

CHAPTER 2.1 BEACHES AND FORESHORES

STATE OF REGION REPORT 2013

COASTS

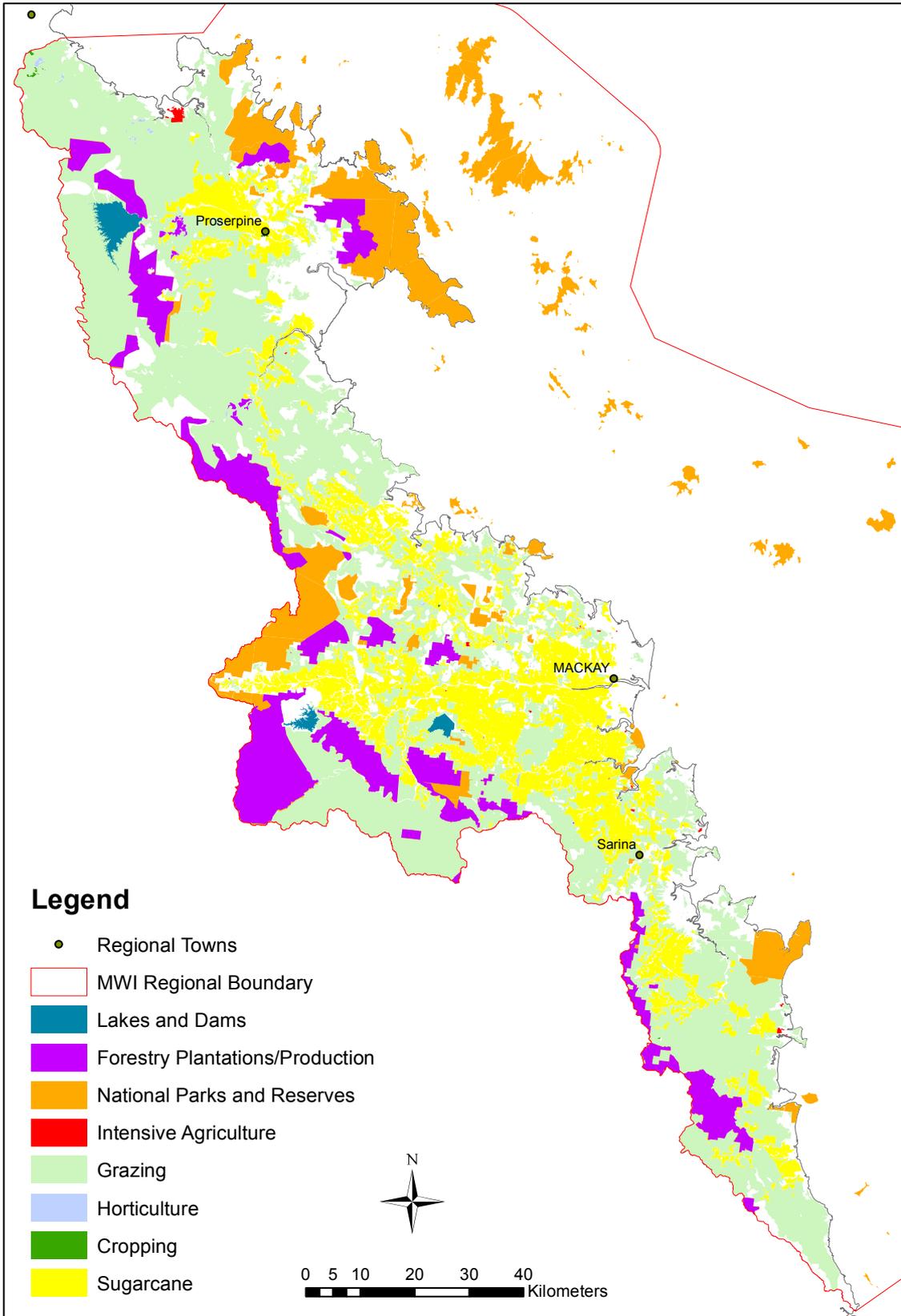


Figure 1 Replace with beaches map

SUMMARY

The Mackay Whitsunday Isaac region includes approximately 900 kilometres of mainland coastline, stretching from Clairview in the south to just south of Bowen in the north. The coastline is nearly 2,000 kilometres when islands are included. The region experiences some of the largest tidal ranges that occur along the Queensland coast ranging from approximately +/- 4m in the north to +/- 6m in the south. As such, much of the regions foreshores are characterised by extensive intertidal sand and mud flats which become exposed at low tide.

Most of the region's coastline lies within the Central Queensland Coast Bioregion, predominantly within the Sarina to Proserpine Lowlands sub-region but also sections of Debella and Whitsunday sub-regions. Rainfall along this stretch of coastline varies significantly; 1200mm per annum at Clairview, increasing to 1600mm in the high rainfall belt from Mackay to Airlie Beach. Different rainfall patterns, geological make-up and history, and varying exposure of the coastline results in a very high diversity of coastal landscapes. These include for example:

- Extensive, exposed muddy to sandy flats associated with the Clairview coast.
- Rocky promontories and foreshores of Cape Palmerston.
- Sandy beaches interspersed with rocky headlands and mangrove inlets in the Sarina area.
- Long sandy beaches and parabolic dunes of Harbour and Northern Beaches.
- Dramatically folded geological landscapes of the Cape Hillsborough and Seaforth areas.
- Isolated beaches from Mentmore to Goorganga Plain and to Repulse Bay interspersed by small rocky headlands and mangrove lined estuaries.
- Extensive rocky and shingle foreshores of the Conway Peninsula through to Hydeaway Bay and Dingo Beach.
- Granitic headlands and associated beaches from Cape Gloucester to Bowen.

Beaches and foreshores are a highly valued part of the region's landscape for multiple reasons that include social, environmental and economic values. Iconic beaches, such as Whitehaven Beach on Whitsunday Island, are some of the most renowned in Australia.

There are also multiple, often competing, uses of these ecosystems and as such they are being faced with increasing pressures from natural and anthropogenic forces. Beaches and foreshores are subject to complex management arrangements which provide additional challenges to achieving environmental sustainability.

Regional Ecosystem	Biodiversity Conservation Status	Extent Protected in Conservation Reserves
8.2.1 Beach foreshore vegetation in Central Queensland Coast: <i>Casuarina equisetifolia</i> open forest to woodland with <i>Ipomoea pescaprae</i> and <i>Spinifex sericeus</i> dominated ground layer on foredunes.	Of concern	High
8.2.2 Beach scrub in Central Queensland Coast: Microphyll vine forest on coastal dunes.	Endangered	Medium
8.2.6 Open woodland on sand dunes: <i>Corymbia tessellaris</i> + <i>Acacia leptocarpa</i> + <i>Banksia integrifolia</i> + <i>Melaleuca dealbata</i> + beach scrub species open forest on coastal parallel dunes.	Of concern	High
8.2.7 Melaleuca and swamp mahogany woodland to forest: <i>Melaleuca</i> spp. and/or <i>Lophostemon suaveolens</i> and/or <i>Eucalyptus robusta</i> open woodland to open forest in wetlands associated with parabolic dunes.	Endangered	High
8.2.8 Eucalypt and heath: Variable eucalypt woodland often with heathy elements on parabolic dunes and beach ridges.	No concern at present	High
8.2.9 Grassland: <i>Heteropogon triticeus</i> , <i>Imperata cylindrica</i> and <i>Themeda triandra</i> grassland on coastal dunes.	Endangered	Medium
8.2.11 Melaleuca swales: <i>Melaleuca</i> spp. woodland in parallel dune swales (wetlands).	Of concern	High
8.2.13 Eucalypt and cabbage palm forest: <i>Corymbia tessellaris</i> , <i>Melaleuca</i> spp., <i>Livistona decipiens</i> and/or <i>Acacia</i> spp. and/or <i>Lophostemon suaveolens</i> open to closed forest on dune sands mixed with alluvial material ± marine sediments.	Endangered	Low
8.2.14 Open woodland on dunes: <i>Banksia integrifolia</i> and/or <i>Corymbia tessellaris</i> and/or <i>Acacia disparrima</i> +/- rainforest spp. tall shrubland, on Holocene parabolic dunes.	Of concern	High
11.2.3 Beach Scrub in the Northern Brigalow Belt: Microphyll vine forest (beach scrub) on sandy beach ridges.	Of concern	High
11.2.5 Open woodland on dunes: <i>Corymbia Melaleuca</i> woodland complex of beach ridges and swales.	No concern at present	Medium

Table 1 Beach and foreshore regional ecosystems occurring within the Mackay Whitsunday region (Queensland Herbarium, 2013; Accad *et al.*, 2012).

VALUES AND SERVICES

ECOSYSTEM SERVICES

Beaches and foreshores are critical buffers between the sea and terrestrial environments. This landscape provides vital ecosystem services, such as disturbance, climate and nutrient regulation, which are of significant financial value and require minimal service costs (Millennium Ecosystem Assessment, 2005; SEQ Catchments, 2013). The capacity of these areas to provide these services hinge on factors such as replenishment of sand through long-shore drift processes, presence of stabilising vegetation, and reservoirs of sand held within both foredune and hind dune areas.

Foredunes act as barriers against the action of waves and tides, and are a source of sand for the beach during periods of erosion. They protect areas behind them from wave damage and saltwater intrusion during storms and are inherently flexible. If they are damaged by storm waves, the remaining vegetation traps sand blown from the beach and the dune is reformed, thus providing protection against future wave attack. Vegetated foredunes are protective and restrict wind, sand and salt spray intrusion into hind dune areas allowing development of a more complex plant community on the hind dunes. Parallel dunes landward of the foredune are protective to a lesser degree. If they are well stabilised, they serve as a second line of defence against water and wind erosion, should the foredune be destroyed by the action of storm waves.

HABITAT

The region's foreshores and beaches are habitats of international significance. The Mackay region is the fifth most important area in Queensland for shorebirds, and is among the 25 most important sites for shorebirds in Australia (Tucker et al., 2006). The regional shorebird survey in October 2012 found that the region is of international importance (>1% flyway population) for six species (Harding, 2012). Significant roost sites have been clearly identified and mapped for the Mackay Whitsunday region (Queensland Wader Study Group and Reef Catchments, 2012). Additionally, Important Bird Areas have been identified along the Mackay Whitsunday coast. These are internationally recognised sites of importance for bird conservation, which meet global criteria (BirdLife Australia, 2013). Foreshore areas are also essential habitat for the Vulnerable Beach Stone-curlew (*Esacus giganteus*).

All sandy beaches within the region are potential nesting sites for marine turtles. Of the world's seven species of marine turtles, six are found in the waters of the Great Barrier Reef. While Green Turtles (*Chelonia mydas*) may occasionally nest on mainland beaches within the region, the vast majority of nesting activity is by Flatback Turtles (*Natator depressus*) which only nest on Australian beaches. Figure 4.2 illustrates nesting activity of marine turtles within the region (Limpus, 2013).

Rocky foreshores provide markedly different habitats than sandy beaches, particularly in association with rocky headlands such as those found at Cape Hillsborough and Cape Palmerston. These areas form important potential roosting habitat for the little known and Vulnerable Coastal Sheathtail Bat (*Taphozous australis*). The species occurs only in Queensland from Shoalwater Bay in the south to Torres Strait in the north (Chimimba and Kitchener 1991, Catling et al., 1994) within a narrow coastal band, extending no more than a few kilometres inland (Richards 1995).

The region's coastal zone supports approximately 1,069 hectares of beach scrub (also known as microphyll vine forest on coastal dunes, regional ecosystem [RE] 8.2.2) (Accad et al., 2012). This ecological community is listed as Critically Endangered nationally (Environment Protection and Biodiversity Conservation Act 1999), owing to its fragmentation, small patch size, demonstrable threats and reduced in integrity (Australian Government, 2009). Beach scrub only occurs in the coastal zone and provides habitat for threatened plants and animals and is an important buffer to coastal erosion and wind damage.

Allow space for 3 x maps:

Figure 2 Recorded shorebird roosts and Important Bird Areas in Mackay Whitsunday region (Queensland Wader Study Group and Reef Catchments, 2012; BirdLife Australia, 2012).

Figure 3 Recorded marine turtle nesting activity 1915-2012 (Limpus, 2013).

Figure 4 Coastal Sheathtail Bat (*Taphozous australis*) Essential Habitat (Queensland Government, 2013d).

STATE OF REGION REPORT

Beaches and Foreshores



“Cane growing and sugar production underpins the economic stability of many coastal communities.

It is the social fabric that has woven itself through the development of coastal townships up and
down the coast.”

Cane Growing in Australia, Canegrowers (2013, 1)

ECONOMIC VALUE

The coastline provides for cargo and people via the development of ports and associated infrastructure, which are of significant economic and social importance in the region. There are many ports in the region ranging from small community ports to one of the largest coal export ports in the world, at Hay Point. During 2012-13, Hay Point had the highest value of exports among all Queensland ports at over \$13 billion (Queensland Government, 2013a). The Port of Hay Point comprises two coal export terminals, Dalrymple Bay Coal Terminal (DBCT) and Hay Point Coal Terminal. Dalrymple Bay Coal Terminal is leased from the State Government by DBCT Management Pty Ltd and Hay Point Coal Terminal is owned by BHP Billiton Mitsubishi Alliance-owned and operated by Hay Point Services. Together these coal terminals service the mines in the Bowen Basin in central Queensland. The mines are linked to the port terminals through an integrated rail-port network (North Queensland Bulk Ports Corporation, 2012). Beaches and foreshores in the region also provide sand and gravel for commercial infrastructure needs (Queensland Government, 2004).

Human settlement patterns along the coast closely mirror attractive and accessible beaches. These areas have very high recreational values and make major contributions to the lifestyles of communities within the region. They are also major attractions which encourage more people to settle within the region. An additional 100,000 people are expected in the region (Mackay, Whitsunday, Isaac) by 2031, with the coastal areas of urban Mackay, Sarina and the Whitsundays absorbing the vast majority of this growth (Queensland Government, 2012).

The region's beaches are major drawcards for tourism. In the year ending June 2013, the Mackay and Whitsunday tourism region recorded a total domestic and international visitor expenditure of \$1,156 million (Tourism and Events Queensland, 2013).

INDIGENOUS VALUES

Beaches and foreshores supply vital resources to Aboriginal people and retain considerable cultural significance. The region contains a large number of middens and stone built fish traps which are tangible reminders of the traditional way of life.

PRESSURES AND THREATS

INCREASED USE OF COASTAL ZONE

With a rapidly growing regional population, there is an ongoing increase in urban development and associated commercial and industrial development to cater for continuing population growth in the region (Queensland Government, 2006).

An expanding urban footprint can result in loss of vegetation, wildlife corridors, and other areas of high biodiversity value along beaches and foreshores. In addition, changes in hydrology, loss of connectivity, encroachment and pollution from development in the coastal zone all threaten the condition and ecological integrity of coastal ecosystems (Schaffelke et al., 2005). Vegetation thinning associated with urban developments and cattle grazing in the coastal zone are practices which can cause incremental but significant damage, particularly in sensitive foreshore environments (Queensland Herbarium, 2013).

Ports and extractive industries impact beach and foreshore ecosystems both directly by replacing or removing coastal habitats and indirectly by altering coastal hydrology. For example port infrastructure and the extraction of sand and gravel change current patterns and littoral drift, altering sediment supply, which may lead to beach erosion or accretion in adjacent areas (United Nations Economic and Social Commission for Asia and the Pacific, 1992; Queensland Government, 2004). Other indirect pressures are construction and dredging, ship traffic and discharges and cargo operations and waterfront industry (United Nations Economic and Social Commission for Asia and the Pacific, 1992).

Recreational use of beaches and foreshores increases with population growth, with most recreational activity in the coastal zone considered sustainable if managed correctly. However, inappropriate use of motorised vehicles on vegetated sand dunes results in the removal of stabilising vegetation and subsequent erosion or physical degradation of these areas. Off-road vehicles and unleashed dogs can also cause disturbance to migratory shorebirds and nesting and hatching turtles. For both shorebirds and turtles, the primary concern is over the summer months (October to April) when migratory shorebirds are visiting coastal areas to feed and roost before returning to the northern hemisphere to breed, and turtles are nesting on the beaches.

INVASIVE SPECIES

Pest plants compete with native vegetation, reduce biodiversity, and generally detract from the environmental and aesthetic value of coastal ecosystems. Non-native vegetation may change the fire regime of coastal ecosystems by increasing fuel loads thus increasing frequency and intensity. Pest plants are often typified by shallow root systems which do not stabilise sand dunes as effectively as the extensive root systems of native foreshore plants (Beach Protection Authority and Queensland Government Department of Environment, 2003). Many of the vegetation communities associated with beaches and foreshores are sensitive to fire and even low intensity, low frequency fires can cause dieback of stabilising vegetation (Reef Catchments, 2010). Fire allows pest plants to establish or increase in density, and in turn the presence of pest plant species can increase the fire risk to fire sensitive ecological communities.

SPECIES SPECIFIC THREATS

Marine turtles nesting on mainland beaches are known to be subject to threats such as disturbance during nesting, illegal harvesting of eggs, predation on eggs by feral animals, drowning in fishing gear, pollution and changes to important turtle habitats, impacts of vehicles on beaches, and light pollution (Environment Australia, 2003). Likewise, The Coastal Sheathtail Bat (*Taphozous australis*) is suspected to be easily disturbed when at roost, and likely suffers from loss of, and fragmentation of foreshore and near coastal foraging habitats. There is currently no widespread decline documented for the species, however, at one site in the Cape Hillsborough National Park an observed decline may be due to human visitation (Hoye 1985, cited in Australian Government, 2011). The loss of foraging habitat through coastal development and sand mining, and roost disturbance (with increasing human access to the coast) may pose threats to this species in the central and southern parts of its distribution (Australian Government, 2011).

CLIMATE CHANGE

The Central Queensland Coast has classic tide-dominated coasts with wide gently sloping intertidal flats that are prone to storm tide inundation, and the Mackay region is identified as one of the most vulnerable sections of the Queensland coast in this sense (Queensland Government, 2011; Harper, 1998 cited in Queensland Government, 2004). Climate change will result in sea level rise, increased storm events, erosion, and damage to sandy coasts, causing them to retreat inland. This is especially problematic where the sandy dune ecosystems are not free to move inland due to constraints imposed by the built landscape, known as the 'coastal squeeze'. The result may be a direct loss of coastal ecosystems and critical habitat for species such as marine turtles (nesting areas), shorebirds, and intertidal species that form the basis of fisheries food chains.

CONDITION AND TRENDS

Over 37% (4,485 hectares) of remnant vegetation has been cleared across the region's beach and foreshore regional ecosystems (Table 4.2, Accad et al., 2012), the majority of which was cleared before 1997 prior to vegetation clearing legislation. This included approximately 2,000 ha of open woodland on sand dunes (Regional Ecosystem 8.2.6), 1,500 ha of eucalypt and cabbage palm forest (RE 8.2.13), 500ha of open woodland on dunes (RE 8.2.14), and 250ha of beach scrub (RE 8.2.2).

Although there has been relatively little broad scale clearing of dune ecosystems since 1997, there has been incremental loss of vegetation due to increasing populations in the coastal zone.

As a result, 9 out of the 11 beach and foreshore regional ecosystems have a biodiversity status of either Endangered or Of Concern, which by area accounts for 88% of remnant vegetation being threatened in this landscape (Figure 4.5). The biodiversity status takes into consideration not only the extent of clearing that has occurred, but the extent of degradation and threatening processes that the regional ecosystem is subject to.

Approximately 30% of the remnant vegetation remaining in beaches and foreshores across the region is protected within National Parks and other Conservation Reserves (Figure 4.6). These areas include Cape Hillsborough National Park, Cape Palmerston National Park, Bakers Creek Conservation Park, Sandringham Bay Conservation Park, and Skull Knob Conservation Park.

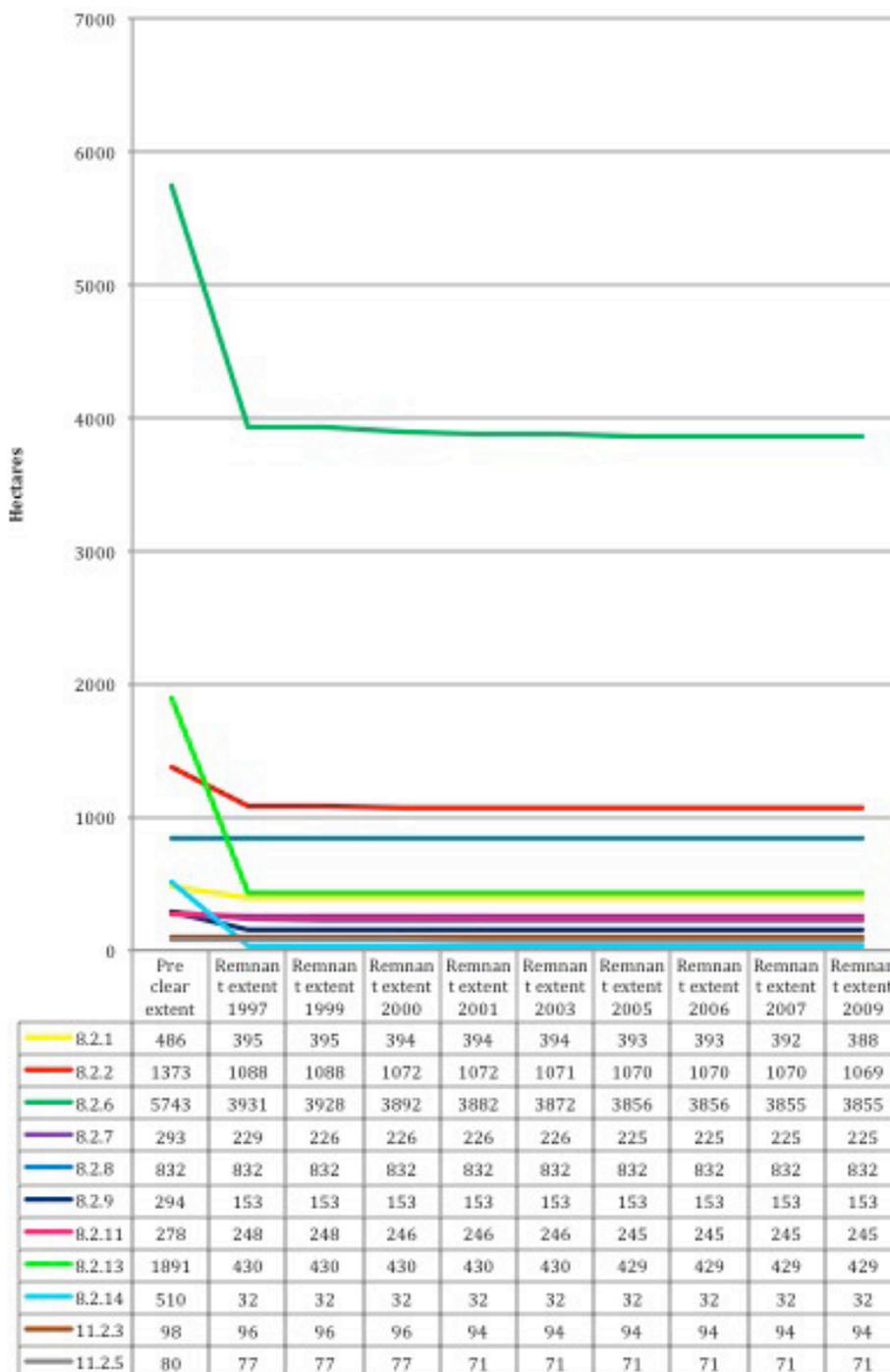


Table 2 Clearing rates of beach and foreshore vegetation; pre-clearing, 1997 – 2009 extent in Mackay Whitsunday NRM region (Accad et al, 2012).

Of primary concern are ecosystems which are both endangered, and with low to medium representation within the protected area estate. These include beach scrub (RE 8.2.2), grassland on coastal dunes (RE 8.2.9), and eucalypt and cabbage palm forest (RE 8.2.t13).

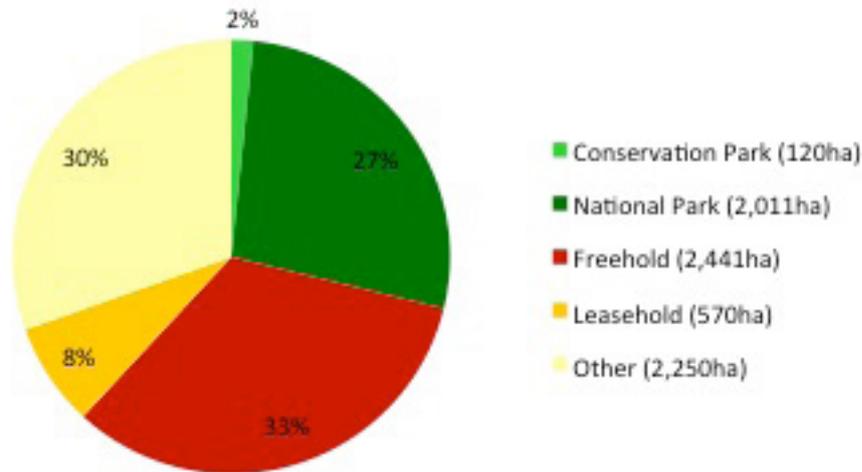


Figure 5 Tenure of beach and foreshore remnant vegetation (Accad et al, 2012)

The Queensland Wader Study Group has undertaken shorebird surveys within the region since 2003 on a near biennial basis (Figure 5). The most recent survey in October 2012 recorded 16,568 shorebirds of 32 species, comprising 21 migratory species and 11 resident species. Based on these current survey results, the region is of international importance (>1% flyway population) for six species (Harding, 2012). Migratory shorebirds move along flyways which span the northern and southern hemispheres and in doing so overfly or visit numerous countries during each migration.

Because these species encounter numerous and varied pressures during their life cycle, it is difficult to establish firm links between population numbers, and management of foreshores within the region, for example controlling threats such as degradation of feeding sites, pollution and hunting/disturbance of shorebirds (Environment Australia and Wetlands International, 2002). However, ongoing monitoring suggests that human disturbance does influence roosting populations, particularly foreshores adjacent to suburban areas that are easily accessible for recreational activities (Harding, 2012; Milton and Harding, 2011).

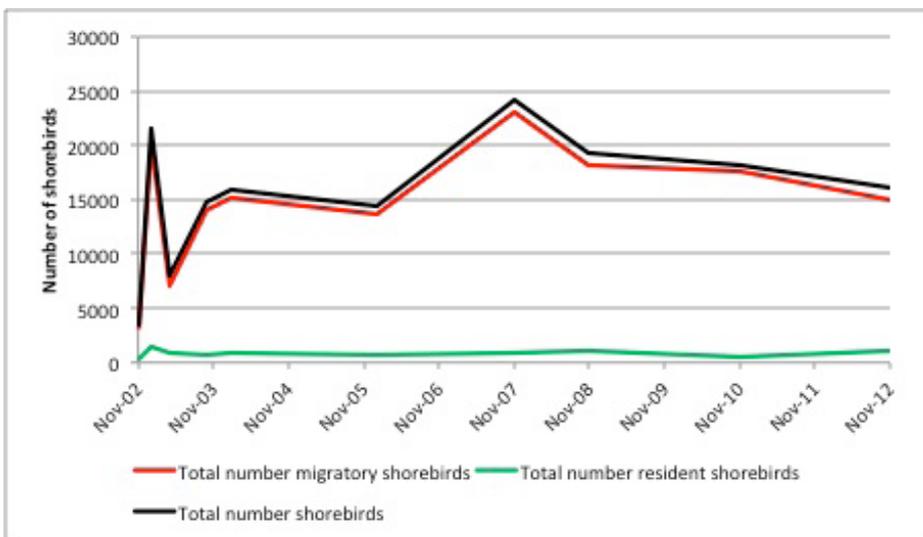


Figure 6 Mackay Whitsunday regional shorebird survey results (Queensland Wader Study Group, 2012).

Records of nesting marine turtles across beaches in the Mackay region (Newry Island in the north to Freshwater Point in the south) have been collected since 1992 (Figure 4.8). However, it is also difficult to establish firm links between population numbers and management of foreshores within the region given the marine, migratory nature of these species.

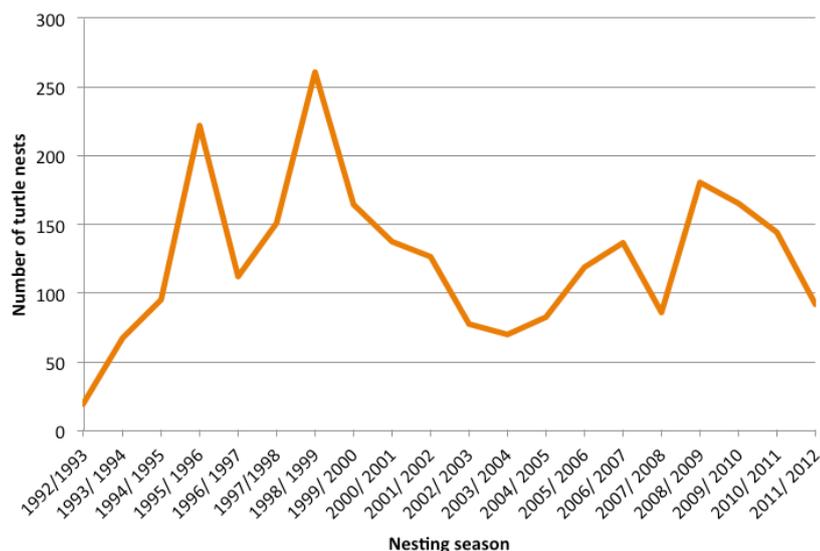
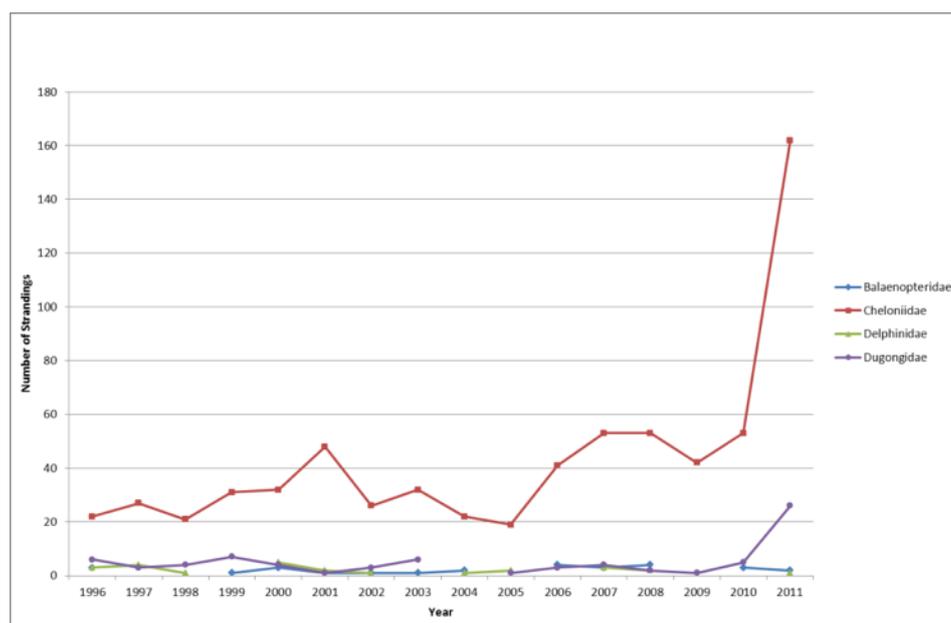


Figure 7 Recorded numbers of marine turtle nests on beaches across the region from Newry Island to Freshwater Point, 1992-2012 (Mackay and District Turtle Watch Association, 2012). Note: This data does not include a measure of volunteer effort which may vary seasonally.

There has been a trend of increased turtle strandings and mortalities since 2011 (Figure 4.9), thought to be related to major flooding events in Queensland which have damaged seagrass beds along the Queensland coast (Queensland Government, 2013b). However, the greatest impact has primarily been on non-breeding immature Green Turtles, so there is little to suggest that this will have a long-term effect on Queensland's Green Turtle population south of Cairns to the New South Wales border at this stage (Queensland Government, 2013b). The loss of seagrass through flooding as a cause of increased strandings and mortality is supported by the concurrent increase in Dugong strandings and mortality over the same period given their reliance on seagrass as a primary food source.

Figure 8 Number of strandings for the Families; Balaenopteridae (baleen whales), Cheloniidae (sea turtles), Delphinidae (dolphins), and Dugongidae (dugongs) by year for the Mackay Whitsunday region (Department of Environment and Heritage Protection, 2013).

Note: Only cases confirmed in the field by a trained person, and later verified by an expert are included.



GOVERNANCE

There are multiple, often overlapping, jurisdictions responsible for management of the coastal zone. With the exception of Ports (Mackay Harbour, Hay Point and Dalrymple Bay) all coastal waters within the region lie within the Great Barrier Reef Coastal Marine Park. This area generally extends to the high water mark and includes all tidal waters and tidal land.

The Coastal Protection and Management Act 1995 gives power to the State Policy for Coastal Management which provides direction for natural resource management decision-makers about land on the coast, such as coastal reserves, beaches, esplanades and tidal areas. However, a Draft Coastal Management Plan has been prepared and will be a statutory amendment to the existing coastal plan under the Coastal Protection and Management Act 1995. The objective of the Coastal Management Plan is to provide policy guidance for managers of coastal land and waters in relation to their natural resource management activities and management of recreational use. The Draft Coastal Management Plan does not address land-use planning or development regulated under the Sustainable Planning Act 2009 (Queensland Government, 2013c),

Development within the coastal zone is regulated under the Sustainable Planning Act 2009 (SPA). The Integrated Development Assessment System (IDAS) of the SPA provides the statutory process for development applications to be made, assessed and decided.

As at 1 July 2013, coastal development will be assessed by the Department of State Development, Infrastructure and Planning (DSDIP) against:

The Coastal Protection State Planning Regulatory Provision (Coastal SPRP)—directs land use planning by local and state governments, and is used for assessing master planned and impact assessable development in the coastal zone and the coastal management district. It suspended the operation of the Queensland Coastal Plan-State Planning Policy for Coastal Protection (SPP 3/11) in October 2012.

It is intended that the Coastal SPRP will be replaced by the single state planning policy (single SPP) during 2013. A draft single SPP has been released for public consultation. The draft single SPP includes policies articulating the state's interests in planning and development including revised coastal SPP 3/11 policies (Queensland Government, 2013c).

On-shore development of new Port facilities or significant expansion of existing facilities currently requires environmental assessment processes either under the State Development and Public Works Organisation Act 1971 (Qld) and/or the Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth) if they are likely to have an impact on a Matter of National Environmental Significance (MNES). MNESs include the Great Barrier Reef World Heritage Area (Queensland Government, 2013e).

Some areas of beaches and foreshores within the region lie within National Park or Conservation Park with management responsibility lying with the Queensland Department of National Parks, Recreation, Sport and Racing. These areas are required to be managed by principles outlined within the Nature Conservation Act 1992. However, most of the region's beaches and foreshores lie within esplanade or other tenure and are governed by the Land Act 1994. Some beaches and foreshores within the region are State Land or have been dedicated as Reserves. Esplanades and Reserves are generally under trusteeship of the respective local Government, which each have their own structure for managing public coastal land (see box below).

There are extensive areas of land behind the primary beach-line, which are held in freehold tenure.

Coastal Management in the Mackay Regional Council area

The Coasts and Communities program is a joint initiative of Reef Catchments and Mackay Regional Council. The Program uses the principle of integrated coastal management to plan, implement, and maintain coastal projects in partnership with multiple agencies, community groups, and individuals to maximise outcomes and ensure the long term sustainability of coastal environments in the Mackay Regional Council area.

The Coasts and Communities program has four key elements;

- Planning; Coastal Management Guidelines and Beach Plans guide the management of coastal foreshores and reserves under MRC jurisdiction, in line with the existing State Policy for Coastal Management.*
- Prioritising; a quantitative conservation framework is used to determine which on-ground projects are the highest priority for implementation annually, depending on funding availability.*
- Implementation and monitoring of on-ground works; Council staff, contractors, community volunteer groups and local residents contribute to the implementation and monitoring of on-ground works selected to be undertaken. A monitoring database collects information on on-ground works completed.*
- Community engagement and education; occurs throughout all stages of the program. A program of Coastcare activities is run at local beaches to provide community the opportunity to get involved in on-ground coastal conservation initiatives.*

Coasts and communities program model:



INDICATORS

Key indicators of the condition of beaches and foreshores include:

- Current biodiversity status of regional ecosystems
- Fire frequency and extent
- Level of physical disturbance
- Weed density and diversity
- Percentage extent of physical disturbance by recreational vehicles and stock
- Level of erosion
- Amount of habitat available for marine turtle nesting and feeding and roosting shorebirds

Aerial imagery (low level 1:12,000 series) is suitable to detect and monitor mid-term changes in condition (>3 years).

BioCondition assessments were carried out in selected beach scrub remnants along the Central Queensland Coast in 2007 using a developed methodology (Cali and Woodcock, 2008). These baseline results could be used for monitoring for quantitative improvements over time (Woodcock, 2008).

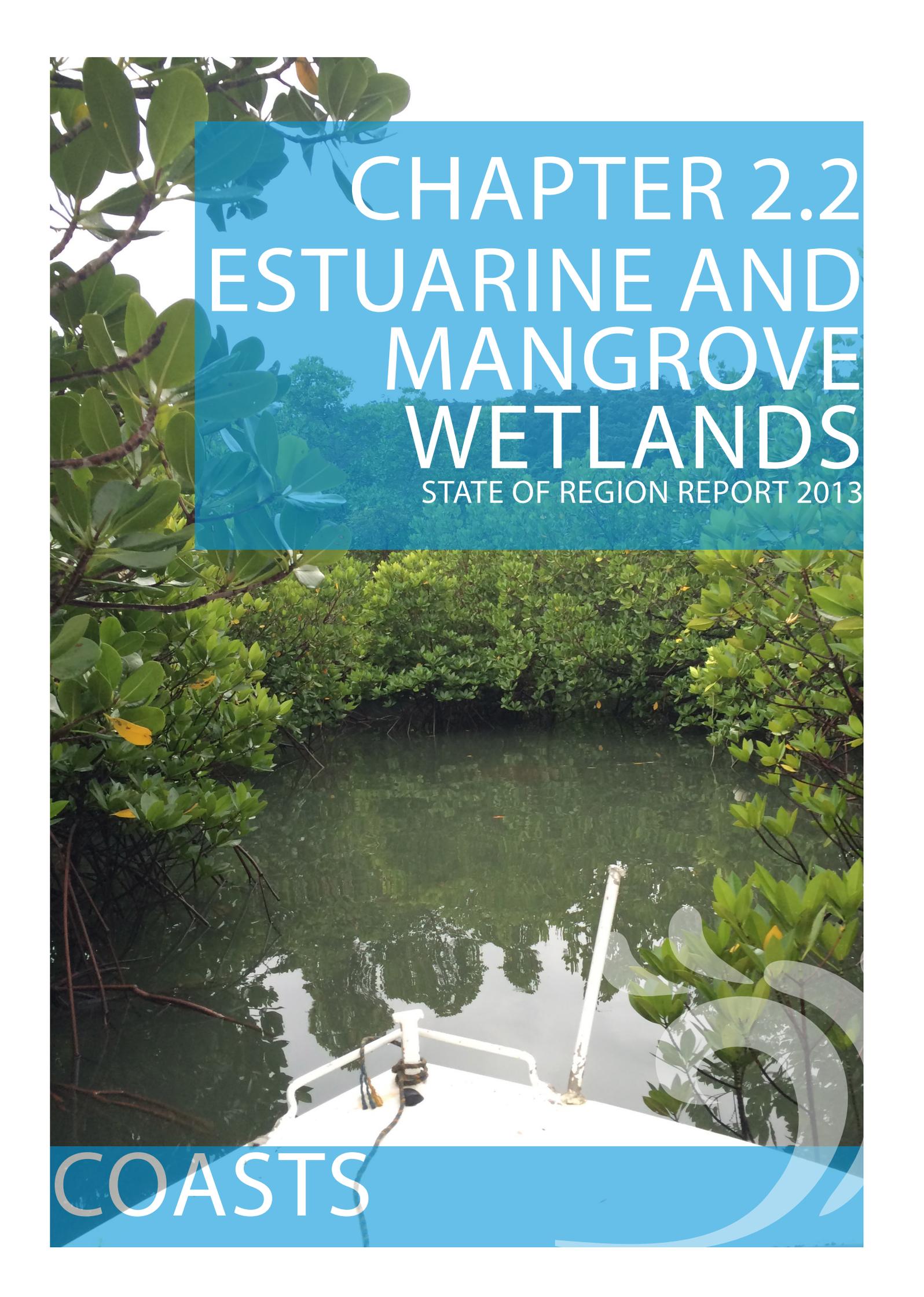
Shorebird populations are monitored biennially by Queensland Wader Study Group. This data resides with them and to date they initiate and fund the monitoring program using experts who visit the region, with the support of local agencies and volunteers from BirdLife Mackay.

Monitoring of turtle nesting is undertaken in by volunteers of Mackay and District Turtle Watch Association from Newry Island in the north to Freshwater Point in the south. This data is contributed to the Queensland Turtle Research Program, and to local coastal managers. Draft Whitsunday Region Marine Turtle Management Plan (Hardy and Stoinescu, 2012) collates some data on the relative importance of sites in the Whitsunday region. All beaches in the Mackay Whitsunday region would benefit by the establishment of coordinated nesting turtle monitoring program and data collection.

Marine Stranding Data is coordinated and collected by Queensland Government with information provided by the community and local government.

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- Queensland Government (2013d) Essential Habitat Mapping Coastal Sheath-tail Bat (*Taphozous australis*). Shapefile.



CHAPTER 2.2 ESTUARINE AND MANGROVE WETLANDS

STATE OF REGION REPORT 2013

COASTS

SUMMARY

The region supports extensive areas of estuarine and mangrove wetlands, these being dominant features of the coastal landscape. Mangroves and associated communities cover 62,094 ha of tidal land in the region, which contains nine wetland areas recognised as nationally important (Environment Australia, 2001).

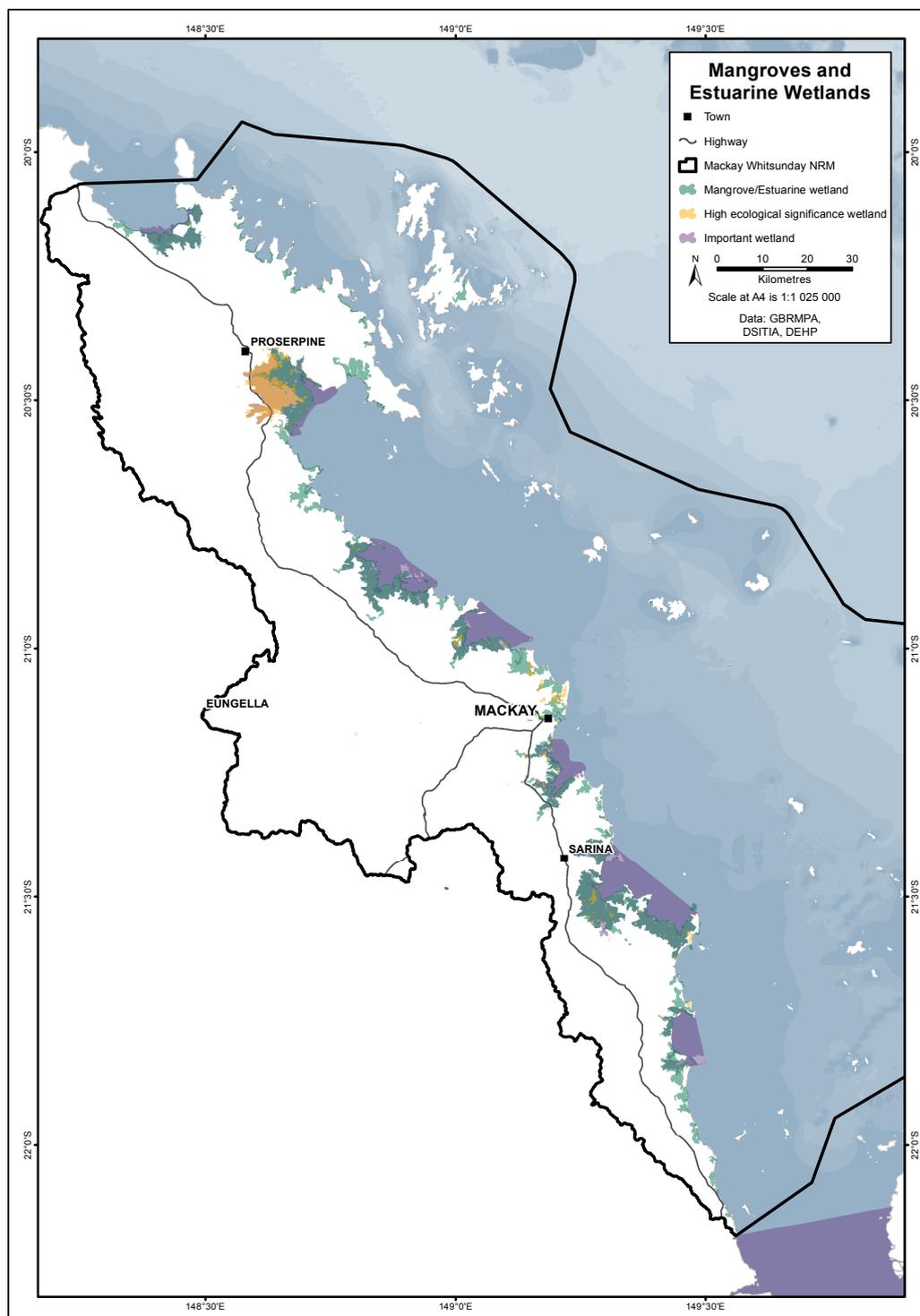


Figure 1 Mangrove and estuarine wetlands, and Nationally important wetland areas within the region.

R E CODE	Regional Ecosystem	Preclear Extent (ha)	2005 Extent (ha)
8.1.1	Mangrove vegetation of marine clay plains and estuaries. Estuarine wetland	33701	32907
8.1.2	Samphire open forbland to isolated clumps of forbs on salt pans and plains adjacent to mangroves	10271	9682
8.1.3	<i>Sporobolus virginicus</i> grassland on marine sediments. Estuarine wetland	4133	3458
8.1.4	<i>Paspalum</i> spp. and <i>Fimbristylis ferruginea</i> sedgeland/grassland (estuarine wetland). Includes areas of deep open water with clumps of <i>Schoenoplectus littoralis</i> ± <i>Eleocharis dulcis</i>	1779	1263
8.1.5	<i>Melaleuca</i> spp. and/or <i>Eucalyptus tereticornis</i> and/or <i>Corymbia tessellaris</i> woodland to open forest (estuarine wetland) with a ground stratum of salt tolerant grasses and sedges, usually in a narrow zone adjoining tidal ecosystems	1779	1263
11.1.1	<i>Sporobolus virginicus</i> grassland on marine clay plains	555	451
11.1.2	Samphire forbland on marine clay plains	8560	8129
11.1.4	Mangrove forest/woodland on marine clay plains	5830	5540

Table 1 Types and extent of mangrove and associated regional ecosystems occurring within the region

There are six criteria by which areas are assessed for inclusion in the listing of nationally important wetlands. Within the region, while not listed as nationally important wetlands; Goorganga Plain, Sand Bay, Sandringham Bay - Bakers Creek Aggregation and Sarina Inlet – Ince Bay Aggregation meet all of the ecological and biological criteria as below.

“The criteria for determining nationally important wetlands in Australia, and hence their eligibility for inclusion in the Directory, are those agreed to by the ANZECC Wetlands Network in 1994.

A wetland may be considered nationally important if it meets at least one of the following criteria:

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

Directory of Important Wetlands (Environment Australia, 2001;11)

Seven broadly recognised mangrove communities occur within the region. Within the high rainfall areas of the central Queensland coast bioregion, estuarine wetlands are about equally dominated by salt pan and samphire flats along the high intertidal area; yellow and orange mangroves (*Ceriops tagal* and *Bruguiera* spp) along the mid-intertidal; and stilted mangroves (*Rhizophora stylosa*) in the lower intertidal.

Vegetation Community	Percentage Extent within the region	
	Central Queensland Coast	Brigalow Belt North
Closed shrubland of <i>Aegiceras corniculatum</i> . This community is rare within the study area and typically occurs as a thin linear fringe on the landward side of other communities.	< 1%	1%
Open to closed forest of <i>Avicennia marina</i> . This community occurs at both landward and seaward margins, and is often structurally variable at any given location.	3%	2.5%
Open to closed forest of <i>Ceriops tagal</i> +/- <i>Bruguiera</i> spp. Two forms of this community are readily recognised. One forms a tall (to 12m) forest near the supralittoral zone and tends to contain <i>Bruguiera</i> spp as co-dominants or rarely, dominant canopy species. The second is a low open to closed forest or shrubland occurring near the supralittoral margin, or on low rises surrounded by saltpan.	25%	6%
Mixed species closed forest.	13%	5%
Closed forest of <i>Rhizophora</i> spp typically <i>R. stylosa</i> . These forests typically occur on seaward margins or in areas close to, or within regular tidal flows.	31%	22%
Saline grassland (dominated by <i>Sporobolus virginicus</i>). Saline grasslands are typically supralittoral communities that grade into adjacent samphire flats and/or terrestrial vegetation.	3.5%	<1%
Saltpan and samphire flats. The level to which salt pans are vegetated by samphire is highly variable and in many areas no vegetation is present.	23%	65%

Table 2 Major inter-tidal vegetation communities within the region: CQC = Central Queensland Coast

VALUES AND SERVICES

The region's estuaries directly support several commercial fisheries. The economic value of the mud crab (*Scylla serata*) fishery in 2000 was \$1.35 million and the estuarine finfish fishery comprised principally of barramundi, salmon and mullet, was \$0.47 million (Dodds, 2004). More recent catch data does not appear to be available for the region, however species are considered as being sustainably fished (Trestrail et al, 2013).

Estuaries also contribute significantly to recreational fisheries with fishers spending approximately \$42 million annually on this pursuit (Dodds, 2004). 28% of residents of the Mackay region fish recreationally, a number significantly higher than the state average of 17% (Department of Employment, Economic Development and Innovation, 2010).

The real economic value of mangroves is however much higher than these combined fisheries, as mangroves act as nursery habitat for numerous other species which are subsequently harvested in different habitats. Estuaries within the region are highly valued by communities particularly for recreational fishing and crabbing opportunities and these are important part of the lifestyle of the region's communities.

In addition to their economic and social values, mangroves provide essential ecosystem services. These notably include coastal protection functions through which the affects of storm surges and cyclones are reduced (Bridgewater and Cresswell, 1999), nutrient retention (Clough et al, 1983), and detoxification of storm water (Anon, 2005). These functions will become increasingly important because of climate change induced sea level rise and increased storm activity (Bridgewater and Cresswell, 1999). The importance of mangroves and saltmarsh in carbon sequestration ('blue carbon') has become increasingly understood (McLeod et al. 2001) and this will be vital in consideration of ongoing management of these systems within the region.

Indigenous Australians with traditional links to the region maintain an overriding interest in sustainable management of natural resources. Fishing remains an essential and integral part of life.

Estuarine crocodiles (*Crocodylus porosus*) inhabit estuarine areas throughout the region and have breeding populations within Proserpine River and associated tributaries, and Rocky Dam Creek. This species remains vulnerable to extinction as a result of dramatic population decline associated with intensive harvesting in the mid 20th century. Based on a Queensland wide study, the broader region from Cape Bowling Green to Shoalwater Bay supported approximately 10% of the Queensland hatchling population during the period 1994 – 2000 (Read et al. 2004). The lack of greater breeding activity is due to suboptimal temperatures and destruction of nesting habitat through clearing and hydrological modification of floodplain based nesting sites. Translocation has been used in the past to alleviate the issue of crocodiles near human settlements, although this may be misguided management tool, as translocated crocodiles return rapidly and purposely to their capture locations for distances up to 411km (Read et al., 2007). The Mackay Whitsunday region does not currently have a crocodile management plan (DEHP, 2013a).

The Mackay area is the type locality for the vulnerable false water rat (*Xeromys myoides*), now more commonly known as the mangrove or water mouse, which was first discovered in Mackay. More recent scientific review considered the species to be endangered (Dickman et al. 2000). Comprehensive study (Ball, 2004) determined that within the region, the mangrove mouse only occurs in supra-littoral communities dominated by yellow and orange mangroves (*Ceriops tagal*, *Bruguiera* spp.) which make up only around 25% of all mangroves present. Subsequent study (Ball, unpublished data) confirmed that the species is very rare and numbers fluctuate markedly among years.

PRESSURES AND THREATS

The major pressures which have and/or continue to act on mangroves and associated estuarine areas are clearing (through urban, port and industry development), dieback, changes in hydrology (e.g. restriction or alteration of flows) and pollution (Schaffelke et al. 2005). In addition to these, overfishing, cattle grazing, pest animals, use of recreational vehicles and fire, have impacts on some components of mangrove and estuarine systems (EHP, 2013b). Some of these pressures are more subtle but may be resulting in considerable changes in ecosystem functioning.

Urban development is becoming increasingly common along mangrove margins and results in increased impervious surfaces, which collect and facilitate discharge of storm-water at point locations into littoral mangrove margins. In contrast, natural storm-water inputs into mangroves are largely diffuse flows. Grapsid crabs are considered 'ecosystem engineers' as they perform roles that have considerable influence on ecosystem processes such as leaf litter processing, soil aeration and nutrient cycling. A comprehensive study within the region found significantly fewer, and sometimes no grapsid crabs in areas influenced by urban stormwater.

Increased understanding of these ecosystems has led to concerns about decreasing connectivity from supra-littoral saltmarsh areas to other coastal ecosystems notable seagrass beds. Bridgewater & Creswell (1999) note that the interlinkage between mangrove saltmarshes and partially or totally submerged seagrass is critical. A study confirmed and partially quantified these linkages (Saintilan et al., 2007), providing support for the hypothesis that fish which reside primarily in seagrass beds, move to saltmarsh to feed during spring high tides. Therefore any loss or decline of either saltmarsh or seagrass habitats within or adjacent to estuarine areas is of concern. Irlandi and Crawford (2007) recommend that to optimise outcomes for fish habitat, mangrove and saltmarsh restoration projects should either be prioritized to locations where available seagrass exists, or should have seagrass restoration incorporated as an objective.

Some fish species such as barramundi, mangrove jack and striped mullet live out part of their life cycle in freshwater before moving into marine and estuarine areas to spawn (Marsden et al., 2006). Thus estuary-freshwater connectivity is crucial for the long-term sustainability of populations of these species. Numerous barriers to fish movement have been identified in the region (Marsden, et al. 2006).

Seven major threats to regional ecosystems which form the region's mangrove and estuarine wetlands are illustrated by Figure x. These threats are often related. For example; hydrological change (including development of ponded pasture) may significantly alter water quality, and heavy and sustained grazing pressure of marine grasslands can dramatically alter ground cover and thus both habitat value, and the filtration and retention capacity of those areas.

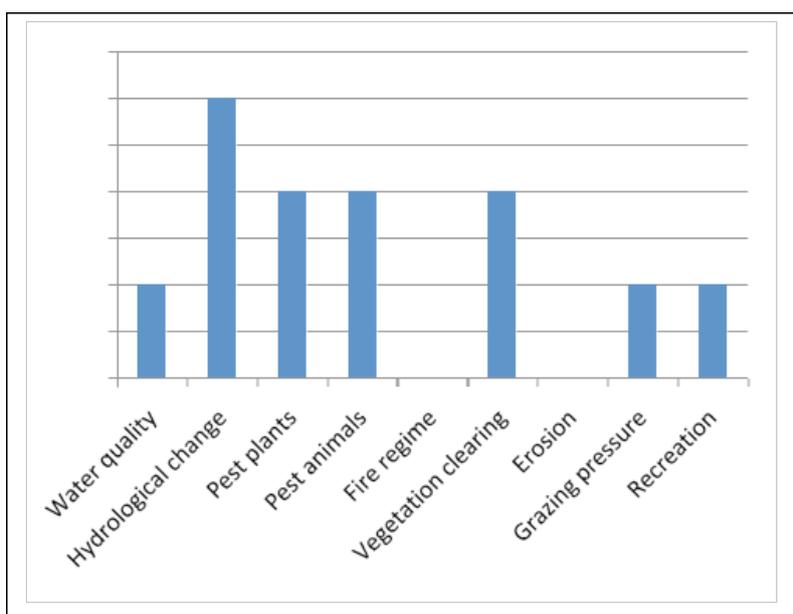


Figure 3 Percentage of mangrove and estuarine regional ecosystems affected by major threats

“Given their geomorphic situation within narrow elevation ranges in the intertidal zone, saltmarshes are sentinel ecosystems in the coastal zone and already the impacts of relative sea-level rise are being manifest. Elevated atmospheric carbon dioxide, temperature rise, altered fire regimes, and a range of hydrological changes may also impact on saltmarshes, compounding the pressure of coastal development, vehicular impacts, pollution and invasive species” (Staintilan and Rogers, 2013; 2)

CONDITION AND TRENDS

The National Land and Water Resources Audit (Australian Government 2001) provides condition reports for all estuaries within the region with exception of several very small areas (e.g. Eimeo Creek). Most estuaries are in either near pristine or largely unmodified condition. One (Pioneer River) is extensively modified, and five (Bakers Creek, Don River, Proserpine River, Rocky Dam Creek, and the un-named estuary Q223) are modified.

The original area of mangroves within the central Queensland coast bioregion was 50,780 ha, of which 47,984 ha remained as at 2003 (i.e. a loss of 2796 ha or 6%; refer to Figure 6). It is important to note however that the vast majority of vegetation clearance occurred prior to 1997; 55 ha had been lost between 1997 and 2003 (or 0.2% of the original extent) and another 10ha between 2003 and 2005. Most of the original loss was of mangrove, samphire and grassland (2056 ha) however a greater proportion of the original extent of the supra-litoral communities (sedgeland/ grassland and fringing forest) was lost. Accordingly these later two communities are considered endangered, a situation made worse by lack of protection for the remaining areas (see below).

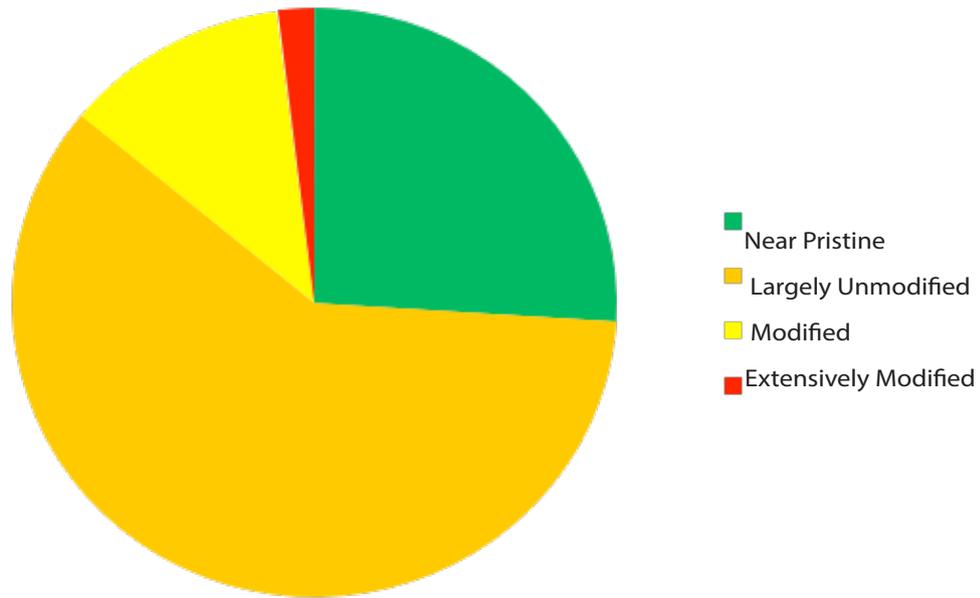


Figure 4 Condition of the region's 42 estuaries

Of the five regional ecosystems which comprise estuarine and mangrove wetlands within the central Queensland coast bioregion; two are considered endangered, two 'of concern' and the other secure. Only two ecosystems (mangroves and samphire) are adequately represented within protected areas (Figure 5). The three regional ecosystems within the brigalow belt are not currently threatened although they have a low representation within protected estate.

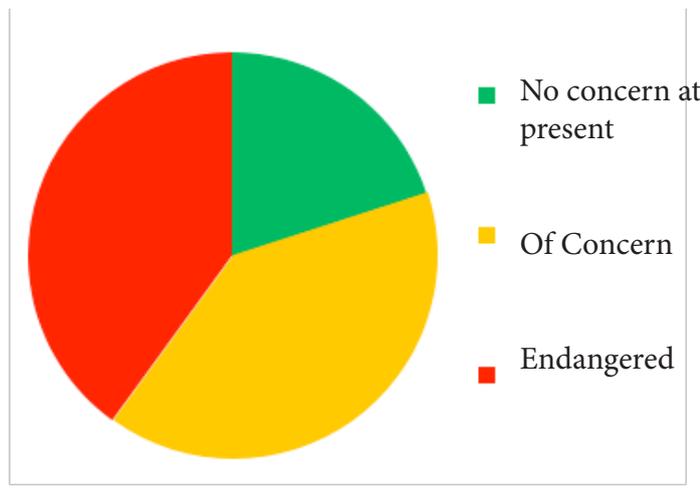


Figure 5 Conservation status of mangrove and estuarine regional ecosystems.

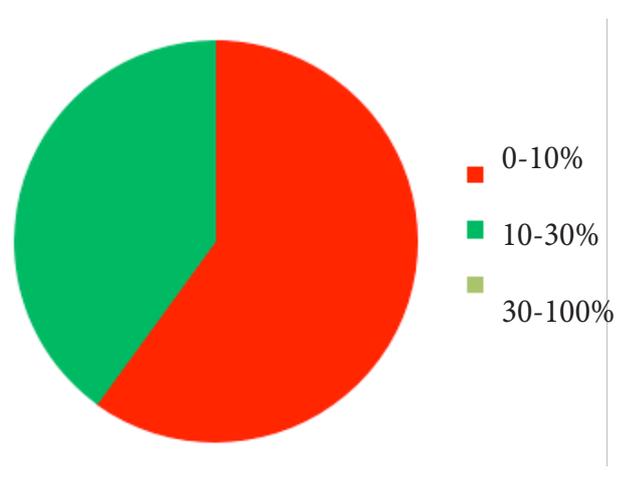


Figure 6 Percentage of pre-clearing extent of mangrove and estuarine regional ecosystems within protected areas

	Regional Ecosystem	Preclear Extent (ha)	2003 Extent (ha)	Area Protected (ha)	% Protected	Biodiversity Conservation Status
8.1.1	Mangrove vegetation of marine clay plains and estuaries. Estuarine wetland	33702	32907	4143	12.3	No concern at present
8.1.2	Samphire open forland to isolated clumps of forbs on salt pans and plains adjacent to mangroves	10270	9683	1293	12.6	Of concern
8.1.3	<i>Sporobolus virginicus</i> grassland on marine sediments. Estuarine wetland	4129	3455	54	1.3	Of concern
8.1.4	<i>Paspalum</i> spp. and <i>Fimbristylis ferruginea</i> sedgeland/grassland (estuarine wetland). Includes areas of deep open water with clumps of <i>Schoenoplectus littoralis</i> ± <i>Eleocharis dulcis</i>	1779	1276	14	0.8	Endangered
8.1.5	<i>Melaleuca</i> spp. and/or <i>Eucalyptus tereticornis</i> and/or <i>Corymbia tessellaris</i> woodland to open forest (estuarine wetland) with a ground stratum of salt tolerant grasses and sedges, usually in a narrow zone adjoining tidal ecosystems	900	663	17	1.9	Endangered

Table 3 Historical and current extent of estuarine vegetation, percent protected and conservation status (Central Queensland Coast Bioregion).

Dieback of one mangrove species; *Avicennia marina* has occurred in several estuaries within the region. Schaffelke et al. (2005) reported that 96.9% of the cover of this species was affected in the Pioneer River and 61.3% in Bakers Creek, but only 16.8% in McReady's Creek and none within Bucasia/ Eimeo Creeks (for a total of 1474 ha affected within the region). The cause of this dieback has not been satisfactorily clarified; Schaffelke et al. (2005) support a link between herbicide pollution and dieback however further investigation (Wake, 2006) does not appear to support the proposed relationship between herbicide concentration and mangrove dieback.

Investigation into the impact of changed hydrology on mangroves communities within the region has largely focused on the impact of urban storm-water run-off (Ball, 2004). This investigation provides strong evidence for a decline in mangrove crab (Family: Grapsidae) abundance in the presence of urban storm-water point discharge. This finding is concerning as grapsid crabs are well recognised as keystone species, and any substantial impact on their populations may have broader consequences to the mangrove community. The actual consequences of a decline in grapsids may include a substantial decline in leaf litter processing and disruption to the flow of organic carbon from mangroves to other coastal ecosystems. For example, within the region crabs removed 4.10 to 5.76 t/ha/year (37-63% of total leaf litter fall) and 1.96 to 6.35 t/ha/year (8-42% of total leaf litter fall; wet season). In the case where crab abundance is reduced a significant amount of this organic carbon will not reach coastal food chains.

GOVERNANCE

In Queensland, mangroves and all other marine plants are completely protected under the Fisheries Act 1994. The protection extends to seagrasses, salt couch and plants such as melaleuca that grow adjacent to tidal lands. Any disturbance (such as trimming, mowing or removal) of marine plants requires an approval from Fisheries Queensland.

Whilst the primary jurisdiction for protection of marine plants lies with Fisheries Queensland, mangroves also lie within Marine Parks and within protected areas under the umbrella of the Nature Conservation Act. Further protection, particularly from downstream impacts as a result of changed land use within coastal catchments, could be afforded by the Coastal Protection Act through development of regional coastal management plans. However, this is currently not the case and less obvious but important impacts such as changes to hydrology, are not currently regulated.

INDICATORS

Periodic reviews of regional ecosystem mapping can be used to track changes in the geographical extent of mangrove and saltmarsh regional ecosystems. Recently completed coastal LIDAR mapping could also be used to predict the potential (or lack thereof) for migration of these ecosystems under sea level rise scenarios.

Aerial photography and site specific monitoring will enable tracking of the recovery of saltpan, saltmarsh and marine grasslands. Property management planning and reporting can provide clear guidance on improved protection of marine plains from grazing pressure.

A greater understanding is needed of the impacts of changed hydrology on mangroves systems, and their capacity to provide functional ecosystem services in terms of water quality. In particular it would be useful to undertake a quantitative assessment and ongoing monitoring of the geographical area of mangroves influenced by urban storm-water runoff.

Reef water quality is improved in line with the thresholds, indicators and mechanisms identified by the Mackay Whitsunday Water Quality Improvement Plan (Drewry 2007).

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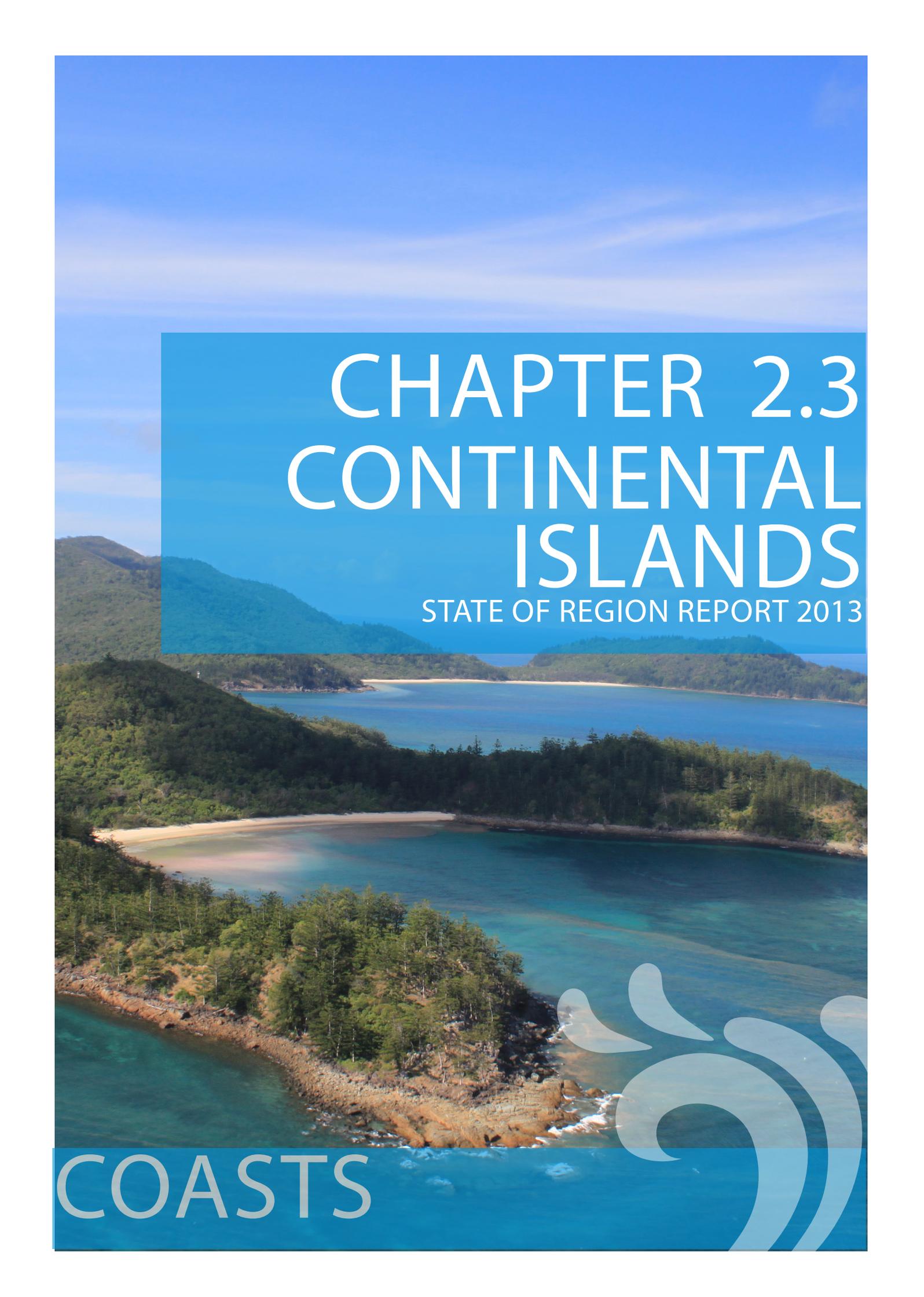
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An aerial photograph of a coastal bay. The water is a vibrant blue-green, with sandy beaches visible on the left and right sides. The surrounding land is covered in dense green forest. In the background, there are rolling hills under a clear blue sky. A semi-transparent blue rectangle is overlaid on the upper part of the image, containing white text.

CHAPTER 2.3 CONTINENTAL ISLANDS

STATE OF REGION REPORT 2013

COASTS

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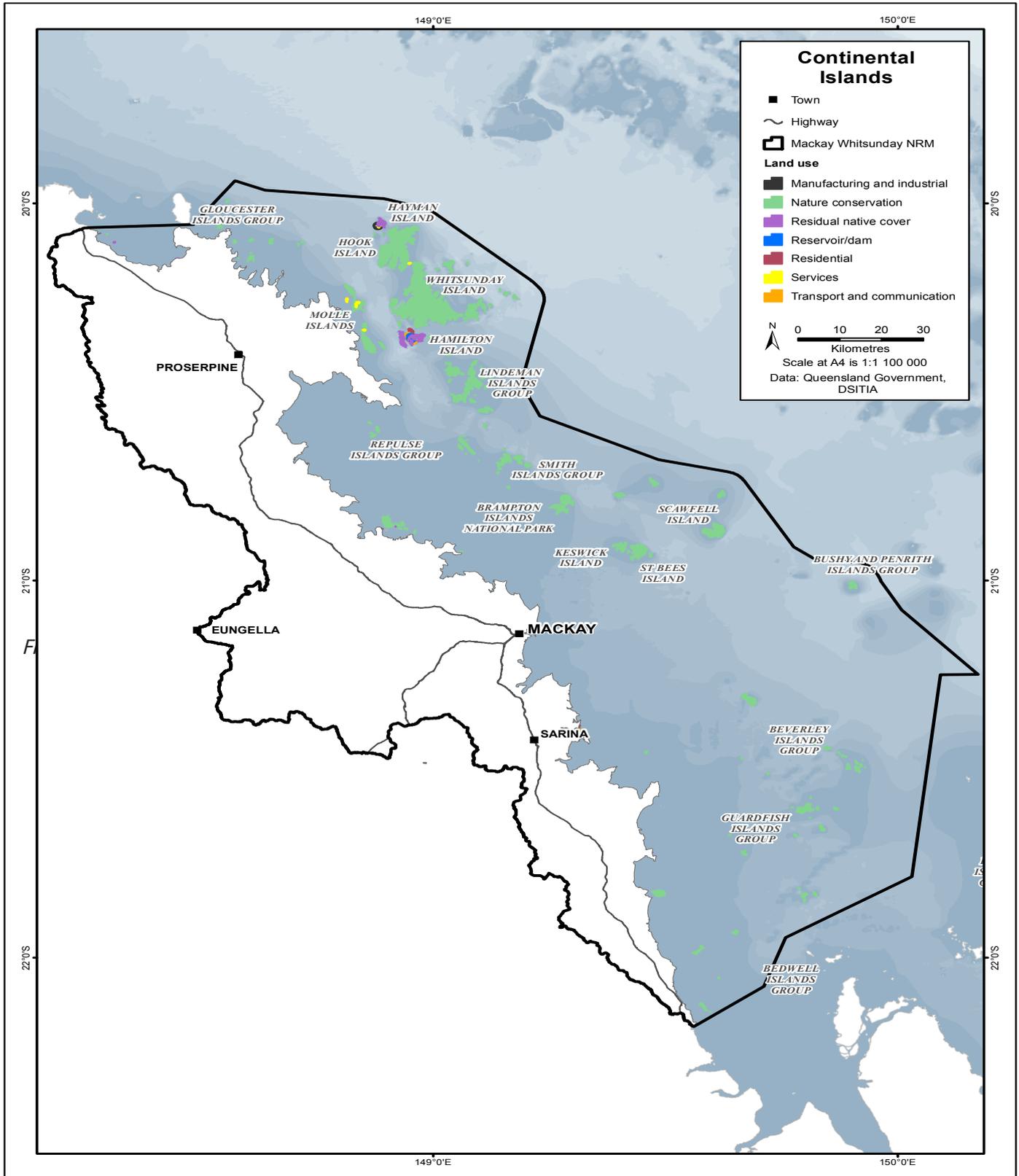


Figure 1 Islands of the region

SUMMARY

The region contains one hundred and forty five islands, of which all but eighteen are protected as National Parks, in addition to numerous smaller islets and exposed rocks. In this respect the region contains almost 25% of all the continental islands that occur along the Queensland coast.

Of the National Park islands, five (South Molle, Long, Hook, Lindeman and Brampton Islands) have been partly developed as tourism resorts on land leased from the National Park. However, most of these are not currently operating largely because of market downturns, for example Lindeman Island and Hook Island resorts. Two resorts are on fully leased islands (Hayman and Hamilton), and resort infrastructure is currently being developed on Dent Island. Middle Percy Island has recently been converted to National Park, with a smaller area as Conservation Park with previous lessee's appointed as caretakers and trustees. A small leased area also exists on St Bees Island and a larger area of Keswick Island is partly developed as a satellite suburb of Mackay City. Several islands remain as unallocated State land where little or no active management is being undertaken.

"It is wrong to think of the individual islands or groups of islands as remnants of particular individual volcanoes. During the 100 million years after eruption, there was sufficient time for the volcanic terrain to erode into a landscape of mountains, hills and valleys only tenuously related to its origins.

The present islands and adjacent mainland are simply the mountain tops and ridges of this old landscape, which has been inundated by the sea in more recent times. No one knows for certain when this 'drowned' landscape first came about. Certainly at the depth of the last ice age 19,000 year ago, the sea level was about 150 m lower than present, and the coastline was about 140 km farther east (east of the outer Barrier Reef). As the climate subsequently warmed, the level of the ocean rose rapidly, and from 10,000 to 6,000 years ago the coastal fringe was progressively inundated and the higher hills became isolated as the islands we see today."

(Willmott, 2006; 107-108)

The islands have strong affinities with natural systems on the adjoining mainland. The Northern Group; Whitsunday, Molle, Lindeman, Repulse, Smith Islands and those of the southern Gloucester Islands aggregation, are closely similar to, and lie within the Whitsunday sub-region of the Central Queensland Coast Bioregion. The few small islands lying adjacent to the Don Basin are within the Townsville Plain sub region of the northern Brigalow Belt Bioregion. The Newry, Cumberland and Brampton Island groups have affinities with coastal hills on the adjoining Mackay coast. There is a strong environmental gradient between the Northumberland and Percy Islands which corresponds largely to a latitude change related to decreasing rainfall in the south, but also an east-west gradient as a result of sea exposure.

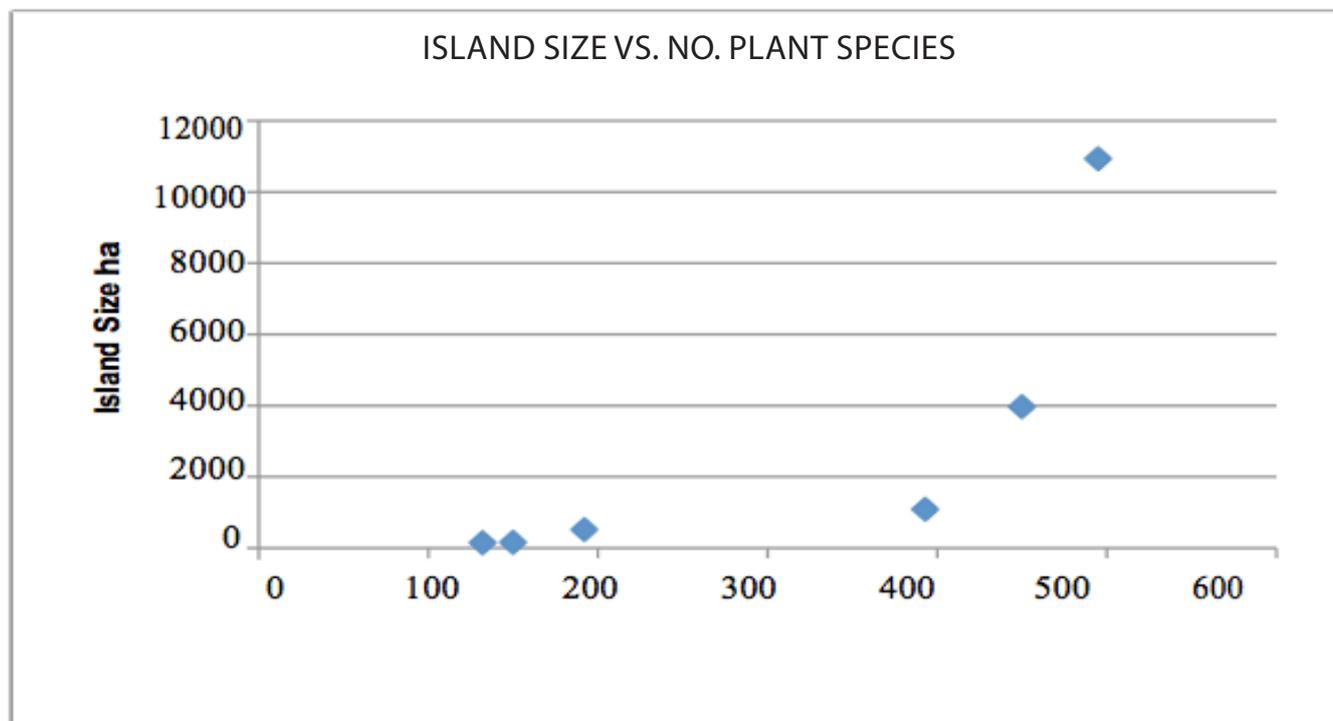


Figure 2 Island size vs. Species richness.

Several Islands are worthy of particular note as they have unique biophysical characteristics. Bushy Island is the only vegetated sand cay within the central region of the Great Barrier Reef. This island is also unique as it has developed on a reef which has formed around Redbill Islet. South Percy Island is the only continental island which is largely formed by serpentinite rocks, a rare and highly geographically restricted geological type. South Percy and Whitsunday Island are also partly formed by extensive sand dune deposits. Rabbit Island in the Newry Group has extensive areas of low lying mangroves and smaller but notable areas of lowland melaleuca wetland (Queensland Herbarium, 2013).

While little documentation exists which describes the terrestrial fauna that inhabits the continental islands, it is well accepted that few large mammals (e.g. macropods, possums, dingos) naturally occur, although some introduced populations exist (e.g. brushtail possums on Hayman, grey kangaroos on Brampton). The exception is presence of the endangered Proserpine rock wallaby on Gloucester Island and possibly unadorned rock wallabies on Whitsunday Island. In addition, goats were introduced to many of the islands, although most populations have either been eradicated or are under current control efforts.

Considerably more information is available regarding island flora (e.g. Batiannoff; 1987, 1992, 1995; Batiannoff & Dillewaard, 1997). Generally there is a strong relationship between species richness and island size, with larger islands having more diverse flora. While islands do support some rare species, they generally have fewer than adjacent coastal mainland areas. There are only three plant species known to be endemic to Queensland's islands, two of which are supported within the region.

STATE OF REGION REPORT

Continental Islands



Importantly however, the region's islands support several regional ecosystems that have no or very little representation on the mainland. These include grasslands on island slopes and headlands, woodlands to closed forest of ironbark (*E. Drepanophylla*) and brushbox (*Lophostemon confertus*), and woodlands of hybridised blue gum (*E. tereticornis*) and poplar gum (*E. Platyphylla*).

WHITSUNDAY ISLANDS	Wirrainbela	Olden	Stone	Curlew
Bird	Workington	Rattray	Holbourne	Digby
Black	Yuindalla	Saddleback	BRAMPTON ISLANDS	Dinner
Border	LINDEMAN ISLANDS	SMITH ISLANDS	Brampton #	Douglas
Buddlibuddli	Baynham	Allonby	Carlisle	Double
Cid	Cornston	Anchorsmith	Wedge	George
Cow and Calf	Gaibirra	Anvil	Round Top	Henderson
Cowrie	Triangle	Bellows	Flat Top	Hirst
Deloraine	Keyser	Blackcombe		Hull
Dent #	Lindeman #	Blacksmith	SOUTH CUMBERLAND ISLANDS	Innes
Dumbell	Little Lindeman	Goldsmith	Aspatria	Irving
Dungarra	Maher	Hammer	Bushy	Keelan
Esk Fitzalan	Mansell	Ingot	Calder	Knight
Hamilton#	Pentecost	Ladysmith	Cockermouth	Minster
Harold	Seaforth	Linne	Derwent	Noel
Haselwood	Shaw	Locksmith	Keswick #	Penn
Hayman #	Thomas	Pincer	Penrith	Poynter
Henning	Volskow	Silversmith	Scawfell	Prudhoe
Hook #	MOLLE ISLANDS	Tinsmith	Snare Peak	Renou
Ireby	Daydream #	NEWRY ISLANDS	St Bees #	Still
Langford	Denman	Acacia	Wigton	Temple
Long #	Goat	Mausoleum	PERCY ISLES	Thonee Peak
Lupton	Mid Molle	Newry	Hotspur	Treble
Nicolson	North Molle	Outer Newry	Middle #	Wallace
East Repulse	Planton	Rabbit	North East	
North Repulse	South Molle #	OTHER ISLANDS	Pine Peak	
South Repulse	NORTHERN GROUP	Carpet Snake	South	
Perseverance	Armit	Camp	Vernon Rocks	
Plum Pudding	Double Cone	Cave	Beverlac	
Sillago	Eshelby	Green	Bluff	
Teague	Gloucester	Gould	Calliope	
Titan	Grassy	Midge	Connor	
Whitsunday	Gumbrell	Pigeon		

Table 1 Island occurring within the region. Shaded are non-protected areas. # = Resort Island

VALUES AND SERVICES

During 2012 643,000 people visited the Whitsunday area, an increase of 2% on the previous year (Tourism and Events Queensland 2012). In 2004 when data was last gathered, 31% of visitors stayed at least one night on an island and 34% visited islands by boat (Anon, 2004). These figures clearly demonstrate the attractiveness of the Whitsunday Islands to tourists, and the contribution they make to local economies. A wide range of tourism experiences are available ranging from 'backpacker' accommodation, to Hayman Island Resort, which is consistently recognised as Australia's premier luxury resort by international standards. Figure 6.2 outlines some recreational opportunities within the Whitsunday area.

The region's islands support over 1000 species of vascular plants, well over 10% of all the plants found in Queensland. Gloucester Island supports the endangered Proserpine rock wallaby (*Petrogale persephone*), the only naturally occurring island population. Recent survey found this population to be healthy but nevertheless limited in abundance by its required rainforest habitat (Ball, 2012 pers obs). A trans-located population of this species occurs on Hayman Island, having been introduced as 'insurance' against declines in mainland populations.

Other threatened species occurring on the islands include the death adder (*Acanthopis antarcticus*), coastal sheath-tail bat (*Taphozous australis*) and beach stone curlew (*Esacus neglectus*) (Wildnet, 2007). Shorebirds and sea birds are particularly notable island fauna with islands such as Eshelby, Tern, and Redbill Islet known nesting areas. Bushy Island supports a large colony of common noddies (*Anous stolidus*), numbering in the thousands despite the relatively small size of the island. Many of the continental islands and rocky islets are important nesting habitat for the migratory pied imperial pigeon (*Ducula bicolor*) during its seasonal movement patterns along the Queensland coast. Marine turtles including flatback turtles (*Natador depressa*), loggerhead turtle (*Caretta caretta*) and green turtles (*Chelonia mydas*) nest on islands within the region (Anon, 2005). Significant green turtle rookeries occur on Bushy, Pine Peak and South Percy Islands. Bushy Island is the northern limit for loggerhead turtle nesting and some also occurs on South Percy Island (Anon, 2005).

Islands are of significant scientific interest as they are living examples of the results of climate change and consequent sea level rise. The different diversity supported by islands of different size, location, altitude and exposure offers opportunity to understand how further climate change may affect other natural systems. In addition, islands with relatively simple ecosystems offer learning opportunities in terms of management of more complex areas. One of the key values of islands is that they can be more easily maintained in natural condition, particularly if robust bio-security measures are put in place to restrict the arrival of pest species (Island Arks 2013). In addition, unlike mainland areas, it is often possible to eradicate feral animals and to a lesser degree some exotic plants. Islands also offer significant opportunities for translocation and management of threatened species populations which otherwise may not survive in mainland situations.

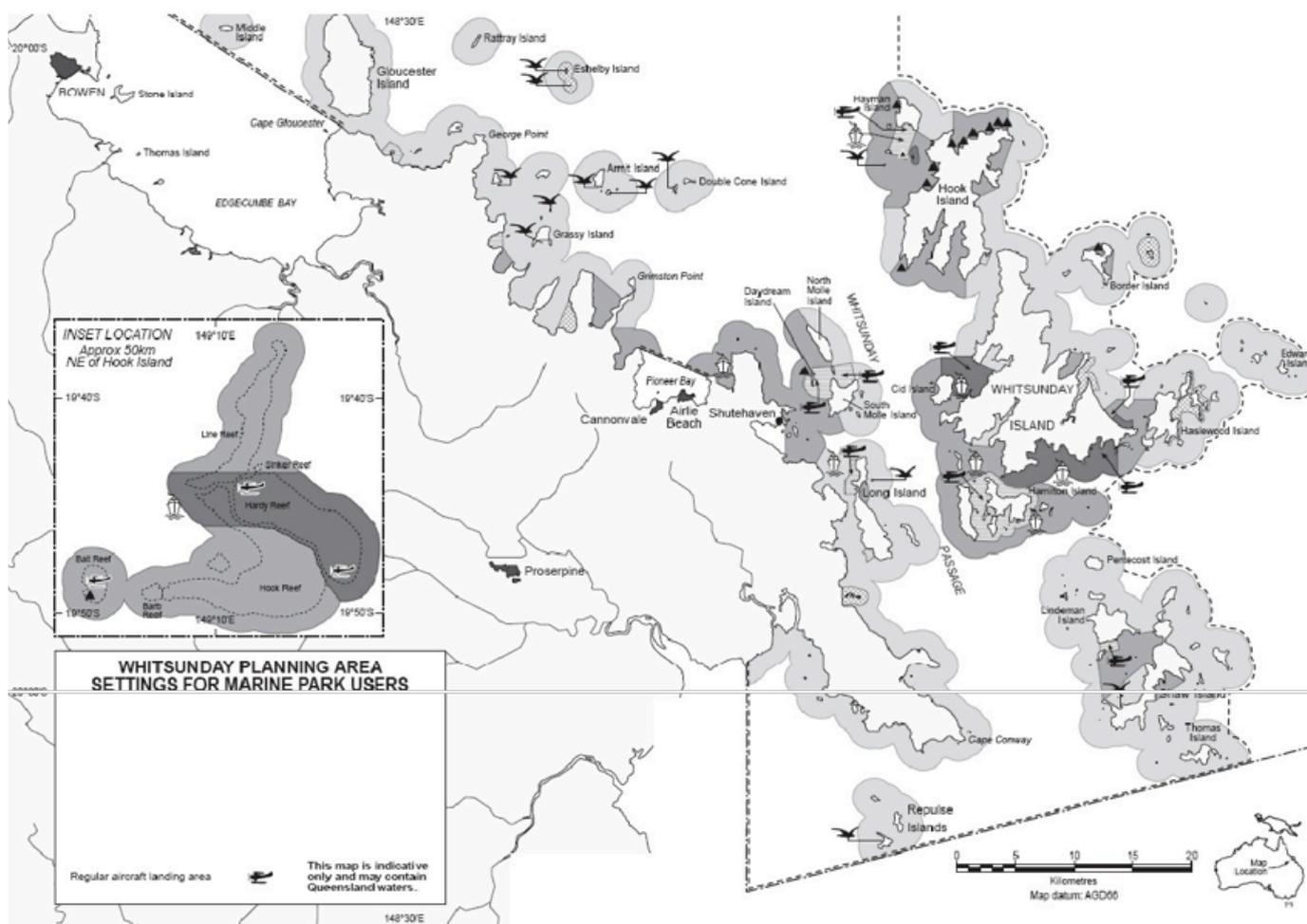


Figure 3 Recreational opportunities and constraints in the Whitsunday Islands (reproduced from the Whitsunday Plan of Management EPA/QPWS, 2008)

PRESSURES AND THREATS

Fire is an integral component of the Australian landscape and has been widely used by both traditional and contemporary land managers for a large range of purposes. However, the science of fire use is in many respects in its infancy, and opinions vary about its appropriate application, particularly on islands. Comparison of historical and more recent aerial photography makes it clear that vegetation patterns on some islands have changed markedly this century (Ball, unpublished data). This is particularly the case on inshore islands, with those further offshore exhibiting significantly more stability. This situation is almost certainly related to both fire management and exposure to marine influences such as wind and a salt laden atmosphere.

The Whitsunday Islands experience significant visitation from tourists and built infrastructure such as fencing, toilets and camping facilities have been provided to reduce impacts from visitors. However, islands off Mackay have relatively less visitation and fewer facilities. There exists continual risk of introducing exotic plants and disease such as the root rot fungi (*Phytophthora cinnamomi*). This is an important consideration for more remote, less visited areas as these tend to have less management presence and thus unwanted introductions could go unnoticed for longer periods of time, allowing pests to become well established. There is also potential for exotic garden plants to 'escape' from island resorts, lighthouses and other gardens into adjoining National Park areas.

In addition to these challenges, resourcing for management of the islands has declined considerably, particularly those off Mackay. However, emergent conservation based tourism is beginning to provide additional resourcing models, for example voluntary groups Wildmob who participate in land management and education activities, and Ecobarge Clean Seas who specialise in the collection of marine debris.

"The role of Aboriginal peoples in the relationship between rainforest and sclerophyll forest is controversial. There were a number of good reasons for Aboriginal peoples to burn islands regularly, i.e. to facilitate travel and food gathering (Brennan 1986). Perhaps mainland tradition alone may well have been enough reason to burn (Haynes 1985). In our view there is a tendency to overestimate the importance of Aboriginal fire regimes on islands. Not all of the 552 continental islands have good access for landing and many are too isolated, small and rocky to offer food or water. We speculate fewer Aboriginal induced fires occurred on islands than on the adjacent mainland. Burning by Aboriginal peoples may have led to changes in the floristic composition and structure but confined to larger islands with fresh water and possibly smaller islands with easy landing. After studying anthropogenic modifications of vegetation on continental islands in the Whitsunday region, Brennan (1986) suggested that much of the *Araucaria cunninghamii* (fire sensitive species) distribution may reflect extensive use of fire by Aboriginal peoples. He cites that most of the Araucarian forests occur on the steep rocky slopes and/or protected gullies of 'topographic refugia'. Brennan (1986) also found that most of the islands supporting large areas of grassland in the Whitsunday region were remote, smaller, offshore islands. Brennan (1986) concluded that most of these grasslands occur on southeast sides of the islands and were natural formations maintained by windshear and salt spray."

Batianoff & Dillewaard, 1997; 307

Some islands have populations of feral animals present, for example goats, cane toads, cats and on Haslewood and Long Islands, feral pigs. In addition, native species such as brush tail possums (*Trichosurus vulpecula*) and macropods have been introduced to some islands with detrimental impacts to natural systems. This is most likely due to the lack of a population of regulating predator species, which are not present on the islands.

CONDITION AND TRENDS

Visitation to the islands in the Whitsunday area continues to rise as indicated by tourist expenditure increases of approximately 30% between 2004 and 2006 (Anon, 2007), however this increase is beginning to stabilise. The Whitsunday Plan of Management (GBRMPA, 2008) and Whitsunday and Mackay Islands Visitor Management Strategy (EPA, 2007) provide a structured management of visitation, and many islands remain protected from intensive use.

The Whitsunday Islands Visitor management Strategy (EPA, 2007) to provide structure and guidelines for managing visitor use to the region's islands and applies a level of setting to a particular location. For example, high-use sites such as Whitehaven Beach are designated "High-use" setting. Large-scale infrastructure and site hardening strategies such as raised wooden access ramps, picnic tables extensive interpretative signage and a large toilet block is present to cope with the higher visitation. These sites provide a focus for tourism and a site specific strategy is in place to provide management guidance and determine appropriate development. In contrast, undeveloped, rarely visited sites such as Carlisle Island are managed primarily as a 'Protected' setting, where the focus is conservation orientated. "Protected" areas are defined as "Natural areas set aside for conservation with minimal visitor use" (EPA 2007; 13) with a small area of 'Natural' setting surrounding Neil's campground on the south-western edge allowing for basic infrastructure such as signage. Sites in the "Natural" setting are "Visitor sites generally free of facilities... unless they are essential to minimise visitor impacts" (EPA, 2007; 16).

	Visitors	Holiday	VFR	Business	Expenditure (\$m)
Domestic overnight	480,000	319,000	82,000	50,000	\$509
Annual % change ¹	▼ -9%	▼ -4%	▲ n/p	▲ n/p	▼ -7%
Trend % change ²	▲ 4%	▲ 3%	▲ n/p	▲ n/p	▼ -2%
International overnight	163,000	155,000	5,000	1,000	\$108
Annual % change	▼ -2%	▼ -3%	▲ n/p	▲ n/p	● 0%
Trend % change	▼ -10%	▼ -11%	▲ n/p	▲ n/p	▼ -13%
TOTAL	643,000	474,000	87,000	51,000	\$617
Annual change	▼ -7%	▼ -3%	▲ n/p	▲ n/p	▼ -6%

Figure 4 Tourism Whitsunday End of Year Snapshot (2012)

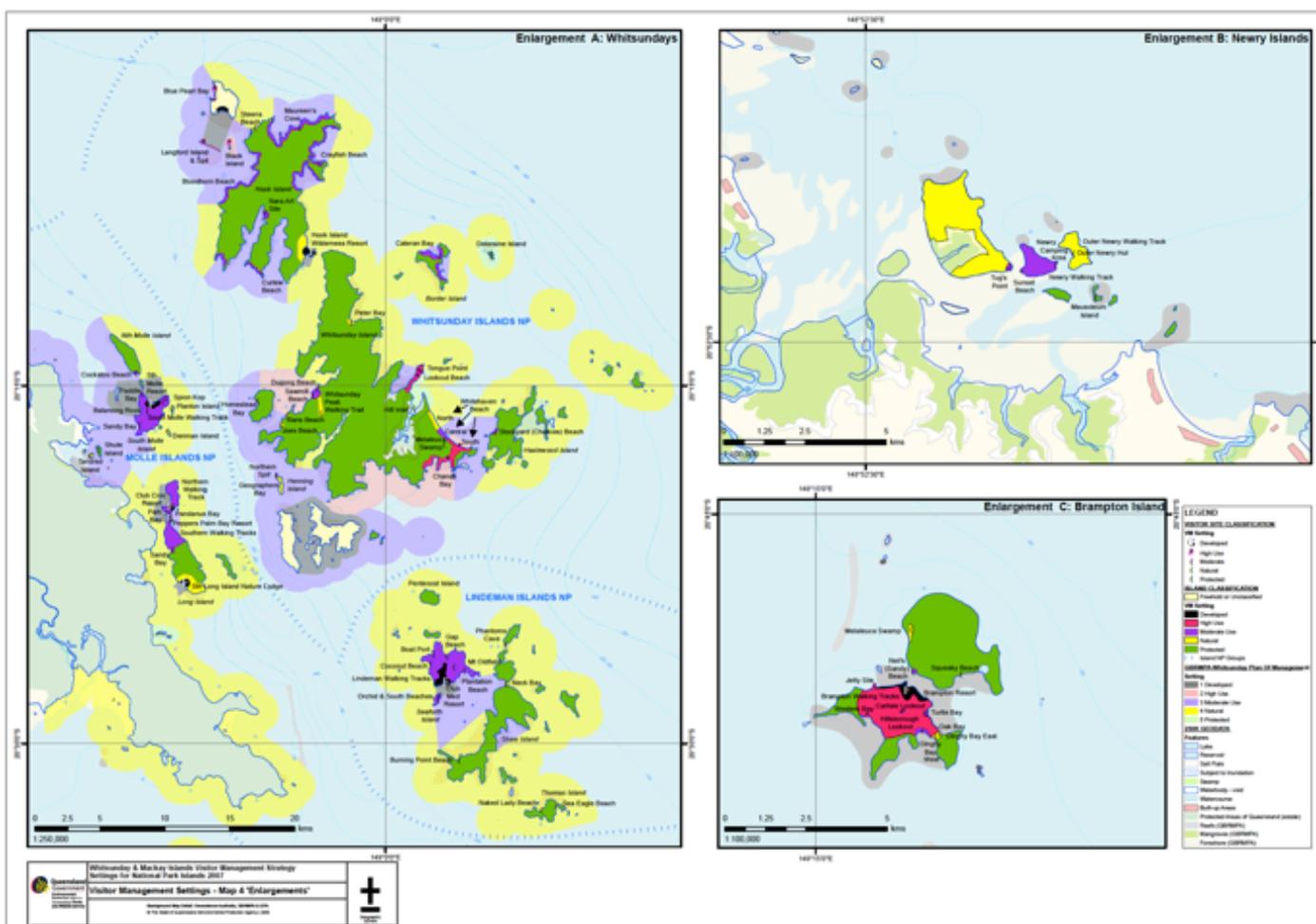


Figure 5 Whitsunday and Mackay Islands Visitor Management Settings for the Whitsunday, Brampton and Newry Island Aggregations (VMS, 2007). Note: Carlisle Island is the most northerly of the Brampton Islands Group (Enlargement C).

At least 163 exotic plants are known on the region's islands. Many of these do not have the capacity to significantly displace other species or modify habitats. However some such as Guinea grass can smother other ground covering species and significantly increase fuel loads with subsequent changes to fire patterns.

Other exotic plants such as sisal hemp aggressively out complete native species through prolific reproduction. Sisal hemp propagules are also able to float and can sustain extreme conditions and continue to germinate (K. McCallie, pers. ob). This species is found in most areas frequented by visitors. Others species such as rubber vine, present on Gloucester Island, have the potential to dramatically dominate native vegetation and substantially reduce habitat condition for the Proserpine rock wallaby. Increased use of the islands by people will present the Queensland Parks and Wildlife Service with increased weed control challenges.

Fauna species not naturally occurring on the islands (including native species from mainland systems) can cause significant damage. Damage includes over grazing/browsing, subsequent weed infestation, erosion, damage to wetlands and soaks and alterations to fire patterns. Goats are a major issue on some islands and a population of feral pigs has established on Long Island. However, this is not the case for introduced koala populations, which appear to have developed balanced populations on Rabbit and St Bees Island. Similarly, the Proserpine rock wallaby population on Hayman Island is not having any known detrimental impact.

A number of endemic species exist within the Whitsunday Islands. *Carlia pectoralis inconnexa* is a species of skink known only from Whitsunday Island (Hobson, 2008) while two subspecies of the Queensland leaf-tail gecko are also found on Whitsunday Island, one of which was only recently described (Couper & Hoskin, 2013).

It is clear that the distribution of vegetation types on some islands has changed significantly as a result of prevailing fire regimes. These changes may result in loss of some vegetation types from some islands, notably grasslands and open sclerophyll woodlands (McCallie, 2009., Ball, 2003).

Given the lack of quantitative baseline data and subsequent monitoring, the status of all key fauna species on the islands cannot be determined. Proserpine rock wallaby populations are actively monitored and indications are that the Gloucester Island population is stable, and numbers are increasing on Hayman Island (Nolan, pers. comm.). Limited seabird and shorebird surveys on outer islands off Mackay indicate that populations are stable, and turtle nesting although variable, does not display any consistent downward trend (Ball, unpublished data).

GOVERNANCE

National Park islands are to be managed in accordance with the Nature Conservation Act 1992. The management principles provided by this act are to:

- Provide, to the greatest possible extent, for the permanent preservation of the area's natural condition and the protection of the area's cultural resources and values;
- Present the area's cultural and natural resources and their values; and
- Ensure that the only use of the area is nature based and ecologically sustainable.

Management responsibility for National Park Islands lies with the Queensland Parks and Wildlife Service.

Resort and several private leases on the islands are administered by the provisions of the Land Act 1994. Conditions of these leases include both general requirements for 'Duty of Care' and also specific management requirements. Some islands remain as Unallocated State Land and are the responsibility of the Department of Natural Resources and Mines. A small number of islands e.g. Pine Islet, once supported lighthouses, and remain under Commonwealth control.

INDICATORS

Tenure of islands, and the negotiation and gazettal of nature conservation covenants, can be readily tracked by the Department of Natural Resources and Mines and the Department of National parks, Recreation, Sport and Racing.

Exotic plants are in most cases more likely to be prevalent in areas of higher visitation. These areas can be used as sentinel sites within monitoring programs. Infestation of exotic animals are normally reported by members of the public as regular surveys, while ideal, are not feasible.

Knowledge relating to the historic distribution and condition of vegetation types, habitats and flora and fauna populations on the islands needs to be reviewed, and acceptable thresholds of change around those conditions adopted and monitored. Current vegetation mapping, while recently updated for the Central Queensland Coast Bioregion (Queensland Herbarium, 2013) remains inadequate for some islands and should be updated. Few fauna surveys have been conducted except in association with specific projects (WIGW Fauna Survey report).

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