	OC	OC

RE	Summary	Province	Conservation status	
			S&W	VMR
7.12.24	White mahogany *Eucalyptus acmenoides*, woodland on granite foothills	2,3,6	OC	OC

The great majority of the 24 'endangered' Wet Tropics REs occur on lowlands that have been largely cleared for agriculture, and many have a naturally restricted distribution. Seventeen of the REs are 'of concern'. These include once extensive types that have been widely developed for agriculture, some that are subject to continuing forestry activities, and others that are changing their structure and floristic composition due to altered fire regimes (Goosem *et. al.* 1999). The remaining patches of Mabi Forest on the Atherton Tablelands (RE 7.8.3, complex notophyll vine forest, *sensu* Webb & Tracey Type 5b) have been added to the national list of critically endangered ecological communities under the EPBC Act.

In Chapter 9 of Sattler and Williams (1999) *The Conservation Status of Queensland's Bioregional Ecosystems,* Morgan described 46 regional ecosystems (REs) for the Einasleigh Uplands bioregion and this is the figure cited in Table 22 above. It is noted that the above-cited data in review will dramatically change that situation. Some indication of bioregion-scale changes in RE numbers is given in Table 25.

Table 25: A comparison of the number and status of currently published bioregional ecosystems in the Einasleigh Uplands and the (proposed) number.

Bioregion	No. 'Endangered' Ecosystems	No. 'Of Concern' Ecosystems	No. 'Not of Concern' Ecosytems	Total number of ecoystems
Einasleigh Uplands	1 (n/a)	21 (n/a)	24 (n/a)	46 (143)

Of the 46 REs first described for the Einasleigh Uplands, the only one with a status of 'endangered' was 9.3.9, *Acacia cambagei* woodland on alluvial plains on cracking grey clays derived from basalts, does not occur in the Wet Tropics NRM Region[6]. A further 21 REs were considered to be 'of concern'. Fifteen are represented in the Plan area (Table 26).

Table 26: 'Endangered' and 'of concern' Einasleigh Uplands REs in the Plan region (Code: S&W (Sattler & Williams 1999); VMR (*Vegetation Management Regulation 2000* [Qld]); OC (Of Concern); NC (Not of Concern).

RE	Summary	Province	Conservation status	
			S&W	VMR
9.3.1	River red gum *Eucalyptus camaldulensis* or blue gum *E. tereticornis* woodland on alluvium	2,3,5,6	OC	NC
9.3.3	Mixed eucalypt woodland and coolibah *Eucalyptus microtheca* woodlands on alluvial terraces	2,3	OC	NC
9.3.4	Lakes on alluvial plains	2,3,5,6	OC	OC
9.3.7	Lakes on Tertiary sand plains	5,6	OC	OC
9.3.8	Gum-topped box *Eucalyptus moluccana* on alluvium	6	OC	OC
9.3.11	Lakes on basalt	5,6	OC	NC
9.5.2	Dry rainforest on Tertiary surfaces	6	OC	OC
9.5.5	White mahogany *Eucalyptus acmenoides* forest on podzolics and earths of Tertiary plains	6	OC	NC

[6] This RE is prescribed as 'not of concern' under the *Vegetation Management Act* (Qld).

RE	Summary	Province	Conservation status	
			S&W	VMR
9.7.2	Lancewood *Acacia shirleyi*, bendee *A. catenulata* open forest on Tertiary plateaus	6	OC	NC
9.8.2	Clarkson's bloodwood *Corymbia clarksoniana* and Mt Molloy box *Eucalyptus leptophleba* on red basalt soils	3,6	OC	NC
9.8.3	Dry rainforest on red basalt soils	5	OC	OC
9.11.8	Dry rainforest and Mt Molloy box *Eucalyptus leptophleba* on limestone	3	OC	OC
9.11.10	*Eucalyptus* spp. on restricted habitats near Herberton	6	OC	NC
9.12.2	Open forests including lemon-scented gum *Corymbia citriodora* on hills on acid intrusive rocks	3,6	OC	NC
9.12.8	Dry rainforest on granites	2,3,6	OC	NC

Another endangered regional ecosystem, the Cape York RE 3.8.3 (Molloy red box *Eucalyptus leptophleba* ± ghost gum *Corymbia papuana* ± *C. clarksoniana* ± *C. erythrophloia* ± Cullen's ironbark *E. cullenii* woodland on basalt flows) is also currently recognised from the NRM Region (see Appendix D).

The threatened ('endangered' and 'of concern') REs listed for the Plan area are shown on Map 2. While the Wet Tropics region is well known for its rainforests, it is worth noting that less than half of the 57 threatened REs in the NRM Region (23 or 40%) are closed forest communities (BVG 15: Rainforest or vine thicket communities, after Wilson *et. al.* 2002). The majority are sclerophyll forests, woodlands and other vegetation complexes. This is in accord with the *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002a), which found that nearly half of the threatened ecosystems in Australia are eucalypt forest and woodlands with shrubby or grassy understorey that have been extensively cleared.

At this point it should be stressed that REs and their status are designed as one aspect of biodiversity assessment (Sattler 1999). While it is used as a surrogate for other levels of biodiversity in nature conservation planning, other factors that need to be assessed include regional landscape function and context, habitat for rare and threatened species and other special values such as endemism and irreplaceability (NLWRA 2002a; Wilson *et. al.* 2002).

Wetlands

Wetland habitats are widespread throughout the Wet Tropics. Although they are most commonly thought of as occurring only where land and sea join (see Section 2), natural wetlands are located in a range of landscapes, including lakes, marshes, rivers and springs (EPA 1999b). Artificial wetlands have also been constructed throughout the region (e.g. Digman 1998).

The Convention on Wetlands of International Importance (Ramsar, Iran, 1971) defined wetlands as:

> *'Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres.'*

Typically, wetlands include areas that show evidence of soil or vegetation to periodic waterlogging – lakes, swamps, freshwater or brackish marshes, melaleuca forests, lignum swamps, canegrass swamps, wooded swamps, claypans, ponded pastures and water storage dams; estuaries, rivers, streams, channels, waterholes and springs; intertidal sand flats, mud flats, salt flats, tidal marshes and mangroves; and shallow marine areas such as seagrass beds or fringing coral reefs (EPA 1999b).

Values and Functions

Wetlands (both artificial and natural) in the Wet Tropics (after EPA 1999b):

- play a key role in supporting the diversity and abundance of plants and animals, and provide important habitat and refuges for many migratory, rare or threatened species;
- are an essential part of natural hydrological cycles, provide water passage and storage, and may contribute to flood mitigation and the recharge of aquifers;
- purify water by stripping nutrients and intercepting sediments;
- provide coastal protection against destructive natural events, such as cyclones;
- make a significant contribution to the economic productivity of the State by providing essential water sources for agricultural, urban and industrial uses, vital breeding, nursery and harvest sites for edible fish, molluscs and crustaceans, broodstock for aquaculture, and areas of pasture for stock;
- are used for navigation and port facilities essential for trade;
- feature significantly in the cultural heritage, spiritual values, and day-to-day living of Aboriginal peoples;
- contribute to the well-being of people through landscape diversity, heritage values, and aesthetic appeal; and
- feature strongly in the region's tourism and recreational appeal.

Nationally Important Wetlands

There are about 850 wetlands in Australia that are considered to be nationally 'important' (Environment Australia 2001). A wetland may be considered nationally important if it meets at least one of the following criteria (ANCA 1996):

- It is a good example of a wetland type occurring within a biogeographic region in Australia;
- It is a wetland which plays an important ecological or hydrological role in the natural functioning of a major wetland system/complex;
- It is a wetland which is important as the habitat for animal taxa at a vulnerable stage in their life cycles, or provides a refuge when adverse conditions such as drought, prevail;
- The wetland supports 1% or more of the national populations of any native plant or animal taxa;
- The wetland supports native plant or animal taxa or communities which are considered endangered or vulnerable at the national level; and/or
- The wetland is of outstanding historical or cultural significance.

The current Queensland listing has a total of 181 nationally important wetlands. Thirty-two of these (18%) are located in the Wet Tropics NRM Region. One, the Great Barrier Reef Marine Park (GBR003QL), extends approximately 2000km along the eastern coast of Queensland and extends over portions of some 16 shires, and is discussed in Section 2 of this report. The remaining 31 nationally important wetlands in the Plan area are listed in Table 27, along with information on their current condition and trend (where available) (see Figure 8).

Figure 8: Nationally important wetlands (Map: NR&M).

Table 27: Nationally important wetlands in the Plan area (Source: ANCA 1996).

Name of Wetland	Catchment	Shire	Current condition[1]	Trend[1]
Wet Tropics				
Alexandra Bay (WT001QL)	Mossman-Daintree	Douglas	Good	Declining
Alexandra Palm Forest (WT002QL)	Mulgrave-Russell	Cairns	Near pristine	Static
Bambaroo Coastal Aggregation (WT003QL)	Herbert	Hinchinbrook	Good	Declining
Bromfield Swamp (WT004QL)	Johnstone	Eacham	Good	Static
Cowley Area (WT005QL)	Johnstone	Johnstone		
Edmund Kennedy Wetlands (WT007QL)	Tully-Murray	Cardwell	Good	Static
Ella Bay Swamp (WT008QL)	Johnstone	Johnstone		
Eubenangee – Alice River (WT009QL)	Mulgrave-Russell	Johnstone		
Herbert River Floodplain (WT010QL)	Herbert	Hinchinbrook		
Hilda Creek Headwater (WT011QL)	Mossman-Daintree	Douglas		
Hinchinbrook Channel (WT012QL)	Tully-Murray & Herbert	Cardwell	Good	Static
Innisfail Area (WT013QL)	Johnstone	Johnstone		
Kurrimine Area (WT014QL)	Johnstone	Johnstone		
Lake Barrine (WT015QL)	Mulgrave-Russell	Eacham		
Lake Eacham (WT016QL)	Barron	Eacham	Good	Static
Licuala Palm Forest (WT017QL)	Tully-Murray	Cardwell		
Lower Daintree River (WT018QL)	Mulgrave-Russell	Douglas		
Missionary Bay (WT019QL)	Tully-Murray & Herbert	Cardwell		
Nandroya Falls (WT020QL)	Johnstone	Johnstone		
Port of Cairns and Trinity Inlet (WT021QL)	Mulgrave-Russell	Cairns		
Russell River (WT022QL)	Mulgrave-Russell	Mulgrave		
Russell River Rapids (WT023QL)	Mulgrave-Russell	Cairns		
Sunday Creek, Broad-leaved Paperbark Site (WT024QL)	Herbert	Cardwell		
Tully River - Murray River Floodplains (WT025QL)	Tully-Murray	Cardwell		
West Mulgrave Falls (WT026QL)	Mulgrave-Russell	Cairns		
Wyvuri Swamp (WT027QL)	Mulgrave-Russell	Johnstone		
Yuccabine Creek (WT028QL)	Herbert	Herberton		

Name of Wetland	Catchment	Shire	Current condition[1]	Trend[1]
Zillie Falls (WT029QL)	Johnstone	Eacham		
Einasleigh Uplands				
Blencoe Falls - Blencoe Creek (EIU001QL)	Herbert	Herberton		
Herbert River Gorge (EIU003QL)	Herbert	Herberton	Good	Static
Innot Hot Springs (EIU004QL)	Herbert	Herberton		

[1]Australian Natural Resources Atlas V2.0. NB. A rating of 'good' indicates that recovery requires little intervention. The table also lists several rapids and waterfalls. The wetlands at these sites consist variously of boulder-strewn rapids punctuated by still pools (most commonly on bends), point bars (most commonly gravel or shingle), bouldery mid channel islands, regularly inundated alluvial flats and rock faces that are kept perpetually wet by seepage (Directory of Important Wetlands in Australia).

Table 28 gives a breakdown of the number of nationally important wetlands that occur in each catchment of the Wet Tropics Plan area.

Table 28: Number of nationally important wetlands by catchment.

Catchment	No. Wetlands
Barron	1
Herbert	9
Johnstone	7
Mossman-Daintree	2
Mulgrave-Russell	9
Tully-Murray	5

Regionally significant wetlands

Regionally significant wetlands were identified Australia-wide in most jurisdictions for the first time as part of the *Australian Terrestrial Biodiversity Assessment* carried out by the National Land and Water Resources Audit (2002a). These were specifically identified to gain an understanding of the extent and significance of wetlands that have not been listed as nationally important wetlands. Regionally significant wetlands are a vital resource for the protection of regional biodiversity and can be easily overlooked and lost through incremental development and other impacts (NLWRA 2002).

Approximately 4,700 regionally significant wetlands were identified and assessed across Australia. The criteria used to identify them were consistent with those used to assess nationally important wetlands (see box, 'Regionally Significant Wetlands'). Fifteen regionally significant wetlands were identified in the Plan area and these are listed and described in Table 29.

REGIONALLY SIGNIFICANT WETLANDS

Regionally significant wetlands meet the following critieria:

- Identified in State and Territory lists of important wetlands;
- Significant for the maintenance of ecological processes at a regional scale;
- Important for breeding, feeding, roosting, moulting, nursery areas or refugia for fauna;
- Support significant numbers of plant and animal taxa or abundant populations; and
- Contain rare or threatened species or ecosystems.

(Source: NLWRA 2002)

Table 29: Provisional identification of wetlands of regional significance in the Plan area (Source: Australian Natural Resources Atlas V2.0).

Wetland name	Wetland type	Sub-region
Wet Tropics		
Lake Barrine (1199.4)	Permanent freshwater lakes (>8ha)	Atherton (WET4)
Lake Eacham (1198.4)	Permanent freshwater lakes (>8ha)	Atherton (WET4)

Tinaroo Falls Dam (1200.4)	Water storage areas	Atherton (WET4)
Lake Morris (1205.4)	Water storage areas	Bellenden Ker – Lamb (WET7)
Tinaroo Falls Dam (1204.4)	Water storage areas	Bellenden Ker – Lamb (WET7)
Herbert River (1194.4)	Permanent freshwater lakes (>8ha)	Herbert (WET1)
Herbert River (1194.5)	Permanent freshwater lakes (>8ha)	Herbert (WET1)
Herbert River (1194.6)	Permanent freshwater lakes (>8ha)	Herbert (WET1)
Mulgrave River (1197.4)	Intermittent freshwater lakes (>8ha)	Innisfail (WET3)
Koombooloomba Dam (1203.4)	Water storage areas	Kirrama – Hinchinbrook (WET6)
Lake Morris (1203.4)	Water storage areas	Macalister (WET8)
Herbert River (1201.4)	Permanent freshwater lakes (>8ha)	Paluma – Seaview (WET5)
Einasleigh Uplands		
Log Cabin Swamp (685.4)	Intermittent freshwater lakes (>8ha)	Herberton – Wairuna (EIU6)
Wurruma Swamp (683.4)	Permanent freshwater lakes (>8m)	Herberton – Wairuna (EIU6)
Nardello's Lagoon (657.4)	Water storage areas	Hodgkinson Basin (EIU3)

The EPA and James Cook University are currently engaged in wetland mapping projects (of the Herbert and Tully – Murray catchments and Daintree – Mossman catchment respectively) but data are not yet available.

Riverine Habitats

Detailed river assessments have been undertaken by the Queensland Department of Natural Resources & Mines for many of the region's rivers, often in conjunction with the river improvement trusts or catchment management groups, including the Herbert, Johnstone and Tully (McDonald *et. al.* 2002). The most recent survey for the Tully River for example (Australian Groundwater Consultants, 2001), for the Cardwell Shire River Improvement Trust, provides a very detailed audit of the middle reaches of the Tully River in terms of its drainage and flooding conditions, ecological and economic values. The audit is presented on an interactive GIS at a scale that identifies sub-reaches of the river at ownership scale. The report also presents a detailed tabulation of the priorities and investment needs for those sub reaches of the river requiring treatments including structural works (rock re-enforcement) and vegetation plantings.

The Queensland Department of Primary Industries' Fisheries branch has conducted a series of reports covering most of the rivers in the Plan area which provide an environmental audit of the rivers encompassing stream ecology and water quality, monitor the impacts of various land use and management practices on stream environment and water quality. Attributes covered in the most recent of these for the Barron River include: in-stream habitat assessment, riparian vegetation, sedimentation, and stream structure, fish habitat types, invasive grasses, wetlands, land use, water quality and fish resources (Russell *et. al.* 2000). The reports include detailed mapping of condition of all stream sections on these attributes.

The conservation values of all waterways within or flowing through the WTWHA were assessed in a study by Natural Resource Assessments (1999). The study assessed 328 sub-catchments in terms of ecosystem function values, aquatic plants, the diversity of

aquatic vertebrates and crustacean, freshwater fish, frogs, turtles, regional ecosystems of specific interest and distinctive flow regime types and/or flow needs.

Several of the 'endangered' and 'of concern' REs referred to above depend on sustained stream flows and water supplies for wetlands, particularly those of the poorly drained coastal plain. However, permanent alteration to the watertable and natural drainage systems, resulting from irrigation and land clearing, is threatening remaining habitats in this area, particularly ecosystems dominated by sclerophyll species (Goosem *et. al.* 1999).

An assessment of riparian zones, including condition trend and the processes threatening them, was undertaken as part of the *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002a). This assessment revealed that many coastal lowland floodplain areas in eastern Australia, including the Wet Tropics, are degraded. Similarly, the riparian zones in many sub-regions dominated by pastoralism were found to be in only fair condition or are degraded. This was principally due to the impact of stock grazing on riparian vegetation. Overgrazing was also found to lead to increased nutrient and sediment loads (see NLWRA 2001). More information on threats is given later in this document.

Information on the average condition and trend for riparian zones in sub-regions represented in the Wet Tropics NRM Region is given in Table 30. It shows that no sub-regions were classified as having near pristine riparian zones. A reliability ranking of this assessment is also indicated (for methodology, go to <http://www.nlwra.gov.au/>).

Table 30: The average condition and trend for riparian zones in sub-regions represented in the Wet Tropics NRM Plan area (Source: Australian Natural Resources Atlas V2.0). Note, a rating of 'good' indicates that recovery requires little intervention, 'fair' that recovery requires significant intervention and 'degraded' that recovery is unlikely in the medium term.

Subregion	Riparian condition	Riparian trend	Reliability of Assessment
Wet Tropics			
Atherton (WET4)	Fair	Declining	Quantitative and qualitative
Bellenden Ker – Lamb (WET7)	Fair	Declining	Quantitative and qualitative
Daintree-Bloomfield (WET9)	Good	Declining	Qualitative
Herbert (WET1)	Fair	Declining	Quantitative and qualitative
Innisfail (WET3)	Fair	Declining	Quantitative and qualitative
Kirrama – Hinchinbrook (WET6)	Fair	Declining	Quantitative and qualitative
Macalister (WET8)	Fair	Declining	Anecdotal
Paluma-Seaview (WET5)	Degraded	Declining	Quantitative and qualitative
Tully (WET2)	Fair	Declining	Quantitative and qualitative
Einasleigh Uplands			
Herberton-Wairuna (EIU6)	Fair)	Declining	Quantitative and qualitative
Hodgkinson Basin (EIU3)	Fair	Declining	Quantitative
Kidston (EIU2)	Good	Declining	Qualitative
Undara – Toomba Basalts (EIU5)	Fair	Declining	Quantitative and qualitative

RIPARIAN ECOSYSTEMS

Riparian ecosystems fringing watercourses are important energy and nutrient sources for stream ecosystems. They provide food, habitat and shade for both terrestrial and aquatic organisms. They are important for streambank stability, guarding against excessive erosion and protecting water bodies from pollutants traveling overland in runoff. Riparian zones provide refuge for plants and animals in times of environmental stress. They serve as important wildlife corridors.

Riparian ecosystems of the coastal floodplains and elevated tablelands in the Wet Tropics region have been heavily cleared for flood mitigation, intensive cropping (notably sugarcane and bananas), grazing and irrigation. Degraded riparian zones have led to extensive weed invasions, among other things. In the Herbert catchment, for example, the introduced para grass has spead from riparian zones to streams and has caused significant choking of watercourses. This has degraded natural stream processes and excluded native aquatic species.

Healthy Wet Tropics riparian ecosystem (Photo: Stuart Bunn)

Accordingly, all sectors of the community are engaging in a high and increasing level of activity in riparian restoration (Harrison *et. al.* 2002). River improvement trusts and catchment management groups in the Wet Tropics have identified riverine degradation as a key issue requiring urgent attention. Between 1997 and 2001, 62 NHT projects involving vegetation works in riparian areas and seven river improvement projects were undertaken in the region (Harrison *et. al.* 2002).

(based on EPA 1999a)

Subterranean Environments

There are no cave and/or lava tube systems of bioregional significance in the Wet Tropics NRM Region. However, shallow sea caves and rock fissures that support populations of at least two threatened bat species occur along the coast. Additionally, there are small caves that are significant enough to harbour bat colonies all along the coastal escarpment (e.g headwaters of the Johnstone and Mulgrave Rivers, Mt Haig) and amongst granite boulders at the base of Mt Bartle Frere. An old lava tube near Atherton and vertical volcanic vents on the southern tablelands also provide subterranean habitat for bat populations, including the 'rare' diadem leafnosed bat and greater large-eared horseshoe bat[7].

Human activities can also provide habitat for cave-dwelling fauna. For example, the importance of abandoned mines as habitat for bats is well known (see Hall *et. al.* 1997). There are no major mine sites left in the Wet Tropics NRM Region, although open voids and underground workings are scattered throughout, most notably in the upper Mulgrave and drier areas to the west (R. Coe, NR&M *pers. comm.*). Hydro tunnels, road and rail culverts, old bridges and military installations (e.g. False Cape emplacements) also provide significant habitat (C. Clague *pers. comm.*).

A significant bioregional site occurs just west of the Plan area, in the headwaters of the Mitchell River at Mount Consider. The site features a small isolated limestone tower covered by mosses and epiphytes in many places. Surrounding country is open woodland. Four caves support large bat populations, including (most likely) the diadem leafnosed bat and greater large-eared horseshoe bat as well as the 'vulnerable' ghost bat. A quarry on the southern end of the outcrop threatens the site (EPA 1999a).

[7] Note: The greater large-eared horseshoe bat (*Rhinolophus philippinensis* [large form]) is listed as 'endangered' under the EPBC Act. In Australia, this species is restricted to northern Queensland (from Malanda to Iron Range; and west to Chillagoe) (Duncan *et. al.* 1999).

3.2.4. REGIONAL SPECIES DIVERSITY

The Wet Tropics bioregion, although accounting for less than one-thousandth of the continent, conserves an extraordinarily high level of Australia's biodiversity (Table 31). The figures presented in Table 31 would be even more impressive if the plants and animals found in the Einasleigh Uplands part of the Plan area were included in the total. In a practical sense, this biodiversity is the result of millions of years of natural selection and evolution in response to the challenges of surviving and competing. The resulting bank of successful genes will hopefully provide the diversity required to adapt to the challenges yet to be posed by phenomena such as global climate change.

Table 31: Importance of the Wet Tropics bioregion to Australia's biodiversity (Source: WTMA 2002).

Taxonomic group	Percentage of Australia's total
Plants	
fern species	65
cycad species	21
conifer species	37
orchid species	30
vascular plant species	26
Animals	
mammal species including:	35
marsupials	30
bats	58
rodents	25
bird species	40
frog species	29
reptile species	20
freshwater fish species	42
butterfly species	58
dung beetle species	42
barkbug species	46
weta species (giant king crickets)	50

Flora

Within the WTWHA alone, there are over 2,800 known species of vascular plants (Table 32), representing at least 1,037 genera and 221 families. Seventy-five genera are endemic to Australia and 43 are restricted to the Wet Tropics bioregion. Over 700 species are restricted to the WTWHA. The Wet Tropics bioregion possesses 26% of Australia's vascular plant diversity and 41% of all Queensland's vascular plant species in slightly over 1% of the State's land area (Table 32). Accordingly, the region is considered to be a biodiversity 'hotspot' of global importance (Davis *et. al.* 1995; see also Myers 2000). Low (1999) labeled the Wet Tropics, 'Australia's biological crown jewels'.

Of the 19 angiosperm families described as the most primitive (Takhtajan 1969), 12 occur in the Wet Tropics bioregion, giving it the highest concentration of primitive plant families on earth (Table 33). Several of these (e.g. *Austrobaileyaceae*, *Eupomatiaceae*, *Idiospermaceae* and *Himantandraceae*) are now small, relict and virtually extinct families. Two of these, the monospecific *Austrobaileyaceae* and *Idiospermaceae*, are restricted Wet Tropics endemic families. The ditypic *Eupomatiaceae* and *Himantandraceae* extend outside of Australia, only to New Guinea and East Malaysia respectively. These relict primitive families represent the last few

remnants of an ancient assemblage that have survived the attrition of rainforest during the extreme climatic fluctuations of the past.

Table 32: Comparative Wet Tropics bioregion vascular plant diversity (Source: WTMA 2002; [1]Hnatiuk, RJ (1990); [2]Leigh, J & Briggs, J (1992); [3]EPA (2002); [4]*Nature Conservation (Wildlife) Regulation 1994*; [5]EPA Wildnet (2001); [6]WTMA GIS, [7]Werren (2001).

Category	Australia	Queensland	Wet Tropics	WHA[6]
Total area ('000 ha)	768,230	173,065	1,976	894
Total area (%)	100.00	22.50	0.26	0.12
a. Native species	15,6381	9,603	ca. 4,0005	ca. 2,845
b. Naturalised species	1,9521	1,2983	5087	ca. 200
c. Extinct species	832	29 4	174	12
Total (a+b+c)	17,673	10,930	4,525	ca. 3,057
Total native species (%)	100	62	26	17

Table 33: Primitive angiosperm families found in the Wet Tropics bioregion (Source: WTMA 2002; [1]Hyland & Whiffen 1993).

	Number present in Wet Tropics		Number present worldwide[1]	
Family	**genera**	**species**	**genera**	**species**
Magnoliales				
Annonaceae	12	30	130	2300
Austrobaileyaceae	1	1	1	1
Eupomatiaceae	1	2	1	2
Himantandraceae	1	1	1	1
Myristicaceae	1	2	15	300
Winteraceae	2	7	9	100
Laurales				
Hernandiaceae (including Gyrocarpaceae)	2	2	4	60
Idiospermaceae	1	1	1	1
Lauraceae	8	83	50	3000
Monimiaceae (including Atherospermataceae)	14	27	30	450

The preceding information on plant diversity generally relates to that part of the Plan area that falls within the Wet Tropics bioregion. While regional flora surveys have been undertaken as part of the recent mapping of the Einasleigh Uplands bioregion (Addicott *in prep.*), the collections from these have not been fully processed and statistical data on the number and identity of species present is not yet available. Nevertheless, as stated above, the Queensland Herbarium believes that, after the Wet Tropics, the Einasleigh Uplands is likely to be the most diverse of the northern bioregions. This is supported to an extent by the *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002), which found that the Einasleigh Uplands supported high species richness and endemicity of *Acacia* and eucalypt (comprising the genera *Angophora*, *Corymbia* and *Eucalyptus*) species.

Fauna

Vertebrates

The Wet Tropics bioregion also has a disproportionate and diverse share of the continent's fauna (Table 34) including more rainforest dependent endemic vertebrates than any other area in Australia. Most of these endemics are confined to the cooler, upland rainforests and are considered to be relicts from formerly widespread temperate environments (Switzer 1991). At least 663 terrestrial vertebrate species have been recorded in the bioregion (DASETT 1987; Williams *et. al.* 1996; S. Williams *pers. comm.*) representing 32% of Australia's terrestrial vertebrate fauna (Table 34). Of this total, 259 are rainforest species (Table 35). The wet sclerophyll forest that forms a narrow band on the western edge of the rainforest is very rich in vertebrate species with at least 227 species in only 72,000 ha. This high diversity (but low regional endemism) is due to this habitat being an overlap zone between rainforest and dry sclerophyll forests and woodlands. There are only five species of vertebrates that are confined to the wet sclerophyll forest in the Wet Tropics and of these only one is a regional endemic.

Table 34: Comparative Wet Tropics bioregion vertebrate diversity (Source: WTMA, based on Williams *et. al.* 1996; DASETT 1987; Pusey & Kennard 1994; EPA 1999; Williams *un pub.*. data 2002; Burrows 2002).

Vertebrate Group	No. of Wet Tropics species	No. of Australian species	No. of Queensland species	% of Australian total	% of Queensland total	No of endemic species	Level of regional endemism
Mammals	110	315	226	35%	49%	13	12%
Birds	314	777	615	40%	51%	13	4%
Reptiles	151	770	442	20%	34%	27	21%
Frogs	58	205	120	28%	48%	24	40%
Freshwater fish	80	190	173	42%	46%	8	10%
Total	741	2,255	1576	33%	47%	85	11%
Terrestrial Total	663	2,065	1403	32%	47%	77	12%

Visitors to the Wet Tropics region are often captivated by the amazing diversity of bird life (see box, 'For the Birds… and their Watchers'). The region is also well known for its mammal, reptile and frog diversity. Less widely known (and reported) is the fact that the Wet Tropics has an extremely high diversity of Australia's freshwater fish with more than 80 species recognised for the region, including approximately 70% of Australia's freshwater fish genera and 42% of the continent's fish species (Table 34; see also Pusey & Kennard 1994, 1996; Burrows 2002). The Russell/Mulgrave and Johnstone river catchments form the core of freshwater fish biodiversity and endemism in the region (B. Pusey 2003 *pers. comm.*).

FOR THE BIRDS…AND THEIR WATCHERS

The Wet Tropics NRM Region has an extraordinary diversity of birds, with at least 350 species expected to occur (by comparison, there are 280 regularly occurring birds in the UK and New Zealand has just 97 native species). Part of the reason for this diversity is the variety of habitat types found within the region. From the beaches and mudflats, beyond the rainforest-clad ranges to the edge of the outback, roughly half of Australia's bird species can be found within two hours drive of Cairns. Not surprisingly, the region is considered a mecca for birdwatchers. The Wet Tropics also has an unusually high number of Australian endemic bird species, with 13 species largely confined to its upland rainforests between Paluma and Big Tableland, only one of which, the blue-faced parrot-finch (*Erythrura tricroa*), also occurs outside Australia. At a broader scale, over 30% of restricted range species are confined to the combined bioregions of northeastern Queensland (Cape York Peninsula, Einasleigh Uplands, Gulf Plains and the Wet Tropics).

(NLWRA 2002)

A breakdown of the bioregion's terrestrial vertebrate fauna by broad habitat preference and regional endemism is presented in Table 35. The apparent higher totals presented in this table compared to Table 34 recognises the fact that some species utilise more than one broad habitat type. Although the dry sclerophyll forests contain the highest overall diversity of vertebrate species, there is low proportional regional endemism (4%). In contrast, the rainforest fauna includes 66 species that are found only in the Wet Tropics bioregion or 25% of the rainforest terrestrial vertebrate species are endemic to the region (Williams *et. al.* 1996).

Table 35: Number of Wet Tropics terrestrial faunal species by broad habitat preference (Source: WTMA 2002, from Williams *et. al.* 1996).

	rain forest	wet sclerophyll	dry sclerophyll	grassland	rocky outcrops	caves	freshwater	mangroves
mammals	51	43	71	13	8	9	3	8
birds	112	107	174	48	3	-	73	63
reptiles	65	61	108	24	27	1	16	14
frogs	31	16	35	20	1	-	30	2
total	259	227	388	105	39	10	124	87
% regional endemism	25%	7%	4%	0%	21%	0%	4%	2%

Only small parts of the Einasleigh Uplands bioregion have been systematically sampled for fauna, although surveys were also undertaken as part of the recent mapping. Morgan (1999) wrote that the bioregion is particularly significant for macropods, and contains more rock wallaby species than anywhere else in Australia. Godman's rock wallaby (*Petrogale godmani*) and the Mareeba rock wallaby (*P. mareeba*) are considered near-endemic to this bioregion (Hilton-Taylor 2000, Strahan 1998), although only the latter species is likely to occur in the NRM Region (K. McDonald QPWS *pers. comm.*). Wetlands of the Herberton-Wairuna bioregional sub-region, 60% of which is contained in the Plan area, are significant at the State scale for waterbird breeding and feeding (ANCA 1996). Springs and spring-fed ecosystems are bioregionally significant refuges for both flora and fauna (Morgan 1999).

Invertebrates

Although the invertebrate fauna of the Wet Tropics bioregion is very poorly known it is undoubtedly the richest of any comparable region in Australia. This is demonstrated by statistics that are available for certain invertebrate groups including:

- 230 species of butterflies (58% of all described Australian species);
- 135 species of dung beetles (42% of all described Australian species);
- 42 species of barkbugs (46% of all described Australian species); and
- 26 species of wetas or giant king crickets (50% of all described Australian species).

The richest overall insect fauna yet studied in Australia lies in the Bellenden Ker Range where an intensive survey yielded 4,029 species of insects including 1,514 species of beetles (Monteith 1994) in addition to more than 300 species of spiders. Land snails form an extraordinarily diverse group with 222 named species of which 185 (85%) are Wet Tropics endemics (Stanisic *et. al.* 1994).

The Wet Tropics also has Australia's highest aquatic invertebrate biodiversity (Pearson *et. al.* 1986) and one of the highest recorded anywhere in the world (R. Pearson *pers. comm.*).

Rare and Threatened Species

Many species in the Wet Tropics, particularly rainforest species, are naturally rare. Relative rarity is influenced by several factors that may influence a species total potential population size such as its geographic range, its local abundance, and its ubiquity of occurrence within its range. It is often the case that species with small geographic ranges also have low local abundance, and are often patchily distributed within their ranges. These characteristics, either independently or in combination, increase the potential for extinction or make such species sensitive to environmental change/disturbance. Because of these attributes, rare species are often a primary focus of conservation planning and monitoring even when no overt or obvious threats to their survival are apparent.

Endangered and vulnerable species on the other hand are a specific sub-set of rarity. These species are presently considered to have endured substantial population declines and to be at immediate risk of disappearing from the wild as a result of threatening processes.

Of particular note is the difference between State listings and the Commonwealth listings. This difference arises out of the different methodologies, where the Commonwealth used expert-validated modeled distributions rather than actual point location records (NLWRA 2002). In the tables that follow, the legal status of plants and animals are based on the lists contained within Queensland's wildlife legislation (*Nature Conservation (Wildlife) Regulation 1994*).

Flora

The Wet Tropics bioregion has a total of 351 officially listed rare or threatened plant species (Tables 36, 37; for complete list see Goosem *et. al.*, Chapter 7 in Sattler & Williams 1999). Of the 29 recognised recent plant extinctions in Queensland, 17 were formally endemic to the Wet Tropics. The presumed extinct species, in general, have not been recorded for over 50 years. The high proportion of the State's presumed extinct, endangered and vulnerable plants coming from the Wet Tropics highlights the vulnerability, small population size and restricted distribution of many of the bioregion's plants and the pattern and extent of past habitat clearing.

Table 36: Rare and threatened Wet Tropics plants in comparison to Queensland as a whole (Source: WTMA 2002; [1]*Nature Conservation (Wildlife) Regulation 1994* (includes all amendments up to SL No. 354 of 2000).

Status	Class	Queensland (No. of species)	Wet Tropics (No. of species)	Wet Tropics as a percentage of the Qld Total
Presumed Extinct (X)	fork ferns	1	1	100
	tassel ferns	2	2	100
	true ferns	8	5	63
	cycads	0	0	0
	conifers	0	0	0
	monocots	6	3	50
	dicots	12	6	50
	subtotal	**29**	**17**	**59**
Endangered (E)	fork ferns	0	0	0
	tassel ferns	4	4	100
	true ferns	7	3	43
	cycads	8	0	0
	conifers	0	0	0
	monocots	32	16	50

Status	Class	Queensland (No. of species)	Wet Tropics (No. of species)	Wet Tropics as a percentage of the Qld Total
Endangered (E)	dicots	98	19	19
	subtotal	**149**	**42**	**28**
Vulnerable (V)	green algae	1	0	0
	fork ferns	0	0	0
	tassel ferns	4	4	100
	true ferns	10	8	80
	cycads	12	1	8
	conifers	0	0	0
	monocots	53	12	23
	dicots	199	29	15
	subtotal	**279**	**54**	**19**
Rare (R)	fork ferns	0	0	0
	tassel ferns	3	1	33
	true ferns	37	27	73
	cycads	5	0	0
	conifers	4	3	75
	monocots	133	37	28
	dicots	519	170	33
	subtotal	**701**	**238**	**34**
TOTAL		**1,158**	**351**	**30**

Table 37: Percentage of total known Wet Tropics flora considered rare or threatened (Source: WTMA 2002).

Class	Threatened (X+E+V)	Rare or threatened (X+E+V+R)
Fork ferns	25.0	25.0
Tassel ferns	83.3	91.7
True ferns	6.4	17.1
Cycads	12.5	12.5
Conifers	0.0	20.0
Monocots	5.7	12.6
Dicots	2.7	11.1
Total	4.0	12.3

The following are considered the most critically threatened plants in the Wet Tropics biogeographic region (Regional Environment Strategy Steering Committee 1997):

- *Sankowskya stipularis;*
- *Toechima pterocarpum;*
- *Carronia pedicellata;*
- *Vrydagzynea paludosa;*
- *Malaxis lawleri;*
- *Lycopodium dalhousianum;*

- *Phalaenopsis amabilis;*
- *Firmiana papuana;*
- *Lepiderema* sp.; and
- *Actephila foetida*

Morgan (1999) lists 62 rare and threatened species of plants in the Einasleigh Uplands bioregion and they and a comparison with the statistics for Queensland are presented in Table 38.

Table 38: Summary of rare and threatened flora species in the Einasleigh Uplands bioregion[1] and a comparison with the Queensland[2] totals (Source: WTMA 2002; [1]Morgan 1999; [2]Nature Conservation (Wildlife) Regulation 1994 (including amendments to SL No. 215 of 2001).

Presumed extinct	Endangered	Vulnerable	Rare	Total
0 (28)	2 (149)	15 (279)	45 (724)	62 (1180)

An analysis of the currently available data provides the data in Table 39 in respect to rare and threatened species in the areas of the Einasleigh Uplands bioregion included in the Wet Tropics NRM Region. The total is likely to be higher after the processing of current collections.

Table 39: Summary of rare and threatened plant species collected[1] from the sub-regions represented in the Wet Tropics NRM Region in the Einasleigh Uplands bioregion (Source: WTMA 2002; [1]data from HERBRECS 2002).

subregion	conservation status			total number
	rare	vulnerable	endangered	
Herberton-Wairuna	3	6	2	11
Hodgkinson Basin	6	1	0	7
Undara-Toomba	1	0	0	1
Kidston	3	0	0	3

The names and conservation status of the 24 species of rare and threatened plants collected from the Wet Tropics NRM Region in the Einasleigh Uplands and included in the Queensland Herbarium collection are presented in Table 40. The data have been extracted from the Queensland Herbarium HERBRECS database and are current to January 2002.

Table 40: Names[1] and conservation status[2] of rare and threatened plants collected from the Einasleigh Uplands part of the NRM Region[3] (Source: WTMA 2002; [1]names from Henderson 2002; [2]*Nature Conservation (Wildlife) Regulation 1994* (including amendments to SL No. 215 of 2001); [3]species listed in **bold** type not found within the Wet Tropics part of the NRM Region (after Goosem *et. al.* 1999).

Species	Conservation status
Acacia purpureopetala	Vulnerable
Brasenia schreberi	Rare
Corymbia rhodops	Vulnerable
Cycas platyphylla	Vulnerable
Dansiea elliptica	Rare
Diuris oporina	Rare
Eucalyptus howittiana	Rare
E. lockyeri	Rare
E. lockyeri subsp. *lockyeri*	Rare

E. lockyeri subsp. *exuta*	Rare
E. pachycalyx subsp. *pachycalyx*	Rare
Goodenia stirlingii	Rare
Grevillea glossadenia	Vulnerable
Homoranthus porteri	Vulnerable
Lastreopsis grayi	Rare
Lysiana filifolia	Rare
Peripleura scabra	Rare
Phaius tancarvilleae	Endangered
Plectranthus amoenus	Vulnerable
Prostanthera clotteniana	Endangered
Rhamphicarpa australiensis	Rare
Solanum multiglochidiatum	Rare
Torrenticola queenslandica	Rare
Triplarina nitchaga	Vulnerable

A complete list of rare and threatened plant species known or expected to occur within the constituent catchments of the NRM Plan Region is shown at Appendix A. This list, created by Andrew Ford (CSIRO) and based on actual records and expert opinion, contains 395 species (for methodology, see Appendix A). Of these species, 17 are presumed extinct, 43 endangered, 59 vulnerable and 276 rare (based on their NCA status). The number of rare and threatened species by catchment is given in Table 41.

Table 41: Rare and threatened plants of Wet Tropics catchments (Source: A. Ford, CSIRO).

Catchment	Records	Expected to occur	Total
Barron	92	8	100
Daintree-Mossman	190	30	220
Herbert	78	22	100
Johnstone	92	5	97
Russell-Mulgrave	152	9	161
Tully-Murray	60	6	66
Trinity Inlet	7	22	29

Fauna

The Wet Tropics bioregion has a total of 98 animal species officially listed as either rare or threatened. 'Endangered' fauna include four mammal species, three birds, two marine reptiles and seven frogs (Tables 42, 43; for complete list see Goosem *et. al.*, Chapter 7 in Sattler & Williams 1999). A further 21 vertebrate species are classified as 'vulnerable' and 57 as 'rare'.

Table 42: Rare and threatened Wet Tropics bioregion animals in comparison to Queensland as a whole[1] (Source: WTMA 2002; [1]*Nature Conservation (Wildlife) Regulation 1994* (including all amendments up to SL No. 354 of 2000), EPA Wildnet 2001).

Status		Mammals	Birds	Reptiles	Frogs	Fish	Total
Presumed Extinct	State	5	1	0	0	0	6
	Wet Tropics	0	0	0	0	0	0
	WHA	0	0	0	0	0	0

Status		Mammals	Birds	Reptiles	Frogs	Fish	Total
Endangered	State	12	11	4	14	3	44
	Wet Tropics	4	3	2 (marine)	7	0	16
	WHA	3	1	0	7	0	11
Vulnerable	State	20	22	15	6	2	65
	Wet Tropics	7 (1 marine)	5	6 (3 marine)	3	0	21
	WHA	6	7	3	0	0	16
Rare	State	31	31	64	25	0	151
	Wet Tropics	16	13	18	10	0	57
	WHA	16	9	15	10	0	50
Total	State	68 (100%)	65 (100%)	83 (100%)	45 (100%)	5 (100%)	266 (100%)
	Wet Tropics	26 (38%)	21 (32%)	26 (31%)	20 (44%)	0 (0%)	98 (35%)
	WHA	25 (37%)	17 (26%)	18 (22%)	17 (40%)	0 (0%)	82 (30%)

Table 43: Percentage of total known Wet Tropics vertebrate fauna considered rare or threatened (Source: WTMA 2002. Code: X (Presumed extinct), E (Endangered), V (Vulnerable)).

Class	Threatened (X+E+V)	Rare or threatened (X+E+V+R)
Mammals	8.2	22.7
Birds	2.5	5.4
Reptiles	2.0	11.9
Frogs	12.1	29.3
Fish	0.0	0.0
Total	3.8	10.8

There are at least 38 rare and threatened species of animals in the Einasleigh Uplands (for complete list see Morgan, Chapter 9 *in* Sattler & Williams 1999). At least 29 are likely to occur in the Plan area (Table 44).

It is noted that nine of the 29 officially listed rare and threatened vertebrate species that occur in the Einasleigh Uplands part of the NRM Region would probably not occur in the Wet Tropics part (after Goosem *et. al.* 1999). One of these, the endangered Gouldian finch, has been reintroduced into the Mareeba Wetlands. The first release of birds was unsuccessful and efforts are ongoing (Koetz 2002; *Jabiru*, Newsletter of the Mareeba Wetland Foundation – Issue 24; see also *Gouldian Finch Recovery Plan*). Another species, the rare Freckled duck, was recently recorded at the Wetlands. Their presence was probably associated with the unusually dry conditions across the normal part of their range. The birds utilised the Reserve for 4 ½ months during the 2002/03 wet season and the highest abundance recorded during this period was 17 birds (*Jabiru* 24:2).

It is further noted that three vertebrate species that are prescribed as common but culturally significant wildlife under the *Nature Conservation Act* - the echidna, koala and platypus - all occur within the NRM Region. The echidna, *Tachyglossus aculeatus*, is found in all habitats across the area; the koala, *Phascolarctos cinereus* subsp. *adustus*, is sparsely distributed in eucalypt forests in the Einasleigh Uplands part of the NRM Region; and the platypus, *Ornithorynchus anatinus*, is common in freshwater streams and impoundments on the Atherton Tablelands.

THE SOUTHERN CASSOWARY – A KEYSTONE SPECIES.

The southern cassowary (*Casuarius casuarius johnsonii*) is an important public symbol of the health and status of the region's landscape. A major disperser of seeds from over 100 species of rainforest trees and vines, the cassowary plays an intrinsic part in the ecology of the forests throughout its range in the Wet Tropics. It is possibly the only long-distance disperser of some tree species with large fleshy fruits.

Cassowaries are also culturally very significant for Rainforest Aboriginal people who have customs, stories, songs and dances about cassowary. They are prized food, and their feathers, claws and bones are used for ornaments and hunting (WTMA 2003).

Conservation of the cassowary is important for maintaining forest dynamics and the persistence of entire species that provide habitat for a great range of organisms. On this basis, the bird can be considered a 'keystone' species. Keystone species are those that play critical ecological roles and whose loss from a particular system could result in the disappearance of other species. While it is not yet feasible to monitor all species in all ecosystems, the monitoring of keystone and other selected indicator species is crucial for assessing the state of ecosystem health and biodiversity in the Wet Tropics.

The cassowary is one of the most threatened vertebrate species in the country. It is currently restricted to closed forest habitats in two isolated populations on Cape York and in the Wet Tropics. The Wet Tropics population is thought to number about 1,500 individuals (Garnett & Crowley 2000) and the birds are now extinct in several areas where they formerly occurred (e.g. Lake Barrine and Mt Whitfield, near Cairns). The species is listed as 'endangered' under both state and federal wildlife legislation.

Loss of cassowary habitat is a major problem in lowland areas where cassowary densities are often highest and the clearance of natural vegetation is greatest (e.g. in the Mission Beach area and north of the Daintree River). Land clearing disrupts individual cassowaries' movement paths, can segregate feeding and breeding sections of an individual's range and predisposes the species to genetic isolation and local extinctions. It also increases the bird's vulnerability to other random events and threatening processes such as disturbance, dog predation and roadkill.

The fact that cassowaries are now endangered is also a grave concern for Rainforest Aboriginal people, and threats to cassowaries also threaten the customs and traditions associated with cassowary (WTMA 2003).

A large proportion of the cassowary's range is included, and thus protected, within the WTWHA. It is a critical component of the new Wet Tropics Conservation Strategy (*in prep.*). Other ongoing processes (e.g. Daintree River Rescue Package, Daintree Buyback, Sugar Coast Environmental Rescue Package, local government planning schemes) could contribute to habitat protection for the species. The Queensland Main Roads Department has also been actively involved in reducing cassowary-vehicle interactions.

The support for cassowary conservation is considerable: active community groups at Mission Beach, Kuranda and the Daintree are achieving significant conservation gains in their local area. Other community groups, such as TREAT, contribute to cassowary habitat restoration on the Atherton Tablelands. Seven targeted NHT projects were carried out in the region between 1997 and 2001 (Harrison *et. al.* 2002).

A cassowary recovery program, coordinated and funded by WTMA and QPWS, also relies on a strong foundation of community involvement and support. A Cassowary Advisory Group made up of local community representatives, scientists, local government delegates and conservation agencies runs the program. This group played an important role in the preparation of the *Recovery plan for the southern cassowary*, released by QPWS in 2002, as well as setting up a research and recovery facility at Mission Beach.

(Based on EPA 1999a)

Southern cassowary and chicks photographed with an infrared-triggered camera on a farm near Millaa Millaa. These birds benefited from the actions of the landholder, who cleared large tracts of lantana thus providing the birds with access to fruiting rainforest trees, in this case lemon aspen (Photo: Doug Clague).

Table 44: Names and conservation status[1] of rare and threatened animals likely to occur in the Einasleigh Uplands part of the NRM Region[2] (based on Morgan 1999).

Scientific name	Common name	Conservation status
Acanthophis antarcticus	Common death adder	Rare
Accipiter novaehollandiae	Grey goshawk	Rare
Aerodramus spodiopygia	White-rumped swiftlet	Rare
Egernia rugosa	Yakka skink	Vulnerable
Ephippiorynchus asiaticus	Black-necked stork	Rare
Erythrotriorchis radiatus	Red goshawk	Endangered
Erythrura gouldiae	Gouldian finch	Endangered
Falco hypoleucos	Grey falcon	Vulnerable
Furina barnardi	Yellow-naped snake	Rare
Hipposideros diadema	Diadem horseshoe-bat	Rare
Lerista ameles	skink	Rare
Lerista storri	skink	Rare
Lophoictinia isura	Square-tailed kite	Rare
Lygisaurus rococo	skink	Rare
Macroderma gigas	Ghost bat	Vulnerable
Melithreptus gularis	Black-chinned honeyeater	Rare
Neochmia phaeton	Crimson finch	Vulnerable
Neochmia ruficauda	Star finch	Endangered
Nettapus coromandelianus	Cotton pygmy-goose	Rare
Petrogale mareeba	Mareeba rock-wallaby	Rare
Podiceps cristatus	Great crested grebe	Rare
Pseudophryne covacevichae	Magnificent broodfrog[3]	Vulnerable
Ramphotyphlops broomi	blind snake	Rare
Rhinolophus philippinensis	Greater large-eared horseshoe bat	Rare[3,4]
Rostratula benghalensis	Painted snipe	Rare
Simoselaps warro	snake	Rare
Stictonetta naevosa	Freckled duck	Rare
Tadorna radjah	Radjah shelduck	Rare
Turnix olivei	Buff-breasted button-quail	Vulnerable

[1]*Nature Conservation (Wildlife) Regulation 1994* (including all amendments up to SL No. 354 of 2000). [2]Species listed in **bold** type not found within the Wet Tropics bioregion (after Goosem *et. al.* 1999). Note: The ground cuckoo-shrike, *Coracina maxima*, although included as a 'rare' species in Morgan's (1999) list, is actually prescribed as 'common' wildlife under the NCA. [3]Not included in Morgan's (1999) list. [4]Listed as 'endangered' under the EPBC Act.

A complete list of rare and threatened plant species known or expected to occur within the constituent catchments of the NRM Plan Region is shown at Appendix B. This list, based on actual records and expert opinion, contains 101 species[8,9]. Of these species,

[8] Not counting the three restricted rare and threatened species found in the Wet Tropics bioregion but outside of the plan area, i.e. the frog, *Cophixalus saxatilis*, gecko, *Nactus galgajuga*, and skink, *Carlia scirtetis*, endemic to the boulder fields of the Black Trevethan Range.
[9] Includes coastal and marine animals, seven of which – five marine turtles, the estuarine crocodile and little tern - are included in Goosem *et. al.* (1999) (list of rare and threatened species of the Wet Tropics bioregion).

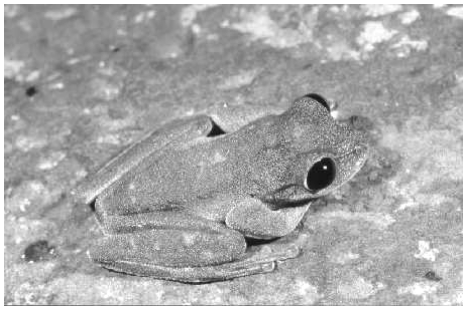
17 are listed as endangered, 58 vulnerable and 26 rare (based on their NCA status).[10] Appendix B further shows that 14 species are endemic to the Wet Tropics NRM Region (i.e. they are found nowhere else). The number of rare and threatened species by catchment is given in Table 45.

Table 45: Rare and threatened animals of Wet Tropics catchments (Source: A. Ford, CSIRO).

Catchment	Records	Expected to occur	Total
Barron	60	3	63
Daintree-Mossman	58	5	63
Herbert	60	5	65
Johnstone	49	2	51
Russell-Mulgrave	49	3	52
Tully-Murray	49	3	52
Trinity Inlet	33	3	36

The faunal group of most concern is arguably the frogs – the *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002) reported that threatened amphibians are declining rapidly in the Wet Tropics bioregion (see also Table 43). Eight locally endemic species are officially listed as rare or threatened (seven endangered, one vulnerable). Populations of three of these species, the sharp-snouted day frog, *Taudactylus acutirostris*, armoured mistfrog, *Litoria lorica*, and mountain mistfrog, *L. nyakalensis*, can no longer be located and another, the northern tinker frog, *T. rheophilus*, is only known from two small streams (Northern Queensland Threatened Frogs Recovery Team 2001). This situation is particularly worrying because frogs are important indicator species as they react swiftly to environmental changes (EPA 1999a). Consequently, declines in their numbers may indicate widespread changes or disturbances in the environment of which we are currently unaware.

Little information has been recorded for other groups such as invertebrates. This reflects not only a paucity of information but the limited protection afforded in legislation. For example, the decline in land snails in tropical savannas has not yet been reflected in listings of threatened species (NLWRA 2002).



Australian lacelid, *Nyctimystes dayi*, one of the declining frog species of the Wet Tropics (Photo: EPA)

Appendix C provides information on those species listed in Australian action plans that are likely to occur in the NRM Region (both land and sea country). This list includes rare and threatened species as well as some common species with no official designation. Further, some rare or threatened species are not included in Australian action plans. Many additional animals that occur in the NRM Plan area do, however, have special status as migratory or marine protected species under the EPBC Act (see Section 2).

3.2.5. REGIONAL GENETIC DIVERSITY

As reported by the EPA (1999a), genetic diversity is the variety of genetic information contained in all individual organisms. The amount of genetic variation determines the capacity of a species to respond to environmental changes. Genetic diversity is of crucial concern in the maintenance of biodiversity: it ensures the short-term viability of individuals and populations, maintains the evolutionary potential of populations and species, and has values as a potential source of genetic resources for humans (Brown *et. al.* 1997 in EPA 1999a). Genetic diversity, unlike species or ecosystem diversity, is often cryptic (i.e. species that look the same may be a complex of hidden species

[10] The spectacled flying-fox (*Pteropus conspicillatus*), although listed as 'vulnerable' under the EPBC Act, is not listed as rare or threatened under the NCA.

distinguishable only by behavioural differences (see Westcott 2002, Westcott & Kroon 2002) or genetic analysis).

Genetic studies have provided an insight into amounts and distribution of genetic diversity for some vertebrate species known from the NRM Region (e.g. bandicoots - Pope *et. al.* 2001; bats – Worthington-Wilmer *et. al.* 1999; ringtail possums – Murray *et. al.* 1989; Moritz 1993; rock-wallabies – Campeau-Peloquin 2001; rainforest birds - Joseph & Moritz 1994; endemic reptiles and amphibians – Schneider *et. al.* 1998; marine turtles – Moritz *et. al.* 1998; skinks - Stuart-Fox *et. al.* 2002; frogs – James & Moritz 2000; freshwater fish – Hurwood & Hughes 1998). Some work into the distribution of genetic diversity for some plant species is currently in progress (e.g. bunya pines - M. Pye; montane flora – J. Playford). However, there are still insufficient data to assess genetic diversity in the Wet Tropics and no coordinated monitoring of genetic diversity occurs.

According to the ANZECC State of the Environment Reporting Task Force (2000), estimated 'populations of selected species', including declining species, are an important measure for assessing the conservation status of species. They are also potential surrogates for assessing changes in genetic diversity. Therefore, population changes are the best indirect measure currently available for assessing conservation actions and identifying potential trends in genetic diversity. However, the monitoring status of this indicator cannot be properly assessed until target species are selected. These species should be indicative of general trends.

The region has benefited from an impressive range of world-class studies on the genetic diversity of its plants and animals and as a result we have a good general understanding of the genetic relationships of populations of many vertebrate species throughout the region. This information has been helpful in identifying current geographical barriers for some species.

3.3. PRESSURE

As reported in Chapter 2, pressures on biodiversity in the Wet Tropics can be separated into underlying pressures, or drivers of change, and those classified as direct pressures. Some examples of these two basic categories acting on terrestrial biodiversity are illustrated in Table 46**.** It should be noted that these pressures also affect the associated cultural values of the area for Indigenous people in the Wet Tropics NRM Region.

Table 46: Examples of underlying drivers and resultant direct pressures (after WTMA 2002).

Underlying drivers	Direct pressures
regional population growth	clearing of native habitat
changes in regional landuse	habitat fragmentation
land tenure patterns	altered drainage patterns and flow regimes
demand for community infrastructure	introduced pest species
- water supplies	alteration/degradation of habitat:
- electricity	- grazing
- roads	- altered fire regimes
- telecommunications	- diseases
tourism & recreation	- pollution
economic development, world trade & technological advances	introduced pest species
weather and climate change	- environmental weeds
	- exotic fauna

How people use the land is a basic factor in understanding the ecological condition of any region. Land use is complicated by divergent values. Some people value land as a commodity, something with economic value that can be used productively, bought and sold. Others value land as part of a life-sustaining ecosystem. The dynamics of public opinion and economics influence the distribution of land among competing uses (US EPA Website).

Land in the Wet Tropics region is used for a variety of purposes such as conservation, livestock grazing, forestry, dryland and irrigated agriculture, human settlements, water supply and storage. However, not all ecosystems have equal capability to satisfy a particular human value, and some are better suited for some uses than others. Although multiple uses are often possible, some difficult choices still have to be made. Decisions about land allocation are critical for both the environment and human society. Some of these issues are discussed in the Background report (Volume 1 of this series). The following discussion focuses on the direct pressures threatening biodiversity conservation in the Wet Tropics NRM Region.

3.3.1. DIRECT PRESSURES

The Australian Terrestrial Biodiversity Assessment (NLWRA 2002) identified the processes that threaten biodiversity and their relative frequency in each of Australia's bioregions (see box 'biodiversity at risk'). In summary, it found that vegetation clearing is the most significant threat to species and ecosystems in eastern Australia and that overgrazing, exotic weeds, feral animals and changed fire regimes are additional key threats to wetlands, riparian zones, threatenend species and ecosystems across much of Australia. More information on each of these threats, which place direct pressure on Wet Tropics biodiversity, is provided below. To this we add climate change as perhaps the most extensive and insidious threat (see Section 2; see also Williams *et. al.* 2003; Thomas *et. al.* 2004).

BIODIVERSITY AT RISK

Wet Tropics

The most common threatened vegetation types are tropical and sub-tropical rainforest and dry rainforest (43% of the threatened ecosystems) followed by eucalyptus forests with a dense broad-leaved understorey (wet sclerophyll; 16% of the threatened ecosystems). Ecosystems under threat include communities on alluvium and lowland vine forests on basalt. Many of the threatened ecosystems are naturally restricted. The main threatening processes are broad scale tree clearing, followed by fragmentation of remnants, changed fire regimes, and exotic weeds.

Einasleigh Uplands

Ecosystems under threat tend to occur on alluvial plains and associated drainage lines. The most common threatened vegetation types are eucalypt woodlands with grassy and shrubby understoreys. The major threatening process for all threatened ecosystems is grazing pressure, followed closely by exotic weeds. Changed hydrology resulting in salinity and broad scale tree clearing in the Herberton-Wairuna subregion are identified as major threatening processes but this is questionable. A number of regional ecosystems are naturally restricted. The condition of the threatened regional ecosystems is declining.

(Source: Australian Natural Resources Atlas V2.0)

Clearing Native Habitat

Land clearance destroys biodiversity. The clearance of native forests results in the loss and depletion of plant species and destroys the habitat for thousands of other species. According to the *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002), vegetation clearing is the most significant threat to species and ecosystems in eastern Australia.

Broad-scale land clearance can fundamentally change the functioning of ecosystems, including regional climate, and sever connectivity of wildlife habitats across the landscape. Patch clearing and habitat destruction and modification by other means can lead to a loss of biodiversity at the local scale. The Regional Environment Strategy Steering Committee (1997) reported that habitat loss in the FNQ region had been most severe in the coastal lowlands, along major river valleys and on the basalt soils of the Atherton-Evelyn Tablelands. In a region like this, where species are patchily distributed and many have specialised needs, this 'death by a thousand cuts' can have the same effect as broad-scale land clearance in the long term.

Current Clearing

The Statewide Landcover and Trees Study (SLATS) (see <http://www.nrm.qld.gov.au/slats>) is a major vegetation monitoring initiative of the Queensland Department of Natural Resources and Mines (NR&M). SLATS has used satellite imagery to compare the vegetation cover of the State between 1988, 1991, 1995, 1997 and 1999. The resolution of the analysis enables most areas of vegetation change of one hectare or greater to be detected (DNR 2000).

For the period 1991 to 1995 the clearing rate for the entire Wet Topics bioregion was 3,583 ha per year (Table 47), which accounted for 1.2% of Queensland's total clearing over this period. Although the Wet Tropics is the third smallest of Queensland's thirteen bioregions it contributed the sixth highest rate of clearing. This contribution to the State's total clearing reduced very substantially for the period 1997 to 1999 (Table 47) where the average clearing rate was almost a third of the 1991-95 rate, and the bioregion's rank contribution has been lowered from sixth to eleventh.

Table 47: Average annual rates of clearing in Wet Tropics bioregion for periods 1991-95 and 1997-99 (Source: WTMA 2002, from DNR 2000; EPA 1999).

1991 - 1995		1997 - 1999	
Clearing rate (ha/yr)	% bioregion area/year	Clearing rate (ha/yr)	% bioregion area/year
3,583	0.2	1,275	<0.1

For the period 1999-2001, the clearing rate for the entire Wet Topics bioregion was reduced again to 1,007 ha per year, which accounted for 0.2% of Queensland's total clearing over this period (Table 48). By comparison, the clearing rate for the Einasleigh Uplands was 5,195 ha or 0.9% of total clearing in Queensland over this period.

Table 48: Summary of bioregional forest conversion for the 1999-2001 period ('000 ha per year) (Source: NR&M 2003).

Bioregion	Pasture	Crops	Forest	Mining	Infrastructure	Settlement	Total cleared
Wet Tropics	0.733	0.067	0.069	0.000	0.108	0.030	1.007
Einasleigh Uplands	3.482	0.336	0.008	0.010	1.351	0.009	5.195

Table 49 shows the SLATS data broken down by the catchments occurring within the NRM Region. It reveals that 1,837 ha were cleared over the period 1999-2001. Most clearing (905 ha or 49%) took place in the Herbert catchment, mainly for pasture (grazing). Next highest was the Barron catchment (626 ha or 34%), followed by the Murray (104 ha or 6%). The region accounted for 0.3% of Queensland's total clearing over this period. Interestingly, this figure is higher than that recorded for the Wet Tropics biogeographic region (0.2%). This result demonstrates the danger of using bioregions as surrogates for NRM regions.

Wilson *et. al.* (2002), meanwhile, provided an overview of the types of vegetation being most impacted by clearing across Queensland. In order to do this, and provide a comparison with other states, they amalgamated 1160 REs across the state into 18 Broad Vegetation Groups (BVGs). As reported earlier in this document, 11 BVGs are found in the Wet Tropics NRM Region. According to Wilson *et. al.* (2002), the BVGs most impacted by clearing are:

- Eucalypt woodlands on lowlands;
- Dry rainforests (vine thickets); and
- Wetlands.

Table 49: Summary of Wet Tropics catchment forest conversion for the 1999-2001 period ('000 hectare per year) (Source: NR&M 2003).

Catchment		Rate of woody vegetation change (,000 ha per year)								% Wooded veg cover 1999	% Total clearing in QLD
Name	Area	New woody regrowth	Clearing								
			Pasture	Crops	Forest	Mining	Infra-structure	Settle-ment	Total Cleared		
Barron	219	0.005	0.434	0.144	0.034	0.000	0.006	0.008	0.626	75.28	0.108
Daintree	211	0.003	0.021	0.001	0.004	0.000	0.000	0.000	0.026	95.76	0.0045
Herbert	984	0.026	0.628	0.000	0.013	0.000	0.264	0.000	0.905	86.87	0.1570
Hinchinbrook Island	40	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	96.80	0.0000
Mossman	47	0.001	0.019	0.000	0.001	0.000	0.000	0.007	0.028	84.19	0.0049
Mulgrave	132	0.001	0.021	0.001	0.008	0.000	0.000	0.001	0.030	76.98	0.0053
Murray	111	0.000	0.097	0.000	0.007	0.000	0.000	0.000	0.104	74.02	0.0181
North Johnstone	103	0.000	0.026	0.002	0.000	0.000	0.000	0.000	0.028	55.96	0.0049
Russell	67	0.004	0.039	0.000	0.000	0.000	0.000	0.000	0.039	72.40	0.0068
South Johnstone	129	0.000	0.015	0.012	0.000	0.000	0.002	0.000	0.029	63.34	0.0049
Tully	168	0.000	0.021	0.000	0.000	0.000	0.000	0.000	0.022	74.46	0.0038
Total	2211	0.04	1.321	0.16	0.067	0.000	0.266	0.016	1.837	N/A	0.3187

As indicated by the figures cited in Table 49, tree clearing for grazing in the upper Herbert accounts for most of the clearing in the Plan area. According to the Australian Natural Resources Atlas, broadscale clearing is a threatening process in the Herberton Wairuna sub-region although it must be stated that a total of 95.33% of the original wooded vegetation cover in this sub-region remained in 1999 (SLATS data).

Elsewhere, clearing occurs in the form of patch clearing (mainly for agriculture and urban development), clearing for linear service-corridors and habitat drowning caused by artificial impoundments. At the time of its inscription (1989), clearings within the WTWHA totaled 7,538 ha, most of which were associated with the provision of community infrastructure (Table 52). Linear service-corridor clearings accounted for 4,475 ha of which 2,406 ha are still maintained clearings providing community and management access and electricity distribution. Patch clearings accounted for a further 2,733 ha, the largest contributor to this total (2,129 ha) was the result of habitat drowning caused by three artificial dams and impoundments that were present prior to listing - Koombooloomba and Copperlode Falls Dams as well as Paluma Dam, which is located south of the Plan area.

Controversy surrounds the issue of the uptake of land containing remnant vegetation for urban development consistent with land use zonings and development approvals. Recent well-publicised examples included the removal of 0.5ha of native vegetation at Clifton Beach in August 2001 and clearing to make way for the marina, resort and residential development at Oyster Point, just south of Cardwell. There is also concern about land clearing and rural residential development in drier parts of the plan area (e.g. Ravenshoe-Wondecla).

The *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002) identified vegetation clearing as a threatening process in all bioregional sub-regions represented in the Plan area.

Table 50: Extent of habitat loss within the WTWHA at the time of listing (Source: WTMA 2002).

Clearing Type	Extent of clearings by subregion[1] (ha)									Total area (ha)
	1	2	3	4	5	6	7	8	9	
Linear service corridor clearings										
powerlines	11	63	37	71	12	204	100	119	155	772
roads (maintained)	11	117	119	177	159	218	226	205	378	1610
roads (unmaintained)	9	57	132	230	285	436	408	186	326	2069
railways	0	9	2	0	0	0	0	11	0	22
cableways	0	0	0	0	0	2	0	0	0	2
total linear clearings	*31*	*246*	*290*	*478*	*456*	*860*	*734*	*521*	*859*	*4,475*
Patch clearings										
quarries	0	4	0	4	0	0	4	0	31	43
inundation (dams)	0	0	0	139	220	1471	50	248	1	2129
recreation areas	0	0	0	0	0	0	41	4	0	45
settlements	0	0	1	0	0	7	9	85	18	120
communication facilities	0	0	0	0	0	0	1	0	2	3
fire degraded hillslopes	0	0	0	0	0	0	0	105	0	105
other: maintained	0	44	44	0	0	0	2	0	0	90
other: unmaintained	0	0	90	0	0	0	20	59	29	198
total patch clearings	*0*	*48*	*135*	*143*	*220*	*1478*	*127*	*501*	*81*	*2733*
Boundary anomalies										
paddocks	0	39	10	26	0	0	5	10	107	197
sugarcane	32	0	29	0	0	0	2	2	0	65
pine plantations	0	29	0	0	0	0	0	7	0	36
orchards and plantations	0	19	0	0	0	0	5	1	7	32
total boundary anomalies	*32*	*87*	*39*	*26*	*0*	*0*	*12*	*20*	*114*	*330*
Total	63	381	464	647	676	2338	873	1042	1054	7538

[1]Subregion names: 1. Herbert, 2. Tully, 3. Innisfail, 4. Atherton, 5. Paluma/Seaview, 6. Kirrama/Hinchinbrook, 7. Bellenden Ker/Lamb, 8. Macalister, 9. Daintree/Bloomfield. Refer to Figure 1 for locational detail.

Habitat Fragmentation

The destruction and modification of native vegetation has left a legacy of patches of native vegetation of various sizes, shapes, connectivity and condition. Fragmentation of native forest creates new edges between the remaining forest and the cleared or disturbed land which leads to a range of 'edge' effects. These include physical changes to the forest in the border region such as different levels of exposure to the sun and wind and changes in water cycles and the local air temperature. Biotic changes include invasion by opportunistic species with good dispersal or colonising abilities such as weeds and feral animals.

Fragmentation also isolates and creates barriers between patches of forest. Roads, powerlines and land cleared for agriculture can create artificial barriers preventing or

restricting the movement of species between habitat fragments. An artificial barrier suddenly alters historic natural patterns of gene flow among populations that may have serious consequences for the long-term preservation of evolutionary diversity. Non-flying terrestrial and arboreal rainforest fauna appear to be among the most seriously affected (Goosem 2000; Wilson 2000).

Roads in the Wet Tropics can interfere with wildlife activities and behaviour (Photo: Geoff McDonald).

Several components of a road can act as a barrier to wildlife movement including the exposed bare road surface and the altered verge habitat. The habitat fragmentation impacts of road infrastructure can be amplified by road use (e.g. vehicles) resulting in noise, vibration, movement, dust, emissions, and lights that can interfere with wildlife activities and behaviour. Road use can also be a significant source of mortality for wildlife. For some species, particularly those that are rare, road carnage can have a significant effect on their conservation status (e.g. the cassowary).

Alongside clearing, increased fragmentation of remnants is considered to be one of the principal factors threatening ecosystems in eastern Australia (NLWRA 2002). The *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002) identified it as a threatening process in all bioregional sub-regions represented in the Plan area.

Altered Drainage Patterns and Flow Regimes

Environmental flow regimes are the amount of water combined with the natural patterns and pulsing of that water that is needed in streams to meet the requirements of aquatic flora and fauna. Insufficient water, or water at the wrong time, can result in a loss of habitat, breeding failure and even death for some species.

Dams, weirs and culverts are major landscape modifiers resulting in the direct loss of both terrestrial and aquatic habitats through drowning, in the introduction of water barriers to terrestrial fauna movement and acting as barriers to the upstream or downstream movement of fishes and aquatic invertebrates. Such barriers may also interfere with successful reproduction or recruitment of juveniles into adult habitats. Streams below impoundments can also become choked with sediments due to altered flow dynamics. Conversely, a major effect of impoundments is to trap sediments, leading to downstream scouring of stream beds in the long term, loss of deltaic deposits, and coastal erosion (e.g. Barron Delta study found that trapping of sand behind weir above the falls was the cause of erosion of the northern beaches).

Removal of water for agricultural use or for power generation has reduced environmental flows in some key rivers. Also, the release of water at certain times of the day for the whitewater rafting industry have as yet unknown impacts on river biodiversity.

Water Supply and Storage

Rainfall over the region, although the highest in Australia, is highly seasonal, with more than 90% of annual totals falling between November and April creating a need for water storages. Demand on the region's water resources is increasing as agricultural, urban and industrial needs expand in line with population growth and rapidly changing land uses. Increasing demand on water resources increases the threat to fauna and flora, and indeed to whole ecosystems, that are dependent on the provision of environmentally sensitive flow regimes. Agricultural, industrial and urban landuses are also upstream sources of pollution, emphasising the need to manage watercourses as whole systems.

There are three major dams and their associated artificial lakes located within the Plan area: Copperlode Falls Dam, which supplies the urban water requirements of the Cairns region; Koombooloomba Dam, which provides a water source for hydroelectric power

generation; and Tinaroo Dam, which supplies water for agricultural use and has a major impact on the Barron River and its tributaries.

Table 51 provides an overview of the capacities of the major water storages as a percentage of the catchment's annual average runoff. As is evident from this table, the Barron River has by far the most heavily regulated flow in the bioregion.

Table 51: Average annual runoff compared with storage capacity by catchment (Source: WTMA 2002, from EPA 1999).

Catchment	Average annual runoff ('000 ML)	Major storage capacity >2500 ML ('000 ML)	Major storage capacity as a percentage of average annual runoff
Tully-Murray	5,300	212	4.0
Russell-Mulgrave	4,200	45	1.1
Barron	1,150	407	35.4
Mossman-Daintree	4,250	95	2.2

The *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002) identified changed hydrology as a threatening process in all bioregional sub-regions represented in the Plan area except Bellenden Ker – Lamb. Further, changed hydrology resulting in salinity was also identified as an important threatening process in two of the sub-regions in the Plan area, namely Herberton-Wairuna and Kidston (NLWRA 2002).

Exotic and Displaced Species

Exotic and displaced species are major threats to biodiversity in the Wet Tropics NRM Region. These species can be defined as non-native plants, animals and diseases, and any native species whose range and/or abundance have changed because of human activities, which become established in natural ecosystems, disrupt natural ecological processes and threaten native biodiversity (which includes the Aboriginal cultural values). Rapidly expanding global trade and travel has proven to be a highway for all sorts of alien species and has accelerated the mixing of faunas and floras across biogeographical borders. The effects can be devastating. They may be as damaging to native species and ecosystems on a global scale as the loss and degradation of habitats and it is in this context that IUCN has identified the need to address the problem of alien invasive species as one of its major initiatives at the global level.

Queensland has been invaded by at least 1,298 vascular plant taxa (EPA 2002), 19 mammals, 11 bird, 11 fish, 2 reptile and 1 amphibian species which have established breeding populations and become naturalised (Table 52). An estimated 50 to 100 new plant species are imported into Queensland each year (EPA 1999a). Within the Wet Tropics bioregion, 508 exotic plant taxa have been identified as having become naturalised (Werren 2001), which amounts to almost 11% of the region's native flora and represents almost 39% of Queensland's naturalised alien plant species total.

Table 52: Numbers of naturalised alien species (Source: WTMA 2002, from [1]EPA 1999; [2]Werren 2001; EPA Wildnet 2001; [3]EPA 2002).

Group	Number of naturalised alien species - Queensland[1]	Number of naturalised alien species - Wet Tropics[2]
Vascular plant taxa	1,298[3]	508
mammals	19	7
birds	11	5
fish	11	5+
reptile	2	2
amphibian	1	1

The Wet Tropics is seen as particularly vulnerable to the threat of invasive pest species. For millions of years natural ocean barriers provided the isolation essential for the Wet Tropics' unique species and ecosystems to evolve. In just over a hundred years this natural barrier has been rendered partially ineffective and millions of years of biological isolation has inadvertently come to an end.

Many invasive pests are 'colonising' species that benefit from the reduced competition that follows habitat disturbance. In the WTWHA many pest invasions are closely related to human activity disturbances, particularly linear service corridors such as roads and powerline easements that act as both habitats and conduits for pest dispersal. Global climate change is likely to become an increasingly significant factor in assisting the spread and establishment of invasive pest species in the region.

Weeds

Growth in world trade combined with a lack of effective controls has led to a spate of unintentional plant naturalisations. Environmental weeds are introduced species capable of invading native forests or waterways. Undisturbed rainforest is generally resistant to weed invasion, however disturbed ecosystems are often highly vulnerable. Cyclone damaged communities, previously logged forests and rainforest margins are particularly susceptible. Although most of the plants causing environmental harm have originated in other countries there are some native plants, such as the vine, *Merremia peltata*, which can also be considered as 'weedy' due to their massive increase in abundance as a result of human disturbance associated with artificial rainforest edges adjacent to agricultural lands and infrastructure corridors.

The magnitude of invasive plant naturalisation within the Wet Tropics bioregion is shown in Figure 9 where the increase in alien plant naturalisations over the last century is illustrated.

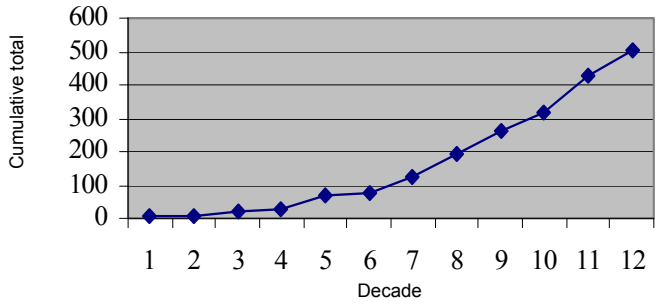


Figure 9: The total number of alien plant species recorded as naturalised in the Wet Tropics bioregion during 10 year increments where Decade: 1 = pre 1900; 2 = 1900-09; 3 = 1910-19; 4 = 1920-29; 5= 1930-39; 6 = 1940-49; 7 = 1950-59; 8 = 1960-69; 9 = 1970-79; 10 = 1980-89; 11 = 1990-99; 12 = unofficial records for the bioregion compiled by Werren (2001) (Source: WTMA 2002).

WTMA commissioned the Rainforest CRC to develop an environmental weed risk assessment and priority ranking system (RAS) tailored to the needs of WTWHA management (Werren 2001). The ranked list shown in Table 53 resulted from applying the Rainforest CRC system to the terrestrial weed species short-listed by Bebawi *et. al.* (2001) plus several additional species considered as of World Heritage management concern by Werren (2001).

Table 53: Ranked list of Wet Tropics environmental weeds of concern (after Werren 2001).

Scientific name	Common name
Annona glabra	Pond apple
Leucaena leucocephala	Leucaena

Scientific name	Common name
Chromolaena odorata	Siam weed
Sphagneticola trilobata	Singapore daisy
Hymenachne amplexicaulis	Hymenachne
Miconia calvescens	Miconia
Psidium guajava	Guava
Thunbergia spp.	Thunbergia
Brachiaria mutica	Pará grass
Mikania micrantha	Mile-a-minute
Panicum maximum	Guinea grass
Parmentiera aculeata	Cucumber tree
Turbina corymbosa	Turbine vine
Ageratina riparia	Mistflower
Andropogon gayanus	Gamba grass
Mangifera indica	Mango
Spathodea campanulata	African tulip tree
Tithonia diversifolia	Japanese sunflower
Solanum seaforthianum	Brazilian nightshade
Azadirachta indica	Neem
Eupatorium catarium	Praxelis
Harungana madagascariensis	Harungana
Stachtarpheta spp.	Snakeweed
Senna obtusifolia	Sicklepod
Syngonium podophyllum	Syngonium
Sansevieria trifasciata	Mother-in-laws tongue
Hyptis spp.	Knob weed
Mimosa diplotricha	Giant sensitive plant
Cyperus aromaticus	Navua sedge
Allamanda cathartica	Yellow allamanda
Elephantopus mollis	Tobacco weed
Euphorbia heterophylla	Milk weed

The environmental weed risk assessment process also identified seven aquatic weed taxa that pose an immediate serious environmental risk to the Wet Tropics bioregion (Table 54).

Table 54: Ranking of alien aquatic weeds using the Wet Tropics RAS (Source: Werren 2001).

Species	Common Name
Eichhornia crassipes	Water hyacinth
Pistia stratiotes	Water lettuce
Salvinia molesta	Salvinia
Elodea canadensis	Pondweed
Sagittaria graminea ssp. *platyphylla*	Arrowhead

Cabomba caroliniana	Cabomba
Alternanthera philoxeroides	Alligator weed

It must be reiterated that the environmental weed risk assessment process was tailored to the needs of WTWHA management. Over the past four years, NR&M has facilitated the development of Local Government Pest Management Plans (PMPs) throughout the State, including all local government areas within the Wet Tropics NRM region. The Far North Queensland Local Government Pest Plan Advisory Committee, under the auspices of the Far North Region Organisation of Councils (FNQROC), is currently engaged in a pest management regional integration exercise.[11,12]. As part of this process, some 84 weed species from the FNQROC planning area have attracted high to medium priority control attention (Werren 2004).

- A total of 15 of these were recommended for eradication. These comprise seven Class 1[13] plants – i.e. alligator weed (*Alternanthera philoxeroides*), Koster's curse (*Clidemia hirta*), limnocharis (*Limnocharis flava*), miconia (*Miconia calvescens*), mikania vine (*Mikania micrantha*), Siam weed (*Chromolaena odorata*), thunbergia vines (other than blue thunbergia – *Thunbergia* spp.) and a further ten weeds that are in comparatively early stages of establishing within the region - i.e. *Barleria prionotis*, *Grewia asiatica*, flacourtia (*Flacourtia jangomas*), hiptage (*Hiptage benghalensis*), Venezualan pokeweed (*Phytolacca rivinoides*), Panama rubber (*Castilla elastica*), triplaris (*Triplaris surinamensis*), and cucumber tree (*Parmentiera edulis*). They can be considered directly comparable to Class 1 Declared weeds since in most instances, while either weed risk was not assessed prior to entry or, in the case of known invasive species entry has not been prevented, eradication is possible.

Pond apple (*Annona glabra*) is one of the Wet Tropics' worst weeds (Photo: Stephen Setter).

- An additional 14 weeds (mostly 'Weeds of National Significance') ranked very highly. These comprise parthenium (*Parthenium hysterophorus*), pond apple (*Annona glabra*), blue thunbergia (*Thunbergia grandiflora*), parkinsonia (*Parkinsonia aculeata*), hymenachne (*Hymenachne amplexicaulis*), water hyacinth (*Eichornia crassipes*), salvinia (*Salvinia molesta*), lantana (*Lantana camara*), giant sensitive weed (*Mimosa diplotricha*), brillantaisia (*Brillantaisia lamium*), praxelis (*Praxelis clematidea*), cabomba (*Cabomba caroliniana*), rubber vine (*Cryptostegia grandiflora*) and chinee apple (*Ziziphus mauritiana*). These are present within the planning area as scattered to widespread infestations or occur only in certain sections of the region – i.e. either in the drier west and northern sectors or along the Wet Tropical coast and adjacent ranges. A strategic approach to infestations being contained and reduced within the planning area is a key recommendation.

- A further subset of 21 weeds was considered to warrant secondary control attention. These are sicklepods (*Senna obtusifolia* and related species), American rats-tail grass (*Sporobolus jacquemontii*), bellyache bush (*Jatropha gossypifolia*), tobacco weed (*Elephantopis mollis*), cats-claw creeper (*Macfadyena unguis-cati*), giant rats-tail grass (*Sporobolus pyramidalis)*, prickly acacia (*Acacia nilotica*), mesquites, Singapore daisy, harungana, *Tribulus terrestris*, annual ragweed, mother-of-millions, turbine vine, Gamba grass, yellow oleander, leucaena (*Leucaena leucocephala*), mother-in-law's tongue (*Sanseviera trifasciata*), thornapples (*Datura stramonium* and related species), spiny emex (*Emex australis*) and castor oil plant (*Ricinus communis*). In most instances, eradication is not achievable but strategic

[11] Hinchinbrook Shire, which is usually part of the North Queensland ROC region, has been included to allow for better integration into regional NRM planning processes.
[12] Pest organisms not considered as part of this process that will be covered by the NRM Regional Plan include non-vertebrate animal pests, marine 'ballast' invaders, fish and pathogens.
[13] The Act specifies three levels (classes) of pests. Class 1 (previously P1) pests whose introduction into the State is prohibited; Class 2 (P2) pests that are to be destroyed throughout the State or parts thereof; and Class 3 (P3) pests whose numbers and/or distribution are to be reduced throughout the State or parts thereof.

containment of infestations is recommended regionally, along with elimination of isolated infestations and appropriate follow-up treatment.

- The remaining 34 weeds receive various degrees of control priority within the local PMPs. Of these, water lettuce (*Pistia stratiotes*), prickly pears (*Opuntia* spp.), African tulip (*Spathodea campanulata*), broad-leaved pepper (*Schinus terebinthifolius*) and asparagus fern (*Protoasparagus* spp.) are State-Declared and warrant control attention commensurate with their classification. While presenting a variety of problems, both environmental and economic, Parã grass (*Brachiaria mutica*), bamboo (various species but mainly *Phyllostachys bambusoides*), Japanese sunflower (*Tithonia diversifolia*), bauhinia (*Bauhinia monandra*), guava (*Psidium guajava*), snakeweeds (*Stachytarpheta* spp.), elephant grass (*Pennesetum purpureum*), milkweed (*Euphorbia heterophylla*), hairy senna (*Senna hirsuta*), privets (*Ligustrum* spp.), goose's foot (*Syngonium podophyllum*), aleman grass (*Echinichloa polystachya*), yellow allamanda (*Allamanda cathartica*), lion's tail (*Leonotis nepetifolia*), Navua sedge (*Cyperus aromaticus*), sensitive weed (*Mimosa pudica*), mistflower (*Ageratina riparia*), dutchman's pipe (non-native *Aristolochia* spp.), *Macrotyloma axillare*, knobweed (*Hyptis capitata*), grader grass (*Themeda quadrivalvis*), camphor laurel (*Cinnamomum camphora*), tobacco bush (*Solanum maruritianum*), itch grass (*Rottboelia cochinchinensis*), giant bramble (*Rubus alceifolius*), Noogoora burr (*Xanthium occidentale*), *Caesalpinia decapetala*, Clyde road grass (*Paspalum virgatum*) and dictonara (*Brachiaria humidicola*) constitute generally low regional priorities. At the same time, control of yellow allamanda (*Allamanda cathartica*) along the Wet Tropical coast, for example, may properly warrant higher priority within individual shires. This group also includes several high utility plants such as imported pasture species that also present high invasion risk, where control may be contentious within local constituencies.

The *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002) identified exotic weeds, including ponded pasture species, as a threatening process in all bioregional sub-regions represented in the Plan area, except Bellenden Ker – Lamb, Kirrama-Hinchinbrook and Paluma – Seaview. In particular, the invasion of weeds into disturbed, dry vine thickets was identified as a significant threatening process in the drier parts of the Plan area (NLWRA 2002).

More information on exotic weeds, especially those that affect agricultural industries in the Wet Tropics NRM Region, is provided in the Sustainable Use Condition Report.

Pest Animals

Evolutionary isolated biological systems that characterise the region are especially vulnerable to biological invasions. Restricted endemic species are particularly vulnerable to extinction through competition or predation from introduced species. Habitat modification through selective feeding, trampling damage, rooting, predation on, competition with, or disturbance of the region's natural systems is the major threatening process acting on many threatened species. In addition, invasive animal pest species may also act as hosts or vectors of diseases and parasites. The feral pig, for example, is an amplifying host for Japanese encephalitis and a potential host of animal disease plagues such as foot-and-mouth and swine fever, and a range of other infectious diseases including tuberculosis, brucellosis, leptospirosis, melioidosis, sparganosis and can act as a vector for parasitic diseases such as screw worm fly, cysticercosis and trichinosis (Johnson 2001).

The Rainforest CRC has developed a vertebrate pest risk assessment scheme for the Wet Tropics designed to establish the relative pest status and the current and potential ecological impacts of exotic vertebrates presently found within the Wet Tropics bioregion (Harrison & Congdon 2001). They found that the current major vertebrate pests are the pig, cat, cane toad and dog/dingo. These species ranked high primarily due to their current levels of ecological impacts and because of the current lack of feasible control options. The assessment also identified a group of 'sleeper' species with moderate current impacts but substantial future potential. These species included the fox and six exotic fish species (gambusia, two tilapia species, swordtail, guppy and

platy). Less significant threats were the black rat, Indian myna and rabbit. The risk assessment process indicates that exotic fish may constitute the principal unrealised threat to the region. Once established these species can dominate aquatic communities, modify habitat to their advantage and are extremely difficult to control. This is because of the intensity of control required and its highly negative impacts on non-target native species. Along with exotic fish, the assessment suggests that the fox is a major future threat to the Wet Tropics. Even though it is not yet found in the region, increasing numbers of rabbits on the Tablelands serve as a warning that the fox may yet establish. If this were to happen then this species would be a major threat to many small native species. Some of the findings of this study are summarised in Table 55.

In recent years deer have escaped from a number of deer farming operations and have established breeding feral populations, notably in the Palmerston, Mena Creek and Bingal Bay sections of the region. The apparent rapid rate of population increase and spread of these destructive feral deer populations and their potential to invade parts of the WTWHA is of considerable concern.

Table 55: Relative ranking of vertebrate pests based on current levels of ecological impact (Source: Harrison & Congdon 2001).

Species	Current impact ranking
Dog/dingo	1
Cane toad	2
Pig	2
Cat	3
Common myna	4
House sparrow	5
Gambusia	6
Guppy	6
Rabbit	7
House mouse	8
Tilapia (T. mariae)	9
Brown rat	10
Swordtail	10
Black rat	11
Nutmeg manikin	11
Platy	12
Spotted turtle-dove	12
Tilapia (O. mossambicus)	12
Red fox	13
House gecko	14
Brown hare	15
Rock dove	16
Horse	17
Chital deer	18
Fallow deer	18
Rusa deer	18
Goat	18
Red-whiskered bulbul	18

As part of the FNQROC regional integration exercise (Werren, *in prep.*), pest animals present within the planning area and addressed in local government PMPs were assigned to three priority classes. These comprise:

- high priority exotic species that are widespread and regionally significant (i.e. feral pigs, wild dogs/dingos and cats);
- medium priority exotic species that are less controllable (e.g. the cane toad), less widespread or which incur only on some parts of the planning area (e.g. rabbits in the south-west of the area); and
- certain native pest species that present particular economic problems to agricultural production (e.g. cane rats to sugarcane production, especially along the Wet Tropics coast) that may warrant some degree of local government control assistance.

The *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002) identified the impacts of feral animals as a threatening process in all bioregional sub-regions represented in the Plan area, except Kidston.

Translocated Native Species

Recreational fishing is a very popular activity and generates considerable economic benefits. Anglers preferentially desire large predatory fighting fish but these do not occur in all locations. In response to this, native fish have been translocated into both natural streams and artificial dams and weirs throughout the region to create recreational fisheries. Even where suitable recreational species do occur, stocks are sometimes supplemented to boost catch rates. Since the introduction of the Recreational Fishing Enhancement Program (RFEP) in 1986, nearly 2 million fish have been stocked in the Wet Tropics (Burrows 2002), and the rate of stocking is rapidly increasing.

Lake Eacham Rainbowfish (Photo: WTMA)

LAKE EACHAM RAINBOWFISH – AN EXAMPLE OF THE IMPACT OF NATIVE FISH TRANSLOCATIONS

One of the most widely publicised examples of the impact of translocated fish is the loss of Lake Eacham rainbowfish (*Melanotaenia eachamensis*) from its type locality (Lake Eacham).

This species was only formally recognised in 1982 (Allen and Cross 1982) and until the late 1980's, Lake Eacham was its only known habitat. Barlow *et. al.* (1987) reported the loss in the wild of this fish species due to translocated native fish predators unofficially released into Lake Eacham during the 1980's. The Lake Eacham rainbowfish was regarded as the first freshwater fish in Australia to have become extinct in the wild (some remained in captivity) since European occupation. Fortunately, since that time, it has been found in a number of new localities within the Wet Tropics, however it remains absent from Lake Eacham despite several reintroduction attempts. At present there are no feasible means of eradicating the translocated predatory fish from the lake without causing further major disruption to the ecology of the lake.

(**Source**: WTMA 2002)

As already reported, the Wet Tropics has an extremely high diversity of Australia's freshwater fish and aquatic invertebrate biodiversity. Regional fish and aquatic invertebrate studies highlight the degree of isolation of upland populations from their lowland counterparts. Although these populations are only a few kilometres apart, they are many thousands or even millions of years apart in evolutionary terms. Waterfalls have provided natural barriers to the upstream movement of large fish predators (except for eels) for millions of years, possibly allowing radiation of many aquatic species that do not have good anti-predator mechanisms. Translocating recreational fish species

above these waterfalls may put the native assemblages of species, and the ecological processes of these streams, at enormous risk.

Although some records may be uncertain, a total of 36 native fish species (plus red-claw crayfish) appear to have been translocated into various waterways of the Wet Tropics. It is inconceivable that the introduction of tens of thousands of large predatory fish does not impact upon the natural values of the waterways into which they are translocated. Despite the extent of stockings that have occurred to date, and the important faunal components of the Wet Tropics streams that may be vulnerable to predation by novel fish predators, no environmental evaluations of the impacts of fish stocking have been yet been undertaken in the Wet Tropics. The distribution of translocated fishes within streams of the Wet Tropics is not adequately known, nor is the extent of overlap between translocated fishes and potentially vulnerable species such as frogs and crustaceans.

More information on introduced and displaced animals, especially those that affect agricultural industries in the Wet Tropics, is provided in the Sustainable Use Condition Report.

Alteration and Degradation of Native Habitat

Processes that can lead to undesirable large-scale alteration or degradation of habitat quality may threaten biodiversity values. This occurs when changes in the environment or in the composition of species trigger a sequence of ecological changes that can lead to a loss of species and changes to ecological processes. Some of the processes responsible for widespread habitat alteration in the region are discussed below.

Grazing

Of all the Australian States and Territories, Queensland has by far the greatest area of land under grazing by domestic stock (EPA 1999a). Approximately 87% of Queensland's area supports sheep and cattle to some extent. Grazing is also a major land use in the Wet Tropics region and clearing for pasture far exceeds that for any other land use in the region (see Table 51).

Most grazing land (>90%) is native pasture (grasses and forbs) that occurs in both grassland and woodland settings (EPA 1999a). Even in areas where apparently intact habitat remains, processes that can lead to ecological degradation may threaten biodiversity. Introduced grazing animals eat and trample vegetation and degrade soil structure, leading to changes in vegetation cover and loss of habitat for ground-dwelling species. Native and feral herbivores add to grazing pressure. This pressure can be compounded by a range of factors including inappropriate size and pasture management, use of better-adapted stock, increased competitiveness of native and exotic trees and shrubs, extended drought, changes in fire frequency and inappropriate placement of artificial water points (Landsberg *et. al.* 1997).

Grazing has been identified as the most widespread pressure on Queensland's wetlands and as a significant factor contributing to the degradation of riparian vegetation (Blackman *et. al.* 1996). Grazing animals have direct impacts on wetland vegetation, soils and water quality that may have indirect impacts on the biology and biogeochemistry of wetlands by altering habitat structure and patterns of primary and secondary production (Robertson 1998, cited in EPA 1999a).

The Wet Tropics has many thousands of hectares of introduced grass pastures and increasing areas of native pastures oversown with introduced legumes. The introduction and spread of these species (including ponded-pasture species) threatens the ecological integrity of lands under grazing occupation. As reported above, the ponded-pasture grass hymenachne is now recognised as one of Australia's top twenty worst weeds and the fodder tree leucaena was ranked second in an assessment of environmental weed risk in the Wet Tropics (Werren 2001).

The *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002) identified grazing pressure as a threatening process in all bioregional sub-regions represented in the Plan

area, except Macalister. Even in regions where the mid and upper layer vegetation is intact (e.g. Kidston sub-region), there has been significant decline in the ground layer condition and diversity from grazing pressure (NLWRA 2002). Impacts from grazing animals are also a major threat to the wetlands of the Plan area, along with invasion by exotic ponded pasture species (NLWRA 2002).

Altered Fire Regimes

Most of the Wet Tropic's non-rainforest ecosystems evolved under the influence of fire and rely on particular fire regimes for their long-term persistence. The ecological effects of a given fire regime vary depending on intensity, frequency, the season of the burn and the nature of the forest. Open forest plants and animals have evolved with a pre-European fire regime and alterations to this regime are having a range of ecological impacts. Determining appropriate fire regimes to protect natural values is difficult because of:

- the difficulties in determining pre-European fire regimes;
- the lack of scientific information on the effects of fire intensity, frequency timing, long term climatic cycles; and
- the impact of introduced species altering fuel loads and burning characteristics.

Woody Vegetation Thickening

Woody vegetation thickening occurs when there is a gradual change in the competitive balance between grasses and shrubs, favouring the latter and leading to thickening woody species coverage (Burrows *et. al.* 2002; Stanton 2002a). Eventually the ground cover may be totally suppressed, and in the higher rainfall environments a closed forest community may develop, leading to a depauperate habitat and likely loss of habitat diversity over large areas. Even in drier areas, the direct effects of reduced groundcover on increasing soil water at depth can contribute to an increase in woody cover (Boulter *et. al.* 2000). This process is accelerated if fire is removed from the system by deliberate management practice or where grazing pressure has left insufficient fuel in to carry fire of sufficient intensity (Stanton 2002a, Sharp and Whittaker 2002). Woody vegetation thickening frequently involves native species (see box 'Tree Thickening in the Upper Herbert').

TREE THICKENING IN THE UPPER HERBERT

There have been several controlled grazing and burning experiments funded by NHT in the plan area. In a project currently underway, the Mt Garnet Landcare Group is investigating whether the combined use of controlled grazing at critical times, and storm season burning, can provide an economically feasible method for controlling or reversing the process of tree thickening.

The experiment has demonstrated the potential capacity of storm season burning after a growing season of stock exclusion, to halt or reverse woody regrowth trends in areas where wattles dominate or are a large part of the understorey. There was also a strong indication that problems created by more intractable species may eventually be solved by repetitive fires, particularly where the vegetation has been weakened by drought conditions. One unanswered question is how best to deal with an understorey dominated by melaleucas, particularly *Melaleuca nervosa*. It is also noted that there is no treatment apart from ringbarking or poisoning that is likely to have an impact on most species other than wattles or casuarinas above about 6 m in height.

(**Source**: Stanton 2000b)

Cattle grazing is the major land use of the upper Herbert catchment, where grazing pressure is compounded by the increased competitiveness of native and exotic trees and shrubs, extended drought and changes in fire frequency. (Photo: Herbert River Catchment Group).

Loss of Wet Sclerophyll Forests and Woodlands

It has been found that ecologically significant changes to the rainforest/open forest boundary have taken place over the last 50 years with large areas of wet sclerophyll forest types, in particular, being progressively converted to simple rainforest. Presently, wet sclerophyll forests occur as a discontinuous strip up to 4 km wide along the western margin of the rainforest and occupy approximately 54,000 ha. This represents only half the extent identified from airphotos taken in the 1940s (Harrington & Sanderson 1993, 1994). The narrow strip of tall open forest is important for the conservation of one of the mammals restricted to the bioregion, the endangered northern bettong (*Bettongia tropica*), and the northern population of two other species of mammals restricted to this forest type - the fluffy glider (*Petaurus australis*) and the swamp rat (*Rattus lutreolus*). It is a matter of urgency to determine which biota is dependent upon wet sclerophyll forest types and the level of threat to these species imposed by this rapid trend toward rainforest conversion. Additional sclerophyll woodland and forest communities exist on the eastern slopes of the ranges and on the coastal lowlands. These have also been invaded by rainforest species in the absence of fire.

The apparent severe disruption of historical fire patterns in the last fifty or more years, particularly where they affect some of the more restricted types of sclerophyll habitat, and the unlikely event of their re-establishment in the future in the face of permanent changes to the landscape from settlement activities, casts in doubt the survival or regeneration of a number of the more restricted sclerophyll types of vegetation within the bioregion.

Rainforest Ecology

It has been assumed that fire does not have a role in the regeneration of most closed rainforest communities (Bowman 2000). However, many rainforest species have the ability to resprout after fire (Unwin 1985; Williams 2000), and several rainforest communities contain emergent Eucalypt and Acacia species that appear to need full sunlight, or ash beds for regeneration (Tracey, 1975). The processes that produced such communities is not clearly understood, although burning by Traditional Owners or lightning, especially after long dry periods or cyclone damage, may have been involved. Such communities may not persist in the long term if not burnt by severe fires. There appears to be a tacit acceptance that this process is inevitable, and that invasion of these communities by non-sclerophyllous taxa is too advanced for fire management to reverse it. However, there has been no systematic examination of whether fire should be used to maintain such communities, nor any examination of the impact of fire on rainforest species away from the forest margins. The Australian Terrestrial Biodiversity - Pressure Terrestrial Biodiversity Assessment (NLWRA 2002) identified changed fire regimes as a threatening process in all bioregional sub-regions represented in the Plan area, except Kidston.

Diseases

Forest D ieback

Dieback is a frequently used term in relation to the death of large or small patches of forest or of single trees. Canopy death may be the result of a range of causes including lightning strikes, changes in the water table, senescence, insect predation and pathogenic infection. WTMA's ongoing vegetation mapping program (Stanton & Stanton 1998-present) has located numerous patches of rainforest dieback across parts of the Tully Falls, Koombooloomba, Kirrama, Bartle Frere and Rumula mapping areas. Species of *Phytophthora,* including *P. cinnamomi*, have been isolated from dieback patches throughout the Wet Tropics by researchers from the Rainforest CRC (Gadek *et. al.* 2001).

Phytophthora cinnamomi's devastating impact on natural ecosystems in other parts of Australia has been well documented, and its presence in rainforest ecosystems poses considerable concern for land management. At least five species of *Phytophthora* have been identified from dieback sites: *P. cinnamomi*, *P. heveae, P. katsuurae, P. palmivora* and another, as yet unidentified species. *P. heveae* has been recorded as affecting *Agathis australis* (Araucariaceae), the New Zealand Kauri (Erwin and Ribeiro 1996).

The abundance of *P. heveae* in the Mt Lewis section of the WTWHA, in particular, raises questions regarding its potential impact on the important isolated disjunct patch of Bunya Pine, *Araucaria bidwillii*, on Mt Lewis.

The effects of *P. cinnamomi* on the region's rainforests vary from no visible impact to slight loss of canopy leaves in susceptible species to the death of all plants in virulent outbreaks. The association of *P. cinnamomi* with patches of rainforest death in the Wet Tropics represents a potentially serious problem, and a management issue of some concern. Where vulnerability and susceptibility occur together in the presence of the pathogen, the anticipated consequences include:

- major disruption to ecological community structure;
- local extinction of populations of some plant species;
- a massive reduction in primary productivity; and
- loss or degradation of habitat for dependent plants and animals.

Over 200 patches of dead rainforest have so far been identified in the Mount Lewis, Lamb Range and Tully Falls areas. Based on preliminary findings, approximately 14 percent of the WTWHA may be susceptible and at risk from rainforest dieback. Subsequent studies (see Gadek & Worboys 2003) indicate a relationship between *P. cinnamomi* and roads, granite or rhyolite soils and notophyll forest type.

Chytrid Fungus

There is widespread evidence of a global and dramatic decline of amphibian species, particularly in tropical forests. As reported earlier, threatened amphibians are declining rapidly in the Wet Tropics bioregion. Eight locally endemic species are officially listed as rare or threatened. Populations of three of these species can no longer be located and another is only known from two small streams (Northern Queensland Threatened Frogs Recovery Team 2001). The declines have occurred across a variety of land tenures, including habitats remote from human interference (the species that have gone missing are all from upland rainforest streams).

Until recently, it was not known what the causal factor(s) in the frog declines was. However an exotic chytrid fungus, known to be fatal to amphibians, has been detected in the skin of sick and dead frogs in Queensland. It has been suggested that the introduction, decades ago, of an African frog used in pregnancy testing was the source of this fungus. Laurance *et. al.* (1996, cited in EPA 1999a) contend that the thriving international trade in aquarium fish is especially likely to promote transmission of pathogens to aquatic organisms like frogs.

Pollution

Pollutants are often dispersed widely from their sources and act synergistically with other contaminants so that effects on biodiversity are difficult to analyse. Consequently, it is difficult to assess the extent of this pressure on biodiversity in the Wet Tropics. This stems primarily from a lack of data.

By world standards, air pollution in the Wet Tropics is limited because of the scattered distribution and generally limited size of human industrial and urban centres. Although many people live in and around Cairns, the city has no major industrial activity, so the airshed is not of immediate concern from an air pollution perspective (EPA 1999a). Consequently, the biota on the whole is exposed to low or negligible levels of atmospheric pollutants. Information on aquatic pollutants is provided in Section 2.

The *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002) identified pollution as a process threatening wetlands in the Herbert, Innisfail, Tully and Einasleigh Uplands sub-regions of the Plan area. It is a riparian threatening process in all bioregional sub-regions represented in the Plan area except Bellenden Ker – Lamb, Herbert, Paluma – Seaview and the Einasleigh Uplands sub-regions (NLWRA 2002).

Harvesting of Native Species

Native plants and animals are harvested from the wild for commercial gain, recreation, subsistence and pest control. The most significant harvesting activities in the Wet Tropics are commercial timber harvesting (see below) and fishing. Information on marine and freshwater fisheries is provided in Section 2 and in the Sustainable Use Condition Report (Volume 2B of this series).

Harvesting of Forest Products

As shown in Table 19**,** rainforests in the Wet Tropics bioregion cover approximately 835,000 ha. This represents nearly 40% of Australia's total remaining rainforest (McDonald 1985, cited in Annandale 2002). There are also 906,000 ha of sclerophyll forests and woodlands and 175,000 ha of other vegetation complexes (shrublands, swamp communities and coastal complexes, mangroves). Apart from their biodiversity values, forests are sourced as sources of variety of commercial products, ranging from soil and gravel, through seed and foliage, to sawlogs and other timber products.

Accessible areas continue to be cleared in the Wet Tropics region (Photo: Nigel Weston).

Table 19 also shows that, although around 80% (669,000 ha) of rainforests are included within the protected area system of the WTWHA, only about 19% of sclerophyll forests and woodlands (172,000 ha) and 25% (43,000 ha) of other vegetation complexes are similarly protected. Hence, the areas of forest outside the protected areas network are not insignificant. As reported by Herd *et. al.* (2000), there is growing concern that the remaining areas that fall into this category, and especially those outside the WTWHA, have little or no protection from timber harvesting or clearance. According to Herd *et. al.* (2000), it is clear that this resource is being degraded and accessible areas continue to be cleared.

Tourism and Recreation

As reported in the Background Report (Volume 1 of this series), tourism in the WTWHA (over 90% of which falls within the plan area) is estimated to generate over $750 million per year. The WTWHA receives around 2.8 million visitors annually. Visitor trends and projections forecast an increase in total visitors to about 4.5 million visitors. In 1998, there were over 210 commercial operators with permits to operate within the Wet Tropics region.

While tourism and recreation provide significant socioeconomic benefits for the region, they are also placing an increasing pressure on the region's natural environment and associated Aboriginal cultural values. The tourism industry is predominantly based on natural and cultural attractions, and the major concern is the high concentration of tourism activities in specific parts of the region. These areas are primarily located along the coast between Cairns and Cape Tribulation.

Studies of nature based tourism opportunities in the WTWHA identify over 180 sites that are regularly used by visitors to the region, 94 of which have associated infrastructure (cited in WTMA, 2000a). A recent study of ten visitor sites in the area found that they were visited by just under one million people in nearly 300,000 vehicles (Bentrupperbaumer and Reser, 2002; WTMA, 2003). Forty percent of all visitors were found to be local residents and 35.5% were repeat visitors (had been to the sites before).

Increases in both the resident and tourist population is placing increasing pressure on the WTWHA, particularly in relation to road access, walking tracks, further developed visitor sites, camping grounds, picnic areas, lookouts and other visitor facilities (WTMA, 2000a). More information is available in the Background Report (Volume 1 of this series).

3.4. RESPONSE

As indicated in Chapter Two, responses are the range of management actions taken to help mitigate pressures and achieve conservation of the region's natural values. Responses may include statutes, policies, management plans and strategies, research and monitoring, management agreements and on-ground land management and community initiatives. Responses may range from the global to the regional and local scales.

3.4.1. NATIONAL INITIATIVES

Chapter Two outlined some of the Commonwealth initiatives that stress the importance of conserving biodiversity in the coastal zone. Other relevant instruments include the *National Strategy for Ecologically Sustainable Development* and *An Australian Strategy for the Conservation of Australian Species and Communities Threatened with Extinction* but perhaps the most significant Commonwealth initiative has been the introduction of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). As its title suggests, one of the objects of this Act is to promote biodiversity conservation. At its commencement on 16 July 2000, the Act repealed the following relevant Commonwealth legislation:

- *Endangered Species Protection Act 1992;*
- *World Heritage Properties Conservation Act 1983;*
- *National Parks and Wildlife Conservation Act 1975; and*
- *Environmental Protection (Impact of Proposals) Act 1974.*

This constitutes the biggest reform of Commonwealth environment laws since the first environment statutes were enacted in the early 1970s.

THE FLYING FOX CASE

The flying fox case involved an application by a conservationist to restrain the mass culling of spectacled flying-foxes, *Pteropus conspicillatus*, by a large aerial electric grid on a 60 ha lychee farm in the Wet Tropics. The electric grid consisted of 20 horizontal electrified wires, spaced 25 m apart, strung between poles at 4-9 m height (slightly above tree-top level), with 14 grid lines stretching for 470-820 m in length, a total of 6.4 km of grid lines. When flying foxes collide with any two of the wires (which are alternated earth – live), they create a circuit and are electrocuted by a high voltage current.

In the first full trial under the EPBC Act, it was decided to grant an injunction restraining an action found to be causing a significant impact on the world heritage values of the WTWHA. The case was considered to be a crucial test of the offence provisions for matters of national environmental significance under the Act and a landmark case highlighting the importance of open standing for public interest litigation to protect the environment.

In particular, the decision clarified a number of crucial issues for the operation of the EPBC Act. It was found that a 'significant impact' was an 'impact that was important, notable or of consequence having regard to its context of intensity' (the operation of the grid killed in the order of 18,000 spectacled flying-foxes in the 2000-2001 lychee season, which equated to roughly 20% of the Australian population at that time). A further important aspect of the case was that it established that an action taken outside a world heritage area can be regulated under the EPBC Act if it has, will have or is likely to have a significant impact on world heritage values.

(Source: McGrath 2001)

Under its biodiversity conservation provisions, the EPBC Act establishes management principles intended to promote national standards of management, planning, environmental impact assessment, community involvement, and monitoring for all of

Australia's World Heritage properties. The Act regulates actions that will, or are likely to, have a significant impact on 'matters of national environmental significance', including nationally threatened species and ecological communities, protected migratory species and the values of a declared World Heritage Area (WHA). This includes relevant actions that occur outside the boundaries of a WHA. Actions that are taken in contravention of the EPBC Act may attract a civil penalty of up to $5.5 million, or a criminal penalty of up to $46,200 or, in extreme cases, up to seven years imprisonment. An 'action' includes a project, development, undertaking or any activity or series of activities (see box 'The Flying Fox Case').

The Commonwealth *Wet Tropics of Queensland WHA Conservation Act 1994* gives effect to the 1990 State-Commonwealth WHA Management Scheme. The scheme outlines broad structural and funding arrangements for the management of the WTWHA.

3.4.2. STATE INITIATIVES

The Queensland *Wet Tropics World Heritage Protection and Management Act 1993* together with its subordinate statute, the *Wet Tropics Management Plan 1998*, provide the legal framework and mechanisms for management of the WTWHA. In general, the legislation regulates activities within the WTWHA that have the potential to impact on World Heritage values including destruction or disturbance to native vegetation, watercourses or earth. They establish responsibilities for the protection, conservation, presentation, rehabilitation and transmission to future generations of the WTWHA, within the meaning of the World Heritage Convention.

The Wet Tropics Management Plan, released after much controversy in 1998, was prepared to help Australia meet these international obligations and its provisions are legally enforceable under the Queensland legislation. The Plan is also about maximizing the benefits of the Area for the local and wider community, while minimizing threats to the Area's integrity (WTMA 1997). It is also about enabling groups and individuals throughout the Wet Tropics region to contribute to the management of the WTWHA. Key components of the *Wet Tropics Management Plan* include:

Zoning System - The Plan divides the WTWHA into four management zones, based on a 'distance from disturbance' model. Part 3 of the Plan describes those activities that are allowed, or subject to a permit, in the different zones. A zoning scheme with associated land use controls for activities occurring or proposed for each zone is the most practical means of providing an appropriate level of protection for the natural values of the WTWHA, and for managing activities which have the potential for adverse impact on those natural values while recognising legitimate uses and activities. The zoning scheme also designates road classes and associated use within the WTWHA.

Permit System - The Plan incorporates a permit system for consideration of applications for regulated activities. The most important consideration in assessing permit applications is the likely impact of the proposed activity on the WTWHA's integrity.

Permit Assessment Guidelines - Section 62 of the Plan allows WTMA to prepare guidelines relevant to decision making and may include guidelines for flora and fauna conservation, scenic amenity, visitor management, seed collection and community consultation on permit applications. WTMA or its delegates must have regard to the information in the guidelines when considering a permit application.

Co-operative Management Agreements - The *Wet Tropics World Heritage Protection and Management Act 1993* provides for WTMA to enter into voluntary co-operative management agreements (CMAs), including joint management agreements, with land holders, Aboriginal peoples particularly concerned with land in the Area and other persons. CMAs play an important role in facilitating good management of the WTWHA and may make provision for financial, scientific, technical or other assistance. They may occur over lands both inside or neighbouring the WTWHA but only with the agreement of the relevant landholder. CMAs provide for variation of standard controls

prescribed under the Plan. Twelve CMAs were finalised in 2000-2001 in the Daintree region. At the time of writing (January 2004), more than 40 CMAs had been approved in the WTWHA.

WTMA also operates under a policy document, *Protection Through Partnerships* (WTMA 1997), which outlines policies, guidelines and actions for achieving desired management outcomes. It provides a framework for guiding management decisions made by WTMA. Table 56 lists the key policy areas covered in this document. In addition, as the need arises, the WTMA Board produces policy statements to guide and clarify decision-making.

Table 56: Key components of Protection Through Partnerships (Source: WTMA 2002).

Management Processes	Conservation Practice and Land Protection	Presentation, Visitor Management and Enjoyment	Managing Resource Use
management partnerships codes of practice Aboriginal interests co-ordinated planning land tenure boundary management	flora and fauna conservation feral animals weeds and diseases rehabilitation fire scenic management cultural heritage	presentation, information and interpretation visitor research walking opportunities	collecting plants and animals private land use defence use communication facilities grazing beekeeping farming water storage, diversion and extraction electricity infrastructure roads and access

There are more than 2,500 individual blocks of land neighbouring the WTWHA's 3,000 km boundary. Both the *Wet Tropics World Heritage Protection and Management Act 1993* and the statutory *Wet Tropics Management Plan 1998* apply only to lands within the boundaries of the WTWHA and not to neighbouring lands. However, a co-operative approach to management is being actively pursued with neighbours in an attempt to maximise the benefits and minimise any negative impacts (both for neighbours and the WTWHA). This includes co-operative approaches to concerns, such as control of feral pigs, and weed and fire management.

Co-operative management agreements are also actively canvassed with landholders, Aboriginal peoples and other parties within and outside the WTWHA as a means of giving the greatest possible effect to achieving the Primary Goal while minimising impacts upon neighbours.

Specific issue-based plans and strategies developed by WTMA include the Nature Based Tourism and Walking Track Strategies as well as the draft Conservation Strategy (WTMA 2003), which promotes cooperative conservation management to ensure the future ecological health of the WTWHA. According to the Strategy, World Heritage legislation has contributed greatly to protecting the integrity of the WTWHA. However, a proactive conservation program is needed for the Area and surrounds to conserve and rehabilitate the values of the WHA and minimise threats. The Strategy identifies where WTMA should focus its conservation efforts and what actions are most achievable and cost-effective. Priorities in brief are given below. For more information, go to <http://www.wettropics.gov.au/mwha/mwha_conservation.htm>.

WET TROPICS CONSERVATION STRATEGY: PRIORITIES IN BRIEF

- Eradicate new incursions of Class 1 weeds. Increase capacity of specialised weed prevention and eradication teams.
- Provide better weed information and education and education for land managers and the community.
- Protect and restore landscape vegetation linkages between the main body of the WHA and outlying coastal and tableland sections.
- Prevent the establishment of new feral animals such as deer and fish species.
- Verify the current and potential impacts of climate change and the need for improved landscape connectivity.
- Review the status of redundant roads under the Wet Tropics Management Plan.
- Rehabilitate wetland and river systems which can be restored to their natural state.
- Complete vegetation mapping for the Wet Tropics Bioregion at 1:50,000.
- Recognise mapped areas of threatened ecosystems, threatened species habitat, and key vegetation corridors under State and Commonwealth legislation.
- Implement fire regimes in woodland and sclerophyll forests to maintain habitat diversity for rare and threatened species such as the mahogany glider, fluffy glider and northern bettong.
- Research and promote the community benefits of the WHA for services such as clean water, genetic resources, climate regulation, flood mitigation, recreation and tourism and scenic beauty.
- Encourage the introduction of tradeable rights and financial incentives for conservation on private lands.
- Foster coordinated, coorperative management of the Area and surrounding lands to ensure conservation of World Heritage values.
- Promote and support Aboriginal participation and the use of traditional knowledge in conservation management.

(Source: WTMA 2003)

The Queensland Parks and Wildlife Service (QPWS), under the *Nature Conservation Act 1992* has primary responsibility for nature conservation in Queensland. In accordance with its roles under the Act, QPWS:

- dedicates and declares protected areas;
- protects native wildlife and habitats;
- regulates the use of protected wildlife;
- manages protected areas;
- manages commercial tour operations (including permit issue);
- maintains infrastructure and public contact in areas under its management; and
- has responsibility for the protection of cultural heritage including identification, recording, and protection of particular cultural sites.

The management of terrestrial protected areas (including the WTWHA) and threatened species and ecosystems is discussed in greater detail later in this report (Sections 3.4.5, 3.4.6).

Over the past few years, the Queensland Government has begun implementing vegetation-clearing control on freehold and leasehold lands. Although there is no blanket ban on clearing in the region, landholders now require approval in most cases to clear native vegetation.[14] The *Vegetation Management Act 1999* (and the *Vegetation*

[14] At the time of writing (January 2004), the Queensland Government has put a temporary hold on land clearing applications, while the Federal and State Governments finalise a major assistance

Management Regulation 2000) makes vegetation clearing on freehold land assessable under the *Integrated Planning Act 1997* while the *Land Act 1994* (and associated regulation) governs vegetation management on leasehold and other state land.

As part of the *Vegetation Management Act*, the Minister for Natural Resources and Mines must approve Regional Vegetation Management Plans for vegetation management in the thirteen bioregions of Queensland and now, under the Land Act, the Minister may approve Local Tree Clearing Guidelines. The Plans (which may include Local Tree Clearing Guidelines) are made by Regional Vegetation Management Committees comprising community representatives and stakeholders supported by government agency staff. At the time of writing (January 2004), two draft plans covering the two bioregions represented in the Wet Tropics NRM Plan Region, the Wet Tropics and Einasleigh Uplands (North), were awaiting approval for release by the Minister. Both aim to provide planning certainty for landholders and the community while achieving ecologically sustainable land development. For more information, go to <http://www.nrm.qld.gov.au/vegetation/rvmp.html>.

The *Forestry Act 1959*, meanwhile, regulates the use of forest products such as timber on all State land including State forests, leasehold land and unallocated state land (approximately one third of the region). A central definition of the Act is 'forest products' which means all vegetable growth and material of vegetable origin. For designated timber producing areas such as State forests, 'forest products' also include honey, native animals, fossils and quarry material (McGrath 2002). DPI, NR&M and the EPA jointly administer the Act.

Guidelines for Private Rainforest Harvesting in North Queensland have been prepared to provide practical guidance to landholders and timber contractors who intend to harvest privately owned rainforest log timber (refer Annandale 2002). These guidelines were developed as part of an NHT funded project, *Sustainable Native Forest Management on Private Lands, Wet Tropics Region*, run by the Queensland Forestry Research Institute, now known as the Agency for Food and Fibre Sciences – Forest Research. The primary aim of this project is to improve the management of private rainforest in north Queensland (for further information, see Herd *et. al.* 2000).

Two concurrent processes have influenced the content of these Guidelines for Private Rainforest Harvesting in North Queensland. Firstly, as part of the development of the Queensland Forest Practices System (QFPS), the Queensland Government is drafting a code for forest practices in native forests on private lands. This is based on the existing Code of Practice for Native Forest Timber Production on Crown Lands, administered by QPWS.

Compliance with the QFPS will enable private forest growers to meet their obligations under the *Vegetation Management Act 1999* and the *Environmental Protection Act 1994*. Secondly, as part of the development of A Private Forestry Model Planning Framework, the Local Government Association of Queensland Inc. (LGAQ) is drafting 'Guidelines for Establishing a Private Forestry Use'. The aim of the LGAQ Private Forestry Model Planning Framework is to assist Queensland Local Government to implement a consistent approach to private forestry provisions within the *Integrated planning Act 1997* compliant planning schemes.

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package for landholders. In the lead up to the State Election, Premier Beattie committed to legislating for a rapid phase out of clearing of mature bushland by 2006.

The guidelines acknowledge both the draft QFPS Code for Native Forest Management on Private Land and the draft LGAQ Private Forestry Model Planning Framework. In the interests of avoiding duplication and possible conflict, these guidelines do not include important matters on timber harvesting that are covered in these other draft documents. Instead, it is intended that they be used in conjunction with these other documents (when they are finalised and then any subsequent revisions of them), rather than as a stand-alone manual.

SANDALWOOD – A POTENTIAL WET TROPICS INDUSTRY

The harvesting of sandalwood from native forests in Australia has long been a significant industry and remains so today. India and Australia are currently the world's two largest producers of sandalwood and Australia therefore has a strong economic interest in the maintenance of this industry (Statham 1990; Radomiljac *et. al.* 1999; Vernes and Robson 2002). Sandalwood export sales are a significant contribution to Western Australia's revenue, with income exceeding $11 M for 1999/00. In Queensland, sandalwood export sales are approximately $100,000 annually. Nevertheless, there is some uncertainty regarding the sustainability of the native resource. An attractive alternative is the use of plantations to supplement the Australian sandalwood industry and maintain the global resource currently in decline (Applegate *et. al.* 1990a; Baruah 1999; Vernes and Robson 2002).

An understanding of the ecology and management of the naturally occurring forests of Queensland sandalwood is necessary in developing appropriate native forest management and conservation techniques with this species. Possibilities for the lower rainfall areas (<2000mm, with distinct dry season) of the wet tropics include both sustainable management of native forest stands, and introduction/expansion of plantations on previously-cleared land. As all the sandalwoods are hemi-parasitic root parasites, growing them can be difficult/tricky, and it is often suggested that if you are going to grow plantations, it is wise to do so with the most valuable sandalwood, *Santalum album* (Indian sandalwood).

There are four pieces of State legislation that regulate the management of Queensland sandalwood. On State land, the harvesting of Queensland sandalwood for commercial products requires a permit under the ***Forestry Act (1959)***, which are issued and administered by the Department of Primary Industries (DPI) Forestry. In association with DPI Forestry's harvesting activities, DPI's Agency for Food and Fibre Sciences forestry researchers are investigating the ecology, growth and yield of Queensland sandalwood in northwestern Queensland. To take and use Queensland sandalwood from State land requires a permit under the ***Nature Conservation Act (1992)*** and is subject to a conservation plan and management plan for whole plant harvesting. Under the *Nature Conservation Act* Queensland sandalwood is listed as a common species. The clearing of remnant vegetation on freehold land is regulated under the ***Vegetation Management Act (1999)*** and associated ***Integrated Planning Act (1997)***. Where sandalwood is harvested on freehold land as part of a forest practice (as defined by the *Vegetation Management Act*), a development permit under the ***Integrated Planning Act 1997*** is not required.

(Source: Bristow *et. al.* 2003)

The *Water Act 2000* provides a framework for the planning, allocation and use of surface water and groundwater in Queensland. The most important planning instrument under the Act are Water Resource Plans, which are prepared through a consultative process on a catchment-by-catchment basis. An important aspect of this regime is the balancing of water allocations (i.e. human use) with environmental flows (i.e. leaving water in a water course to maintain natural processes) (McGrath 2002). Just one catchment in the Plan area, the Barron, has had a Water Resource Plan prepared for it. As reported in the Sustainable Use Condition Report (Volume 2B of this series), a Wet Tropics Resource Plan is under consideration for other rivers from the Daintree to the Herbert.

The *Environmental Protection Act 1994* is a central component of Queensland's environmental legal system. The object of the Act is environmental protection within the context of ecologically sustainable development. To achieve this, the Act provides a wide range of tools, including environmental protection policies (EPPs) for water, air, noise and waste management. While the Act is generally administered to regulate only contaminant release/ pollution control rather than wider environmental harm such as land clearing, recent court findings suggest there is no basis for such a limitation to the Act (McGrath 2002).

Finally, the *Integrated Planning Act 1997* (IPA) is Queensland's principal planning legislation. Its purpose is to seek to achieve ecological sustainability. It does this through:

- coordinating and integrating planning at the local, regional and State levels;
- managing the process by which development occurs; and
- managing the effects of development on the environment.

Hence the importance of clearly establishing the linkages between regional planning processes and planning schemes.

The Act establishes a framework for the creation of planning schemes by local governments and a development assessment system known as the 'Integrated Development Assessment System' (IDAS). This is the regulatory system that is progressively replacing the many different development related control systems applying in Queensland at both State and local government level. IDAS is a framework that establishes a common statutory system for making, assessing and deciding development applications, regardless of the nature of the development, its location or the authority administering the regulatory control. IDAS is designed to be a common regulatory system for development related assessment and decision-making.

In essence, IDAS is a process for making, assessing and deciding applications for development. Under the Act at present, there is a coordinated terms of reference/information gathering process for certain designated developments and for development in or adjacent to certain designated areas including protected areas under the Nature Conservation Act, declared fish habitat areas, wetlands and the Wet Tropics World Heritage area. This provides government agencies and statutory authorities with responsibility for natural resource management the opportunity to view certain development applications (material change of use and reconfiguration), request further information and provide written comment but does not confer the power to decide applications or impose conditions unless the agency has concurrence agency powers under the Act. When IDAS is fully operational these transitional referral coordination arrangements will be replaced by applicable provisions in IPA compliant planning schemes and integration of the full range of development related assessment systems.

BIODISCOVERY

Biodiscovery has the potential to be another lucrative industry in the Wet Tropics. Biodiscovery is the search for active compounds in biological material that can be developed into commercial products. The regions' rich biodiversity, developed economy and research capabilities uniquely position it as a leader in the emerging biodiscovery industry. Because current administrative and regulatory frameworks were not designed for biodiscovery activities, the State Government released the draft Biodiscovery Bill in 2003 for public comment. The proposed Bill had three key objectives:

1. to facilitate sustainable access to the State's native biodiversity for biodiscovery;
2. to encourage the devlopment of value added biodiscovery; and
3. to ensure the benefits arising from discoveries sourced from Queensland biodiversity are shared by all Queenslanders

The Bill was not well received by environmentalists and Traditional Owners in the region because of concerns over its failure to respect traditional knowledge and its lack of strong environmental safeguards (S. Hall, EDO-NQ, *pers. comm.*).

FNQ Regional Plan

The FNQ Regional Planning project (FNQ 2010) was established as a joint Government and community initiative to develop a comprehensive Regional Plan for the Far North Queensland region (from Cape Tribulation to Cardwell and west to Herberton) to guide decision making relating to growth, development and management of the region over the next twenty years or more. Commonwealth, State and local government, as well as key stakeholder interests representing Aboriginal and Torres Strait Islander people, business and industry, human services and environmental sectors contributed to the preparation of the FNQ Regional Plan. Endorsed in 1999, the Regional Plan has been instrumental in guiding all three levels of Government when determining future policies, priorities, work programs and resource allocation in the region as well as informing the private and community sectors.

Importantly, the FNQ Regional Plan is the principal strategic framework addressing ecological sustainability in the region and deals with natural resource management issues within the broader context of balancing social and economic considerations. The Plan documents arrangements to progress implementation of regional plan outcomes an important means being through IPA compliant planning schemes that must address issues of State and regional significance. The preparation of the Wet Tropics NRM Plan is another means by which implementation of FNQ Regional Plan outcomes can be achieved.

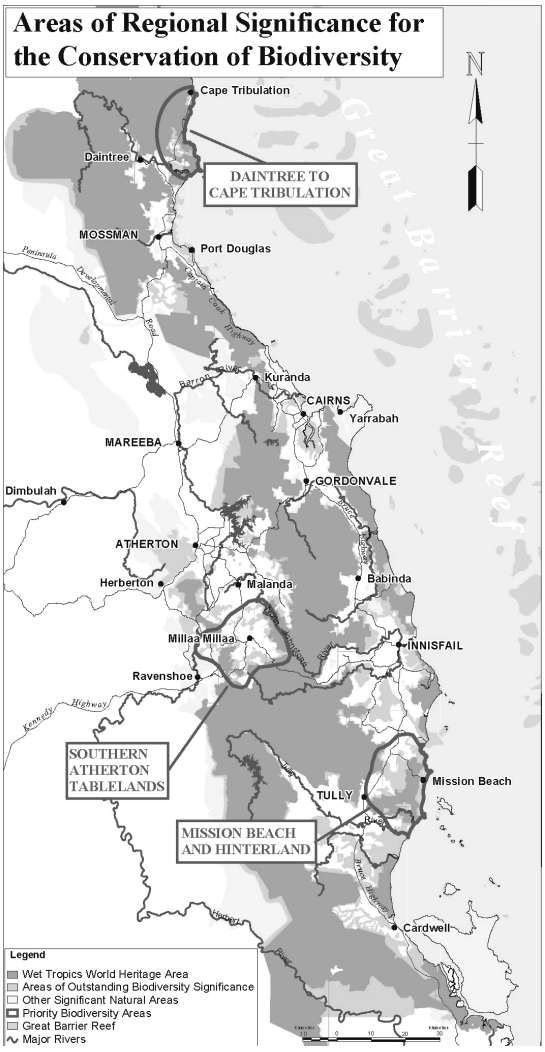

Figure 10: The three 'Areas of Regional Significance for the Conservation of Biodiversity' (Source: DLGP).

FNQ 2010 Biodiversity and Rehabilitation Priorities

The FNQ Regional Plan identified three 'Areas of Regional Significance for the Conservation of Biodiversity' (See Figure 10) . These were:

1. Lowland Forests and Corridors Centered on Mission Beach;
2. Southern Atherton Tableland/Evelyn. High Quality Rainforest on Basalt Soil; and
3. All Native Unprotected Forest in Lowlands north of Daintree River to Emmagen Creek.

The following provides the basic justification for the above listings:

Mission Beach Lowlands

- Largest remaining lowland mosaic complex with rare and threatened communities (i.e. Types 3a, 3b, 1a, 18, 17-24, etc). The 'last stand' of lowland forest;
- Largest remaining cassowary population in Australia. Vital for their survival;
- Numerous rare and threatened species, and important corridor links.

Southern Atherton Tableland/Evelyn Tablelands on Basalt

- Node of rainforest complexity and diversity;
- Core refugial area with concentration of regionally endemic species (e.g., Tree Kangaroo 'hot spots', rainforest endemic frog, reptile, mammal and bird core habitats);
- Cassowaries and large concentration of rare and threatened species (e.g., Lake eacham Rainbowfish), and species of biogeographic signisicance (e.g., Gondwanic species);
- Rare rainforest types (5a, 1b) on fertile soils;
- Highly important corridors remain which have escaped past clearing, or have regenerated naturally.

Daintree Lowlands North of Daintree River

- Refer to reports by A. Small, S. Goosem, L. Webb, G. Werren, G. Tracey, etc.

The Supporting Technical Document: Environment identified 41 areas of Outstanding Biodiversity Significance (see Regional Environment Strategy Steering Committee 1997, pp84-90) and the following Regional Conservation Priorities (Vegetation Communities):

- Lowland complex mesophyll vine forest (Tracey and Webb Type 1a);
- Coastal palm rainforest (Types 3a, 3b);
- Southern Atherton Tableland/Evelyn Tableland high quality rainforest on basalt soil (especially types 5a, 1b and Type 5b [to the north-west]);
- Vine forest types on beach sand (Types 7 and 2b);
- Wet sclerophyll (Types 14a; 14b);
- Coastal melaleuca swamps (Types 15a, 18);
- Mosaics of coastal wetlands with rainforest and sclerophyll (especially melaleuca and palm forest) (Types 17, 18, 19, 20, 23a).

The regional conservation priorities with respect to plants and animals, although now considered to be well out of date (M. Trenerry, EPA *pers. comm.*), were identified as:

Plants

- *Sankarskya stipularis;*
- *Toechima pterocarpum;*
- *Carronia pedicellata;*
- *Vrydagzynea paludosa;*
- *Malaxis lawleri;*
- *Lycopodium dalhousianum;*
- *Phalaenopsis amabilis;*
- *Firmaina papuana;*
- *Lepiderema* sp.; and
- *Actephila foetida*

Animals

- Mahogany glider;
- Tropical bettong;
- Cassowary;
- Declining rainforest stream frogs;
- Yellow-bellied glider (fluffy glider);
- Arboreal rainforest marsupials (possums & tree-kangaroos); and
- Lake Eacham rainbowfish.

The most significant of the Regional Rehabilitation Priorities in the FNQ region were:

- Links between the Bellenden Ker Range and the Graham Range to Russell River NP through riparian strips and vegetation corridors;
- Consolidation around the Herberton Range including links around Mt Fisher;
- Rehabilitation of the Tolga Scrub and consolidation of type 5b rainforest communities;
- Links in the Julatten area through riparian strips and vegetation corridors; and
- Consolidation and repair of fragmented seasonally inundated swamplands including Fan Palm, Feather palm and Melaleuca wetlands.

3.4.3. LOCAL INITIATIVES

As reported in the Background Report (Volume 1 of this series), the Wet Tropics NRM Region wholly or partly covers eleven Local Government Areas and two Aboriginal Community Councils. Local government responsibility for land use planning and development is the most significant mechanism through which councils contribute to biodiversity conservation. Mechanisms in place include strategic plans, development control plans, land use designations, local planning policies, by-laws and vegetation

protection ordinances. The *Integrated Planning Act* requires all local governments to have new statutory planning instruments in place by 2004[15]. It should also be noted that places supporting biodiversity or resilience are recognised as 'valuable features' under IPA, which means that they are one of the core matters that must be addressed by local governments in a planning scheme (Kingham 1999).

Maintenance of local government community infrastructure such as Shire roads and water supplies within the WTWHA is being managed under agreed codes of practice developed co-operatively between WTMA and local government. Where there is inconsistency between a management plan prepared under the *Wet Tropics World Heritage Protection and Management Act 1993* and a local government planning scheme, the Wet Tropics Plan prevails over the planning scheme to the extent of the inconsistency. Local governments may apply to have the Wet Tropics Management Plan amended should the need arise to place critical community infrastructure in natural areas. The amendment process would involve public exhibition of an envronmental impact study and approval from Governor in Council. At the time of writing (January 2004) Mareeba Shire was pursuing such an amendment for provision of an emergency access route to Russett Park.

All local government jurisdictions within the region have developed Pest Management Plans that identify and target the major environmental and agricultural weeds and pest animals found within different sections of the region. As discussed earlier in this report, these are currently being amalgamated into a Regional Pest Management Strategy (Werren 2004), under the auspices of FNQROC.

The significance of local government involvement in biodiversity conservation was affirmed with the endorsement of a *National Local Government Biodiversity Strategy* by unanimous vote at the National General Assembly of Local Government in November 1998. The document represented an agreed local government position at the national level on the management of biodiversity, recognising that (Campbell & Kitching 1999):

- conservation and sustainable use of our natural resources will only be achieved through local area planning and management, along with community education and participation;
- there is a willingness of local government across Australia to play a lead role in dealing with our most pressing and complex conservation issue – the loss of biodiversity; and
- a clear and cooperative partnership arrangement is required between the three spheres of government.

Some local governments in the NRM Region have responded with non-planning scheme measures. For example, the Johnstone Shire launched its *Strategy for the Conservation of Biodiversity in the Johnstone Shire* in early 2004. The purpose of this policy is to:

- Identify priority areas for conservation of biodiversity in the Johnstone Shire; and
- Provide a prioritised list that will be recognised by funding bodies as a strategic approach towards conservation of biodiversity in the Johnstone Shire.

It was also prepared to provide Council and the Shire Community with *inter alia* a link into the regional NRM process in regards to conservation of biodiversity (Dryden 2004).

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[15] The Aboriginal Community Councils are subject to IPA and ATSI Councils can choose to prepare an IPA Planning Scheme or deal with land use under a By-law prepared under the *Community Services (Aborigines) Act 1984*.

The contribution and commitment of other local governments, such as Douglas Shire, is reflected in their ongoing pursuit to develop and implement innovative environmental improvements and best practice standards and through their successful encouragement of local community involvement in the Douglas Shire region. Indeed, most local governments are supporting community-based programs to protect and manage biodiversity in the Wet Tropics.

3.4.4. WIDER COMMUNITY INVOLVEMENT

As reported by the EPA (1999a), community groups and networks play a vital role in monitoring, organizing and linking individuals in community conservation activities. The success of Bushcare and other NHT programs, organisations such as Conservation Volunteers Australia (CVA), EDO-NQ and Greening Australia, and community conservation networks such as the Marine and Coastal Community Network and the Threatened Species Network are testimony to the positive role of these groups. Peak conservation organisations are also active in stimulating public debate on conservation issues and are involved in public policy formulation, direct action campaigns and public media and education campaigns. The umbrella group for these organisations in the NRM Region is the Cairns and Far North Environment Centre (CAFNEC), based in Cairns.

Many community groups and organisations in the NRM Region take part in projects to protect, rehabilitate or restore biodiversity. For example, there are a large number of groups actively involved in tree planting:

- QPWS Centre for Tropical Restoration;
- TREAT (Trees for the Evelyn and Atherton Tablelands);
- Greening Australia;
- Private Forestry North Queensland
- CVA;
- C4 (Community for Coastal and Cassowary Conservation);
- School for Field Studies;
- Catchment and Landcare groups; and
- Individual landholders.

Other groups, such as Birds Australia (North Queensland Group), the Low Isles Protection Society (LIPS), Tree Kangaroo and Mammal Group (TKMG) and Wildlife Preservation Society of Queensland (WPSQ, branches in Cairns, Tully and Ingham), regularly monitor aspects of biodiversity and aim to increase public awareness of, and involvement in, the protection and recovery of threatened species and their habitat. Some local governments also support community efforts through their conservation and environmental programs and employ local government conservation, vegetation, wildlife and extension officers.

All these groups are achieving very significant improvements to the region's environment and in time should contribute to the gradual re-establishment of ecosystem processes to many of the region's degraded landscapes.

The Natural Heritage Trust (NHT) program has been a major funding source for many community group projects in Queensland and the Wet Tropics. Of the 399 projects funded across the State in 1997-98, 58% were conducted by community groups. The investment in community projects represented 38% ($9.7million) of the total funding. State government agencies attracted 48% of the funding.

The Wet Tropics Regional Directory is currently collating NHT project information for the Wet Tropics Region for the period 1997 - 2001. One hundred and thirty projects were approved with funding totalling $11.9million (Catterall & Harrison *in prep.*). Community groups commenced 68 (52%), Local Council Organisations 31 (24%) and State Government Departments 22 (17%) projects (Harrison *et. al.* 2002). The majority

of projects were managed through the Bushcare (55 projects), Landcare (36) and Rivercare (29) Programs. As at May 2003, 86 had been completed (44, 28 and 14 respectively). Of these, 55 involved vegetation works, 49 through the Bushcare and Landcare Programs.

The 49 Bushcare and Landcare projects referred to above received $6.8 million (57%) in NHT funds, with total project funds equalling $18.9 million (Table 57). Reinstatement of 584 ha of native vegetation absorbed $6 million NHT funds with a further $11M being contributed by partner organisations ($17.1 million in total). The cost of reinstating one hectare of vegetation, regardless of program, averaged $29000 (Total $). Enhancement of 251 hectares of vegetation was achieved with $0.7 million NHT funds and averaged at $6000 per hectare (Total$). The two protection projects undertaken costed to $67/hectare NHT funds or $138/ha in Total funds, however further verification of this data is required (refer to Catterall & Harrison *in prep.*).

Table 57: Vegetation work types, costs, and types of achievement (Source: Catterall & Harrison *in prep.*) (Funds are in thousands of dollars).

Onground Activity	No. of Projects	Protect-ion (ha)	Enhance-ment (ha)	Reinstate-ment (ha)	Project Area (ha)	NHT $K	Total $K	NHT$K/Area	Total $K/Area
Protection	2	2300	10	7	2317	154	305	0.07	0.13
Enhancement	18	120	87	44	251	682	1477	3	6
Reinstatement	28*	1	46	538	584	6040	17083	10	29
Non specific	1	1	1	0	2	3	23	2	15
Total	49	2422	143	588	3153	6879	18888		

*Includes outcomes from the two reinstatement projects funding the WTTPS 1997-2001.

The majority of vegetation enhancement and protection projects (57%) covered areas up to 5 hectares (Catterall & Harrison *in prep.*). These small projects received over one million dollars (44%) in NHT funds considered and comprised 17% (60 ha) of all on ground works examined. These small projects also had the highest $/ha costs; $9000 for enhancement and $17000 for reinstatement for 1- 5 ha projects. Reinstatement of less than 1 ha averaged to $78000 per hectare. Projects were concentrated in the Barron (14) and Johnstone (15) River catchments. For further information, see report *Rainforest Restoration Activities in Australia's Tropics and Subtropics* (Catterall & Harrison *in prep.*).

The extent and effectiveness of community involvement across the region, while substantial, are difficult to assess as the number of groups and their members fluctuate considerably and depend on the groups' current activities and funding arrangements. Under new NHT reporting requirements, data on the extent of community group involvement are beginning to be collated to enable reporting against national NHT indicators.

With a few notable exceptions (see box), Indigenous involvement in NRM activities in the region has been lacking. Figures from the NHT Program demonstrate that Indigenous peoples received only one percent of available funding, despite being major landholders (*Regional Environment and Natural Resource Management Forum, Wet Tropics Region, Forum Proceedings, 14-15 March 2002, Cairns*). According to Horsfall there are about 30 Aboriginal organisations concerned with land and sea management within the Wet Tropics region. These organisations are heavily involved in a range of ongoing processes such as Native Title issues. Organisations that deal with land and sea matters include *inter alia* Bama Ngappi Ngappi, Bamanga Bubu Ngadimunku Inc, Bar-Barrum Aboriginal Corporation, Budjubulla, Buringu Aboriginal Corporation, Djabugay Ranger Agency, Djabugay Tribal Aboriginal Corporation, Girringun Aboriginal Corporation, Jimmar-ma Aboriginal Corporation, Jirrbal

Aboriginal Corporation, Ma:Mu Aboriginal Corporation, Ngadjon Mitch Yarrabah Community Council, Wujal Wujal Community Council, and Yirrganydji Corporation.

More information on community involvement in biodiversity conservation initiatrives is provided later in this report (See *Off-Reserve Conservation,* Section 3.4.6.).

CASE STUDY: MONA MONA COMMUNITY NATURAL RESOURCE MANAGEMENT

The Djabugay Ranger Agency is the Cultural and Land Management Agency of the Djabugay Tribal Aboriginal Corporation. They received a devolved grant from the NRM Board (Wet Tropics) to undertake to implement the recommendations of the Mona Mona Environmental Protection Plan. This involved setting up wildlife corridors, building strategic fencing areas, and the rehabilitation of degraded areas to limit threatening processes caused by feral animals and weeds.

Activities undertaken included:

- Conducting a Flora and Fauna Survey of key habitats in Mona Mona;
- Implementing the Fauna Protection Plan including identification of habitat corridors and strategic fencing area; and
- Conducting wide-spread consultation and dissemination of project information.

The partner organisations were the Wet Tropics Management Authority and the Department of Aboriginal and Torres Strait Islander Policy and Development, and there was on ground support from the Environmental Protection Agency.

The project provided an opportunity for people to get back to 'country' and to learn about fauna surveys and the biology of fauna from a western scientific perspective, and for the information gained to go back to the community.

'The project was about getting information going back into the community. The money was used to get us on country. We were able to pay four fellows to be part of the team…we got to know the differences between Melomys and other rats…we are learning more about the species, its biology….'

Barry Hunter (Jnr), quoted in Regional Environment and Natural Resource Management Forum, Wet Tropics Region, Forum Proceedings, 14-15 March 2002, Cairns.

Djabugay Fauna Study (Photo: Barry Hunter Jnr.).

3.4.5. TERRESTRIAL PROTECTED AREAS

In Queensland, many categories of reserves provide different levels of protection. While all categories of reserves, including multiple-use categories, are significant for biodiversity conservation, those that have nature conservation as their primary role are particularly important (EPA 1999a).

The Queensland *Nature Conservation Act* provides for the declaration of protected areas that are representative of the State's biodiversity, natural features and landscapes. Several classes of protected areas provide for varying levels of protection in the Plan area (shown as 'nature conservation' on Figure 1.5). National parks (scientific), national parks, conservation parks and resources reserves are declared over Crown land only. National parks (Aboriginal land) can be declared over Crown land and various land tenures described in the *Aboriginal Land Act*. Nature refuges, coordinated conservation areas, wilderness areas, world heritage management areas and international agreement areas can be declared over other forms of tenure, including private land. Each protected area is managed in accordance with the management principles outlined in the Act and the purpose for which the protected area was created.

An inspection of the Natural Resources Assessment Atlas V2.0 reveals that the Wet Tropics bioregion has 376,204 ha under reserve tenure. This represents 19% of the total area of the bioregion and includes 20 national parks and five conservation parks. The Atlas provides a ranking of reserve management and the Wet Tropics bioregion is assessed as 'poor'. The Einasleigh Uplands bioregion, meanwhile, has only 2.42% of its total area under reserve tenure and includes 10 National Parks, two Conservation Parks and three Resource Reserves. Parts of two national parks (Lumholtz and Forty Mile Scrub) occur within the Plan area. The bioregion has a reserve management ranking of 'fair'.

Protected Area Status of Ecosystems

Of the 98 Wet Tropics regional ecosystems (REs) known from the NRM Region, 74 are represented in protected areas[16]. Those REs that occur within the NRM Region but are not represented in protected areas are listed and described in Table 58. This list includes 11 'endangered' and six 'of concern' REs (after Sattler & Williams 1999). Significant gaps include acid peat sedgelands on the Atherton Tablelands, several open forest and woodland ecosystems on the drier basalt uplands, a range of woodland ecosystems on well drained lowland alluvial soils, and riparian open forest ecosystems and hoop pine dominated rainforests in the southern sub-regions (Goosem *et. al.* 1999). It should also be noted that both the 'endangered' RE 7.8.3 (Complex notophyll vine forests of the moist lowlands, foothills and uplands, *sensu* Webb & Tracey Type 5b) and RE 7.11.19 (Pink bloodwood woodland on moist to dry metamorphic foothills and uplands), which is 'of no concern at present', although not listed in Table 58, are represented in protected areas <1000 ha.

Twelve of the 35 Einasleigh Uplands REs that occur within the NRM Region (current to mid 2003) are not represented in protected areas, including seven 'of concern' REs (Table 60).

The Cape York REs 3.3.1 and 3.3.6 are protected in reserves outside of the NRM Region. However, the 'endangered' RE 3.8.3 has no representation in protected areas. This RE is associated with basalt flows around Lakeland Downs and Hopevale and less than 10% remains of a naturally restricted type (7070 ha original extent) (Goosem *et. al.* 1999).

In total, 87 of the 136 REs that are recognised within the NRM Region (current to mid 2003) are represented in protected areas. This represents 64% of the total ecosystem diversity in the NRM Region. By comparison, 67% of Australia's ecosystem diversity is captured by national parks and formal reserves, with a further 5% included in other protected areas and covenants on private land (NLWRA 2002).

Table 58: REs of the Plan area not represented in protected areas[1]. Code: S&W (Sattler & Williams 1999); VMR (*Vegetation Management Regulation 2000* [Qld]). [1]It is noted that Wet Tropics RE 7.11.15 is listed by Goosem *et. al.* (1999) as having no representation in protected areas. This RE has since been transferred to the equivalent RE in land zone 12 (7.12.13) (J. Kemp, Queensland Herbarium *pers. comm.*), which is represented in both Lumholtz and Tully Gorge NPs.

Bioregion	RE	Description	Province	Conservation status	
				S&W	VMR
WET TROPICS	7.2.2	Notophyll vine forests with *Acacia* spp. emergents of the moist and dry lowlands on siliceous and calcareous beach sands.	8	Endangered	Endangered
	7.3.2	Closed sedgeland/grassland on poorly drained, periodically flooded, acid peat in alluvial depressions and volcanic craters (e.g. Bromfield Swamp) on the Atherton Tableland.	4	Endangered	Endangered

[16] Two of the remaining seven REs from the Wet Tropics bioregion are represented in Black Mountain NP, near Cooktown (i.e. within the Cape York NRM Region).

Bioregion	RE	Description	Province	Conservation status	
				S&W	VMR
	7.3.13	Low to medium woodland with *Corymbia nesophila, Eucalyptus tereticornis, E. intermedia, C. tessellaris, E. platyphylla, Lophostemon suaveolens, Xanthorrhoea johnsonii*; dry lowland and foothills on red sandy and gravelly alluvial soils in the Ayton-China Camp area.	9	Endangered	Endangered
WET TROPICS	7.3.18	Mesophyll rainforest with emergent *Corymbia intermedia, Syncarpa glomulifera, Acacia polystachya* and *A. mangium* on moderately sloping piedmont fans of well drained sandy clay loam and sandy light clay, often with a large gravel component.	2,3,9	No concern at present	Of concern
	7.3.24	*Melaleuca dealbata, M. leucadendra* forest associated with riparian areas and relict levees of prior streams on fertile moderately drained alluvial soils.	1,2	Endangered	Endangered
	7.3.25	*Melaleuca dealbata, M. fluviatilis, Corymbia tessellaris* open forest with vine thicket and rainforest species on stream levees and prior streams on well-drained sandy clay loam alluvial soils.	1	Endangered	Endangered
	7.8.5	Notophyll vine forests characterised by, and canopy dominated by, *Acacia melanoxylon* and *A. aulacocarpa* on cloudy wet uplands and highlands on basaltic krasnozems.	4	No concern at present	Not of concern
	7.8.6	Semi-deciduous mesophyll vine forest on moist basaltic kraznozem foothills.	3,9	Endangered	Endangered
	7.8.7	Tall open forest and tall woodland of *Eucalyptus tereticornis, Corymbia injtermedia, E. phaeotricha, Angophora floribunda* and *Allocasuarina torulosa* of the moist uplands and highlands on basaltic krasnozem and prairie soils.	4	Endangered	Endangered
	7.8.8	Low to medium woodland with *Eucalyptus phaeotricha, Corymbia intermedia, E. crebra, Syncarpia glomulifera, E. pellita* and *Allocasuarina torulosa* of the moist uplands and highlands on basaltic krasnozem and prairie soils.	4	Endangered	Endangered
	7.8.9	Low to medium woodland with *Eucalyptus leptophleba, Corymbia clarksoniana, E. platyphylla, C. dallachiana, C. tessellaris, E. tereticornis, Erythrophleum chlorostachys, Lophostemon grandiflorus, Melaleuca viridiflora, M. minutifolia, Allocasuarina littoralis, A. luehmannii* and *Livistona muelleri* of the dry uplands on basaltic euchrozem-krasnozem.	4	Of concern	Of concern
	7.8.10	Low to medium woodland with *Eucalyptus tereticornis, E. acmenoides, Corymbia intermedia, C. tessellaris, Allocasuarina torulosa* and *Angophora floribunda* of the dry uplands and highlands on basaltic euchrozem-krasnozem.	4	No concern at present	Of concern
	7.11.2	Mesophyll vine forest dominated by the fan palm *Licuala ramsayi* on wet foothills and tablelands on humic gley metamorphic-derived soils with seasonally impeded drainage.	8	Endangered	Endangered

Bioregion	RE	Description	Province	Conservation status	
				S&W	VMR
	7.11.8	Notophyll vine forests with *Acacia* emergents on moist metamorphic lowlands and foothills.	2,3,8	Endangered	Endangered
WET TROPICS	7.11.15	Simple notophyll rainforest characterised by *Acacia melanoxylon* and/or *A. aulacocarpa*, of the cloudy wet uplands and highlands on metamorphic yellow earths.	6,8,9	No concern at present	Not of concern
	7.11.16	Tall open woodland with *Corymbia intermedia, Allocasuarina torulosa, Lophostemon suaveolens* of the moist uplands on metamorphic red and yellow earths.	5,6	Of concern	Of concern
	7.11.20	Medium woodland and open forest with *Corymbia nesophila, C. intermedia, Eucalyptus tetrodonta. C. tessellaris, E. tereticornis, E. acmenoides, E. brassiana, Erythrophleum chlorostachys, Xanthorrhoea johnsonii* of dry metamorphic lowlands and foothills on yellow and red podzolics.	9	Of concern	Of concern
	7.12.2	Mesophyll vine forest, dominated by *Licuala ramsayi,* of the very wet lower foothills on granitic grey earths with seasonally impeded drainage (includes sheet flood fans).	3,9	Of concern	Of concern
	7.12.3	Mesophyll rainforest, with *Eucalyptus tereticornis, Corymbia tessellaris, C. intermedia, Acacia aulacocarpa* and *A. flavescens* emergents, of the wet and moist foothills on granitic red earths.	6,9	No concern at present	Not of concern
	7.12.10	Notophyll araucarian vine forest (with *Araucaria cunninghamii*) of the moist foothills and uplands on granites of the Seaview and Paluma Ranges.	5	Of concern	Of concern
	7.12.11	Notophyll semi-evergreen vine forest of the moist and dry foothills and uplands on granites of the eastern escarpments of the Seaview and Paluma Ranges.	5	No concern at present	Of concern
	7.12.12	Notophyll vine forest with *Acacia* spp. emergents on moist granitic foothills.	5,8	Endangered	Endangered
	7.12.18	Low microphyll araucarian vine forest (often with *Araucaria cunninghamii*) of the moist and dry foothills and uplands on granites of the Seaview and Paluma Ranges.	5	Of concern	Of concern
	7.12.23	Tall open woodland, with *Corymbia intermedia, Allocasuarina torulosa* and *Lophostemon suaveolens*, of the moist uplands on red and yellow earths from granites and acid volcanics.		Of concern	Of concern
	7.12.27	Low to medium woodland with *Eucalyptus phaeotricha, Corymbia intermedia, E. tereticornis, Syncarpia glomulifera, E. pellita, Allocasuarina torulosa* on moist uplands and highlands on shallow granitic and acid volcanic soils.	6,7	No concern at present	Of concern
	7.12.33	Low to medium woodland, with *Corymbia nesophila, Eucalyptus crebra, E. brassiana, E. tetrodonta, E. acmenoides, Erythrophleum chlorostachys, Xanthorrhoea johnsonii*, on dry upper, mid and lower slopes of granitic hills and ranges on granitic podzols.	9	No concern at present	Not of concern
EINASLEIGH UPLANDS	9.3.4	Swamps, lakes and billabongs on alluvial plains and their associated vegetation.	3,5,6	Of concern	Of concern
	9.3.7	Lakes on Tertiary surfaces, often formed against basalt flows, and their associated vegetation.	5,6	Of concern	Of concern

Bioregion	RE	Description	Province	Conservation status	
				S&W	VMR
	9.5.2	Dry rainforest on deep red earths on Tertiary sandstone plateaus.	6	Of concern	Of concern
EINASLEIGH UPLANDS	9.7.1	*Eucalyptus persistens* woodland, with of without a lower tree storey, on texture contrast soils on partially stripped Tertiary plateaus.	6	No concern at present	Not of concern
	9.7.2	*Acacia shirleyi* open forest on skeletal soils and red earths of Tertiary plateaus.	6	Of concern	Not of concern
	9.8.2	*Corymbia clarksoniana* and *Eucalyptus leptophleba* woodland on red basalt soils.	3,6	Of concern	Not of concern
	9.11.1	Eucalyptus shirleyi woodland on skeletal soils on hills on folded sedimentary and metamorphic rocks.	2	No concern at present	Not of concern
	9.11.2	*Eucalyptus crebra* and *Corymbia dallachiana* woodland on shallow podzolics soils on hills and downs on folded sedimentary and metamorphic rocks.	2	No concern at present	Not of concern
	9.11.4	*Corymbia citriodora, Eucalyptus drepanophylla, E. acmenoides* and *E. cloeziana* open forest on skeletal soils on hills on sedimentary and metamorphic rocks.	3,6	No concern at present	Not of concern
	9.11.7	*Eucalyptus platyphylla* woodland on texture contrast soils of lowlands on folded sedimentary and metamorphic rocks.	3	No concern at present	Not of concern
	9.11.10	*Eucalyptus* spp. open woodland on a variety of rock types west of Herberton. Includes serpentinite outcrops and other restricted habitats.	6	Of concern	Not of concern
	9.12.3	*Eucalyptus tetrodonta, Corymbia* sp. and *Erythrophleum chlorostachys* open forest or tall woodland.	2	No concern at present	Not of concern

According to the Australian Natural Resources Assessment Atlas V2.0, the main reservation priorities are lowland vine forest and sedgeland communities. The priority communities include 7.11.8 - notophyll vine forest with acacia (*Acacia sp*p.) emergents on moist metamorphic lowlands and foothills, 7.3.2 - sedgeland and grassland freshwater swamps of seasonally inundated tableland volcanic craters and alluvial depressions, 7.8.3 - complex notophyll vine forest on moist basalt lowlands, foothills and uplands, 7.11.2 - mesophyll fan palm (*Licuala ramsayi*) swamp vine forest on very wet poorly drained metamorphic foothills and tablelands, 7.12.12 -notophyll vine forest with acacia (*Acacia spp*.) emergents on moist granite lowlands and foothills, 7.3.13 - Melville Island bloodwood (*Corymbia nesophila*) woodland on dry well drained lowland gravelly alluvial soils, 7.2.2 - notophyll vine forest with acacia emergents of moist to wet coastal lowlands on beach sands and 7.3.25 - weeping tea-tree (*Melaleuca fluviatilis*), *Melaleuca leucadendra*, Moreton Bay ash (*Corymbia tessellaris*) open forest with notophyll riparian vine forest spp., on levees.

In the drier part of the Plan area, the major reservation priorities consist of areas of serpentinite, dry rainforest, and fringing lake communities. The priority communities include 9.11.10 - eucalypt woodlands on serpentinites and other restricted habitats, 9.5.2 - dry vine forest on deep red earths on Tertiary sandstone plateaus, 9.3.7 - Lakes on Tertiary sand plains, 9.8.2 - Bloodwood and Molloy Red Box on red soil plains and 9.3.11 - lakes and seasonally flooded depressions on basalts (Australian Natural Resources Assessment Atlas V2.0).

This work has demonstrated the importance of Lumholtz National Park with respect to the protected area status of REs. This park protects 47 REs (38 from the Wet Tropics and nine from the Einasleigh Uplands), which probably makes it one of the most

biodiverse national parks in the state. The importance of Daintree National Park, which protects 37 Wet Tropics REs, is also particularly evident.

It is also worth noting that some of the unprotected Wet Tropics REs are located just outside the Plan area. For example, RE 7.3.9 is restricted to the Wyaaba Plain north of Wujal Wujal, RE 7.3.15 is confined to a dry area between Trevethan Creek and Mount Amos, and RE 7.11.9 is confined to the eastern and northern escarpments of the Paluma Range. Other unprotected REs from both the Wet Tropics and Einasleigh Uplands, although represented in the Plan area, have better representation in adjacent Plan areas. For example, RE 7.12.23 occurs mainly in the moist uplands at the head of the Burdekin River, RE 7.12.33 is confined to the coastal ranges north of the Bloomfield River and RE 9.11.10 occurs on a variety of rock types west of Herberton.

In parts of the Wet Tropics NRM Region, the opportunity to implement a comprehensive reserve system has been lost or is rapidly diminishing and the data above highlight the importance of working cooperatively across NRM planning regions.

Bioregional Priorities for the Further Consolidation of Australia's Protected Area System

The goals of the National Reserve System (NRS) Program are the establishment and management of a comprehensive, adequate and representative system of protected areas (EPA 1999a). Under the NRS Program, a number of projects are funded through the NHT with the aim of extending the national reserve system and developing best practice management.

The *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002) set bioregional priorities for the further consolidation of Australia's protected area system on a 1 to 5 priority scale (1 being the highest priority).

The Einasleigh Uplands scored a reservation priority of 2 (second highest) and the Wet Tropics scored 4 (second lowest). However, the NLWRA (2002) was at pains to stress that within these bioregions, some sub-regions may have particular reservation needs owing to the disproportionate level of threat or the number of ecosystems or species requiring protection through reservation. The authors cited the Wet Tropics as an example, writing:

> *'This bioregion contains extensive national parks and the World Heritage Area occurring over the upland sub-regions. However, the limited reservation, number of threatened species and ecosystems and degree of threatening processes throughout the lowlands identify these sub-regions as high priority for expanded reservation compared with low priority for a number of the upland sub-regions. Additional reservation of lowland alluvial ecosystems also will contribute significantly to the protection of wetlands and fisheries.' (NLWRA 2002, p.123)*

Table 59 shows the sub-regional priorities of the Wet Tropics NRM Region. They are classed as high, medium and low priority. Table 60, meanwhile, shows the regional ecosystem priorities to consolidate the National Reserve System and associated ecosystem constraints.

Table 59: Sub-regional priorities to consolidate Australia's protected area system (Source: Australian Natural Resources Atlas V2.0).

Sub-region	Priority
Wet Tropics	
1. Herbert	High
2. Tully	Medium
3. Innisfail	High
4. Atherton	High
5. Paluma-Seaview	Low
6. Kirrama-Hinchinbrook	Low
7. Bellenden Ker-Lamb	Low
8. Macalister	Low
9. Daintree-Bloomfield	Low
Einasleigh Uplands	
2. Kidston	High
3. Hodgkinson Basin	High
5. Undara-Toomba Basalts	Low
6. Herberton-Wairuna	Medium

Table 60: Ecosystem priorities to consolidate the National Reserve System and associated ecosystem constraints (Source: Australian Natural Resources Atlas V2.0)[1].

Bioregion	Ecosystem	Ecosystem priority notes	Ecosystem constraints
WET TROPICS	7.11.16	Declining ecosystem. No representation	Economic constraints
	7.11.2	Endangered declining ecosystem. No representation	Irreplacibility
	7.11.8	Endangered rapidly declining ecosystem. No representation	Limited opportunity to meet comprehensiveness, adequacy and representativeness (CAR) criteria
	7.12.12	Endangered declining ecosystem. No representation	Limited opportunity to meet CAR criteria
	7.12.2	Declining ecosystem. No representation	Economic constraints
	7.2.2	Endangered declining ecosystem. No representation	Limited opportunity to meet CAR criteria
	7.3.13	Endangered declining ecosystem. No representation	Irreplacibility
	7.3.2	Endangered declining ecosystem. No representation	Limited opportunity to meet CAR criteria
	7.3.24	Endangered declining ecosystem. No representation	Irreplacibility
	7.3.25	Endangered declining ecosystem. No representation	Limited opportunity to meet CAR criteria
	7.8.3	Endangered rapidly declining ecosystem. No representation	Limited opportunity to meet CAR criteria
	7.8.6	Endangered ecosystem. No representation	Limited opportunity to meet CAR criteria
	7.8.9	Declining ecosystem. No representation	Economic constraints
EINASLEIGH UPLANDS	7.12.10	Declining ecosystem. No representation	Economic constraints
	7.12.21	No representation	Economic constraints
	7.12.22	No representation in bioregion. Declining	Economic constraints
	7.12.23	No representation	Economic constraints
	7.12.24	Declining ecosystem. No representation	Economic constraints

EINASLEIGH UPLANDS	7.12.27	No representation vulnerable ecosystem	Economic constraints
	7.3.21	No representation	Economic constraints
	7.8.7	No representation of endangered ecosystem	Limited opportunity to meet CAR criteria
	9.11.10	No representation of declining ecosystem	Economic constraints
	9.3.11	Low representation EIU4,5. Declining	Economic constraints
	9.3.7	No representation of declining ecosystem	Economic constraints
	9.5.2	No representation vulnerable ecosystem	Economic constraints
	9.5.3	Declining ecosystem. Low representation EIU2,4	Economic constraints
	9.8.2	No representation vulnerable ecosystem	Economic constraints
	9.8.3	Declining ecosystem. Low representation EIU5	Economic constraints

[1] Comprehensiveness, Adequacy and Representativeness criteria in this assessment are defined as:
Comprehensiveness: the degree to which ecosystems identified at an appropriate regional scale are captured in the reserve system across each bioregion. This is recorded as the percent reserved.
Adequacy: the area (hectares and percent of the area of the bioregion) reserved in each bioregion, recognising that this does not address the complex issues of viability particularly for rare and threatened species and ecosystems, and other special organisms.
Representativeness: the degree that the inherent variation within an ecosystem is reserved. This is assessed by the degree to which ecosystems are captured in protected areas across their geographic range as measured by their representation across sub-regions. This information is presented as a proportion of ecosystems that are represented across their whole sub-regional range (ie. 100% of their sub-regional range) and the proportion of regional ecosystems that are represented across 50% or more of their sub-regional range.

The QPWS Master Plan 2000 acknowledges the rights and interest of Indigenous peoples in respect of protected areas. It states that:

> *'Responsibilities, interests and aspirations of the Indigenous peoples will be respected in relation to their lands, and their roles in park management will be supported. The Parks system will be managed with a high level of cooperation between Indigenous peoples and the Service in a manner appropriate to Indigenous cultural heritage and the protection of natural and cultural values.'*

Another major Queensland Government initiative is the '*Towards a Ten Year Partnership with Aboriginal and Torres Strait Peoples*'. This has resulted in a draft Land, Natural Resources and Cultural Heritage Agreement, 'Looking After Country Together'. The three key outcomes, which are the focus of the Agreement, are:

- Increased Indigenous access to land and sea country;
- Stronger Indigenous involvement in planning and management of land and sea country; and

- Stronger Indigenous involvement in and influence on broader natural resource planning and policy development.

Wet Tropics World Heritage Area

As reported in Section 1, the Wet Tropics World Heritage Area (WTWHA) is one of two WHAs represented in the Plan area, the other being the Great Barrier Reef. Complementary Commonwealth and State legislation creates a comprehensive scheme of environmental protection and management for these areas.

Changes in Land Ownership and/or Legal Status

The Wet Tropics NRM region contains about 91% (816,512.979 ha) of the WTWHA. This comprises a variety of land tenures including freehold, leasehold, unallocated state land, state forest, timber reserve, forest reserve and national park (Figure 11) and a corresponding range of government agencies and private land holders with responsibilities for managing these tenures under different legislation. World Heritage listing does not affect land ownership. Land management agencies are still responsible for issuing permits on land under their jurisdiction.

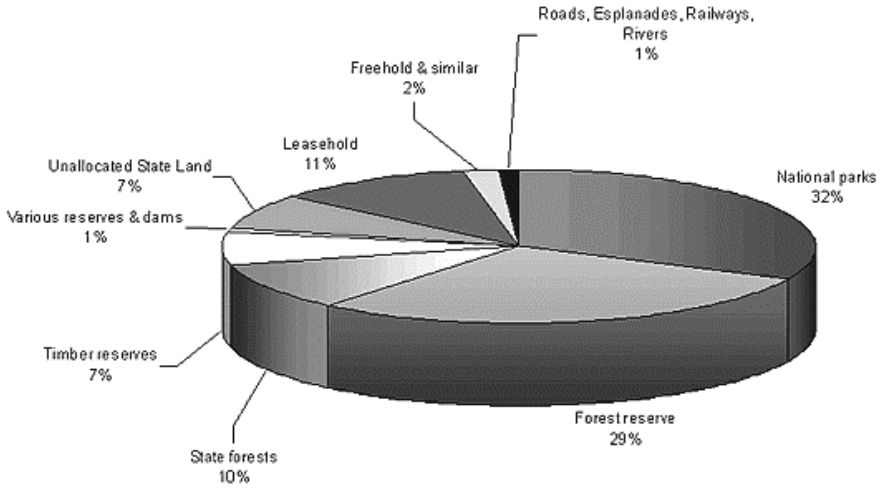


Figure 11: Representation of various tenures in the WTWHA (Source: WTMA Website).

Under the Wet Tropics Management Plan, landholders may have certain special rights (subject to certain conditions). These rights apply to:

- freehold title holders;
- native title holders; and
- government landholders.

Freehold and native title rights include:

- building a residence;
- building an access;
- establishing a garden or orchard; and
- extracting water for domestic use.

Special rights for government landholders include operation of community infrastructure.

Transfer of ownership of leasehold or privately owned land is not restricted. However, WTMA's general policy is to support the conversion of land tenure within the WTWHA to achieve a higher order of protection where opportunities arise. The outcome of this policy has seen the area of national park increase by 35,878 ha between

1992 and 2000, state forests also increased by 26,510 ha over this period while the total area of leases and freehold land has been reduced by 53,055 ha.

WTMA in consultation with QPWS has developed acquisition priorities for lands within or adjoining the WTWHA. The acquisition policy for lands both within and external to the WHA is supported by a Board adopted guideline that provides criteria for assessment of offers of land and for determining priorities between different offers.

To encourage a positive and cooperative atmosphere with landholders, WTMA only pursues voluntary land acquisition. WTMA only enters into land acquisition negotiations where funds are available and other avenues for protecting World Heritage values have been considered and found to be inappropriate or unachievable**.** Other protection mechanisms might include:

- cooperative management agreements;
- Nature Refuge declarations;
- tenure related dealings (e.g., lease conditions, management plans etc);
- conditions applied to development consents;
- facilitated land transfers to ownership supportive of the protection of natural values;
- land swaps where alternative properties are available; and
- possible future conservation incentives such as rate/tax rebates

Area Management

In 1990 the Comonwealth and Queensland Governments agreed on a freamwork to manage the Wet Troics World Heritage Area. They decided to establish a small Cairns-based agency which would be responsible for managing the Wet Tropics according to Australia's obligations under the World Heritage Convention. Unlike a regular Government department, it would answer to both levels of Government, and it would be directed by an independent board of directors appointed by the Ministerial Council (WTMA Website).

Wet Tropics Management Authority

WTMA is a relatively small, policy-focussed organisation with about 30 staff members. It is not responsible for day-today management issues such as maintenance, routine permits, and enforcement activities, which are the responsibilities of the QPWS. However, it is responsible for the coordination of on-the-ground management to ensure the WHA is properly protected. WTMA's main functions are:

- To developand implement the management plans, policies and programs;
- To administer funding arranagements;
- To promote research and monitor the state of the Wet Tropics;
- To enter into cooperative management agreements and other arrangements with land holders and Aboriginal people;
- To develop community education programs; and

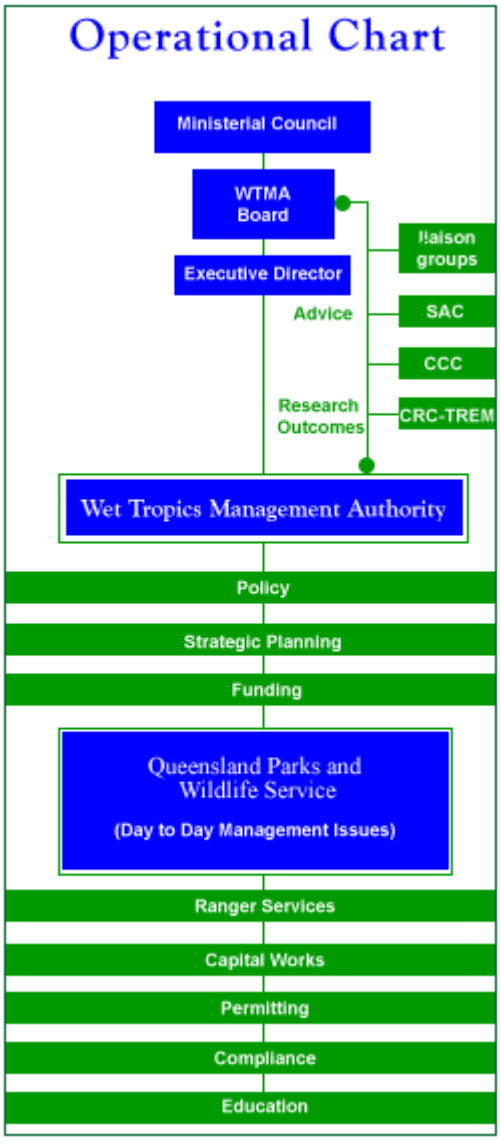


Figure 12: WTMA Operational Chart (Source: WTMA Website).

- To promote the Wet Tropics locally, nationally and internationally.

WTMA's activites include:

- Policy and planning - major strategic planning for the Area including the Wet Tropics Plan, specific issue-based plans, and coordination with other regional planning processes such as FNQ2010 and the new regional NRM arrangements;
- Research and monitoring – enhancing understanding of the importance of the WHA and monitoring the State of the Wet Tropics on an annual basis;
- Funding – applying allocated funds for strategic outcomes, seeking new funding sources and new ways of value-adding to existing managemenmt programs;
- Education and interpretation – through visitor centres, signs and displays, public and education programs;
- Threat abatement – providing advice and strategic support for feral pig trapping programs, weed control, and fire management; and
- Involvement of Aboriginal communities – through the Interim Negotiating Forum process (see below).

Indigenous Management

Under the Wet Tropics Management Plan, Aboriginal people can enter into voluntary agreements with WTMA. The first such agreement occurred in 2001 with the Djabugay Tribal Aboriginal Corporation regarding Mona Mona. Agreements have also been reached with Ma:Mu people in the development of a canopy walk and long distance trail (memorandum or understanding). An MOU between EPA, WTMA and the *Ngadjon Jii* Traditional Owners was signed in February 2003, which relates to traditional *Ngadjon Jii* lands that fall within the boundaries of the Wooroonooran National Park.

Aboriginal Resource Management Program

WTMA's Aboriginal Resource Management Program (ARM) is responsible for helping WTMA build partnerships with Rainforest Aboriginal peoples to facilitate their involvement in the management of the Wet Tropics World Heritage area. ARM also assists in incorporating Aboriginal perspectives into other Authority programs. The program works closely with, and assists, Aboriginal representative organisations such as ATSIC (Aboriginal and Torres Strait Islander Commission), North Queensland, Cape York and Central Queensland Land Councils and Girringun Elders and Reference Group and key tribal organisations such as Djabugay Tribal Aboriginal Corporation and the Burungu Aboriginal Corporation operating within the area.

The major role of ARM is to ensure that effective and appropriate communication, negotiation and consultation occurs between WTMA, land management agencies and the rainforest Aboriginal community. There are three positions for Aboriginal community liaison officers (CLOs) to work with the ARM program to facilitate the involvement of rainforest Aboriginal people in the management of the WTWHA.

Interim Negotiating Forum

One of the key recommendations of the 'Which Way Our Cultural Survival' which was a review of Aboriginal involvement in the management of the Wet Tropics World heritage Area was the establishment of an Interim Negotiation Forum (INF) whose objective is to negotiate solutions to difficult management issues identified in the review.

The INF is made up of an Aboriginal Negotiating Team, a Government Negotiating Team and a neutral facilitator. It has been set up to facilitate the Wet Tropics regional agreement negotiation process and to develop the final agreement. The key issues to be discussed within the INF are:

- Recognition of the cultural values of the world heritage area;
- Native title;
- Aboriginal involvement in policy, planning and management;
- Development of meaningful management agreements; and
- Traditional resource use, and the use of ecological knowledge.

Other Areas Protected

Several of the region's State forest and timber reserves are dedicated to flora and fauna conservation. During 2001/02 a program of conversion of State forests within the WTWHA to the protected area estate was undertaken. Approximately 288,400 ha of State forest within the WTWHA was transferred under the *Nature Conservation Act 1992* to forest reserve, of which 259,382 ha is unencumbered by leases. This tenure conversion, which occurred in 2001, involved 32% of the WHA, with further staged transfers scheduled over the next few years. As reported in the Background Report (Volume 1 of this series), a media release issued in late 2003 confirmed the Queensland Government's decision to give higher protection to nearly half a million hectares of tropical forest in the WTWHA. Queensland Premier, Peter Beattie, was quoted as saying that almost all of the 480,889 hectares of state forests and timber reserves in the Wet Tropics of north Queensland would become national park.

Local government also plays an important role in acquiring and protecting areas of significant conservation value through enforcement of development controls, regulation of clearing and purchase of land (see box). Increasingly, non-profit organisations (e.g. Bush Heritage Fund, Australian Rainforest Foundation) are acquiring and managing areas of ecological importance. This work is largely funded by donations from the public.

3.4.6. MANAGEMENT OF THREATENED SPECIES AND ECOSYSTEMS

As reported earlier, 395 officially listed rare and threatened plant species or subspecies and 101 rare or threatened animals occur in the Wet Tropics NRM Region. State-listed rare and threatened species are afforded statutory protection under the *Nature Conservation Act 1992.* The lists are contained in the *Nature Conservation (Wildlife) Regulation 1994.*

The Commonwealth's EPBC Act lists nationally threatened ecological communities and species and provides for the development and implementation of recovery plans. Environment Australia's Endangered Species Program is implemented through parallel programs run by the State. QPWS is the lead agency with respect to species recovery planning within Queensland. Recovery plans comprehensively describe, schedule and cost actions assessed as necessary to support the recovery of threatened species. Recovery plans are presently in place for the following Wet Tropics species:

- stream-dwelling rainforest frogs (seven species);
- magnificent broodfrog;
- cave-dwelling bats (three species, two within Plan area);
- northern bettong;
- mahogany glider; and
- cassowary.

Resource constraints presently limit the implementation and expansion of recovery programs with only these programs being prepared or implemented in the region for 14 endangered animal species compared to about 150 threatened species of both plants and animals. Draft recovery plans for the spotted-tailed quoll and marine turtles have been prepared and one for Mabi Forest (Complex Notophyll Vine Forest, *sensu* Webb & Tracey Type 5b), which was recently added to the national list of critically endangered ecological communities under the EPBC Act, is currently in preparation (N. Tucker, *pers. comm.*). Reptiles, rainforest frogs, and freshwater fauna are identified in the

Australian Natural Resources Atlas V2.0 as the priority groups for recovery actions within the Wet Tropics. Freshwater fauna and reptiles require inventory, and life history information as initial recovery actions.

Many more species in the Plan area are subject to Australian action plans (see Appendix C). Action plans are strategic documents undertaken by scientists to review the status of a defined group of related organisms (e.g. reptiles, frogs). They review the conservation status of major Australian taxonomic groups against IUCN categories, identify threats and recommend actions to minimise those threats. Action plans assist government and non-government organisations to establish national priorities for threatened species conservation.

The EPBC Act also gives special conservation protection to listed migratory and marine species, many of which occur in the coastal zone of the Plan area (see Chapter 2). There is an *Action Plan for the Conservation of Migratory Shorebirds in the East Asian-Australasian Flyway: 2001-2005* (Shorebird Working Group of Wetland International – Asia Pacific 2001).

In terms of active on-ground management, the Cassowary Advisory Group is a community-based group that is provided with administrative support by WTMA. The group has been particularly active in the three cassowary hotspots of Mission Beach, the Daintree lowlands and Kuranda. Intensive field surveys have been completed in these areas, which identify individual cassowaries, their habitats and threats to their survival. On ground recovery actions to minimise the identified threats have been initiated in partnership with community groups, other government agencies and local government.

The Rainforest CRC in collaboration with JCU, the Commonwealth Department of the Environment and Heritage, WWF and several government bodies hosted a conference and workshop on amphibian diseases in August 2000. This conference brought together the world's leading authorities on this topic. Several very practical outcomes resulted including agreed and documented management strategies aimed at decreasing the risks to frogs due to communicable diseases (Speare 2001). These strategies have been adopted as acceptable field protocols for all researchers involved in handling stream-dwelling frogs in the WTWHA.

The Rainforest CRC, in collaboration with the Queensland Department of Main Roads and WTMA, has also been undertaking a range of research aimed at identifying and separating the impacts of roads and their associated edge effects on wildlife from the impacts of traffic volume, noise and pollutants on wildlife. A preliminary report of their findings has been published (Goosem & Turton 2000). A feature of this work has been the trailing of practical solutions to the dual problems of roadkill and habitat fragmentation. In 2000-01, the Department of Main Roads built three dedicated fauna underpasses as part of a major road upgrade near Millaa Millaa and supported the construction of canopy bridge trials at various sites in the Wet Tropics (Goosem & Weston 2002; see also Weston 2003).

Off-Reserve Conservation

As reported by the EPA (1999a), the establishment of a representative protected areas is widely regarded, both nationally and internationally, as one of the most effective mechanisms for protecting biodiversity in situ while permitting the sustainable use of natural resources. However, it is now realized that protected areas, constrained in size by human population pressures and political realities, will be inadequate to protect biodiversity in the long-term (Hale & Lamb 1997).

Most of the Wet Tropics region is still managed for production-oriented outcomes. While much biodiversity exists on this land, the amount managed for conservation purposes or used in an ecologically sustainable manner is not known. While much is under leasehold with some regulatory controls in place, approximately 25% (543,315 ha) is managed by private landholders under freehold tenure with little control in place. Much of this freehold land still retains considerable biodiversity, e.g. while about

264,000 ha have already been cleared, 95,000 ha are still covered by rainforest vegetation (Annandale 2002).

While strategies are in place to increase the protected area network, opportunities for acquisition of large tracts of land for conservation are diminishing, due in part to the small size of the many remnants (e.g. Atherton Tablelands), urban development and acquisition costs. These costs are very high in the more fertile parts of the Plan area. An example is the scale of investment required to protect remaining habitat of the endangered mahogany glider and other threatened lowland species and ecosystems at risk from sugarcane and other agricultural expansion. Through the Sugar Coast Environmental Rescue Package, $15 million of the total $16 million funding package was allocated for land acquisition.

Increased attention is being given to further protection and sustainable use of biodiversity outside protected areas. This 'off-reserve' conservation involves a range of strategies to involve landholders in the management of biodiversity on their land. Several local governments in the region offer or manage a range of financial incentives including grants, rate deferrals and rebates, management agreements, covenants, revolving funds and development benefits (see box 'Ecosystem Management through the Johnstone Shire Planning Scheme'). Other incentive schemes (e.g. Bush Tender Trials) have yet to be applied in the region, while local government could do more to encourage the expansion of private forestry in areas of the landscape that may contribute to the ecosystem services of the region (see LGAQ's Private Forestry Model Planning Framework) (G. Borschmann, Greening Australia, *pers. comm.*). Industry Codes of Practice also provide opportunities for increasing the conservation of biodiversity off reserve.

ECOSYSTEM MANAGEMENT THROUGH THE JOHNSTONE SHIRE PLANNING SCHEME

The Johnstone Shire is located within the Wet Tropics bioregion and contains 39 regional ecosystems. Many of these ecosystems are endangered or of concern, as are many of the species contained within them, including plants, mammals, birds, frogs, insects and fish. Large areas of these ecosystems are on freehold land and are unprotected through state and federal legislation. The proposed Planning Scheme will expand on the habitat protection provisions contained in the current Scheme that uses incentives for landowners to protect habitat on their site.

The proposed Planning Scheme and Planning Scheme Policies contains:

- Rural Conservation Precinct where increased development density may be permitted in exchange for long term habitat protection;
- Measures to restrict development including the clearing of native vegetation in identified habitat areas; and
- Measures to ensure wildlife corridors are protected from fragmentation by fencing and roads.

These provisions in combination with other non Planning Scheme measures should contribute to the long-term protection of the Shire's habitat systems.

(**Source**: Jones 2002)

BIODIVERSITY CONSERVATION – A GRAZIER'S PERSPECTIVE

Consideration of the prevailing environmental position is possibly one of the foremost issues the landholder addresses.

As each issue becomes better understood more sound science and technical assistance is sought by landholders (in this instance, graziers) from the various agencies. Although economics are the primary driver, equally important are the social and environmental outcomes.

Effects of the drought on the environment and how landholders address the problems.

The station in question is in northwest Queensland, and is doing it tough like 70% of rural Queensland. In January of 2003 a decision was made to destock, having again experienced minimal annual rainfall and the 'wet' still hadn't arrived. The economic loss of selling into a declining market was considered, however the stock were in reasonable condition and would return at least cost price. This needed to be considered with the alternative of going through another year having to feed the cattle, even though there was still a chance of a late wet.

The major issue was to give the country time to recover. Without livestock and fencing waterways to keep out neighbouring livestock, the native pastures have regenerated. Within a few months and with modest rain these pastures are returning (it needs to be understood that approximately $200,000 was foregone by taking this decision).
A major problem is feral pigs and wallabies. The swan, duck and turtle population has noticeably declined. Unfortunately the pigs are getting onto the islands that are made as the water recedes, digging up and eating the eggs. This is an area we are addressing by gaining the cooperation of adjoining landowners. Trapping, shooting and baiting is a high priority, given the need to retain both our fragile topsoil, which is lost through pig diggings, and also our native species. Another problem is the potential for damage by rubber vine and lantana and other weed infestations.

An acknowledgement by landholders of the importance of keeping good ground cover appears to have significantly reduced sediment, while contributing to biodiversity conservation.

(Source: Roz Burtenshaw, 'Coolgarra' Station, Mt Garnet)

Integrated Natural Resource Management

Integrated natural resource management projects include wetland restoration, creating a flood level database, encouraging owls onto sugarcane farms, rate rebates for landholders entering into conservation or land management agreements and developing irrigation strategies with treated effluent (Australian Natural Resources Atlas V2.0).

Appendix E provides some indication of the contribution of integrated NRM to the protection of biodiversity in each sub-region represented in the NRM Region by tabling the measures and their effectiveness (from NLWRA).

According to the NLWRA, priority actions for natural resource management in the Wet Tropics include:

- Proactive targeting of nature refuge program;
- On-ground conservation works to protect remnant areas and riparian vegetation;
- Re-establishment of vegetation in critical locations; and
- Creative local government planning instruments.

In the drier parts of the Plan area, grassy and shrubby eucalypt woodlands including riparian areas require conservation action through habitat protection on private lands and reserves. Grazing pressure needs to be controlled and in places removed through fencing and feral animal control (Australian Natural Resources Atlas V2.0).

Coolgarra Station, upper Herbert catchment (Photo: Ros Burtenshaw).

Farm forestry plot near Babinda (Photo: Nigel Weston).

Restoration of Biodiversity

The rehabilitation of degraded lands and the restoration of ecosystems are important elements of landscape conservation management throughout the bioregion. Rehabilitation aims to revive important ecological services on degraded lands. More ambitiously, restoration attempts to bring lands modified by human use back to their natural state. Left to natural processes many small, disturbed areas will return to something like their pre-disturbance condition. How long natural recovery takes depends upon the type of ecosystem and the type and severity of disturbance. However, even where an ecosystem might naturally revive after disturbance, tree-planting programs can dramatically speed recovery and assist in directing successional processes. Revegetation undertaken as private forestry intended for varying degrees and styles of harvest also demonstrates a very real rural business activity that delivers wider benefits to the community (G. Borshman, Greening Australia, *pers. comm.*).

Most projects established within planning frameworks rely on catchment management plans or local government conservation strategies. The Wet Tropics Vegetation Management Program developed a series of action plans in consultation with Traditional Owners, Landcare and catchment groups, CSIRO, local government and state government staff. The importance of revegetation was also recognised in the FNQ Regional Plan and it has been used to assign priority for a range of revegetation action plans. Data are currently being compiled through the Wet Tropics Regional Directory project (Harrison *et. al.* 2002) to assess the effectiveness of these activities across the region. In future, they will be guided by a new Regional NRM Plan that is being developed in response to the requirements of the extension of the NHT Program. Other planning instruments, like the Wet Tropics Conservation Strategy, will, in turn, inform the NRM Plan.

3.4.7. RESEARCH AND MONITORING

Managing and conserving the region's natural values requires accurate, reliable and timely scientific information from both the natural and social sciences. It is a requirement of the new generation NRM plans that they be based on 'best available science'. Sound science allows management to devise suitable environmental and social policies and to develop appropriate strategies. Intensified efforts are being made to identify and fill information gaps, to harmonise information from different sources and to strengthen capacities in information collection and analysis. The capacity to manage, analyse and present information in a form useful for decision making at the management level is critical.

As the State Government agency with primary responsibility for nature conservation in Queensland, the EPA/QPWS conduct monitoring of and research on threatened ecosystems, rare and threatened species and protected area management issues. Within the Planning Area, QPWS Conservation Services Unit focuses particular attention on research and management priorities for species including the endangered southern cassowary, mahogany glider, northern bettong, marine turtles and declining frogs. Habitat mapping for the southern cassowary and mahogany glider has been developed as planning and assessment tools. Problematic threatened species including the estuarine crocodile and fruit bats are also subject to research and management effort. QPWS directs significant resources into the development and implementation of fire management programs across the protected area estate. The program includes monitoring the response of vegetation communities to fire prescriptions. Through its Center for Tropical Restoration, QPWS undertakes habitat restoration works and integrated weed management on protected areas and critical landscape linkages. This unit continues to work closely with the Rainforest CRC and wider community in all aspects of ecosystem restoration, including monitoring of use in restoration areas by wildlife species.

One of the EPA's major initiatives (through the Queensland Herbarium) is the identification of REs and the continuing mapping of their remnant and pre-clearing extent. The Queensland Herbarium also documents Queensland's flora and vegetation communities; carries out plant identification, vegetation surveys and mapping; and undertakes taxonomic and ecological research (EPA 1999a).

The EPA has prepared a Biodiversity Assessment and Mapping Methodology (BAMM) to provide a consistent approach for assessing biodiversity values at the landscape scale in Queensland using vegetation mapping data generated or approved by the Queensland Herbarium as a fundamental basis. The BAMM is being used by the EPA to generate Biodiversity Planning Assessments (BPAs) for each of Queensland's bioregions, although the Wet Tropics has yet to be assessed. The BPAs can be used by Agency staff, other government departments, local governments or members of the community to advise a range of planning or decision-making processes.

Continuing statewide assessment of wetlands is being undertaken through the Queensland Wetland Inventory Program. Regional-scale identification, classification and delineation of all wetland aggregations, including the characterising of wetlands relevant to criteria of importance, are major priorities (EPA 1999a).

As Queensland's lead land management agency, the Department of Natural Resources & Mines is involved in researching and monitoring land management issues that directly and indirectly affect biodiversity. The Statewide Landcover and Trees Study (SLATS) is directed at monitoring land clearing, tree growth and regrowth. Data are used for policy decisions regarding sustainable land management.

The Queensland Museum is a major public research institution involved in identifying the region's biodiversity. Museum staff undertake taxonomic and ecological research on the region's fauna.

The *Wet Tropics Research and Information Needs Report* (WTMA 2000b) provides an outline of the management areas, issues and priorities WTMA and its land management

partners have identified as important, and identifies research and associated activities it would like seen undertaken over the next seven years. WTMA has been a partner in the Cooperative Research Centre for Tropical Rainforest Ecology and Management (Rainforest CRC) since its inception in 1993. This Centre brings together the research capabilities and facilities of:

- CSIRO;
- James Cook University;
- Griffith University; and
- The University of Queensland.

The seven research programs of the current term of the Rainforest CRC (1999 to 2006) are:

- Environmental planning and management in tropical rainforests;
- Functional ecology: evaluating ecosystem goods and services in a dynamic landscape;
- Rainforest visitation and business;
- Rainforest access: managing and monitoring impacts;
- Rehabilitation and restoration;
- Conservation principles and management; and
- Aboriginal and collaborative management.

The outcomes of the Rainforest CRC's research programs are being progressively utilised and incorporated into planning and management across the region. The *Wet Tropics Research and Information Needs Report* is being used as a key component in promoting World Heritage research priorities within the Rainforest CRC and with other research organisations. Research projects recently targeted and funded by WTMA were:

- Forest dieback mapping and impact assessment;
- Development of an infrastructure corridor (weed and ecological connectivity) monitoring system;
- Fish stocking and translocation scoping study;
- Development of socio-economic indicators;
- Development of a visitor monitoring system;
- Visitor surveys; and
- Community attitudes surveys

Current major research areas include the impact and control of feral pigs (with the Pest Animal Control CRC) and global warming in the Wet Tropics. The Rainforest and Reef CRCs are also about to commence a joint research program to develop tools to identify and monitor the impacts of land-based contaminants on water quality and the health of rivers, reefs and associated habitats. The program, called *Catchment to Reef*, includes a number of postgraduate scholarships in the following research areas:

- Remote sensing of water quality in coastal waters of the Great Barrier Reef;
- Effects of water quality on inshore corals of the Great Barrier Reef;
- Effects of water quality on seagrass meadows of the Great Barrier Reef;
- New technologies for sampling organic pollutants in coastal seas;
- Reproductive biology of fishes on tropical floodplains;
- Stress in freshwater animals as an indicator of river health; and

- Geomorphological dynamics of Wet Tropics rivers.

As reported above, the CSIRO is a partner organisation of the Rainforest CRC. Through its Tropical Landscapes Program, CSIRO is delivering benefits to the region by applying scientific skills in partnerhip with the people who influence, use and manage the landscape. The Tropical Landscapes Program is based at CSIRO Sustainable Ecosystems offices in Atherton, Brisbane and Townsville and has a focus on **Tropical Landscapes Ecology and Conservation** as well as **Livelihoods and Environment** and **Production Systems**. The Ecology and Conservation Group aims to assist in the conservation and management of tropical landscapes through ecological research that leads to the resolution of human-conservation conflicts and the development of effective conservation strategies in the face of global change. Research focuses on issues that are **fundamental to the evolution and functioning of tropical rainforests**, with an aim to provide the information and tools upon which management is based. This focus goes beyond biological entities, to consider issues at the landscape scale and within an economic and social context.

Some of the main focus areas include:

- Rainforest plant community and dynamics
- Documentation of regional patterns of landcover change, modelling of vegetation responses to climate variation, estimation of past, present and future vegetation distributions
- Prediction of global climate change impacts on tropical rainforest distribution and biodiversity
- Documenting and predicting the influence of landscape structure on ecosystem processes such as seed dispersal and on processes operating within vertebrate populations
- Conservation and management of threatened species in both natural and agricultural landscapes
- Regional conservation and land-use planning

Some current projects are outlined below:

Regional patterns of tropical forests in relation to climate. Gaining predictive understanding of the dynamics of tropical rainforests in the context of past climates.

Plot scale patterns of forest dynamics. Spatial models of biomass and stocks and flows of mineral elements. Used to predict effects of tropical rainforest disturbance on essential ecological processes using extensive historical data sets.

Regional patterns of landcover change. Mapping landcover change and predicting trends, while understanding human impacts on regional dynamics of the landscape.

Conservation planning. Mapping priority areas for the allocation of scarce biodiversity management resources, e.g. through Rainforest CRC Project 6.5, CSIRO is developing concepts and strategies that incorporate dynamic ecological and evolutionary processes identified in other programs into management tools for conservation planning, setting of priorities and monitoring of biodiversity values.

Landscape change and ecosystem processes. Studying the complex process of seed dispersal and managing the consequences of threats to this process. Using this understanding to inform the management of rainforest remnants and to improve weed management strategies.

On ground conservation management procedures. Development of population monitoring and management procedures for rare and threatened rainforest vertebrates.

For more information, go to <http://www.cse.csiro.au/research/program1/ecology.htm>.

4. LINKS TO THE NEW REGIONAL NRM PLAN

As mentioned in the introduction to this report, a new NRM Plan is currently being prepared for the Wet Tropics. This is being done to meet new planning guidelines for community-based programs such as the Natural Heritage Trust (NHT) Program.

In particular, the NHT extension will have a clear emphasis on regional outcomes. Key elements of this new emphasis will be:

- Regional empowerment and ownership through an integrated regional planning approach to natural resource management;
- Funding that will focus on the natural resource management outcomes to be achieved;
- Establishment of measurable and achievable resource condition and management action targets; and
- Actions based on sound science.

This requires the best possible use of available data and scientific knowledge.

The current study has reported on the current condition of biodiversity resources in the Wet Tropics NRM Region and the pressures acting upon them. It has provided information on the approaches currently being taken to manage these resources and addressed some of the key management actions required for the conservation of biodiversity within the region. In so doing, it has demonstrated the importance of information in setting priorities for investment in biodiversity conservation at the regional level. The information provided in this report provides context for the regional NRM body (FNQ NRM Ltd) in the development of its plan in response to the NHT extension, especially in the target areas of:

- Terrestrial ecosystems;
- Inland aquatic ecosystems;
- Coastal, marine and estuarine ecosystems;
- Significant species and ecological communities; and
- Ecologically invasive species.

As reported in the Background Report (Volume 1 of this series), there has been a lot of research in the Wet Tropics region. This has been both welcome and necessary, given that the region is of great significance to global biodiversity. Befitting this, planning too has flourished and there have been plans and strategies prepared for coasts, catchments, endangered species, world heritage areas, national parks and so on (see Background Report, Volume 1 of this series). Priority biodiversity actions from two key processes dealing with NRM in the Wet Tropics, the former NRM Board's strategy and FNQ Regional Plan, were included in the briefing papers prepared for the Regional NRM Science Panel meeting, held in November 2002.

As reported in the *Australian Terrestrial Biodiversity Assessment* (NLWRA 2002), the challenge before the regional NRM body is how best to utilise these various information sets to create a regional investment strategy, trading-off various values and determining the most cost-effective and achievable activities to improve the productive and environmental quality of the landscape (see box 'Working towards integrated natural resource management').

WORKING TOWARDS INTEGRATED NATURAL RESOURCE MANAGEMENT

Integrating total catchment management with bioregional planning for biodiversity can provide an effective framework for improved natural resource management and the achievement of biodiversity outcomes.

A mix of tools is required to address natural and cultural resource management and biodiversity issues at a range of scales. These tools include:

Preventative measures such as land use planning that recognises the constraints and capabilities of the land and alternative market and non-market values;

Protective measures that protect key natural areas managed principally for nature conservation and the maintenance of landscape function;

Rehabilitation measures that target key degraded resources and threatened biodiversity values;

Extension measures that build an understanding of how natural systems operate and of appropriate practices to maintain ecosystem function, biodiversity and sustainable production;

Decision support systems that integrate biophysical, social and economic needs;

Best practice management that seeks continuous improvement in natural resource management so that biodiversity outcomes are effectively integrated and external costs are minimised;

Demonstration sites to provide examples of improvement as catalysts for change;

Policy initiatives that translate natural resource management aspirations into outcomes;

Incentives to off-set the costs that individuals often bear when implementing practices to manage and protect common resources;

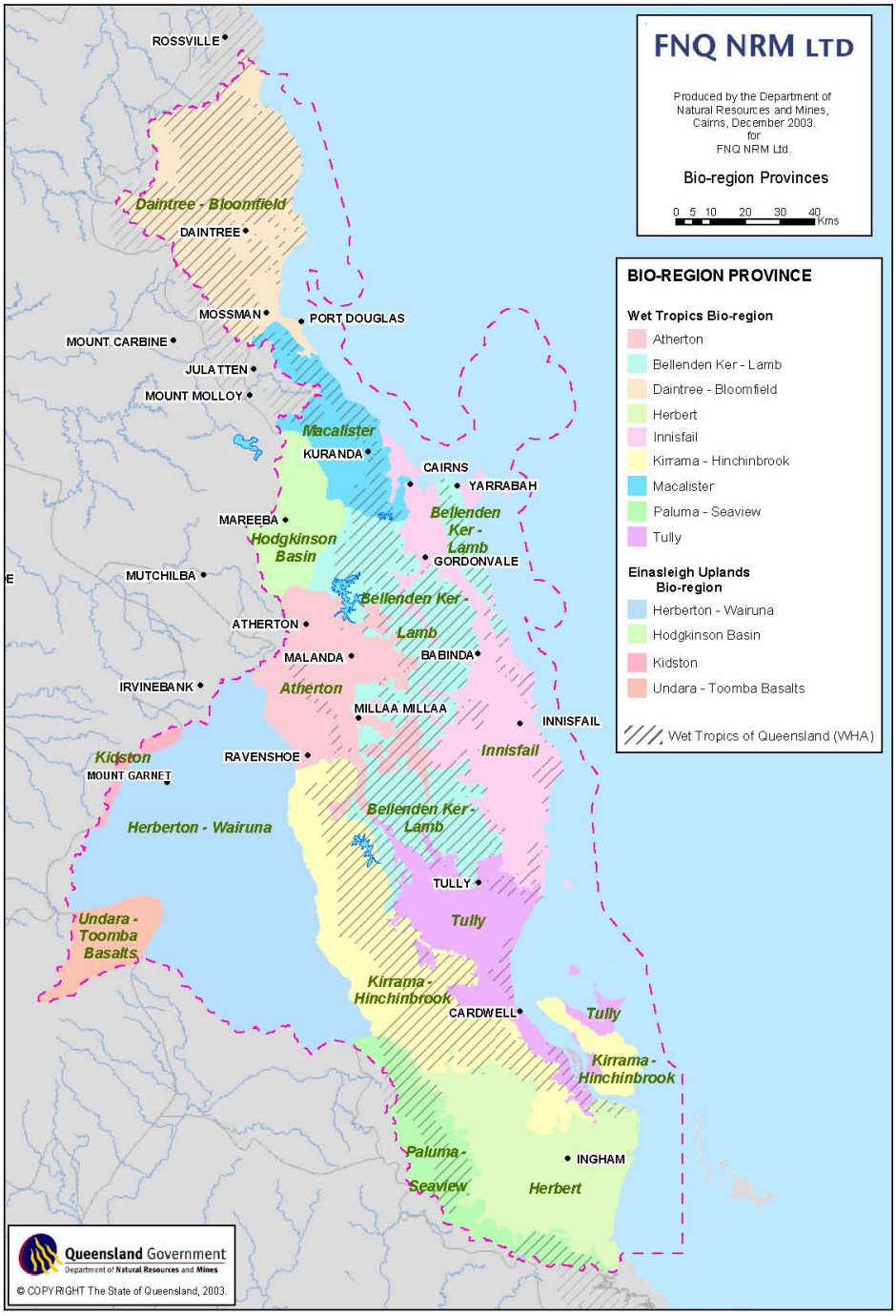
Legislation and regulatory approaches to underpin natural resource outcomes; and

Monitoring and evaluation to assess progress of resource condition and program outcomes.

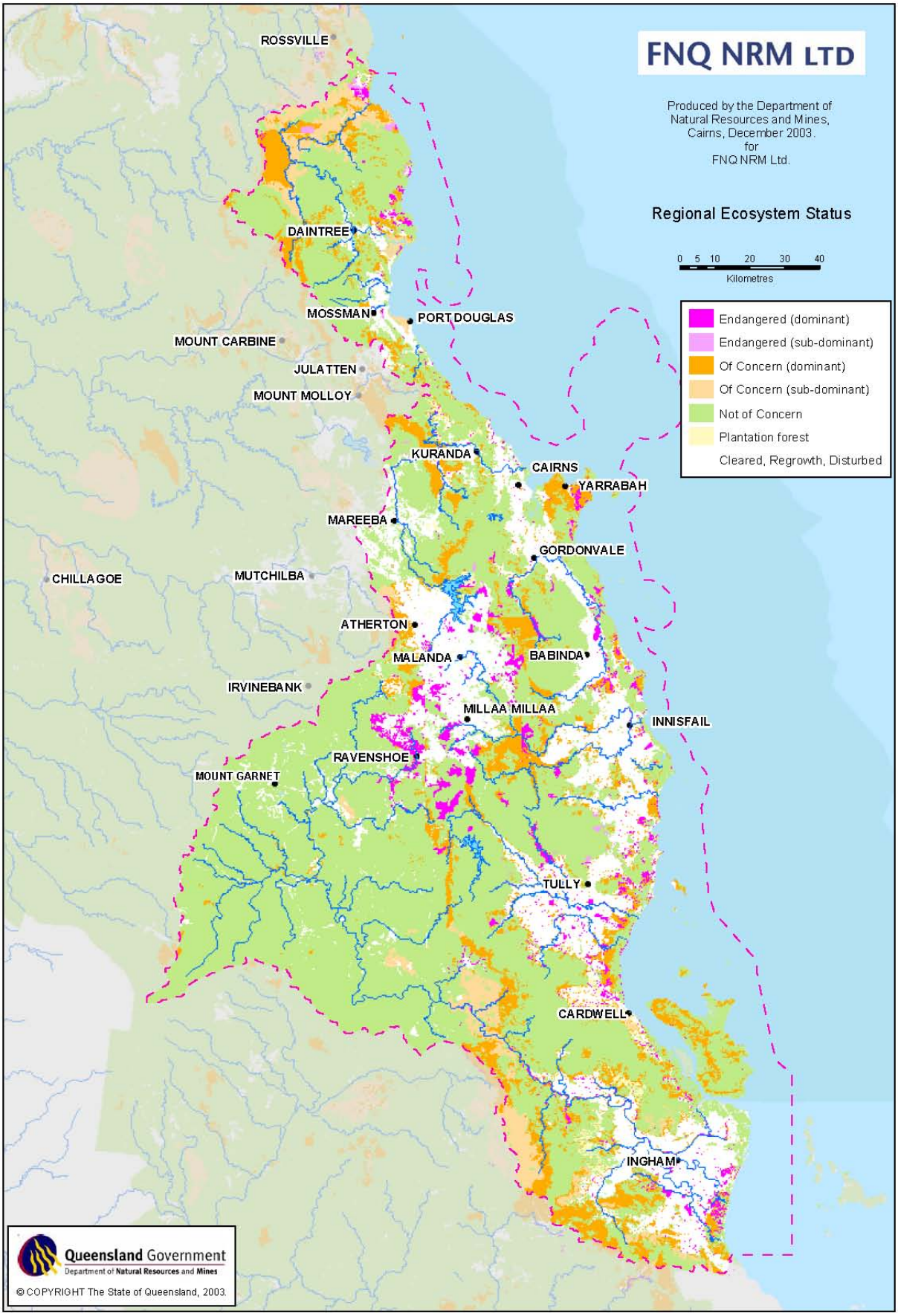
(Source: NLWRA 2002)

It is also crucial to acknowledge that a key challenge for the management of the Wet Tropics NRM region will be the incorporation of Aboriginal cultural values are a key part of NRM, into policy and management. For this to occur there must be recognition by the wider community that these values are not separate to the biophysical values of the region, but an integral part of them. The incorporation of Aboriginal values into management programs and policies offers a number of positive outcomes for the improvement of the management of the Wet Tropics NRM Region. This has been recognised as a key issue for the new NRM Plan.

Finally, it should be noted that the information contained in this report reflects the region's current state of knowledge and data collection and significant gaps remain. Further, several relevant management and decision-support systems are either nearing completion (e.g. Einasleigh Uplands RE mapping), in process (e.g. Rainforest CRC Project 6.5) or have yet to commence (e.g. conversion of Stanton Wet Tropics vegetation mapping into REs, *Catchment to Reef*). These constraints and any identified opportunities should be further investigated so as to inform the development of regional investment strategies for biodiversity conservation in the Wet Tropics.



Map 1: Wet Tropics NRM Region bioregional sub-regions (provinces) (Map: NR&M).



Map 2: Wet Tropics NRM Region RE status (Map: NR&M).

APPENDICES

APPENDIX A

RARE OR THREATENED AUSTRALIAN PLANT (ROTAP) LIST FOR THE WET TROPICS PLANNING REGION

The following steps are an account of how this list was created, validated and finalised.

1. An existing list of ROTAP's from a Wildnet extract of the Wet Tropics bioregion, from Ms Ellen Weber of WTMA, was examined for species accuracy by Andrew Ford (CSIRO). This list contained 342 species. This list outdated nomenclature.
2. A HERBRECS (Queensland Herbarium) extract, dated 2 September 2003, with current nomenclature, showing all ROTAP's for a rectangular area bounded by NW-SE corner decimal degrees (-15.68S and 144.57E, -19.00S and 146.38E) to include areas just outside the Wet Tropics NRM Planning Region (WTPR), was provided by Mr Paul Robins from the Queensland Herbarium.
3. The HERBRECS extract was converted to a text file with all fields kept. The text file was then loaded as a Table into ArcView 3.2 (GIS software), and the ROTAP locations displayed over a background coverage of the WTPR. See Figure 1. The data points created were from actual specimens at the Queensland Herbarium (BRI). A unique list of species within the rectangle was created in Access, and formed the basis of both actual and possible taxa in the WTPR.

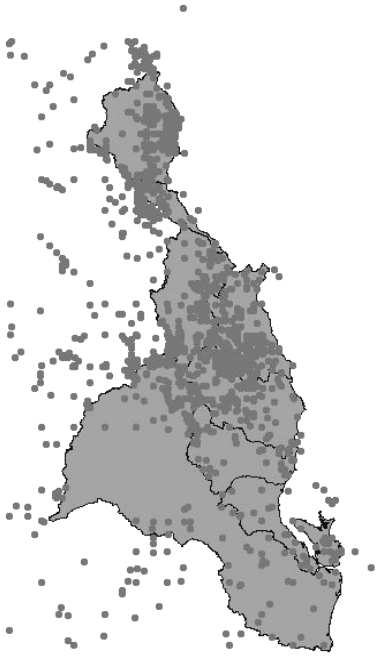


Figure 1: Raw data from BRI

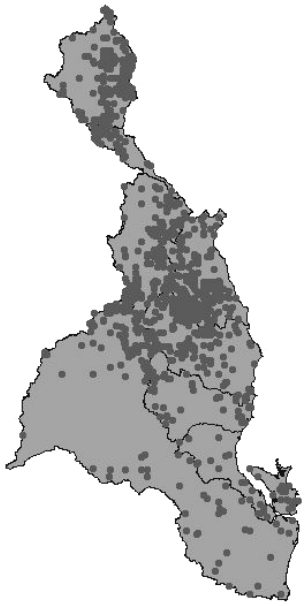


Figure 2: Clipped BRI data

4. Using a simple geoprocessing command in ArcView, the BRI data was clipped to the WTPR (Figure 2), so that actual taxa recorded as present within the WTPR could be further analysed. Taxa eliminated from the region external to the WTPR were examined to ensure they did not occur within the WTPR. A simple spatial analysis of the data was achieved by intersecting the BRI records with the catchment polygons of the WTPR. The output table provided a list of the catchments that each record occurred in. By then doing a simple Unique Values query in Access, each taxa then had a single catchment representation. This data was then entered into the catchment columns.
5. The actual species distributions, determined from the above GIS process, were then analysed against expert opinion, and where necessary alterations to the table were made. In many instances the accuracy of the record was challenged, so that the 'real' locality (on the collection information data), where appropriate,

could be identified on a topographic map. Records from BRI have a precision of accuracy, which enables a 'sphere of influence' to be placed around the actual 'x' on the map. In addition, records were added from personal observations whilst on routine botanical sampling for the Rainforest CRC. Other records were added from the CSIRO, Plant Industry herbarium at Atherton (QRS). Mr Bruce Gray provided personal and valuable comments for Orchidaceae. Figure 3 is an example of a taxon with an apparent narrow distribution in the Russell-Mulgrave and Johnstone catchments (according to HERBRECS). However, a record at QRS from TR 165 (Roaring Meg Creek area) now places this plant in the Daintree-Mossman catchment.

6. Taxa not represented in the WTPR were considered, with many added to the list as they potentially could occur if specific areas were targeted appropriately by ground survey. These species are given a '?' for a catchment in which it was believed they could be found.

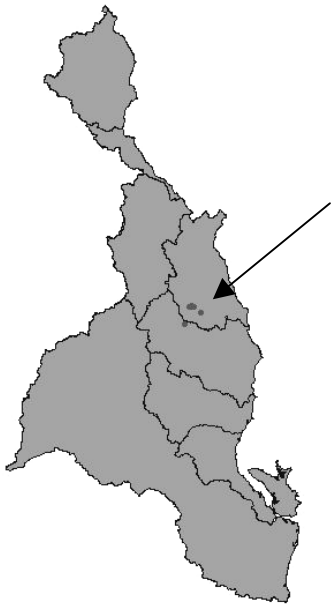


Figure 3: Distribution of Eidothea at BRI.

7. A total of 69 additional species were added to the original list from Wildnet, and 16 species were deleted from the Wildnet list as there were no valid records for them occurring in the WTPR.
8. Conservation Status for the additional species was determined from both the NCA (*de facto* through the HERBRECS extract) and the EPBC (on the Web).

Important Notes

- It was not possible to secure a digital coverage of the WTPR which includes Trinity Inlet. Consequently, several species are marked with a '?' for TI. Thus, the list and catchment presence information should be treated with some caution;
- Many species had their catchment ranges extended through the geographical and botanical knowledge of the compiler (Andrew Ford). It is not a complete or final list for any catchment or species, but merely an initial attempt to categorise the ROTAPs. Certainly other botanists will and may have a very different point of view for certain taxa; and
- No attempt at all was made to fill in the 'Common Names' or 'Dist' column. The 'Dist' is a very complex task. Plants don't know political boundaries, and rarely adhere to them. It is recommended that this task be undertaken as a future project and that some kind of 'confidence interval' be put on each species. It has been suggested that something in the order of 90-95% of an individual species records / observations / populations be present within any designated boundary in order for it to be classified as 'Endemic'. A fine example is with *Flindersia bourjotiana.* It occurs in all sorts of rainforest between the Paluma Range and the McIvor River area. Mostly it is found in the wetter forests of the Wet Tropics bioregion, but at its northern limit it is out of the bioregion. If the 90-95% rule was applied, it is endemic…but if not…

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23 September 2003

Table 1: ROTAP list for the Wet Tropics Planning Region (Source: Andrew Ford, CSIRO).

Class	Family	Scientific Name	Common Name	NCA	EPBC	Dist	B	DM	H	J	RM	TM	TI
higher dicots	Anacardiaceae	Buchanania mangoides		R		U		?				?	
lower dicots	Annonaceae	Haplostichanthus sp. (Coopers Creek B.Gray 2433)		R		U		y					
lower dicots	Annonaceae	Haplostichanthus sp. (Mt Finnigan L.W.Jessup 632)		R		U		y					
lower dicots	Annonaceae	Haplostichanthus sp. (Topaz L.W.Jessup 520)		R		U	y		y	y	y	y	
lower dicots	Annonaceae	Meiogyne sp. (Henrietta Creek L.W.Jessup 512)		R		U		y		y			
lower dicots	Annonaceae	Polyalthia sp. (Wyvuri B.P.Hyland RFK2632)		R		U				y	y	?	?
lower dicots	Annonaceae	Pseuduvaria froggattii		R		U	?	y					
lower dicots	Annonaceae	Pseuduvaria hylandii		R		U				?	y		
lower dicots	Annonaceae	Pseuduvaria mulgraveana var. glabrescens		R		U	y				y		y
lower dicots	Annonaceae	Pseuduvaria mulgraveana var. mulgraveana		R		U					y		
lower dicots	Annonaceae	Pseuduvaria villosa		R		U				y	y	y	
higher dicots	Apiaceae	Oenanthe javanica		R		U	y		y	y			
higher dicots	Apiaceae	Trachymene geraniifolia		R		U		y					
higher dicots	Apocynaceae	Parsonsia bartlensis		V		U		y			y		
higher dicots	Apocynaceae	Parsonsia largiflorens		R		U	y		y				
higher dicots	Apocynaceae	Parsonsia lenticellata	narrow-leaved parsonsia	R		U	y	y	?				
higher dicots	Apocynaceae	Parsonsia wildensis		R		U			y		y		
monocots	Aponogetonaceae	Aponogeton bullosus		E	E	Q			y	y	y	y	
monocots	Aponogetonaceae	Aponogeton elongatus		R		U					y		
monocots	Aponogetonaceae	Aponogeton elongatus subsp. elongatus		R		U				y			
monocots	Aponogetonaceae	Aponogeton proliferus		E	E	U				y			

higher dicots	Aquifoliaceae	Ilex sp. (Gadgarra B.P.Hyland RFK2011)		R		U				y	y	y	
monocots	Araceae	Pothos brassii		R		U		y					
higher dicots	Araliaceae	Polyscias bellendenkerensis		R	V	U		y			y		
conifers	Araucariaceae	Agathis microstachya	bull kauri	R		U	y			y	y		
monocots	Arecaceae	Archontophoenix myolensis		E	E	U	y						
monocots	Arecaceae	Arenga australasica		V	V	U						y	?
monocots	Arecaceae	Linospadix microcarya		R		U		y		y	y		
monocots	Arecaceae	Linospadix palmeriana		R		U		y		y	y		
monocots	Arecaceae	Livistona drudei	Halifax fan palm	V		U			y	y			
lower dicots	Aristolochiaceae	Pararistolochia praevenosa		R		U					y		
higher dicots	Asclepiadaceae	Cryptolepis grayi		R		U	y				y		?
higher dicots	Asclepiadaceae	Marsdenia araujacea		PE	EX	Q			y		y		?
higher dicots	Asclepiadaceae	Marsdenia brevifolia		V		U			?				
higher dicots	Asclepiadaceae	Marsdenia hemiptera	rusty vine	R		U		y					?
higher dicots	Asclepiadaceae	Marsdenia rara		V		U					y		?
higher dicots	Asclepiadaceae	Marsdenia straminea		V		U	y						
higher dicots	Asclepiadaceae	Tylophora rupicola		E	E	Q	y		y		y		
ferns	Aspleniaceae	Asplenium athertonense		R		U	y	y		y	y		
ferns	Aspleniaceae	Asplenium excisum		R		U	y			y	y		
ferns	Aspleniaceae	Asplenium pellucidum		V	V	U				y			
ferns	Aspleniaceae	Asplenium unilaterale		V		U				y	?		
ferns	Aspleniaceae	Asplenium wildii		V	V	U		y			?		
higher dicots	Asteraceae	Glossocardia orthochaeta		R		U			?				
higher dicots	Asteraceae	Peripleura scabra		R		U	y	?	y				
higher dicots	Asteraceae	Peripleura sericea		R		U			?				

higher dicots	Asteraceae	Tetramolopium sp. (Mt Bowen D.G.Fell+ DGF1224)		R		U			y				
ferns	Athyriaceae	Diplazium cordifolium		V	V	U				y	y		?
ferns	Athyriaceae	Diplazium pallidum		E	E	QAI	y				y		y
ferns	Blechnaceae	Pteridoblechnum acuminatum		R		U		y					
higher dicots	Burseraceae	Canarium acutifolium var. acutifolium		V	V	U	y	y		y	y		
higher dicots	Cabombaceae	Brasenia schreberi		R		U	y						
higher dicots	Caesalpiniaceae	Caesalpinia robusta	giant mother-in-law vine	R		U	y			y	y	y	
higher dicots	Caesalpiniaceae	Cassia sp. (Paluma Range G.Sankowsky+ 450)		R		U			y				
higher dicots	Campanulaceae	Pratia podenzanae		R		U	y						
higher dicots	Casuarinaceae	Gymnostoma australianum		R		U		y					
higher dicots	Celastraceae	Euonymus globularis		R		U		y					
higher dicots	Celastraceae	Hexaspora pubescens		V	V	U					y		
higher dicots	Clusiaceae	Garcinia brassii		R		U		y					
higher dicots	Clusiaceae	Mammea touriga	brown touriga	R		U				y	y		
higher dicots	Clusiaceae	Mesua larnachiana		R		U		y					
higher dicots	Combretaceae	Dansiea elliptica		R		U	y				y	y	
monocots	Commelinaceae	Cartonema brachyantherum		R		U			?				
higher dicots	Connaraceae	Rourea brachyandra		R		U	?	y	y	y	y	y	?
higher dicots	Convolvulaceae	Ipomoea saintronanensis		R		U			y				
monocots	Corsiaceae	Corsia sp. (Herberton Range B.Gray 3994)		R		U	y	?	y	y			
higher dicots	Cunoniaceae	Ceratopetalum corymbosum		R		U		y					
higher dicots	Cunoniaceae	Ceratopetalum macrophyllum		R		U		y					
higher dicots	Cunoniaceae	Schizomeria whitei	white birch	R		U	y				y		
ferns	Cyatheaceae	Cyathea baileyana	wig tree fern	R		U	y	y	y	y	y	y	
ferns	Cyatheaceae	Cyathea celebica		R		U	y		y	y		y	

cycads	Cycadaceae	Cycas platyphylla		V	V	U			y				
monocots	Cyperaceae	Carex breviscapa		R		U		y	y		y		
monocots	Cyperaceae	Carex cruciata var. rafflesiana		R		U		y			y		
monocots	Cyperaceae	Cyperus cephalotes		E	E	U			y				
monocots	Cyperaceae	Eleocharis retroflexa		V	V	U					y		?
monocots	Cyperaceae	Fimbristylis adjuncta		E	E	Q					y		
monocots	Cyperaceae	Gahnia insignis		R		U			?			y	
monocots	Cyperaceae	Paramapania parvibractea		R		U		y					
ferns	Dennstaedtiaceae	Oenotrichia dissecta		R		U		y					
ferns	Dicksoniaceae	Calochlaena villosa		R		U	y	y	y				
ferns	Dipteridaceae	Dipteris conjugata		R		U				y	y	?	
higher dicots	Droseraceae	Drosera adelae		R		U			y			y	
higher dicots	Droseraceae	Drosera prolifera	trailing sundew	V	V	U		y					
higher dicots	Droseraceae	Drosera schizandra	notched sundew	V	V	U					y		
ferns	Dryopteridaceae	Dryopteris hasseltii		R		U				y	y		
ferns	Dryopteridaceae	Dryopteris sparsa		V		U		y			y		
ferns	Dryopteridaceae	Lastreopsis grayi		R		U	y				y		
ferns	Dryopteridaceae	Lastreopsis tinarooensis		R		U	y	?			y		
ferns	Dryopteridaceae	Lastreopsis walleri		R	V	U	y		y	y	y		
ferns	Dryopteridaceae	Revwattsia fragilis		R		U		?	?	y		y	
higher dicots	Ebenaceae	Diospyros sp. (Mt Lewis L.S.Smith 10107)		R		U	y	y			y		
higher dicots	Ebenaceae	Diospyros sp. (Mt Spurgeon C.T.White 10677)		R		U		y			y		
higher dicots	Elaeocarpaceae	Aceratium ferrugineum	rusty carabeen	R		U		y					
higher dicots	Elaeocarpaceae	Aceratium sericoleopsis	silky aceratium	R		U				y	y		
higher dicots	Elaeocarpaceae	Elaeocarpus coorangooloo		R		U	y	?	?	y			
higher dicots	Elaeocarpaceae	Elaeocarpus johnsonii	Kuranda quandong	R		U		y		y	y		

higher dicots	Elaeocarpaceae	Elaeocarpus stellaris		R		U		y		y			
higher dicots	Elaeocarpaceae	Elaeocarpus thelmae		R		U		y					
higher dicots	Elaeocarpaceae	Peripentadenia mearsii	buff quandong	R		U		?		y	y		
higher dicots	Elaeocarpaceae	Peripentadenia phelpsii		R		U		y					
higher dicots	Epacridaceae	Acrotriche baileyana		R		U	y				y		
higher dicots	Epacridaceae	Dracophyllum sayeri		R		U		y			y		
higher dicots	Epacridaceae	Leucopogon malayanus subsp. novoguineensis		R		U		y			y		
higher dicots	Eucryphiaceae	Eucryphia wilkiei		V	V	U					y		
higher dicots	Euphorbiaceae	Acalypha lyonsii		V		U	y				?		?
higher dicots	Euphorbiaceae	Actephila foetida		V	V	U		y			y		
higher dicots	Euphorbiaceae	Actephila sessilifolia		R		U			?				
higher dicots	Euphorbiaceae	Austrobuxus megacarpus		R		U		y		?	y		
higher dicots	Euphorbiaceae	Chamaesyce carissoides		V	V	U			?				
higher dicots	Euphorbiaceae	Cleistanthus discolor		R		U	y	y		y		y	
higher dicots	Euphorbiaceae	Cleistanthus myrianthus		R		U		y					
higher dicots	Euphorbiaceae	Croton densivestitus		R		U	y			y	y		
higher dicots	Euphorbiaceae	Dissiliaria tuckeri		V		U		y					
higher dicots	Euphorbiaceae	Glochidion pruinosum		R		U		y					
higher dicots	Euphorbiaceae	Glochidion pungens		R		U		y					
higher dicots	Euphorbiaceae	Macaranga polyadenia		R		U	y	y		y	y	y	?
higher dicots	Euphorbiaceae	Phyllanthus brassii		R		U		y					
higher dicots	Euphorbiaceae	Phyllanthus distichus		R		U		y					
higher dicots	Euphorbiaceae	Sankowskya stipularis		E	E	Q		y					
higher dicots	Euphorbiaceae	Sauropus macranthus		R	V	U	y				y		
higher dicots	Euphorbiaceae	Wetria australiensis		V		Q	y						
higher dicots	Euphorbiaceae	Whyanbeelia terrae-reginae		R		U		y			y		
higher dicots	Fabaceae	Cajanus mareebensis		E	E	U		y					

higher dicots	Fabaceae	Callerya pilipes	northern wisteria	R		U		y		y	y		
higher dicots	Fabaceae	Desmodium macrocarpum		R		U			y				
higher dicots	Fabaceae	Dioclea hexandra		V	V	U		y		y			
higher dicots	Fabaceae	Strongylodon lucidus		R		U		y					
higher dicots	Fabaceae	Tephrosia leveillei		V	V	U			?				
higher dicots	Fabaceae	Tephrosia savannicola		R		U		y	?				
higher dicots	Fabaceae	Zornia pallida		R		U			?				
higher dicots	Flacourtiaceae	Ryparosa javanica		R		U		y					
higher dicots	Flacourtiaceae	Xylosma sp. (Mt Lewis G.Sankowsky+ 1108)		R		U		y					
higher dicots	Gesneriaceae	Boea kinnearii		E		U		y					
higher dicots	Gesneriaceae	Lenbrassia australiana var. australiana		R		U		y				y	
higher dicots	Gesneriaceae	Lenbrassia australiana var. glabrescens		R		U		y					
higher dicots	Goodeniaceae	Goodenia stirlingii		R		U			y				
ferns	Grammitidaceae	Ctenopteris walleri		V	V	U		?		y			
ferns	Grammitidaceae	Grammitis albosetosa		R		U		?		y	y		
ferns	Grammitidaceae	Grammitis leonardii		R		U		?					
ferns	Grammitidaceae	Grammitis reinwardtii		V	V	U		?					
higher dicots	Grossulariaceae	Argophyllum cryptophlebum		R		U		y			y		
higher dicots	Grossulariaceae	Polyosma rigidiuscula		R		U		y			y		
higher dicots	Hamamelidaceae	Neostrearia fleckeri		R		U		y			y		
higher dicots	Hamamelidaceae	Noahdendron nicholasii		E		U		y					
monocots	Hydrocharitaceae	Vallisneria nana		R		U					y	y	?
ferns	Hymenophyllaceae	Crepidomanes aphlebioides		E		U		y					
ferns	Hymenophyllaceae	Crepidomanes digitatum		R		U					y		
ferns	Hymenophyllaceae	Crepidomanes endlicherianum		R		U	y			y			
ferns	Hymenophyllaceae	Crepidomanes majoriae		R		U	y		?		y		
ferns	Hymenophyllaceae	Crepidomanes pallidum		R		U		y			y		

ferns	Hymenophyllaceae	Hymenophyllum gracilescens		R		U		y	y		y		
ferns	Hymenophyllaceae	Hymenophyllum kerianum		R		U		y		y	y		
ferns	Hymenophyllaceae	Hymenophyllum lobbii		PE	EX	U					y		
ferns	Hymenophyllaceae	Hymenophyllum whitei		PE	EX	U		y					
ferns	Hymenophyllaceae	Trichomanes exiguum		PE	EX	U					y		
ferns	Hymenophyllaceae	Trichomanes mindorense		R		U	y	y		y	y		
higher dicots	Lamiaceae	Plectranthus amoenus		V		U	y		y		y		?
higher dicots	Lamiaceae	Plectranthus gratus		V	V	U					y		?
higher dicots	Lamiaceae	Plectranthus spectabilis		R		U		y					
higher dicots	Lamiaceae	Prostanthera albohirta		PE	EX	U	?	y					
higher dicots	Lamiaceae	Prostanthera clotteniana		E		U			y				
higher dicots	Lamiaceae	Prostanthera sp. (Dinden P.I.Forster+ PIF17342)		E		U	y						
lower dicots	Lauraceae	Beilschmiedia castrisinensis		R		U		y					
lower dicots	Lauraceae	Beilschmiedia volckii	Boonjee blush walnut	R		U		y		y	y		
lower dicots	Lauraceae	Cinnamomum propinquum		R		U					y		
lower dicots	Lauraceae	Endiandra anthropophagorum		R		U		y			y		
lower dicots	Lauraceae	Endiandra bellendenkerana		R		U				y	y		
lower dicots	Lauraceae	Endiandra cooperana		E	E	U		y					
lower dicots	Lauraceae	Endiandra dichrophylla	coach walnut	R		U			y	y	y	y	
lower dicots	Lauraceae	Endiandra globosa	ball-fruited walnut	R		U				y	y		
lower dicots	Lauraceae	Endiandra grayi		R		U		y					
lower dicots	Lauraceae	Endiandra jonesii		R		U		y					
lower dicots	Lauraceae	Endiandra microneura		R		U		y					
lower dicots	Lauraceae	Endiandra phaeocarpa		R		U		y					
lower dicots	Lauraceae	Endiandra sideroxylon		R		U	y		y	y	y	y	
lower dicots	Lauraceae	Litsea granitica		R		U		y					
ferns	Lindsaeaceae	Lindsaea pulchella var. blanda		PE		U			?			?	

ferns	Lindsaeaceae	Lindsaea terrae-reginae		R		U		y					
ferns	Lindsaeaceae	Lindsaea walkerae		R		U				y			
ferns	Lomariopsidaceae	Elaphoglossum callifolium		R		U	y	y			y		
higher dicots	Loranthaceae	Lysiana filifolia		R		U	y		y				
club mosses	Lycopodiaceae	Huperzia dalhousieana	blue tassel fern	E	E	QAI					?		?
club mosses	Lycopodiaceae	Huperzia filiformis		E	E	U	y	y	y			y	
club mosses	Lycopodiaceae	Huperzia lockyeri		V	V	U	y	?			y		
club mosses	Lycopodiaceae	Huperzia marsupiiformis		V	V	U	y	?				y	
club mosses	Lycopodiaceae	Huperzia phlegmaria	coarse tassel fern	R		U	y	y	y	y	y	y	?
club mosses	Lycopodiaceae	Huperzia phlegmarioides	layered tassel fern	V	V	U		y		y	y	y	y
club mosses	Lycopodiaceae	Huperzia prolifera	square tassel fern	V	V	U		?		y			
club mosses	Lycopodiaceae	Huperzia serrata		PE	EX	U					y		
club mosses	Lycopodiaceae	Huperzia squarrosa	rock tassel fern	E	E	QAI		y			y		
club mosses	Lycopodiaceae	Huperzia varia		R		U		?					
club mosses	Lycopodiaceae	Lycopodium volubile		PE	EX	U					y		
higher dicots	Malpighiaceae	Tristellateia australasiae		R		U		y		y			
higher dicots	Meliaceae	Aglaia brassii		R		U		y					
lower dicots	Menispermaceae	Carronia pedicellata		E	E	U		y		y	y		
lower dicots	Menispermaceae	Hypserpa smilacifolia		R		U	y	?	y		y	y	
higher dicots	Mimosaceae	Acacia guymeri		V	V	U	?						
higher dicots	Mimosaceae	Acacia homaloclada		R		U			y			y	
higher dicots	Mimosaceae	Acacia hylonoma		R		U					y		y
higher dicots	Mimosaceae	Acacia longipedunculata		R		U	?		y				
higher dicots	Mimosaceae	Acacia meiosperma		R		U			y				
higher dicots	Mimosaceae	Acacia purpureopetala		V		U	?		y				
higher dicots	Mimosaceae	Acacia ramiflora		E	V	U			y				
higher dicots	Mimosaceae	Acacia tingoorensis		V		U			?				
higher dicots	Mimosaceae	Archidendron kanisii		E		U		y					
higher dicots	Mimosaceae	Archidendropsis xanthoxylon	yellow siris	R		U	y						

lower dicots	Monimiaceae	Gen.(Aq20546) sp. (Mt Hemmant L.J.Webb+ 10908)		R		U		y					
lower dicots	Monimiaceae	Gen.(Aq385424) sp. (McDowall Range J.G.Tracey 14552)		R		U		y					
lower dicots	Monimiaceae	Steganthera australiana		R		U	y		y	y	y		
lower dicots	Monimiaceae	Tetrasynandra sp. (Mt Lewis B.P.Hyland 1053)		R		U		y					
lower dicots	Monimiaceae	Wilkiea sp. (Mt Lewis L.J.Webb+ 10501)		R		U		y					
lower dicots	Monimiaceae	Wilkiea wardellii		R		U	y	y	y		y	y	
monocots	Musaceae	Musa fitzalanii		PE	EX	U		y					
monocots	Musaceae	Musa jackeyi		R		U		y		y	y		
higher dicots	Myrsinaceae	Ardisia fasciculata		R		U		?					
higher dicots	Myrsinaceae	Tapeinosperma flueckigeri		PE		U					y		
higher dicots	Myrtaceae	Acmena sp. (Cooper Creek P.I.Forster+ PIF15557)		E		U		y					
higher dicots	Myrtaceae	Barongia lophandra		R		U				y			
higher dicots	Myrtaceae	Corymbia leptoloma		V	V	Q			y				
higher dicots	Myrtaceae	Corymbia rhodops	red-throated bloodwood	V	V	Q			y				
higher dicots	Myrtaceae	Eucalyptus howittiana		R		U			y				
higher dicots	Myrtaceae	Eucalyptus lockyeri subsp. exuta		R		Q	y		y				
higher dicots	Myrtaceae	Eucalyptus lockyeri subsp. lockyeri		R		Q	y		y				
higher dicots	Myrtaceae	Eucalyptus pachycalyx subsp. pachycalyx		R		U			y				
higher dicots	Myrtaceae	Gossia lewisensis		R		U		y					
higher dicots	Myrtaceae	Gossia lucida		R		U		?					
higher dicots	Myrtaceae	Gossia macilwraithensis		R		U		y					
higher dicots	Myrtaceae	Homoranthus porteri		V	V	U		?	y				
higher dicots	Myrtaceae	Kunzea sp. (Herbert River R.J.Cumming 11309)		R		U			y				
higher dicots	Myrtaceae	Micromyrtus delicata		E		U			y				

higher dicots	Myrtaceae	Mitrantia bilocularis		R		U		y					
higher dicots	Myrtaceae	Rhodomyrtus effusa		R		U		y					
higher dicots	Myrtaceae	Ristantia gouldii		R	V	U		y			y	y	
higher dicots	Myrtaceae	Sphaerantia chartacea	Shipton's penda	R		U		?					
higher dicots	Myrtaceae	Sphaerantia discolor	Tully penda	R		U		y		y	y	y	?
higher dicots	Myrtaceae	Stockwellia quadrifida		R		U				?	y		
higher dicots	Myrtaceae	Syzygium hodgkinsoniae		V	V	U				?	y		
higher dicots	Myrtaceae	Syzygium malaccense	Malay apple	R		U		y					
higher dicots	Myrtaceae	Thaleropia queenslandica	pink myrtle	R		U	y		y	y		y	
higher dicots	Myrtaceae	Triplarina nitchaga		V	V	U			y			y	
higher dicots	Myrtaceae	Waterhousea mulgraveana		R		U		y		y	y		
higher dicots	Myrtaceae	Xanthostemon formosus		E	E	U		y					
higher dicots	Myrtaceae	Xanthostemon graniticus		R		U		y					
higher dicots	Myrtaceae	Xanthostemon verticillatus		R		U		y					
higher dicots	Nepenthaceae	Nepenthes mirabilis		E		U					y		
monocots	Orchidaceae	Acianthus amplexicaulis		R		U	y		y		?		
monocots	Orchidaceae	Acianthus sublestus		R		U	y		y		?		
monocots	Orchidaceae	Aphyllorchis anomala		R		U	y	?			?		
monocots	Orchidaceae	Aphyllorchis queenslandica		R		U		y			y	y	
monocots	Orchidaceae	Bulbophyllum boonjee		R		U	y	?		?	y		
monocots	Orchidaceae	Bulbophyllum grandimesense		R		U		?					
monocots	Orchidaceae	Bulbophyllum windsorense		R		U		y					
monocots	Orchidaceae	Bulbophyllum wolfei		R		U		y					
monocots	Orchidaceae	Calochilus psednus		E	E	U						y	
monocots	Orchidaceae	Chiloglottis longiclavata		R		U			y		y		
monocots	Orchidaceae	Corybas abellianus	nodding helmet orchid	R		U	y						
monocots	Orchidaceae	Corybas cerasinus		R		Q			y		y		
monocots	Orchidaceae	Crepidium flavovirens		R		U		?		y	y		
monocots	Orchidaceae	Crepidium lawleri		E	E	U		?					

monocots	Orchidaceae	Dendrobium callitrophilum	cypress orchid	V	V	U		y				y	
monocots	Orchidaceae	Dendrobium fellowsii		R		U	y	y	y			y	
monocots	Orchidaceae	Dendrobium lithocola		E	E	U		y					
monocots	Orchidaceae	Dendrobium mirbelianum	mangrove orchid	E	E	QAI		y			y		
monocots	Orchidaceae	Dendrobium nindii		E	E	U		y		y	y		
monocots	Orchidaceae	Dendrobium phalaenopsis		V	V	U		?					
monocots	Orchidaceae	Didymoplexis pallens	crystal bells	R		U						y	
monocots	Orchidaceae	Diplocaulobium masonii		PE	EX	U		y					
monocots	Orchidaceae	Diuris oporina	northern white donkeys tails	R		U	y		y			?	
monocots	Orchidaceae	Eria dischorensis		R		U							y
monocots	Orchidaceae	Eria irukandjiana		R		U		?					y
monocots	Orchidaceae	Eulophia bicallosa		R		U					y	y	
monocots	Orchidaceae	Gastrodia queenslandica		R		U		y			y		
monocots	Orchidaceae	Gastrodia urceolata		R		U	y		y				
monocots	Orchidaceae	Genoplesium alticola		R		U	y						
monocots	Orchidaceae	Genoplesium tectum		E	E	U						y	
monocots	Orchidaceae	Goodyera grandis		R		U		y		y			
monocots	Orchidaceae	Goodyera viridiflora		R		U	y	y			y	y	
monocots	Orchidaceae	Habenaria divaricata		R		U						y	
monocots	Orchidaceae	Habenaria rumphii		R		U			y			y	
monocots	Orchidaceae	Habenaria xanthantha		R		U						y	
monocots	Orchidaceae	Liparis simmondsii		R		U	?	y	y			y	
monocots	Orchidaceae	Oberonia attenuata		PE	EX	U		y					
monocots	Orchidaceae	Pachystoma pubescens		R		U						y	
monocots	Orchidaceae	Peristylus banfieldii		R		U	y		y			?	
monocots	Orchidaceae	Phaius pictus		V	V	U		y		y	y		
monocots	Orchidaceae	Phaius tancarvilleae		E	E	U	y	y	y		y		
monocots	Orchidaceae	Phalaenopsis amabilis subsp. rosenstromii		E		U		y	y				

monocots	Orchidaceae	Spathoglottis paulinae		R		U	y	y			y		?
monocots	Orchidaceae	Taeniophyllum confertum		R		U	y	?					y
monocots	Orchidaceae	Taeniophyllum lobatum		R		U	y	y	y	y			
monocots	Orchidaceae	Vrydagzynea paludosa		E	E	QAI		y					
monocots	Orchidaceae	Zeuxine polygonoides		V	V	U	y					y	
monocots	Pandanaceae	Freycinetia marginata		V		U		y					
monocots	Pandanaceae	Freycinetia percostata		V		U		y					
monocots	Pandanaceae	Pandanus gemmifer		R		U	y		y		y	y	?
lower dicots	Piperaceae	Peperomia bellendenkerensis		R		Q	y	y		y	y	y	
lower dicots	Piperaceae	Piper mestonii	long pepper	R		U				y	y		
monocots	Poaceae	Arthraxon hispidus		V	V	U		y					
monocots	Poaceae	Bambusa forbesii		R		U		y					
monocots	Poaceae	Centotheca philippinensis		R	V	U		y					?
monocots	Poaceae	Dichanthium setosum		R	V	U			?				
monocots	Poaceae	Garnotia stricta var. longiseta		R		U		y		y			
monocots	Poaceae	Ichnanthus pallens var. majus		R		U		y		y	y	y	
monocots	Poaceae	Lepturus sp. (Chillagoe M.Godwin C2576)		V		U			?				
monocots	Poaceae	Lepturus xerophilus		V		U			?				
monocots	Poaceae	Paspalidium scabrifolium		R		U					?		
conifers	Podocarpaceae	Prumnopitys ladei	Mt. Spurgeon black pine	R		U		y					
higher dicots	Podostemaceae	Cladopus queenslandicus		R		U			y	y	y	y	
higher dicots	Polygalaceae	Comesperma praecelsum		R		U						y	
ferns	Polypodiaceae	Lemmaphyllum accedens		PE	EX	QAI	y						
ferns	Polypodiaceae	Microsorum membranifolium	pimple fern	R		U		y			y		
higher dicots	Proteaceae	Alloxylon flammeum		V	V	U	y		y	y	y		
higher dicots	Proteaceae	Austromuellera trinervia		R		U	y	y		y	y		
higher dicots	Proteaceae	Austromuellera valida		R		U		y					
higher dicots	Proteaceae	Banksia plagiocarpa		R		U			?			y	
higher dicots	Proteaceae	Buckinghamia ferruginiflora		R		U		y					

higher dicots	Proteaceae	Eidothea zoexylocarya		R		U		y		y	y		
higher dicots	Proteaceae	Grevillea glossadenia		V	V	U	y		y				
higher dicots	Proteaceae	Helicia grayi		R		U		y					
higher dicots	Proteaceae	Helicia lamingtoniana		R		U	y		y	y		y	
higher dicots	Proteaceae	Helicia lewisensis		R		U		y					
higher dicots	Proteaceae	Helicia recurva		R		U		y			y		?
higher dicots	Proteaceae	Hollandaea riparia		R		U		y					
higher dicots	Proteaceae	Hollandaea sayeriana		R		U				y	y	y	
higher dicots	Proteaceae	Macadamia grandis		R		Q		y		y			
higher dicots	Proteaceae	Megahertzia amplexicaulis		R		U		y					
higher dicots	Proteaceae	Stenocarpus cryptocarpus	giant-leaved stenocarpus	R		U		y			y		
higher dicots	Proteaceae	Stenocarpus davallioides	fern-leaved stenocarpus	R		U		y					
higher dicots	Rhamnaceae	Gouania australiana		R		U	y		y	y	y	y	
higher dicots	Rubiaceae	Cyclophyllum costatum		V	V	U		y					
higher dicots	Rubiaceae	Gardenia actinocarpa		E	E	Q		y					
higher dicots	Rubiaceae	Hedyotis novoguineensis		E		U		y					
higher dicots	Rubiaceae	Myrmecodia beccarii		V	V	U		y		y		y	?
higher dicots	Rubiaceae	Oldenlandia polyclada		R		U			y			y	
higher dicots	Rubiaceae	Oldenlandia tenelliflora var. papuana		PE		U		y					
higher dicots	Rubiaceae	Randia audasii		R		U	y	y					
higher dicots	Rubiaceae	Uncaria cordata var. cordata		R		U					y		
higher dicots	Rubiaceae	Wendlandia basistaminea		R		U	y			y	y		
higher dicots	Rubiaceae	Wendlandia connata		R		U		y					
higher dicots	Rubiaceae	Wendlandia psychotrioides		PE		U					y		
higher dicots	Rutaceae	Acronychia acuminata		R		U		y					
higher dicots	Rutaceae	Citrus inodora		V		U		y			y		
higher dicots	Rutaceae	Dinosperma longifolium		E		U	y				y		
higher dicots	Rutaceae	Euodia hylandii		R		U		y					
higher dicots	Rutaceae	Euodia pubifolia		V		U		y					

higher dicots	Rutaceae	Flindersia oppositifolia	mountain silkwood	R		U		y			y		
higher dicots	Rutaceae	Leionema ellipticum		V		U		?					
higher dicots	Rutaceae	Medicosma glandulosa		R		U		y					
higher dicots	Rutaceae	Zieria obovata		V	V	U	?		y				
higher dicots	Sapindaceae	Alectryon semicinereus		R		U	y		y		?	y	
higher dicots	Sapindaceae	Arytera dictyoneura		R		U			y				
higher dicots	Sapindaceae	Atalaya calcicola		R		U			y				
higher dicots	Sapindaceae	Cupaniopsis cooperorum		V		U				y	y		
higher dicots	Sapindaceae	Diploglottis harpullioides		R		U		y			y		
higher dicots	Sapindaceae	Diploglottis pedleyi		R		U				y	y		
higher dicots	Sapindaceae	Dodonaea uncinata		R		U			?				
higher dicots	Sapindaceae	Jagera javanica subsp. australiana		R		U		y					
higher dicots	Sapindaceae	Lepiderema hirsuta		R		U		y					
higher dicots	Sapindaceae	Lepiderema largiflorens		R		U				y	y		
higher dicots	Sapindaceae	Mischocarpus albescens		R		U		y					
higher dicots	Sapindaceae	Sarcopteryx acuminata		R		U	y	y		y	y		
higher dicots	Sapindaceae	Sarcopteryx montana		R		U		y					
higher dicots	Sapindaceae	Sarcotoechia villosa		R		U	y	y					
higher dicots	Sapindaceae	Toechima pterocarpum	orange tamarind	E	E	Q		y					
higher dicots	Scrophulariaceae	Rhamphicarpa australiensis Steenis		R		U	y						
higher dicots	Simaroubaceae	Quassia baileyana		R		U		y		y	y		
higher dicots	Solanaceae	Nicotiana wuttkei		E		U			y				
higher dicots	Solanaceae	Solanum dimorphispinum		R		U		y					
higher dicots	Solanaceae	Solanum hamulosum		R		U	y		y	y	y		
higher dicots	Solanaceae	Solanum multiglochidiatum		R		U			y				
higher dicots	Sterculiaceae	Argyrodendron sp. (Boonjie B.P.Hyland RFK2139)		R		U	y			y	y		
higher dicots	Sterculiaceae	Argyrodendron sp. (Whyanbeel B.P.Hyland RFK1106)		R		U		y					
higher dicots	Sterculiaceae	Firmiana papuana	lacewood	R		U	y		?			y	

higher dicots	Symplocaceae	Symplocos ampulliformis		R		U		y			y		
higher dicots	Symplocaceae	Symplocos crassiramifera		R		U		y					
higher dicots	Symplocaceae	Symplocos graniticola		R		U		y					
higher dicots	Symplocaceae	Symplocos sp. (Mt Finnigan L.J.Brass 20129)		R		U		y			y		
higher dicots	Symplocaceae	Symplocos stawellii var. montana		R		U		y			y		
ferns	Thelypteridaceae	Amphineuron immersum		E		U					y		
ferns	Thelypteridaceae	Chingia australis		E	E	Q		y		y	y		
ferns	Thelypteridaceae	Plesioneuron tuberculatum		E	E	U				y	y		
ferns	Thelypteridaceae	Pneumatopteris costata		R		U				y	y	y	
higher dicots	Thymelaeaceae	Phaleria biflora		R	V	U		y					
ferns	Tmesipteridaceae	Tmesipteris lanceolata		PE	EX	U					y		
ferns	Vittariaceae	Antrophyum plantagineum		R		U				y	y		
ferns	Vittariaceae	Antrophyum subfalcatum		R		U	y						
ferns	Vittariaceae	Monogramma dareicarpa		PE		U					y		
lower dicots	Winteraceae	Bubbia queenslandiana subsp. australis		R		U				y	y		
lower dicots	Winteraceae	Bubbia queenslandiana subsp. queenslandiana		R		U		y					
lower dicots	Winteraceae	Bubbia whiteana		R		U		y					
higher dicots	Xanthophyllaceae	Xanthophyllum fragrans		R		U		y					
monocots	Zingiberaceae	Alpinia hylandii		R		U	y	?					
monocots	Zingiberaceae	Amomum dallachyi		R		U	y	y				y	
monocots	Zingiberaceae	Costus potierae		E		U		y				y	

APPENDIX B

RARE AND THREATENED ANIMALS OF THE WET TROPICS NRM REGION (INCLUDING COASTAL WATERS)

Based on WildNet species list for Wet Tropical Rainforest Bioregion (extracted: 14/08/2003 10:38:24), with expert review by Associate Professor Stephen Garnett, Keith McDonald and Mike Trenerry.

Code for Table

Conservation Status

NCA – *Nature Conservation Act 1992* (Qld);
EPBC – *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth);
EX – Extinct;
CE – Critically Endangered;
E – Endangered;
V – Vulnerable;
R – Rare.

Distribution

Q – Queensland;
A – Australia;
I – International.

[1] – Endemic to Wet Tropics NRM Region (as opposed to Bioregion);
[2] – Endemic to Wet Tropics Bioregion, occurs in adjacent NRM regions;
[3] – Endemic to Wet Tropics Bioregion, does not occur in Wet Tropics NRM Region (i.e. restricted to Black Mountain NP, Cape York NRM Region);
[4] – Non-core range, most often recorded in other NRM regions;
[5] – Subject to taxonomic revision.

Wet Tropics NRM Catchment

B – Barron;
DM – Daintree-Mossman;
H – Herbert;
J – Johnstone;
RM – Russell-Mulgrave;
TM – Tully-Murray;
TI – Trinity Inlet.

✔ Occcurs;
Occurs (marine species);
? Possibly occurs.

Table 1: Rare and threatened animals of the Wet Tropics NRM Region (including coastal waters).

Class	Family	Scientific Name	Common Name	Cons. status		Dist.	Wet Tropics NRM Catchment						
				NCA	EPBC		B	DM	H	J	RM	TM	TI
amphibians	Myobatrachidae	*Pseudophryne covacevichae*	magnificent broodfrog	V	V	Q[1]			✔				
amphibians	Myobatrachidae	*Taudactylus acutirostris*	sharp snouted dayfrog	E	EX	Q[2]	✔	✔	✔	✔	✔	✔	✔
amphibians	Myobatrachidae	*Taudactylus rheophilus*	northern tinkerfrog	E	E	Q[1]	✔	✔			✔		
amphibians	Hylidae	*Litoria genimaculata*	tapping green eyed frog	R		QAI[2]	✔	✔	✔	✔	✔	✔	✔
amphibians	Hylidae	*Litoria lorica*	little waterfall frog	E	E	Q[1]		✔					
amphibians	Hylidae	*Litoria nannotis*	waterfall frog	E	E	Q[2]	✔	✔	✔	✔	✔	✔	✔
amphibians	Hylidae	*Litoria nyakalensis*	mountain mistfrog	E	E	Q[1]	✔	✔		✔	✔	✔	
amphibians	Hylidae	Litoria revelata	whirring treefrog (northern population)	R		QA	✔			✔	✔		
amphibians	Hylidae	*Litoria rheocola*	common mistfrog	E	E	Q[2]	✔	✔	✔	✔	✔	✔	✔
amphibians	Hylidae	*Nyctimystes dayi*	Australian lacelid	E	E	Q[2]	✔	✔	✔	✔	✔	✔	✔
amphibians	Microhylidae	*Austrochaperina fryi*	peeping whistlefrog	R		Q[2]	✔	✔					?
amphibians	Microhylidae	*Austrochaperina robusta*	robust whistlefrog	R		Q[2]	✔		✔	✔	✔	✔	
amphibians	Microhylidae	*Cophixalus bombiens*	buzzing nurseryfrog	R		Q[2]		✔					
amphibians	Microhylidae	*Cophixalus concinnus*	tapping nurseryfrog	R		Q[2]		✔					
amphibians	Microhylidae	*Cophixalus exiguus*	dainty nurseryfrog	R		Q[2]		✔					
amphibians	Microhylidae	*Cophixalus hosmeri*	rattling nurseryfrog	R		Q[2]		✔					
amphibians	Microhylidae	*Cophixalus infacetus*	creaking nurseryfrog	R		Q[1]			✔	✔	✔	✔	✔
amphibians	Microhylidae	*Cophixalus monticola*	mountain nurseryfrog	R		Q[2]			✔				
amphibians	Microhylidae	*Cophixalus neglectus*	Bellenden Ker nurseryfrog	V		Q[1]					✔		
amphibians	Microhylidae	*Cophixalus saxatilis*	Black Mountain boulderfrog	V		Q[3]							
birds	Casuariidae	*Casuarius casuarius johnsonii*	southern cassowary (southern population)	E	E	Q[2]	✔	✔	✔	✔	✔	✔	✔
birds	Anatidae	*Nettapus coromandelianus*	cotton pygmy-goose	R		QAI	✔					✔	✔
birds	Anatidae	*Stictonetta naevosa*	freckled duck	R		QA[4]	✔						
birds	Anatidae	Tadorna radjah	radjah shelduck	R		QAI	✔	✔	✔	✔	✔	✔	✔
birds	Podicipedidae	*Podiceps cristatus*	great crested grebe	R		QA	✔		✔	✔		✔	
birds	Phaethontidae	*Phaethon rubricauda*[4]	red-tailed tropicbird	V		QAI	✔	✔	✔	✔	✔	✔	✔
birds	Ciconiidae	*Ephippiorhynchus asiaticus*	black-necked stork	R		QAI	✔	✔	✔	✔	✔	✔	✔
birds	Accipitridae	*Accipiter novaehollandiae*	grey goshawk	R		QAI	✔	✔	✔	✔	✔	✔	✔
birds	Accipitridae	*Erythrotriorchis radiatus*	red goshawk	E	V	QA	✔	✔	✔	✔	✔	✔	✔
birds	Accipitridae	*Lophoictinia isura*	square-tailed kite	R		QA	✔	✔	✔	✔	✔	✔	✔
birds	Falconidae	*Falco hypoleucos*	grey falcon	R		QA[4]	✔	✔	✔				
birds	Rallidae	*Rallus pectoralis*	Lewin's rail	R		QAI	✔	✔	✔	✔	✔	✔	✔
birds	Turnicidae	*Turnix olivii*	buff-breasted button-quail	V	E	Q	✔	✔					

Class	Family	Scientific Name	Common Name	Cons. status		Dist.	Wet Tropics NRM Catchment						
				NCA	EPBC		B	DM	H	J	RM	TM	TI
birds	Scolopacidae	*Numenius madagascariensis*	eastern curlew	R		QAI	✔	✔	✔	✔	✔	✔	✔
birds	Rostratulidae	*Rostratula benghalensis*	painted snipe	R		QAI	✔	✔	✔	✔	✔	✔	✔
birds	Burhinidae	*Esacus neglectus*	beach stone-curlew	V		QAI	✔	✔	✔	✔	✔	✔	✔
birds	Haematopodidae	*Haematopus fuliginosus*	sooty oystercatcher	R		QA	✔	✔	✔	✔	✔	✔	✔
birds	Laridae	*Sterna albifrons*	little tern	E		QAI	✔	✔	✔	✔	✔	✔	✔
birds	Columbidae	*Geophaps scripta scripta*	squatter pigeon (southern subspecies)	V		QA[4]			✔				
birds	Psittacidae	*Cyclopsitta diophthalma macleayana*	Macleay's fig-parrot	V		Q	✔	✔	✔	✔	✔	✔	✔
birds	Strigidae	*Ninox rufa queenslandica*	rufous owl (southern subspecies)	V		Q	✔	✔	✔	✔	✔	✔	✔
birds	Tytonidae	*Tyto novaehollandiae kimberli*	masked owl (northern subspecies)	V	V	QA	✔	✔	✔	✔	✔	✔	
birds	Tytonidae	*Tyto tenebricosa*	sooty owl	R		QA	✔	✔	✔	✔	✔	✔	
birds	Apodidae	*Collocalia spodiopygius*	white-rumped swiftlet	R		Q	✔	✔	✔	✔	✔	✔	✔
birds	Meliphagidae	*Melithreptus gularis*	black-chinned honeyeater	R		QA[4]	✔	✔	✔				
birds	Passeridae	*Erythrura gouldiae*	Gouldian finch	E	E	QA[4]	✔		✔				
birds	Passeridae	*Erythrura trichroa*	blue-faced parrot-finch	R		QAI		✔	✔	✔	✔		
birds	Passeridae	*Neochmia phaeton*	crimson finch	V		U	✔	✔	✔	✔	✔	✔	✔
birds	Passeridae	*Poephila cincta cincta*	black-throated finch (southern subspecies)	V	V	QA[4]			✔				
insects	Lycaenidae	*Hypochrysops apollo apollo*	Apollo jewel (Wet Tropics subspecies)	V		Q[1]	✔	✔	✔	✔	✔	✔	✔
mammals	Dasyuridae	*Antechinus godmani*	Atherton antechinus	R		Q[1]	✔		✔	✔	✔	✔	
mammals	Dasyuridae	*Dasyurus maculatus gracilis*	spotted-tailed quoll (northern subspecies)	E	E	Q[2]	✔	✔	✔	✔	✔	✔	✔
mammals	Dasyuridae	*Sminthopsis leucopus*	white-footed dunnart (northern population)	R		QA				✔			
mammals	Phascolarctidae	*Phascolarctos cinereus*	koala	V		QA			✔				
mammals	Petauridae	*Petaurus australis*	yellow-bellied glider (northern population)	V	V	Q[2]	✔	✔	✔			✔	
mammals	Petauridae	*Petaurus gracilis*	mahogany glider	E	E	Q[1]			✔			✔	
mammals	Pseudocheiridae	*Hemibelideus lemuroides*	lemuroid ringtail possum	R		Q[2]	✔	✔	✔	✔	✔	✔	
mammals	Pseudocheiridae	*Pseudochirops archeri*	green ringtail possum	R		Q[2]	✔	✔	✔	✔	✔	✔	
mammals	Pseudocheiridae	*Pseudochirulus cinereus*	Daintree River ringtail possum	R		Q[2]		✔					
mammals	Pseudocheiridae	*Pseudochirulus herbertensis*	Herbert River ringtail possum	R		Q[1]	✔		✔	✔	✔	✔	
mammals	Potoroidae	*Bettongia tropica*	northern bettong	E	E	Q[2]	✔	✔	✔				
mammals	Macropodidae	*Dendrolagus bennettianus*	Bennett's tree-kangaroo	R		Q[2]		✔					

Class	Family	Scientific Name	Common Name	Cons. status		Dist.	Wet Tropics NRM Catchment						
				NCA	EPBC		B	DM	H	J	RM	TM	TI
mammals	Macropodidae	*Dendrolagus lumholtzi*	Lumholtz's tree-kangaroo	R		Q[2]	✔	✔	✔	✔	✔	✔	✔
mammals	Macropodidae	*Petrogale mareeba*	Mareeba rock-wallaby	R		Q			✔				
mammals	Macropodidae	*Petrogale sharmani*	Sharman's rock-wallaby	E		Q[4]			✔				
mammals	Pteropodidae	*Dobsonia moluccensis*	bare-backed fruit bat	R		QAI[4]		?					
mammals	Pteropodidae	*Pteropus conspicillatus*	spectacled flying-fox		V	QAI	✔	✔	✔	✔	✔	✔	✔
mammals	Megadermatidae	*Macroderma gigas*	ghost bat	V		QA[4]	✔	✔	✔			?	
mammals	Rhinolophidae	*Rhinolophus philippinensis*	greater large-eared horseshoe bat	R	E	QAI	✔	✔	✔	✔	✔	✔	✔
mammals	Hipposideridae	*Hipposideros diadema reginae*	diadem leaf-nosed bat	R		QAI	✔	✔	✔	✔	✔	✔	✔
mammals	Hipposideridae	*Hipposideros semoni*	Semon`s leaf-nosed bat	V	E	QAI					?		
mammals	Emballonuridae	*Saccolaimus saccolaimus nudicluniatus*	bare-rumped sheathtail bat	R	CE	QAI		✔				✔	
mammals	Emballonuridae	*Taphozous australis*	coastal sheathtail bat	V		QAI	✔	✔	✔	✔	✔	✔	✔
mammals	Vespertilionidae	*Kerivoula papuensis*	golden-tipped bat	R		QAI	✔	✔	✔			✔	✔
mammals	Vespertilionidae	Murina florium	tube-nosed insectivorous bat	V		QAI	✔	✔	✔	✔		✔	
mammals	Muridae	*Xeromys myoides*	false water-rat	V	V	QA	?	?	?	?	?	?	?
mammals	Dugongidae	*Dugong dugon*	dugong	V		QAI	✔	✔	✔	✔	✔	✔	✔
mammals	Delphinidae	*Sousa chinensis*	Indopacific humpback dolphin	R		QAI	✔	✔	✔	✔	✔	✔	✔
mammals	Delphinidae	*Orcaella brevirostris*	Irrawaddy river dolphin	R		QAI	✔	✔	✔	✔	✔	✔	✔
mammals	Balaenopteridae	*Megaptera novaeangliae*	humpback whale	V		QAI	✔	✔	✔	✔	✔	✔	✔
reptiles	Crocodylidae	*Crocodylus porosus*	estuarine crocodile	V		QAI	✔	✔	✔	✔	✔	✔	✔
reptiles	Cheloniidae	*Caretta caretta*	loggerhead turtle	E	E	QAI	✔	✔	✔	✔	✔	✔	✔
reptiles	Cheloniidae	*Chelonia mydas*	green turtle	V	V	QAI	✔	✔	✔	✔	✔	✔	✔
reptiles	Cheloniidae	*Eretmochelys imbricata*	hawksbill turtle	V	V	QAI	✔	✔	✔	✔	✔	✔	✔
reptiles	Cheloniidae	*Natator depressus*	flatback turtle	V	V	QAI	✔	✔	✔	✔	✔	✔	✔
reptiles	Dermochelyidae	*Dermochelys coriacea*	leatherback turtle	E	V	QAI	✔	✔	✔	✔	✔	✔	✔
reptiles	Gekkonidae	*Nactus galgajuga*		R		Q[3]							
reptiles	Pygopodidae	*Delma labialis*	striped-tailed delma	V	V	Q[4]			?				
reptiles	Pygopodidae	*Delma mitella*		R	V	Q[2]	✔			✔			
reptiles	Varanidae	*Varanus semiremex*	rusty monitor	R		Q	?	?	?	?	?	✔	?
reptiles	Scincidae	*Calyptotis thorntonensis*		R		Q[1]		✔					
reptiles	Scincidae	*Carlia scirtetis*		R		Q[3]							
reptiles	Scincidae	*Coeranoscincus frontalis*		R		Q[2]	✔	✔	✔	✔	✔	✔	
reptiles	Scincidae	*Egernia rugosa*	yakka skink	V	V	Q[4]			✔				
reptiles	Scincidae	*Eulamprus frerei*		R		Q[1]					✔		

Class	Family	Scientific Name	Common Name	Cons. status		Dist.	Wet Tropics NRM Catchment						
				NCA	EPBC		B	DM	H	J	RM	TM	TI
reptiles	Scincidae	*Eulamprus tigrinus*		R		Q[2]	✔	✔		✔	✔	✔	
reptiles	Scincidae	*Glaphyromorphus mjobergi*		R		Q[2]	✔	?		✔	✔		
reptiles	Scincidae	*Lampropholis robertsi*		R		Q[1]	✔	✔		✔	✔		
reptiles	Scincidae	*Lygisaurus rococo*		R		Q[4]			?				
reptiles	Scincidae	*Saproscincus spectabilis*		R		Q[2]	✔	✔	✔	✔	✔	✔	✔
reptiles	Scincidae	*Bartleia jigurru*		R		Q[1]					✔		
reptiles	Elapidae	*Acanthophis antarcticus*	common death adder	R		QA[5]	?	?	?			?	
reptiles	Elapidae	*Furina barnardi*	yellow-naped snake	R		Q[4]	✔		✔				
reptiles	Elapidae	*Simoselaps warro*	robust burrowing snake	R		Q[4]	✔		✔				

APPENDIX C

WET TROPICS WILDLIFE OF SPECIAL SIGNIFICANCE

Wildlife species listed in Australian action plans that are likely to occur in the Wet Tropics NRM Region.

Code for Table

Threatened species status under the Commonwealth *Environment Protection and Biodiversity Conservation Act* and the Queensland *Nature Conservation Act* (i.e. listed in Schedules 1-4 of the Nature Conservation (Wildlife) Regulation) is shown. It is noted that different provisions of the EPBC Act cover some of the species listed (e.g. marine and migratory species), whilst all native mammals (with the exception of the Dingo), birds, reptiles and amphibians are protected as 'common wildlife' under the NCA. Some fish and butterfly species are also protected under the NCA, whilst additional protection may be given to some fish species under the Queensland *Fisheries Act* or bag limits may apply. It is further noted that there are several species likely to occur in the Wet Tropics NRM Region that are listed in Schedules 1-4 of the Queensland Nature Conservation (Wildlife) Regulation but are not included in action plans.

Conservation Status (after Garnett & Crowley 2000):

Critically Endangered:	Taxa that face an extremely high risk of extinction in the wild in the immediate future;
Endangered:	Taxa that are not Critically Endangered but face an extremely high risk of extinction in the wild in the near future;
Vulnerable	Taxa that are neither Critically Endangered nor Endangered, but face a high risk of extinction in the wild in the medium-term future;
Lower Risk	Taxa that, after evaluation, do not satisfy any of the criteria for any of the above categories. Separated into following categories: (a) *Conservation Dependent* – Taxa that are the focus of a continuing taxon-specific or habitat-specific conservation program targeted towards the taxon in question; (b) *Near Threatened* – Taxa that do not qualify for *Conservation Dependent* but are close to qualifying for vulnerable; (c) *Least Concern* – Taxa that do not qualify for *Conservation Dependent* or *Near Threatened*; and (d) *Data Deficient* – Taxa for which there is inadequate information to make a direct, or indirect, assessment of risk of extinction based on distribution and/ or population status.

It is noted that remaining patches of Mabi Forest on the Atherton Tablelands (RE 7.8.3, complex notophyll vine forest, sensu Webb & Tracey Type 5b) have been added to the national list of critically endangered ecological communities under the EPBC Act.

Table 1: Wildlife species listed in Australian action plans that are likely to occur in the Wet Tropics NRM Region.

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS		
		Action Plan	EPBC Act (Cwlth)	NCA (Qld)
Bats (Duncan et. al. 1999)				
Bare-rumped Sheathtail Bat	Saccolaimus saccolaimus nudicluniatus	Critically Endangered (A1a)	Not listed	Rare
Coastal Sheathtail Bat	Taphozous australis	Lower Risk (near threatened)	Not listed	Vulnerable
Ghost Bat	Macroderma gigas	Lower Risk (near threatened)	Vulnerable	Vulnerable
Greater Broad-nosed Bat	Scoteanax rueppellii	Lower Risk (near threatened)	Not listed	Not listed
Greater Large-eared Horseshoe Bat*	Rhinolophus philippinensis	Endangered (C2a)	Endangered	Rare
Golden-tipped Bat	Kerivoula papuensis	Lower Risk (near threatened)	Not listed	Rare
Little Pied Bat	Chalinolobus picatus	Lower Risk (near threatened)	Not listed	Rare
Spectacled Flying-fox	Pteropus conspicillatus	Lower Risk (near threatened)	Vulnerable	Not listed
Semon's Leaf-nosed Bat*	Hipposideros semoni	Endangered (C2a, D)	Not listed	Vulnerable
Tube-nosed Insectivorous Bat	Murina florium	Lower Risk (near threatened)	Not listed	Vulnerable
Birds (Garnett & Crowley 2000)†				
Australian Bustard	Ardeotis australis	Near Threatened: c	Not listed	Not listed
Beach Stone-curlew	Esacus neglectus	Least Concern	Not listed	Vulnerable
Black Bittern (Australasian)	Ixobrychus flavicolllis australis	Least Concern	Not listed	Not listed
Black-necked Stork	Ephippiorhynchus asiaticus australis	Least Concern	Not listed	Rare
Brown Treecreeper (Cape York Peninsula)	Climacteris picumnus melanotus	Near Threatened: c	Not listed	Not listed
Buff-breasted Button-quail	Turnix olivii	Endangered: B1+2bcde, C2b	Endangered	Vulnerable
Bush Stone-curlew	Burhinus grallarius	Near Threatened: c	Not listed	Not listed
Cotton Pygmy-Goose (Australian)	Nettapus coromandelianus albipennis	Near Threatened: c	Not listed	Rare
Emu (mainland)	Dromaius novaehollandiae novaehollandiae	Least Concern	Not listed	Not listed
Glossy Black-Cockatoo (northern)	Calyptorhynchus lathami erebus	Least Concern		Vulnerable
Great-billed Heron	Ardea sumatrana	Least Concern	Not listed	Not listed
Grey-crowned Babbler (eastern)	Pomatostomus temporalis temporalis	Near Threatened: a	Not listed	Not listed
Grass Owl (eastern)	Tyto capensis longimembris	Least Concern	Not listed	Not listed
Grey Falcon	Falco hypoleucos	Near Threatened: d	Not listed	Rare
Herald Petrel	Pterodroma heraldica	Australian breeding population Critically Endangered: D; population visiting Australian territory Least Concern	Not listed	Not listed
Latham's Snipe	Gallinago hardwickii	Population visiting Australian territory Least Concern	Not listed	Not listed
Lewin's Rail (eastern)	Rallus pectoralis pectoralis	Near Threatened: c	Not listed	Rare
Little Bittern (Australasian)	Ixobrychus minutus dubius	Near Threatened: c	Not listed	Not listed
Little Tern (western Pacific)	Sterna albifrons sinensis	Australian breeding population Least Concern; population visiting Australian territory Least Concern	Not listed	Endangered
Magpie Goose	Anseranas semipalmata	Least Concern	Not listed	Not listed
Masked Owl (northern)	Tyto novaehollandiae kimberli	Near Threatened: c	Vulnerable	Vulnerable
Painted Honeyeater	Grantiella picta	Near Threatened: c	Not listed	Rare
Painted Snipe (Australian)	Rostratula benghalensis australis	Vulnerable: A1b	Not listed	Rare
Radjah Shelduck (Australian)	Tadorna radjah rufitergum	Least Concern	Not listed	Rare
Red-backed Button-quail (Australian)	Turnix maculosa melanota	Least Concern	Not listed	Not listed
Red Goshawk	Erythrotriorchis radiatus	Vulnerable: D1	Vulnerable	Endangered
Red-tailed Tropicbird	Phaethon rubricauda	Near Threatened: c	Not listed	Vulnerable
Rufous Owl (eastern)	Ninox rufa queenslandica	Near Threatened: d	Not listed	Vulnerable
Sarus Crane (Australian)	Grus antigone gillae	Least Concern	Not listed	Not listed
Orange-footed Scrubfowl (eastern Queensland)	Megapodius reinwardt castanotus	Least Concern	Not listed	Not listed
Sooty Oystercatcher (northern)	Haematopus fuliginosus opthalmicus	Least Concern	Not listed	Rare

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS		
		Action Plan	EPBC Act (Cwlth)	NCA (Qld)
Southern Cassowary (Australian)*	Casuarius casuarius johnsonii	Endangered: C1	Endangered	Endangered
Square-tailed Kite	Lophoictinia isura	Least Concern	Not listed	Rare
Star Finch (southern)	Neochmia ruficauda ruficauda	Critically Endangered: C2a, D	Endangered	Endangered
Black-faced Woodswallow (Cape York Peninsula)	Artamus cinereus normani	Near Threatened: c	Not listed	Not listed
Butterflies (Sands & New 2002)				
Apollo jewel	Hypochrysops apollo apollo	Ingham to Innisfail populations: Lower Risk (Near Threatened)	Not listed	Endangered
Purple ant-plant jewel	Hypochrysops arronica arronica	Data Deficient	Not listed	Not listed
Cetaceans (Bannister et. al. 1996)				
Bottlenose dolphin	Tursiops truncatus	No category assigned because of insufficient information	Not listed	Not listed
Bryde's whale	Balaenoptera edeni	No category assigned, but possibly secure	Not listed	Not listed
Common dolphin	Delphinus delphis	No category assigned, but possibly secure	Not listed	Not listed
Cuvier's beaked whale, goose-beaked whale	Ziphius cavirostris	No category assigned, but possibly secure	Not listed	Not listed
Dwarf sperm whale	Kogia simus	No category assigned, because of insufficient information	Not listed	Not listed
False killer whale	Pseudorca crassidens	No category assigned, but possibly secure	Not listed	Not listed
Fraser's dolphin, Sarawak dolphin	Lagenodelphis hosei	No category assigned, because of insufficient information	Not listed	Not listed
Ginkgo-toothed beaked whale, ginkgo-toothed whale	Mesoplodon ginkgodens	No category assigned, because of insufficient information	Not listed	Not listed
Humpback Whale	Megaptera novaeangliae	Vulnerable	Vulnerable	Vulnerable
Indo-Pacific humpbacked dolphin	Sousa chinensis	Insufficiently known	Not listed	Rare
Irrawaddy dolphin	Orcaella brevirostris	Insufficiently known	Not listed	Rare
Killer whale, orca	Orcinus orca	No category assigned but probably secure	Not listed	Not listed
Melon-headed whale	Peponocephala electra	No category assigned, because of insufficient information	Not listed	Not listed
Minke whale	Balaenoptera acutorostrata	Dark-shoulder form: Secure; Diminutive form: No category assigned, because of insufficient information	Not listed	Not listed
Pantropical spotted dolphin, spotted dolphin	Stenella attenuata	No category assigned, because of insufficient information	Not listed	Not listed
Pygmy killer whale	Feresa attenuata	No category assigned, because of insufficient information	Not listed	Not listed
Pygmy sperm whale	Kogia breviceps	No category assigned, because of insufficient information	Not listed	Not listed
Risso's dolphin, grampus	Grampus griseus	No category assigned, because of insufficient information	Not listed	Not listed
Rough-toothed dolphin	Steno bredanensis	No category assigned, because of insufficient information	Not listed	Not listed
Sei Whale	Balaenoptera borealis	Vulnerable	Not listed	Not listed
Short-finned pilot whale	Globicephala macrorhynchus	No category assigned, but possibly secure	Not listed	Not listed
Spinner dolphin	Stenella longirostris	Insufficiently known	Not listed	Not listed
Striped dolphin, euphrosyne dolphin	Stenella coeruleoalba	No category assigned, because of insufficient information	Not listed	Not listed
Frogs (Tyler 1997)				
Armoured Frog, Armoured Mist Frog, Thornton Peak Tree Frog, Little Waterfall Frog*	Litoria lorica	Endangered	Endangered	Endangered
Torrent Tree Frog, Waterfall Frog*	Litoria nannotis	Endangered	Endangered	Endangered
Nyakala Frog, Waterfall Mist Frog*	Litoria nyakalensis	Endangered	Endangered	Endangered
Creek Frog, Common Mist Frog*	Litoria rheocola	Endangered	Endangered	Endangered

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS		
		Action Plan	EPBC Act (Cwlth)	NCA (Qld)
Day's Frog, Lace-eyed Tree Frog, Australian Lace-lid*	Nyctimystes dayi	Endangered	Endangered	Endangered
Sharp-nosed Torrent Frog, Sharp-nosed Day Frog*	Taudactylus acutirostris	Endangered	Presumed extinct	Endangered
Tinkling Frog*	Taudactylus rheophilus	Endangered	Endangered	Endangered
Magnificent Broodfrog**	Pseudophryne covacevichae	Endangered	Vulnerable	Vulnerable
Freshwater Fishes (Wager & Jackson 1993)				
Lake Eacham Rainbowfish	Melanotaenia eachamensis	Extinct (in the wild)	Endangered	Not listed
Marine & Estuarine Fishes (Pogonoski et. al. 2002)				
Sculptured Frogfish	Halophryne queenslandiae	Lower Risk (near threatened)	Not listed	Not listed
Blind Sharks	Brachaelurus colcloughi	Vulnerable	Not listed	Not listed
Common Blacktip Shark	Carcharhinus limbatus	Data Deficient	Not listed	Not listed
Dusky Shark	Carcharhinus obscurus	Lower Risk (near threatened)	Not listed	Not listed
Sandbar Shark	Carcharhinus plumbeus	Lower Risk (near threatened)	Not listed	Not listed
Estuary Stingray	Dasyatis fluviorum	Lower Risk (near threatened)	Not listed	Not listed
Freshwater Whipray	Himantura chaophraya	Vulnerable	Not listed	Not listed
Porcupine Ray	Urogymnus asperrimus	Lower Risk (near threatened)	Not listed	Not listed
Humphead Maori Wrasse	Cheilinus undulatus	Lower Risk (conservation dependent)	Not listed	Not listed
Banded Wobbegong	Orectolobus ornatus	Data Deficient	Not listed	Not listed
Narrow Sawfish	Anoxypristis cuspidata	Vulnerable	Not listed	Not listed
Dwarf Sawfish	Pristis clavata	Endangered	Not listed	Not listed
Green Sawfish	Pristis zijsron	Endangered	Not listed	Not listed
Multicolour Dottyback	Ogilbyina novaehollandiae	Data Deficient	Not listed	Not listed
Whale Shark	Rhincodon typus	Data Deficient	Not listed	Not listed
Humpheaded Parrotfish	Bolbometopon muricatum	Data Deficient	Not listed	Not listed
Camouflage Grouper	Epinephelus polyphekadion	Lower Risk (least concern)	Not listed	Not listed
Greasy Rockcod	Epinephelus tauvina	Lower Risk (least concern)	Not listed	Not listed
Potato Cod	Epinephelus tukula	Lower Risk (conservation dependent)	Not listed	Not listed
Barramundi Cod	Cromileptes altivelis	Lower Risk (conservation dependent)	Not listed	Not listed
Estuary Rockcod	Epinepehelus coioides	Lower Risk (least concern)	Not listed	Not listed
Purple Rockcod	Epinephelus cyanopodus	Lower Risk (least concern)	Not listed	Not listed
Bar Rockcod	Epinephelus ergastularius	Data Deficient	Not listed	Not listed
Flowery Cod	Epinephelus fuscoguttatus	Lower Risk (least concern)	Not listed	Not listed
Queensland Grouper	Epinephelus lanceolatu	Lower Risk (conservation dependent)	Not listed	Not listed
Malabar Grouper	Epinephelus malabaricus	Lower Risk (least concern)	Not listed	Not listed
Gulper Shark	Centrophorus granulosus	Data Deficient	Not listed	Not listed
Banded Pipefish	Dunckerocampus dactyliophorus	Lower Risk (least concern)	Not listed	Not listed
Low-crown Seahorse	Hippocampus dahli	Lower Risk (near threatened)	Not listed	Not listed
Eastern Spiny Seahorse	Hippocampus hendriki	Data Deficient	Not listed	Not listed
Queensland Seahorse	Hippocampus queenslandicus	Data Deficient	Not listed	Not listed
Common Seahorse	Hippocampus taeniopterus	Data Deficient	Not listed	Not listed
Zebra Seahorse	Hippocampus zebra	Data Deficient	Not listed	Not listed
Pallid Pipehorse	Solegnathus hardwickii	Data Deficient	Not listed	Not listed
Alligator Pipefish	Syngnathoides biaculeatus	Data Deficient	Not listed	Not listed
Swordfish	Xiphias gladius	Data Deficient	Not listed	Not listed
Marsupials & Monotremes (Maxwell et. al. 1996)				
Spotted-tailed Quoll (N Qld), Yarri	Dasyurus maculatus gracilis	Endangered: C2a	Endangered	Endangered
Northern Bettong*	Bettongia tropica	Endangered: B1+2c	Endangered	Endangered
Mahogany Glider*	Petaurus gracilis	Endangered: A1b,B1+2a,b,c,C2a	Endangered	Endangered
Fluffy Glider, Yellow-bellied Glider (N subspecies)	Petaurus australis unnamed subsp.	Vulnerable: B1+2c,d,e,C2a	Vulnerable	Vulnerable
Atherton Antechinus	Antechinus godmani	Lower Risk (near threatened): b	Not listed	Rare
Northern Quoll	Dasyurus hallucatus	Lower Risk (near threatened): a, c	Not listed	Not listed

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS		
		Action Plan	EPBC Act (Cwlth)	NCA (Qld)
Brush-tailed Phascogale (N mainland)	Phascogale tapoatafa pirata	Lower Risk (near threatened): a, c	Not listed	Not listed
Common Dunnart (N Qld)	Sminthopsis murina tatei	Lower Risk (near threatened): b	Not listed	Not listed
Southern Brown Bandicoot (Cape York)	Isoodon obesulus peninsulae	Lower Risk (near threatened): b	Not listed	Not listed
Koala	Phascolarctos cinereus	Lower Risk (near threatened): a, c	Not listed	Not listed[3]
Bennett's Tree-kangaroo	Dendrolagus bennettianus	Lower Risk (near threatened): b	Not listed	Rare
Lumholtz's Tree-kangaroo	Dendrolagus lumholtzi	Lower Risk (near threatened): b	Not listed	Rare
Spectacled Hare-wallaby (mainland)	Lagorchestes conspicillatus leichardti	Lower Risk (near threatened): c	Not listed	Not listed
Mt Claro Rock-wallaby	Petrogale sharmani	Lower Risk (near threatened): b, d	Not listed	Rare
Lemuroid Ringtail Possum	Hemibelideus lemuroides	Lower Risk (near threatened): b	Not listed	Rare
Green Ringtail Possum	Pseudochirops archeri	Lower Risk (near threatened): b	Not listed	Rare
Daintree River Ringtail Possum	Pseudochirulus cinereus	Lower Risk (near threatened): b	Not listed	Rare
Herbert River Ringtail Possum	Pseudochirulus herbertensis	Lower Risk (near threatened): b	Not listed	Rare
Squirrel Glider	Petaurus norfolcensis	Lower Risk (near threatened): c	Not listed	Not listed
Long-tailed Pygmy-possum (Australian subspecies)	Cercartetus caudatus macrurus	Lower Risk (near threatened): b	Not listed	Not listed
Reptiles (Cogger et. al. 1993)				
Freshwater Crocodile	Crocodylus johnstoni	Rare or Insufficiently Known	Not listed	Not listed
Estuarine Crocodile	Crocodylus porosus	Rare or Insufficiently Known	Not listed	Vulnerable
Loggerhead Turtle***	Caretta caretta	Vulnerable	Endangered	Endangered
Green Turtle***	Chelonia mydas	Vulnerable	Vulnerable	Vulnerable
Hawksbill Turtle***	Eretmochelys imbricata	Vulnerable	Vulnerable	Vulnerable
Olive Ridley***	Lepidochelys olivacea	Vulnerable	Vulnerable	Endangered
Flatback Turtle***	Natator depressus	Rare or Insufficiently Known	Not listed	Vulnerable
Leatherback Turtle***	Dermochelys coriacea	Vulnerable	Vulnerable	Endangered
legless lizard	Delma mitella	Rare or Insufficiently Known	Vulnerable	Rare
Rusty Monitor	Varanus semiremex	Rare or Insufficiently Known	Not listed	Rare
Bartle Frere Skink	Techmarscincus (syn. Bartleia) jigurru	Rare or Insufficiently Known	Not listed	Rare
Thornton Peak Calyptotis	Calyptotis thorntonensis	Rare or Insufficiently Known	Not listed	Rare
striped skink	Ctenotus monticola	Rare or Insufficiently Known	Not listed	Not listed
striped skink	Ctenotus terrareginae	Rare or Insufficiently Known	Not listed	Not listed
Yakka Skink	Egernia rugosa	Rare or Insufficiently Known	Vulnerable	Vulnerable
bar-sided skink	Eulamprus tigrinus	Rare or Insufficiently Known	Not listed	Rare
skink	Glaphyromorphus fuscicaudis	Rare or Insufficiently Known	Not listed	Not listed
lerista	Lerista ameles	Rare or Insufficiently Known	Not listed	Rare
lerista	Lerista storri	Rare or Insufficiently Known	Not listed	Rare
skink	Lygisaurus rococo	Rare or Insufficiently Known	Not listed	Rare
blind snake	Ramphotyphlops broomi	Rare or Insufficiently Known	Not listed	Rare
Barnard's Snake	Furina barnardi	Rare or Insufficiently Known	Not listed	Rare
North-eastern Burrowing Snake	Simoselaps warro	Rare or Insufficiently Known	Not listed	Rare
Rodents (Lee 1995)				
Black-footed Tree-rat	Mesembriomys gouldii	Regionally Rare: secure in Arnhem Land, on the Cobourg Peninsula and on Melville Island; rare in the Kimberley and on Cape York.	Not listed	Not listed
False Water-rat	Xeromys myoides	Insufficiently known	Vulnerable	Vulnerable
Thornton Peak Uromys (syn. Thornton Peak Melomys)	Uromys hadrourus	Rare	Not listed	Not listed

* Subject to a recovery plan;
** Subject to a recovery plan but not included in action plans; and
*** Subject to a draft recovery plan.
† Migratory shorebirds in the East Asian-Australasian flyway are subject to an action plan.

APPENDIX D

Table 1: Wet Tropics Bioregion REs in Wet Tropics NRM Region (current to June 2003) (Source: Queensland Herbarium).

RE (Hectares)	RE (Hectares)
3.3.1 (976)	3.3.6 (95)
3.8.3 (28)	7.1.1 (42819)
7.1.1rs (1)	7.1.2 (3414)
7.1.3 (707)	7.1.3rs (1)
7.11.1 (122918)	7.11.10 (5168)
7.11.10ra (350)	7.11.11 (5490)
7.11.12 (13411)	7.11.13 (16931)
7.11.13ra (23)	7.11.14 (3846)
7.11.16 (2687)	7.11.16x1 (13012)
7.11.16x1rs (91)	7.11.16x2 (1921)
7.11.17 (10286)	7.11.17rs (10)
7.11.18 (6629)	7.11.18rs (7)
7.11.19 (12049)	7.11.19rs (109)
7.11.1ra (3978)	7.11.2 (1)
7.11.20 (5462)	7.11.21 (21851)
7.11.21rs (22)	7.11.22 (7892)
7.11.2ra (14)	7.11.2x1 (36)
7.11.3 (1177)	7.11.4 (6248)
7.11.4ra (1229)	7.11.5 (4543)
7.11.5ra (123)	7.11.6 (799)
7.11.6ra (1)	7.11.7 (26863)
7.11.7ra (370)	7.11.8 (136)
7.12.1 (132194)	7.12.10 (1168)
7.12.11 (2107)	7.12.12 (24)
7.12.13 (940)	7.12.14 (3548)
7.12.14a (128)	7.12.14b (1550)
7.12.15 (34605)	7.12.16 (112776)
7.12.16b (56)	7.12.17 (2602)
7.12.19 (45082)	7.12.19ra (19)
7.12.1ra (839)	7.12.2 (1923)
7.12.20 (9132)	7.12.21 (8799)
7.12.22 (20675)	7.12.23 (11321)
7.12.23b (51)	7.12.24 (26170)
7.12.24x1 (1731)	7.12.25 (5583)
7.12.25x1 (5573)	7.12.26 (14638)
7.12.27 (1909)	7.12.28 (21382)
7.12.29 (18042)	7.12.29rs (2)
7.12.3 (6665)	7.12.30 (4756)
7.12.31 (13909)	7.12.31x1 (1093)
7.12.33 (143)	7.12.34 (13886)
7.12.34rs (3)	7.12.35 (12320)
7.12.35rs (3)	7.12.36 (1425)
7.12.37 (13346)	7.12.4 (1530)
7.12.5 (3705)	7.12.5ra (9)
7.12.6 (71)	7.12.7 (16083)

RE (Hectares)	RE (Hectares)
7.12.7ra (111)	7.12.8 (241)
7.12.8ra (1)	7.12.9 (12029)
7.12.9ra (92)	7.2.1 (556)
7.2.1ra (22)	7.2.2 (233)
7.2.2ra (2)	7.2.2x1 (416)
7.2.3 (11140)	7.2.3rs (95)
7.2.3x2 (843)	7.2.4 (3882)
7.3.1 (4316)	7.3.10 (7013)
7.3.10ra (763)	7.3.11 (1066)
7.3.11ra (23)	7.3.12 (2070)
7.3.12rs (71)	7.3.13 (811)
7.3.14 (1834)	7.3.16 (4579)
7.3.17 (11776)	7.3.17ra (458)
7.3.18 (1472)	7.3.18ra (182)
7.3.19 (25484)	7.3.1rs (1)
7.3.2 (104)	7.3.20 (8231)
7.3.21 (4177)	7.3.21a (49)
7.3.22 (6052)	7.3.22ra (479)
7.3.23 (6000)	7.3.24 (431)
7.3.25 (161)	7.3.26 (757)
7.3.27 (3166)	7.3.28 (2588)
7.3.2rs (2)	7.3.3 (2640)
7.3.3ra (26)	7.3.4 (450)
7.3.4ra (7)	7.3.5 (11573)
7.3.5rs (220)	7.3.6 (4384)
7.3.6rs (87)	7.3.7 (1660)
7.3.7rs (145)	7.3.7x1 (380)
7.3.8 (10896)	7.3.8rs (5)
7.8.1 (22621)	7.8.10 (233)
7.8.10rs (1)	7.8.1ra (1098)
7.8.2 (6808)	7.8.2ra (87)
7.8.3 (1130)	7.8.3ra (146)
7.8.4 (9830)	7.8.4ra (73)
7.8.5 (7)	7.8.6 (2)
7.8.7 (429)	7.8.7x1 (468)
7.8.8 (49)	9.12.1x10 (1)
9.12.2 (5244)	9.12.2d (21)
9.12.2x12 (115)	9.12.2x13 (254)
9.12.2x6 (1701)	9.3.1 (160)
9.5.5c (381)	9.5.5x3 (3327)
9.8.1a (57)	9.8.1x7 (4)
9.8.2 (217)	9.8.4a (19)
9999 (13678)	

Table 2: Einasleigh Uplands Bioregion REs in Wet Tropics NRM Region (current to June 2003) (Source: Queensland Herbarium).

RE (Hectares)	RE (Hectares)
7.11.13 (24)	7.11.16x1 (115)
7.11.18 (531)	7.11.19 (46)
7.11.19x20 (929)	7.11.21 (1650)
7.12.10 (18)	7.12.14 (629)
7.12.18 (2054)	7.12.19 (880)
7.12.21 (311)	7.12.22 (4043)
7.12.23 (90)	7.12.24 (4)
7.12.25 (14086)	7.12.26 (729)
7.12.27 (162)	7.12.28 (2071)
7.12.29 (16233)	7.12.30 (138)
7.12.34 (18623)	7.12.35 (3892)
7.12.36 (635)	7.12.7 (6)
7.12.n31 (14)	7.3.12 (29)
7.3.14a (1975)	7.3.19 (289)
7.3.21a (1022)	7.3.22 (172)
7.3.26 (2360)	7.3.28 (254)
7.5.1 (1389)	7.8.10 (2935)
7.8.3 (2831)	7.8.7 (18738)
7.8.9 (5361)	9.11.10x1 (23799)
9.11.1a (4)	9.11.2b (79)
9.11.2e (147)	9.11.2h (4801)
9.11.2x1a (8)	9.11.3a (1557)
9.11.3f (8854)	9.11.3g (632)
9.11.4a (3341)	9.11.5a (94)
9.11.5b (39)	9.11.7a (7578)
9.11.7x1a (1500)	9.12.1c (305)
9.12.1d (13534)	9.12.1x3a (725)
9.12.1x5 (4114)	9.12.2a (44472)
9.12.2x1 (14596)	9.12.2x3c (318)
9.12.3a (935)	9.12.4b (4033)
9.12.4d (1538)	9.12.4x3a (7621)
9.12.4x3b (3584)	9.12.4x3c (3526)
9.12.7a (3063)	9.12.7b (14745)
9.12.7j (88)	9.12.7x1 (5793)
9.12.8a (12)	9.12.8c (2657)
9.3.10x1 (2655)	9.3.10x4 (1363)
9.3.11a (3036)	9.3.1a (3262)
9.3.1b (6939)	9.3.1e (1656)
9.3.1k (6242)	9.3.1n (42)
9.3.1o (1498)	9.3.1p (147)
9.3.1x3b (41)	9.3.2x2a (100)
9.3.3c (5147)	9.3.3d (503)
9.3.3f (24553)	9.3.4 (2858)
9.3.6 (13)	9.3.7 (195)
9.3.8 (5640)	9.5.2 (152)
9.5.3x2 (1707)	9.5.5a (17572)
9.5.5b (41582)	9.5.5c (42640)

RE (Hectares)	RE (Hectares)
9.5.5d (13789)	9.5.5e (16057)
9.5.5x1 (713)	9.5.6a (54528)
9.5.6x1a (6562)	9.5.6x1c (6814)
9.7.1b (155)	9.7.2a (261)
9.7.3a (4729)	9.7.3c (4426)
9.7.3x5a (69)	9.8.1a (11036)
9.8.1b (17466)	9.8.1c (15539)
9.8.1d (8150)	9.8.1x3 (6588)
9.8.1x4 (1732)	9.8.1x5 (4675)
9.8.2a (16148)	9.8.3 (233)
9.8.5b (7790)	9.8.7 (22)

APPENDIX E

The contribution of integrated NRM to the protection of biodiversity in each sub-region represented in the NRM region: existing measures and effectiveness (Source: Australian Natural Resources Assessment Atlas V2.0).

Existing activities	Assessed effectiveness	Comments
Atherton (WET4)		
Capacity building with stakeholders (specify)	Identified capacity to integrate conservation	Very degraded subregion with intensive effort required to integrate and improve the condition of biodiversity due to the lack of remaining natural areas. Building and Enhancing Community Capacity to Monitor Riverine Health and its Response to Management Programs Queensland Community Group Coordinator Community Rainforest Reforestation Program Demonstrating Stocking Rates for Sustainable Productivity Capacity Building to Resource Natural Resource Management Strategies Carrington Falls Creek Rehabilitation Project Wet Tropics Community Waterways Monitoring for Catchment Management Capacity Building for Forest Growers Queensland Bushcare Facilitators Pennefather Tourist Management Project
Environmental management systems	Identified capacity to integrate conservation	Very degraded subregion with intensive effort required to integrate and improve the condition of biodiversity due to the lack of remaining natural areas. Beneficial Use Irrigation Strategies with Treated Urban Effluent Water Management for Sustainable Wet Tropical Floodplains Extent & Impacts of Dryland Salinity Environmental Guidelines for Sugar Cane Assignments Improved Natural Resource Management - Queensland-Northern NSW Dairy Farms Sloping Farming Land & Riparian Zone Management on Dairy Farms
Incentives	Identified capacity to integrate conservation	Very degraded subregion with intensive effort required to integrate and improve the condition of biodiversity due to the lack of remaining natural areas. Advancing Lower Peterson Creek Revegetation Project Rehabilitation of Mick Creek Johnstone Shire Council rate rebate scheme for voluntary conservation agreements Measuring Post-Development Success of a Revegetation Project Implementing Rate Rebates for Conservation of Habitat Peterson Creek Corridor Consolidation (Stage II)Conservation of Remnant Vegetation on Private on the Atherton Tableland Upper Barron Revegetation Project Upper North Johnstone River Revegetation Project Mazlin Creek Rehabilitation Project Kuranda Environmental World Heritage Corridor Upper Johnstone Revegetation Project Stage 3 Extension Mazlin Creek Rehabilitation Project (Stage 2)Mates of Marcus Creek
Institutional reform	Identified capacity to integrate conservation	Very degraded subregion with intensive effort required to integrate and improve the condition of biodiversity due to the lack of remaining natural areas. Improved natural resource management: Queensland/northern NSW dairy farms
Integration with Landcare, catchment and planning	Identified capacity to integrate conservation	Very degraded subregion with intensive effort required to integrate and improve the condition of biodiversity due to the lack of remaining natural areas. Facilitating Sustainable Pastoral Development and Native Tree Retention in Queensland Access to Learning Opportunities for Landcare Management Planning - Northern Dairy Industry 'Smart Move' Management Planning Priors Creek Revegetation Project (Continuing)Yungaburra Sewage Scheme A Coordinated National Approach to Weed Management Awareness Sustainable Private Native Forest Management in the Wet Tropics Development of Johnstone River Catchment Water Management Plan
Other - describe	Identified capacity to integrate conservation	Very degraded subregion with intensive effort required to integrate and improve the condition of biodiversity due to the lack of remaining natural areas. Locating Populations of Threatened Birds on Cape York
Other planning opportunities	Identified capacity to integrate conservation	Very degraded subregion with intensive effort required to integrate and improve the condition of biodiversity due to the lack of remaining natural areas. Wet Tropics NHT Regional Strategy Group Coordination Accelerated Community Based NRM Outcomes in the Wet Tropics Region Wet Tropics Natural Heritage Trust Regional Strategy Group Coordination Development of a National Dryland Salinity Statement

Existing activities	Assessed effectiveness	Comments
Threat abatement planning	Identified capacity to integrate conservation	Very degraded subregion with intensive effort required to integrate and improve the condition of biodiversity due to the lack of remaining natural areas. Coordination, Sustainable Farming Systems Projects and Revegetation Programs Development and Implementation of Queensland Management Guidelines for Acid Sulfate Soils Wet Tropics Vegetation and Biodiversity Management Program Wet Tropics Vegetation Management Program
Valuing ecosystem services	Identified capacity to integrate conservation	Very degraded subregion with intensive effort required to integrate and improve the condition of biodiversity due to the lack of remaining natural areas. Agency Support for Community Waterwatch & Catchment Monitoring
Bellenden Ker - Lamb (WET7)		
Capacity building with stakeholders (specify)	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Strategic Management Plan Implementation Reach Four Russell River Community Rainforest Reforestation Program Wet Tropics Community Waterways Monitoring for Catchment Management Capacity Building to Resource Natural Resource Management Strategies Building and Enhancing Community Capacity to Monitor Riverine Health and its Response to Management Programs Demonstrating Stocking Rates for Sustainable Productivity Queensland Bushcare Facilitators Best Practice Riparian Management and Enhancement for Tully River and Tributaries North Queensland Land for Wildilfe Queensland Community Group Coordinator
Environmental management systems	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Implementing Sustainable Best Practice Agricultural Landuse Application of On-Farm Techniques for Sustaining Aquatic Habitats Water Management for Sustainable Wet Tropical Floodplains Environmental Guidelines for Sugar Cane Assignments Extent & Impacts of Dryland Salinity
Incentives	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Rehabilitation of Threatened Type 5b Forest Remnants Kuranda Environmental World Heritage Corridor Restoring the Riparian and Aquatic Habitats along Sweeney Creek - an Urban Waterway Incentives & Recognition for the Protection of Freehold Land for Conservation Aesthetic & Heritage Values Johnstone Shire Council rate rebate scheme for voluntary conservation agreements Cardwell Shire Rate Rebates for vegetation retention Cairns city council incentive payments and grants for land management agreements Cairns city council rate rebate scheme for land management agreements Rehabilitation of Freshwater Creek, Kamerunga and Lake Placid Sections Peterson Creek Revegetation Project The Lakes Corridor Project Implementation of Incentive Packages for Vegetation Retention/Management Implementing Rate Rebates for Conservation of Habitat Managing Tilapia to Minimise Spread in the Barron Johnstone Community Wetland Rehabilitation Program - Component D - Bulguru Swamp
Integration with Landcare, catchment and planning	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Management Planning Management Planning on the Atherton Tablelands & Coastal North Queensland Sustainable Private Native Forest Management in the Wet Tropics Development of Johnstone River Catchment Water Management Plan Access to Learning Opportunities for Landcare A Coordinated National Approach to Weed Management Awareness Implementation of the Russell Mulgrave Catchment Strategy South Johnstone River Stabilisation Project Facilitating Sustainable Pastoral Development and Native Tree Retention in Queensland Project Manager - Johnstone River Catchment Projects Russell & Mulgrave, Employment of Coordinator
Other - describe	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Flood Level Data Base
Other planning opportunities	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Wet Tropics NHT Regional Strategy Group Coordination Accelerated Community Based NRM Outcomes in the Wet Tropics - Component 2 Accelerated Community Based NRM Outcomes in the Wet Tropics Region Development of a National Dryland Salinity Statement Community Implementation of Regional Strategies Component, Management of Sustainable Productivity & Biodiversity (Tully Flood Plains)Wet Tropics Natural Heritage Trust Regional Strategy Group Coordination

Existing activities	Assessed effectiveness	Comments
Threat abatement planning	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. North Johnstone River stabilisation and riparian vegetation reinstatementWet Tropics Vegetation and Biodiversity Management Program Best Management Practices Using Sediment Traps and Riparian Restoration Adjacent to Wetland Additional Bank Protection Works Tully-Murray Rivers Development and Implementation of Queensland Management Guidelines for Acid Sulfate Soils Wet Tropics Vegetation Management Program Jonhstone Community Vegetation Initiative - Stage 2 Environmental Audit of Eprapah Creek Estuary and Adjacent Coast
Valuing ecosystem services	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Agency Support for Community Waterwatch & Catchment Monitoring
No data	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Clancy Estate Wetland Remnant Rehabilitation Project
Daintree - Bloomfield (WET9)		
Capacity building with stakeholders (specify)	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Demonstrating Stocking Rates for Sustainable Productivity Building and Enhancing Community Capacity to Monitor Riverine Health and its Response to Management Programs Queensland Community Group Coordinator Queensland Bushcare Facilitators Wet Tropics Community Waterways Monitoring for Catchment ManagementCapacity Building to Resource Natural Resource Management Strategies
Environmental management systems	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Water Management for Sustainable Wet Tropical FloodplainsExtent & Impacts of Dryland Salinity Environmental Guidelines for Sugar Cane Assignments Encouraging Owls onto Sugarcane Farms Streambank Stabilisation and Riparian Revegetation in Douglas Shire
Incentives	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Conservation Grants on Rural Lands (Stage II)
Integration with Landcare, catchment and planning	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Facilitating Sustainable Pastoral Development and Native Tree Retention in Queensland A Coordinated National Approach to Weed Management Awareness Management Planning on the Atherton Tablelands & Coastal North Queensland Sustainable Private Native Forest Management in the Wet Tropics Management PlanningAccess to Learning Opportunities for Landcare
Other planning opportunities	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Accelerated Community Based NRM Outcomes in the Wet Tropics Region Wet Tropics NHT Regional Strategy Group CoordinationCottage Point to Jessica Point Management ProjectDevelopment of a National Dryland Salinity StatementWet Tropics Natural Heritage Trust Regional Strategy Group Coordination
Threat abatement planning	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Wet Tropics Vegetation and Biodiversity Management ProgramWet Tropics Vegetation Management ProgramDevelopment and Implementation of Queensland Management Guidelines for Acid Sulfate Soils
Valuing ecosystem services	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Agency Support for Community Waterwatch & Catchment Monitoring
Herbert (WET1)		

Existing activities	Assessed effectiveness	Comments
Capacity building with stakeholders (specify)	NRM instruments in place with some outcomes	Building and Enhancing Community Capacity to Monitor Riverine Health and its Response to Management ProgramsQueensland Bushcare FacilitatorsCommunity Rainforest Reforestation ProgramCapacity Building to Resource Natural Resource Management StrategiesAdopt and Restore the Macknade WetlandDemonstrating Stocking Rates for Sustainable ProductivityQueensland Community Group Coordinator
Environmental management systems	NRM instruments in place with some outcomes	Management Planning on the Atherton Tablelands & Coastal North QueenslandEnvironmental Guidelines for Sugar Cane AssignmentsExtent & Impacts of Dryland SalinityBeneficial Use Irrigation Strategies with Treated Urban Effluent
Incentives	NRM instruments in place with some outcomes	Cardwell Foreshore Site Planning & Rehabilitation ProjectCampwin Beach Revegetation & Dune Stabilisation Project
Integration with Landcare, catchment and planning	NRM instruments in place with some outcomes	Access to Learning Opportunities for LandcareImplementation of the Herbert River Catchment Management StrategyFacilitating Sustainable Pastoral Development and Native Tree Retention in Queensland Management Planning in the Ingham DistrictWater Management for Sustainable Wet Tropical Floodplains Management Planning Coordinated National Approach to Weed Management Awareness
Other - describe	NRM instruments in place with some outcomes	Herbert River Anabranch StabilisationMahogany Glider Recovery Plan
Other planning opportunities	NRM instruments in place with some outcomes	Inventory of Herbert Soils for Sustainable Sugarcane ProductionAccelerated Community Based NRM Outcomes in the Wet Tropics RegionWet Tropics NHT Regional Strategy Group Coordination
Threat abatement planning	NRM instruments in place with some outcomes	Development and Implementation of Queensland Management Guidelines for Acid Sulfate SoilsCommunity Implementation of Herbert River Catchment StrategyWet Tropics Natural Heritage Trust Regional Strategy Group CoordinationWet Tropics Vegetation and Biodiversity Management Program
Valuing ecosystem services	NRM instruments in place with some outcomes	Agency Support for Community Waterwatch & Catchment Monitoring
No data	NRM instruments in place with some outcomes	Wet Tropics Community Waterways Monitoring for Catchment ManagementIngham TYTO Wetlands (Stage 2)
Innisfail (WET3)		
Capacity building with stakeholders (specify)	NRM instruments in place with some outcomes	Project Manager - Johnstone Catchment ProjectsCommunity Rainforest Reforestation ProgramQueensland Bushcare FacilitatorsBuilding and Enhancing Community Capacity to Monitor Riverine Health and its Response to Management ProgramsWet Tropics Community Waterways Monitoring for Catchment ManagementQueensland Community Group CoordinatorDemonstrating Stocking Rates for Sustainable ProductivityCapacity Building to Resource Natural Resource Management Strategies
Environmental management systems	NRM instruments in place with some outcomes	Water Management for Sustainable Wet Tropical FloodplainsEnvironmental Guidelines for Sugar Cane AssignmentsCoordinator, Grazing Systems Management & Revegetation ProgramsExtent & Impacts of Dryland SalinityEdmonton Constructed WetlandsBeneficial Use Irrigation Strategies with Treated Urban Effluent

Existing activities	Assessed effectiveness	Comments
Incentives	NRM instruments in place with some outcomes	Yarrabah DOGIT Scrub Cleaning And Reforestation Clifton Beach Foreshore Rejuvenation ProjectCairns Urban Creeks Rehabilitation Project (formerly Skeleton Creek Revegetation Project) Foreshore Rejuvenation ProjectRestore Our Reserve ProjectCairns city council rate rebate scheme for land management agreementsCairns city council incentive payments and grants for land management agreementsRehabilitation of Crowley CreekArtificial Wetland - Pilot Project For Trinity Inlet CairnsRehabilitation of Chapman River Foreshore (Northern Section)
Integration with Landcare, catchment and planning	NRM instruments in place with some outcomes	Management Planning on the Atherton Tablelands & Coastal North Queensland A Coordinated National Approach to Weed Management Awareness Voluntary Riverbank Restoration Scheme (A Mary Catchment Strategy Implementation Scheme) Access to Learning Opportunities for Landcare Management Planning Management Planning in the Bowen/Burdekin/Whitsunday Grazing LandsSustainable Private Native Forest Management in the Wet TropicsFacilitating Sustainable Pastoral Development and Native Tree Retention in QueenslandImplementing Catchment Strategies to On-ground ActionCairns Regional Urban Landcare Officer
Other - describe	NRM instruments in place with some outcomes	Development of Johnstone River Catchment Water Management Plan
Other planning opportunities	NRM instruments in place with some outcomes	Accelerated Community Based NRM Outcomes in the Wet Tropics RegionDevelopment of a National Dryland Salinity StatementMinimising Soil Loss From Upper Johnstone Grazing LandsWet Tropics NHT Regional Strategy Group CoordinationWet Tropics Natural Heritage Trust Regional Strategy Group Coordination
Threat abatement planning	NRM instruments in place with some outcomes	Development and Implementation of Queensland Management Guidelines for Acid Sulfate SoilsWet Tropics Vegetation and Biodiversity Management ProgramWet Tropics Vegetation Management Program
Valuing ecosystem services	NRM instruments in place with some outcomes	Agency Support for Community Waterwatch & Catchment Monitoring
Kirrama - Hinchinbrook (WET6)		
Capacity building with stakeholders (specify)	Conservation outcomes well integrated into NRM	The greater part of the subregion is in the park estate or World Heritage Areas or native forests. Queensland Community Group CoordinatorCapacity Building to Resource Natural Resource Management StrategiesCommunity Rainforest Reforestation ProgramDemonstrating Stocking Rates for Sustainable ProductivityQueensland Bushcare FacilitatorsBest Practice Riparian Management and Enhancement for Tully River and TributariesWet Tropics Community Waterways Monitoring for Catchment ManagementBuilding and Enhancing Community Capacity to Monitor Riverine Health and its Response to Management Programs
Environmental management systems	Conservation outcomes well integrated into NRM	The greater part of the subregion is in the park estate or World Heritage Areas or native forests. Application of On-Farm Techniques for Sustaining Aquatic HabitatsImplementing Sustainable Best Practice Agricultural LanduseExtent & Impacts of Dryland SalinityHerbert River Anabranch StabilisationWater Management for Sustainable Wet Tropical Floodplains
Incentives	Conservation outcomes well integrated into NRM	The greater part of the subregion is in the park estate or World Heritage Areas or native forests. Key Habitat Connectivity in the Cardwell ShireCardwell Shire rate rebate for vegetation retentionImplementation of Incentive Packages for Vegetation Retention/ManagementIngham Tyto Wetlands
Integration with Landcare, catchment and planning	Conservation outcomes well integrated into NRM	The greater part of the subregion is in the park estate or World Heritage Areas or native forests. Management Planning on the Atherton Tablelands & Coastal North QueenslandA Coordinated National Approach to Weed Management Awareness Access to Learning Opportunities for LandcareSustainable Private Native Forest Management in the Wet Tropics Management PlanningApplication of On-Farm Techniques for Sustaining Aquatic HabitatsFacilitating Sustainable Pastoral Development and Native Tree Retention in QueenslandICM Coordinator - Cardwell Shire Catchment Coordinating Committee

Existing activities	Assessed effectiveness	Comments
Other - describe	Conservation outcomes well integrated into NRM	The greater part of the subregion is in the park estate or World Heritage Areas or native forests. Inventory of Herbert Soils for Sustainable Sugarcane ProductionFlood Level Data BaseManagement of Major Sediment Sources - Herbert Catchment
Other planning opportunities	Conservation outcomes well integrated into NRM	The greater part of the subregion is in the park estate or World Heritage Areas or native forests. Community Implementation of Regional Strategies Component, Management of Sustainable Productivity & Biodiversity (Tully Flood Plains)Wet Tropics NHT Regional Strategy Group CoordinationWet Tropics Natural Heritage Trust Regional Strategy Group CoordinationDevelopment of a National Dryland Salinity StatementBiodiversity Assessment for Local Government Planning - Herberton ShireAccelerated Community Based NRM Outcomes in the Wet Tropics Region
Threat abatement planning	Conservation outcomes well integrated into NRM	The greater part of the subregion is in the park estate or World Heritage Areas or native forests. Wet Tropics Vegetation Management ProgramCommunity Implementation of Regional Strategies - Component GWet Tropics Vegetation and Biodiversity Management ProgramDevelopment and Implementation of Queensland Management Guidelines for Acid Sulfate SoilsHinchinbrook Beach Co-operative Conservation PlanIngham Tyto Wetlands (NWP) Additional Bank Protection Works Tully-Murray Rivers
Valuing ecosystem services	Conservation outcomes well integrated into NRM	The greater part of the subregion is in the park estate or World Heritage Areas or native forests. Agency Support for Community Waterwatch & Catchment Monitoring
Macalister (WET8)		
Capacity building with stakeholders (specify)	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Demonstrating Stocking Rates for Sustainable ProductivityWet Tropics Community Waterways Monitoring for Catchment ManagementQueensland Community Group CoordinatorCapacity Building to Resource Natural Resource Management StrategiesKuku Yalanji Turtle & Dugong Management & Education ProjectBuilding and Enhancing Community Capacity to Monitor Riverine Health and its Response to Management ProgramsQueensland Bushcare Facilitators
Environmental management systems	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Environmental Guidelines for Sugar Cane AssignmentsExtent & Impacts of Dryland SalinityWater Management for Sustainable Wet Tropical Floodplains
Incentives	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Strategic Revegetation of Mazlin Creek to Address Community and Ecological NeedsIncentives & Recognition for the Protection of Freehold Land for Conservation Aesthetic & Heritage Values
Institutional reform	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Implementing the Barron River Integrated Catchment Management Strategy
Integration with Landcare, catchment and planning	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. A Coordinated National Approach to Weed Management Awareness Access to Learning Opportunities for LandcareFacilitating Sustainable Pastoral Development and Native Tree Retention in QueenslandSustainable Private Native Forest Management in the Wet TropicsCo-ordinate the implementation of the Barron River Integrated Catchment Management StrategyWater Quality Action Plan for Barron River Strategy Management Planning Management Planning on the Atherton Tablelands & Coastal North Queensland
Other - describe	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Quantifying the Sources of Faecal Pollution Entering Tinaroo Dam

Existing activities	Assessed effectiveness	Comments
Other planning opportunities	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Wet Tropics NHT Regional Strategy Group CoordinationAccelerated Community Based NRM Outcomes in the Wet Tropics RegionDevelopment of a National Dryland Salinity StatementWet Tropics Natural Heritage Trust Regional Strategy Group Coordination
Threat abatement planning	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Development and Implementation of Queensland Management Guidelines for Acid Sulfate SoilsWet Tropics Vegetation Management ProgramWet Tropics Vegetation and Biodiversity Management ProgramIntegrating the Barron River (NR-7-95)
Valuing ecosystem services	Conservation outcomes well integrated into NRM	The bulk of the subregion is in park estate, World Heritage Area or native forest. Agency Support for Community Waterwatch & Catchment Monitoring
Paluma - Seaview (WET5)		
Capacity building with stakeholders (specify)	Conservation outcomes well integrated into NRM	The subregion contains significant areas of park estate and World Heritage Area and native forestry. Community Rainforest Reforestation ProgramCapacity Building to Resource Natural Resource Management StrategiesWet Tropics Community Waterways Monitoring for Catchment ManagementQueensland Bushcare FacilitatorsDemonstrating Stocking Rates for Sustainable ProductivityQueensland Community Group CoordinatorBuilding and Enhancing Community Capacity to Monitor Riverine Health and its Response to Management Programs
Environmental management systems	Conservation outcomes well integrated into NRM	The subregion contains significant areas of park estate and World Heritage Area and native forestry. Beneficial Use Irrigation Strategies with Treated Urban EffluentWater Management for Sustainable Wet Tropical FloodplainsExtent & Impacts of Dryland Salinity
Incentives	Conservation outcomes well integrated into NRM	The subregion contains significant areas of park estate and World Heritage Area and native forestry. Palm Creek Rejuvenation Ingham
Integration with Landcare, catchment and planning	Conservation outcomes well integrated into NRM	The subregion contains significant areas of park estate and World Heritage Area and native forestry. Sustainable Private Native Forest Management in the Wet TropicsAccess to Learning Opportunities for LandcareFacilitating Sustainable Pastoral Development and Native Tree Retention in Queensland Management PlanningA Coordinated National Approach to Weed Management Awareness
Other - describe	Conservation outcomes well integrated into NRM	The subregion contains significant areas of park estate and World Heritage Area and native forestry.
Other planning opportunities	Conservation outcomes well integrated into NRM	The subregion contains significant areas of park estate and World Heritage Area and native forestry. Accelerated Community Based NRM Outcomes in the Wet Tropics RegionWet Tropics NHT Regional Strategy Group CoordinationWet Tropics Natural Heritage Trust Regional Strategy Group CoordinationDevelopment of a National Dryland Salinity Statement
Threat abatement planning	Conservation outcomes well integrated into NRM	The subregion contains significant areas of park estate and World Heritage Area and native forestry. Wet Tropics Vegetation and Biodiversity Management ProgramCommunity Implementation of Herbert River Catchment StrategyWet Tropics Vegetation Management ProgramDevelopment and Implementation of Queensland Management Guidelines for Acid Sulfate Soils
Valuing ecosystem services	Conservation outcomes well integrated into NRM	The subregion contains significant areas of park estate and World Heritage Area and native forestry. Agency Support for Community Waterwatch & Catchment Monitoring
Tully (WET2)		

Existing activities	Assessed effectiveness	Comments
Capacity building with stakeholders (specify)	Identified capacity to integrate conservation	Queensland Bushcare FacilitatorsCapacity Building to Resource Natural Resource Management StrategiesBest Practice Riparian Management and Enhancement for Tully River and TributariesDemonstrating Stocking Rates for Sustainable ProductivityWet Tropics Community Waterways Monitoring for Catchment ManagementQueensland Community Group CoordinatorBuilding and Enhancing Community Capacity to Monitor Riverine Health and its Response to Management ProgramsCommunity Rainforest Reforestation Program
Environmental management systems	Identified capacity to integrate conservation	Extent & Impacts of Dryland SalinityEnvironmental Guidelines for Sugar Cane AssignmentsWater Management for Sustainable Wet Tropical FloodplainsImplementing Sustainable Best Practice Agricultural LanduseWater Quality Assessment for Sustainable Agriculture
Incentives	Identified capacity to integrate conservation	Cardwell Shire reta rebate for vegetation retentionReconstruction of Cutten Brothers Walking TrackIngham Tyto WetlandsKey Habitat Connectivity in the Cardwell ShireWongaling Beach Community Foreshore Rehabilitation Project
Integration with Landcare, catchment and planning	Identified capacity to integrate conservation	Additional Bank Protection Works Tully-Murray RiversA Coordinated National Approach to Weed Management Awareness Community Implementation of Regional Strategies Component, Management of Sustainable Productivity & Biodiversity (Tully Flood Plains) Sustainable Private Native Forest Management in the Wet TropicsAccess to Learning Opportunities for LandcareImplementation of Catchment Management in Gowrie Creek CatchmentFlood Level Data Base Management PlanningICM Coordinator - Cardwell Shire Catchment Coordinating CommitteeApplication of On-Farm Techniques for Sustaining Aquatic Habitats Management Planning on the Atherton Tablelands & Coastal North QueenslandFacilitating Sustainable Pastoral Development and Native Tree Retention in Queensland
Other - describe	Identified capacity to integrate conservation	Beneficial Use Irrigation Strategies with Treated Urban Effluent
Other planning opportunities	Identified capacity to integrate conservation	Accelerated Community Based NRM Outcomes in the Wet Tropics RegionApplication of On-Farm Techniques for Sustaining Aquatic HabitatsWet Tropics NHT Regional Strategy Group CoordinationWet Tropics Natural Heritage Trust Regional Strategy Group CoordinationDevelopment of a National Dryland Salinity Statement
Threat abatement planning	Identified capacity to integrate conservation	Hinchinbrook Beach Co-operative Conservation PlanCommunity Implementation of Regional Strategies - Component GIngham Tyto Wetlands (NWP) Wet Tropics Vegetation Management ProgramWet Tropics Vegetation and Biodiversity Management ProgramDevelopment and Implementation of Queensland Management Guidelines for Acid Sulfate Soils
Valuing ecosystem services	Identified capacity to integrate conservation	Agency Support for Community Waterwatch & Catchment Monitoring
Herberton - Wairuna (EIU6)		
Capacity building with stakeholders (specify)	Significant constraints to integrate conservation	Sub-region lies between Wet Tropics and Nothern Gulf groups. On ground NRM actions difficult to co-ordinate. Number o minning leases exist in north of the sub-region which may provide some opportunities. Queensland Bushcare FacilitatorsQueensland Community Group CoordinatorCapacity Building to Resource Natural Resource Management StrategiesDemonstrating Stocking Rates for Sustainable ProductivityBuilding and Enhancing Community Capacity to Monitor Riverine Health and its Response to Management Programs
Environmental management systems	Significant constraints to integrate conservation	Sub-region lies between Wet Tropics and Nothern Gulf groups. On ground NRM actions difficult to co-ordinate. Number o minning leases exist in north of the sub-region which may provide some opportunities. Extent & Impacts of Dryland Salinity

Existing activities	Assessed effectiveness	Comments
Integration with Landcare, catchment and planning	Significant constraints to integrate conservation	Sub-region lies between Wet Tropics and Nothern Gulf groups. On ground NRM actions difficult to co-ordinate. Number o minning leases exist in north of the sub-region which may provide some opportunities. Facilitating Sustainable Pastoral Development and Native Tree Retention in QueenslandA Coordinated National Approach to Weed Management Awareness Management of Major Sediment Sources - Herbert CatchmentAccess to Learning Opportunities for Landcare Management Planning
Other planning opportunities	Significant constraints to integrate conservation	Sub-region lies between Wet Tropics and Nothern Gulf groups. On ground NRM actions difficult to co-ordinate. Number o minning leases exist in north of the sub-region which may provide some opportunities. Development of a National Dryland Salinity StatementGrazing Management Strategies for Seasonably Variable Tropical SavannasBiodiversity Assessment for Local Government Planning - Herberton Shire
Threat abatement planning	Significant constraints to integrate conservation	Sub-region lies between Wet Tropics and Nothern Gulf groups. On ground NRM actions difficult to co-ordinate. Number o minning leases exist in north of the sub-region which may provide some opportunities. Evaluation of Remnant Vegetation of Central & Eastern QueenslandDevelopment and Implementation of Queensland Management Guidelines for Acid Sulfate Soils
Valuing ecosystem services	Significant constraints to integrate conservation	Sub-region lies between Wet Tropics and Nothern Gulf groups. On ground NRM actions difficult to co-ordinate. Number o minning leases exist in north of the sub-region which may provide some opportunities. Agency Support for Community Waterwatch & Catchment Monitoring
Hodgkinson Basin (EIU3)		
Capacity building with stakeholders (specify)	Significant constraints to integrate conservation	Large number of mining leases in sub-region may be an opportunity for off-park biodiversity managementDemonstrating Stocking Rates for Sustainable ProductivityCapacity Building to Resource Natural Resource Management StrategiesQueensland Bushcare FacilitatorsBuilding and Enhancing Community Capacity to Monitor Riverine Health and its Response to Management ProgramsQueensland Community Group Coordinator
Environmental management systems	Significant constraints to integrate conservation	Large number of minning leases in sub-region may be an opportunity for off-park biodiversity managementExtent & Impacts of Dryland SalinityMitchell River Water & Environmental Quality Management Data
Incentives	Significant constraints to integrate conservation	Large number of minning leases in sub-region may be an opportunity for off-park biodiversity managementLower Peterson Creek Revegetation ProjectOn-ground Works for Native Vegetation Management and Rehabilitation (Devolved Grant)
Integration with Landcare, catchment and planning	Significant constraints to integrate conservation	Large number of minning leases in sub-region may be an opportunity for off-park biodiversity managementFacilitating Sustainable Pastoral Development and Native Tree Retention in QueenslandA Coordinated National Approach to Weed Management Awareness Access to Learning Opportunities for Landcare Management Planning
Other planning opportunities	Significant constraints to integrate conservation	Large number of minning leases in sub-region may be an opportunity for off-park biodiversity managementGrazing Management Strategies for Seasonably Variable Tropical SavannasDevelopment of a National Dryland Salinity Statement
Threat abatement planning	Significant constraints to integrate conservation	Large number of minning leases in sub-region may be an opportunity for off-park biodiversity managementNorthern Gulf Regional Strategy - Bioregional Coordinator, Business Development & CommunicationEvaluation of Remnant Vegetation of Central & Eastern QueenslandDevelopment and Implementation of Queensland Management Guidelines for Acid Sulfate Soils

Existing activities	Assessed effectiveness	Comments
Valuing ecosystem services	Significant constraints to integrate conservation	Large number of minning leases in sub-region may be an opportunity for off-park biodiversity managementAgency Support for Community Waterwatch & Catchment Monitoring
Kidston (EIU2)		
Capacity building with stakeholders (specify)	Identified capacity to integrate conservation	Northern Gulf Regional strategy GroupCapacity Building to Resource Natural Resource Management StrategiesBuilding and Enhancing Community Capacity to Monitor Riverine Health and its Response to Management ProgramsQueensland Bushcare FacilitatorsGeorgetown Community PartnershipQueensland Community Group CoordinatorDemonstrating Stocking Rates for Sustainable Productivity
Environmental management systems	Identified capacity to integrate conservation	Northern Gulf Regional strategy GroupRiparian & Subdivisional Fencing for Spelling & RevegetationDeveloping Landcare in the Etheridge ShireExtent & Impacts of Dryland Salinity
Incentives	Identified capacity to integrate conservation	Northern Gulf Regional strategy GroupOn-ground Works for Native Vegetation Management and Rehabilitation (Devolved Grant)
Institutional reform	Identified capacity to integrate conservation	Northern Gulf Regional strategy GroupReclamation of Degraded Frontage LandsLand Use Adaptive Management - Gilbert Catchment
Integration with Landcare, catchment and planning	Identified capacity to integrate conservation	Northern Gulf Regional strategy GroupA Coordinated National Approach to Weed Management Awareness Facilitating Sustainable Pastoral Development and Native Tree Retention in Queensland Management PlanningAccess to Learning Opportunities for LandcareEastern Gulf Catchments: Strategic Planning & Project Management
Other planning opportunities	Identified capacity to integrate conservation	Northern Gulf Regional strategy GroupGrazing Management Strategies for Seasonably Variable Tropical SavannasDevelopment of a National Dryland Salinity Statement
Threat abatement planning	Identified capacity to integrate conservation	Northern Gulf Regional strategy GroupEvaluation of Remnant Vegetation of Central & Eastern QueenslandNorthern Gulf Regional Strategy - Bioregional Coordinator, Business Development & CommunicationDevelopment and Implementation of Queensland Management Guidelines for Acid Sulfate Soils
Valuing ecosystem services	Identified capacity to integrate conservation	Northern Gulf Regional strategy GroupAgency Support for Community Waterwatch & Catchment Monitoring
Undara - Toomba Basalts (EIU5)		
Capacity building with stakeholders (specify)	Identified capacity to integrate conservation	Subregion covers a large geographic range that is difficult to co-ordinate. May be better to cooperate with more localised NRM groupsQueensland Community Group CoordinatorQueensland Bushcare FacilitatorsDemonstrating Stocking Rates for Sustainable ProductivityBetter Grazing Distribution in the Balfes Creek Catchment using Mine Tyres as Water TroughsBuilding and Enhancing Community Capacity to Monitor Riverine Health and its Response to Management ProgramsCapacity Building to Resource Natural Resource Management Strategies

Existing activities	Assessed effectiveness	Comments
Environmental management systems	Identified capacity to integrate conservation	Subregion covers a large geographic range that is dissivult to co-ordiante. May be better to cooperate with more localised NRM groupsExtent & Impacts of Dryland Salinity
Incentives	Identified capacity to integrate conservation	Subregion covers a large geographic range that is dissivult to co-ordiante. May be better to cooperate with more localised NRM groupsOn-ground Works for Native Vegetation Management and Rehabilitation (Devolved Grant)
Industry codes of practice	Identified capacity to integrate conservation	Subregion covers a large geographic range that is dissivult to co-ordiante. May be better to cooperate with more localised NRM groupsPractical Grazing Management Guidelines for Dalrymple Shire
Institutional reform	Identified capacity to integrate conservation	Subregion covers a large geographic range that is dissivult to co-ordiante. May be better to cooperate with more localised NRM groupsEcologically sustainable management of the Birdbush Basalt Environment and Grazing IndustryLand Use Adaptive Management - Gilbert Catchment
Integration with Landcare, catchment and planning	Identified capacity to integrate conservation	Subregion covers a large geographic range that is dissivult to co-ordiante. May be better to cooperate with more localised NRM groupsFacilitating Sustainable Pastoral Development and Native Tree Retention in QueenslandRiparian Zone Management - Central Upper Burdekin Catchment Access to Learning Opportunities for LandcareDalrymple Landcare Project Coordination Management PlanningEastern Gulf Catchments: Strategic Planning & Project ManagementA Coordinated National Approach to Weed Management Awareness Co-ordination of Landcare Groups in the Upper Burdekin Rangelands
Other planning opportunities	Identified capacity to integrate conservation	Subregion covers a large geographic range that is dissivult to co-ordiante. May be better to cooperate with more localised NRM groupsGrazing Management Strategies for Seasonably Variable Tropical SavannasDevelopment of a National Dryland Salinity Statement
Threat abatement planning	Identified capacity to integrate conservation	Subregion covers a large geographic range that is dissivult to co-ordiante. May be better to cooperate with more localised NRM groupsDevelopment and Implementation of Queensland Management Guidelines for Acid Sulfate SoilsNorthern Gulf Regional Strategy - Bioregional Coordinator, Business Development & CommunicationEvaluation of Remnant Vegetation of Central & Eastern Queensland
Valuing ecosystem services	Identified capacity to integrate conservation	Subregion covers a large geographic range that is difficult to co-ordinate. May be better to cooperate with more localised NRM groupsAgency Support for Community Waterwatch & Catchment Monitoring

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