Photo: Suzanne Long

A Prototype Report Card for the

STATUS AND TRENDS OF BIODIVERSITY, SOILS AND LANDSCAPES IN THE WET TROPICS

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Australian Government
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Reef & Rainforest RESEARCH CENTRE

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WET TROPICS MANAGEMENT AUTHORITY

Wet Tropics Status and Trends Report Card 2010

This report card presents the results and recommendations of the Wet Tropics based project '*Status and trends of biodiversity and ecosystem services: State of the Environment reporting and gap filling'*, funded by the Australian Government's Marine and Tropical Sciences Research Facility (MTSRF). Presented here is a prototype indicator framework for the biodiversity, soils and landscape assets of the Wet Tropics, and preliminary results for their present condition based on expert opinion and the most recent available data. For each of these natural assets, the current status and trends are assessed, and priorities for natural resource management actions are identified. The report card also highlights information gaps, and makes recommendations for how these gaps should be filled.

Condition status indicators in this report card are graded from 'Very good' to 'Very poor'. Where possible, trend data are also provided but these are limited. Results are presented spatially for the twelve major catchments, nine subregions, the Wet Tropics bioregion and the World Heritage Area occurring within the Wet Tropics.

Data sets from 1972 enabled the determination of trends for vegetation extent and condition. Much has of course changed in the Wet Tropics since 1972, most notably the listing of a World Heritage Area in December 1988 and the introduction of the *Vegetation Management Act 1999.* Despite this and other considerable advances towards the conservation of natural resources, the Wet Tropics is still under pressure and declines in biodiversity are reported. It is almost universally accepted that biodiversity and healthy ecosystems are essential for the existence of societies and our economies; however we are still failing to protect them adequately.

Our preliminary assessment illustrates that the Wet Tropics biodiversity, soil and landscapes remain under pressure, and Natural Resource Management (NRM) policy responses have been insufficient in halting that general decline. This report card, and associated scientific journal papers by Pert *et al.* (in prep.) and Bruce *et al.* (in prep.) (see References, page 40), is an important aid for the setting of NRM resource condition targets and allows an insight of what we need to do better – and more importantly where – to halt the loss of biodiversity.

Pressures on biodiversity are generally not geographically uniform. Analysis of the condition indicators suggests that, with respect to the status and trends of biodiversity, the overall score for the entire MTSRF study area was 'good'. In assessing the threats to biodiversity it is clear that native vegetation fragmentation, weeds and feral animals remain a problem.

Invasive species remain a moderate threat, particularly in the Russell and the North and South Johnstone catchments. While invasive species are recognised as a major driver of biodiversity loss, in the future the issue needs to be considered more broadly in the context of climate change. Urban sprawl and intensification of previously cleared land are putting pressure on natural and semi-natural areas; this is reflected in the Mulgrave catchment with an increasing level of urbanisation.

The current state of Wet Tropics catchments reflects the cumulative effects of the last 140 years of settlement and land clearance, combined with recent cyclone events. This report card responds to the need for long term, consistent assessment of natural assets in determining the status and trends of the Wet Tropics. It should inform the policies, plans and activities of a wide range of sectors, both public and private. It is hoped that the spatial products presented in this report card will be widely used and built upon and integrated into the e-Atlas*. The challenge is to translate the biodiversity priorities identified here into conservation action on the ground; and the prototype indicator framework into consistent monitoring.

* http://e-atlas.org.au/

BACKGROUND

MTSRF Project 1.2.1(c), '*Status and trends of biodiversity and ecosystem services: State of the Environment reporting and gap filling*' aims to provide the knowledge, methods and results of accurate and up-to-date *State of the Environment* reporting on the key biodiversity and ecosystem services assets of North Queensland. This information is designed to support future iterations of natural resource planning by Terrain NRM Ltd (the Natural Resource Management Board for the Wet Tropics), and the management of the Wet Tropics World Heritage Area by the Wet Tropics Management Authority (WTMA).

ABOUT THIS REPORT CARD

This report card presents a set of indicators which report on the state of the environment across the Wet Tropics study region. Core indicators for measuring the condition of biodiversity, soils and landscapes have been developed in consultation with the WTMA, Terrain NRM and regional researchers. The purpose of this report card is to:

- Provide access to scientifically credible, timely and relevant information on the current condition, status and trends of biodiversity, soils and landscapes in the Wet Tropics;
- Identify driving forces and direct pressures influencing environmental change;
- Assist decision-making in policy development, environmental management and resource use;
- Raise public awareness and understanding of environmental issues in order to improve the way we use, manage, and value the environment; and
- Make recommendations on future actions required to improve monitoring of environmental condition to support planning for sustainable development.

READING THE SCORECARD

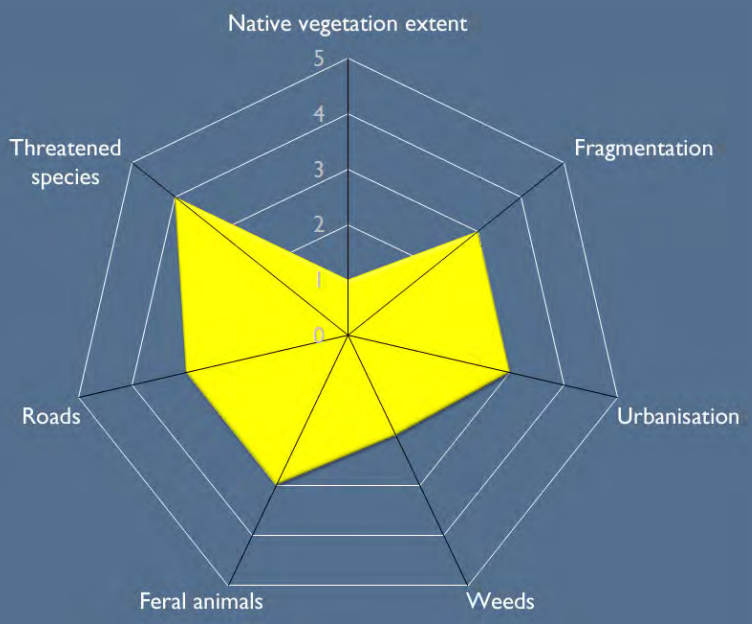
The scorecard presents the change in status over time. Reporting periods are 1972-2006 for the MTSRF study area, 1988-2006 for WTMA subregions and 2004-2006 for Terrain NRM catchments. The status of indicators reports the relative condition in the year for which the latest data are available, usually 2006. Indicator values were scored as follows:

Very good	Top 20% of indicator values	5
Good		4
Moderate		3
Poor		2
Very poor	Bottom 20% of indicator values	1

The trend in the condition of indicators is represented with arrows, as follows:

Trend of Indicator	
Decreasing condition	↓
Continuing condition	→
Improving condition	↗
Rapidly improving condition	↑
Stable condition	↔
Unknown	?

'Radar plots' are used to provide a indicative simple display of the relative status of assets. They are primarily used at the reporting area scale (e.g. catchment, subregion). Each plot is comprised of triangular wedges, with each wedge displaying the result for an indicator score (from 1 to 5). Thus, the area determined by the joining lines between each arm is a visual way of assessing the condition of the asset: the bigger the area, the better the condition of the asset in the reporting area. The centre of the plot represents the lowest score (i.e. 1 or 'Very poor'), while the outer edge represents the highest score (i.e. 5 or 'Very good').



Example of a radar plot, displaying the relative status of indicators.

REPORTING AREAS

The overall study area for this project incorporates the Wet Tropics World Heritage Area, Wet Tropics Bioregion, parts of the Brigalow Belt and Einasleigh Bioregions and the Terrain NRM plan region (Figure 1). The reporting area also incorporates a southern extension that includes Mt Elliott, just south of Townsville, because it is biogeographically similar to much of the Wet Tropics Bioregion.

Figure 1: Study area, encompassing the Wet Tropics World Heritage Area and Terrain NRM reporting areas (catchments).

STATE OF THE ENVIRONMENT REPORTING

State of the Environment (SoE) reporting is a system for delivering useful information and assessments about the environment to all parts of society including the public, government, industry, and non-government organisations. SoE reports facilitate environment-related decision-making and contribute significantly to education about the environment and natural resources. SoE reporting:

- **Is scientifically credible.** The information it delivers is objectively based on the best available scientific data and advice;
- **Identifies status and trends,** making it a useful tool for decision-makers; and
- **Assesses broadscale efforts to manage important environmental issues.** This information enables performance evaluation of environmental management and strategic planning.

Environmental indicator reports have been previously developed for national SoE reporting (e.g. Newton *et al.* 1998; Saunders *et al.* 1998; Manton and Jasper 1998; Hamblin 1998; Fairweather and Napier 1998; Ward *et al.* 1998; Pearson *et al.* 1998), however an annual report is now lacking.

SoE IN THE WET TROPICS

Since 1993, the WTMA has had a statutory requirement to report annually to both the Queensland and Australian governments on the state of the Wet Tropics World Heritage Area, and each six years to the UNESCO. The WTMA has produced seventeen annual *State of the Environment* reports (WTMA 1994-2009), sixteen of which have followed a Pressure-State-Response reporting framework, but have focused primarily on biodiversity. There has been no integrated reporting of all the natural assets (including biodiversity, water and wetlands, climate and soil) across the entire Wet Tropics (MTSRF study region) or human systems (human and social capital) associated with NRM. There is also a need to develop indicators and reporting mechanisms for the FNQ Regional Plan 2031, introduced in 2009. However, so far this has not been progressed.

ENVIRONMENTAL INDICATORS

A number of approaches have been used to develop and structure condition indicators. One of the commonly used causal frameworks for describing the interactions between society and the environment is the drivers, pressure, state, impacts and response (DPSIR) model, based on the Pressure-State-Response framework model proposed by the Organisation for Economic Cooperation and Development (OECD) in 1993 (Figure 2). Environmental indicators help track changes in the environment by selecting key measures which may be physical, chemical, biological or socio-economic. Using indicators it is possible to evaluate the fundamental status, trend and condition of the environment without having to capture the full complexity of the system. When time series data for an indicator show a trend, then there is a need to assess its implications. Over time, in the case of a state or condition indicator, this change can be matched to particular pressure and response indicators to assess both the effects of particular pressures and the efficacy of NRM responses. The scale at which the information is needed for management purposes dictates the scales (spatial and temporal) at which the monitoring program must focus.

WHY DEVELOP ENVIRONMENTAL INDICATORS?

Environmental indicators simplify SoE reporting in two important ways. Firstly, indicators have a well-understood meaning and can be measured regularly. Trends in indicators are thus readily interpreted to yield valuable information about the condition of the environment. Secondly, environmental indicators can be an aid to communication. They allow information about the environment to be communicated effectively. As users of information become more familiar with the indicators and the prototype report card format (as applied here), they will be able to absorb information more quickly. Environmental indicators can also help focus and rationalise environmental monitoring and rehabilitation programs by drawing attention to areas where critical measures are required.

In this study we focused on indicators of environmental condition for biodiversity, soils and landscapes. The method developed may provide a standardised approach for reporting the condition of other natural assets such as water, wetlands and climate, and contribute to future monitoring by Terrain NRM, the WTMA and the FNQ Regional Plan 2031.

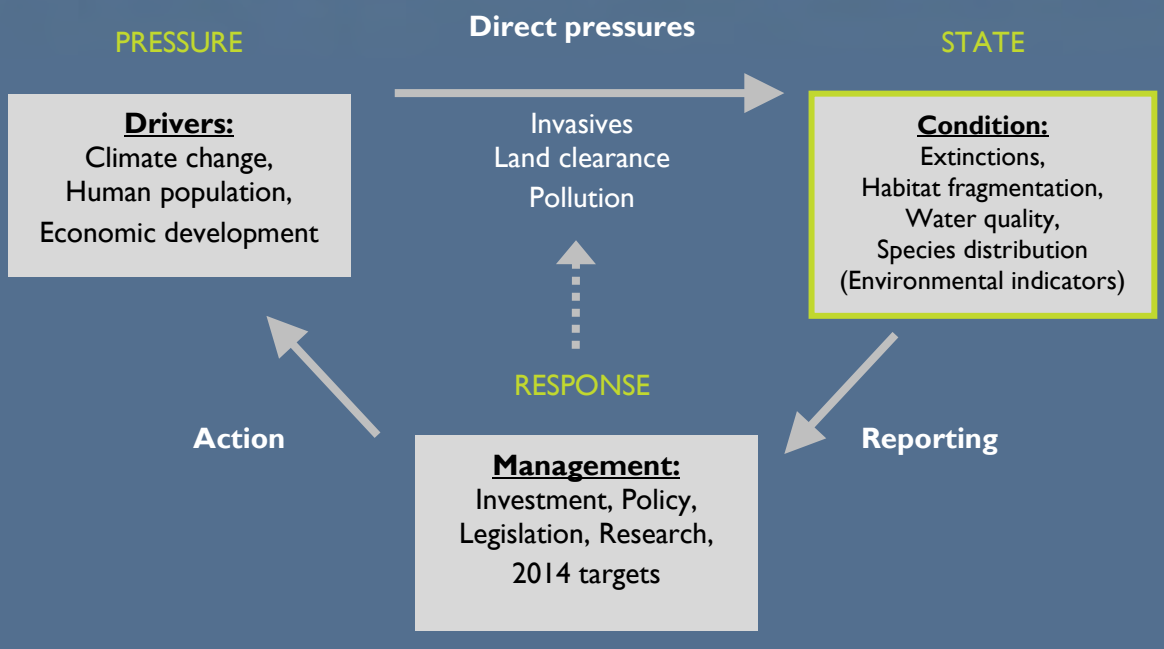


Figure 2: The Pressure-State-Response framework.

BIODIVERSITY ASSET

In the first two years of research, expert working groups identified key ecosystem services provided by the Wet Tropics region's four natural assets, as identified in the 2004-2008 Wet Tropics NRM Plan (FNQ NRM Ltd and Rainforest CRC, 2004): **biodiversity**, **water**, **climate** and **production resources**. Also identified were the ecological functions supporting these services, indicators of the condition of these functions, and indicators of threatening processes and pressures on the ecological functions.

Where possible thresholds of concern were also identified, representing limits or targets beyond which ecosystem function is likely to be degraded. Due to the lack of knowledge of the relationship between ecosystem condition, function and their supply of services, thresholds of concern as determined by Terrain NRM and based on aspirational management targets or 'Resource Condition Targets' (RCTs) were examined. In the course of reviewing the Wet Tropics Regional NRM Plan 2004-2008, drafting of the 2008-2012 Plan and discussions between Terrain NRM, the WTMA and the CSIRO, the asset framework was redesigned. The RCTs for the biodiversity asset were also revisited, and distilled from six to three:

RCT1: No net loss of native vegetation extent across the region by 2014

RCT2: No net loss of native vegetation condition across the region by 2014

RCT3: No decline in species of conservation significance and their habitats by 2014

The biodiversity asset provides six broad ecosystem services within the Wet Tropics region (Table 1) and these are supported by seven ecosystem functions or processes (the actual components of the ecosystem). *Numbers and distribution of species* was the most important indicator, representing four of the ecosystem services and all seven ecosystem functions. *Native vegetation extent and condition* was the second most important, covering three ecosystem services and four ecosystem functions. Together, these indicators represented the condition of all ecosystem services and their underpinning functions. Thus, the assessment of these two indicators in this report, together with assessment of *presence/absence of feral and weed species* (representing two ecosystem services and two ecosystem functions) is comprehensive in that it provides information on the indicators which, combined, represent all of the region's ecosystem services.

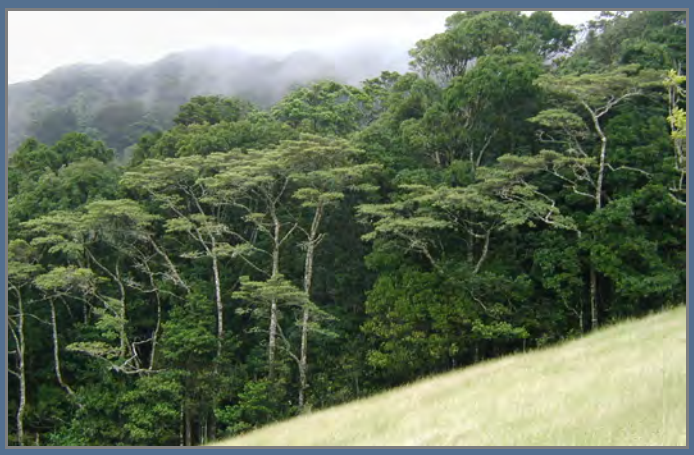
Table 1: The number of underlying ecosystem functions for the six ecosystem services provided by the *biodiversity* asset in the Wet Tropics, and the indicators representing their condition.

		Ecosystem Service						
		Features of natural beauty*	Iconic species**	Regulation of diseases and pests	Regulation of native species through seed dispersal	Regulation of species through pollination	Species supporting fishing, hunting and gathering	Total Ecosystem Functions represented
Biodiversity Indicator	Numbers and distribution of species		1	1	4		1	7
	Extent and condition of native vegetation	2			1	1		4
	Social indicators	1	3				2	6
	Other	1				1		2
	Presence/absence of feral and weed species		1	1				2

* Includes World Heritage Area Criterion VII (exceptional coastal scenery that combines tropical rainforest, white sandy beaches and fringing reefs just offshore; rugged mountain peaks and gorges).

** Includes World Heritage Area Criterion VIII (outstanding examples representing the major stages of the earth's evolutionary history); Criterion IX (outstanding examples representing significant ongoing geological processes, biological evolution and man's interaction with his natural environment); and Criterion X (contains the most important and significant habitats where threatened species of plants and animals of outstanding universal value from the point of view of science and conservation still survive).

INDICATOR 1 – NATIVE VEGETATION



INDICATOR DESCRIPTION

The extent and proportion (or percent change) of forest cover in the Wet Tropics region. We measured trends in forest extent against the Wet Tropics Regional NRM Plan RCT 1 for biodiversity: 'No net loss of native vegetation extent across the region by 2014'.

DATA SOURCES

We assessed nine datasets that potentially provided suitable data for estimating native vegetation extent in the Wet Tropics region. We chose the National Carbon Accounting System (NCAS) satellite imagery-derived data series from the Australian Government's Department of Climate Change to undertake this analysis for assessment of extent since 1972. While the data has a fine-scale resolution (25 m) and 35-year time series (1972-2006), it does not include more open or 'non-forest' (as defined by the NCAS) native vegetation types. It includes non-native tree plantations, though some of these were removed during subsequent processing. After initial analysis, the base NCAS data was also found to have an unacceptably low classification accuracy for our purposes, due mainly to the effects of shading and brightening, and wetness on the original imagery. We applied both manual editing and automated decision rules within a GIS to reduce this error and produce an enhanced data series. Despite these deficiencies the NCAS data set currently provides the most useful cost-free source of information for assessing native vegetation change at the spatial and temporal reporting scales required by the WTMA and Terrain NRM. The following scoring was used:

Score	Percentage change in forest cover (for reporting period 1972-2006)*
Very good	> 5.0
Good	0 to 4.0
Moderate	-0.1 to -5.0
Poor	-5.1 to -10.0
Very poor	> -10.0

* Negative values indicate a decline (reduction) in forest cover.

RESULTS

Across three of the four extents we assessed, there has been a net loss of forest extent of -3.4% ('Moderate', MTSRF study area, 1972-2006), -1.6% ('Moderate', Wet Tropics Bioregion, 1988-2006, Figure 3) and -0.5% ('Moderate', Terrain NRM catchments, 2004-2006, Figure 4).

Forest extent within the Wet Tropics World Heritage Area remained steady (no change, 1988-2006). The most recent data is available for 2006, and it is possible that declines or increases have occurred since then. We estimate that in order to achieve the RCT1 by 2014, at least 23,593 ha (Wet Tropics Bioregion) of native vegetation will have to be restored to regain 1988 extent and at least 8,446 ha to regain the 2004 extent.

Our analysis shows that the Tully ('Very poor', -15.3%) and Herbert ('Very poor', -8.7%) subregions have lost the highest proportion of native vegetation (as a function of vegetation extent in 1988) (Figure 3, Table 2) and could be priorities for revegetation. This recommendation is based purely on the reported results, and does not consider other factors that the WTMA may consider important in prioritising restoration, such as areas within the World Heritage Area where infrastructure has been removed.

For the Terrain NRM plan region, over the shorter reporting period of 2004-2006 most of the catchments scored 'Moderate', excluding Hinchinbrook Island and the Barron, Mulgrave and Mossman River catchments, which scored 'Good' (Figure 4, Table 2). The Murray and North Johnstone catchments have lost relatively large areas of native vegetation (-1.7% and -1.2% respectively) since 2004, both scoring 'Poor' (Table 2).

The trend in loss of forest cover has continued to decline for the entire MTSRF study area since 1972, as well as for catchments and subregions (Figure 5).

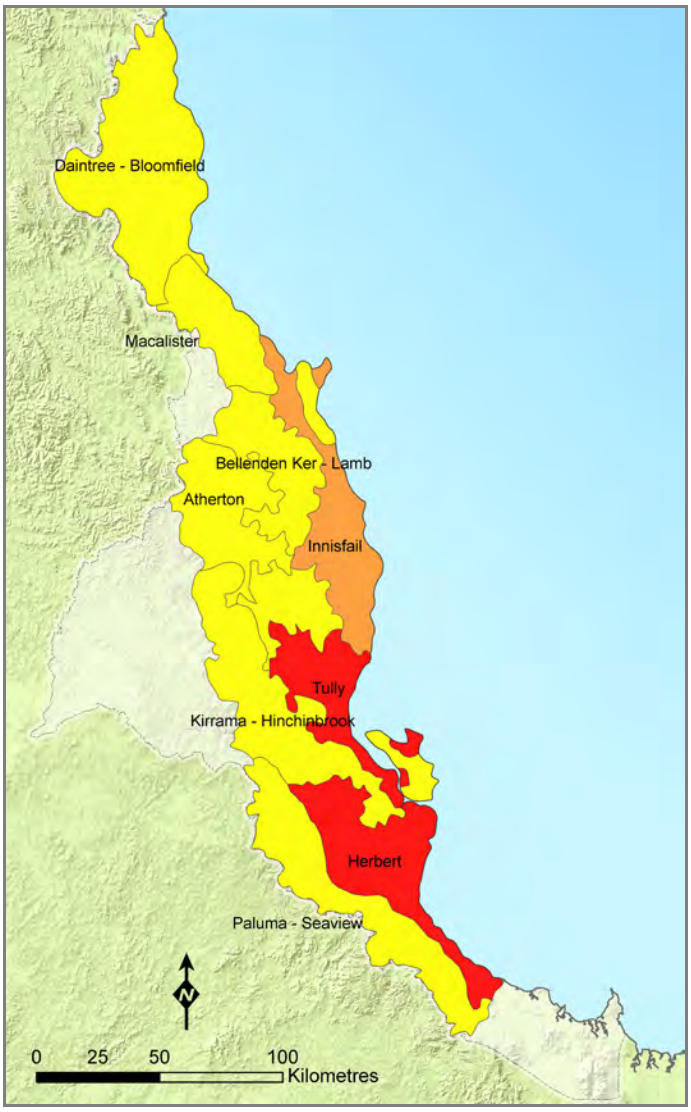


Figure 3: Areal extent (percent change of forest cover) and overall indicator score for the Wet Tropics subregions (WTMA reporting areas), 1988-2006.

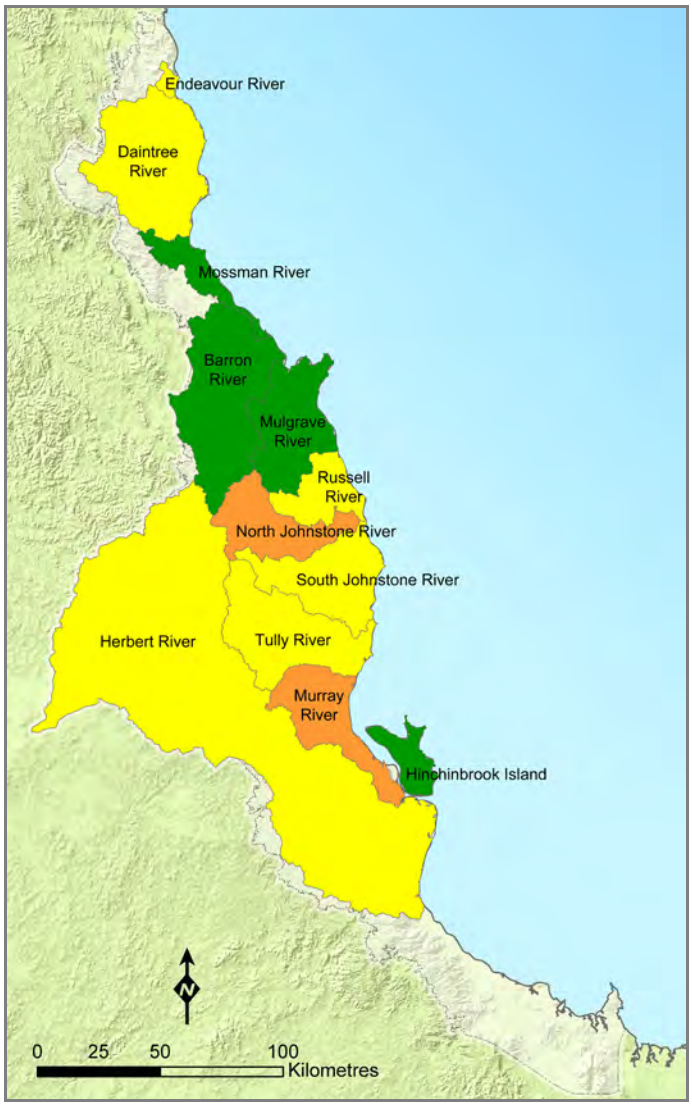


Figure 4: Areal extent (percent change of forest cover) and overall indicator score for Terrain NRM reporting areas (catchments), 2004-2006.

Very good	5
Good	4
Moderate	3
Poor	2
Very poor	1

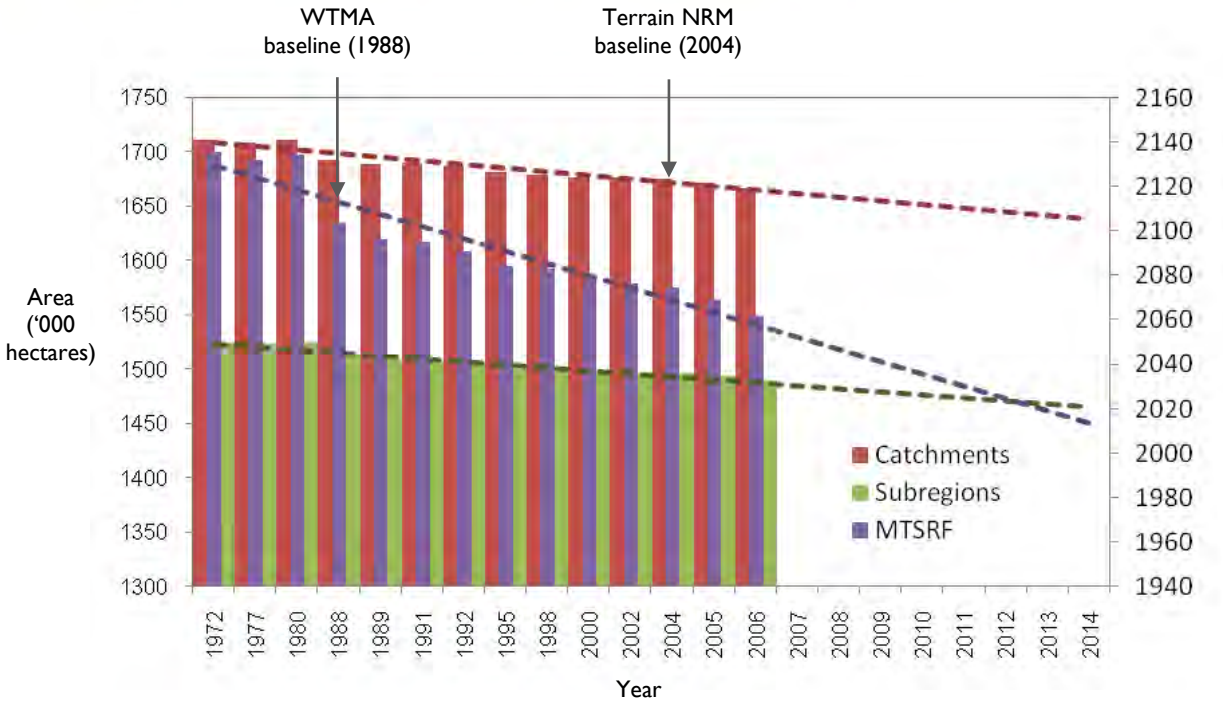


Figure 5: The trend in loss of forest cover in area (hectares) for the MTSRF study area, Wet Tropics subregions and Terrain NRM reporting areas (catchments), 1972-2014. Note, the reporting period for the WTMA was 1988-2006 and for Terrain NRM catchments 2004-2006.

Table 2: Native vegetation trend score (Indicator 1) for individual catchments, subregions and the MTSRF study area from 1972-2006, reporting periods, current status score (2006) and trend since 1972 for reporting periods.

	Score		
Terrain NRM Catchment	1972-2006	Reporting periods (Terrain NRM 2004-2006; WTMA 1998-2006)	Trend for reporting periods
Barron	Good	Moderate	↓
Daintree	Moderate	Very good	↗
Endeavour	Moderate	Moderate	↔
Herbert	Moderate	Moderate	↔
Hinchinbrook	Good	Very good	↗
Mossman	Good	Very good	↗
Mulgrave	Good	Moderate	↓
Murray	Poor	Moderate	↗
North Johnstone	Poor	Moderate	↗
Russell	Moderate	Moderate	↔
South Johnstone	Moderate	Moderate	↔
Tully	Moderate	Moderate	↔
Wet Tropics Subregion	1972-2006	Reporting periods (Terrain NRM 2004-2006; WTMA 1998-2006)	Trend for reporting periods
Atherton	Moderate	Moderate	↔
Bellenden Ker-Lamb	Moderate	Very good	↗

	Score		
Daintree-Bloomfield	Moderate	Moderate	↔
Herbert	Very poor	Poor	↗
Innisfail	Poor	Very good	↑
Kirrama-Hinchinbrook	Moderate	Moderate	↔
Macalister	Moderate	Moderate	↔
Paluma-Seaview	Moderate	Moderate	↔
Tully	Very poor	Very poor	↔
Wet Tropics Bioregion	Moderate	Moderate	↔
Inside Wet Tropics World Heritage Area	Good	Very good	↗
MTSRF Study Area	1972-2006	Reporting periods (Terrain NRM 2004-2006; WTMA 1998-2006)	Trend for reporting periods
MTSRF	Moderate	Moderate	↔

THRESHOLDS OF CONCERN

Currently the MTSRF study region is not on track to meet the RCT 1 of 'no net loss of native vegetation extent by 2014'. We estimate that in order to achieve RCT1 by 2014, at least 23,593 ha (Wet Tropics Bioregion) of native vegetation would need to be restored in order to regain the 1988 extent, and at least 8,446 ha to regain the 2004 extent. These large areas are economically unfeasible to actively revegetate, so restoration planting needs to focus on sub-areas which conform to prioritisation criteria. Passive native regrowth may further assist in revegetating the area.


Photo: Suzanne Long

INDICATOR 2 – NATIVE VEGETATION CONDITION

INDICATOR DESCRIPTION

Information is required to understand the capacity of remaining native vegetation to provide habitat for native plants and animals at local and landscape scales. Reporting on vegetation condition is the key to understanding biodiversity of these areas and identification of priority areas for restoration. A composite indicator of vegetation condition was derived from five indicators: fragmentation, urbanisation, weeds, feral animals and roads. As recognised threats to vegetation condition, all five indicators were scored 'inversely', i.e. the higher their scores, the lower the condition of the native vegetation. Expert opinion weighting was applied to indicators based on the direct or indirect influence on native vegetation condition.

DATA SOURCES

Fragmentation: This indicator describes the loss of forest cover and the spatial configuration of that loss based on the NCAS forest and regrowth monitoring data sets from Landsat satellite imagery. Fragmentation classes: patch, edge, perforated and core >100 ha were then converted to a condition score of 'Very poor' to 'Very good'.

Urbanisation: Night-time 'city light' footprints were derived from DMSP/OLS satellite images (80 metre resolution) for approximating the extent of built-up land or urbanisation. Using image processing techniques, we generated maps where the 'city lights' were classified into five density classes ranging from 1 to 5, where 5 was least dense ('Very good') and 1 was greatest density ('Very poor').

Weeds: In 2007 and 2008, data was collated on the known distribution of important weed species as identified by officers from regional councils, Queensland Parks and Wildlife and Biosecurity Queensland. Data was gathered by interviewing local officers and mapped into 1 km^2 grid cells using a purpose-built GIS tool developed with Terrain NRM. Data were also collected on the density of problem species and attributed with one of the following density categories: *high*, *medium*, *scattered* or *low*). Using this density attribute a score was then recorded as follows: high density score = 1, medium density score = 2, scattered density score = 3, low density score = 4, unknown density score = 0. A total density was then calculated by summing all of these scores. Intervals were then built to divide the scores into five categories: 'Very good', 'Good', 'Moderate', 'Poor' and 'Very poor' (with 'Very poor' representing the highest density of weeds).

Feral Animals: This data was gathered in the same fashion as for weeds. The following feral species were recorded (where data existed): rabbit, deer, pig, dog, cat, goat, horse and cattle. High density score = 1, medium density score = 2, low density score = 3, unknown density score = 0. A total density was then calculated by summing all of these scores. Intervals were then built to divide the scores into five categories: 'Very good', 'Good', 'Moderate', 'Poor' and 'Very poor' (with 'Very poor' representing the highest density of feral animals).

Roads: To obtain the density of roads, a spatial scale of 1:50,000 was used to calculate the number and length of roads per reporting unit as a percentage of the total reporting unit area. The following categories were used: 'Very good', 'Good', 'Moderate', 'Poor' and 'Very poor' (with 'Very poor' representing a high density of roads per reporting area and a 'Very good' rating representing a low density of roads per reporting area.

Composite Condition Indicator: The scores of the five indicators were combined by summing the value for each indicator (including weighting scores), yielding a new score (composite condition index) which ranged from 0 to >20 and using a 'Very poor' to 'Very good' continuum of condition, as follows:

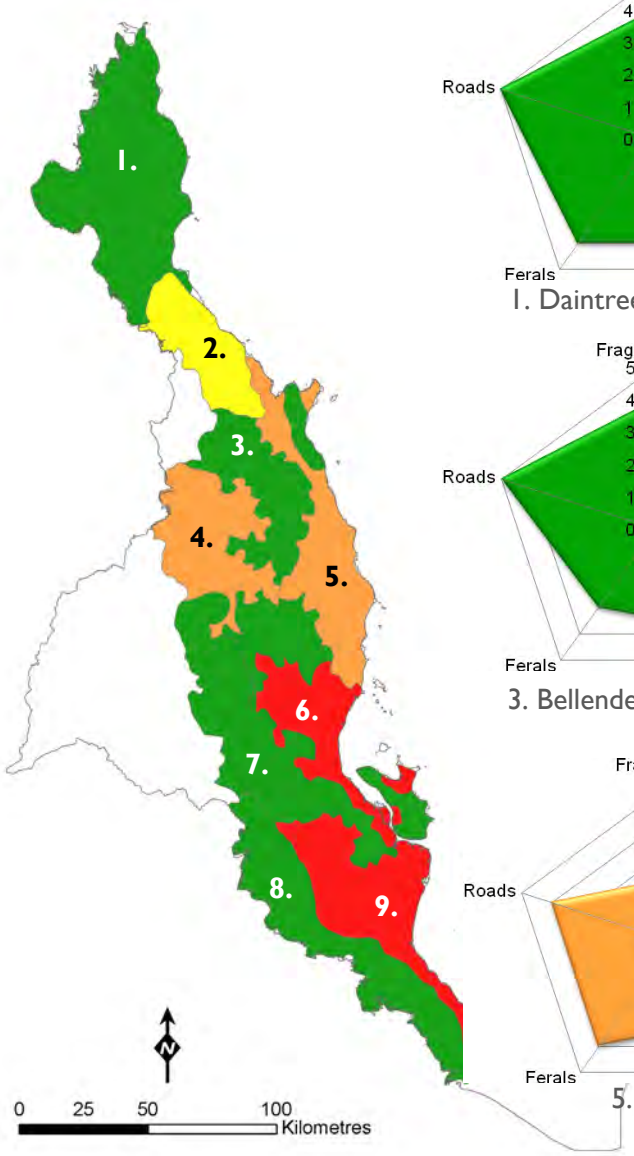
	Score	Composite
Very good	5	0 to 4
Good	4	5 to 9
Moderate	3	10 to 14
Poor	2	15 to 19
Very poor	1	> 20

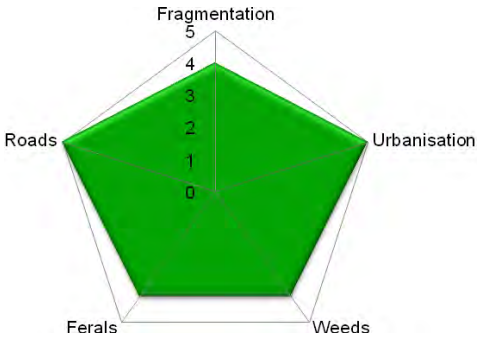
RESULTS

The vegetation composite condition index for the MTSRF study area was 'Good'. For the WTMA reporting areas (subregions) our analysis shows that the majority scored 'Good' (Figure 5). The majority of Terrain NRM reporting catchments scored 'Good', however the Herbert catchment scored 'Moderate' (Figure 6).

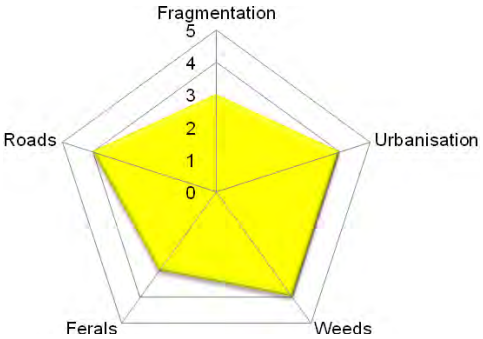
THRESHOLDS OF CONCERN

Currently the MTSRF study region is not on track to meet the RCT 2 of 'no net loss of vegetation condition across the region by 2014'. Areas of concern include the Tully and Herbert subregions, with fragmentation scores of 'Very poor'.

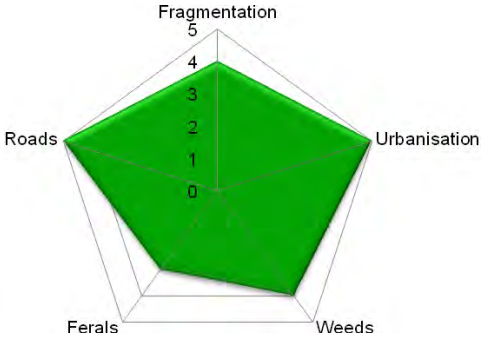




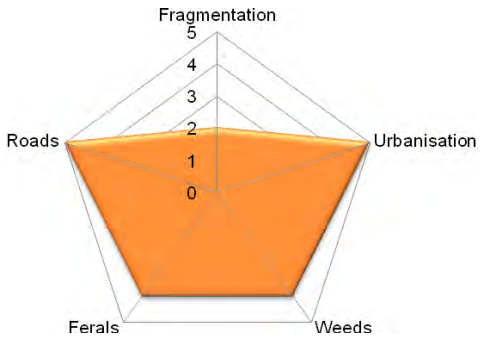
1. Daintree - Bloomfield



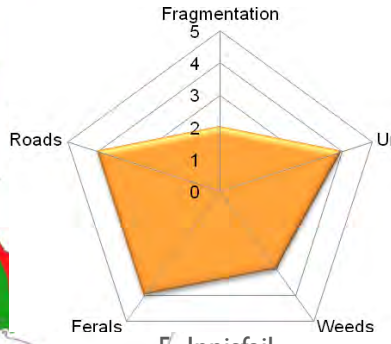
2. Macalister



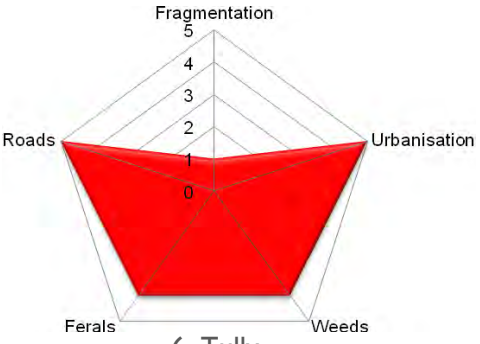
3. Bellender Ker - Lamb



4. Atherton

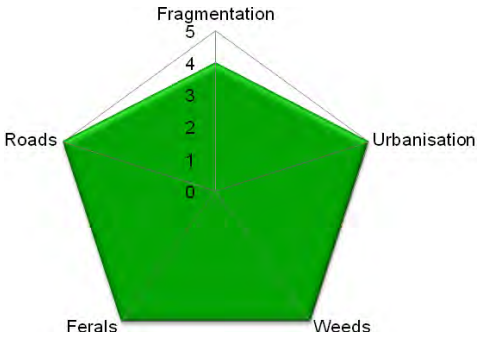


5. Innisfail



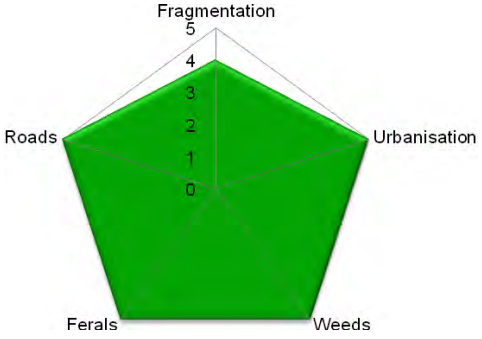
6. Tully

Figure 6: Overall score for Indicator 2 'Native vegetation condition' for the WTMA reporting areas (subregions), 1972-2006.

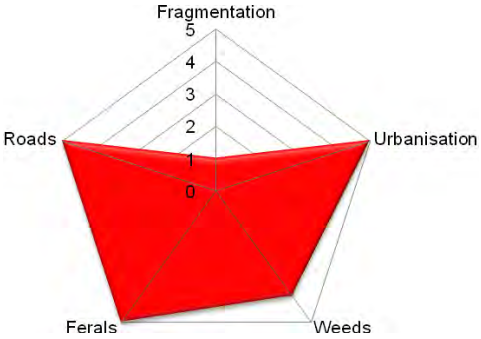


7. Kirrama - Hinchinbrook

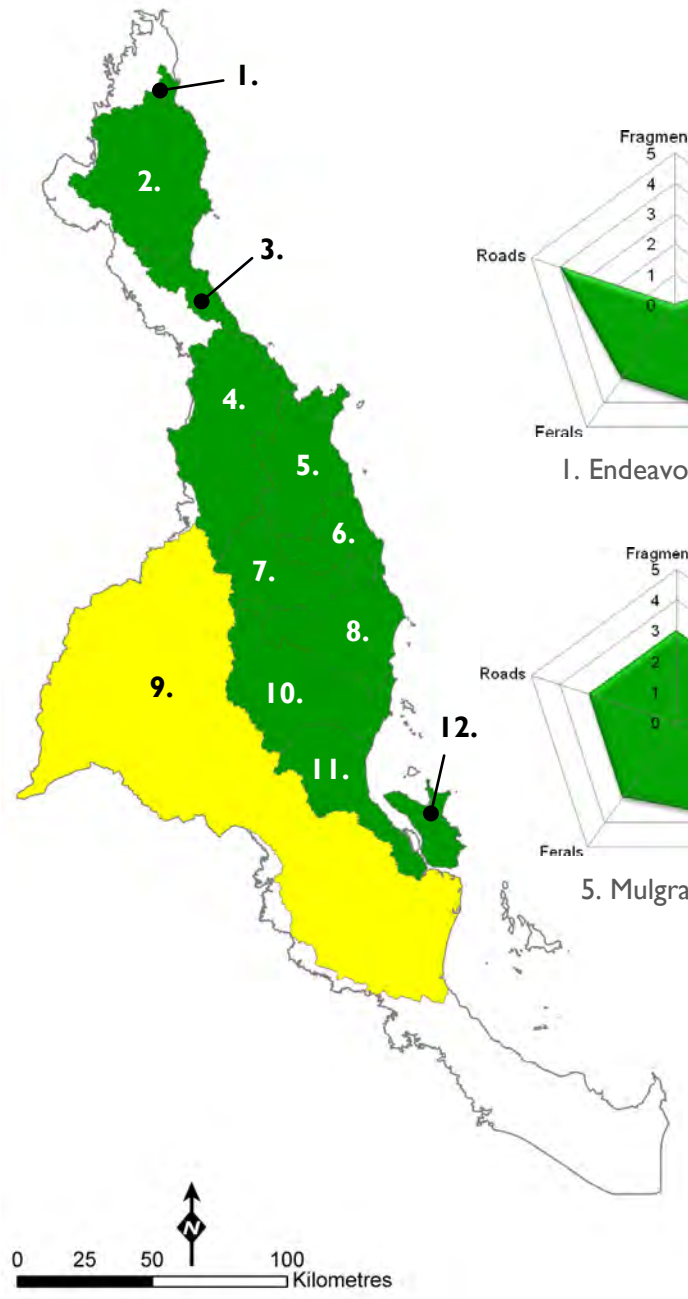
Very good	5
Good	4
Moderate	3
Poor	2
Very poor	1

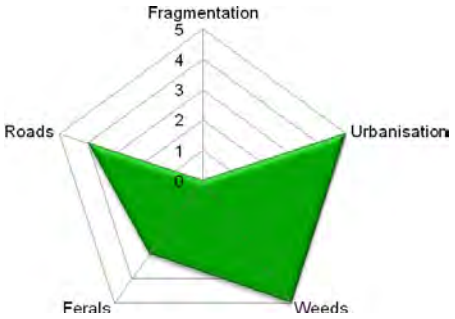


8. Paluma - Seaview

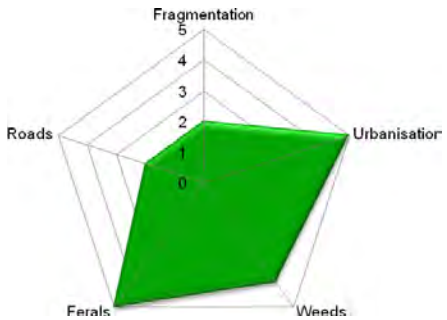


9. Herbert

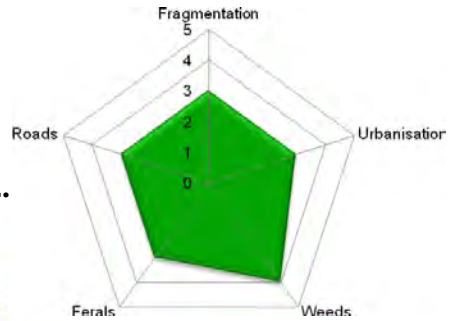




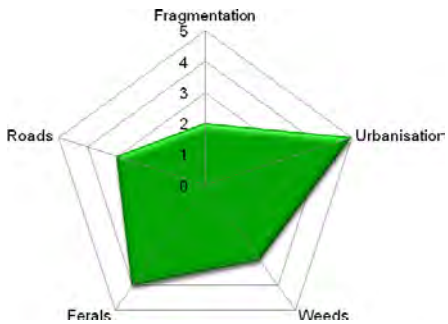
1. Endeavour River



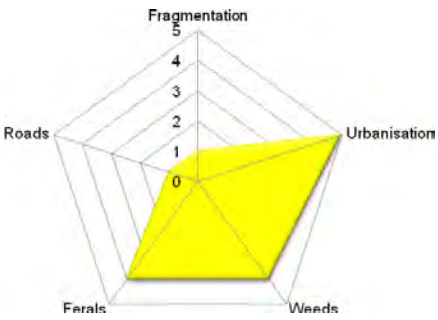
2. Daintree River



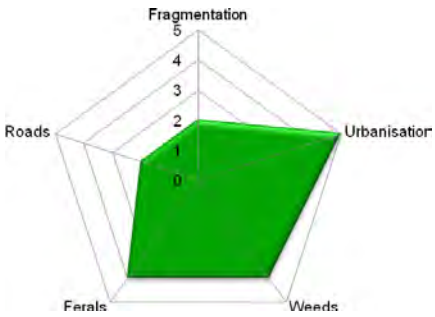
5. Mulgrave River



6. Russell River



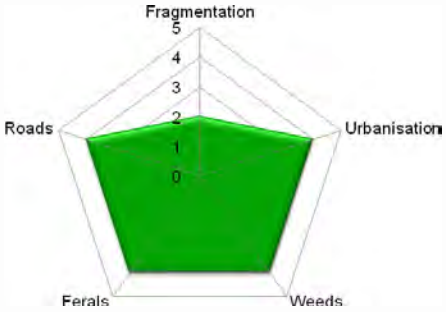
9. Herbert River



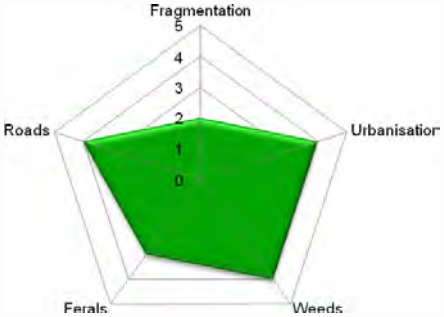
11. Murray River

Figure 7: Overall score for Indicator 2 'Native vegetation condition' for the Terrain NRM reporting areas (catchments), 1972-2006 (continues to page 15).

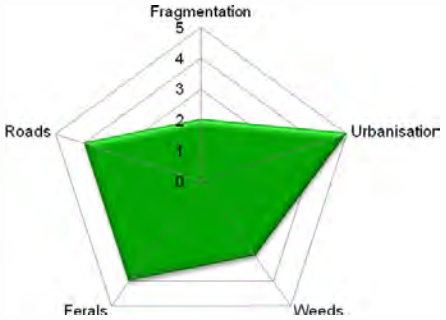
Very good	5
Good	4
Moderate	3
Poor	2
Very poor	1



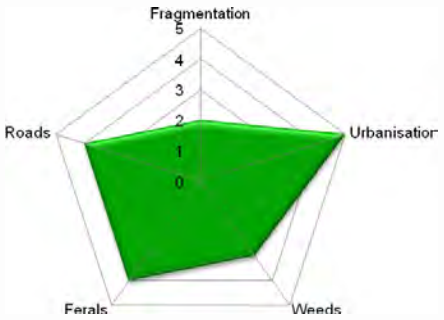
3. Mossman River



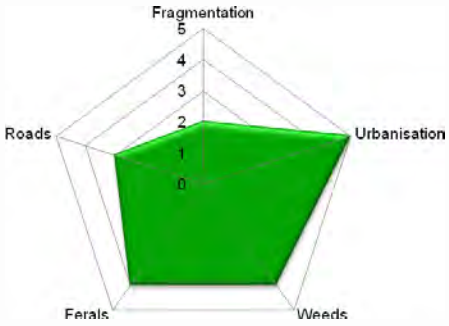
4. Barron River



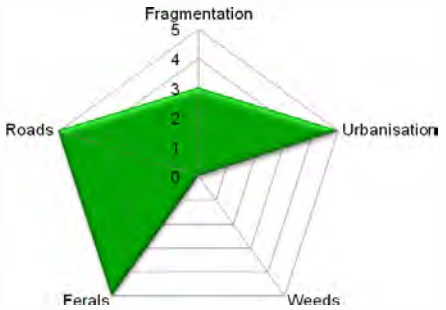
7. North Johnstone River



8. South Johnstone River



10. Tully River



12. Hinchinbrook Island

Photo: Shannon Hogan

INDICATOR 3 – THREATENED SPECIES


Photo: David Souter

INDICATOR DESCRIPTION

Indicator 3 describes the number of threatened species (i.e. species presumed extinct, endangered, vulnerable and rare) across the Wet Tropics MTSRF study area. This indicator is important as extinction of species equates to a loss of species diversity.

DATA SOURCES

Using WildNet (plant and animal) records provided by the Queensland Department of the Environment and Resource Management, the number of presumed extinct, endangered and vulnerable species (as listed by the *Nature Conservation Act 1992* and the *Environment Protection and Biodiversity Conservation Act 1999*) were summarised for each subregion, catchment and for the entire MTSRF study area. The ratio of these species per reporting area was then calculated, with the following scale applied:

Description	Score	Number/area
Very low density	5	0-0.3
Low density	4	0.4-0.5
Moderate density	3	0.6-0.7
High density	2	0.8-0.9
Very high density	1	> 1

To ascertain trends in species populations, a subsequent analysis was conducted which utilised existing literature and EPBC Conservation Advice to derive trends. Population size and distribution trends were classified as 'Stable' (↔), 'Decline' (since World Heritage listing in 1988) (↓), 'Decline(?) '↓(?)' where there was limited or conflicting information, or 'Unknown' '?'.

RESULTS

For the entire MTSRF Study area a score of 'Good' was obtained based on number per unit area.

The Daintree-Bloomfield and Atherton subregions scored 'Very poor', whilst Macalister and Innsifail scored 'Poor', Bellenden Ker-Lamb 'Moderate' and Kirrama-Hinchinbrook, Paluma-Seaview and Herbert 'Very good' (Figure 8).

For the Terrain NRM plan region, the Russell, Mossman and Endeavour Rivers scored 'Very poor', Barron, North Johnstone and Daintree Rivers scored 'Moderate', whilst remaining catchments: South Johnstone, Tully, Murray, Herbert and Mulgrave Rivers and Hinchinbrook Island all scored 'Very good' (Figure 9).

Out of 92 species assessed, 51 species were considered 'Stable', 20 in 'Decline', and an additional 15 'Decline(?)' and 14 'Unknown'.

THRESHOLDS OF CONCERN

Currently the MTSRF region is not on track to meet the RCT 3 of 'no net loss of threatened species across the region by 2014'. Areas of concern include the Daintree-Bloomfield and Atherton subregions, all with a very high density of threatened species. In order to achieve the RCT3 by 2014, areas of priority for Terrain NRM plan region include the Endeavour, Mossman and Russell River catchments. Significant deficiencies in the existing monitoring data for endangered taxa limit the applicability of further developing a multi-species indicators approach that have been described to date (Mawdsley and O'Malley 2009).

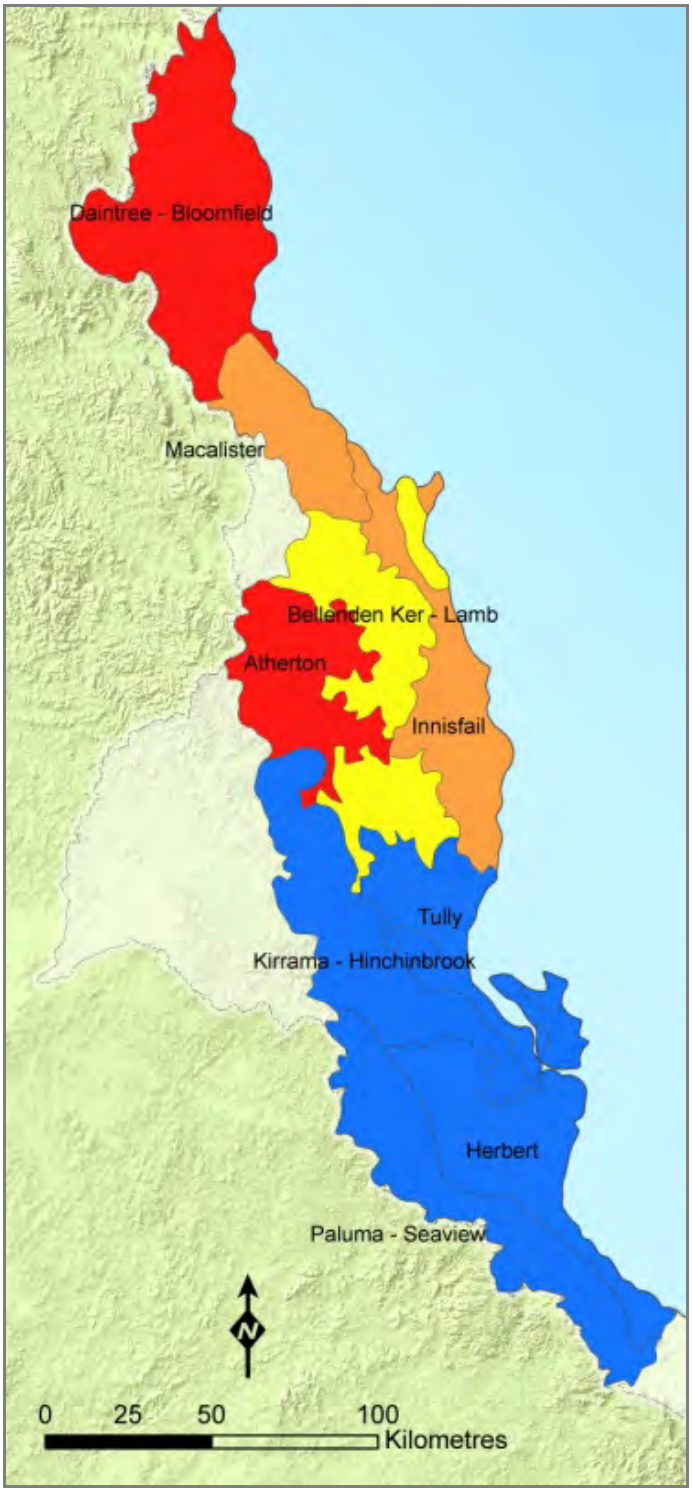


Figure 8: Overall score for Indicator 3 'Threatened species' for WTMA reporting areas – subregions.

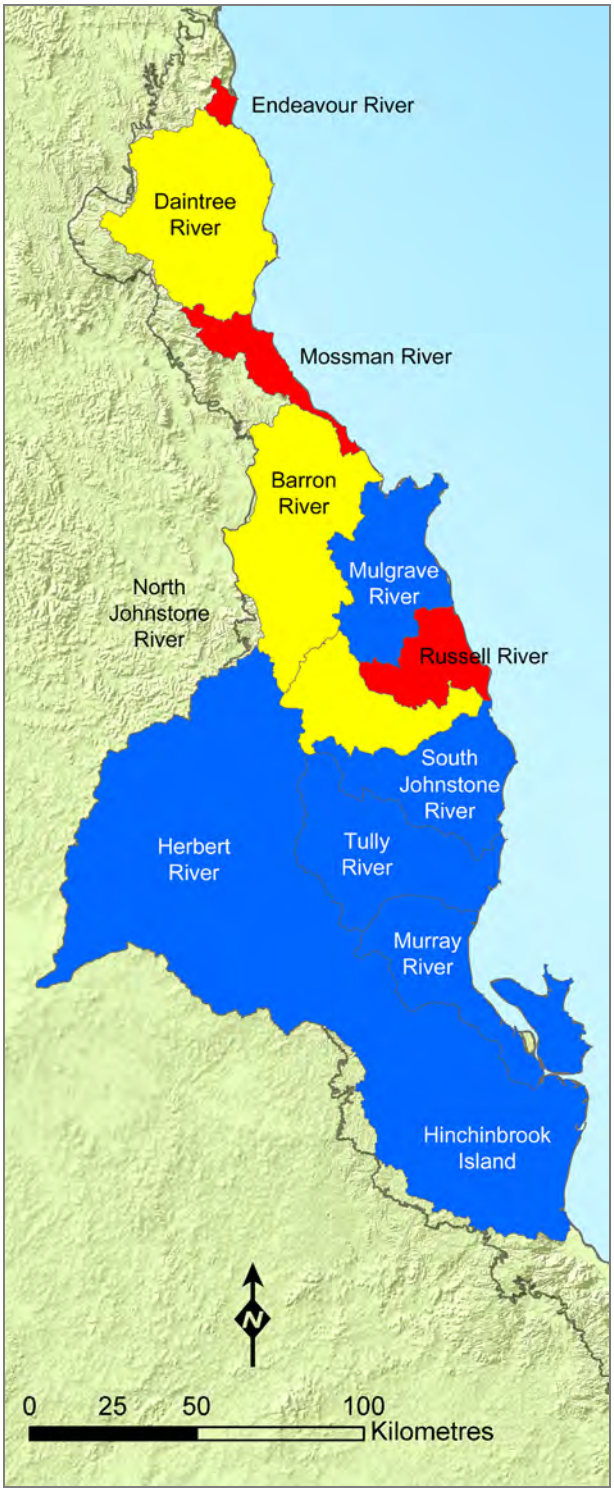


Figure 9: Overall score for Indicator 3 'Threatened species' for Terrain NRM reporting areas – catchments.

Table 3: Assessment of threatened species trend and associated threats (as determined by EPBC conservation advice).

Species name	Infrastructure maintenance	Exotic plant species	Feral animal species	Collecting for horticulture	Changed fire regimes	Climate change and stochastic events	Clearing native vegetation	Mining activities	Grazing	Diseases	Agriculture	Development	Fragmentation	Threats not identified	Trend	EPBC Act Threat Category
Animal Species																
Southern Cassowary *(Casuarius casuarius johnsonii)*		•	•		•	•	•			•		•	•		↓	Endangered
Red Goshawk *(Erythrotriorchis radiatus)*							•						•		↓	Endangered
Gouldian Finch *(Erythrura gouldiae)*			•		•	•			•						↓	Endangered
Australian Painted Snipe *(Rostratula australis)*											•				↓	Vulnerable
Armoured Mistfrog *(Litoria lorica)*										•					↓	Critically endangered
Waterfall Frog/Torrent Frog *(Litoria nannotis)*										•					↓	Endangered
Mountain Mistfrog *(Litoria nyakalensis)*										•					↓	Critically endangered
Common Mistfrog *(Litoria rheocola)*										•					↓	Endangered
Lace-eyed Tree frog *(Nyctimystes dayi)*										•					↓	Endangered
Magnificent Broodfrog *(Pseudophryne covacevichae)*	•						•		•			•			↓	Vulnerable
Sharp-snouted Day Frog *(Taudactylus acutirostris)*										•					↓	Endangered
Tinkling Frog *(Taudactylus rheophilus)*										•					↓	Endangered
Northern Bettong *(Bettongia tropica)*			•		•	•									↓	Endangered
Northern Quoll *(Dasyurus hallucatus)*			•		•			•							↓	Endangered
Spotted-tail Quoll *(Dasyurus maculatus gracilis)*			•			•	•						•		↓	Endangered

Species name	Infrastructure maintenance	Exotic plant species	Feral animal species	Collecting for horticulture	Changed fire regimes	Climate change and stochastic events	Clearing native vegetation	Mining activities	Grazing	Diseases	Agriculture	Development	Fragmentation	Threats not identified	Trend	EPBC Act Threat Category
Yellow-bellied Glider *(Petaurus australis unnamed subsp.)*					•	•	•					•	•		↔	Vulnerable
Mahogany Glider *(Petaurus gracilis)*		•			•		•		•				•		↓	Endangered
Spectacled Flying Fox *(Pteropus conspicillatus)*			•				•		•		•	•	•		↔	Vulnerable
Bare-rumped Sheathtailed Bat *(Saccolaimus saccolaimus nudicluniatus)*															↓	Critically endangered
Lake Eacham Rainbow Fish *(Melanotaenia eachamensis)*			•												?	Endangered
Collared Legless Lizard *(Delma mitella)*					•	•						•	•		↔	Vulnerable
Plant Species																
Acacia purpureopetala	•							•	•			•			↔	Vulnerable
Acriopsis javanica		•		•	•							•			↔	Vulnerable
Actephila foetida	•						•								↔	Vulnerable
Alloxylon flammeum							•				•				↔	Vulnerable
Aponogeton bullosus		•		•							•				↓ (?)	Endangered
Aponogeton proliferus		•		•			•				•				↓ (?)	Endangered
Archontophoenix myolensis		•			•		•				•	•	•		↓ (?)	Endangered
Arenga australasica			•		•		•	•				•			↓ (?)	Vulnerable
Asplenium pellucidum														•	↔	Vulnerable
Asplenium wildii		•	•									•			↓ (?)	Vulnerable
Calochilus psednus	•	•		•	•								•		?	Endangered
Canarium acutifolium var. acutifolium														•	↔	Vulnerable

INDICATOR 3 – THREATENED SPECIES

Species name	Infrastructure maintenance	Exotic plant species	Feral animal species	Collecting for horticulture	Changed fire regimes	Climate change and stochastic events	Clearing native vegetation	Mining activities	Grazing	Diseases	Agriculture	Development	Fragmentation	Threats not identified	Trend	EPBC Act Threat Category
Canthium costatum														•	↔	Vulnerable
Carronia pedicellata							•								↔	Endangered
Centotheca philippensis															?	Vulnerable
Chingia australis	•	•	•				•								↔	Endangered
Corymbia rhodops								•							↔	Vulnerable
Ctenopteris walleri														•	↔	Vulnerable
Cyperus cephalotes		•													?	Endangered
Dendrobium callitrophilum				•	•		•								↔	Vulnerable
Dendrobium mirbelianum				•			•								↔	Endangered
Dendrobium superbiens		•		•	•		•								↔	Vulnerable
Dioclea hexandra														•	?	Vulnerable
Diplazium cordifolium		•	•			•	•								↔	Vulnerable
Diplazium pallidum	•	•	•			•	•								↔	Endangered
Drosera prolifera				•											↔	Vulnerable
Drosera schizandra														•	↔	Vulnerable
Durabaculum nindii (*Dendrobium nindii*)				•			•								↔	Endangered
Eleocharis retroflexa			•		•				•						↔	Vulnerable
Endiandra cooperana	•						•					•			↔	Endangered
Eucryphia wilkiei	•					•									↔	Vulnerable
Fimbristylis adjuncta														•	?	Endangered
Gardenia actinocarpa	•	•										•			↔	Endangered
Genoplesium tectum		•	•	•	•	•						•			?	Endangered
Grammitis reinwardtii														•	↓ (?)	Vulnerable

Species name	Infrastructure maintenance	Exotic plant species	Feral animal species	Collecting for horticulture	Changed fire regimes	Climate change and stochastic events	Clearing native vegetation	Mining activities	Grazing	Diseases	Agriculture	Development	Fragmentation	Threats not identified	Trend	EPBC Act Threat Category
Grevillea glossadenia		•				•		•							↓ (?)	Vulnerable
Hexaspora pubescens														•	↔	Vulnerable
Hodgkinsonia frutescens														•	↔	Vulnerable
Homoranthus porteri														•	↔	Vulnerable
Huperzia filiformis				•		•	•								?	Endangered
Huperzia lockyeri				•		•	•								↓	Vulnerable
Huperzia marsupiiformis				•		•	•								↓	Vulnerable
Huperzia phlegmarioides				•		•	•								↔	Vulnerable
Huperzia prolifera				•		•	•								↔	Vulnerable
Huperzia squarrosa				•		•	•								↓	Endangered
Lastreopsis walleri		•					•								?	Vulnerable
Leucopogon cuspidatus		•			•		•	•							↔	Vulnerable
Lindsaea pulchella var. blanda														•	?	Vulnerable
Marsdenia brevifollia					•		•	•	•						?	Vulnerable
Mesua sp. Boonjee (A.K.Irvine 1218)														•	↔	Vulnerable
Myrmecodia beccarii				•			•					•			↔	Vulnerable
Oreodendron biflorum														•	↔	Vulnerable
Phaius pictus				•										•	?	Vulnerable
Phaius tancarvilleae	•	•	•	•	•		•		•		•	•	•		↔	Endangered
Phalaenopsis rosenstromii				•										•	?	Endangered
Plectranthus gratus		•											•		↓ (?)	Vulnerable
Plesioneuron tuberculatum			•												↓ (?)	Endangered
Polyscias bellendenkerensis										•					↔	Vulnerable

Species name	Infrastructure maintenance	Exotic plant species	Feral animal species	Collecting for horticulture	Changed fire regimes	Climate change and stochastic events	Clearing native vegetation	Mining activities	Grazing	Diseases	Agriculture	Development	Fragmentation	Threats not identified	Trend	EPBC Act Threat Category
Ristantia gouldii														•	?	Vulnerable
Sankowskya stipularis			•				•								↓ (?)	Endangered
Sarcochilus roseus		•	•	•	•										↓ (?)	Vulnerable
Sauropus macranthus		•					•		•				•		↔	Vulnerable
Syzygium hodgkinsoniae	•	•		•		•	•		•		•	•	•		↓ (?)	Vulnerable
Toechima pterocarpum	•						•								↓ (?)	Endangered
Triplarina nitchaga					•										↔	Vulnerable
Tylophora rupicola		•			•										↔	Endangered
Tylophora williamsii		•	•		•		•								↔	Vulnerable
Vappodes lithocola (Dendrobium lithocola)		•		•	•		•								↓ (?)	Endangered
Vappodes phalaenopsis (D. phalaenopsis)		•		•	•		•								↔	Vulnerable
Vrydagzynea paludosa (Vrydagzynea grayi)		•	•	•											?	Endangered
Xanthostemon formosus												•			↔	Endangered
Zeuxine polygonoides			•	•											↔	Vulnerable
Zieria obovata		•			•	•	•								↔	Vulnerable
Zieria rimulosa					•	•									↔	Vulnerable
Total 92 species	12	28	21	26	25	20	39	6	9	9	9	17	13	16		
Marsdenia araujacea																Extinct
Tmesipteris lanceolata																Extinct
Huperzia serrata																Extinct
Lycopodium lobbii																Extinct
Hymenophyllum whitei																Extinct
Trichomanes exiguum																Extinct

Species name	Infrastructure maintenance	Exotic plant species	Feral animal species	Collecting for horticulture	Changed fire regimes	Climate change and stochastic events	Clearing native vegetation	Mining activities	Grazing	Diseases	Agriculture	Development	Fragmentation	Threats not identified	Trend	EPBC Act Threat Category
Lemmaphyllum accedens																Extinct
Monogramma dareicarpa																Extinct
Argyreia soutteri																Extinct
Musa fitzalanii																Extinct
Oberonia attenuata																Extinct
Prostanthera albohirta																Extinct
Prostanthera clotteniana																Extinct
Additional species within the MTSRF Study area																
Macropteranthes montana														•	↔	Vulnerable
Yakka Skink *(Egernia rugose)*															?	Vulnerable
Eriocaulon carsonii															?	Endangered
Ectrosia blakei					•				•						↓ (?)	Vulnerable
Cycas platyphylla																Vulnerable
Chamaesyce carissoides					•			•	•						↔	Vulnerable
Cajanus mareebensis	•														↔	Endangered
Acacia guymeri														•	?	Vulnerable
Star Finch *(Neochmia ruficauda ruficauda)*		•	•					•	•						↓	Endangered

SUMMARY OF BIODIVERSITY ASSET

The overall biodiversity score presented here is a combination of the three indicators: native vegetation extent, native vegetation condition and threatened species. It should be recognised that these results are only indicative, since they are based on the best available data at the time. Biological condition is extremely difficult to quantify, and these indicators fall short of capturing its full range, however they were the best practical options available during this study.

The overall biodiversity score for the entire MTSRF Study area was 'Moderate'. However, analysis at a Wet Tropics catchment and subregional scale presented a different story. The Daintree-Bloomfield subregion scored the best ('Good'), whilst most of the other subregions were graded as 'Moderate' (Figure 10). Overall the Wet Tropics bioregion scored 'Good' (Table 4). The overall biodiversity score for the majority of Terrain NRM reporting areas (catchments) was 'Moderate', however the Herbert River and Hinchinbrook Island catchments scored 'Poor', whilst the Endeavour, North Johnstone and Russell River catchments scored 'Good' (Figure 11).

Photo: Dan Metcalfe

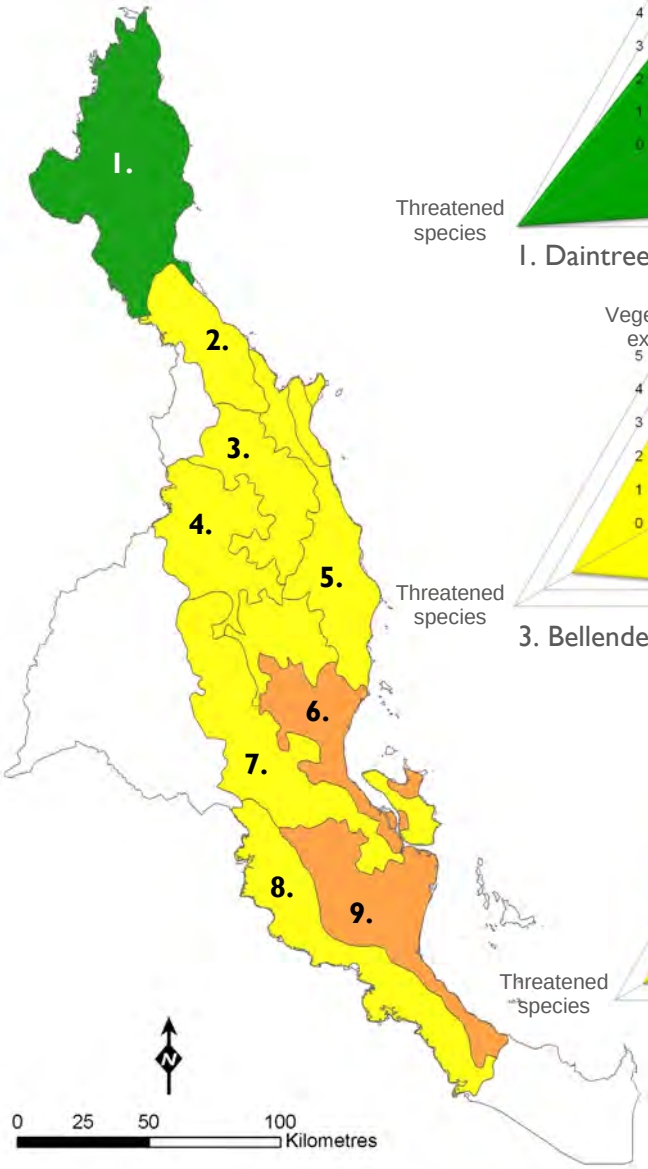
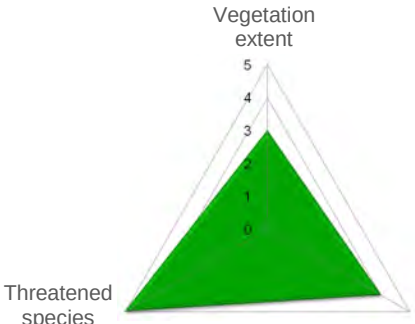
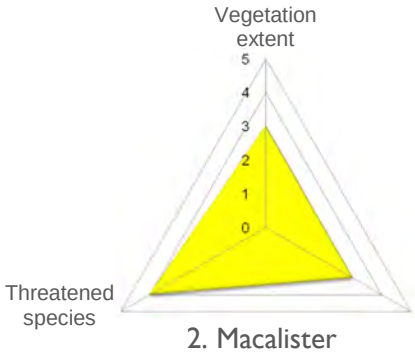
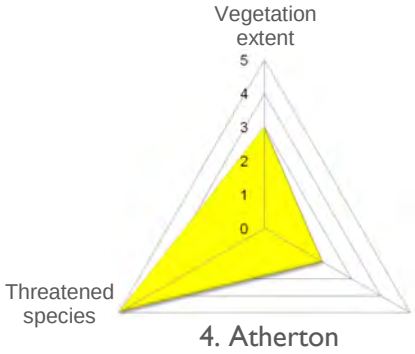
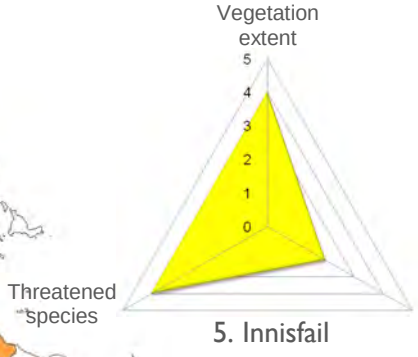


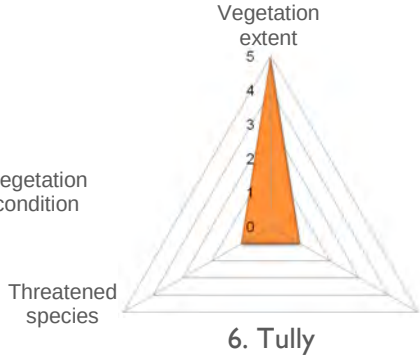
Figure 10: Overall biodiversity condition status score for WTMA reporting areas (subregions).

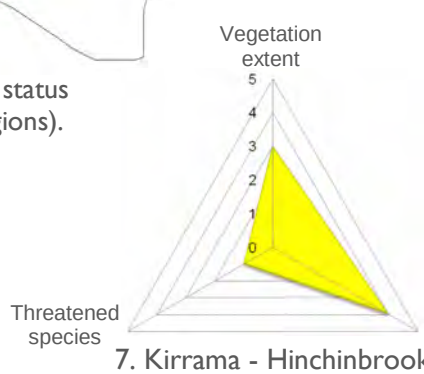


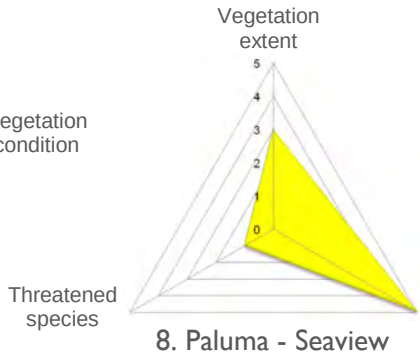




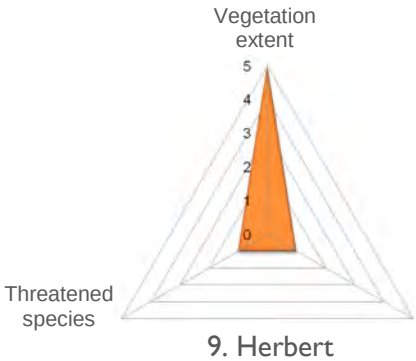




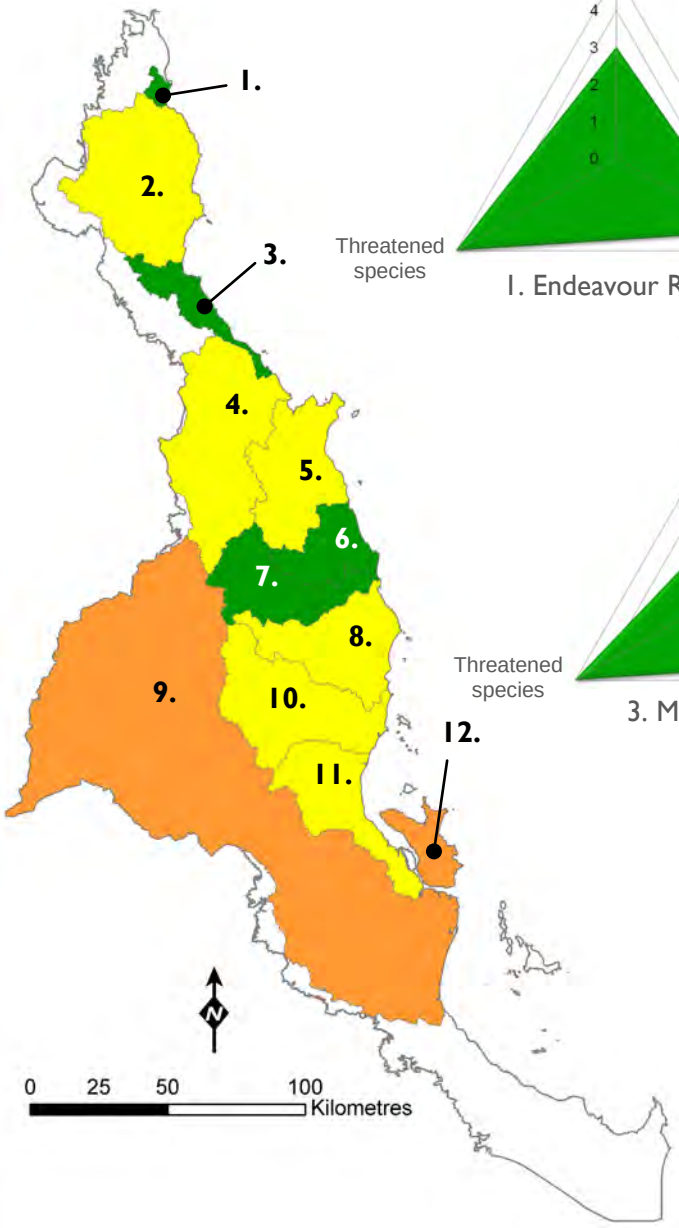


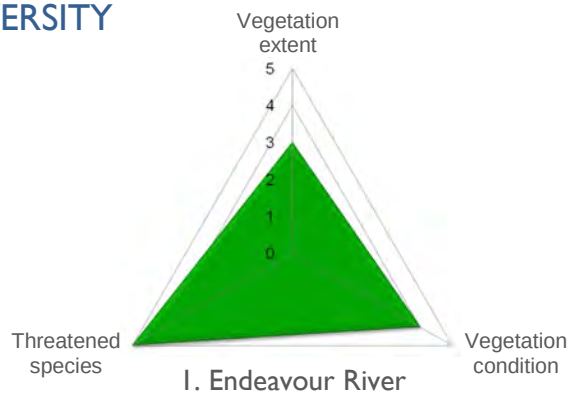


Very good	5
Good	4
Moderate	3
Poor	2
Very poor	1

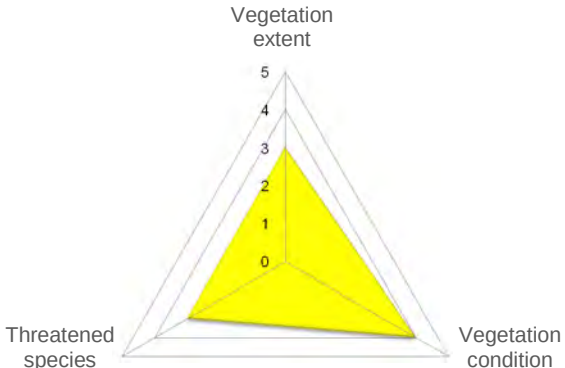


OVERALL BIODIVERSITY

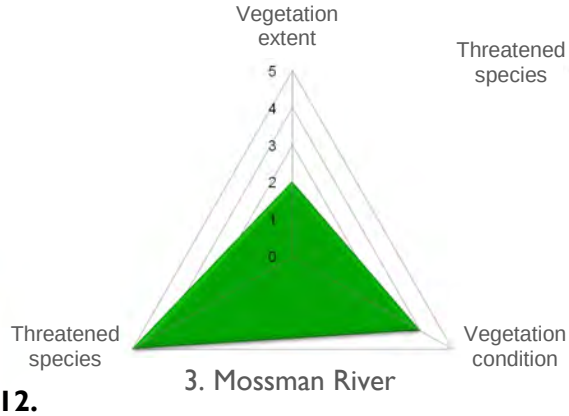




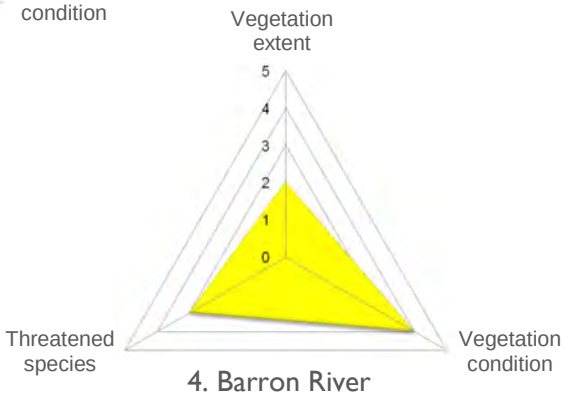
1. Endeavour River



2. Daintree River



3. Mossman River



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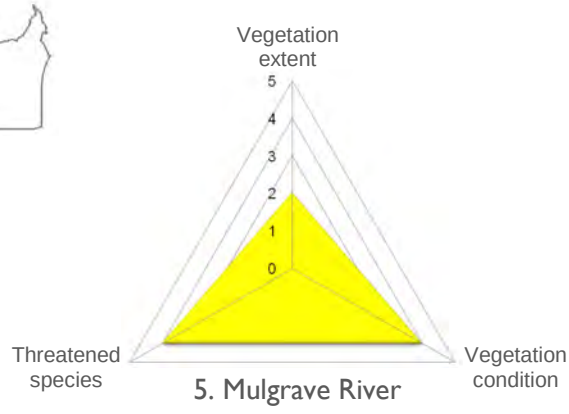
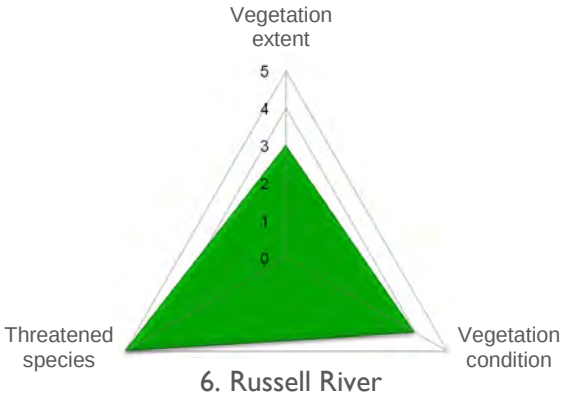


5. Mulgrave River

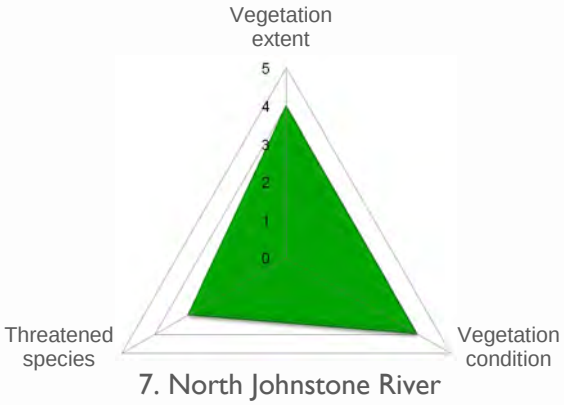


6. Russell River

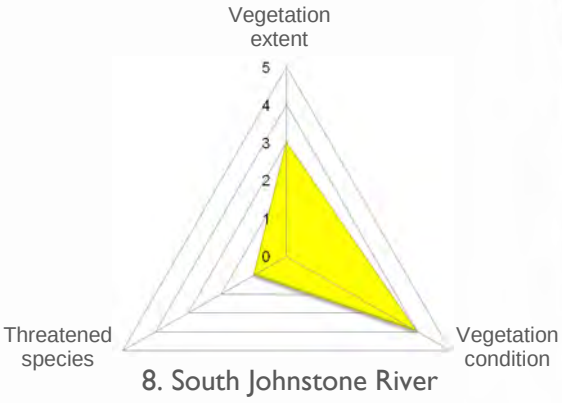
Figure 11: Overall biodiversity condition status score for Terrain NRM report areas (catchments) (continues to page 27).

Very good	5
Good	4
Moderate	3
Poor	2
Very poor	1

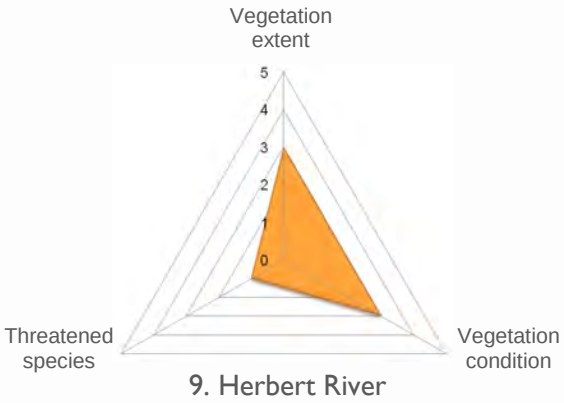
Very good	5
Good	4
Moderate	3
Poor	2
Very poor	1



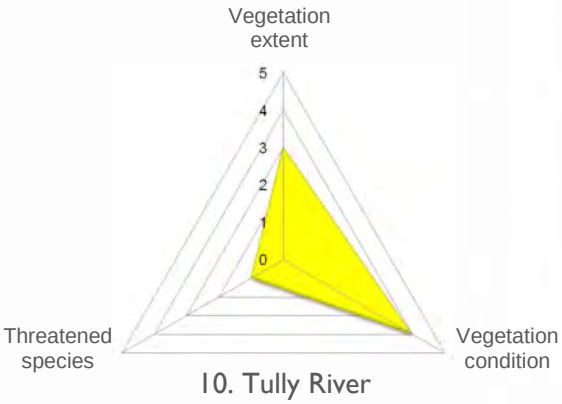
7. North Johnstone River



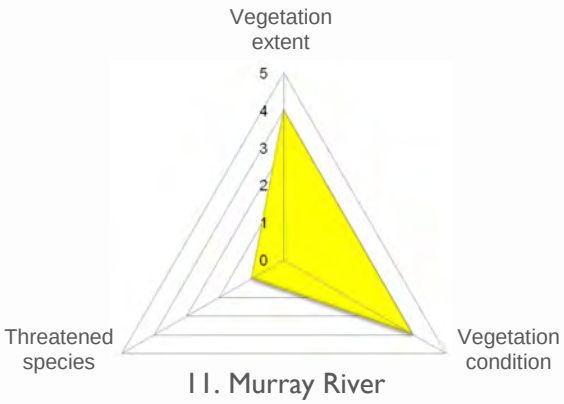
8. South Johnstone River



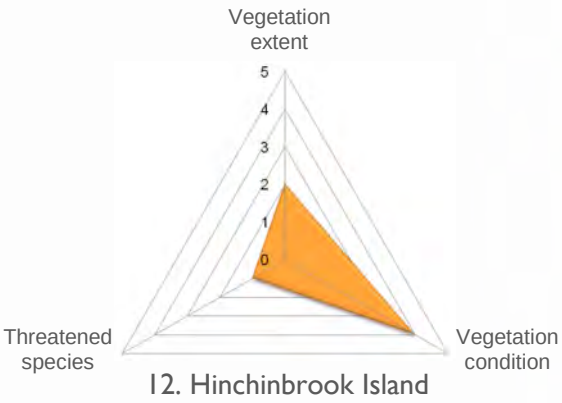
9. Herbert River



10. Tully River



11. Murray River



12. Hinchinbrook Island

Table 4: Overall biodiversity status score for individual catchments, subregions and the MTSRF study area.

Terrain NRM Reporting areas	**Catchment**	**Status Score**
	Barron	Moderate
	Daintree	Moderate
	Endeavour	Good
	Herbert	Poor
	Hinchinbrook	Poor
	Mossman	Good
	Mulgrave	Moderate
	Murray	Moderate
	North Johnstone	Good
	Russell	Good
	South Johnstone	Moderate
	Tully	Moderate
Wet Tropics Management Authority Reporting areas	**Subregion name**	**Status Score**
	Atherton	Moderate
	Bellenden Ker-Lamb	Moderate
	Daintree-Bloomfield	Good
	Herbert	Poor
	Innisfail	Moderate
	Kirrama-Hinchinbrook	Moderate
	Macalister	Moderate
	Paluma-Seaview	Moderate
	Tully	Poor
	Wet Tropics Bioregion	Good
MTSRF	MTSRF study area	Moderate

SOIL AND LANDSCAPE ASSET

INDICATOR DESCRIPTION

Soil quality can be defined as 'the capacity of a soil to function within ecosystem boundaries to sustain biological productivity, maintain environmental quality, and promote plant and animal health' (Doran and Parkin 1992). It encompasses soil chemical, physical and biological quality factors. Soil quality has now become a concept that assists in the assessment of the effect of management practices on soil, and evaluating the sustainability of these practices (e.g. Karlen *et al.* 1992; Acton and Padbury 1993). Soil quality attributes, or indicators, defined as measurable soil properties that influence the capacity of a soil to perform a specified function, can thus be considered as tools to assess soil health (Acton and Padbury 1993).

DATA SOURCES

The soil/landscape asset has been assessed for the Wet Tropics in the Terrain NRM and WTMA reporting areas. Where possible, the datasets from "sham: Soil property estimates for the Wet Tropics created using NRM 'Soil Attribute Surfaces for Landscape Salinity Hazard Assessment'" were chosen preferably to those from ASRIS because of their better accuracy (Wet Tropics-wide, eighty-metre accuracy, instead of Australia-wide, 1 km accuracy). The Terrain NRM plan reporting area was further sub-divided into land uses to create more homogeneous and useful units for reporting (Figure 12). These land uses include *intensive production* (predominantly coastal cropping areas), *grazing land* (primarily extensive rangeland areas), *protected areas* (all registered parks and reserves) and *tablelands* (intensive cropping and dairy production on the Atherton Tablelands). Urban land use areas were also identified and subsequently removed from further analysis due to the soil asset not being as important a factor in urban areas. Consequently a total of 26 assessments of the Soil and Landscape asset were made in the Terrain NRM plan area, based on the number of land use by catchment units. For the WTMA reporting unit, as the only land use type is Protected Area, the reporting was restricted to the nine subregions within the MTSRF area.

Sustainability indicators specific to each land use were chosen to assess the quality of the soil and landscape asset. Ecosystem services provided by the soil specific to each land use were identified and sustainability indicators chosen based on all of these ecosystem services. Sustainability indicators are representative of ecosystem services for the specific land use, and changes in the indicator values would have an impact on the specific land use. For example, The set of indicators chosen to assess soil and landscape quality for the intensive land use areas consisted of physical and chemical sustainability indicators (available water capacity, bulk density, *k* factor, organic C, pH, rooting depth and soil thickness). These indicators represent the ecosystem services of nutrient cycling (pH and soil organic carbon), physical stability (bulk density), water relations (available water capacity) and structural and chemical resilience (soil organic carbon). Each land use by reporting unit was individually assessed (scored from 1 to 5, with 1 representing 'Very poor condition' and 5 representing 'Very good condition') using the identified indicators for each land use. Condition maps showing the overall score and radar plots presenting the individual indicator scores were drawn for each subdivision. Due to the relative nature of the scoring system, and the fact that land-use-specific sustainability indicators are used for each land use, comparisons are possible between reporting units within each land use, however comparisons between the land uses cannot be made.

Condition	Score
Very good	5
Good	4
Moderate	3
Poor	2
Very poor	1

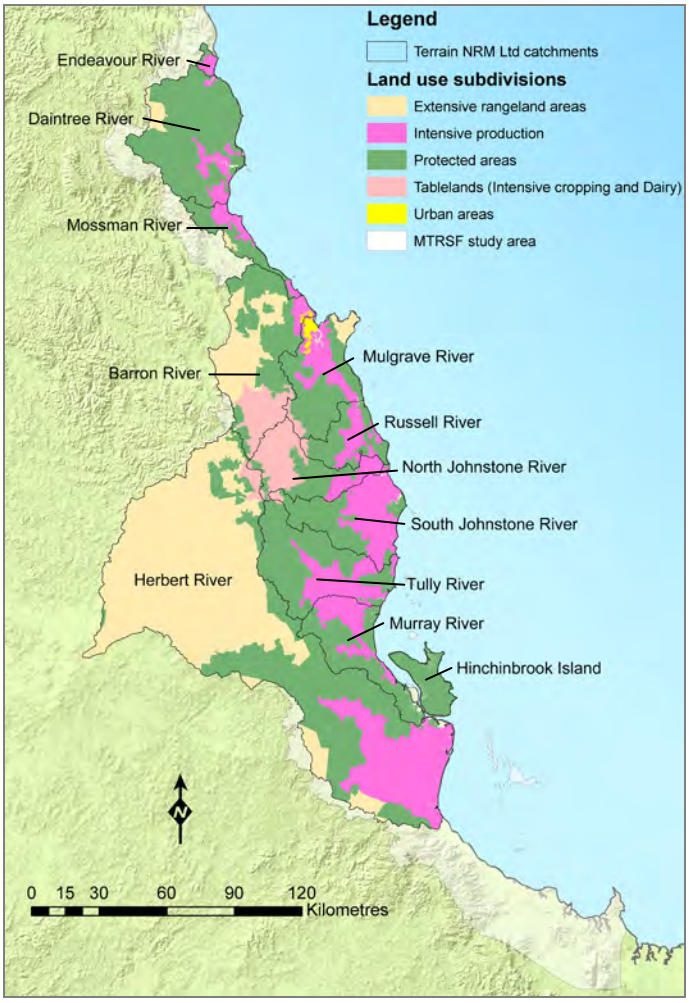


Figure 12: Land use subdivisions used in the 'Soil and Landscapes Asset' assessment, showing Terrain NRM reporting areas (catchment boundaries).


Photo: TRaCK CERF

RESULTS

Ten catchments had intensive land use subdivisions (Figure 13): the Daintree, Endeavour, Herbert, Mossman, Mulgrave, Murray, North Johnstone, Russell, South Johnstone and Tully catchments. Eight subdivisions appeared to be in 'Good' condition for the soil and landscape asset, while Mossman and Daintree intensive subdivisions appeared to be in 'Moderate' condition (Daintree subdivision scored 'Poor' for pH and Mossman subdivision for Organic C).

All catchments contained protected areas (Figure 14). The set of indicators chosen to assess the landscape quality within protected subdivisions addressed the extent and status of native vegetation (conservation reserves, connectivity), as well as hydrological conditions, threatened plants and animals, and land zoning. The North Johnstone subdivision appeared to be in poorer condition ('Moderate') than the others, especially due to 'Poor' scores for conservation reserves, connectivity in native vegetation and percentage of land in Zone A[1] within the World Heritage Area. The Mossman, Russell and South Johnstone subdivisions fell not very far behind, being in between 'Moderate' and 'Good' conditions. The other eight subdivisions appeared to be in good condition, scoring 'Good' for extent of and connectivity in native vegetation.

For the Wet Tropics bioregion, the nine subregions within the Wet Tropics were assessed using the same indicators as for protected areas, namely addressing landscape health (Figure 15). The Atherton subregion proved to be in quite damaged condition (score of 2 'Poor condition') compared to the others, scoring poorly for six of the eight indicators (connectivity, hydrolocal conditions, biodiversity indicators and land zoning). The Herbert, Tully, Innisfail and Macalister regions are in 'Moderate' condition, scoring still quite poorly for the biodiversity indicators and connectivity. The four other subregions were assessed as in good

[1] Land included in Zone A has a high degree of integrity and is remote from the disturbances associated with modern technological society. It is in its natural ecological, physical and aesthetic condition and sustaining this condition is the intent of this zoning. Visitors may expect to find solitude and no obvious management presence. To qualify for inclusion in Zone A, land must: (a) be at least five hundred metres from all roads, cableways, powerlines, pipelines, towers, mines, quarries and other structures; (b) be at least seven hundred metres from clearings; (c) include a minimum area of 150 hectares of undisturbed habitat; and (d) have no obvious signs of disturbance in the last forty years (e.g. logging) (http://www.wettropics.gov.au/map/map_zoning.html)

condition, due particularly to scoring 'Good' for extent of native vegetation, hydrological conditions and percentage of land in Zone A.

The Barron and Herbert river catchments had grazing land subdivisions (Figure 16). Their condition was assessed according to the land types and using indicators such as land condition (ABCD framework[2]), soil condition, pasture condition, ground cover, tree thickening, weed invasion and *k* factor. Both subdivisions appeared to be in 'Good' condition without much differentiation between them. Scores showed threats in indicators such as weed invasion and pasture condition. Erosion appeared to be a threat too, especially when there was dominance of the alluvial land type (Barron grazing lands).

The tablelands were made of two subdivisions (Barron and North Johnstone catchments). They were assessed under different land uses, as a cropping area for the Barron subdivision and as a dairy area for the North Johnstone subdivision. New indicator classifications were built after the intensive land use was developed, adapted to cropping (reference maize) and dairy pastures. Both subdivisions proved to be in quite good condition.

This analysis provides a useful macro ranking system for use by Terrain NRM and WTMA planners to quickly assess and compare their management units, with the ability to quickly identify an overall score for the soil asset as well as the sustainability indicators that contribute to that score.

[2] In 2003, the Queensland Department of Primary Industries and Fisheries developed its 'ABCD' framework to describe grazing land condition. The method considers pasture composition, soil condition, weed infestation and woodland density to assign an 'ABCD' ranking to a land type. 'A' condition describes the land type at 100% of original carrying capacity or potential; 'B' condition represents 75% of original carrying capacity; 'C' condition represents 55% of original carrying capacity; and 'D' condition accounts for less than 20% or zero carrying capacity. Taking into account rainfall variability it is considered that a sustainable management system would see grazing lands moving between 'A' and 'B' condition.

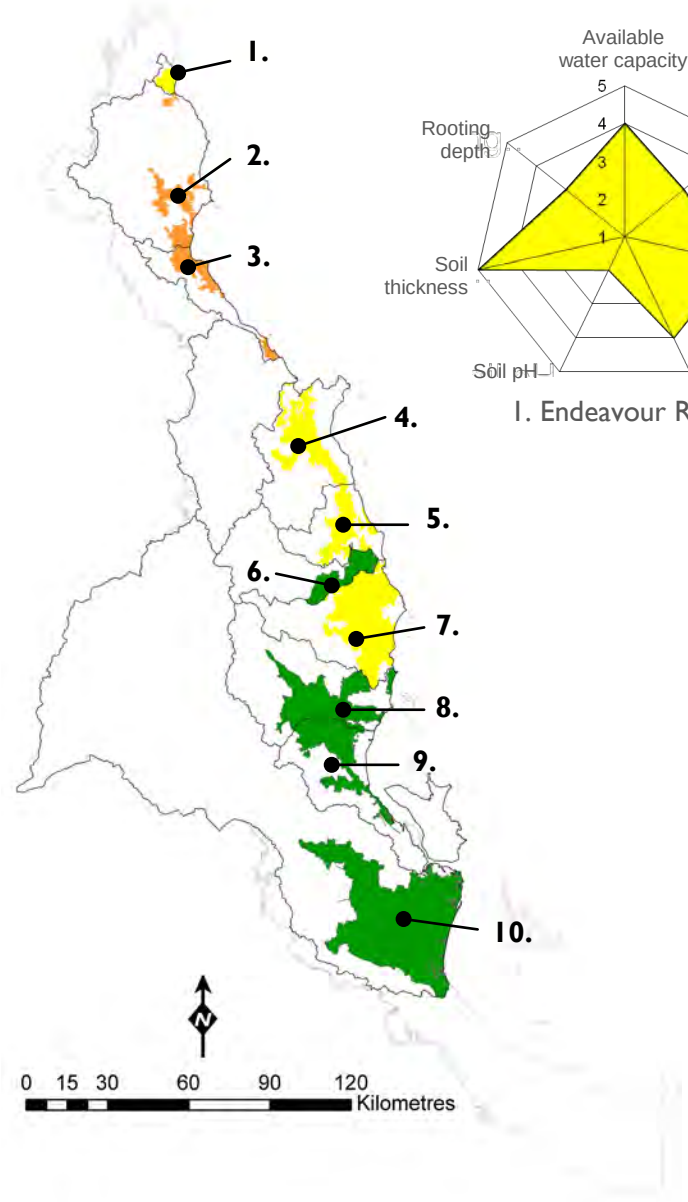
THRESHOLDS OF CONCERN

No RCT has been set by Terrain NRM for the soil and landscape asset. Because there was only one data point for this asset, there is only a status result, and not trend. Scores of 1 or 2 for any indicator are considered to be 'of concern' relative to other land uses in the MTSRF region, and management interventions may be warranted. On this basis, soil pH is the indicator of concern in the 'intensive' land use assessment, receiving a score of 'Poor' in six out of the ten Terrain NRM catchments. Within 'protected' land use catchments, Threatened Terrestrial Vertebrates (Tv) are of concern, scoring 'Poor' in 11 of the 12 Terrain NRM catchments, while Threatened Plants (Tp) scored 'Poor' in seven catchments, also representing an indicator of concern.

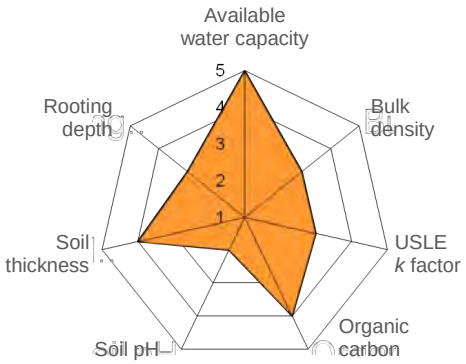
These two indicators each scored 'Poor' in three of the nine Wet Tropics subregions, while Degree of Connectivity (C) and Changed Hydrological Conditions (H) scored 'Poor' in four subregions each, indicating these four indicators are of most concern in the Wet Tropics subregions.

Only one RCT developed by Terrain NRM existed for pastures: in extensive rangelands, seventy percent of all pasture landscapes are to be in 'A' and 'B' condition by 2017 (FNQ NRM Ltd and Rainforest CRC, 2004). The data available for assessing the soil/landscape asset has only been collected once, and consequently there is no trend data available for this asset. These data were used because of their coverage, being consistent over the entire study area, allowing comparisons between subdivisions within a land use. Assessment of the data was such that scores are relative to each other within a land use, and scores of 1 or 2 for any indicator are considered to be 'of concern', and management interventions to increase these indicator scores investigated.

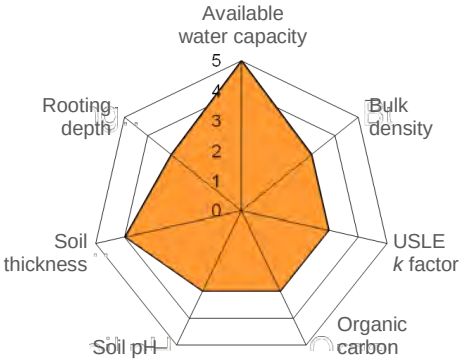
Photo: Andrew Ford



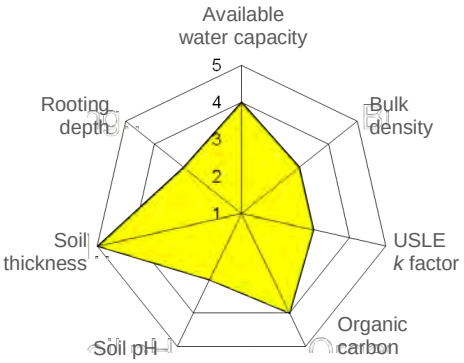
1. Endeavour River



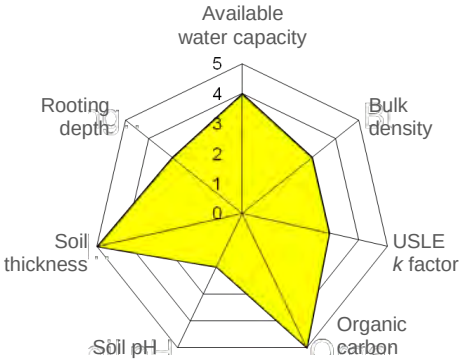
2. Daintree River



3. Mossman River



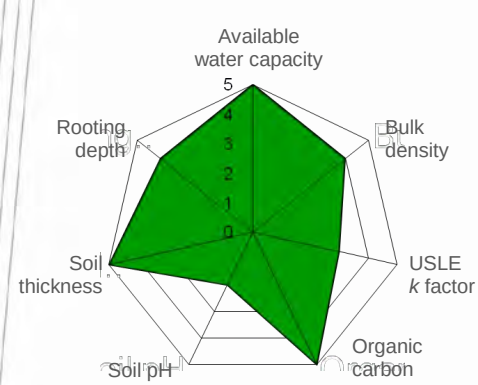
4. Mulgrave River



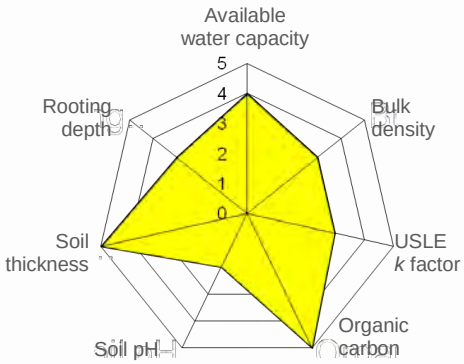
5. Russell River

Figure 13: Summary of Terrain NRM planning region (catchments) sustainability indicators for intensive land use in catchments (continues to page 33).

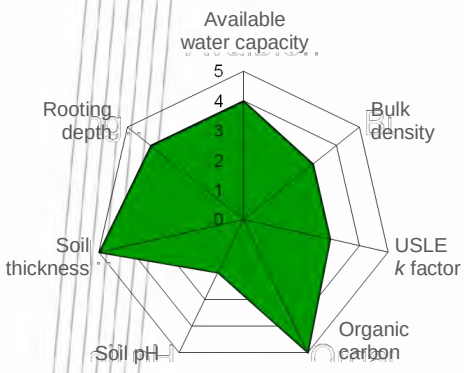
Very good	5
Good	4
Moderate	3
Poor	2
Very poor	1



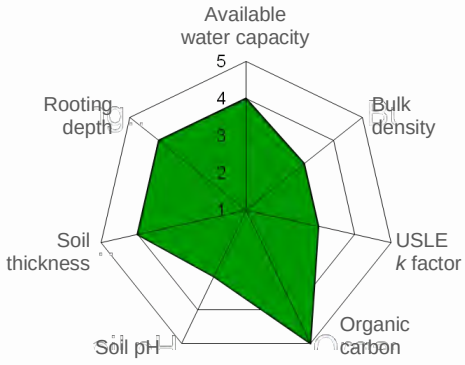
6. North Johnstone River



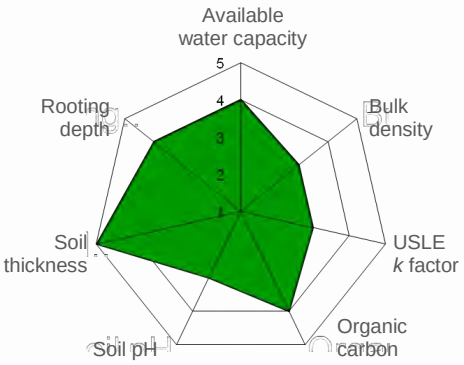
7. South Johnstone River



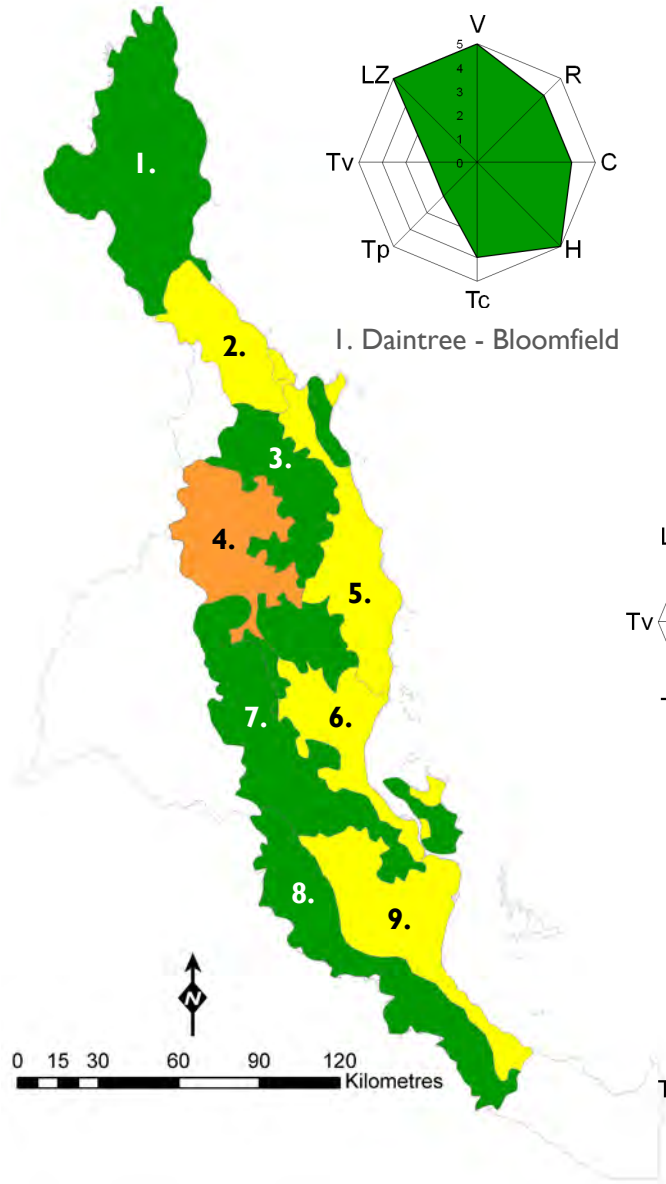
8. Tully River



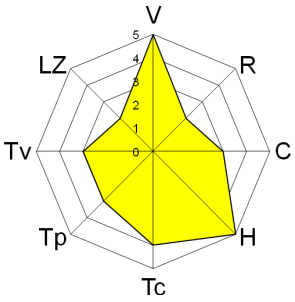
9. Murray River



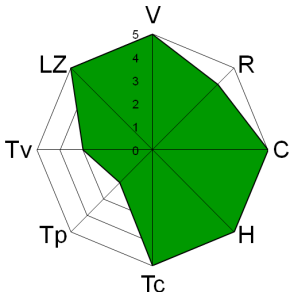
10. Herbert River



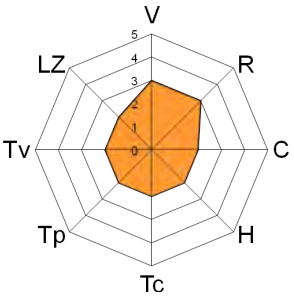
1. Daintree - Bloomfield



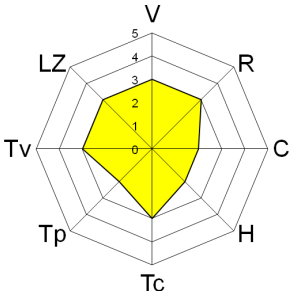
2. Macalister



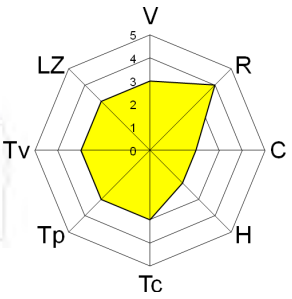
3. Bellenden Ker - Lamb



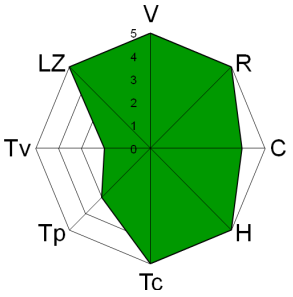
4. Atherton



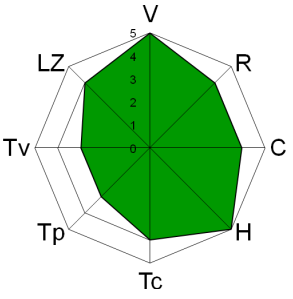
5. Innisfail



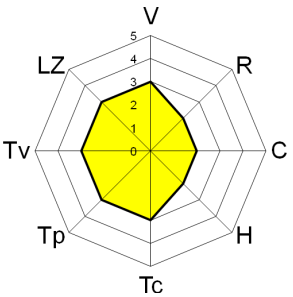
6. Tully



7. Kirrama - Hinchinbrook



8. Paluma - Seaview



9. Herbert

Figure 14: Summary of WTMA subregion sustainability indicators.

V = Extent of native vegetation
R = Native vegetation in conservation reserves
C = Degree of connectivity in native vegetation
H = Degree of changed hydrological conditions
Tc = At risk ecological communities
Tp = Threatened plants
Tv = Threatened terrestrial vertebrate animals
LZ = Land zoning

Very good	5
Good	4
Moderate	3
Poor	2
Very poor	1

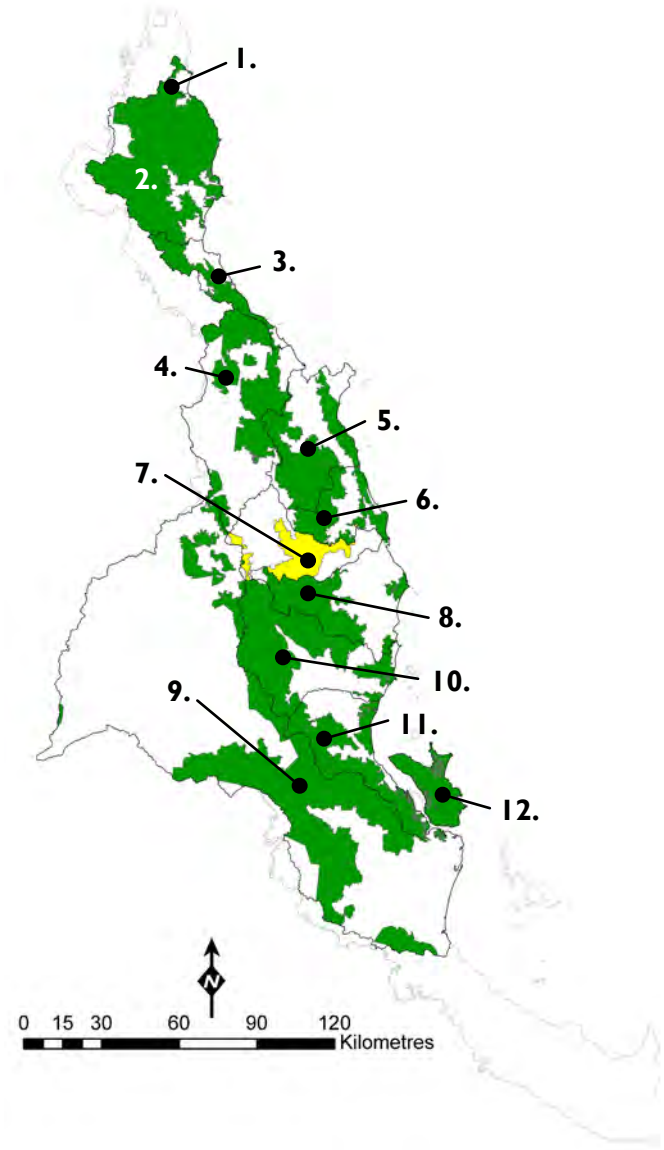
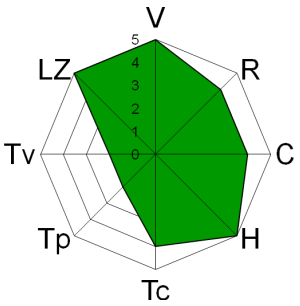


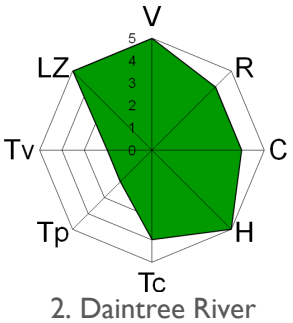
Figure 15: Summary of Terrain NRM catchment sustainability indicators.

V = Extent of native vegetation
R = Native vegetation in conservation reserves
C = Degree of connectivity in native vegetation
H = Degree of changed hydrological conditions
Tc = At risk ecological communities
Tp = Threatened plants
Tv = Threatened terrestrial vertebrate animals
LZ = Land zoning

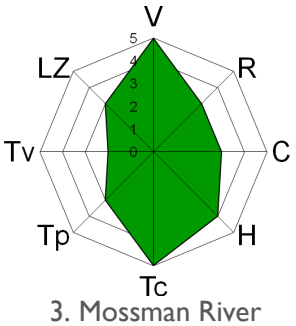
Very good	5
Good	4
Moderate	3
Poor	2
Very poor	1



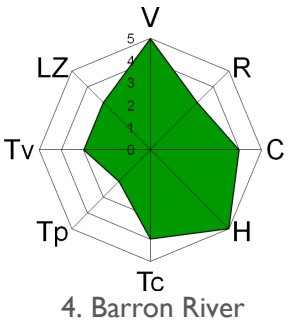
1. Endeavour River



2. Daintree River



3. Mossman River



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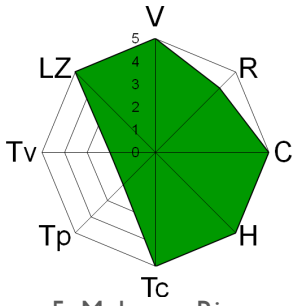

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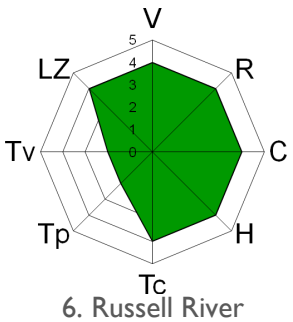

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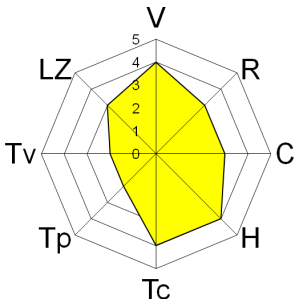
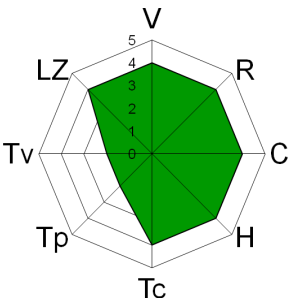
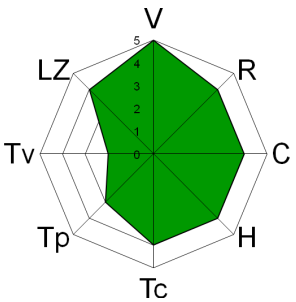


7. North Johnstone River



8. South Johnstone River



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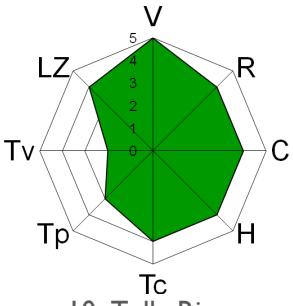

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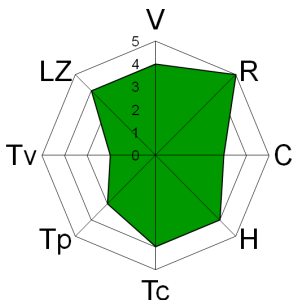

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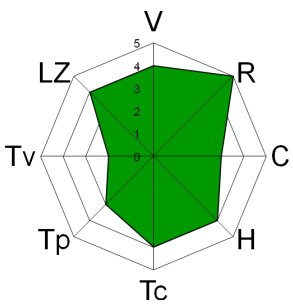

12. Hinchinbrook Island

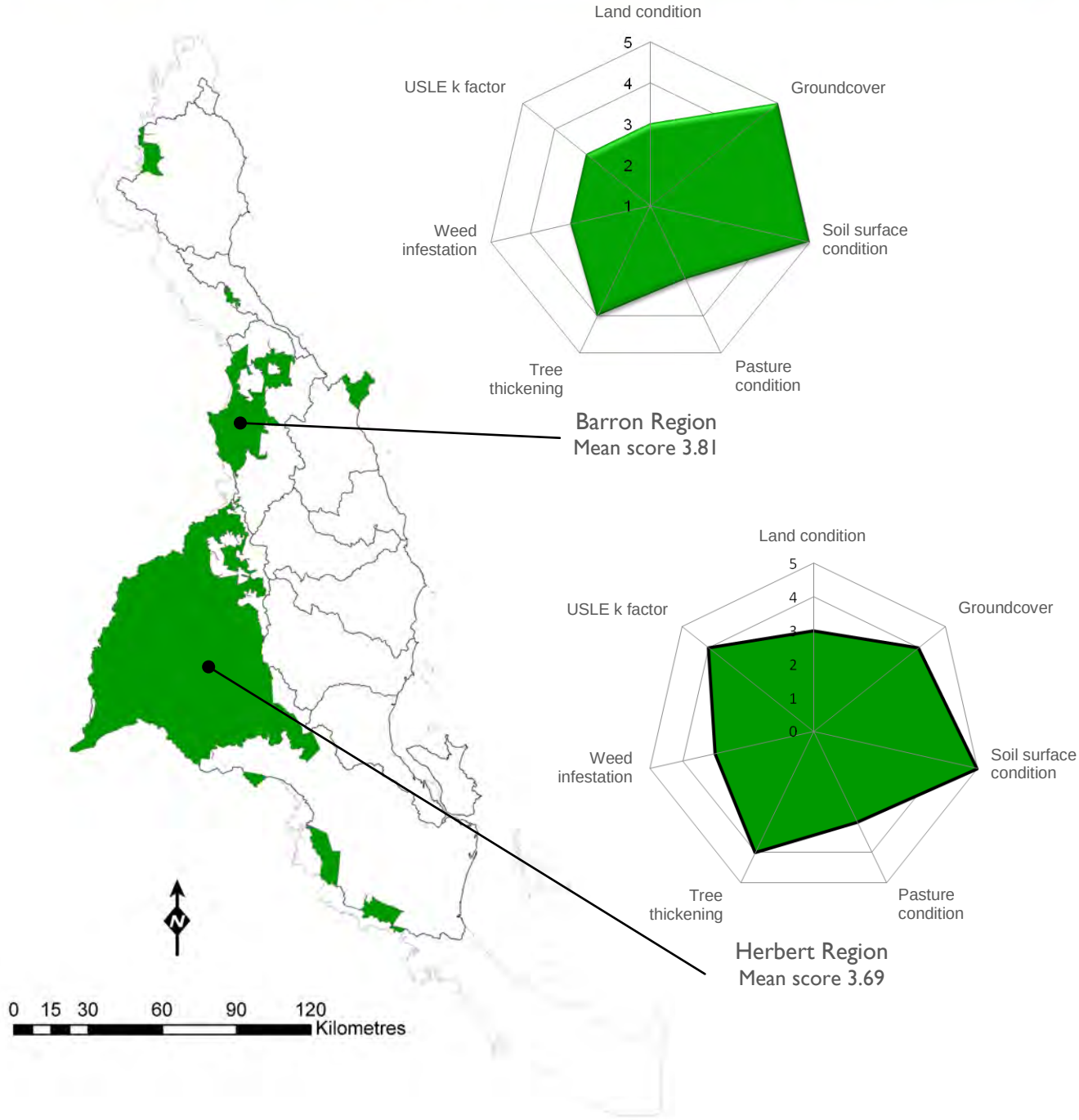

Figure 16: Summary of sustainability indicators for extensive land use in Terrain NRM catchments.

Very good	5
Good	4
Moderate	3
Poor	2
Very poor	1

KEY FINDINGS AND RECOMMENDATIONS

KEY FINDINGS

1. Standardised reporting and monitoring and coordinated management of relevant datasets is required. The integration of existing and future datasets is important, and a central repository of data should be established which is accessible to those responsible for managing threatened species.
2. Prioritise investment to enhance vegetation and biodiversity management outside the Wet Tropics World Heritage Area and adjacent to the World Heritage Area.
3. Ecosystem services should be included in the planning and management of Wet Tropics landscapes, in order to recognise the role of landholders in providing stewardship of natural assets. Methods and tools to value ecosystem services, and to identify and map trade-offs between them should be developed.

PROCEDURES AND MONITORING

4. Better data collection, monitoring and reporting regimes should be implemented to enable more accurate, integrated and long-term *State of the Environment* reporting of natural assets' condition. A standardised approach to monitoring 'pressure' and 'response' indicators is also required.
5. The setting, monitoring and reporting of short, medium and long term resource condition targets should form an integral component of management of natural resources, biodiversity and threatened species in the Wet Tropics.
6. Development of a nationwide program of environmental monitoring focusing on biodiversity, the carbon cycle and water resources, by adopting the indicators put forward here and combining these with National Land and Water Resources Audit indicators.
7. That five-yearly estimates be undertaken of all native vegetation cover, based on high-quality aerial photography or satellite imagery, with the aim of public reporting towards the RCT1 goal of 'no net loss of native vegetation extent across the region by 2014', and RCT2, 'no net loss of native vegetation condition across the region by 2014'.
8. That study is undertaken to evaluate the contributions of conservation on private land to biodiversity retention, and develop an integrated portfolio of strategies to improve the status and support trends of native vegetation and biodiversity on private land.
9. That advisory lists for all taxa, including invertebrates be provided with ongoing maintenance.
10. Prioritise a strategic, coordinated and ongoing survey effort for the Wet Tropics flora and fauna, particularly targeting those taxa and locations which are identified as knowledge gaps.

THREATENED SPECIES

11. The review of threatened species recovery plans and resources allocated to ensure maximum effectiveness in protecting biodiversity within the constraints of projected climate change.

WEEDS AND FERAL ANIMALS

12. The review, at regular intervals, of the Declared Plants of Queensland under the *Land Protection (Pest and Stock Route Management) Act 2002* to ensure that information about weed species is accurate and up to date.
13. Prioritise investigations into the mechanisms for raising awareness of the weed potential of garden plants sold in nurseries.
14. Prioritise the development of options for developing long term regional-scale projects to monitor and protect biodiversity from exotic predators.

SOILS

15. Prioritise the development of a program to ascertain the significance of soil structure decline as a threat to soil health.
16. Development of a 'community engagement' framework for soil health data collection and management to influence management change in soil health. This can only be achieved through benchmarking of soil conditions and management regimes against a set of agreed indicators for the purpose of knowledge exchange, learning, target setting and action implementation within stakeholder groups.

GENERAL RECOMMENDATIONS

17. That new target(s) be specific, measurable, ambitious, realistic, time-bound and developed on the basis of robust scientific evidence. The importance of the biodiversity for our green infrastructure and the value of ecosystem service to society should be recognised. Given the time needed to establish monitoring systems and develop indicators, this work is considered crucial in the region.
18. Prioritise collation of spatial data on the economic value of biodiversity and land resources.
19. Investigate and compare the social, economic, cultural and regulatory drivers of biodiversity loss and provide links between other socio-cultural indicators and datasets.
20. Identify environments that are most vulnerable to biodiversity loss, in order to effectively protect biodiversity at regional and local (property) scales.


Photo: WTMA


Photo: Suzanne Long

REFERENCES

Acton, D.F. and Padbury, G.A. (1993) A conceptual framework for soil quality assessment and monitoring. In: *A program to assess and monitor soil quality in Canada: Soil quality evaluation summary*. Research Branch, Agriculture Canada, Ottawa, ON. (p. 2-10).

Bruce, C., Pert, P.L., Butler, J. and Metcalfe, D. (In prep.) *Declining forest extent across the Wet Tropics Bioregion, Australia, 1972-2006: Spatio-temporal characteristics of change derived from a multi-temporal, long-term data series.*

Doran, J.W. and Parkin, T.B. (1992) Defining and assessing soil quality. In: Symposium on Defining Soil Quality for a Sustainable Environment, at the 1992 American Society of Agronomy Annual Meeting, Minneapolis. Soil Science Society of America.

EEA (1999) *Environment in the European Union at the turn of the century*. EEA Environmental assessment report. European Environment Agency, Copenhagen, Denmark.

Fairweather, P. and Napier, G. (1998) *Environmental indicators for National State of the Environment reporting – Inland Waters*. Australia: State of the Environment (Environmental Indicator Report), Department of the Environment, Canberra.

FNQ NRM Ltd and Rainforest CRC (2004) *Sustaining the Wet Tropics: A Regional Plan for Natural Resource Management 2004-2008*. FNQ NRM Ltd, Innisfail (208pp.).

Hamblin, A. (1998) *Environmental indicators for National State of the Environment reporting – The Land*. Australia: State of the Environment (Environmental Indicator Report), Department of the Environment, Canberra.

Hopkins, M.S. and Johnson, R. (1995) *The development of a plot-based monitoring strategy for assessing changes in World Heritage Values in the Wet Tropics*. CSIRO Tropical Forest Research Centre, Atherton and Rainforest CRC, Cairns.

Karlen, D.L. and Stott, D.E. (1992) A framework for evaluating physical and chemical indicators of soil quality. In: Symposium on Defining Soil Quality for a Sustainable Environment, at the 1992 American Society of Agronomy Annual Meeting, Minneapolis. Soil Science Society of America.

Manton, M. and Jasper, D. (1998) *Environmental indicators for National State of the Environment reporting – Atmosphere.* Australia: State of the Environment (Environmental Indicator Report), Department of the Environment, Canberra

Mawdsley, J. and O'Malley, R. (2009) Development of multi-species indicators for the Nevada Wildlife Action Plan*. Ecological Indicators* 9(5): 1030-1036.

Newton, P., Flood, J., Berry, M., Bhatia, K., Brown, S., Cabelli, A., Gomboso, J. and Richardson, T. (1998) *Environmental indicators for National State of the Environment reporting – Human settlements*. Australia: State of the Environment (Environmental Indicator Report), Department of the Environment, Canberra.

Pearson, M. Johnson, D., Lennon, J., McBryde, I., Marshall, D., Nash, D. and Wellington, B. (1998) *Environmental indicators for National State of the Environment reporting – Natural and Cultural Heritage*. Australia: State of the Environment (Environmental Indicator Report), Department of the Environment, Canberra.

Pert, P.L., Bruce, C., Butler, J. and Metcalfe, D. (In prep.) *The use of a composite indicator suggests that continuing decline of native vegetation condition across the Wet Tropics, Queensland, Australia.*

Saunders, D., Margules, C. and Hill, B. (1998) *Environmental indicators for National State of the Environment reporting – Biodiversity*. Australia: State of the Environment (Environmental Indicator Report), Department of the Environment, Canberra.

Ward, T., Butler, E. and Hill, B. (1998) *Environmental indicators for National State of the Environment reporting – Estuaries and the Sea*. Australia: State of the Environment (Environmental Indicator Report), Department of the Environment, Canberra.

WTMA (2002) *State of the Wet Tropics Report 2001-02*. Wet Tropics Management Authority, Cairns.

WTMA (2003) *State of the Wet Tropics Report 2002-03*. Wet Tropics Management Authority, Cairns.

WTMA (2004) *State of the Wet Tropics Report 2003-04.* Wet Tropics Management Authority, Cairns.

WTMA (2005) *State of the Wet Tropics Report 2004-05*. Wet Tropics Management Authority, Cairns.

WTMA (2006) *State of the Wet Tropics Report 2005-06*. Wet Tropics Management Authority, Cairns.

WTMA (2007) *State of the Wet Tropics Report 2006-07.* Wet Tropics Management Authority, Cairns.

WTMA (2008a) *State of the Wet Tropics Report 2007-08*. Wet Tropics Management Authority, Cairns.

WTMA (2008b) *Climate Change in the Wet Tropics: Impacts and Responses. State of the Wet Tropics Report 2007-2008.* Wet Tropics Management Authority, Cairns.

WTMA (2009) *State of the Wet Tropics Report 2008-09.* Wet Tropics Management Authority, Cairns.

Photo: Suzanne Long

ACRONYMS USED IN THIS REPORT

AGO ..... Australian Greenhouse Office

ARC ..... Aboriginal Rainforest Council

ASRIS ..... Australian Soil Resource Information System

CAFNEC ..... Cairns and Far North Environment Centre

DERM ..... Department of Environment and Resource Management (Queensland)

DMR ..... Department of Main Roads (Queensland) (former)

EPA ..... Environmental Protection Agency (Queensland) (former)

EPBC ..... Environmental Protection and Biodiversity Conservation (Act)

FNQ ..... Far North Queensland

GIS ..... Geographic Information System

GU ..... Griffith University

IBRA ..... Interim Bioregionalisation of Australia

MTSRF ..... Marine and Tropical Sciences Research Facility

NCAS ..... National Carbon Accounting System

NRM ..... Natural Resource Management

RCT ..... Resource Condition Target

SoE ..... State of the Environment

UNESCO ..... United Nations Educational, Scientific and Cultural Organization

WHA ..... World Heritage Area

WTMA ..... Wet Tropics Management Authority

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