Wet Tropics region

Chapter 7

"The proximity of vulnerable coral reef ecosystems to the coast, the frequency and intensity of rainfall events and the presence of intensive agriculture on the coast floodplain amplifies the risk of pollutants entering the Great Barrier Reef lagoon."

Photo by K Sorensen, Terrain NRM

7.1 Profile

The Wet Tropics region extends from the Bloomfield River in the north, to Crystal Creek in the south, and west to include the Atherton Tablelands. The region, some 22,000 square kilometres in extent, includes most of the Queensland Wet Tropics World Heritage Area and parts of the Great Barrier Reef World Heritage Area. With these two significant areas, the region is one of the most biodiverse places in the world. The deeply incised landscape incorporates seven catchments: Daintree–Mossman, Barron, Mulgrave, Russell, Johnstone, Tully–Murray and Herbert. The tropical climate results in cyclones and 60 to 70 per cent of the rainfall (1500 to 4000 millimetres) occurs in summer.

The region is the most populous of northern Australia and is growing rapidly. Cane farming is the major land use, while dairying, grazing, cropping, tropical horticulture and mining are also present. With its World Heritage properties, the region is a destination for millions of visitors each year, making nature-based tourism such as reef visitation, recreational fishing and boating a major contributor to the economy.

The proximity of vulnerable coral reef ecosystems to the coast, the frequency and intensity of rainfall events and the presence of intensive agriculture on the coast floodplain with significant use of fertilisers and pesticides amplifies the risk of pollutants entering the Great Barrier Reef lagoon. Increased fragmentation of remnant vegetation, overgrazing and exotic weeds have led to a decline in riparian areas.

The regional natural resource management body, Terrain Natural Resource Management works with landholders to adopt improved management practices that reduce nutrient, pesticide and sediment runoff. The focus has been on sugarcane (the largest intensive agricultural use in the region and a major source of nitrogen and photosystem inhibiting (PSII) chemicals), bananas, pawpaws, mixed cropping in the Tablelands, and grazing in both wet and dry country.

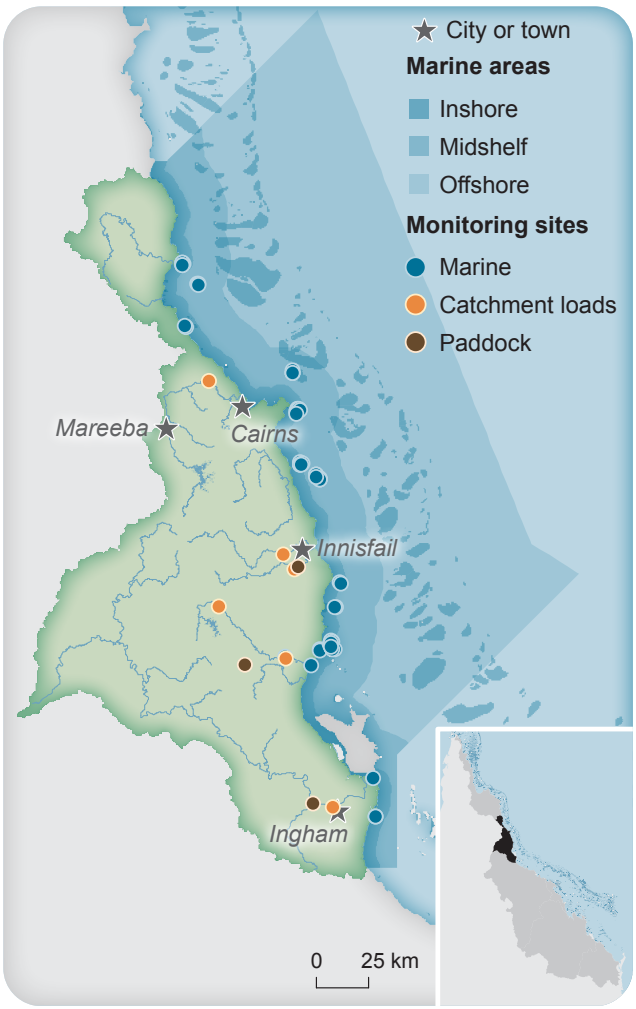
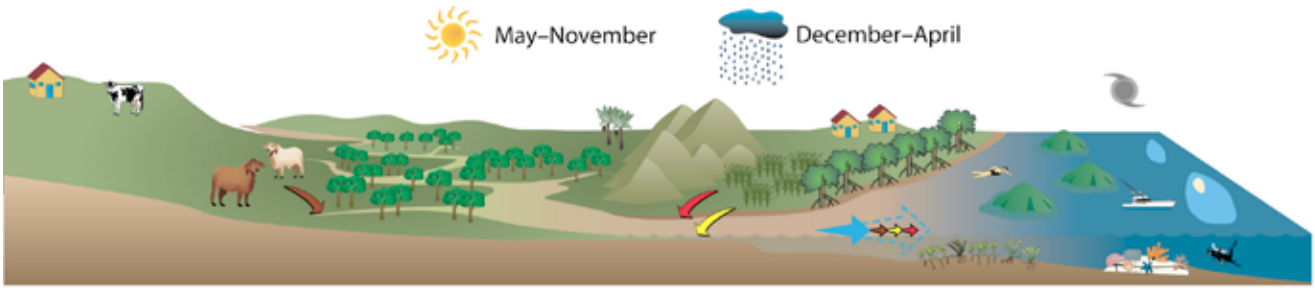


Figure 7.1 – Map of the Wet Tropics region and Great Barrier Reef Marine Park showing the paddock, catchment and marine monitoring sites.



The Wet Tropics region has occasional cyclones and highly variable rainfall predominantly in summer that delivers sediments nutrients and pesticides to the inshore and sometimes offshore portions of the reef in pulsed flows. Coastal ranges separate the western areas and floodplain. The Wet Tropics World Heritage area covers nearly half the landscape. The dominant land uses include grazing to the west , sugarcane on the narrow coastal floodplain, and some horticulture across the region. Cairns is the major urban centre with many smaller towns on the coastal strip and Atherton Tablelands. The proximity of the outer reef supports strong tourism and recreational and commercial fisheries. Habitats include fringing and offshore reefs, shallow-water seagrass and extensive coastal mangroves. There is a mix of continental islands and coral cays.

Figure 7.2 – Conceptual model showing the key processes influencing water quality and reef ecosystem health in the Wet Tropics region.

7.2 Adoption of improved management practices

7.2.1 Results

- **Overall, cutting-edge (A) or best management (B) practices are used by 10 per cent of sugarcane growers. Practices considered unacceptable by industry or community standards (D) are used by 46 per cent of sugarcane growers.**
- **In terms of nutrient management, cutting-edge (A) or best management (B) practices are used by 20 per cent of sugarcane growers. Practices considered unacceptable by industry or community standards (D) are used by 72 per cent of sugarcane growers.**
- **In terms of soil management, cutting-edge (A) or best management (B) practices are used by seven per cent of sugarcane growers with 56 per cent using unacceptable (D) soil management practices.**
- **Overall, cutting-edge (A) or best management (B) practices are used by 67 per cent of horticulture producers. Practices considered unacceptable by industry or community standards (D) are used by 13 per cent of horticulture producers.**
- **In terms of nutrient management, cutting-edge (A) or best management (B) practices are used by 43 per cent of horticulture producers. Practices considered unacceptable by industry or community standards (D) are used by 28 per cent of horticulture producers.**
- **Management practice adoption data for the grazing industry is not available at this time.**

The adoption of improved management practices for sugarcane and horticulture is presented using the ABCD management practice framework, a suite of management practices that are recommended to maintain and/or improve water quality:

A – Cutting-edge practice

B – Best practice

C – Common or code of practice

D – Practices considered unacceptable by industry or community standards.

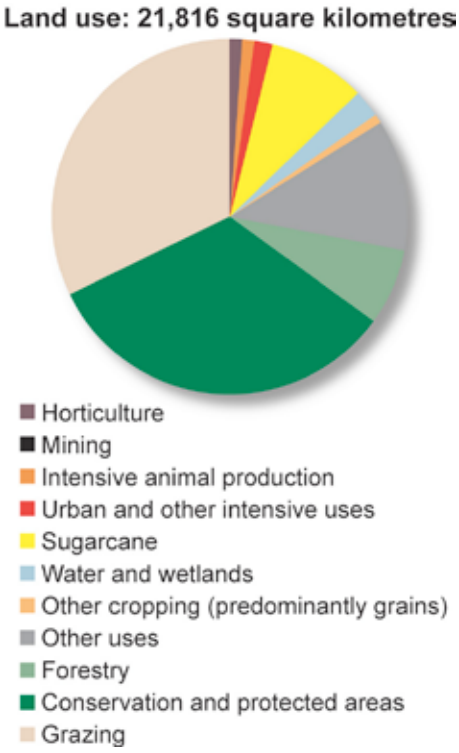


Figure 7.3 – Wet Tropics region land use.

7.2.2 Sugarcane

There are 1527 landholders growing sugarcane on 1947 square kilometres of land within the Wet Tropics region as at 2008–2009. The overall management practices (including nutrient, herbicide and soil) are shown in Table 7.1. Adoption of specific nutrient, herbicide and soil management practices are also reported.

Cutting-edge (A) or best management (B) practices are used by 10 per cent of sugarcane growers on 10 per cent of the land area. Code of practice or common (C) practices are used by 44 per cent of growers. Practices considered unacceptable by industry and community standards (D) are used by 46 per cent of growers.

Cutting-edge (A) or best management (B) practices for nutrients are used by 20 per cent of sugarcane growers. Nutrient management practices considered unacceptable (D) are used by 72 per cent of growers.

Cutting-edge (A) or best management (B) practices for herbicides are used by only four per cent of growers. The vast majority of growers (87 per cent) are using herbicide management practices which are common practice or equivalent to code of practice (C). Only nine per cent of growers are using herbicide management practices considered unacceptable (D).

Cutting-edge (A) or best management (B) practices for soil are used by only seven per cent of sugarcane growers. Soil management practices considered unacceptable (D) are used by 56 per cent of growers.

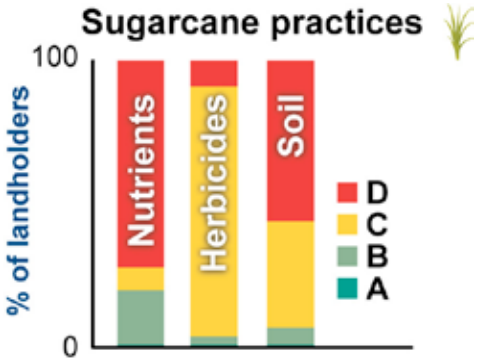


Figure 7.4 – Adoption of improved sugarcane management practices using the ABCD management framework for the Wet Tropics region.

Table 7.1 – ABCD sugarcane management practices for the Wet Tropics region (Source: modified from GHD, 2010b).

Combined management	A cutting-edge	B best practice	C code practice	D unacceptable practice
Number of cane growers	15	143	672	697
% of cane growers	1%	9%	44%	46%
Area (km²)	19	182	857	889
% of area	1%	9%	44%	46%
Nutrient management	**A cutting-edge**	**B best practice**	**C code practice**	**D unacceptable practice**
Number of cane growers	15	290	122	1100
% of cane growers	1%	19%	8%	72%
Area (km²)	19	370	156	1402
% of area	1%	19%	8%	72%
Herbicide management	**A cutting-edge**	**B best practice**	**C code practice**	**D unacceptable practice**
Number of cane growers	15	46	1328	138
% of cane growers	1%	3%	87%	9%
Area (km²)	19	58	1694	176
% of area	1%	3%	87%	9%
Soil Management	**A cutting-edge**	**B best practice**	**C code practice**	**D unacceptable practice**
Number of cane growers	15	92	565	855
% of cane growers	1%	6%	37%	56%
Area (km²)	19	117	720	1091
% of area	1%	6%	37%	56%

7.2.3 Horticulture

As at 2008–2009, there are 330 landholders growing horticultural crops on 251 square kilometres of land within the Wet Tropics region. The main horticultural crops include bananas, pawpaws and potatoes.

The overall management practices (including nutrient, herbicide and soil) are shown in Table 7.2. Adoption of specific nutrient, herbicide and soil management practices are also reported.

Cutting-edge (A) or best management (B) practices are used by 67 per cent of producers on 74 per cent of the horticultural land area. Code of practice or common (C) practices are used by 20 per cent of producers. Practices considered unacceptable by industry or community standards (D) are used by 13 per cent of producers.

Cutting-edge (A) or best management (B) practices for nutrients are used by 43 per cent of producers. Nutrient management practices considered unacceptable (D) are used by 28 per cent of producers.

Cutting-edge (A) or best management (B) practices for herbicides are used by 88 per cent of producers, while one per cent of producers are using unacceptable (D) class nutrient management practices.

Cutting-edge (A) or best management (B) practices for soil are used by 72 per cent of producers, while nine per cent are using unacceptable (D) class soil management practices.

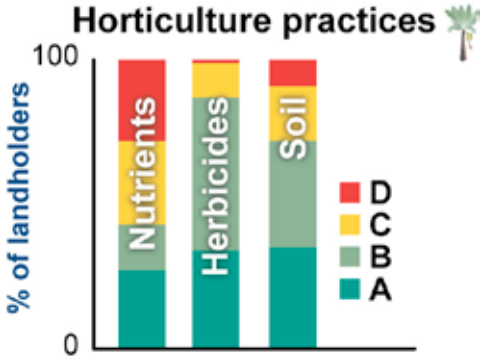


Figure 7.5 – Adoption of improved management practices for horticulture using the ABCD management framework for the Wet Tropics region.

Table 7.2 – ABCD horticulture management practices for the Wet Tropics region (Source: modified from Wallace S, 2010).

Combined management	A cutting-edge	B best practice	C code practice	D unacceptable practice
Number of horticulture producers	106	117	65	42
% of horticulture producers	31%	36%	20%	13%
Area (km²)	93	94	36	28
% of area	37%	37%	15%	11%
Nutrient management	**A cutting-edge**	**B best practice**	**C code practice**	**D unacceptable practice**
Number of horticulture producers	90	53	95	92
% of horticulture producers	27%	16%	29%	28%
Area (km²)	90	48	52	61
% of area	36%	19%	21%	24%
Herbicide management	**A cutting-edge**	**B best practice**	**C code practice**	**D unacceptable practice**
Number of horticulture producers	112	176	38	4
% of horticulture producers	35%	53%	11%	1%
Area (km²)	107	123	20	2
% of area	42%	49%	8%	1%
Soil management	**A cutting-edge**	**B best practice**	**C code practice**	**D unacceptable practice**
Number of horticulture producers	115	124	61	30
% of horticulture producers	35%	37%	19%	9%
Area (km²)	83	110	36	22
% of area	33%	44%	14%	9%

7.3 Catchment indicators

7.3.1 Results

- **The total riparian area in the Wet Tropics region is 470,000 hectares, of which an estimated 1900 hectares are likely to be susceptible to erosion (non-forested and low groundcover).**
- **The loss of riparian vegetation between 2004 and 2008 was 787 hectares (0.17 per cent).**
- **The extent of wetlands (including vegetated freshwater swamps, lakes and mangroves) across the Wet Tropics region is 81,000 hectares.**
- **The loss of vegetated freshwater swamps since pre-European times has been high (51 per cent) in the Wet Tropics region. The Barron catchment has lost 81 per cent of vegetated freshwater swamps.**
- **The loss of vegetated freshwater swamps over the 2001–2005 period was 233 hectares (0.63 per cent) with the Mossman catchment losing 17 hectares (8.33 per cent) of vegetated freshwater swamps during this period.**
- **The 2009 mean dry season groundcover for the grazing lands of the Herbert catchment is 95 per cent, which is above the Reef Plan target of 50 per cent.**

7.3.2 Riparian vegetation

The Wet Tropics region has a total of 427,000 hectares or 91 per cent of riparian areas forested, 36,000 hectares (7.74 per cent) of non-forested areas with high groundcover and 1900 hectares (0.4 per cent) non-forested with low groundcover. The non-forested and low groundcover areas are likely to be susceptible to erosion and, therefore, sediment loss to streams. The loss of riparian vegetation between 2004 and 2008 was 787 hectares (0.17 per cent). The Murray catchment had the highest clearing of riparian vegetation between 2004 and 2008 with 254 hectares (1.6 per cent) cleared.

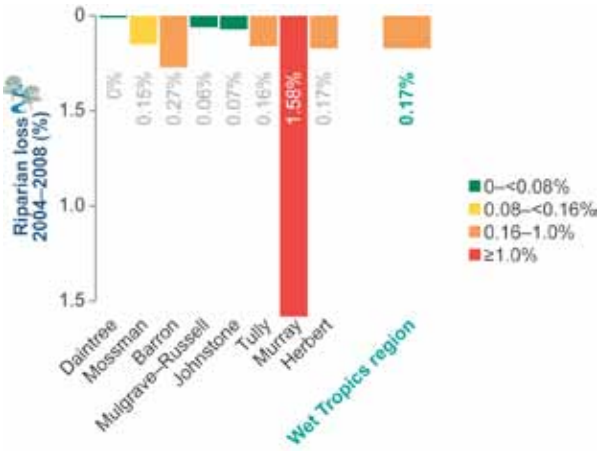


Figure 7.6 – Loss of riparian vegetation between 2004 and 2008 in the Wet Tropics region.

Table 7.3 – Areas forested within the riparian buffer, non-forested with high groundcover (above or equal to 50 per cent), non-forested with low groundcover (less than 50 per cent) for 2008 and the area cleared from 2004 to 2008.

Catchment	Total riparian buffer area	Forested		Non-forested high groundcover		Non-forested low groundcover		Missing data*	2004–2008 riparian clearing	
	(ha)	Area (ha)	%	Area (ha)	%	Area (ha)	%	%	Area (ha)	%
Daintree	120,673	119,372	98.92	1162	0.96	39	0.03	0.08	5	0.00
Mossman	16,368	14,830	90.60	1400	8.55	34	0.21	0.63	24	0.15
Barron	44,189	40,242	91.07	3396	7.69	178	0.40	0.84	121	0.27
Mulgrave Russell	29,203	24,676	84.50	3947	13.52	169	0.58	1.41	17	0.06
Johnstone	37,903	30,532	80.55	6331	16.70	171	0.45	2.29	26	0.07
Herbert	178,008	160,049	89.91	15,074	8.47	1127	0.63	0.99	296	0.17
Tully	27,195	23,562	86.64	2933	10.79	133	0.49	2.09	44	0.16
Murray	16,065	13,509	84.09	2118	13.18	66	0.41	2.32	254	1.58
Wet Tropics region	**469,606**	**426,772**	**90.88**	**36,361**	**7.74**	**1917**	**0.40**	**0.97**	**787**	**0.17**

*Missing data refers to areas affected by cloud, cloud shadow, topographic shadow or areas of water within the riparian buffer.

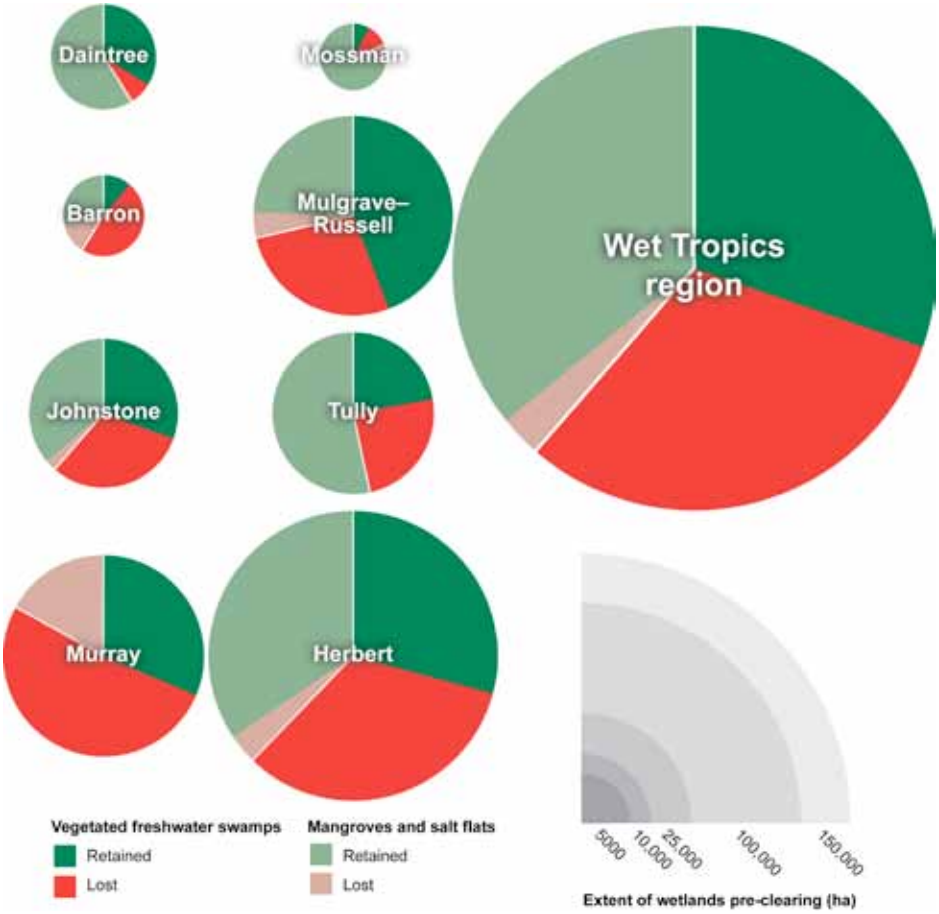


Figure 7.7 – Extent (hectares) and proportion of vegetated freshwater swamps and mangroves/salt flats remaining from pre-European extent in the Wet Tropics region.

7.3.3 Wetlands

Wetland types

As at 2005, there are approximately 81,000 hectares of wetlands in the Wet Tropics region. Of these wetland areas there are:

- 37,000 hectares of vegetated freshwater swamps (palustrine wetlands). The greatest area of vegetated freshwater swamps is in the Herbert and Mulgrave Russell catchments.
- 770 hectares of lakes (lacustrine wetlands).
- 43,000 hectares of mangroves/salt flats (estuarine wetlands). These wetlands occur in the greatest density in the Herbert and Murray catchments.

Across the Great Barrier Reef catchments, the greatest loss of wetlands has occurred in the Wet Tropics, with 34 per cent of the total wetlands lost since pre-European times. Fifty-one per cent of vegetated freshwater swamps have been lost across the region since pre-European times. The Barron catchment has had significant loss (81 per cent) of vegetated freshwater swamps leaving only 19 per cent remaining. Ninety-three per cent of mangroves and salt flats remain for the region.

The overall loss of all wetlands in the Wet Tropics region between 2001 and 2005 was 266 hectares (0.33 per cent).

The loss of vegetated freshwater swamps over the 2001–2005 period was 233 hectares (0.63 per cent). The greatest loss of vegetated freshwater swamps during this period was in the Mossman catchment with 8.33 per cent. There was a small reduction in the extent of mangroves/salt flats over the 2001–2005 period, ranging from nil to 0.33 per cent.

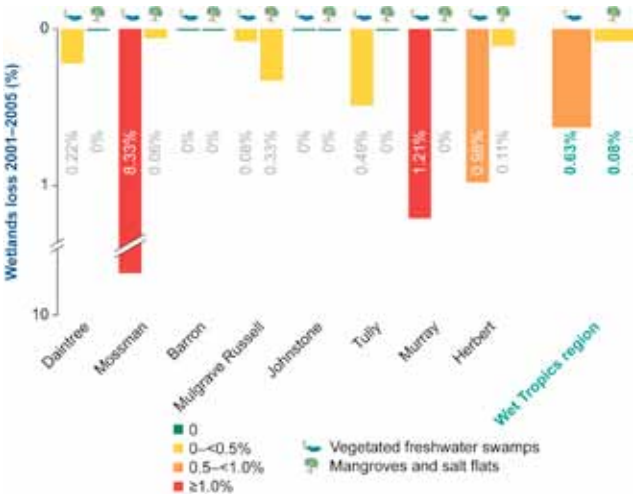


Figure 7.8 – Loss of vegetated freshwater swamps and mangroves/salt flats (between 2001 and 2005) for the Wet Tropics region.

Table 7.4 – The extent of wetlands in 2005 and change between 2001 and 2005 across the Wet Tropics region for vegetated freshwater swamps, lakes and mangrove/salt flat wetlands.

	Vegetated freshwater swamps			Lakes			Mangroves and salt flats			All wetlands		
Catchment	Extent 2005 (ha)	Extent (% pre-European)	Loss 2001–2005 (% of 2001)	Extent 2005 (ha)	Extent (% pre-European)	Loss 2001–2005 (% of 2001)	Extent 2005 (ha)	Extent (% pre-European)	Loss 2001–2005 (% of 2001)	Extent 2005 (ha)	Extent (% pre-European)	Loss 2001–2005 (% of 2001)
Barron	380	19	0	100	100	0	980	71	0	1460	47	0
Daintree	1930	83	0.22	ND	ND	ND	3295	98	0	5225	92	0.08
Herbert	12,675	47	0.98	520	99	0	14,870	91	0.11	28,065	63	0.5
Johnstone	3510	50	0	5	100	0	4100	93	0	7615	67	0
Mossman	190	43	8.33	10	100	0	1675	91	0.06	1875	80	0.97
Mulgrave Russell	9110	62	0.08	120	100	0	5015	86	0.33	14,245	70	0.17
Murray	4680	48	1.21	5	100	0	11,140	100	0	15,825	77	0.36
Tully	4260	38	0.49	10	100	0	2250	99	0	6520	49	0.32
Wet Tropics region	**36,735**	**49**	**0.63**	**770**	**100**	**0**	**43,325**	**93**	**0.08**	**80,830**	**66**	**0.33**

ND – denotes no data.

7.3.4 Groundcover in grazing lands in the Herbert catchment

Groundcover is influenced by a combination of factors including the land type, climate and management practices. The Herbert is the only catchment in the Wet Tropics with a significant area of grazing land (Table 5.6). The long term mean dry season groundcover for the grazing lands of the Herbert catchment over the 1986–2009 period is 93 per cent, which is above the Reef Plan target of 50 per cent. Similar to other regions, the average groundcover in 2009 is higher than the historical average, increasing to 95 per cent. The proportion of the grazing area with groundcover of 50 per cent or greater in 2009 is very high (99 per cent). Only 1.2 per cent of the area was below the 50 per cent groundcover target with 0.8 per cent of the area below 30 per cent.

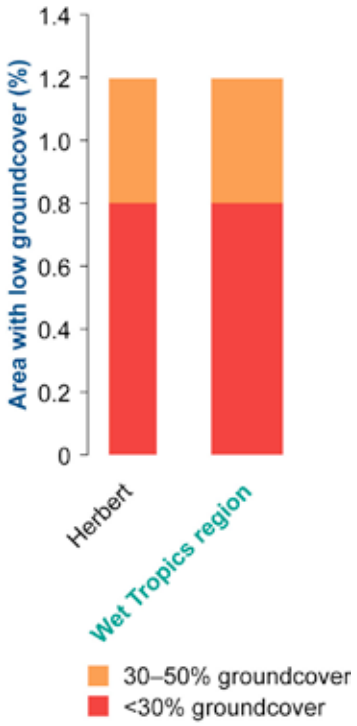


Figure 7.9 – Area with low groundcover (area less than 30 per cent and between 30 per cent and 50 per cent) as at 2009 for the Herbert catchment.

7.4 Catchment loads

The total suspended solids load leaving the catchments of the Wet Tropics region is an estimated 1.4 million tonnes per year, of which 1.1 million tonnes are from human activity (Kroon et al., 2010).

The fertilised agricultural areas of the coastal Wet Tropics are one of the key areas for nutrients (mainly nitrogen) that pose the greatest risk to the Great Barrier Reef (Brodie, 2007).

The estimated total nitrogen load leaving the catchments of the Wet Tropics is 16,000 tonnes per year, of which 11,000 tonnes are from human activity.

The dissolved nitrogen load is 11,000 tonnes per year, of which 6300 tonnes are from human activity, significantly higher than other regions. It is estimated that the main source of this load in the Wet Tropics region is fertiliser loss from sugarcane areas (Brodie et al., 2009).

The estimated total phosphorus load leaving the catchments of the Wet Tropics is 2000 tonnes per year, of which 1500 tonnes are from human activity.

The dissolved phosphorus load is 530 tonnes per year, of which 230 tonnes are from human activity.

The total photosystem inhibiting (PSII) pesticide load leaving the catchments of the Wet Tropics region is an estimated 10,000 kilograms per year. Along with the Mackay Whitsunday region, this is significantly higher than other regions. The pesticide residues most commonly found in surface waters from areas of sugarcane cultivation are diuron, atrazine, ametryn and hexazinone (Lewis et al., 2009). It is important to note that this estimate does not include several land uses known to leak PSII pesticides (e.g. grazing, forestry, cotton, urban) and non-PSII pesticides, indicating that the total pesticide pollutant load to the Great Barrier Reef is likely to be higher.

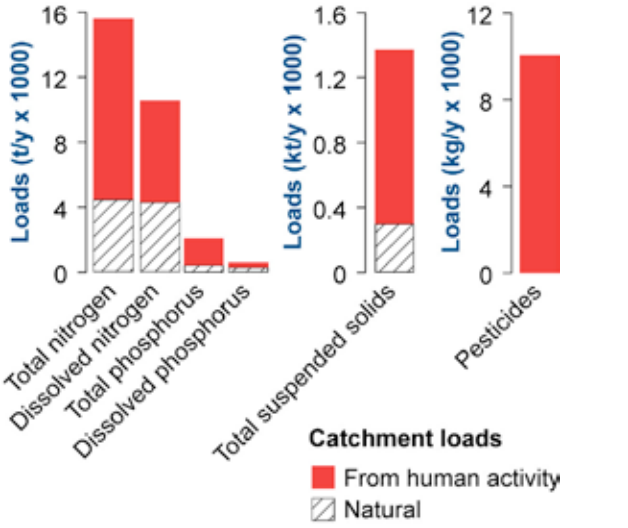


Figure 7.10 – Total and anthropogenic (caused by human activity) pollutant load estimates for total suspended solids, total nitrogen, total phosphorus, dissolved nitrogen, dissolved phosphorus and pesticides.

7.5 Great Barrier Reef water quality and ecosystem health

7.5.1 Results

- **Inshore waters in the Wet Tropics region have concentrations of chlorophyll *a* and suspended solids above Great Barrier Reef Marine Park Water Quality Guidelines. A range of pesticides including diuron, atrazine, hexazinone, simazine and tebuthiuron are detectable in inshore waters of the region.**
- **Seagrass abundance is variable within the region. Seagrass meadows in the southern portion of the region have lower cover due to losses from cyclones prior to 2009, and many meadows have low numbers of reproductive structures, indicating reduced resilience to disturbance.**
- **The overall status of inshore reefs in the Wet Tropics region is good. Reefs in the northern part of the region have high coral cover, low cover of macroalgae, and moderate to high densities of juvenile colonies relative to other regions. However, reefs in more southern parts are in poor condition and have low coral cover, higher abundance of algae and have not yet shown recovery following disturbance.**

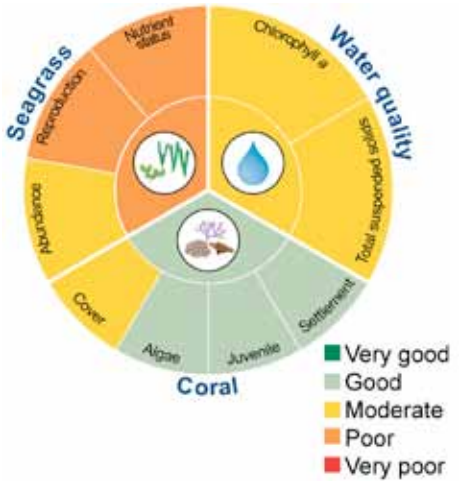


Figure 7.11 – Water quality and ecosystem health of the Wet Tropics region showing the status of water quality, seagrass and corals.

7.5.2 Water quality

Freshwater flows in the Barron, Russell, Johnstone and Tully rivers for 2008–2009 were slightly above (1.08 to 1.29 times) median flows for these major regional rivers. In contrast, freshwater discharge from the Herbert River was much higher, being more than three times the annual median flow in 2008–2009.

Great Barrier Reef Marine Park Water Quality Guideline exceedances for chlorophyll *a* and suspended solids concentrations were calculated for the May 2008 to April 2009 period from satellite imagery. The mean chlorophyll *a* and suspended sediment concentrations exceeded the Great Barrier Reef Marine Park Water Quality Guidelines values (GBRMPA, 2009) in some inshore areas of the Wet Tropics region (Table 7.5).

Table 7.5 – Summary of the exceedance of mean annual chlorophyll *a* and non-algal particulate matter (as a measure of suspended solids) for the Wet Tropics region (1 May 2008–30 April 2009).

Chlorophyll *a*: Relative area (%) of the waterbody where the annual mean value exceeds the water quality guideline value			**Suspended solids:** Relative area (%) of the waterbody where annual mean value exceeds the water quality guideline value		
Inshore	Midshelf	Offshore	Inshore	Midshelf	Offshore
57	9	0	41	13	12

A range of pesticides were detected in time-integrated passive samplers deployed in inshore marine waters in the Wet Tropics region over the 12-month monitoring period (Figure 5.13). Detected pesticides included diuron, atrazine, hexazinone, simazine and tebuthiuron. Concentrations of detected pesticides were typically higher during the wet season, and the maximum water concentrations of individual herbicides ranged from 2 to 15 nanograms per litre.

In high river flow conditions, a similar range of pesticides were detected off the Tully and Murray Rivers in 2008 but not above Great Barrier Reef Marine Park Water Quality Guidelines. However, concentrations of diuron did exceed 100 nanograms per litre (Lewis et al., 2009), which is above the effects level for photosynthesis inhibition in a number of marine plants.

7.5.3 Seagrass status

Seagrass meadows are monitored at reef and coastal sites at four locations in the Wet Tropics region. Seagrass cover, although seasonal, has generally increased or stabilised over the past 12 months and is naturally lower at coastal locations compared to reef locations (Figure 7.12). The Lugger Bay and Dunk Island sites were impacted by the passage of Cyclone Larry across the Queensland coast in 2006. Seagrass cover at the Dunk Island site has recovered since the cyclone. Monitoring suggests that seagrass meadows throughout the region are receiving reduced light levels (from elevated epiphytes and high turbidity) and are nutrient rich. Nitrogen levels are high and increasing at coastal locations in the region.

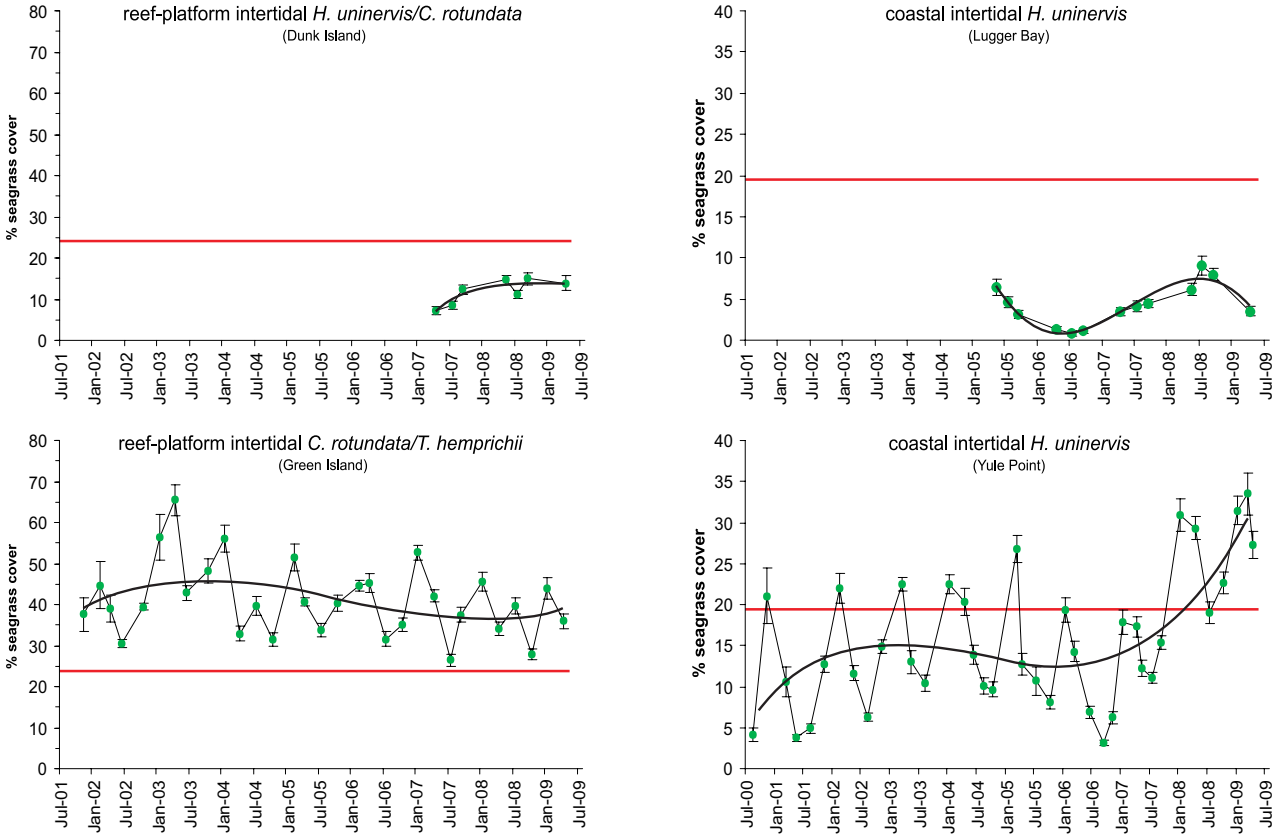


Figure 7.12 – Long term seagrass cover, Yule Point (coastal), Green Island (reef), Lugger Bay (coastal) and Dunk Island (reef), Wet Tropics region, compared with long term Great Barrier Reef average (red line) (Source: DEEDI).

7.5.4 Coral status

Twelve inshore reefs are monitored in the Wet Tropics region, and the overall status of these inshore reefs is good. Reefs in the northern Wet Tropics region, including those at Snapper Island and in the Fitzroy/Frankland Island Groups, are in good condition. They have high coral cover which increased during periods without disturbance, variable to high numbers of juvenile corals and low density of macroalgae. Importantly, these reefs have demonstrated potential to recover from environmental disturbances such as cyclones, bleaching, floods and outbreaks of crown-of-thorns starfish. In contrast, surveyed reefs in the southern section of the Wet Tropics region in the vicinity of the Herbert and Tully Rivers have lower coral cover, lower numbers of juvenile corals at some locations, higher levels of macroalgae, and have shown no clear pattern of increasing coral cover following disturbances.

Table 7.6 – Summary of coral community status of monitored reefs in the Wet Tropics region, 2008–2009.

Reef	Depth (m)	Overall status	Coral cover	Change in hard coral cover	Macroalgae cover	Juvenile density	Settlement
Snapper Island North	2	+	+	neutral	neutral	neutral	N/A
	5	++	+	neutral	+	neutral	N/A
Snapper Island South	2	+++	neutral	+	+	+	N/A
	5	+	+	neutral	+	-	N/A
Fitzroy Island East	2	+++	neutral	neutral	+	+	+
	5	+++++	+	+	+	+	+
Frankland Group East	2	+	neutral	neutral	+	neutral	neutral
	5	++++	neutral	+	+	+	+
Frankland Group West	2	-	neutral	neutral	+	-	-
	5	-	+	-	neutral	neutral	-
Fitzroy Island West	2	+++++	+	+	+	+	+
	5	+++++	+	+	+	+	+
High Island East	2	++	+	neutral	+	neutral	neutral
	5	+++	+	neutral	+	neutral	+
High Island West	2	+	+	-	+	neutral	neutral
	5	+	neutral	neutral	+	neutral	neutral
North Barnard Group	2	-	-	neutral	-	+	N/A
	5	-	-	neutral	-	+	N/A
Dunk Island North	2	-	-	neutral	-	+	N/A
	5	neutral	-	neutral	neutral	+	N/A
King Reef	2	- - - -	-	-	-	-	N/A
	5	- -	-	-	-	+	N/A
Dunk Island South	2	- -	-	neutral	-	neutral	N/A
	5	neutral	neutral	neutral	neutral	neutral	N/A

Explanatory note: + status and resilience is good; neutral denotes status and resilience is moderate; - status and resilience is poor. Overall status is estimated by summing the individual status scores.