



CHAPTER 1.1
CORAL REEF
STATE OF REGION REPORT 2013

MARINE



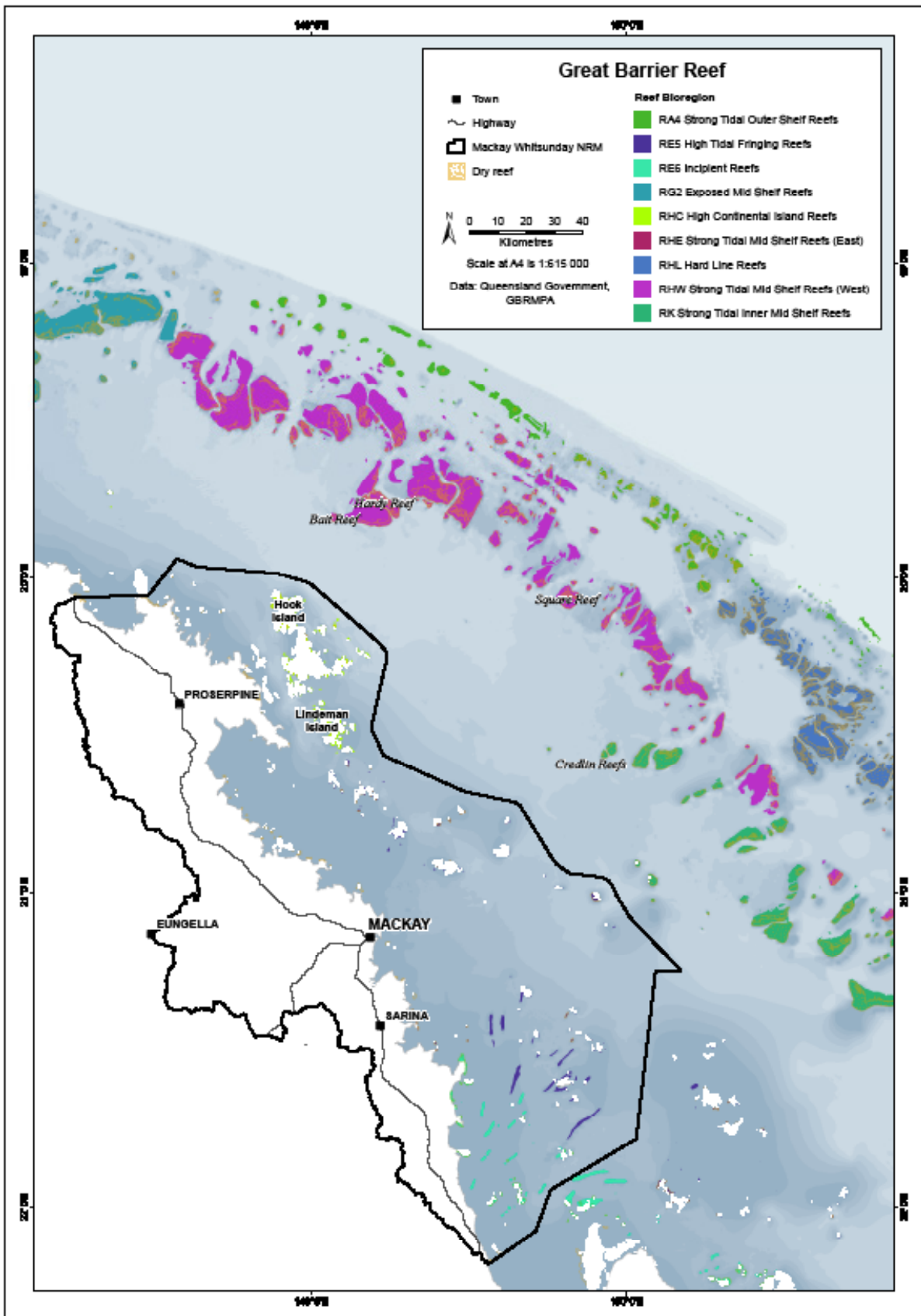


Figure 1: Coral reefs of the Mackay, Whitsunday and Isaac Region and immediate surrounds

SUMMARY

The Great Barrier Reef (GBR) stretches more than 2,300 km from the south-east Gulf of Papua to just north of Bundaberg. The GBR consists of over 2,500 individual reefs, over 900 islands and covers more than 348,000 square kilometres. The larger part of this area was gazetted as a World Heritage area in 1981. It is the only living organism that can be seen from space, is considered by some to provide the most spectacular marine scenery on the planet, is one of the richest and most complex natural ecosystems on earth and has globally significant marine faunal groups (DSEWPAC, 2012).

The regions fringing reefs vary considerably from species-poor muddy reefs close to the discharge of the Proserpine River, through to fragile hard and soft coral communities in inlets and embayments. Significant cross shelf and north to south gradient of reef type exists, so the reef changes gradually from a particular state inshore to mid-shelf and outer reefs, and in a similar manner from north to south.

In the Shoalwater Bay area incipient reefs are common. Here corals can grow but sediment is high and the water deep, meaning the conditions for forming reefs are poor. Conditions improve around southern Mackay islands with clear and shallower water. The northern Mackay and Whitsunday Islands provide the best conditions for coral growth in the north south gradient with shallow, warm water and high island density.

The cross shelf (or in the case of the GBR west to east) gradient is influenced by distance from the coast. Inshore and fringing reefs are exposed to higher levels of sedimentation and lower wave energy, which generally grades across the mid-shelf (lower sediment, higher energy) to the outer reef that has the least sedimentation and highest exposure. However, broad generalisations do not account for all factors, or combinations of factors that result in the differences in individual reefs.

Strong tidal mid-shelf reefs (e.g. Bait and Hardy Reefs) are typified by high-energy environments and contain distinct fish communities. Similarly, strong tidal outer shelf reefs (e.g. those associated with the outer area of Hydrographer's Passage) have high-energy environments, strong tidal influences and distinct biological communities. Hard line reefs (e.g. Cockatoo Reef) form an extensive outer barrier to this section of the GBR. Hard line reefs contain steep walled channels and sheltered leeward reef communities.

Strong tidal mid-shelf reefs (e.g. Credlin Reef) are high in diversity and are characterised by non coral dominated communities in leeward areas. Strong tidal inner mid-shelf reefs (e.g. those around Mackay islands such as Flat Top and Round Top Islands) form in moderate to high turbidity (very hazy) with varying exposure to wave action and other factors that influence their biological diversity and health. High tidal fringing reefs (e.g. Keswick and St Bees Islands) generally have high turbidity, which advantages non-hermatypic corals, octo-corals and gorgonian communities. Incipient Reefs are high in macro-algae coverage and poor in coral diversity.

REEF BIOREGION	EXAMPLE
RG2: Exposed mid shelf reefs	Stanley Reef
RHC: High continental islands (fringing reefs)	Whitsunday Islands fringing reefs
RHW: Strong tidal mid shelf reefs (west)	Hardy and Bait reefs
RA4: Strong tidal outer shelf reefs	Hydrographer's Passage reefs
RHL: Hard line reefs	Cockatoo Reef
RE4: Strong tidal inner mid shelf reefs	Flat Top and Round Top Islands
RK: Strong tidal mid shelf reefs	Credlin Reef
RE5: High tidal fringing reefs	Keswick and St Bees Islands fringing reefs
RE6: Incipient reefs	Cape Palmerston fringing reef

Table 1 Regional Reef Bioregions

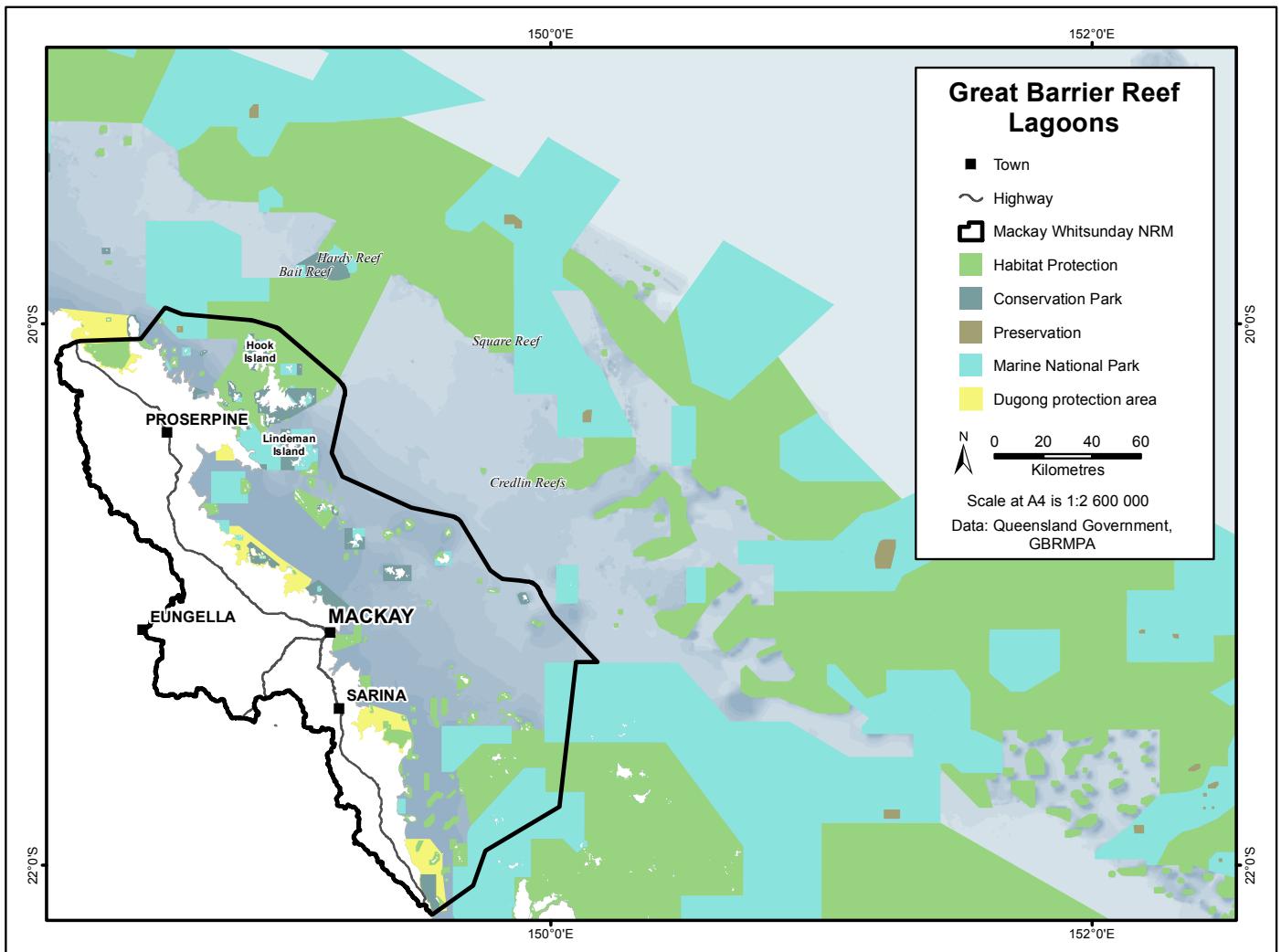


Figure 2 Protection areas within the GBR lagoon in the region

VALUES AND SERVICES

International Environmental Value

Inscribed on the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage List in 1981, the GBR was the first ever marine site listed for all four of the natural criteria and considered to have Outstanding Universal Value (OUV) as the largest assemblage of coral reefs in the world (McGrath, 2012). The OUV criteria were of sites that represent:

- Major stages of earth's evolutionary history
- Superlative natural phenomena or exceptional natural beauty
- Significant ongoing geological processes, biological evolution and man's interaction with his natural environment
- Habitats where populations of rare or endangered species still survive.

Ecological Value

Ecologically the GBR is unique amongst reef systems in the world. It provides habitat for a number of key species and assemblages that are international migrants. These include marine turtles, shorebirds and humpback whales. These natural assets are shared amongst international communities and Australia's duty of care for these whilst in Australian territories, is embedded within international treaties, such as the China-Australia Migratory Bird Agreement and Japan-Australia Migratory Bird Agreement.

The following provides a breakdown of the extent of the GBR's ecological values:

- The world's most extensive stretch of reef and an area of outstanding aesthetic value, providing what some consider the most spectacular marine scenery on earth.
- The Whitsunday Islands are an important calving area for humpback whales (GBRMPA, 2008), and an important feeding ground for turtles.
- Has globally significant marine fauna groups, providing habitat for:
 - o 1,500 species of fish
 - o 30 species of cetacean
 - o 6 species of turtle (out of a total of seven world-wide)
 - o 400 species of coral (including almost 1/3 of the world's species of soft coral)
 - o 800 species of echinoderms (e.g. sea stars) constituting 13% of the world's total species
 - o 4,000 species of mollusc
 - o 240 species of birds
 - o An array of other species such as dugong, sponges, anemones marine worms and crustaceans. (DSEWPAC, 2012).

Economy, Trade and Shipping

A variety of commercial and recreational activities are supported by the GBR and many Australians rely on these regional economies for their livelihoods. In 2005 the GBR was considered to be worth over \$5 billion per annum to the Australian economy (Access Economics, 2008) and accounted for some \$17 billion of Australia's export trade.

At present 12 ports operate within the GBR World Heritage Area and two are within the Marine Park. One of the largest, Hay Point, is located within the catchment and Abbot Point is less than 30 km to the north. The port of Mackay and Dalrymple Bay are also found within the catchment.

These ports service a population of around 1 million in northern regional Queensland - nearly 27% of Queensland's population (Access Economics, 2008). The GBR is an internationally recognised safe shipping route, and as a marine nation the ports are valuable trade access points for Australian goods.

Visitor Services

According to the Great Barrier Reef Marine Park Authority (GBRMPA) (2011a) approximately 1.92 million visitor days are recorded on the Great Barrier Reef each year with 800,000 and 120,000 of those visiting the Townsville/Whitsunday and Mackay/Capricorn areas respectively during 2011/2012.

Recreational use of coral reefs including fishing is very high within the region. The Queensland direct economic value of this activity is estimated at \$300 million (Anon, 2005) of which at least 10% would be spent within the Mackay Whitsunday region.

Access Economics (2008) provide figures for tourism expenditure within the region in 2004/05 and 2005/06. \$1,202 million was spent within the Mackay Whitsunday Region in 2005/06, a 30% increase from 2004/05 (Table 2). Across Reef Catchment areas, tourism industries are responsible for employing at least 30,000 people directly (Anon, 2005). Based on the assumption that employment level is proportional to expenditure it is estimated that approximately 6,600 people are directly employed by tourism industries in the region. It is important to note that neither expenditure nor employment figures take into consideration indirect benefits to the economy from tourism, and that these are substantial.

Tourism Region	2004-05				2005-06				2005-06	
	day	domestic overnight	intl	total	day	domestic overnight	intl	total	overnight share (%)	intl share (%)
Tropical North Qld	141	1,377	1,039	2,557	178	1,346	1,111	2,635	39%	82%
Northern	67	477	74	618	121	460	64	645	13%	5%
Whitsundays	19	440	110	569	32	676	121	829	20%	9%
Mackay	56	284	13	353	79	280	14	373	3%	1%
Fitzroy	179	435	30	644	182	502	32	716	14%	2%
Bundaberg	50	195	15	260	85	200	11	296	5%	1%
Total GBRCA	512	3,208	1,281	5,001	677	3,464	1,353	5,494	100%	100%
Australia	11,614	39,380	12,544	63,538	12,611	40,691	13,402	66,704		
GBRCA/Aust	4.4%	8.1%	10.2%	7.9%	5.4%	8.5%	10.1%	8.2%		

Table 2 Tourism expenditure in Great Barrier Reef Catchment Areas \$ Million.

Other Values

Due to the relatively new nature of biotechnology industries, the potential contribution of coral reefs to development of resources such as novel pharmaceuticals is difficult to gauge. However, due to their inherent biodiversity the value of coral reefs is likely to be high to very high. At present, biotechnology industries in Queensland are generating in excess of \$150 million per annum and employ over 1000 persons (Anon, 2005).

PRESSURES AND THREATS

“Almost all the biodiversity of the Great Barrier Reef will be affected by climate change, with coral reef habitats the most vulnerable. Coral bleaching resulting from increasing sea temperature and lower rates of calcification in skeleton-building organisms, such as corals, because of ocean acidification, are the effects of most concern and are already evident.”

Great Barrier Reef Outlook Report (GBRMPA, 2009; i)

Climate Change

Coral reefs have always been impacted by tropical cyclones and are adapted to recover. However under climate change scenarios the intensity of cyclones is expected to increase (IPCC, 2007), therefore a threat exists in the cumulative impacts of cyclone damage particularly when combined with anthropogenic impacts. Cyclones are expected to track further southwards with some studies suggesting by as much as 130 km (Hardy et al., 2004 in Low, 2011), meaning the reefs within the catchment could experience more cyclone damage than in previous centuries (DERM, 2010). Reef damage from cyclonic activity includes damage to the physical structure of coral as well as the impacts of flood plumes including increased sedimentation, nutrient levels and an increase in turbidity.

The combined impacts of climate change, such as increased temperatures and reduced water quality, has potential to result in a reduced ability of a reef to recover from future cyclone impacts (GBRMPA, 2012). A rapid health assessment survey was conducted following category five cyclone Yasi which crossed the coast in February 2011 and was one of the most powerful cyclones to affect the Queensland coast since records began. Surveys confirmed that more severe damage occurred to reefs in areas exposed to greater wind speeds, and reefs south of the cyclone were more damaged than those to the north. It is expected that signs of reef recovery will occur within 5 years in areas of low to moderate damage providing no further cyclones or other impacts such as Crown of Thorns Starfish (COTS) outbreaks occur. In more severely impacted areas this can be expected to increase to about 15 years, however damage will still be seen for decades on the reef proper.

Ocean Acidification and Coral Bleaching

Ocean acidification is the name given to the process of the world's oceans absorbing excess carbon dioxide from the atmosphere. A chemical reaction between water and the carbon dioxide results in a net increase in the acidity of the oceans. Further chemical reactions mean that there are a reduced number of carbonate ions available for reef builders such as corals to form their calcium carbonate (limestone) skeletons and make them more prone to dissolving. Calcium carbonate is also the main component of the shells of marine organisms.

This process, which is projected to increase in projected climate change scenarios, has obvious impacts on the ability of coral reefs to grow and repair following damage (e.g. after a cyclone) or bleaching event and make them more prone to breakage thus resulting in greater initial impact and possibly slower recovery time.

Water Quality

Coral ecosystems depend on the quality of water that surrounds them. Sediment, nutrients and contaminants such as pesticides all impact coral colonies. It has recently been shown that pollution and sedimentation combined dramatically increase coral death, and that this can occur rapidly when exposed to sediment containing even small amounts of organic matter (Weber et. al, 2012).

Coastal corals are naturally resilient to low levels of organic matter within the water, however when corals are coated with a thin layer of sediment such as occurs following flood plumes and through regular run off, just 1% organic matter within this sediment removes oxygen (through increased microbial activity) and raises acidity levels resulting in small areas of the coral dying (Weber et al., 2012). Continued microbial activity creates hydrogen sulfide that is highly toxic to coral and in the rest of the colony covered in sediment results in death in as little as 24 hours.

Earlier studies outline other problems with poor water quality for example Fabricius (2005) found that high sediment loads reduced the ability of coral polyps to settle and form new colonies and resulted in their death. Fabricius and De'ath (2004) found reduced recruitment, reduced diversity and subsequently a reduced species richness in highly turbid environments. Weber et al in 2012 found that marine snow (microscopic algae bound with sediment) has resulted in a major loss of coral cover and sea grass decline on the GBR by smothering young corals. They found that sediments enriched with organic nutrients reduced oxygen and increased acidity and caused coral death and were most common in areas of coastal development exposed to water enriched by flood plumes or during re-suspension events (e.g. dredging). Combine this information with the findings of Andutta et. al (2013), discussed below, and Brodie et. al (2012) that sediment, nutrients and other pollutants are thought to remain longer in the GBR lagoon than the freshwater they are suspended in, and a picture of the importance of water quality to coral colonies and their survival becomes evident, particularly close to areas of coastal development.

Coastal Development

"It is clear that the scale of coastal development currently being proposed and consented presents a significant risk to the conservation of the OUV (outstanding universal value) and integrity of the property, and that the scale and pace of development proposals appear beyond the capacity for independent, quality and transparent decision making"

(Douvere and Badman, 2012; 255)

Coal Port Expansion

The pressures placed on the GBR by the expansion of coal ports within and adjacent to the catchment (Hay and Abbot Points), is considered significant and compounded by current governance arrangements including regulatory, administrative and operational, which can inhibit effective management of port and shipping impacts (Grech et. al, in review).

The pressures placed on the GBR by the expansion of coal ports within and adjacent to the catchment (Hay and Abbot Points), is considered significant and compounded by current governance arrangements including regulatory, administrative and operational, which can inhibit effective management of port and shipping impacts (Grech et. al, in review).

A report commissioned by the Abbot Point Working Group with direction from BHP Billiton and North Queensland bulk ports states that as a direct consequence of the coal port expansion shipping traffic is expected to increase more than 9 times out of Abbot Point and nearly three times out of Hay Point in the next 20 years (Polglaze, 2012).

Increased coal shipping traffic increases the risk of oil and coal spills, groundings and vessel strikes impacting species such as migrating humpback whales. Other impacts include underwater acoustic (noise) pollution, coal dust, the impacts of dredging spoil on reef water quality, and the aesthetic values of the region. Increased shipping traffic also increases the risk of invasive species being introduced and contaminants such as toxic antifoul, sewage and galley scraps impacting marine ecosystems.

Dredging, Marinas and Marine Material Placement

The GBRMPA consider that the major impacts from dredging activity within the GBR come from the operation of coal ports (GBRMPA, 2011b). However, new and existing coastal developments such as marinas and other land reclamation activities have short-term (construction phase) and longer-term impacts on coral reefs that should also be considered when discussing the impact of dredging and marine material placement at the local scale.

New marinas such as the development at Port of Airlie (Muddy Bay) and the proposed marina development at Shute Harbour place increasing pressure on coral communities especially within inshore areas, as well as having detrimental impacts to other marine life such as seagrass communities. With a rapidly growing regional population, such pressures are forecast to increase.

Recent studies have shown that within the central GBR the time taken for fresh water from outside the reef to flush waters inside the reef under real wind conditions was 67 days. However, under calm weather conditions and with little external reef current inflow the flushing time could be as long as 9 months. In addition, up to half of the water leaving the GBR returns to the GBR through the movement of oceanic currents (Andutta et al, 2013). This means that marine material dredged from the ocean floor stays within the GBR for an extended period and may return once it has left.

Pests

Increased shipping and other vessel traffic increases the risk of species such as the Asian green mussel being transported to the catchment. The Asian green mussel can be carried on vessel hulls, in ballast water and in internal seawater systems (e.g. fire hoses) and may have serious economic, ecological and human health implications.

COTS (*Acanthaster planci*) are a species of starfish native to the Indo-Pacific region that consume hard corals and in high numbers can dramatically reduce living coral cover. These outbreaks cause considerable public and industry concern particularly amongst marine tourism operators as they reduce the aesthetic value of the reef at the outbreak site. When combined with pressures such as declining water quality and climate change, COTS outbreaks reduce the reefs capacity to recover from such disturbances.

It is now well understood that COTS numbers increase as nutrient levels increase (Brodie et al. 2005). Phytoplankton are the primary food source of larval-stage COTS and increase in numbers due to elevated nutrient levels. COTS populations are thus able to increase dramatically as their primary food source also increases.

Outbreaks occur when the COTS summer breeding season coincides with a dramatic increase in nutrient levels in the water such as has occurred from the recent La Niña cycle. Increased nutrient levels allow many more of the larval COTS to survive, causing localised outbreaks on the GBR.

The GBRMPA is in the process (at April 2013) of formulating a control strategy for COTS to assist the tourism industry to protect coral at high value visitor sites. This short-term strategy is backed by longer term plans to improve water quality entering the GBR lagoon, such as the Reef Rescue Initiative and the Reef Water Quality Protection Plan (Reef Plan).

Coral Disease

Like COTS coral diseases are a natural occurrence in coral ecosystems and to date have not caused significant outbreaks on the GBR possibly due to its overall condition. Osbourne et. al (2011) state that only 6.5% of coral mortality between 1995 and 2009 was attributed to coral diseases and managing overall reef health will likely maintain this low incidence.

However world-wide infectious disease in corals has increased since the 1970's. Multiple factors are at play, however it has been established that increased ocean temperatures, increased carrier and host densities and the intensity of coral bleaching have a significant relationship with coral disease prevalence. Nearly all of the other negative anthropogenic coral reef impacts (e.g. ocean acidification, overfishing and marine pollution) have been suggested contributors in some way to coral disease (The Nature Conservancy, 2012).

Commercial Marine Tourism

According to Harriott (2002) the pressures of commercial marine tourism on the GBR can be summarised into 6 main types; coastal tourism development, island and marine based tourism infrastructure, boat-induced damage, water-based activities and wildlife interactions.

Commercial marine tourism is managed by GBRMPA and the Queensland Parks and Wildlife Service (QPWS) through a permit system. Anchor damage is managed through the installation of mooring and 'no-anchor zones' in heavily used areas. 85% of tourism on the GBR is centred around Cairns and the Whitsundays collectively meaning visitor numbers are high over an area covering only 7% of the GBR. This impacts coral reefs in particular through fin damage, collecting, in-water pollutants (such as sunscreens and oils) and impacts on the behavioural characteristics of marine creatures.

Fishing

Commercial and recreational fishing have a direct impact on the GBR through the removal of herbivorous fish, damage to the seabed and other habitats and removal of non-target species (by-catch). For example the removal or reduction in the number of herbivorous fish present within a coral colony can allow excessive growth of resilient and aggressive algae and seaweed. If fish stocks are consistently depleted algae and seaweed may dominate in the coral colony, and in some cases completely destroy it.

No take zones and other commercial fishing restrictions have a significant positive impact on the protection of the GBR and it's coral colonies (McCook et. al, 2010). Various other functional groups of herbivorous marine creatures (such as bioeroders or coral grazers) play important roles in the health of coral communities so maintaining the variety and abundance of the various functional groups and species will have the highest ecological impact.

CONDITIONS AND TRENDS

“While most of the stressors that are responsible for the decline of coral reefs worldwide are present on the GBR, damage to date has been localised rather than system wide”

Sweatman, 2011; 1

The condition of Australia's marine environment, when compared to the rest of the world is considered good (Australian Government, 2011). The eastern region including the GBR as defined by the SoE (2011) is also considered to be in good overall condition. However, herbicides in significant levels have been found within all sampling sites within the GBR and Kennedy, et. al (2010) consider these levels to have significant impacts on coral and other marine life. According to Reef Plan (2012), inshore reefs are in moderate condition and coral cover is poor but macroalgae results are very good (low cover). The number of juvenile corals is good but has declined in recent years.

The primary information sources on coral reef condition within the region are: Sweatman et al. (2011) - Long-term Reef Monitoring Project (LTRM) (Australian Institute of Marine Science (AIMS), 2012, which has occurred since 1985; and Sweatman et al, 2012) (AIMS); individual reports on local reefs available online; the first report card of the Reef Water Quality Protection Plan (Queensland Government, 2013); and the Great Barrier Reef Outlook Report 2009 (GBRMPA, 2009). It should be noted that The Outlook Report and Reef Plan report do not incorporate more recent information that includes recent storm and subsequent flooding events that will have impacted water quality.

“The major conclusion from the Long-Term Monitoring Program is that coral cover has undergone a wide range of changes, including dramatic increases and decreases on different reefs, and that there is no strong, consistent overall trend across the Great Barrier Reef... This is a reflection of the vast size of the ecosystem, the number and diversity of reef types, and the circumstances and events that affect them”
Outlook Report (2013; 14)

Although long-term data (i.e. greater than 20 years) are not available, there is some agreement from authors that there has been a general decline in coral cover (Bellwood et. al, 2004, Death et al, 2012) some by as much as 50%. However, other reports state that coral cover is stable (Osbourne et al, 2011), although a criticism of this study remarks that due to the depth at which the study was undertaken (6-9m) effects of flood plumes and coral bleaching may not be adequately considered as they tend to occur in shallower regions of the reef (Brodie, 2012). Indeed Brodie (2012) provide a comprehensive overview of the assessment of coral condition and the difficulty faced in coming to an absolute measure of coral health of the GBR.

In 1999, Van Woesik et al. found that inshore reefs close to river discharge had limited 'reef building' capacity and that this capacity had only recently been lost. They proposed that inshore reefs such as those at the mouth of the Proserpine River (e.g. Repulse Island fringing reefs) have 'switched off' as a result of increased nutrient and sediment load.

Cheal et al. (2001) also propose that patterns in reef development within the Northumberland Island are correlated with distance away from river discharge. Further, these authors recommend that reefs at South Percy, Pine and

Prudhoe Island are most suitable for monitoring studies because they are reef building, but lie on the limits of incipient reefs e.g. they may be more sensitive to disturbance.

The below tables represent a range of sites across the catchment and include inshore, mid shelf and outer shelf sites. These sites were selected to give an overview of the catchment trends (further information including data on all reefs from the AIMS LTMP can be found at <http://www.data.aims.gov.au>).

Fixed sites on NE flank	Current 10 year GBR		
	Year	Range	Mean
Hard Coral Cover in 2011	31%	28%	23%
Number of Fish Species	46	45	64

Table 3 Border Island Fringing Reef (surveyed for 16 years, last survey April 2013)

Fixed sites on NE flank	Current 10 year GBR		
	Year	Range	Mean
Hard Coral Cover in 2011	28%	33%	23%
Number of Fish Species	71	69	64

Table 4 Reef 19-138 mid-shelf lagoonal reef (surveyed for 23 years, last survey April 2013)

Fixed sites on NE flank	Current 10 year GBR		
	Year	Range	Mean
Hard Coral Cover in 2011	3%	15%	23%
Number of Fish Species	69	68	64

Table 5 Rebe Reef outer shelf planar reef (surveyed for 17 years, last survey April 2013)

There are active COTS outbreaks on 3 reefs adjacent to the catchment at present and an incipient outbreak on 1, while 19 have no outbreaks and 5 are recovering. On each of the reefs with current outbreaks hard coral cover is still in good condition and as they are mid-shelf reefs located well away from river mouths their ability to recover should be high.

Cyclone Hamish, a category 5 tropical cyclone that passed to the east of the region in March 2009, significantly damaged the outer shelf of the reef in the northern part of the catchment. According to Miller (2011) large areas of coral at Rebe Reef weighing tonnes were 'thrown onto the reef crest like so much gravel' demonstrating the damage caused by cyclonic activity.

Long term monitoring data describing reef fish communities is only available for some of the Whitsunday sector of the region. Generally populations of key indicator species have remained stable over 13 years of monitoring. On some reefs e.g. Border Island numbers of heavily targeted species such as coral trout (*Plectropomus leopardus*) and sweetlip/snapper (*Lutjanidae*) have decreased noticeably, although on some other reefs coral trout numbers have increased. A key tool in managing reef fish populations is through dedication of No Take Areas (NTA's). Within the region, the percentage of area of each reef bioregion within NTA's is relatively high but not always the 30% required for each bioregion (Bellwood, 2004). No take areas have been proven effective in recovering fish numbers (McCook et. al 2010).

REEF BIOREGION	% WITHIN NO TAKE AREAS (NTA'S)
RG2: Exposed mid shelf reefs	20.3
RHC: High continental islands (fringing reefs)	21.0
RHW: Strong tidal mid shelf reefs (west)	27.0
RA4: Strong tidal outer shelf reefs	31.8
RHL: Hard line reefs	21.4
RE4: Strong tidal inner mid shelf reefs	21.2
RK: Strong tidal mid shelf reefs	21.0
RE5: High tidal fringing reefs	30.2
RE6: Incipient reefs	40.0

Table 6 Percentage of No Take Areas (NTA's) over each reef bioregion.

Within the Whitsunday Islands sector of the region the level of damage from anchoring and swimmer/diver activity formed the impetus for a major investment in public mooring and fringing reef marker infrastructure. However, little such investment has been made within other areas of the region, and significant damage has been recorded from fringing reefs around the islands off Mackay (CREW, 2001). Nevertheless, the magnitude and distribution of current damage remains unclear.

Location of public moorings and reef protection markers

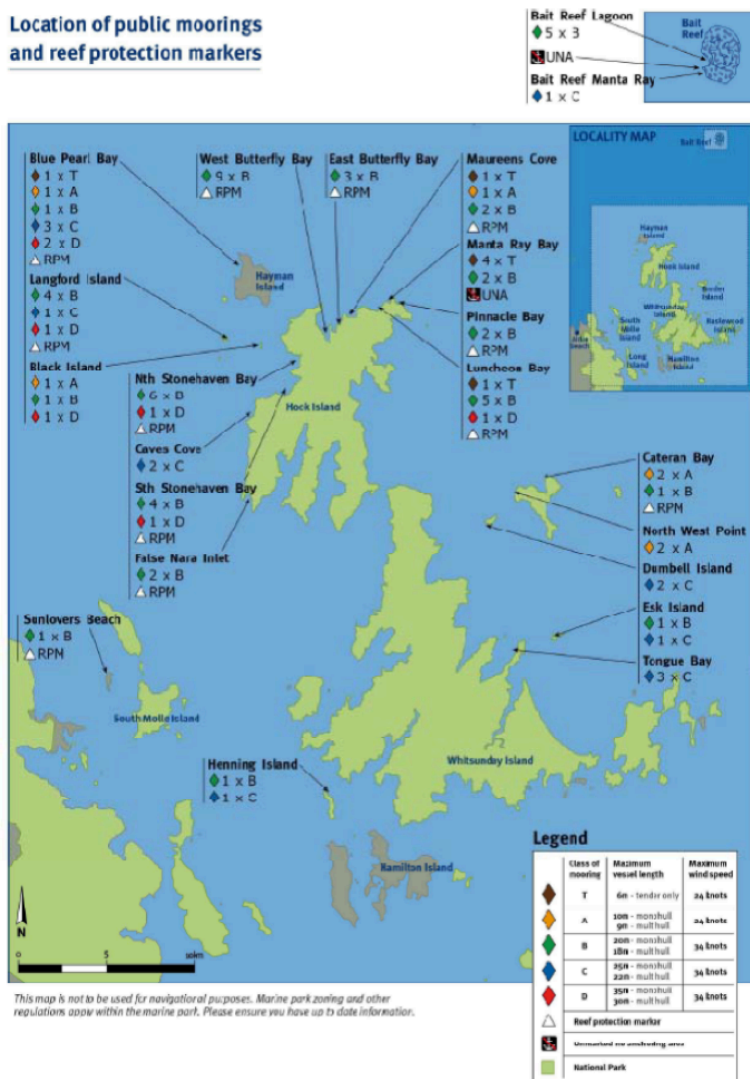


Figure 3 Reef protection infrastructure within the Whitsunday sector of the region

World Heritage Committee (WHC) and the International Union for the Conservation of Nature (IUCN) conducted a reactive monitoring mission in early 2012 that culminated in a report to the WHC (Douvere & Badman, 2012) co-authored by UNESCO and the International Union for the Conservation of Nature (IUCN). The conclusions of the report were that significant and positive steps towards effective management of the GBR had been undertaken by the state and federal governments to date including increasing no-take zones to 33% and the implementation of programs such as Reef Rescue to improve water quality. However, should the current impacts and proposed future development of coastal areas (in particular, coal ports and coal seam gas infrastructure) and greater measures not be taken to increase resilience of the reef to climate change continue, the GBR was on track to be included in the List of World Heritage in Danger under the World Heritage Convention.

In summary coral reef condition varies with time and coral cover is dynamic and driven by various factors. There is a great deal of information available on reef condition, much of it conflicting, but there is general agreement that coral cover reef wide has declined at least in the last 20 years particularly in inshore areas. Local reef specific data is available but is not an adequate reflection of the trend of coral generally within the region as the sites selected have not been monitored for long enough to show a reasonable trend (e.g. Penrith Island fringing reef has only been established for 3 years, Pompey 1 Reef for 4 years), or are poorly selected to adequately reflect the effects of changes in water quality within the catchment (e.g. inshore sites are located in the northern Whitsunday Islands aggregation and not adjacent to river mouths).

GOVERNANCE

Most of the GBR within the region lies within the Great Barrier Reef Marine Park (GBRMP) and is managed under the auspices of the Great Barrier Reef Marine Park Act 1975 and Regulations. The latest review of the Zoning Plan for this area was completed and gazetted in 2004. GBRMPA has management responsibility for the area in partnership with the Queensland Parks and Wildlife Service as set out in the Great Barrier Reef Intergovernmental Agreement. The agreement outlines the obligation of each party in managing the reef through the Field Management Program. The sections of the GBR which fall within Queensland State waters lies within the Great Barrier Reef Coast Marine Park (GBRCMP) which was formed, and is managed through the Queensland Marine Parks Act 2004 and Regulations. Rezoning of the GBRMP was mirrored within the GBRCMP in 2004. These marine parks combined form the Great Barrier Reef World Heritage Area for which Australia has international management obligations.

There are four Port areas within the region that are not part of either Marine Park; Abbot Point, Port of Bowen, Port of Mackay, and Hay Point/ Dalrymple Bay. Coral reefs occur within the jurisdiction of the latter three areas.

Commercial and recreational fishing throughout the GBR is managed by the Queensland Department of Primary Industries and Fisheries under the Fisheries Act 1994. Management instruments notably include reef zoning, quotas, size and bag limits and seasonal closures. Compliance is undertaken by the Boating and Fisheries Patrol (DPIF), Marine Parks (QPWS) and the Queensland Water Police.

INDICATORS

Reef water quality is improved in line with the thresholds, indicators and mechanisms identified by the Mackay Whitsunday Isaac Water Quality Improvement Plan and the Water Quality Management Plan (in press) due for release in June 2014. The condition and resilience of offshore reefs will continue to be measured by the long term monitoring study (AIMS, 2013) using key indicators including coral cover and type, reef fish assemblages, presence of COTS, disease and bleaching.

Measurement of the condition and resilience of inshore reefs should be improved through the establishment of a monitoring project that assesses coral cover, coral diversity, (using growth form) and selected species of herbivorous fish (e.g. coral trout, sweet lip and other selected species that are considered good indicators of overall health of coral colonies). This approach is desired as the current LTRM project does not have adequate coverage for the local area with monitoring sites locally in the northern Whitsunday Islands, well away from river mouths. Suggested sites for monitoring include those most influenced by outflows of the Pioneer River, the largest within the catchment, and could include, Flat Top, Keswick and Penrith Islands Derek Ball, Pers. Comm (2013).

COTS and/or other pressures continue to be monitored at key marine tourism settings using robust coral reef assessment techniques (AIMS, 2013).

Representative inshore reefs are assessed for condition using robust coral reef assessment techniques including assessment of anchor damage. Resilience of these reefs is increased by improved water quality, and reduction in unnecessary impacts such as anchor damage.

“Fisheries catch data continue to demonstrate general sustainability of reef based fisheries with only one, the snapper (*Pagrus auratus*) considered overfished, however for many species the level to which they are fished sustainability is uncertain or not assessed”

DEEDI, 2010; 5

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