

Appendix 2

Summary of Natural Heritage Attributes of the Great Barrier Reef World Heritage Area

Source: Lucas P.H.C., Webb T., Valentine P.S. and Marsh H. 1997, The Outstanding Universal Value of The Great Barrier Reef World Heritage Area, Great Barrier Reef Marine Park Authority, Townsville.

Attribute 1: Algae

- Great Barrier Reef World Heritage Area benthic macroalgae are typical of the Indo-West Pacific region, with moderately high diversity but relatively low endemism;
- approximately 400–500 species of macroalgae occur in the Great Barrier Reef World Heritage Area;
- importance of the Great Barrier Reef World Heritage Area is by virtue of its latitudinal and cross-shelf extent giving rise to a huge variety of habitats;
- algae are important in cementing reef structures;
- algae are significant contributors to reefal and inter-reefal sediments;
- algae are the primary producers of reefal systems as zooxanthellae, macroalgae (including seaweed and turf algae) and phytoplankton;
- important food resource for numerous animals, especially fishes.

Attribute 2: Ascidians (sea-squirts)

- at least 330 species of ascidians are likely to occur in the Great Barrier Reef World Heritage Area; and a further 100 or more indigenous Australian temperate species appear to have been derived from the tropical fauna that flourishes in the reefal habitats of the Great Barrier Reef World Heritage Area;

- most species occurring in the Great Barrier Reef World Heritage Area occupy a vast geographic range covering its latitudinal length;
- the Great Barrier Reef World Heritage Area acts as a bridge for ascidians between tropical and temperate waters, providing the reefal habitats that accommodate the extension of the range of tropical species to the south, at least to the Tropic of Capricorn, and by providing candidates for speciation in the temperate waters of Australia, contributes to the species diversity of the continent;
- The Great Barrier Reef World Heritage Area, is an avenue for gene flow which contributes to the genetic diversity of the Indo-West Pacific tropical fauna by accommodating populations of tropical species well to the south of their usual range.

Attribute 3: Birds

- Great Barrier Reef World Heritage Area contains globally important areas for seabirds, including breeding colonies for 22 species;
- Great Barrier Reef World Heritage Area is at the extremity of distribution for some species;
- areas that are of international importance to migratory shorebirds are adjacent to or included within the Great Barrier Reef World Heritage Area;
- Great Barrier Reef World Heritage Area contains populations of threatened species;
- birds play important roles in nutrient addition to cays, and the establishment of terrestrial flora;
- significant aesthetic value derived from large breeding colonies.

Attribute 4: Bryozoans

- Indo-West Pacific region contains the highest diversity of bryozoans;
- Great Barrier Reef World Heritage Area contains an estimated 300–500 species of bryozoans (8–12% of world fauna);

- bryozoans along with sponges and ascidians form 'natural isolates' that provide important structure and habitats for other invertebrate species in areas of soft sediments;
- likely that the bryozoan fauna of reefal and shelf environments are distinct;
- some species particularly noted for their beauty.

Attribute 5: Butterflies

- 118 species have been identified within the Great Barrier Reef World Heritage Area, representing 30% of all known Australian butterflies;
- two endemic subspecies have been described;
- limited study of the Great Barrier Reef World Heritage Area butterflies has taken place;
- rapid speciation processes may be at work on some of the islands following the post-glacial sea-level rise, however studies are required;
- several rare and little-known species occur within the Great Barrier Reef World Heritage Area;
- remarkable migratory and aggregation records occur for some Great Barrier Reef World Heritage Area butterflies;
- the butterfly fauna have strong links with the coastal fauna and islands may provide relatively secure populations in the face of coastal development pressures;
- the addition of the Torres Strait area to the Great Barrier Reef World Heritage Area would add greatly to the butterfly richness and significance.

Attribute 6: Crocodiles and Terrestrial Reptiles

- estuarine crocodiles occur in the Great Barrier Reef World Heritage Area, but these individuals are marginal to the mainland population;
- reefal island crocodiles are unlikely to have any significant contribution back to the main populations, however they form part of the reefal ecosystem;

- at least 9 snakes and 31 lizards occur on the islands of the Great Barrier Reef World Heritage Area;
- one threatened lizard occurs on Magnetic Island.

Attribute 7: Crustaceans

- many of the groups have been poorly studied;
- the Great Barrier Reef World Heritage Area is likely to be highly diverse for most groups with a cosmopolitan Indo-West Pacific fauna;
- endemism of reef fauna is low, but other habitats may have greater endemism;
- the extensive range of habitats in the Great Barrier Reef World Heritage Area is important for crustacean diversity.

Attribute 8: Echinoderms

- an estimated 800 extant species of echinoderms occur in the Great Barrier Reef World Heritage Area, representing about 13% of the world's taxa;
- many rare taxa occur in the Great Barrier Reef World Heritage Area;
- higher phylogenetic diversity of echinoderms is well expressed in the Great Barrier Reef World Heritage Area;
- Great Barrier Reef World Heritage Area is likely to have the greatest species diversity of echinoderms for any marine protected area in the world;
- distinct reefal and non-reefal suites of species exist with very strong zonation observable in both assemblages.

Attribute 9: Fishes

- species diversity of Great Barrier Reef World Heritage Area is high but is less diverse than for the Indo-West Pacific centre;
- endemism is low as most fish are distributed through the Indo-West Pacific;
- heterogeneity of the Great Barrier Reef World Heritage Area at a range of spatial scales offers an extensive range of habitats for fish;
- life histories of some species demonstrate the connectivity of the range of nearshore and offshore habitats within the Great Barrier Reef World Heritage Area;

- abundance and diversity of fishes changes over a range of spatial and temporal scales;
- abundance and huge diversity in fishes shape, size and colour contributes to the aesthetic value of the Great Barrier Reef World Heritage Area.

Attribute 10: Flatworms

- platyhelminth fauna of the Great Barrier Reef World Heritage Area is largely Indo-West Pacific in distribution with correspondingly low levels of endemism;
- flatworm fauna exhibits high diversity in free-living macro and meiofaunal forms, and very high diversity in parasitic forms;
- the polyclad turbellarians are a conspicuous animal on the reef with vivid colours and patterns contributing to the aesthetic value of the Great Barrier Reef World Heritage Area.

Attribute 11: Fringing Reefs

- fringing reefs cover 667 km² of the Great Barrier Reef World Heritage Area with the majority being adjacent to continental islands;
- they can exhibit high species diversity, and often high coral cover;
- Great Barrier Reef World Heritage Area contains some of the largest and oldest coral colonies;
- the genotype of some colonies may have been present on the reef for several thousand years;
- inshore coral communities in the southern regions of the Great Barrier Reef World Heritage Area may offer new insights into coral reef formation and evolution;
- fringing reefs can exhibit very high aesthetic value.

Attribute 12: Geological and Geomorphological Aspects

- Great Barrier Reef World Heritage Area contains the largest reef system the world has ever known;
- the size and morphological diversity of the Great Barrier Reef makes the Great Barrier Reef World Heritage Area unique;

- Great Barrier Reef World Heritage Area contains 2904 coral reefs covering 20 055 km²;
- geological evolution of continental islands, reefs and cays is intimately connected with sea-level change;
- major changes in sea-level are recorded in the reef's structure;
- cross-shelf gradients in many parameters are particularly evident in the Great Barrier Reef World Heritage Area;
- as a consequence of its young age, the total history of the reef's evolution is available, offering a unique opportunity for greater understanding of coral reef evolution;
- Great Barrier Reef World Heritage Area contains examples covering nearly all stages of reef development;
- Great Barrier Reef World Heritage Area contains exceptional examples of blue holes;
- the Great Barrier Reef World Heritage Area contains more than 300 coral islands displaying a range of morphologies;
- coastal attributes of world importance include rock types and morphologies, sand barriers, deltas, and dune systems.

Attribute 13: Geological Aspects of Continental Islands

- a majority of the 600 continental (high) islands are composed of massive granites or silicic volcanics with two significant age groups, Late Palaeozoic (330–270 Ma) and Cretaceous (120–100 Ma);
- the Great Barrier Reef World Heritage Area contains some exceptional sites for studying particular geological assemblages;
- the Great Barrier Reef World Heritage Area contains some assemblages, including the serpentinite rocks of South Percy Island, not commonly found elsewhere.

Attribute 14: *Halimeda* Banks (calcareous green algae)

- 20 species of *Halimeda* occur in the Great Barrier Reef World Heritage Area;
 - significant sediment contributors to reefal and inter-reefal environments;
 - the Great Barrier Reef World Heritage Area contains the most extensive, actively accumulating *Halimeda* beds in the world;
 - actively accumulating for up to 10 000 years;
 - primarily located in the northern region with unique deepwater *Halimeda* beds in the central region of the Great Barrier Reef World Heritage Area;
 - may provide important nursery habitat for a range of taxa.
- 37 species recorded in the Great Barrier Reef World Heritage Area, being 54% of world flora;
 - Great Barrier Reef World Heritage Area has a comparable and complimentary diversity to other areas of high diversity;
 - important trends at a range of spatial scales makes the Great Barrier Reef World Heritage Area the prime location for research into mangrove ecology and evolution;
 - habitat for a range of taxa, in particular the juveniles of some species;
 - important contributors to ecological processes.

Attribute 15: Hard Corals

- the Great Barrier Reef World Heritage Area contains the largest coral reef system in the world;
- 2904 coral reefs cover 5.6% of the Great Barrier Reef World Heritage Area;
- the Great Barrier Reef World Heritage Area contains an extensive diversity of reef morphologies, including deltaic, dissected and detached reefs;
- high heterogeneity at a range of spatial scales gives rise to high habitat diversity;
- 359 species of hard corals recorded from the Great Barrier Reef World Heritage Area;
- Great Barrier Reef World Heritage Area exhibits low endemism, with most species distributed through the Indo-West Pacific;
- long lived massive corals can provide historical information regarding environmental conditions over several hundreds of years;
- Great Barrier Reef World Heritage Area occurs within a jurisdiction that has a higher potential for effective conservation management than other reefal areas of the Indo-West Pacific region.

Attribute 16: Mangroves

- 2069 km² of mangroves occur in or directly adjacent to Great Barrier Reef World Heritage Area;

Attribute 17: Marine Mammals

- The Great Barrier Reef World Heritage Area is a significant refuge for cetacean biodiversity in the tropical Indo-Pacific as coastal species such as the Irrawaddy dolphin and the Indo-West Pacific humpback dolphin are unlikely to survive outside Australia. It is also a breeding ground for the threatened humpback whale.
- The Great Barrier Reef World Heritage Area supports an estimated 15% of the dugongs that have been recorded in Australian waters to date. The dugong is the only extant species of the family *Dugongidae* and one of only four species in the mammalian order *Sirenia*. The dugong is classified as vulnerable to extinction by the IUCN with poor long-term survival prospects outside Australia.

Attribute 18: Marine Turtles

- Great Barrier Reef World Heritage Area contains globally important nesting and feeding grounds for loggerhead, green, hawksbill and flatback turtles;
- southern Great Barrier Reef World Heritage Area loggerhead turtle breeding population is approximately 70% of the southern Pacific population;
- Raine Island accommodates the largest green turtle breeding population in the world;
- Great Barrier Reef World Heritage Area contains one of the last significant breeding population of the hawksbill turtle in the world;

- approximately 10% of the endemic flatback turtles breed on a few islands in the southern region of the Great Barrier Reef World Heritage Area;
- olive ridley and leatherback turtles also utilise the resources of the Great Barrier Reef World Heritage Area.

Attribute 19: Molluscs

- the number of mollusc species occurring in the Great Barrier Reef World Heritage Area is estimated to range from a minimum of 5000, to possibly as many as 8000;
- Great Barrier Reef World Heritage Area molluscan fauna represents a significant proportion of world molluscan diversity;
- there are four main components to the Great Barrier Reef World Heritage Area molluscan fauna, with the most speciose being the shallow reefal fauna, with tropical Indo–West Pacific affinities and very low levels of endemism;
- the other three main components are the shallow coastal molluscan fauna and the shelf fauna both of which are shared with southern Queensland and New South Wales, and a tropical coastal component that is shared, in large part, with northern Australia;
- endemism is highest in the components that are shared with southern Queensland and New South Wales;
- the gastropod family Volutidae exhibits the highest degree of endemism in the Great Barrier Reef World Area;
- many species have large colourful shells prized by shell collectors, and adding to the aesthetic qualities of the Great Barrier Reef World Heritage Area;
- some species of bivalves are important in bioerosion of coral substrates;
- larval molluscs and other planktonic molluscs are important components of the Great Barrier Reef plankton;
- much of the molluscan fauna of the Great Barrier Reef World Heritage Area is poorly known, in particular the smaller sized taxa.

Attribute 20: Octocorals

- from 270 genera of octocorals worldwide, an estimated 80 genera are likely to occur in the Great Barrier Reef World Heritage Area;
- octocorals occur in all habitats, across all shelf positions and throughout the latitudinal extent of the Great Barrier Reef World Heritage Area;
- soft corals are a major component of the sessile benthic reef fauna of the Great Barrier Reef World Heritage Area;
- form and colour of octocorals contribute to the aesthetic value of the Great Barrier Reef World Heritage Area.

Attribute 21: Phytoplankton (microscopic algae)

- phytoplankton are the principal primary producers in the open shelf waters of the Great Barrier Reef World Heritage Area (approximately 95% of the World Heritage Area);
- includes a diverse group of algae ranging in size from 0.5 microns to 200+ microns;
- two broad communities exist: an offshore oceanic community and a lagoonal community;
- phytoplankton biomass is highest in shallow nearshore waters;
- upwelling of nutrients along the shelf break, cyclonic disturbances of shelf sediments and flood waters may locally increase phytoplankton biomass;
- *Trichodesmium* is a significant contributor of nitrogen to the Great Barrier Reef World Heritage Area.

Attribute 22: Polychaete Worms

- polychaetes are an old group extending back to Cambrian times (500 Ma);
- dominant macrofauna (in numbers of species and individuals) in reefal sediments and coral substrates;
- currently 80 species are recorded for the reefs of the Great Barrier Reef World Heritage Area, however total species diversity could exceed 500;

- diversity is a product of latitudinal extent, habitat diversity and good condition of the Great Barrier Reef;
- polychaetes play important roles in ecosystems;
- the tropical polychaete fauna is very poorly known.

Attribute 23: The Proserpine Rock-wallaby

- Proserpine rock-wallaby is classified internationally as endangered;
- restricted to a very small range, including one continental island in the Great Barrier Reef World Heritage Area.

Attribute 24: Seagrasses

- 15 species of seagrass are recorded from the Great Barrier Reef World Heritage Area and other species may yet be described;
- Great Barrier Reef World Heritage Area flora is typical of the Indo-West Pacific flora;
- several species reach latitudinal limits in the Great Barrier Reef World Heritage Area, and at least two species appear endemic;
- more than 3000 km² of seagrass habitat within the Great Barrier Reef World Heritage Area;
- extensive meadows of deepwater seagrass recently found;
- important nursery for many fishes and penaeid prawns;
- important food resource for threatened dugong and green turtle;
- important roles in sediment stabilisation and nutrient capture.

Attribute 25: Sea Snakes

- 17 species of sea snakes occur in the Great Barrier Reef World Heritage Area;
- distinct reefal and soft bottom assemblages are apparent;
- patterns of abundance and distribution poorly known;
- trawling is the major anthropogenic impact on sea snakes in the Great Barrier Reef World Heritage Area.

Attribute 26: Soft Bottom Habitats

- soft bottom habitats occupy the majority (approx. 94%) of the Great Barrier Reef World Heritage Area;
- species diversity of soft bottom habitats is high, but poorly documented;
- strong cross-shelf zonation is apparent, with four discernible zones;
- lagoonal and inter-reefal diversity is associated with the presence of 'natural isolates' that create small areas of hard substrate in the soft bottom environment;
- 'natural isolates' are particularly vulnerable to periodic disturbance such as trawling.

Attribute 27: Sponges

- 1500 species estimated to occur in the Great Barrier Reef World Heritage Area, being equivalent to approximately 30% of the extant Australian sponge fauna;
- sponge fauna tends to be Indo-West Pacific in distribution;
- endemism likely to be low but lack of taxonomic studies limits quantification;
- relicts of reef-building sponges prominent during the Ordovician Period have been recorded in the Great Barrier Reef World Heritage Area;
- cross-shelf trends in sponge abundance and diversity exhibited;
- play significant roles in ecosystem processes.

Attribute 28: Terrestrial Flora

- over 2100 plant species occur on the Great Barrier Reef World Heritage Area islands, representing about 25% of Queensland's floral diversity in just 0.1% of its area;
- over 75 species are rare or threatened, with a number of endemic species;
- the southern limits of world distribution for a number of pantropic plants are reached in the Great Barrier Reef World Heritage Area;
- the Great Barrier Reef World Heritage Area provides a unique opportunity to investigate theories of island biogeography through the continuing processes of rainforest species invasion;

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- birds are important for the dispersal, colonisation and establishment of some plants;
 - 5 floristic regions on continental islands can be delineated, and an additional 2 for coral cays;
 - distinct latitudinal trends in community composition are expressed.